UNITED STATES OF AMERICA
DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

In re:	)	Administrative Law Judge
	)	Hon George J. Jordan
Proposed Waiver and Regulations Governing	)	Docket No. 19-NMFS-0001
the Taking of Eastern North Pacific Gray	)	
Whales by the Makah Indian Tribe	)	RIN: 0648-BI58 and
	)	RIN: 0648-XG584

DECLARATION OF DR. JEFFREY MOORE

I, Dr. Jeffrey Moore, declare as follows:

QUALIFICATIONS and EXPERTISE

1. I am a research biologist with the Marine Mammal and Turtle Division (Division) of the National Marine Fisheries Service (NMFS), Southwest Fisheries Science Center (SWFSC), within the National Oceanic and Atmospheric Administration (NOAA). Within the Division, I lead the California Current Marine Mammal Assessment Program. My program is responsible for publishing Stock Assessment Reports (SARs) for all marine mammal population stocks in waters off the U.S. West Coast, as well as for providing key inputs into those SARs, most notably population size estimates, which we obtain by employing a variety of survey methodologies, and estimates of human-caused mortality and serious injury (for example, from fisheries bycatch). SARs are developed by NMFS pursuant to requirements under Section 117 of the U.S. Marine Mammal Protection Act (MMPA), 16 U.S.C. §§ 1361 *et seq.* The MMPA requires SARs to include, among other things, population size estimates, a calculation of Potential Biological Removal (PBR) (discussed below), an assessment of whether incidental fishery takes exceed regulatory thresholds, and indication of the stock's management status under the MMPA (e.g., whether they are considered "strategic," which has implications for

management actions taken under the Act). These assessments are used to guide policy and management by NMFS. Analyses conducted in my program are routinely used to inform agency processes.

2. I hold B.S., M.S., and Ph.D. degrees in Wildlife and Conservation Biology. I have held post-doctoral and research faculty appointments at Duke University. My Curriculum Vitae is attached as NMFS Ex. 4-1.[1]

3. I am a recognized expert in cetacean quantitative ecology, population dynamics and risk assessment. As an expert in this field, I have developed and applied Bayesian statistical methods for estimating marine mammal abundance, trends and other demographic parameters; quantifying population impacts of bycatch on sea turtles and marine mammals; conducting risk assessments for protected species; and developing quantitative decision tools for policy and management. I have worked on international small-scale fisheries bycatch issues and serve on advisory committees such as the Cetacean Specialist Group of the International Union for Conservation of Nature, the NMFS Biological Review Team that reviews the status of northeastern Pacific white sharks, and the expert statistical panel for analysis of vaquita monitoring data. I regularly contribute to protected species management processes such as updating the SARs, developing Guidelines for Preparing Stock Assessment Reports Pursuant to the 1994 Amendments to the MMPA (also known as the Guidelines for Assessing Marine Mammal Stocks, or GAMMS[2]) (2011, 2016), participating on MMPA Take Reduction Teams,

[1] NMFS's exhibits are labeled as follows: "NMFS Ex. 1-XX" for exhibits attached to the Declaration of Chris Yates; "NMFS Ex. 2-XX" for exhibits attached to the Declaration of Dr. Shannon Bettridge; "NMFS Ex. 3-XX" for exhibits attached to the Declaration of Dr. David Weller; and, "NMFS Ex. 4-XX" for exhibits attached to the Declaration of Dr. Jeffrey Moore.

[2] *Available at* https://www.fisheries.noaa.gov/national/marine-mammal-protection/guidelines-assessing-marine-mammal-stocks (last visited March 28, 2019).

and Pacific Fishery Management Council-related activities. I have also participated as a member of the Scientific Committee (SC) for the International Whaling Commission (IWC).[3]

4. Throughout my career, I have authored more than 40 peer-reviewed scientific journal articles in addition to numerous NMFS and IWC technical reports.

5. I am a member of the Society of Marine Mammologists, the largest international association of marine mammal scientists in the world. This professional society promotes the global advancement of marine mammal science and its relevance and impact in education, conservation and management.

6. The Marine Mammal and Turtle Division of the NMFS SWFSC in La Jolla, California (Division) leads NOAA's gray whale science program. As a program lead within the Division, I am familiar with, and have developed expertise in, the policies and tools utilized by NMFS to manage marine mammals under the MMPA. 16 U.S.C. §§ 1361 *et seq.* I regularly advise NMFS on best practices and scientific methods to inform the assessment of, and risk management for, marine mammals.

7. The Division is charged with the collecting and analyzing the best available science to assess gray whale status and stock structure, which in turn informs the SARs issued by NMFS and published by NOAA as part of implementing NMFS's management responsibilities under the MMPA. I routinely participate in the development and review of these reports including the Eastern North Pacific gray whale (ENP) SAR and the Western North Pacific gray

[3] More information on this Committee *available at* https://iwc.int/scmain (last visited March 28, 2019).

whale (WNP) SAR. In 2012, I participated in a workshop of NOAA expert scientists for the purposes of evaluating gray whale stock structure. NMFS Ex. 3-2 (Weller *et al.* 2013[4]).

STOCK ASSESSMENT REPORTS OVERVIEW

8. The SARs identify the Optimum Sustainable Population (OSP) range for a stock if OSP has been estimated. OSP is defined in NMFS regulations as a range in population size between carrying capacity (K) at the high end and maximum net productivity level (MNPL) at the low end. 50 C.F.R. § 216.3; *see also* 16 U.S.C § 1362(9). MNPL is the population where productivity from natural birth and death processes is expected to be maximized. Maintaining stocks within OSP is a key objective under the MMPA. 16 U.S.C. § 1361. Stocks below OSP may be designated "depleted" and therefore also "strategic" (stocks are considered strategic if they are depleted, listed as threatened or endangered under the Endangered Species Act, or if human-caused mortality and serious injury exceed statutory limits), 16 U.S.C §§ 1362(1), (19), with consequences for their management.

9. Since the first SAR for the ENP stock, NMFS Ex. 4-2 (Small and DeMaster 1995[5]), scientists have determined that the ENP stock's abundance has been within its optimum sustainable population level relative to the stock's carrying capacity, as defined under the MMPA. This indicates that the ENP gray whale stock is healthy. Most recently, Punt and Wade (2012[6]), NMFS Ex. 4-3, concluded that the ENP stock was at 85% of carrying capacity, with an 88% likelihood that the stock was above its maximum net productivity level (MNPL), putting the

[4] Weller, D. W., and 7 co-authors. 2013. Report of the National Marine Fisheries Service gray whale stock identification workshop. March 2013. NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-507.

[5] Small, R. J., and D. P. DeMaster. 1995. Alaska marine mammal stock assessments 1995. U.S. Dep. Commer., NOAA Tech. Memo. NMFSAFSC-57.

[6] Punt, A. E. and P. R. Wade. 2012. Population status of the eastern North Pacific stock of gray whales in 2009. Journal of Cetacean Research and Management 12(1):15-28.

stock within its OSP range. The SAR adopted the conclusion that the ENP gray whale stock was at OSP (NMFS Ex. 2-6 (Carretta *et al*. 2015[7]) and that conclusion was reaffirmed in the most recent SAR (NMFS Ex. 2-7 (Carretta *et al*. 2017[8]). The IWC SC reviewed the analysis of Punt and Wade (2012), NMFS Ex. 4-3, and agreed that results were consistent with the Committee's gray whale assessment NMFS Ex. 4-4 (IWC 2013a[9]).

10. In her Declaration, Dr. Shannon Bettridge describes other details related to the current status of ENP and WNP gray whale stocks as documented in the most recent SARs. Bettridge Decl. ¶¶ 18–24. She also explains the status of the Pacific Coast Feeding Group (PCFG) within the ENP stock. Bettridge Decl. ¶¶ 15–16.

MODELING POTENTIAL EFFECTS OF THE PROPOSED HUNT ON WNP GRAY WHALES

11. As explained in Dr. Bettridge's Declaration, WNP gray whales are recognized as a separate stock under the MMPA. Bettridge Decl. ¶ 17. The WNP stock is listed as endangered under the ESA and is classified as "depleted" under the MMPA. 50 C.F.R. § 224.101; 80 Fed. Reg. 50,599 (Aug. 20, 2015). The observation of some WNP whales within the area where hunting would occur under the proposed regulations raised concern about the possibility that WNP gray whales might be affected by the Tribe's proposed hunt.

12. To address that concern, in 2011, Dr. Dave Weller and I undertook a study to estimate the probability that one or more whales identified in the WNP might be subjected to a strike, an unsuccessful strike attempt, or an approach, as those terms are defined in the proposed

[7] Carretta, J., and 15 co-authors. 2015. U.S. Pacific Marine Mammal Stock Assessments: 2014. NOAA-TM-NMFS-SWFSC-549.

[8] Carretta, J., and 15 co-authors. 2017. U.S. Pacific Marine Mammal Stock Assessments: 2016. NOAA-TM-NMFS-SWFSC-577.

[9] IWC. 2013a. Report of the Scientific Committee. Journal of Cetacean Research and Management (suppl.) 14:1-86. Report of the Scientific Committee.

regulations and discussed in the Declaration of Chris Yates, during a Makah Tribal hunt of ENP gray whales. We based our analysis on the Makah Tribe's gray whale hunt proposal as presented to the IWC in 2012 and 2013. NMFS Ex. 4-5 (IWC 2013b[10]); NMFS Ex. 4-6 (IWC 2014[11]). We presented our results in Moore and Weller (2013[12]), NMFS Ex. 4-7, and to the IWC SC, which found the analyses appropriate. NMFS Ex. 4-5 (IWC 2013b); NMFS Ex. 4-6 (IWC 2014). These results have subsequently been updated as discussed below.

13. In 2018, NMFS developed a revised hunt proposal, which it presented to the IWC SC for analysis. Dr. Weller and I updated our original analysis using the revised proposal and updated data presented at the 2017 and 2018 IWC SC range-wide workshops. We presented our updated results in a 2018 paper titled "Updated estimates of the probability of striking a western North Pacific gray whale during the proposed Makah hunt," published as NOAA Technical Memo. NMFS Ex. 4-8 (Moore and Weller 2018[13]).

14. Our 2018 analysis makes use of the following empirical data inputs:

a. ***Abundance estimates***—The most recent ENP abundance estimate (for 2015–16) was 26,960 (CV = 0.05). NMFS Ex. 3-42, Durban *et al.* 2017[14]. (CV = coefficient of variation, is a common descriptor of the precision of an estimate, calculated as the standard error of the estimate divided by the estimate). The most recent WNP abundance

[10] IWC 2013b. Report of the Scientific Committee. Annual Meeting 2013. June 3–15, 2013.

[11] IWC 2014. Report of the Scientific Committee. Journal of Cetacean Research and Management (suppl.) 15:1-75. Report of the Scientific Committee.

[12] Moore, J. E. and D. W. Weller. 2013. Probability of taking a western North Pacific gray whale during the proposed Makah hunt. NOAA Technical Memorandum NMFS-SWFSC-506. January 2013.

[13] Moore, J.E. and D.W. Weller. 2018. Updated estimates of the probability of striking a western North Pacific gray whale during the proposed Makah hunt. NOAA Technical Memorandum NMFS-SWFSC-605. August 2018.

[14] Durban, J.W., D.W. Weller, and W.L. Perryman. 2017. Gray whale abundance estimates from shore-based counts off California in 2014/15 and 2015/16. Paper SC/A17/GW/06 presented to the International Whaling Commission Scientific Committee.

estimate (for 2015) was 200 (CV = 0.03) for the number of individuals older than one year (i.e., this estimate was based on "mark-resight" analysis of photo ID data, which excludes calves) (mark-resight analysis is a conventional approach for analyzing photo ID data, where animals of known identity are seen or not seen during subsequent sampling periods spanning days, weeks, months or years). NMFS Ex. 3-66 (Cooke 2018[15]). We multiplied the WNP estimate by 1.099 to estimate the full population including calves. This multiplier is based on the ratio of the population size with and without calves in 2012. NMFS Ex. 4-9 (IUCN 2012[16]).

b. ***Mixing proportions based on sightings in the Makah Hunt Area***—Mixing proportion refers to the proportion of animals in the Makah Hunt Area (and during the timing of the hunt) that belong to different gray whale populations/groups, i.e., the WNP, PCFG, or larger ENP. This is important for assessing the likelihood that a struck whale would belong to the WNP. Spring surveys (March to May) between 1996–2012 recorded 181 observed whale-days within the Northern Washington portion of the Makah hunt area. NMFS Ex. 4-10 (Calambokidis *et al*. 2014[17]). The term "whale-day" refers to a 24-hour period during which an individual whale is sighted one or more times—multiple sightings of the same individual on the same day count as just one whale-day, but the same individual seen the next day would count as a second whale-day. None of the 181 whale-

[15] Cooke, Justin G. 2018. Abundance estimates for western North Pacific gray whales for use with stock structure hypotheses of the Range-wide Review of the Population Structure and Status of North Pacific gray whales. Paper SC/678/ AS 1/02 presented to the International Whaling Commission.

[16] IUCN 2012. Report of the 11th Meeting of the Western Gray Whale Advisory Panel. Geneva, Switzerland. February 12-14, 2012.

[17] Calambokidis, J., J. Laake, and A. Perez. 2014. Updated analysis of abundance and population structure of seasonal gray whales in the Pacific Northwest, 1996–2012. Final Report to National Marine Mammal Laboratory, Seattle, WA.

days observed included WNP whales[18]; 73 (40.3%) of the individuals sighted were considered PCFG whales; and the rest (108, or 59.7%) of the individuals were assumed to be migrating ENP whales. However, rather than use 40.3% as the expected PCFG proportion, we used 28% based on analyses summarized in a 2018 IWC workshop that showed this number would more fully account for information and uncertainty about mix proportions in other parts of the Makah hunt area. NMFS Ex. 3-39 (IWC 2018d[19]). This makes the inference more conservative (i.e., increases the WNP risk estimates) because it implies a greater proportion of animals (72%) encountered by the Makah would be non-PCFG animals (i.e., more ENP and potentially WNP animals).

c. ***Proportion of WNP whales migrating with ENP whales***—The proportion of the WNP population that migrates along the North American coast is unknown but estimated to be at least 0.37 based on analysis by Cooke (2015[20]), NMFS Ex. 4-11, and reported to a 2015 IWC workshop on gray whale population structure. NMFS Ex. 4-12 (IWC 2016[21]). The greater the numbers of WNP animals migrating along the U.S. West Coast with the ENP population, the greater the risk that a WNP whale could be struck during a hunt.

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[18] Although not in the Makah hunt area, Weller *et al.* (2012), report observing three WNP whales on 2 May 2004 and three more on 25 April 2008 near Barkley Sound off the west coast of southern Vancouver Island, British Columbia, Canada. NMFS Ex. 3-57, Weller, D. W., A. Klimek, A. L. Bradford, J. Calambokidis, and others. 2012. Movements of gray whales between the western and eastern North Pacific. Endang Species Res. 18:193-199.

[19] IWC. 2018d. Report of the Fifth Rangewide Workshop on the Status of North Pacific Gray Whales. Report SC/67B/REP/07 Rev1.

[20] Cooke, J.G. 2015. Implications of observed whale movements on the relationship between the Sakhalin gray whale feeding aggregation and putative breeding stocks of the gray whale. Paper SC/A15/GW02 presented to the Second Workshop on the Rangewide Review of the Population Structure and Status of North Pacific Gray Whales, 1-3 April 2015, La Jolla, CA, USA.

[21] IWC 2016. Report of the Scientific Committee. Report of the 2nd workshop on the rangewide review of the population structure and status of North Pacific gray whales, 1-3 April 2015, La Jolla, CA, USA. Journal of Cetacean Research and Management (suppl.) 17:567-581.

15. Our 2018 analysis makes use of the following information and assumptions: Under the proposed regulations, odd-year hunts are limited to summer/fall months (July–October). Given that WNP gray whales feed in the Western North Pacific during those months, *see* Weller Decl. ¶ 63, we assumed that none would be in the Makah hunt area during this time and thus there was no possibility of Makah hunters striking a WNP during odd years. Even-year hunts can occur from December 1st of an odd-numbered year through May 31st of the following even-numbered year, months when WNP could be present. The proposed regulations limit all strikes to three during even-year hunts; so for purposes of our analysis we assumed a maximum of 15 strikes over 10 years. The regulations would further limit hunters to no more than 18 unsuccessful strike attempts in even-year hunts; thus we assumed a maximum of 90 strike attempts during the 10 years. And finally, the regulations limit hunters to no more than 353 approaches per year. Because approaches are not limited by season (that is, during an odd-numbered year, hunters could make training approaches during the migration season when WNP gray whales might be present), the analysis examined the potential for hunters to approach WNP gray whales a total of 3,530 times across all 10 years. This assumption is conservative (likely to over-estimate risk to WNP) since many approaches would likely take place during the summer months of both odd and even years, when WNP gray whales are not expected to be present. Realistically we would expect a substantial number of approaches to occur outside this period, i.e., during the summer when ocean conditions are more favorable and, in odd years, when hunting approaches are restricted to July–October. Ex. 4-8 at 8 (Moore and Weller 2018). *See also* 2015 DEIS at 3.15.3.2.2, Fig. 3-17, Table 4.2 (estimating suitable hunting days, with the majority falling between April and October). Our model also assumed that WNP animals migrating with the ENP population are randomly mixed; thus, on a per-capita basis, a migrating

WNP animal is just as likely to be encountered by hunters as any particular ENP individual. Finally, our model assumed that ENP and WNP population sizes remain constant according to the analysis inputs. Even though we understand this assumption won't actually hold true over the 10 years analyzed, in practice we still consider the results robust because the ENP is so much larger than the WNP (i.e., the ratio of WNP to ENP population, and hence the per-capita likelihood of a struck whale being from the WNP, will remain small).

16. We explored several models in the 2013 and 2018 analyses. Inferences below are based on Model 2A (as described in NMFS Ex. 4-8 (Moore and Weller 2018)). It is my opinion that Model 2A makes the best use of all available information relevant to WNP risk (whereas some of the models only used a subset of such information) and that it used more conservative assumptions (more likely to over-estimate than under-estimate risk) than underpinned Model 2B, a similar, previous model described in NMFS Ex. 4-7 (Moore and Weller 2013). In short, Model 2A calculates that for any given struck animal, the probability of this being a WNP animal (P_{WNP}) is given by the probability that it is not a PCFG animal (call this P_{mig}, estimated from the mixing proportion data), multiplied by the conditional probability that it is a WNP animal given that is not a PCFG animal (call this $P_{WNP|mig}$). Thus, $P_{WNP} = P_{mig}\ P_{WNP|mig}$. The conditional probability $P_{WNP|mig}$ is given by the ratio of the WNP:ENP population sizes (see data inputs above), multiplied by the fraction of the WNP population that actually migrates with the ENP (see data inputs above) (Model B differed from A in how it calculated $P_{WNP|mig}$, allowing for it to be as low as zero—in case no WNP animals actually move through the Makah area—and defining an upper bound based on larger-than-estimated WNP population estimate. However, the upper bound under Model B is difficult to reasonably define and the added uncertainty stemming from this model may not be justified, making Model A preferred). From these

parameters, we derived the probability of striking at least one WNP animal as $1 - (1 - P_{WNP})^X$, where X is the expected number of strikes (or attempts, or approaches). Thus, for example, the probability of striking a WNP animal out of 3 animals struck in an even-year hunt is $1 - (1 - P_{WNP})^3$, and the probability of striking a WNP animal out of the 15 allowed to be struck over the course of 10 years is $1 - (1 - P_{WNP})^{15}$. Model parameters were estimated using widely accepted Bayesian and Markov-chain Monte-Carlo statistical methods.

17. Inferences from our 2018 analysis include the following:

- If one gray whale is subjected to a strike, unsuccessful strike attempt, or approach during an even-year hunt, there is a 0.4% chance that it would be a WNP whale.
- Over the 10 years of the regulations, there is a 5.8% chance of striking at least one WNP whale, assuming a maximum of 15 strikes are made during even-year hunts (this is equivalent to saying that we would expect one WNP whale to be struck every 170 years, on average, if the regulations continued in perpetuity, the maximum number of strikes were made each year, and the WNP and ENP population sizes remained constant).
- There is a 30% chance of an unsuccessful strike attempt on a WNP whale if all 90 such attempts are made over 10 years (equivalent to saying we would expect one such encounter every 33 years, on average, if the regulations continued in perpetuity, the maximum number of unsuccessful strike attempts were made each year, and the WNP and ENP population sizes remained constant).
- There is very high probability (essentially 100%) of approaching at least one WNP whale if all 3,530 approaches are made over 10 years during the migration season. Specifically, the model predicts that if all allowed approaches are made and all occur during the migration season, we would expect 14 of those approaches to be on WNP whales.

18. Based on my expertise, I conclude this 2018 analysis uses the best available data and science and is the most appropriate method to provide advice to NMFS decision-makers on risks to WNP gray whales associated with the proposed 10-year limited hunt of ENP gray whales.

MODELING POTENTIAL EFFECTS OF THE PROPOSED HUNT ON PCFG GRAY WHALES

19. For the purposes of protecting not just the WNP but also PCFG whales, there are additional management triggers (besides the strike limits) in the proposed regulations for managing the hunt. Namely, hunts would cease if estimates of PCFG abundance fall below certain threshold levels, or, in the absence of up-to-date estimates, if forecasted estimates of PCFG abundance fall below these levels. There are two threshold levels for triggering a hunt cessation. If estimated or forecast abundance of PCFG whales falls below 192, or if the minimum (20^{th} percentile) estimate of abundance falls below 171 whales, then the hunt would cease in the year of crossing this threshold. These thresholds represent the lowest values observed during the 2002–15 time period, (i.e., in 2007, the population was estimated to be 192 with a 20^{th} percentile estimate of 171). We used 2002 as the starting point (for identifying a population trigger threshold) because that year marked the beginning of a stable population period. Before 2002, PCFG numbers were low but increasing rapidly.

20. To support decision-making related to the PCFG abundance triggers, I developed a PCFG population forecasting model using R, a free, open-source software environment that is widely used among scientists for statistical computing and graphics. The model forecasts PCFG abundance (associated minimum, i.e., lower 20^{th} percentile, abundance estimates) for 10 years (i.e., for the duration of the hunt regulation period). The following is an abbreviated description

of the model. A fuller description can be found in Appendix 2 of NMFS Biological Report on the ENP Gray Whale Stock. NMFS Ex. 1-7.

21. The PCFG population forecasting model is based on population size estimates from 2002 to 2015. NMFS Ex. 3-33, Calambokidis *et al.* 2017[22]. Again, the year 2002 was used as a starting point for estimating model parameters because this approximately marks the beginning of a decade-long period during which the PCFG population size was fairly stable. Including pre-2002 data in the model would inflate estimates of the population's more recent and current growth rate and thus likely overestimate population growth and abundance during the forecast period.

22. Assumptions and key elements of the PCFG population forecast model are:

- The population follows a stochastic exponential population-growth process, i.e., $N_t = N_{t-1}\lambda_t - M_t$, where the population size (N) in year t is given by the product of N for the previous year and the annual rate of change (λ_t), minus hunting mortality for the year (M_t).
- The annual rate of change estimates for the forecast period are based on the mean and variance in these rates from 2002–15.
- PCFG mortality (M_t) is has an average of $\theta = 1.6$ animals per year, given the terms of the hunting proposal.

23. A bootstrap simulation approach was used to estimate model parameters and forecast population size. The approach consists of repeating the following steps many thousands of times, with one repetition referred to as an iteration, or i. For each i:

[22] Calambokidis, J., Laake, J., and A. Perez. 2017. Updated analysis of abundance and population structure of seasonal gray whales in the Pacific Northwest, 1996–2015. Paper SC/A17/GW/05 presented to the International Whaling Commission.

- Draw random values for each N_t (for the years 2002 to 2015) from the distributions for these population estimates (random values were drawn assuming a multivariate normal process and using the variance-covariance matrix for the estimates described in Calambokidis *et al*. 2017, NMFS Ex. 3-33, provided to Jeff Moore by Andre Punt through pers. comm., Oct 19, 2017).
- Use the randomly drawn N_t to estimate the λ_t (i.e., $\lambda_t = N_t / (N_t - 1)$), from which μ and σ^2 are estimated as the mean and variance, respectively, for the log(λt).
- Given μ and σ^2, and a random value M_t drawn from a Poisson distribution with a mean of $\theta = 1.6$ animals per year, generate a population forecast using the exponential growth model above, where in each forecast year t, random λ_t and M_t are drawn from their respective distributions.

This process generates many thousands of plausible population trajectories. These are summarized to forecast the expected population size from 2016 onward (i.e., the mean population size across trajectories in each year t). The 20th percentile value at each t (i.e., the value for which 20% of the N_t estimates are smaller) represents minimum population estimate for year *t*.

24. Among other things, this PCFG population forecast model allowed me to analyze likely future abundance of the PCFG with and without a hunt. For example, the model projects that at the end of a 10-year hunting period that began in 2018, the expected PCFG population size would be 281, with a minimum (20th percentile) estimate of 178. Without hunting, the expected population size after 10 years is expected to be 298, with a minimum estimate of 195. Both sets of numbers are above the PCFG abundance management triggers. It should be noted

that these forecasts will be updated with future survey data. Managing the PCFG population and Makah hunt is not expected to rely on the current state of these forecasts.

25. Based upon my expertise, I conclude this model uses the best available data and science and is a reliable method for advising NMFS decision makers on the likely future abundance of PCFG whales, for meeting the management goal for PCFG whales.

I declare, under penalty of perjury under the laws of the United States, that the foregoing is true and correct to the best of my knowledge, information, and belief.

MOORE.JEFFREY.E.1392968578 Digitally signed by MOORE.JEFFREY.E.1392968578 Date: 2019.04.01 09:31:25 -07'00'

Jeffrey Moore

Dated: ____________________

DECLARATION OF DR. JEFFREY MOORE
<u>EXHIBIT LIST</u>

4-1. Curriculum Vitae (CV)
4-2. Small, R. J., and D. P. DeMaster. 1995. Alaska marine mammal stock assessments 1995. U.S. Dep. Commer., NOAA Tech. Memo. NMFSAFSC-57.
4-3. Punt, A. E. and P. R. Wade. 2012. Population status of the eastern North Pacific stock of gray whales in 2009. Journal of Cetacean Research and Management 12(1):15-28.
4-4. IWC. 2013a. Report of the Scientific Committee. Journal of Cetacean Research and Management (suppl.) 14:1-86. Report of the Scientific Committee.
4-5. IWC 2013b. Report of the Scientific Committee. Annual Meeting 2013. June 3–15, 2013.
4-6. IWC 2014. Report of the Scientific Committee. Journal of Cetacean Research and Management (suppl.) 15:1-75. Report of the Scientific Committee.
4-7. Moore, J. E. and D. W. Weller. 2013. Probability of taking a western North Pacific gray whale during the proposed Makah hunt. NOAA Technical Memorandum NMFS-SWFSC-506. January 2013.
4-8. Moore, J.E. and D.W. Weller. 2018. Updated estimates of the probability of striking a western North Pacific gray whale during the proposed Makah hunt. NOAA Technical Memorandum NMFS-SWFSC-605. August 2018.
4-9. IUCN 2012. Report of the 11th Meeting of the Western Gray Whale Advisory Panel. Geneva, Switzerland. February 12-14, 2012.
4-10. Calambokidis, J., J. Laake, and A. Perez. 2014. Updated analysis of abundance and population structure of seasonal gray whales in the Pacific Northwest, 1996–2012. Final Report to National Marine Mammal Laboratory, Seattle, WA.
4-11. Cooke, J.G. 2015. Implications of observed whale movements on the relationship between the Sakhalin gray whale feeding aggregation and putative breeding stocks of the gray whale. Paper SC/A15/GW02 presented to the Second Workshop on the Rangewide Review of the Population Structure and Status of North Pacific Gray Whales, 1-3 April 2015, La Jolla, CA, USA.
4-12. IWC 2016. Report of the Scientific Committee. Report of the 2nd workshop on the rangewide review of the population structure and status of North Pacific gray whales, 1-3 April 2015, La Jolla, CA, USA. Journal of Cetacean Research and Management (suppl.) 17:567-581.

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Professional Employment

Since 2015	Leader, California Current Marine Mammal Assessment Program, Marine Mammal and Turtle Division, Southwest Fisheries Science Center, NOAA Fisheries, La Jolla, CA
Since 2010	Research Wildlife Biologist, Marine Mammal and Turtle Division, Southwest Fisheries Science Center, NOAA Fisheries, La Jolla, CA
2010 - 2013	Adjunct Assistant Professor, Nicholas School of the Environment, Duke University Marine Laboratory, Beaufort, NC.
2009	Research Scientist, Center for Marine Conservation, Nicholas School of the Environment, Duke University Marine Laboratory, Beaufort, NC.
2006 – 2008	Postdoctoral Scientist, Center for Marine Conservation, Nicholas School of the Environment, Duke University Marine Laboratory, Beaufort, NC.

Professional Education

2005	Ph.D.	Wildlife Science, Purdue University
2002	M.S.	Wildlife Biology, Humboldt State University
1996	B.S.	Wildlife & Conservation Biology, University of California at Davis, Honors

Current Research Interests and Expertise

* Population assessment; population dynamics of species of conservation concern
* Inference and decision-making in data-poor systems
* Applications of quantitative methods to applied problems in ecology and conservation
* Fisheries sustainability

Committees, Working Groups

2018 --	International Committee for the Recovery of the Vaquita (CIRVA)
2018 --	National Technical Working Group on Bycatch (National Marine Fisheries Service), Chair
2017--	Ocean Modeling Forum working group on marine mammal bycatch
2017--	DENMOD – Working group for the advancement of marine species density modeling
2014 --	Cetacean Specialist Group, IUCN Species Survival Commission

2014 -- Expert panel member for vaquita abundance modeling for the International Committee for the Recovery of the Vaquita (CIRVA)
2013 Biological/Status Review Team for Northeastern Pacific white sharks
2012 – 2013 NCEAS working group: Developing comprehensive management models for marine mammals

Peer-reviewed Journal Articles, incl. NOAA Tech Memos

2019 Carretta JV, **Moore JE**, Forney KA. Estimates of marine mammal, sea turtle, and seabird bycatch from the California large-mesh drift gillnet fishery: 1990 – 2017. NOAA Technical Memorandum NOAA-TM-SWFSC-XXX.

2018 **Moore JE**, Weller DW. Updated estimates of the probability of striking a western north Pacific gray whale during the proposed Makah hunt. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-605.

2018 Boyd C, Barlow J, Becker EA, Forney KA, Gerrodette T, **Moore JE**, Punt AE. Estimation of population size and trends for highly mobile species with dynamic spatial distributions. *Diversity and Distributions* 24:1-12.

2018 **Moore JE**, Martin AR, da Silva VMF. Intrinsic growth (R_{max}) and generation time (T) estimates for *Inia geoffrensis*, in support of an IUCN Red List re-assessment. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-596.

2018 Lennert-Cody C, Buckland ST, Gerrodette T, Webb A, Barlow J, Fretwell PT, Maunder MN, Kitakado T, **Moore JE**, Scott MD, Skaug HJ. Review of potential line-transect methodologies for estimating abundance of dolphin stocks in the eastern tropical Pacific. *Journal of Cetacean Research and Management* 19:9-21.

2018 Yano KM, Oleson EM, Keating JL, Balance LT, Hill MC, Bradford AL, Allen AN, Joyce TW, **Moore JE**, Henry A. Cetacean and seabird data collected during the Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS), July – December 2017. NOAA Technical Memorandum NOAA-TM-PIFSC-72.

2017 Thomas L, Jaramillo-Legorreta A, Cardenas-Hinojosa G, Nieto-Garcia E, Rojas-Bracho L, Ver Hoef JM, **Moore J**, Taylor B, Barlow J, Tregenza N. Last call: passive acoustic monitoring shows continued rapid decline of critically endangered vaquita. *Journal of Acoustical Society of America Express Letters*. 142, EL512 (2017); doi: 10.1121/1.5011673

2017 **Moore JE**, Barlow J. Population abundance and trend estimates for beaked whales and sperm whales in the California Current from ship-based visual line-transect survey data, 1991 – 2014. NOAA Tech Memo NOAA-TM-NMFS-SWFSC-585.

2017 Carretta JV, **Moore JE**, Forney KA. Regression tree and ratio estimates of marine mammal, sea turtle and seabird bycatch in the California drift gillnet fishery: 1990-2015. NOAA Tech Memo NOAA-TM-NMFS-SWFSC-568.

2017 Williams R, Ashe E, Gaut K, Gryba R, **Moore JE**, Rexstad E, Sandilands D, Steventon J, Reeves R. Animal counting toolkit: a practical guide to small-boat surveys for estimating abundance of coastal marine mammals. *Endangered Species Research* 34:149-165.

2016 Taylor BL, Rojas-Bracho L, **Moore J**, Jaramillo-Legorreta A, Ver Hoef J.M., Cardenas-Hinojosa G, Nieto-Garcia E, Barlow J, Gerrodette T, Tregenza N, Thomas L, Hammond P.S. Extinction is imminent for Mexico's endemic porpoise unless fishery bycatch is eliminated. *Conservation Letters* DOI: 10.1111/conl.12331

2016 Jaramillo-Legorreta A, Cardenas-Hinojosa G, Nieto-Garcia E, Rojas-Bracho L, Ver Hoef J, **Moore J**, Tregenza N, Barlow J, Gerrodette T, Thomas L, Taylor B. Acoustic monitoring reveals a catastrophic decline in Mexico's vaquita, the world's most endangered marine mammal. *Conservation Biology* 31:183-191

2016 Nadeem K, **Moore JE**, Zhang Y, Chipman H. 2016. Integrating Population Dynamics Models and Distance Sampling Data: A Spatial Hierarchical State-Space Approach. Ecology 97:1735-1745.

2016 Williams R, **Moore JE**, Gomez-Salazar C, Trujillo F, Burt L. Searching for trends in river dolphin abundance: Designing surveys for looming threats, and evidence for opposing trends of two species in the Colombian Amazon. *Biological Conservation* 195: 136 - 145

2015 Curtis KA, **Moore JE**, Benson SR. Estimating limit reference points for western Pacific leatherback turtles (Dermochelys coriacea) in the U.S. West Coast EEZ. *PLoS ONE* 10(9): e0136452.

2015 Curtis KA, **Moore JE**, Boyd C, Dillingham PW, Lewison RL, Taylor BL, James KC. Managing catch of marine megafauna: guidelines for setting limit reference point. *Marine Policy* 61: 249-263

2015 **Moore JE**. Intrinsic growth (rmax) and generation time (T) estimates for the cetacean genera Sousa, Orcaella, and Neophocaena, in support of IUCN Red List assessments. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-550

2015 Dillingham P, **Moore JE**, Fletcher D, Cortes E, James K, Curtis KA, Lewison RL. In press. Improved estimation of intrinsic growth rmax for long-lived species: integrating matrix models and allometry. *Ecological Applications*

2015 James K, Lewison RL, Dillingham P, Curtis KA, **Moore JE**. In press. Drivers of retention and discards of elasmobranch non-target catch. *Environmental Conservation*

2015 Martin SL, Stohs SM, **Moore JE**. In press. Bayesian modeling and risk classification for rare-event bycatch in marine fisheries: a case study on the California drift gillnet fishery. *Ecological Applications* 25:416-429

2014 **Moore JE**, Barlow JP. Improved abundance and trend estimates for sperm whales in the eastern North Pacific from Bayesian hierarchical modeling. *Endangered Species Research* 25:141-150

2014 Carretta JV, **Moore JE**. Recommendations for pooling annual bycatch estimates when events are rare. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-528.

2014 Lewison RL, Crowder LB, Wallace BP**, Moore JE**, Cox TM, Zydelis R, McDonald S, DiMatteo A, Dunn D, Kot CY, Bjorkland R, Kelez S, Soykan C, Stewart KR, Sims M, Boustany A, Read AJ, Halpin P, Nichols WJ, Safina C. 2014. Global patterns of marine mammal, seabird and sea turtle bycatch reveal taxa-specific and cumulative megafauna hotspots. *Proceedings of the National Academy of Sciences of the United States*. doi: 10.1073/pnas.1318960111

2013 **Moore, JE**, Curtis KA, Dillingham PW, Cope JM, Fordham S, Heppell S, Pardo SA, Simpfendorfer CA, Tuck G, Zhou S. Evaluating sustainability of fisheries bycatch mortality for marine megafauna: conservation reference points for data-limited populations. *Environmental Conservation* 40:329-344

2013 **Moore, JE**, and J. Barlow. Declining abundance of beaked whales (family Ziphiidae) in the California Current large marine ecosystem. *PLoS ONE* 8(1): e52770

2013	Curtis, K.A., and **JE Moore**. Calculating reference points for sustainable take of marine turtles. *Aquatic Conservation: Marine & Freshwater Ecosystems* 23:441-459.
2013	Turvey ST, CL Risley, **JE Moore**, LA Barrett, H Yujiang, Z Xiujiang, Z Kaiya, W Ding. In press. Can local ecological knowledge be used to assess status and extinction drivers in a threatened freshwater cetacean? *Biological Conservation* 157:352-360
2013	**Moore, J.E.,** and D.W. Weller. Probability of taking a western North Pacific gray whale during the proposed Makah hunt. U.S. Department of Commerce, NOAA Technical Memorandum NMFS, NOAA-TM-NMFS-SWFSC-506
2013	Punt A.E., and **J.E. Moore**. Seasonal gray whales in the Pacific Northwest: An assessment of optimum sustainable population level for the Pacific Coast Feeding Group. U.S. Department of Commerce, NOAA Technical Memorandum NMFS, NOAA-TM-NMFS-SWFSC-518.
2013	Weller D.W., Bettridge S., Brownell R.L., Laake J.L., **Moore J.E.,** Rosel P.E., Taylor B.L., Wade P.R. Report of the National Marine Fisheries Service Gray Whale Stock Identification Workshop. U.S. Department of Commerce, NOAA Technical Memorandum NMFS, NOAA-TM-NMFS-SWFSC-507.
2012	**Moore JE**. Management reference points to account for direct and indirect impacts of fishing on marine mammals. *Marine Mammal Science* DOI: 10.1111/j.1748-7692.2012.00586.x
2011	**Moore JE**, and R. Merrick (eds). Guidelines for Assessing Marine Mammal Stocks: Report of the GAMMS III Workshop, February 15-18, 2011, La Jolla, California. NOAA Technical Memorandum NMFS-OPR-47. U.S. Department of Commerce.
2011	Finkbeiner EM, BP Wallace, **JE Moore**, RL Lewison, LB Crowder, AJ Read. Cumulative estimates of sea turtle bycatch and mortality in USA fisheries between 1990 – 2007. *Biological Conservation*.
2011	**Moore JE** and J Barlow. Bayesian hierarchical estimation of fin whale abundance trends from a 1991-2008 time series of line-transect surveys in the California Current. *Journal of Applied Ecology*.
2011	Zydelis R, RL Lewison, SA Shaffer, **JE Moore**, AM Boustany, JJ Roberts, M Sims, DC Dunn, BD Best, Y Tremblay, MA Kappes, PN Halpin, DP Costa, LB Crowder. Dynamic habitat models: using telemetry data to project fisheries bycatch. *Proceedings of the Royal Society, Series B*. Accepted.
2011	Lewison RL, CU Soykan, T Cox, H Peckham, N Pilcher, N LeBoeuf, S McDonald, **JE Moore**, C Safina, LB Crowder. Ingredients for addressing the challenges of fisheries bycatch. *Bulletin of Marine Science.* Accepted.
2010	**Moore, J. E.,** T.M. Cox, R.L. Lewison, A.J. Read, R. Bjorkland, S.L. McDonald, L.B. Crowder, E. Aruna, I. Ayissi, P. Espeut, C. Joynson-Hicks, N. Pilcher, C. Poonian, B. Solarin, and J. Kiszka. An interview-based approach for assessing marine mammal and sea turtle captures in artisanal fisheries. *Biological Conservation* 143:795-805.
2009	J. Bryant, et al. (many authors). Fire drives transcontinental variation in tree birch defense against browsing by snowshoe hares. *American Naturalist* 174:13-23.
2009	**Moore, J. E**., B. Wallace, R. Lewison, R. Zydelis, T. Cox, L. Crowder. 2009. A review of marine mammal, sea turtle and seabird bycatch in USA fisheries and the role of policy in shaping management. *Marine Policy* 33:435-451.

2009	Rizkalla, C., **J.E. Moore**, and R.K. Swihart. Modeling patch occupancy: relative performance of ecologically scaled landscape indices. *Landscape Ecology* 24:77-88.
2008	Soykan, C.U., **J.E. Moore**, R. Zydelis, R.L. Lewison, L.B. Crowder, and C. Safina. Why study bycatch? An introduction to the Theme Section on fisheries bycatch. *Endangered Species Research* 5:91-102.
2008	**Moore, J.E.,** and A. J. Read. A Bayesian uncertainty analysis of cetacean demography and bycatch mortality using age-at-death data. *Ecological Applications* 18:1914-1931.
2008	**Moore J.E.** and R. Zydelis. Quantifying seabird bycatch: where do we go from here? *Animal Conservation* 11:257-259.
2008	Eckert, S.A, **J. E. Moore**, D. D. Dunn, R. Sagarminaga, K. L. Eckert, P. N. Halpin. Hierarchical state-space models of loggerhead sea turtle movement behavior in relation to turtle size and oceanography. *Ecological Applications* 18:290-308
2008	Poonian, C.N.S., M.D. Hauzer, A.B. Allaoui, T.M. Cox, **J.E. Moore**, A.J. Read, R.L. Lewison, and L.B. Crowder. Rapid assessment of sea turtle and marine mammal bycatch in the Union of the Comoros. *WIOMSA Journal* 7:207-216.
2008	**Moore, J. E.,** and R. K. Swihart. Factors affecting the relationship between seed removal and seed mortality. *Canadian Journal of Zoology* 86:378-385.
2007	**Moore, J. E.,** A. B. McEuen, R. K. Swihart, T. A. Contreras, and M. A. Steele. Determinants of seed-removal distance by scatter-hoarding rodents in deciduous forests. *Ecology* 88:2529-2540
2007	**Moore, J. E.,** and R. K. Swihart. Toward ecologically explicit null models of nestedness. *Oecologia* 152:763-777
2007	**Moore, J. E**. and R. K. Swihart. Importance of fragmentation-tolerant species as seed dispersers in disturbed landscapes. *Oecologia* 151:663-674.
2007	Lee, D. E., J. M. Black, **J. E. Moore**, and J. S. Sedinger. Age-specific stopover ecology of Black Brant at Humboldt Bay, California. *Wilson Journal of Ornithology* 119:9-22.
2006	**Moore, J. E**. and R. K. Swihart. Diet choice of captive Blue Jays: implications for tree dispersal. *Condor.*108:377-388.
2006	Swihart, R. K., J. J. Lusk, J. E. Duchamp, C. E. Rizkalla, and **J. E. Moore**. The roles of landscape context, niche breadth, and range boundaries in predicting species responses to habitat alteration. *Diversity and Distributions* 12:277-287.
2006	**Moore, J. E**. and J. M. Black. Slave to the tides: spatio-temporal foraging dynamics of spring staging black brant. *Condor*108:661-677.
2006	**Moore, J. E**., and J. M. Black. Historical changes in black brant use on Humboldt Bay, California. *Wildlife Biology* 12:151-162.
2005	**Moore, J. E**., and R. K. Swihart. Modeling patch occupancy by forest rodents: incorporating detectability and spatial autocorrelation with hierarchically structured data. *Journal of Wildlife Management* 69:933-949
2004	**Moore, J. E**., M. A. Colwell, R. M. Mathis, and J. M. Black. Staging of Pacific flyway brant in relation to eelgrass abundance and site isolation, with special consideration of Humboldt Bay, California. *Biological Conservation* 115:475-486.
2004	**Moore, J. E**., Scheiman, D. M. and R. K. Swihart 2004. Field comparison of removal and modified double-observer modeling for estimating detectability and abundance of birds. *Auk* 121:865-876.
1998	**Moore, J.E.** and P. V. Switzer. Pre-roosting aggregations in the American Crow *Corvus brachyrhyncos. Canadian Journal of Zoology* 76:508-512.

Books and Book Chapters

2017 **Moore JE**, Forney KA, Weller DW. Surveys. Chapter 17 in *Encyclopedia of Marine Mammals*, 2nd ed.

2016 **Moore JE**, Curtis KA. 2016. Developing control rules for threatened bycatch species. Pages 278-297 in Edwards CTT and Dankel DJ (eds), Management Science in Fisheries: An Introduction to Simulation-Based Methods. Taylor and Francis.

2004 Swihart, R. K. and **J. E. Moore**. Conserving Biodiversity in Agricultural Landscapes: Model-Based Planning Tools. Purdue University Press, West Lafayette, IN.

2004 **Moore, J. E.** and R. E. Russell. 2004. Empirical considerations for modeling animal movements in human-dominated landscapes. Pages 165-180 in R.K. Swihart and J.E. Moore, editors. Conserving Biodiversity in Agricultural Landscapes: Model-Based Planning Tools. Purdue University Press, West Lafayette, IN.

2004 Russell, R. E., **J. E. Moore,** M. S. Miller, T. M. Sutton, and S. M. Knapp. Selecting surrogate species for ecological assessments in land-use planning: a case study in the Upper Wabash River Basin. Pages 181-213 in R.K. Swihart and J.E. Moore, editors. Conserving Biodiversity in Agricultural Landscapes: Model-Based Planning Tools. Purdue University Press, West Lafayette, IN.

Other Publications, incl. IWC reports

2017 **Moore JE**, Barlow J, Falcone E, Schorr G, Moretti D, Curtis KA. A power analysis and recommended study design to directly detect population-level consequences of acoustic disturbance. Final Report to Office of Naval Research (ONR). Award Number N0001415IP00088.

2016 PacMAPPS: Toward Developing a Strategic Plan for Conducting Multispecies Cetacean and Ecosystem Assessment Surveys in the Pacific Ocean (lead author). White paper available at: https://swfsc.noaa.gov/uploadedFiles/Divisions/PRD/Projects/Research_Cruises/PacMAPPS/PacMAPPS-DevelopingAStrategicPlan.pdf

2013 Moore JE, Stolen M, Westgate A, Johnston DW. Using marine mammal strandings and observer data to estimate life history parameters and assess demographic impacts of marine fisheries for odontocete populations in the northwestern Atlantic Ocean. Final report for Prescott Grant program, Award Number NA09NMF4390234

2012 **Moore JE**, and J Barlow. Beaked whale abundance trends in the California Current, 1991-2008. IWC Scientific Committee paper SC/64/SM11

2012 **Moore JE**, and D. Weller. Probability of taking a western North Pacific gray whale during the proposed Makah hunt. IWC Scientific Committee paper SC/64/BRG9.

2011 **Moore, J.E**., and R. Leaper. Partitioning variance components to estimate historical bycatch: an example for minke whales in Japan. IWC Scientific Committee paper SC/63/BC1

2009 **Moore, J.E.** Cumulative impacts of U.S. fisheries bycatch on northwestern Atlantic loggerhead turtle populations. Report to Oceana.

2007 **Moore, J.E.,** and A. J. Read. A Bayesian uncertainty analysis of cetacean demography and bycatch mortality using age-at-death data. IWC Scientific Committee Paper SC/59/BC6 (http://www.iwcoffice.org/_documents/sci_com/SC59docs/SC-59-BC6.pdf).

2001 **Moore, J.E.** Assessment of shorebird and wader use of Bird Island in Arcata Bay, California: is bird distribution affected by the presence of a bat ray exclusion fence? Report prepared for Coast Seafoods, Inc., Eureka, California.

2000 **Moore, J.E.** White-tailed kite (*Elanus leucurus)*. Species account written for the California Partners in Flight Grassland Bird Conservation Plan (http://www.prbo.org/calpif/htmldocs/species/grassland/wtkiacct.html).

Funding

2017 $1,340,000. Bureau of Ocean Energy Management. "Pacific Marine Assessment Program for Protected Species (PacMAPPS)"

2016 $150,000. Bureau of Ocean Energy Management. "California Current Cetacean and Ecosystem Assessment Survey and Use of Data to Produce and Validate Cetacean and Seabird Density Maps" (PASCAL project)

2016 $67,000. NOAA Office of Science and Technology. "Tools for Improving Population Assessment Components for Protected Species". Lead PI.

2015 $66,476. Office of Naval Research. "A Power Analysis and Recommended Study Design to Directly Detect Population level Consequences of Acoustic Disturbance". Lead PI.

2014 $50,000. NOAA Office of Science and Technology. "Advancing development of a limit reference point estimator for sea turtles, and evaluating methods for applying local management to highly migratory species". Lead PI.

2014 $55,000. NOAA Assessment Methods Working Group. "Developing a user-friendly software package for conducting Bayesian trend and power analysis for marine mammal stock assessments". Lead PI.

2013 $50,000. NOAA Office of Science and Technology. "Advancing development of a limit reference point estimator for sea turtles, and evaluating methods for applying local management to highly migratory species". Lead PI.

2012 $36,900. National Center for Ecological Analysis and Synthesis (NCEAS). Developing comprehensive management models for marine mammals. Working group participant (lead: Leah Gerber).

2011 $560,000. Lenfest Ocean Program. "Estimating sustainable limits of incidental mortality for data-poor marine wildlife. Co-PI (lead) with P Dillingham, R Lewison, A Curtis.

2010 $40,000. NOAA Office of International Affairs. "Improving interview-based assessments of sea turtle and marine mammal bycatch in West Africa." Co-PI with RL Lewison.

2009 $54,000. Lenfest Ocean Program. "A model-based decision tool for setting incidental take limits for marine turtles in U.S. fisheries". Lead PI.

2009 $98,418. NOAA – Prescott Grant Program. "Using marine mammal strandings and observer data to estimate life history parameters and assess demographic impacts of marine fisheries for odontocete populations in the northwestern Atlantic Ocean". Co-PI (lead) with D. Johnston and M. Stolen.

2009 $29,983. International fund for animal welfare. "Assessing the effects of climate variability and global change on ice-associated seals in the North". Co-PI with D. Johnston and A. Friedlaender.

2008 $37,562. U.S. Marine Mammal Commission. "An uncertainty analysis of to assess relative risk of marine mammal stocks to indirect effects of fishing". Co-PI (lead) with A. Read.

2008 $14,958. Oceana. "VPA for Western Atlantic loggerheads: assessing cumulative bycatch impacts from Atlantic USA fisheries". Co-PI (lead) with L. Crowder

Other Research Experience

2001 – 2005 Research Assistant, Purdue University, West Lafayette, IN.

1999 – 2001 Wildlife Biologist, Coast Seafoods, Inc., Eureka, CA.

1999 Biological Science Technician, Mad River Biologists, McKinleyville, CA.

1997, 1998 Biological Science Technician, GS-5, U.S. Forest Service, Redwood Science Lab, Arcata, CA.

1998 Biological Science Technician, GS-5, U.S. Geological Survey, Biological Research Division, Corvallis, OR.

1997 Biological Science Technician, National Park Service, Yellowstone National Park.

Teaching Experience

2009 Instructor, Research Methods (juniors and seniors), Duke University Marine Laboratory.

2004 Instructor, Vertebrate Population Dynamics (senior & graduate course), Dept. Forestry & Natural Resources, Purdue University (Instructor rating = 4.1 / 5.0, with 5 being "excellent" and 1 being "very poor", n = 28 students)

2001 Teaching Assistant, Behavioral Ecology (upper division undergraduate course), Dept. of Wildlife, Humboldt State University

Mentoring

Jessica Umansky, professional Master's program, 2011/2012 academic year. Project: IATTC and ICCAT: Understanding drivers of change for bycatch mitigation in two RFMOs.

K. Alexandra Curtis, postdoctoral researcher, March – November 2010. Project: A model-based decision tool for setting incidental take limits for marine turtles in U.S. fisheries

Guest Lectures

2014 SIO 286 Marine Science, Economics and Policy: Fisheries Management; Winter 2014

2011, 2013, 2015 Bayesian approach to hierarchical models. Lecture for Computer intensive statistics (SIO 279), Scripps Institute of Oceanography, UCSD.

2006, 2007 Marine ecology (upper division & graduate course), lectures/labs in population dynamics, Nicholas School of the Environment and Earth Sciences, Duke University Marine Laboratory

2006, 2007 Marine megafauna (undergraduate course), lectures in life history theory and population dynamics, Nicholas School of the Environment and Earth Sciences, Duke University Marine Laboratory

Honors and Awards

2012	NMFS Cash Award for Performance, Organizer of bycatch assessment workshop
2011	NMFS Cash Award for Performance, Convener of GAMMS III workshop
2005	A. Brazier Howell Graduate Student Paper Award, American Society of Mammalogists
2005	Best Scientific Poster - Purdue Dept of Forestry and Natural Resources Research Symposium
2005	Purdue University Graduate Student Award for Outstanding Teaching
2005	Nominee for Purdue's Kirkpatrick Memorial Award for leadership and conservation work in the wildlife profession
2001	Marin Rod and Gun Club Scholarship
2001	Humboldt State University Travel Grant
2001	Phi Kappa Phi Honorary Fraternity, Humboldt State Graduate Student Chapter
1999	Humboldt State University Small Grant
1999	Stockton Sportsmen's Club Scholarship
1996	Phi Kappa Phi Honorary Fraternity, U.C. Davis Chapter
1996	Phi Sigma Honorary Fraternity, Gamma Delta Chapter
1995	Golden Key National Honor Society
1995	Mutual of Omaha Marlin Perkins Scholarship (Outstanding Junior Award)
1992	San Diego Gas and Electric Scholarship

Organized workshops or symposia

2016	"Developing a Joint Strategic Science and Funding Plan (NMFS-Navy-BOEM-USFWS)", SWFSC
2013	"Improving estimates of marine mammal productivity", SWFSC
2012	"Calculating productivity and related estimates for sharks", SWFSC
2012	"Use of Reference Points for Bycatch Risk Assessment of Marine Megafauna: Workshop I", 6 – 8 March 2012, Southwest Fisheries Science Center, La Jolla, CA
2011	"Advancing management of marine megafauna bycatch: estimating and implementing fisheries take limits", 2nd International Marine Conservation Congress, 13 May, Victoria, British Columbia.
2011	3rd workshop on revising the Guidelines for Assessing Marine Mammal Stocks (GAMMS III) under the Marine Mammal Protection Act, 15-18 February, NOAA Southwest Fisheries Science Center, La Jolla, CA
2010	Two-week training workshop for conducting interview-based research of small-scale fisheries and bycatch: "Marine mammals, sea turtles and Nigerian fisheries". Lagos, Nigeria, November 2010.

Invited Presentations and Seminars

2015	Assessing impacts of bycatch on protected species off the U.S. West Coast. Invited presenter and panelist, Southern California Marine Mammal Workshop, Newport Beach, CA.

2013 Bayes, bycatch, and beaked whales. Invited presenter at San Diego State University, San Diego, CA.
2013 Bayes, bycatch, and beaked whales. Invited presenter at Scripps Institute of Oceanography, La Jolla, CA.
2011 Rapid assessment of sea turtle and marine mammal bycatch in artisanal fisheries. Workshop of the Artisanal Fisheries Research Network, UCSD, La Jolla, CA.
2009 How much information do we need to manage sea turtle populations? Southwest Fisheries Science Center (NOAA), San Diego, CA.
2009 Squeezing blood from the turnip: population ecology and conservation of marine mammals and sea turtles, with few data. Southwest Fisheries Science Center (NOAA), San Diego, CA.
2009 Squeezing blood from the turnip: population ecology and conservation of marine mammals and sea turtles, with few data. Southeast Fisheries Science Center (NOAA), Beaufort, NC.
2008 Understanding collateral impacts of marine fisheries on wildlife. University of North Carolina Chapel Hill, Institute of Marine Science, Morehead City, North Carolina.
2008 Studying megavertebrate bycatch in the world's fisheries: filling knowledge gaps and assessing impacts. Mote Marine Laboratory, Sarasota, Florida.
2007 Impacts of commercial gillnet fisheries on harbor porpoise: a demographic uncertainty analysis. University of North Carolina Wilmington, Wilmington, North Carolina.
2006 Demographic analyses for species of concern: the problem of limited data. Workshop for assessing fisheries bycatch in the southwest Atlantic, Mar del Plata, Argentina.
2005 Modeling patch occupancy by forest rodents: incorporating detectability and spatial autocorrelation with hierarchically structured data. American Society of Mammalogists' meeting, Springfield, MO.
2004 On the utility of ecological scaling in predicting species responses to landscape alteration. The Wildlife Society meeting, Calgary, Alberta, Canada.
2001 Distribution of black brant in relation to feeding opportunities on Humboldt Bay, CA. California Native Plant Society, North Coast Chapter. Arcata, CA.
2000 Distribution of black brant in relation to feeding opportunities on Humboldt Bay, CA. Stockton Sportsmen's Club, Stockton, CA.

Presentations at Scientific Meetings (First-authored/presenter)

2019 Moore JE, Barlow J. Estimating population abundance for beaked whales for drifting acoustic recorders and other data sources. Protected Species Stock Assessment Workshop, La Jolla, CA.
2017 **Moore JE**, Holmes E, Coleman H. An R Shiny tool for Bayesian bycatch estimation from a time series of fisheries observer data. Protected Species Stock Assessment Workshop, Seattle, WA.
2017 **Moore JE**, Barlow J, Forney K, Taylor B. Estimating cetacean abundance trends from survey time series: integrating multiple data sources within a Bayesian framework. Protected Species Stock Assessment Workshop, Seattle, WA.
2015 **Moore JE,** Carretta J. Improving bycatch estimation and inference through model-based approaches. Biennial Meeting of the Society of Marine Mammalogy, San Francisco, CA USA.

2013	**Moore JE**, Dillingham P, James K, Lewison R, Curtis A. Intrinsic population growth rates of marine mammals. Biennial Meeting of the Society of Marine Mammalogy, Dunedin, New Zealand.
2011	**JE Moore** and JP Barlow. Bayesian state-space model of cetacean abundance trends in the California Current. Society of Marine Mammalogy biennial meeting, Tampa, FL.
2011	**J.E. Moore** and K. Alex Curtis. A model-based tool for setting cumulative interaction limits for marine turtles. International Sea Turtle Symposium, San Diego, CA.
2011	**J.E. Moore** and J. Barlow. Bayesian state-space model of fin whale abundance trends from a 1991-2008 time series of line-transect surveys in the California Current. Southern California Marine Mammal Conference, Newport Beach, CA.
2010	**J.E. Moore**, et al. Interview-based assessments of marine mammal and sea turtle bycatch in artisanal fisheries. Fishery Dependent Data Conference, Galway, Ireland
2009	**J. E. Moore.** Incorporating prey depletion by fisheries into estimates of Potential Biological Removal for marine mammals. Society of Marine Mammalogy, Quebec City, Quebec, Canada.
2008	**J. E. Moore**., et al. Rapid assessment of sea turtle and marine mammal bycatch in artisanal fisheries. International Sea Turtle Symposium, Loreto, Mexico.
2007	**J. E. Moore** and A. J. Read. A Bayesian uncertainty analysis of cetacean demography and bycatch mortality using age-at-death data. Society of Marine Mammalogy meeting, Cape Town, South Africa.
2007	**J. E. Moore**, et al. Project GloBAL: assessing bycatch of marine megafauna in the world's fisheries. West African Talks on Cetaceans and their Habitats (WATCH), under the Convention on Migratory Species (CMS), Tenerife, Spain.
2007	**J. E. Moore**., et al. Rapid assessment of sea turtle and marine mammal bycatch in artisanal fisheries. Society for Conservation Biology, Port Elizabeth, South Africa.
2007	**J. E. Moore,** D. Dunn, S. Eckert, and R. Sagarminaga. Hierarchical state-space model of loggerhead movement in the Mediterranean Sea. International Sea Turtle Symposium, Myrtle Beach, NC.
2007	**J. E. Moore**, T. Cox, R. Zydelis, and B. Wallace. Toward a global bycatch assessment: an overview of sea turtle bycatch in USA fisheries. International Sea Turtle Symposium, Myrtle Beach, NC.
2005	**J. E. Moore** and R. K. Swihart. Modeling patch occupancy by forest rodents: incorporating detectability and spatial autocorrelation with hierarchically structured data. Purdue Dept of Forestry and Natural Resources Research Symposium.
2005	**J. E. Moore** and R. K. Swihart. Modeling patch occupancy by forest rodents: incorporating detectability and spatial autocorrelation with hierarchically structured data. American Society of Mammalogists' meeting, Madison, WI.
2004	**J. E. Moore**. Approaches to analyzing multi-scale data for population studies: issues of non-detection and spatial dependence. Midwest Fish and Wildlife conference, Indianapolis, IN.
2004	**J. E. Moore** and R. K. Swihart. Effects of landscape pattern on proportional occupancy of forest patches by songbirds in fragmented landscapes. The Wildlife Society conference. Calgary, Alberta, Canada.
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2003	**J. E. Moore** and R. K. Swihart. Consequences of forest fragmentation for regeneration of animal-dispersed hardwood trees in the Midwest. Ecological Society of America meeting, Savannah, GA.
2003	**J. E. Moore** and R. K. Swihart. Consequences of forest fragmentation for regeneration of animal-dispersed hardwood trees in the Midwest. American Society of Mammalogists meeting, Lubbock, TX.
2003	**J. E. Moore** and R. K. Swihart. Consequences of forest fragmentation for regeneration of animal-dispersed hardwood trees in the Midwest. Midwest Ecology and Evolution conference, Akron, OH.
2002	**J.E. Moore** and J.M. Black. Spring staging of black brant throughout the Pacific Flyway in relation to eelgrass abundance and site isolation, with special consideration of Humboldt Bay, California. North American Ornithological conference, New Orleans, LA.
2002	**J.E. Moore** and J.M. Black. Distribution of black brant in relation to feeding opportunities on Humboldt Bay. Pacific Flyway Symposium, Otter Rock, OR.
2002	**J.E. Moore** and J.M. Black. Variation in eelgrass characteristics on Humboldt Bay. Pacific Flyway Symposium, Otter Rock, OR.
2002	**J.E. Moore**, M.A. Colwell, R.M. Mathis, and J.M. Black. Black brant and eelgrass in the Pacific Flyway. Pacific Flyway Symposium, Otter Rock, OR.
2002	**J.E. Moore** and J.M. Black. Historical trends in brant use on Humboldt Bay. Pacific Flyway Symposium, Otter Rock, OR.
2002	**J.E. Moore** and J.M. Black. Can brant in Humboldt Bay meet their energetic requirements feeding on exposed eelgrass? Pacific Flyway Symposium, Otter Rock, OR.
2001	**J.E. Moore** and J.M. Black. Distribution of black brant in relation to feeding opportunities on Humboldt Bay. North American Arctic Goose Conference and Workshop, Quebec City, Quebec.

Professional Development

2010	Bayesian Population Biology workshop, USGS Patuxent, Laurel, MD.
2010	Advanced Distance Sampling workshop, St. Andrews, Scotland
2006	Course audit: Bayesian methods in ecology, Duke University.
2005	Bayesian statistics workshop, customized for Purdue Dept of Forestry & Natural Resources, West Lafayette, IN.
2005	Bayesian statistics workshop in Chicago, IL.
2004	Bayesian statistics and MCMC workshop at TWS meetings in Calgary, Alberta, Canada.
2000	Program MARK workshop, Humboldt State University, Arcata, CA

Service

2014	Scientific organizing committee, Southern California Marine Mammal Workshop, Newport Beach, CA.
2013	Reviewer of abstracts, Society of Marine Mammalogy meeting, Dunedin, New Zealand.
2012	Member of the U.S. Delegation to the International Whaling Commission, Panama City, Panama
2011	Member of the Artisanal Fisheries Research Network, UC San Diego.

2011	Reviewer of abstracts, Society of Marine Mammalogy meeting, Tampa, FL.
2011	Member of the U.S. Delegation to the International Whaling Commission, Tromso, Norway.
2011	Reviewer of symposia/workshop abstracts, 2nd International Marine Conservation Congress, Victoria, BC.
2010	Scientific Program Committee Member, International Sea Turtle Symposium, San Diego, CA.
2008	Evaluator of Presentations, Graduate Student Symposium, Duke University
2008 - 2009	Advisory Council, Carteret County Crossroads (local environmental sustainability organization), Beaufort, NC
2007 – 2008	Leadership Committee, Duke Green Wave (campus sustainability group), Duke University Marine Lab
2006	Evaluator of Presentations, Southeast and Mid-Atlantic Marine Mammal Symposium, Duke University Marine Lab
2006	Member, Marine Mammal Committee, American Society of Mammalogists
2005	Member, Conservation Committee, American Society of Mammalogists
2005	Evaluator of Presentations, American Society of Mammalogists meeting.
1999	Seabird Rehabber, Humboldt Marine Wildlife Care Network, Arcata, CA.

Peer Referee for:

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Professional Society Memberships

Society for Marine Mammalogy – Active
Society for Conservation Biology – Past
Ecological Society of America – Past
American Society of Mammalogists - Past
Cooper Ornithological Society - Past
American Ornithologists' Union - Past
Animal Behavior Society - Past

NOAA Technical Memorandum NMFS-AFSC-57

Alaska Marine Mammal Stock Assessments 1995

by
R. J. Small and D. P. DeMaster

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

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NOAA Technical Memorandum NMFS

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Alaska Marine Mammal Stock Assessments 1995

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September 1995

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PREFACE

On April 30,1994, Public Law 103-238 was enacted allowing significant changes to provisions within the Marine Mammal Protection Act. Interactions between marine mammals and commercial fisheries are addressed under three new Sections. This new regime replaced the interim exemption that has regulated fisheries-related incidental takes since 1988. Section 117, Stock Assessments, required the establishment of three regional scientific review groups to advise and report on the status of marine mammal stocks within Alaskan waters, along the Pacific Coast (including Hawaii), and the Atlantic Coast (including the Gulf of Mexico). This report provides information on the marine mammal stocks of Alaska under the jurisdiction of the National Marine Fisheries Service.

Each stock assessment includes a description of the stock's geographic range, a minimum population estimate, current population trends, current and maximum net productivity rates, optimum sustainable population levels and allowable removal levels, and estimates of annual human-caused mortality and serious injury through interactions with commercial fisheries and subsistence hunters. Under the new regime, these data will be used to evaluate the progress of each fishery towards achieving its goal of zero mortality and serious injury.

This is a working document. Each stock assessment report is designed to stand alone and will be updated as new information becomes available. The authors wish to solicit any new data or comments that would serve to improve future stock assessment reports.

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CONTENTS

GRAY WHALE (*Eschrichtius robustus*): Eastern North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The following information was considered in classifying stock structure of gray whales based on the Dizon et al. (1992) phylogeographic approach (1) Distributional data: isolated geographic distribution in the North Pacific Ocean: (2) Population response data: unknown; (3) Phenotypic data: unknown; and (4) Genotypic data: unknown. Based on this limited information, two stocks have been recognized in the North Pacific: the eastern North Pacific stock, which breeds along the West Coast of North America, and the western Pacific or "Korean" stock, which apparently breeds off the coast of eastern Asia (Rice 1981). Most of the eastern North Pacific stock spends the summer feeding in the northern Bering, Chukchi, and Beaufort Seas (Rice and Wolman 1971). However, gray whales have been reported feeding in the summer in waters off Southeast Alaska, British Columbia, Oregon, and Washington. The whales migrate near shore along the coast of North America from Alaska to the central California coast (Rugh et al. 1993) starting in October and November. After passing Point Conception, California, Rice et al. (1984) reported the majority of the animals take a more direct offshore route across the southern California Bight to northern Baja California. The eastern Pacific stock winters mainly along the west coast of Baja California. The pregnant females assemble in certain shallow, nearly landlocked lagoons and bays where the calves are born from early January to mid-February (Rice et al. 1981). The northbound migration generally begins in mid-February and continues through May (Rice et al. 1981).

POPULATION SIZE

An abundance estimate, based on shore-based counts of southward migrating gray whales in 1987/1988, of 20,869 (CV=0.044) animals was reported by Buckland et al. (1993). Preliminary estimates of abundance for the southward migrations of gray whales in 1992/1993 and 1993/1994 were reported at the International Whaling Commission's Scientific Committee meetings in 1994 (RIWC 1995), where the 1992/1993 estimate (17,674 animals) was significantly less than that for 1993/1994 (23,109 animals). However, the 1993/1994 estimate was not significantly different from the 1987/1988 estimate of abundance for this stock of gray whales. The 1993/1994 estimate is currently considered the most reliable abundance estimate, thus the abundance estimate for this stock is 23,109 (CV=0.0740).

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from equation 1 from the PBR Guidelines (NMFS in prep.): $N_{MIN} = N/\exp(0.842*[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate of 23,109 and its associated CV of 0.074, N_{MIN} for this stock is 21,715.

Current Population Trend

The estimated annual rate of increase, based on shore counts of southward migrating gray whales between 1967 and 1988 is 3.29% with a standard error of 0.44% (Buckland et al. 1993). Incorporating the two most recent counts resulted in an annual rate of increase of 2.57% (SE = 0.4%: RIWC 1995).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Wade (1994) reported that based on a Bayesian analysis of the census data between 1968 and 1994, the eastern North Pacific stock of gray whales was between 0.51 and 0.97 of its carrying capacity and that the rate of net production at the maximum net productivity level was 0.033 (95% CI: 0.023, 0.044). However, this conclusion was regarded as questionable at the 1994 Scientific Committee meetings of the IWC because the analysis may have been unduly influenced by the 1992 census and because the variance of the abundance estimate was likely underestimated (i.e., negative biased). Until consensus is reached, it is recommended (NMFS in prep.) that the cetacean maximum net productivity rate (R,) of 4% be employed for this stock of gray whales. Because this stock is thought to be midway between the lower limit of its optimum sustainable population (OSP) level and carrying capacity (K), the observed rate of increase is likely to be substantially less than R_{MAX}.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 re-authorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = N_{MIN} x $0.5R_{MAX}$ x F_R. The recovery factor (F_R) for this stock is 1.0, the upper limit of the range

(0.5-1.0) of values for cetacean stocks with unknown population status but increasing with a known human take (NMFS in prep.). Thus, for the Eastern North Pacific stock of gray whale, PBR = (21,715 x 0.02 x 1.0) or 434 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Since 1990, there have been no observed reports of incidental mortality related to commercial fishery operations in the eastern North Pacific. Based on logbook reports maintained by boat operators required by the MMPA interim exemption program during the 3-year period between 1990-92, one injury and one mortality was recorded in the Bristol Bay salmon set and drift gillnet fishery in 1990. However, because logbook records are most likely negatively biased (Credle et al. 1994), these are considered to be minimum estimates.

The estimated annual mortality rate incidental to commercial fisheries (0.3; based on observer data (0) and logbook reports (0.3) where observer data were not available) is less than 10% of the PBR (43) and, therefore, is considered insignificant and approaching a zero mortality and serious injury rate.

Subsistence/Native Harvest Information

At the 1991 annual meeting of the International Whaling Commission, the U.S. “put on record that it was not requesting and will not in future years request an allocation or use of 10 gray whales” (RIWC 1992: pp. 32). This represented a change from the previous quota period, where an annual block quota of 179 animals had been authorized, of which 10 were subject to mutual consideration with the U.S. subsistence hunters in Russia took an average of 177 whales per year between 1966 and 1991 (RIWC 1995). No takes were reported for 1992 and 1993. In 1994, 44 gray whales were harvested by Russian aboriginals. The current IWC quota for gray whales taken by aboriginals is 140 animals per year. In addition, Treaty Indian Tribes in Washington State have expressed an interest in harvesting up to 5 animals per year for subsistence and ceremonial purposes.

STATUS OF STOCK

The estimated annual level of human-caused mortality and serious injury (0.3) does not exceed the PBR (434), thus this stock of gray whale is not classified as a strategic stock. It should be noted that this stock was recently (1994) removed from the List of Endangered and Threatened Wildlife (i.e., it is no longer considered endangered or threatened under the U.S. Endangered Species Act).

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Population status of the eastern North Pacific stock of gray whales in 2009

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ABSTRACT

An age- and sex-structured population dynamics model is fitted using Bayesian methods to data on the catches and abundance estimates for the Eastern North Pacific (ENP) stock of gray whales. The prior distributions used for these analyses incorporate revised estimates of abundance for ENP gray whales and account explicitly for the drop in abundance caused by the 1999–2000 mortality event. A series of analyses are conducted to evaluate the sensitivity of the results to different assumptions. The model fits the available data adequately, but, as in previous assessments, the measures of uncertainty associated with the survey-based abundance estimates are found to be negatively biased. The data support the inclusion of the 1999–2000 mortality event in the model, and accounting for this event leads to greater uncertainty regarding the current status of the resource. The baseline analysis estimates the ENP gray whale population to be above the maximum sustainable yield level (MSYL) with high probability (0.884). The posterior mean for the ratio of 2009 (1+) abundance to MSYL is 1.29 (with a posterior median of 1.37 and a 90% probability interval of 0.68–1.51). These results are consistent across all the model runs conducted. The baseline model also estimates the 2009 ENP gray whale population size (posterior mean of 20,366) to be at 85% of its carrying capacity (posterior mean of 25,808), and this is also consistent across all the model runs. The baseline model estimate of the maximum rate of increase, λ_{max}, is 1.062 which, while high, is nevertheless within the range of estimates obtained for other baleen whales.

KEYWORDS: ASESSMENT; GRAY WHALES; WHALING – ABORIGINAL

INTRODUCTION

The eastern North Pacific (ENP) gray whale (*Eschrichtius robustus*) population has been hunted extensively by both commercial and aboriginal whalers. Indigenous peoples of both North America and Russia have hunted gray whales in some locations for centuries and possibly for 2000 years or more (Krupnik, 1984; O'Leary, 1984). The winter breeding grounds of the ENP gray whale (lagoons and adjacent ocean areas in Baja California, Mexico) were discovered by Yankee whalers in the early 19th century, and two commercial whaling vessels first hunted gray whales (in Magdalena Bay) in the winter of 1845–46 (Henderson, 1984). This began a period of intense hunting with large catches of ENP gray whales by Yankee whalers from 1846 until 1873 which decimated the population. Whaling ships and shore-based whalers continued to catch gray whales for the next two decades which drove the population to apparent commercial extinction by 1893. In the 20th century, modern commercial pelagic whaling of ENP gray whales began in 1910 and ended in 1946 when gray whales received full protection under the International Convention for the Regulation of Whaling (Reeves, 1984). Aboriginal catches of ENP gray whales along the Chukotka Peninsula of Russia have continued since 1946 until the present.

From 1846 to 1900 recorded commercial kills numbered nearly 9,000 gray whales, and it is roughly estimated that about 6,500 gray whales were killed by aboriginal hunters during this same period, for a total of more than 15,500 whales caught (Table 1). Since 1900, about 11,500 additional ENP gray whales have been killed by commercial and aboriginal whalers for a total since 1846 of more than 27,000 whales caught (Table 1). The magnitude of the catches, particularly for the period of high exploitation during the 1800s, gives some information on the likely pre-exploitation population size. For example, Jones *et al.* (1984) state that 'most whaling historians and biologists believe the pre-exploitation stock size was between 15,000 and 24,000 animals'.

ENP gray whales migrate along the west coast of North America, and the US National Marine Fisheries Service (NMFS) has taken advantage of this nearshore migration pattern to conduct shore-based counts of the population in central California during December–February from 1967–68 to 2006–07. These survey data have been used to estimate the abundance of the ENP gray whale stock over the survey period (Buckland *et al.*, 1993; Hobbs *et al.*, 2004; Laake *et al.*, 1994; Reilly, 1981; Rugh *et al.*, 2008a; 2005). The resulting sequence of abundance estimates has also been used to estimate the population's growth rate (Buckland and Breiwick, 2002; Buckland *et al.*, 1993), as well as its status relative to the maximum sustainable yield level (MSYL)[1] and carrying capacity (*K*) (Cooke, 1986; Lankester and Beddington, 1986; Punt and Butterworth, 2002; Reilly, 1981; Wade, 2002). However, attempts to model the gray whale population from 1846 until the present, accounting for the catch record and assuming that the stock was at its carrying capacity in 1846, have run into difficulties because the catch history cannot be reconciled with a population that increased at the observed rate from 1967/68 to 1979/80 (Cooke, 1986; Lankester and Beddington, 1986; Reilly, 1981). The

[1] MSYL expressed in terms of 1+ component of the population.

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Table 1a

Historical (pre-1944) aboriginal catches from the eastern North Pacific stock of gray whales (C. Allison, IWC Secretariat, pers. comm.).

Years	Annual kill
1600–1675	182
1676–1750	183
1751–1840	197.5
1841–1846	193.5
1847–1850	192.5
1851–1860	187
1861–1875	111
1876–1880	110
1881–1890	108
1891–1900	62
1901–1904	61
1905–1915	57
1916–1928	52
1929–1930	47
1931–1939	10
1940–1943	20

explanation for this is simple; if one assumes a relatively low maximum growth rate, the ENP gray whales would not have been able to increase between 1967/68 and 1979/80 because of the catches during that time, and if one assumes a high maximum growth rate, the population would not be increasing then because it would have already returned to carrying capacity. Butterworth *et al.* (2002) investigated the inability to fit a standard population dynamics model to the data for the ENP gray whales extensively and concluded that the catch history and the observed rate of increase could be reconciled in one of three different ways, which were not mutually exclusive: (1) a 2.5X increase in K between 1846 and 1988, (2) a 1.7X increase or more in the commercial catch between 1846 and 1900, and (3) a 3X increase or more in aboriginal catch levels prior to 1846 compared to what was previously assumed (Butterworth *et al.*, 2002).

Given these difficulties, recent gray whale assessments have been conducted by modelling the population since 1930 or later, rather than trying to model the population since 1846 (e.g. Punt and Butterworth, 2002; Wade, 2002). These analyses differed from the earlier assessments by not assuming that the population size in 1846 was K. Instead, K is essentially estimated by the recent trend in abundance, where a growing population implies that K has likely not yet been reached, and a roughly stable population implies the population is at or near K. Based on abundance surveys through 1995–96, point estimates of K from these analyses ranged from 24,000 to 32,000, but these estimates were relatively imprecise because they had broad probability intervals (Punt and Butterworth, 2002; Wade, 2002). In particular, the results did not exclude the possibility that K could be much larger than this range. However, these analyses did suggest that the population was probably close to K and at or above its MSYL. For example, Wade (2002) estimated a probability of 0.72 that the population was above $MSYL^{1+}$ in 1996. Punt and Butterworth (2002) also conducted analyses projecting the population from the year 1600 under various assumptions that historic commercial and aboriginal catches were underestimated (as in Butterworth *et al.*, 2002). Those analyses resulted in point estimates of K that ranged between 15,000 and 19,000. In those analyses, it was estimated the population was at a very high fraction of K in 1996 and had a very high probability of being above $MSYL^{1+}$.

Recently, Rugh *et al.* (2008b) evaluated the accuracy of various components of the shore-based survey method, with a focus on pod size estimation. They found that the correction factors that had been used to compensate for bias in pod size estimates were calculated differently for different sets of years. In particular, the correction factors estimated by Laake *et al.* (1994) were substantially larger than those estimated by Reilly (1981). Also, the estimates for the surveys prior to 1987 in the trend analysis were scaled based on the abundance estimate from 1987–88. This meant that the first 16 abundance estimates used one set of correction factors, and the more recent 7 abundance estimates used different (and larger) correction factors which would influence the estimated trend and population trajectory. In addition, there were other subtle differences in the analysis methods used for the sequence of abundance estimates. Thus, a revaluation of the analysis techniques and of the abundance estimates was warranted to apply a more uniform approach throughout the years. Laake *et al.* (In press) derived a better, more consistent, approach to abundance estimation, and incorporated it into an analysis to re-estimate abundance for all 23 shore-based surveys. These new revised abundance estimates led to the present re-assessment of the ENP gray whale population.

The population is assessed by fitting an age- and sex-structured population model to these revised abundance estimates, using methods similar to those of Wade (2002) and Punt and Butterworth (2002); recent abundance estimates from 1997/98, 2000/01, 2001/02, and 2006/07 that were not available in previous assessments are also used. As in Punt and Butterworth (2002), sensitivity tests are performed to examine various assumptions or modelling decisions.

The analyses also incorporate new information about the biology of the ENP gray whales from recent studies. In particular, it is now recognised that the population experienced an unusual mortality event in 1999 and 2000. An unusually high number of gray whales were stranded along the west coast of North America in those years (Gulland *et al.*, 2005; Moore *et al.*, 2001). Over 60% of the dead whales were adults, and more adults and subadults stranded in 1999 and 2000 relative to the years prior to the mortality event (1996–98), when calf strandings were more common. Many of the stranded whales were emaciated, and aerial photogrammetry documented that migrating gray whales were skinnier in girth in 1999 relative to previous years (Perryman and Lynn, 2002; W. Perryman, SWFSC, pers. comm.). In addition, calf production in 1999 and 2000 was less than one third of that in the previous years (1996–98). In 2001 and 2002, strandings of gray whales along the coast decreased to levels that were below their pre-1999 level (Gulland *et al.*, 2005) and average calf production in 2002–2004 returned to the level seen in pre-1999 years (Table 2). A US Working Group on Marine Mammal Unusual Mortality Events (Gulland *et al.*, 2005) concluded that the emaciated condition of many of the stranded whales supported the idea that starvation could have been a significant contributing factor to the higher number of strandings in 1999 and 2000. Perryman *et al.* (2002) found a

Table 1b

Commercial and recent aboriginal (post-1943) catches from the eastern North Pacific stock of gray whales (C. Allison, IWC Secretariat, pers. comm.).

Year	Male	Female	Year	Male	Female	Year	Male	Female	Year	Male	Female
1846	23	45	1889	7	13	1932	3	7	1975	58	113
1847	23	45	1890	7	13	1933	36	69	1976	69	96
1848	23	45	1891	7	13	1934	64	92	1977	86	101
1849	23	45	1892	7	13	1935	48	96	1978	94	90
1850	23	45	1893	0	0	1936	74	114	1979	57	126
1851	23	45	1894	0	0	1937	5	9	1980	53	129
1852	23	45	1895	0	0	1938	18	36	1981	36	100
1853	23	45	1896	0	0	1939	10	19	1982	56	112
1854	23	45	1897	0	0	1940	39	66	1983	46	125
1855	162	324	1898	0	0	1941	19	38	1984	59	110
1856	162	324	1899	0	0	1942	34	67	1985	55	115
1857	162	324	1900	0	0	1943	33	66	1986	46	125
1858	162	324	1901	0	0	1944	0	0	1987	47	112
1859	162	324	1902	0	0	1945	10	20	1988	43	108
1860	162	324	1903	0	0	1946	7	15	1989	61	119
1861	162	324	1904	0	0	1947	0	1	1990	67	95
1862	162	324	1905	0	0	1948	6	13	1991	69	100
1863	162	324	1906	0	0	1949	9	17	1992	0	0
1864	162	324	1907	0	0	1950	4	7	1993	0	0
1865	162	324	1908	0	0	1951	5	9	1994	21	23
1866	79	159	1909	0	0	1952	15	29	1995	48	44
1867	79	159	1910	0	1	1953	19	29	1996	18	25
1868	79	159	1911	0	1	1954	13	26	1997	48	31
1869	79	159	1912	0	0	1955	20	39	1998	64	61
1870	79	159	1913	0	1	1956	41	81	1999	69	55
1871	79	159	1914	6	13	1957	32	64	2000	63	52
1872	79	159	1915	0	0	1958	49	99	2001	62	50
1873	79	159	1916	0	0	1959	66	130	2002	80	51
1874	79	159	1917	0	0	1960	52	104	2003	71	57
1875	17	33	1918	0	0	1961	69	139	2004	43	68
1876	17	33	1919	0	0	1962	53	98	2005	49	75
1877	17	33	1920	1	1	1963	60	120	2006	57	77
1878	17	33	1921	13	25	1964	81	138	2007	50	82
1879	21	42	1922	6	4	1965	71	110	2008	64	66
1880	17	34	1923	0	0	1966	100	120			
1881	17	33	1924	1	0	1967	151	223			
1882	17	33	1925	70	64	1968	92	109			
1883	19	39	1926	25	17	1969	93	121			
1884	23	45	1927	7	25	1970	70	81			
1885	21	41	1928	4	8	1971	62	91			
1886	17	33	1929	0	3	1972	66	116			
1887	7	13	1930	0	0	1973	98	80			
1888	7	13	1931	0	0	1974	94	90			

significant positive correlation between an index of the amount of ice-free area in gray whale feeding areas in the Bering Sea and their estimates of calf production for the following spring for the years 1994 to 2000; the suggested mechanism is that longer periods of time in open water provides greater feeding opportunities for gray whales. Whether or not heavy ice cover was ultimately the mechanism that caused the 1999–2000 event, it is clear that ENP gray whales were substantially affected in those years; whales were on average skinnier, they had a lower survival rate (particularly of adults) and calf production was dramatically lower. Given that this event may have affected the status of the ENP gray whale population relative to K, an additional model parameter ('catastrophic mortality') has been specified in the model that allowed for lower survival in the years 1999 and 2000 to investigate this effect.

METHODS

Available data

A variety of data sources are available to assess the status of the ENP stock of gray whales. These data sources are used when developing the prior distributions for the parameters of the population dynamics model, when pre-specifying the values for some of the parameters of this model, and when constructing the likelihood function. Table 1 lists the time-series of removals. It should be noted that the catches for the years prior to 1930 are subject to considerable uncertainty, and evaluating these catches remains an active area of research. However, the uncertainty associated with these early catches is inconsequential for this paper because the population projections do not start before 1930.

The key source of information on the abundance of the ENP gray whales is data collected from the southbound surveys that have been conducted since 1967/68 near Carmel, California (Laake *et al.*, In press; Table 2). Information on trends in calf numbers are also available from surveys of calves during the northbound migration (Perryman *et al.*, 2002; W. Perryman, pers. comm.; Table 2). The calf abundance data are not included in the baseline analyses, but are considered in one of the tests of sensitivity.

Analysis methods

The population dynamics model

An age- and sex-structured population dynamics model is used that assumes that all whaling takes place at the start of

Table 2

Baseline estimates of 1+ abundance (and associated standard errors of the logs) from southbound surveys (Laake *et al.*, In press), the estimates of 1+ abundance used in previous assessments, two alternative series of abundance estimates ('Hi' and 'Lo', see footnote 7 for details), and estimates of calf numbers from northbound surveys (W. Perryman, SWFSC, pers. comm.).

	1+ abundance								1+ abundance			
	Laake *et al.* (In press)		Unrevised estimates			Calf counts			Lo series		Hi series	
Year	Estimate	CV	Estimate	CV	Year	Estimate	SE	Year	Estimate	SE	Estimate	SE
1967/68	13,426	0.094	13,776	0.078	1994	945	68.2	1967/68	12,961	0.094	14,298	0.095
1968/69	14,548	0.080	12,869	0.055	1995	619	67.2	1968/69	14,043	0.080	15,493	0.081
1969/70	14,553	0.083	13,431	0.056	1996	1,146	70.7	1969/70	14,049	0.082	15,498	0.084
1970/71	12,771	0.081	11,416	0.052	1997	1,431	82.0	1970/71	12,328	0.081	13,601	0.082
1971/72	11,079	0.092	10,406	0.059	1998	1,388	92.0	1971/72	10,695	0.092	11,799	0.093
1972/73	17,365	0.079	16,098	0.052	1999	427	41.1	1972/73	16,763	0.079	18,493	0.080
1973/74	17,375	0.082	15,960	0.055	2000	279	34.8	1973/74	16,772	0.081	18,503	0.083
1974/75	15,290	0.084	13,812	0.056	2001	256	28.6	1974/75	14,760	0.084	16,283	0.085
1975/76	17,564	0.086	15,481	0.060	2002	842	78.6	1975/76	16,955	0.086	18,705	0.087
1976/77	18,377	0.080	16,317	0.050	2003	774	73.6	1976/77	17,739	0.079	19,570	0.081
1977/78	19,538	0.088	17,996	0.069	2004	1,528	96.0	1977/78	18,860	0.088	20,806	0.089
1978/79	15,384	0.080	13,971	0.054	2005	945	86.9	1978/79	14,850	0.080	16,383	0.081
1979/80	19,763	0.083	17,447	0.056	2006	1,020	103.3	1979/80	19,077	0.082	21,046	0.083
1984/85	23,499	0.089	22,862	0.060	2007	404	51.2	1984/85	22,684	0.089	25,025	0.090
1985/86	22,921	0.081	21,444	0.052	2008	553	53.0	1985/86	22,126	0.081	24,409	0.082
1987/88	26,916	0.058	22,250	0.050	2009	312	41.9	1987/88	25,661	0.057	28,692	0.056
1992/93	15,762	0.067	18,844	0.063				1992/93	14,785	0.065	17,879	0.072
1993/94	20,103	0.055	24,638	0.060				1993/94	19,468	0.057	21,124	0.056
1995/96	20,944	0.061	24,065	0.058				1995/96	20,636	0.063	22,314	0.063
1997/98	21,135	0.068	29,758	0.105				1997/98	20,426	0.063	22,378	0.065
2000/01	16,369	0.061	19,448	0.097				2000/01	16,051	0.063	17,145	0.062
2001/02	16,033	0.069	18,178	0.098				2001/02	15,162	0.066	16,883	0.067
2006/07	19,126	0.071	20,110	0.088				2006/07	18,775	0.071	20,129	0.072

the year, and that all animals are 'recruited' to the hunted population by age 5 (i.e. hunting only occurs on animals age 5 and older) (Punt, 1999; Punt and Butterworth, 2002). The dynamics of the population are assumed to be governed by the equations:

$$N^s_{t+1,a} = \begin{cases} 0.5P^M_{t+1}f_{t+1} & \text{if } a=0 \\ N^s_{t,a-1}(1-F^s_{t,a-1})S_{a-1}\tilde{S}_t & \text{if } 1 \le a \le x-1 \\ N^s_{t,x}(1-F^s_{t,x})S_x\tilde{S}_t + N^s_{t,x-1}(1-F^s_{t,x-1})S_{x-1}\tilde{S} & \text{if } a=x \end{cases} \quad (1)$$

where

$N^s_{t,a}$ is the number of animals of age a and sex s (m/f) at the start of year t,

S_a is the annual survival rate of animals of age a in the absence of catastrophic mortality events (assumed to be the same for males and females),

$\tilde{S}_t$ is the amount of catastrophic mortality (represented in the form of a survival rate) during year t (catastrophic events are assumed to occur at the start of the year before mortality due to whaling and natural causes; in general $\tilde{S}_t = 1$, i.e. there is no catastrophic mortality),

$F^s_{t,a}$ is the exploitation rate on animals of sex s and age a during year t,

P^M_t is the number of females that have reached the age at first parturition by the start of year t,

$$P^M_t = \sum_{a=a_m+1}^{x} N^f_{t,a} \quad (2)$$

a_m is the age-of-maturity,

f_t is pregnancy rate (number of calves of both sexes per 'mature' female) during year t (note that Equation (1) assumes an equal male : female sex ratio at birth), and

x is the maximum age-class, which for convenience is lumped across older age-classes (i.e. individuals stay in this age-class until they die).

Density dependence on fecundity can be modelled by writing the pregnancy rate, f_t, as follows:

$$f_t = \max\left(f_{eq}\left[1 + A\left\{1 - \left(\bar{S}_{t-2}P^{1+}_{t-2} / K^{1+}\right)^z\right\}\right], 0\right). \quad (3)$$

Where f_{eq} is the pregnancy rate at the pre-exploitation equilibrium, $f(F = 0)$[2]:

$$f(F) = 2\left\{\sum_{a=a_m+1}^{x} \tilde{N}^f_a(F)\right\}^{-1} \quad (4)$$

A is the resilience parameter:

$$A = \frac{f_{max} - f_{eq}}{f_{eq}} \quad (5)$$

f_{max} is the maximum (theoretical) pregnancy rate,

z is the degree of compensation,

P^{1+}_t is number of animals aged 1 and older at the start of year t:

$$P^{1+}_t = \sum_s \sum_{a=1}^{x} N^s_{t,a} \quad (6)$$

K^{1+} is the (current) pre-exploitation equilibrium size (carrying capacity) in terms of animals aged 1 and older, and

$\tilde{N}^s_a(F)$ is the number of animals of sex s and age a when the exploitation rate is fixed at F, expressed as a fraction of the

[2]The pregnancy rate at the pre-exploitation equilibrium can be considered to be the equilibrium pregnancy rate when the exploitation rate, F, is fixed at zero.

number of calves of the same sex s (see appendix 1 of Punt (1999) for details).

Although these equations are written formally as if only the pregnancy rate component of 'fecundity' as defined here is density-dependent, exactly the same equations follow if some or all of this dependence occurs in the infant survival rate (Punt, 1999). Catastrophic mortality is assumed to occur before density-dependence because many of the deaths in 1999 and 2000 occurred before mating was likely to have occurred. Non-catastrophic natural mortality does not appear in Equation 3 because it cancels out. The time-lag in Equation 3 is specified to match the reproductive cycle of gray whales; mature female gray whales mate and become pregnant in early winter, have a gestation period of slightly longer than one year, and give birth at the start of the next year (on average in January) (Rice and Wolman, 1971; Shelden *et al.*, 2004). Their body condition at the end of the summer feeding season will help determine their probability of becoming pregnant the following winter and producing a calf a year later. Therefore, the density-dependent effect on calf production is assumed to be determined by the population size during the feeding season two time-steps prior (approximately 1.5 years earlier).

Following past assessments of the ENP stock of gray whales (e.g. Butterworth *et al.*, 2002; Punt *et al.*, 2004; Punt and Butterworth, 2002), the catch (by sex) is assumed to be taken uniformly from the animals aged five and older, that is:

$$F^{s}_{t,a} = C^{s}_{t} / \sum_{a=5}^{x} N^{s}_{t,a} \qquad (7)$$

Where C^s_t is the catch of animals of sex s during year t.

The population is assumed to have had a stable age-structure at the start of the projection period (year t_{INIT}).

$$N^{s}_{t_{INIT},a} = N^{Tot}_{t_{INIT}} \tilde{N}^{s}_{a}(F_{INIT}) / \sum_{s'} \sum_{a'=0}^{x} \tilde{N}^{s'}_{a'}(F_{INIT}) \qquad (8)$$

Where $N^{Tot}_{t_{INIT}}$ is the size of the total (0+) component of the population at the start of year t_{INIT}. The value of F_{INIT} is selected numerically so that:

$$N^{Tot}_{t_{INIT},a} = 0.5 N_0(F_{INIT}) / \sum_{s} \sum_{a=0}^{x} N^{s}_{a}(F_{INIT}) \qquad (9)$$

Where $N_0(F_{INIT})$ is the number of calves (of both sexes) at the start of the year when $F = F_{INIT}$:

$$N_0(F_{INIT}) = \left(1 - \frac{1}{A}\left[\frac{f(F_{INIT})}{f_{eq}} - 1\right]\right)^{1/z} \frac{K^{1+}}{\tilde{P}^{1+}(F_{INIT})} \qquad (10)$$

$\tilde{P}^{1+}(F)$ is the size of the 1+ component of the population as a function of F, expressed as a fraction of the number of calves (of both sexes).

Parameter estimation

Catastrophic mortality is assumed to be zero (i.e. $\tilde{S}_y = 1$) except for 1999 and 2000 when it is assumed to be equal to a parameter $\tilde{S}$. This assumption reflects the large number of dead whales observed stranded along the coasts of Oregon and Washington during 1999 and 2000 relative to numbers stranding there annually historically (Brownell *et al.*, 2007; Gulland *et al.*, 2005).

The parameters of the population dynamics model are a_m; $\tilde{S}$; K^{1+}; the 1+ population size at the start of 1968, P^{1+}_{1968}[3]; MSYL^{1+} (the maximum sustained yield level for the 1+ population, which is the population size at which maximum sustained yield (MSY) is achieved when hunting takes place uniformly on animals aged 1 and older, relative to K^{1+}); MSYR^{1+} (the ratio of MSY to MSYL^{1+}); f_{max}; and the non-calf survival rate, S_{1+}. The analysis does not incorporate a prior distribution for the survival rate of calves (S_0) explicitly. Instead, following Wade (2002), an implicit prior distribution for this parameter is calculated from the priors for the five parameters a_m, f_{max}, S_{1+}, MSYR^{1+} and MSYL^{1+}. For any specific draw from the prior distributions for these five parameters, the value for S_0 is selected so that the relationships imposed by the population model among the six parameters are satisfied. If the resulting value for S_0 is less than zero or greater than that of S_{1+}, the values for S_{1+}, a_m, f_{max}, MSYR^{1+} and MSYL^{1+} are drawn again[4]. Thus, the prior for S_0 is forced to conform to the intuitive notion that the survival rate of calves must be lower than that for older animals and must be larger than zero (Caughley, 1966).

Under the assumption that the logarithms of the estimates of abundance based on the southbound surveys are normally distributed, the contribution of these estimates to the negative of the logarithm of the likelihood function (ignoring constants independent of the model parameters) is:

$$-\ell nL = 0.5\ell n\left|\mathbf{V} + \Omega\right|$$
$$+0.5\sum_i \sum_j (\ell n N^{obs}_i - \ell n\hat{P}^{1+}_i)[(\mathbf{V}+\Omega)^{-1}]_{i,j}(\ell n N^{obs}_j - \ell n\hat{P}^{1+}_j), \qquad (11)$$

Where N^{obs}_i is the i^{th} estimate of abundance[5],

$\hat{P}_i$ is the model-estimate corresponding to N^{obs}_i,

V is the variance-covariance matrix for the abundance estimates, and

Ω is a diagonal matrix with elements CV^2_{add} (this matrix captures sources of uncertainty not captured elsewhere; termed 'additional variance' in Wade (2002)).

A Bayesian approach is used to estimate the 'free' parameters of the model based on the prior distributions in Table 3 and the sampling/importance resampling (SIR) algorithm (Rubin, 1988).

(a) Draw values for the parameters S_{1+}, a_m, f_{max}, MSYR^{1+}, MSYL^{1+}, K^{1+}, P^{1+}_{1968}, $\tilde{S}$, and CV_{add} from the priors in Table 3.

(b) Solve the system of equations that relate S_0, S_{1+}, a_m, f_{max}, MSYR^{1+}, MSYL^{1+}, A and z (Punt, 1999; Eqs. 18–21) to find values for S_0, A, and z, and find the population size in year t_{INIT} and the population rate of increase in this year, so that, if the population is projected from year t_{INIT}

[3]The 1968 population size is taken to be a measure of initial abundance so that the analyses based on different starting years are comparable in terms of their prior specifications.

[4]The implications of different treatments of how to handle situations in which the calculated value for S_0 is outside of plausible bounds is examined by Brandon *et al.* (2007).

[5]The abundance estimate for year $y/y+1$ is assumed to pertain to abundance at the start of year $y+1$.

to 1968, the total (1+) population size in 1968 equals the generated value for P^{1+}_{1968}.

(c) Compute the likelihood for the projection (see Equation 11).

(d) Repeat steps (a)–(c) a very large number (typically 5 million) of times.

(e) Select 5,000 parameter vectors randomly from those generated using steps (a)–(d), assigning a probability of selecting a particular vector proportional to its likelihood

The above formulation implies that the year for which a prior on abundance is specified (1968) is not necessarily the same as the first year of the population projection (t_{INIT}, baseline value 1930). Starting the population projection before the first year for which data on abundance are available allows most of the impact of any transient population dynamics caused by the assumption of a stable age-structure to be eliminated. Therefore, the model population should mimic the real population more closely by allowing the sex- and age-selectivity of the catches to correctly influence the sex- and age-distribution of the population once the trajectory reaches years where it is compared to the data (i.e. 1967/68 and beyond).

Table 3
The parameters and their assumed prior distributions.

Parameter	Prior distribution
Non-calf survival rate, S_{1+}	U[0.950, 0.999][a]
Age-at-maturity, a_m	U[6,12][b]
Maximum pregnancy rate, f_{max}	U[0.3, 0.6][a]
Carrying capacity, K^{1+}	U[10,000, 70,000][c]
Population size in 1968, P^{1+}_{1968}	U[5,000, 20,000][c]
Maximum Sustainable Yield Level, MSYL^{1+}	U[0.4, 0.8][a]
Maximum Sustainable Yield Rate, MSYR^{1+}	U[0, 0.1][a]
Catastrophic mortality, $\tilde{S}$	U[0.2, 1.0][c]
Additional variance, 1+ abundance estimates, CV_{add}	U[0, 0.35][a,c]
Additional variance, calf counts, CV_{add-2}	U[0.2, 0.8][c,d]
Constant of proportionality, ℓnq	U[$-\infty$, ∞][d,e]

[a]Equal to the prior distribution used in the most recent assessments (Punt *et al.*, 2004); [b]Bradford *et al.* (2010); [c]preliminary analyses provided no evidence of posterior support for values outside this range; [d]not used in the baseline analysis; [e]the non-informative prior for a scale parameter (Butterworth and Punt, 1996).

Output statistics

The results are summarised by the posterior medians, means and 90% credibility intervals for MSYR^{1+}, MSYL^{1+}, S_{1+}, S_0, $\tilde{S}$, and K^{1+} and the following management-related quantities:

(a) P^{1+}_{2009} is the number of 1+ animals at the start of 2009;

(b) P^{1+}_{2009} / K^{1+} is the depletion level, or the number of 1+ animals at the start of 2009, expressed as a percentage of that corresponding to the equilibrium level;

(c) $P^{1+}_{2009} / MSYL^{1+}$ is the MSYL *ratio*, the number of 1+ animals at the start of 2009, expressed as a percentage of that at which MSY is achieved; and

(d) λ_{max} is the maximum rate of increase (given a stable age-structure and the assumption of no maximum age; Breiwick *et al.*, 1984)

P^{1+}_{2009} / K^{1+} is termed the *depletion level* because it provides a measure of how depleted the population is relative to the carrying capacity, as the equilibrium level in a density-dependent model is equivalent to carrying capacity. P^{1+}_{2009} / $MSYL^{1+}$ is referred to as the MSYL *ratio* because it provides a measure of whether the population is above MSYL^{1+} Note that λ_{max} can be equated to r_{max} (e.g. as in Wade, 1998) through the equation $r_{max} = \lambda_{max} - 1.0$.

Sensitivity tests

Our baseline assessment includes the baseline estimates of 1+ abundance (Table 2) and allows for a catastrophic mortality event in 1999–2000. The sensitivity of the results of the analyses is explored to:

(a) varying the first year considered in the population projection (1940, 1950 and 1960);

(b) replacing the estimates of abundance for the southbound migration by the values used in the previous assessment (Table 2, 'Unrevised estimates');

(c) replacing the abundance estimates with the 'Lo' and 'Hi' series (Table 2)[6] ;

(d) ignoring the catastrophic event in 1999–2000 (abbreviation 'No event');

(e) basing the analysis on the generalised logistic equation (see Appendix 1 for details; abbreviation 'Gen Logist')[7];

(f) splitting the abundance series after 1987/88 (abbreviation 'Split series'), where the first abundance series is treated as a relative index of abundance scaled to absolute abundance through a constant of proportionality, and the second series is treated as an absolute index of abundance; and

(g) including the calf counts at Point Piedras Blancas, California (Perryman *et al.*, 2002; Perryman, pers. comm.) in the analysis (abbreviation 'With calf counts').

For the last sensitivity test, the contribution of the data on calf counts to the negative of the logarithm of the likelihood function (ignoring constants independent of the model parameters) is based on the assumption that the calf counts are relative indices of the total number of calves and are subject to both modelled and unmodelled sources of uncertainty:

$$-\ell nL = 0.5\sum_i \ell n(\sigma_i^2 + CV_{add-2}^2) + 0.5\sum_i \frac{(\ell nA_i^{obs} - \ell n(q(N_{i,0}^m + N_{i,0}^f)))^2}{\sigma_i^2 + CV_{add-2}^2} \qquad (12)$$

[6]The sequence of gray whale abundance estimates depends in part on the estimates of observer detection probability that were measured with the double observer data. Assessment of matches amongst the pods detected by the observers depends on the weighting parameters for distance and time measurements (Laake *et al.*, In press). The weighting parameters used for the baseline abundance estimates were selected such that 95% of the observations of the same pod would be correctly matched. Sensitivity is explored to matching weighting parameters that gave 98% and 90% (table A2; Laake *et al.*, In press).

[7]This sensitivity test is provided because the generalised logistic model has been the basis for some previous management advice for this stock (for example, Wade, 2002).

where

A_i^{obs} is the estimate of the number of calves during year i based on the surveys at Point Piedras Blancas;

q is the constant of proportionality between the calf counts and model estimates of the number of calves;

σ_i is the standard error of the logarithm of C_i^{obs} ; and

CV_{add-2}^2 is the additional variance associated with the calf counts.

Prior distributions

The prior distributions (Table 3) are generally based on those used in recent International Whaling Commission (IWC) assessments of ENP gray whales. The prior distributions for S_{1+}, K^{1+}, $\tilde{S}$, CV_{add}, CV_{add-2}, and ℓnq were selected to be uniform over a sufficiently wide range so that there is effectively no posterior probability outside of that range.

The prior for the age-at-maturity differs from that used in previous assessments, Uniform[5,9], based on the review by Bradford *et al.* (2010) who could find no basis for that range in the literature. They concluded that the most relevant data set for age-at-maturity was that of Rice and Wolman (1971), corrected by Rice (1990) for the underestimation of whale ages by one year in the original study, resulting in a median age of 9, and lower and upper bounds of 6 and 12. Bradford *et al.* (2010) note that the only observation of the age-at-first-reproduction (AFR) in ENP gray whales (a known whale observed with a calf for the first time) was 7 years for a whale first seen as a calf in a lagoon in Mexico. In the western Pacific population of gray whales, there have been observations of AFR of 7 and 11 years for the only two whales whose first calving has been documented to date (Bradford *et al.*, unpublished ms). The prior for the maximum pregnancy rate, f_{max}, was set equal to the prior selected for recent assessments (Punt and Butterworth, 2002; Wade, 2002). This prior implies a minimum possible calving interval between 1.67 and 3.33 years.

The prior for the population size (in terms of animals aged 1 and older) in 1968 differs from that used in previous assessments. Rather than combining a uniform prior on 1968 population size with the abundance estimate for 1968 to create an informative prior for P_{1968}^{1+} as was the case in previous assessments, this assessment assumes a broad uniform prior for 1968 population size, and includes all of the estimates of abundance in the likelihood function. This is because the previous approach cannot be applied because all of the estimates of abundance are correlated (Laake *et al.*, In press).

The prior for MSYR^{1+} is bounded below by the minimum possible value and above by a value which is above those supported by the data. This prior is broader than those considered in previous assessments because those assessments assigned a prior to MSYR^{1+} when this parameter is expressed in terms of removals of mature animals only. The prior for MSYL^{1+} has been assumed to be uniform from 0.4 to 0.8. The central value for this prior reflects the common assumption when conducting IWC assessments of whale stocks that maximum productivity occurs at about 60% of carrying capacity. The upper and lower bounds reflect values commonly used to bound MSYL for whale stocks (e.g. those used in the tests that evaluated the IWC's catch limit algorithm).

RESULTS

The baseline assessment estimates that ENP gray whales increased substantially from 1930 until 1999 when a substantial reduction in population size from close to carrying capacity (in terms of median parameter estimates) occurred (Fig. 1). This reduction was associated with an estimated decline in non-calf survival from 0.982 to 0.847 (posterior means, where 0.981 × 0.863 = 0.847) in each of 1999 and 2000. The population is estimated to have been

Table 4

Posterior distributions for the key model outputs (posterior mean, posterior median [in square parenthesis], and posterior 90% intervals) for the baseline analysis and the sensitivity tests.

	Baseline	t_{INIT}=1940	t_{INIT}=1950	t_{INIT}=1960	Unrevised estimates	No event	Gen logist	With calf counts
K^{1+}	25,808 [22,756]	25,450 [22,506]	24,681 [22,282]	24,396 [22,047]	41,046 [37,889]	21,640 [20,683]	21,146 [20,668]	27,716 [24,194]
	(19,752 49,639)	(19,537 49,109)	(19,454 43,887)	(19,212 43,307)	(24,214 66,564)	(18,301 25,762)	(18,229 24,292)	(20,387 51,775)
MSYR^{1+}	0.046 [0.048]	0.047 [0.048]	0.049 [0.049]	0.048 [0.049]	0.035 [0.034]	0.052 [0.053]	0.065 [0.066]	0.040 [0.040]
	(0.022 0.064)	(0.022 0.067)	(0.024 0.068)	(0.024 0.070)	(0.025 0.050)	(0.026 0.068)	(0.034 0.096)	(0.022 0.057)
MSYL^{1+}	0.656 [0.669]	0.664 [0.677]	0.677 [0.689]	0.691 [0.702]	0.611 [0.611]	0.672 [0.684]	0.630 [0.640]	0.632 [0.638]
	(0.532 0.725)	(0.535 0.741	(0.541 0.762)	(0.545 0.786)	(0.506 0.706)	(0.577 0.730)	(0.441 0.786)	(0.514 0.725)
P_{2009}^{1+} / K^{1+}	0.849 [0.919]	0.865 [0.933]	0.885 [0.946]	0.899 [0.959]	0.615 [0.598]	0.956 [0.977]	0.964 [0.976]	0.775 [0.816]
	(0.393 1.006)	(0.403 1.016)	(0.451 1.022)	(0.453 1.043)	(0.334 0.948)	(0.872 0.987)	(0.922 0.989)	(0.372 0.984)
$P_{2009}^{1+} / MYSL^{1+}$	1.288 [1.366]	1.295 [1.362]	1.302 [1.355]	1.296 [1.343]	1.002 [0.992]	1.423 [1.424]	1.541 [1.515]	1.217 [1.284]
	(0.681 1.508)	(0.701 1.522)	(0.775 1.516)	(0.786 1.513)	(0.580 1.459)	(1.303 1.583)	(1.252 2.091)	(0.681 1.494)
P_{2009}^{1+}	20,366 [20,447]	20,489 [20,511]	20,583 [20,648]	20,678 [20,705]	22,773 [22,701]	20,247 [20,127]	20,213 [20,090]	19,892 [19,863]
	(17,515 23,127)	(19,628 23,274)	(17,726 23,247)	(17,856 23,497)	(19,910 25,865)	(17,726 22,993)	(17,827 22,910)	(16,872 22,723)
λ_{max}	1.062 [1.063]	1.063 [1.063]	1.063 [1.062]	1.062 [1.060]	1.054 [1.052]	1.068 [1.069]	0.107 [0.088]	1.057 [1.057]
	(1.032 1.088)	(1.033 1.094)	(1.035 1.094)	(1.035 1.092)	(1.036 1.081)	(1.038 1.091)	(0.042 0.242)*	(1.033 1.080)
S_{1+}	0.981 [0.982]	0.981 [0.982]	0.980 [0.982]	0.980 [0.982]	0.978 [0.980]	0.983 [0.985]	N/A	0.972 [0.972]
	(0.957 0.997)	(0.957 0.997)	(0.957 0.997)	(0.957 0.997)	(0.956 0.997)	(0.960 0.998)		(0.954 0.993)
S_0	0.711 [0.732]	0.716 [0.734]	0.713 [0.727]	0.706 [0.720]	0.662 [0.666]	0.730 [0.747]	N/A	0.722 [0.751]
	(0.423 0.950)	(0.426 0.949)	(0.426 0.952)	(0.425 0.949)	(0.400 0.926)	(0.437 0.955)		(0.428 0.943)
$\tilde{S}$	0.863 [0.865]	0.866 [0.867]	0.868 [0.870]	0.870 [0.870]	0.814 [0.809]	1	N/A	0.847[0.840]
	(0.772 0.951)	(0.778 0.951)	(0.779 0.960)	(0.781 0.961)	(0.725 0.915)			(0.749 0.949)

*r rather λ_{max}.

Cont.

Table 4 (continued).

	Baseline	Split series	Lo series	Hi series	Unrevised no event	Calf counts no event
K^{1+}	25,808 [22,756] (19,752 49,639)	27,489 [22,870] (19,640 55,929)	25,826 [22,030] (19,129 52,878)	26,902 [24,181] (21,043 48,118)	24,162 [23,044] (20,946 29,554)	21,501 [20,887] (18,439 24,793)
$MSYR^{1+}$	0.046 [0.048] (0.022 0.064)	0.046 [0.047] (0.024 0.062)	0.046 [0.048] (0.021 0.064)	0.046 [0.048] (0.023 0.063)	0.047 [0.048] (0.032 0.061)	0.049 [0.050] (0.028 0.065)
$MSYL^{1+}$	0.656 [0.669] (0.532 0.725)	0.648 [0.663] (0.529 0.721)	0.654 [0.670] (0.520 0.725)	0.654 [0.664] (0.537 0.725)	0.663 [0.673] (0.568 0.722)	0.668 [0.676] (0.577 0.733)
P^{1+}_{2009} / K^{1+}	0.849 [0.919] (0.393 1.006)	0.819 [0.908] (0.358 1.003)	0.837 [0.917] (0.355 1.008)	0.855 [0.913] (0.428 1.005)	0.957 [0.975] (0.881 0.985)	0.958 [0.974] (0.906 0.984)
$P^{1+}_{2009} / MYSL^{1+}$	1.288 [1.366] (0.681 1.508)	1.253 [1.357] (0.642 1.502)	1.270 [1.361] (0.632 1.504)	1.301 [1.366] (0.748 1.512)	1.446 [1.442] (1.344 1.608)	1.438 [1.436] (1.314 1.607)
P^{1+}_{2009}	20,366 [20,447] (17,515 23,127)	20,380 [20,372] (17,708 23,139)	19,752 [19,817] (16,925 22,432)	21,654 [21,594] (18,607 24,683)	22,781 [22,456] (20,432 26,047)	20,337 [20,283] (17,912 23,050)
λ_{max}	1.062 [1.063] (1.032 1.088)	1.063 [1.064] (1.037 1.088)	1.062 [1.063] (1.032 1.088)	1.063 [1.064] (1.034 1.089)	1.063 [1.062] (1.043 1.087)	1.065 [1.065] (1.037 1.090)
S_{1+}	0.981 [0.982] (0.957 0.997)	0.981 [0.982] (0.957 0.997)	0.980 [0.982] (0.957 0.997)	0.981 [0.982] (0.957 0.998)	0.982 [0.984] (0.959 0.997)	0.980 [0.982] (0.958 0.997)
S_0	0.711 [0.732] (0.423 0.950)	0.711 [0.729] (0.420 0.949)	0.710 [0.728] (0.420 0.949)	0.708 [0.725] (0.425 0.949)	0.705 [0.716] (0.420 0.950)	0.720 [0.732] (0.426 0.954)
$\tilde{S}$	0.863 [0.865] (0.772 0.951)	0.860 [0.862] (0.763 0.958)	0.862 [0.862] (0.775 0.950)	0.855 [0.857] (0.772 0.939)	1	1

increasing since 2000. The model fits the data well, although, as in previous IWC assessments, the analyses suggest that the coefficients of variation for the abundance estimates are underestimated (by 14% median estimate). The baseline assessment estimates that this stock is currently well above $MSYL^{1+}$ (posterior mean for P^{1+}_{2009} / $MSYL^{1+}$ of 1.29) (Table 4). The posterior probability that the stock is currently greater than $MSYL^{1+}$ is 0.884.

The posterior probability that the stock is currently above $MSYL^{1+}$ is less for the baseline analysis and for the analysis in which the original abundance estimates are used ('Unrevised estimates' in Table 4) than in some earlier assessments. The reasons for this are explored using the analyses in which no allowance is made for survival having dropped in 1999–2000 ('No Event' and 'Unrevised, No event' in Table 4, see also Fig. 2) because the previous assessments did not explicitly account for the mortality event. This comparison suggests that allowing for the possibility of a catastrophic mortality event in 1999–2000 has reduced the ability to constrain the upper bound for carrying capacity because the lower 5% limit for P^{1+}_{2009} / $MSYL^{1+}$ is notably higher for the analyses which ignore this event (Table 4). Bayes factors comparing the analyses which include a 1999–2000 catastrophic mortality event and those which do not provide support for estimating a parameter for the 1999/2000 event. For example, in the baseline analysis the *ln* (Bayes factor) value is 3.00 compared to the 'No event' model. This is interpreted as strong, but not definitive, support (Kass and Raftery, 1995) for including the catastrophic mortality parameter in the model.

The results are insensitive to changing the first year of the analysis (Table 4, Fig. 3). The key management-related results are also not sensitive to splitting the series in 1987–88, using the calf count estimates and using the 'Lo' and 'Hi' abundance estimates (Fig. 4). The results for the generalised logistic model are most comparable with the two 'No event' analyses because no account is taken of a catastrophic mortality event in 1999–2000 when fitting the generalised logistic model (see Appendix 1). While not entirely comparable, the qualitative conclusions from the generalised logistic model are identical to those from the age-structured model.

Fig. 5 shows the posterior distributions for the parameters for the baseline analysis. These posteriors show that the data update the priors for $MSYR^{1+}$ and $MSYL^{1+}$ to a substantial extent. The posterior for $MSYL^{1+}$ emphasises higher values for $MSYL^{1+}$, which is not unexpected given that the rate of

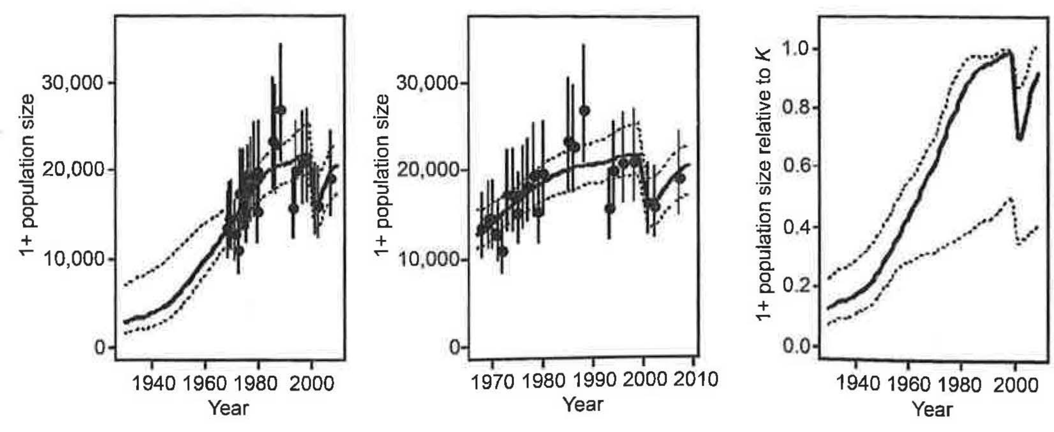

Fig. 1. Posterior distributions (medians and 90% credibility intervals) for the time-trajectories of 1+ population size (left and centre panels) and 1+ population size expressed relative to (current) carrying capacity (right panel) for the baseline analysis.

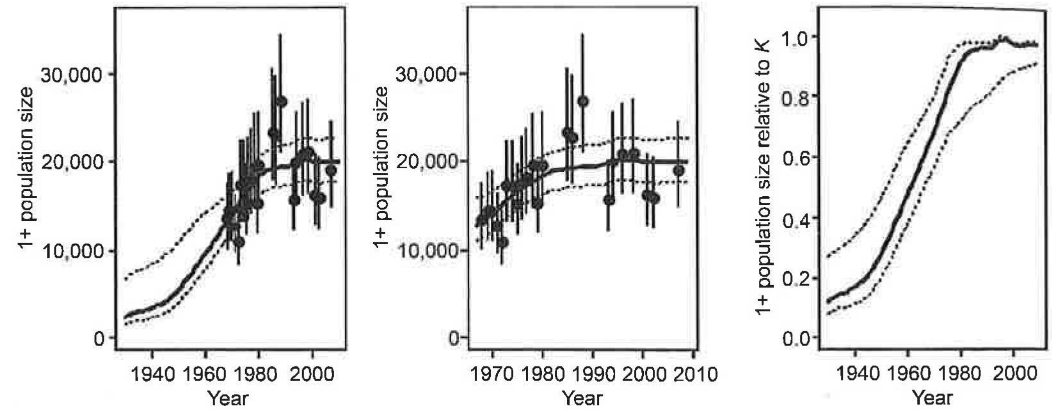

Fig. 2. Posterior distributions (medians and 90% credibility intervals) for the time-trajectories of 1+ population size (left and centre panels) and 1+ population size expressed relative to (current) carrying capacity (right panel) for the 'No Event' analysis.

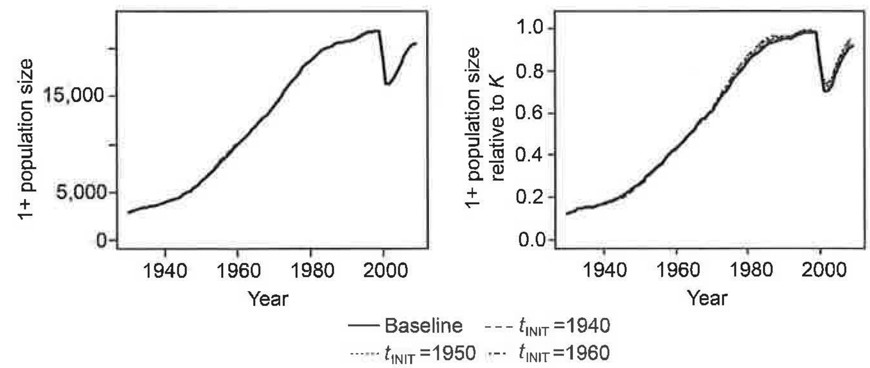

Fig. 3. Posterior median time-trajectories of 1+ population size (left panel) and 1+ population size expressed relative to (current) carrying capacity (right panel) for the baseline analysis and the sensitivity tests which vary the value for t_{INIT}.

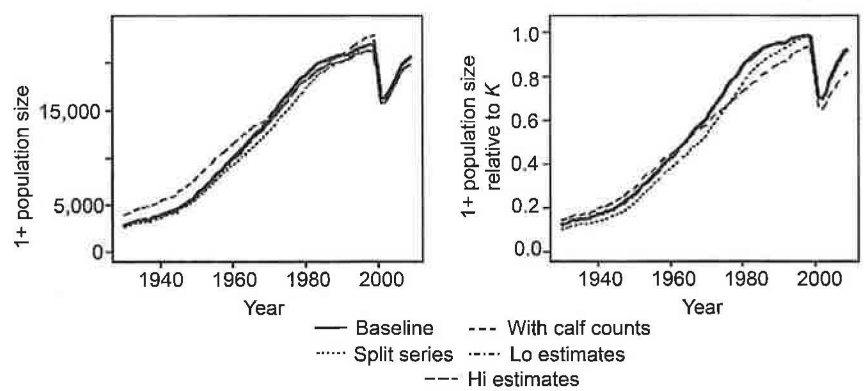

Fig. 4. Posterior median time-trajectories of 1+ population size (left panel) and 1+ population size expressed relative to (current) carrying capacity (right panel) for the baseline analysis and a subset of the sensitivity tests.

increase for the ENP gray whales is assessed to have been high until just before this population (almost) reached its current carrying capacity. The posteriors for the age-at-maturity, maximum fecundity, and adult survival place greatest support on low, high, and high values, respectively. This is consistent with the fairly high growth rates and values for MSYR^{1+}. The posterior for the survival multiplier is also updated substantially, with both high (close to 1) and low values (below 0.7) assigned low posterior probability. Sensitivity tests in which the bounds for the priors were widened (results not shown) did not lead to outcomes which differed noticeably from the baseline assessments.

The maximum rate of increase, λ_{max}, is well-defined in all of the analyses. The posterior mean estimates of this quantity range from 1.057 to 1.068 and are fairly precisely determined (Table 4).

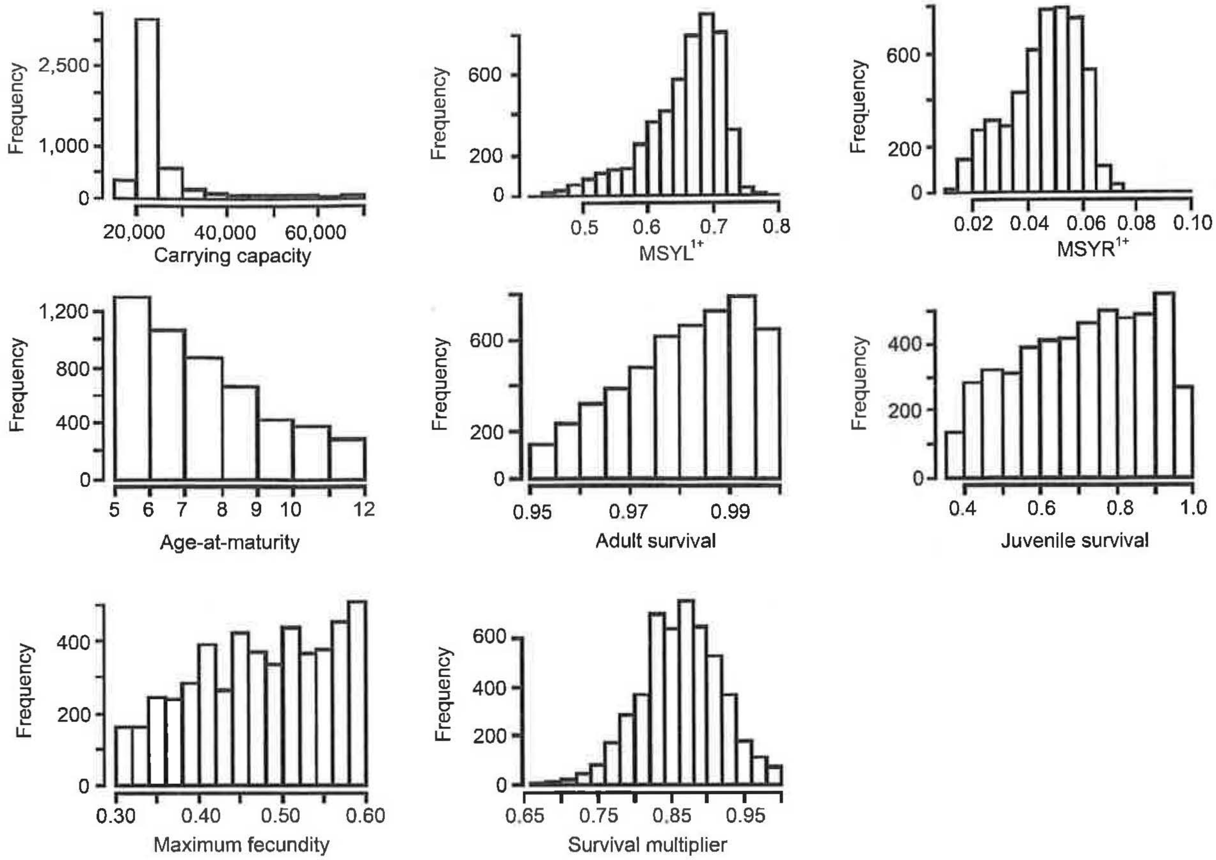

Fig. 5. Posterior distributions for the parameters of the baseline analysis.

DISCUSSION

The sensitivity tests were designed to examine the effect of various assumptions on the assessment results and to examine the effect of changes in the methods that have occurred, particularly related to abundance estimation. Overall, the results are consistent across most of the sensitivity tests with some exceptions. In particular, the baseline model fit to the unrevised abundance estimates had relatively different results from the other analyses. Leaving aside that analysis for the moment, the posterior medians for the parameters of interest were relatively consistent. Across all the other analyses, posterior means for K^{1+} ranged from 21,146 to 27,716, for the *depletion level* ranged from 0.76 to 0.96, and for the *MSYL ratio* ranged from 1.22 to 1.54. Therefore, as in previous assessments, the ENP gray whale population is estimated to be above MSYL^{1+} and approaching or close to *K*. The estimates of *depletion level* and *MSYL ratio* in Wade (2002) and in Punt and Butterworth (2002) are very similar to the results presented here, although our current estimates of *K* are lower. The results in Wade and Perryman (2002) and Brandon (2009), which were the only previous assessments to use abundance estimates from the 1997/98 and subsequent surveys, gave higher and more precise estimates for *depletion level* and *MSYL ratio* than estimated here. However, in common with previous assessments, those results are superseded by this new assessment because it uses the revised abundance estimates of Laake *et al.* (In press).

The posterior means for the life history parameters were very consistent as well, with the posterior means for λ_{max} ranging from 1.057 to 1.068, non-calf survival ranging from 0.972 to 0.983, and calf survival ranging from 0.706 to 0.730. The parameter MSYL^{1+} was updated to strongly emphasise higher values in the baseline analysis. There are theoretical arguments for why MSYL should be relatively higher in marine mammals than, say, marine fishes (Eberhardt and Siniff, 1977; Fowler, 1981; Taylor and DeMaster, 1993), but, in general, there has not been empirical data of sufficient quantity and quality to estimate this parameter well for marine mammals (Gerrodette and DeMaster, 1990; Goodman, 1988; Ragen, 1995). Empirical evidence that is available for large, long-lived mammals has shown convex nonlinear density-dependence in life history parameters such as age-specific birth and mortality rates (Fowler, 1987; 1994; Fowler *et al.*, 1980), which suggest MSYL > 0.5*K*. A relatively long time-series of abundance estimates has documented the recovery of harbour seal (*Phoca vitulina*) populations in Washington state, and Jeffries *et al.* (2003) estimated MSYL to be greater than 0.5*K* for these populations. In the ENP gray whale analysis here, values from 0.40 to 0.54 for MSYL^{1+} have low probability in the posterior distribution (Fig. 5, Table 4) which is consistent with the conclusions of Taylor and Gerrodette (1993) that MSYL was likely to be greater than 0.5*K*. Thus, the posterior distribution for MSYL^{1+} estimated here (posterior means for the baseline analysis of 0.656, range of posterior means 0.611– 0.691), suggests that the ENP gray whale population experienced a decrease in population growth only when it was relatively close to K^{1+}.

The results did not vary much for a large number of the sensitivity tests, providing assurance that the assumptions made for the baseline analysis did not have a substantial influence on the results. Changing the initial year from which the model was projected had little effect on the results, which is similar to the results seen in Punt and Butterworth (2002) for initial years ranging from 1930 to 1968, as used here. The results for the 'Lo' and 'Hi' series of abundance estimates are very similar to the baseline results, suggesting that assumptions made in calculating the abundance estimates do not have a strong influence on the results of the assessment. Additionally, splitting the abundance time series in 1987/88 did not have a substantial effect. This is particularly reassuring, because some changes in the field methods happened at that time, notably the use of a second independent observer during that and subsequent surveys (Laake *et al.*, In press). The generalised logistic model provided similar results to the 'No-event' analysis, with some small differences. This was similar to results seen in Wade (2002), where the quantitative values for some parameters were somewhat different for the generalised logistic, although the qualitative results are nearly identical in this case. That the quantitative results differ between the generalised logistic and our baseline analyses is to be expected because the analysis based on the generalised logistic did not account for the dynamics of sex- and age-structure, and also ignored time-lags in the dynamics.

The baseline analysis fits the abundance data better than in the 'No-event' analysis because it includes the catastrophic mortality event in 1999–2000 (Figs 1 and 2). Furthermore, the Bayes factor confirms that there is strong, but not definitive, evidence supporting the use of a model including the catastrophic mortality. The model estimates that 15.3% of the non-calf population died in each of the years with catastrophic mortality, compared to about 2% in a normal year. In that 2-year period, the model estimates of the population size relative to K^{1+} fell from being at 99% of K^{1+} in 1998 to 83% in 1999 and 71% in 2000, before increasing back up to 91% by 2009. In contrast, the 'No-event' analysis estimates the population had reached a level very close to K^{1+} by ~1995 and has remained there since, which clearly does not match the evidence regarding the biological effects on the population in 1999 and 2000. In the baseline analysis, the estimate of the number of whales that died in 1999 and 2000 was 3,303 (90% interval 1,235–7,988) and 2,835 (90% interval 1,162–6,389), respectively, for a combined total for the two years of 6,138 (90% interval 2,398–14,377). In comparison, the 'No-event' analysis estimates that the number of whales that died in 1999 was 587 and in 2000 it was 447. Comparing the number of strandings (from Mexico to Alaska) reported in Gulland *et al.* (2005) in the years around the mortality event to these estimates of total deaths from the baseline model indicates that only 3.9–13.0% of all ENP gray whales that die in a given year end up stranding and being reported.

The baseline analysis is more conservative regarding status relative to K^{1+} than the 'No-event' analysis. On the other hand, it can be argued that the 'No-event' analysis provides a more accurate estimation of current average K^{1+}. In other words, the baseline analysis does a better job of modelling the actual time-course of the population by including the mortality event, but it might provide an overestimate of the average recent K^{1+} by essentially considering high abundance estimates to be near K^{1+}, but lower abundance estimates to be lower than K^{1+}. The different interpretations hinge on whether K^{1+} is viewed as relatively fixed, with the 1999–2000 mortality event considered to be unrelated to density-dependence (and therefore K^{1+}), or whether K^{1+} is viewed as something that can vary from year to year, with the 1999–2000 years viewed as an event when K^{1+} itself was low. As populations increase in density, the impact of density-independent factors on population dynamics probably becomes more pronounced (Durant *et al.*, 2005; Wilcox and Eldred, 2003). The actual carrying capacity of the environment, in terms of prey available for the ENP gray whale population, is likely to vary from year to year to a greater or lesser extent due to oceanographic conditions affecting primarily benthic production. In terms of the model, the parameter K^{1+} that is being estimated is interpreted as the average carrying capacity in recent years. In the baseline analysis, the estimated K^{1+} is approximately (though not exactly) the average recent K^{1+} for the years before 1999–2000, whereas in the 'No-event' analysis, the estimate of average recent K^{1+} includes all the recent years, including 1999–2000, and is lower. This is clear from the results, where the baseline estimate of K^{1+} is 25,808 (90% interval 19,752–49,639), whereas the 'No-event' estimate of K^{1+} is substantially lower, 21,640 (90% interval 18,301–25,762).

The analysis using the original unrevised estimates is not a sensitivity test in the usual sense. Those results are provided simply to aid in interpretation of the results of the other analyses relative to past results using the unrevised estimates. For example, no previous analyses other than Brandon (2009) had used the 2006/07 abundance estimate, so this sensitivity test provides a comparison in which both analyses use that estimate. In the 'No-event' model, the analyses using the original and revised abundance estimates are nearly identical for estimates of *depletion level* and *MSYL ratio*. K^{1+} was estimated to be higher in the analysis that used the original abundance estimates, but even though K^{1+} is lower using the revised abundance estimates, overall the entire time-series is shifted such that the estimates of status relative to K^{1+} are unchanged.

In contrast, in the baseline model, the original abundance estimates give a fairly different result from any other analysis. From the discussion of how correction factors for the abundance estimates were calculated in different years in Laake *et al.* (In press), it is clear that the revised abundance estimates should be more accurate, and there were shifts of certain sequences of abundance estimates relative to one another that influence the results. For example, the three estimates from 1993/94 to 1997/98 are the three highest estimates in the original time-series, whereas the three estimates from 1984/85 to 1987/88 are the three highest estimates in the revised time-series. This has an effect on the baseline analysis results because the model is trying to fit the drop in abundance that occurred after the 1997/98 abundance estimate. That drop is substantially larger in the unrevised data set than it is in the revised data set, and therefore the results for the baseline model differ somewhat between the revised and unrevised data sets.

The only previous assessment that modelled the 1999–2000 mortality event was that of Brandon (2009), whose point estimates of total natural mortality in those years ranged from 1,300 to 5,200, depending upon a variety of assumptions he explored, lower than the 6,138 estimated here in the baseline model. The difference presumably arises because Brandon (2009) modelled mortality as a function of a sea-ice index for the Bering Sea, following the relationship found between calf production and sea-ice (Perryman *et al.*, 2002). This constrains the dynamics of the mortality in Brandon (2009) to reflect the dynamics of the index to some extent. In contrast, the 1999–2000 mortality was unconstrained in the baseline analysis here and is essentially estimated by what value fit the drop in abundance estimates best. Brandon (2009) noted this difficulty in his analysis, stating it was not possible in his analysis to fit the strandings data for the 1999–2000 mortality event without allowing for some additional process error in the survival rates during those years.

λ_{max} is estimated to be 1.062 (90% interval 1.032–1.088) in the baseline analysis. This is similar to, but a little lower than, the estimate from Wade (2002) of 1.072 (90% interval 1.039–1.126) and the estimates from Wade and Perryman (2002). The posterior for λ_{max} from the 'No-event' analysis is very similar to this, as is that from the 'No-event' analysis using the unrevised abundance estimates, indicating the lower estimates of λ_{max} seen here are not due entirely to the revision of the abundance estimates but are instead partly due to the additional four abundance estimates used here (1997/98 to 2006/07) that were not available at the time the Wade (2002) analysis was conducted. To get an estimate of λ_{max} of 1.062, the posterior distribution favoured a low age-of-maturity, a high maximum fecundity, and a high adult survival. λ_{max} appears to be well-defined, as the posterior medians from most of the sensitivity tests are very similar. It should be noted that these are theoretical estimates of the population growth rate at a very low population size, based upon the density-dependent assumptions of the population model; the ENP gray whale has not been observed to actually grow this rapidly because the population was estimated to be approaching *K* by the time its growth rate was monitored; consequently, the observed population growth rate was less than its theoretical maximum.

The small and endangered western North Pacific population of gray whales has been estimated to have an annual population increase that is between 2.5% and 3.2% per year, but there is concern that this growth rate is low because of possible Allee effects and from ongoing human-caused mortality (Bradford *et al.*, 2008). Best (1993) summarised the growth rates of eight severely depleted baleen whale populations (other than gray whales) and the values ranged from 3.1% to 14.4%. Some of these estimates were not very precise, and Zerbini *et al.* (2010) suggested that the higher rates are implausible given life-history constraints for (at least) humpback whales (*Megaptera novaeangliae*). In more recent studies of other species, a number of estimates of trend have been similar to the estimates of λ_{max} reported here. In a simulation study based on empirical estimates of life history parameters for humpback whales, Zerbini *et al.* (2010) estimated maximum rates of increase of 7.5%/year (95% CI 5.1–9.8%) using one approach and 8.7%/year (95% CI 6.1–11.0%) using a second approach. Calambokidis *et al.* (2008) calculated point estimates of 4.9% to 6.7% for the North Pacific humpback whale population using data from a recently completed North Pacific study of humpback whale abundance. Zerbini *et al.* (2006) used line transect data from sequential surveys to estimate an annual rate of increase for humpback whales in shelf waters of the northern Gulf of Alaska from 1987 to 2003 of 6.6% per year (95% CI 5.2–8.6%), and for fin whales of 4.8% (95% CI 4.1–5.4%). On the other hand, Mizroch *et al.* (2004) estimated a rate of increase for North Pacific humpback whales in Hawaii using mark-recapture methods for the years 1980–1996 of 10% per year, but the confidence limits were wide (95% CI 3–16%). Other unpublished estimates are available spanning essentially a similar range as originally reported by Best (1993) (i.e. see IWC, 2010)). In summary, the estimates of λ_{max} reported here are similar to trend estimates seen in other species, but there are also lower and higher values that have been recorded.

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Appendix 1

ANALYSES BASED ON THE GENERALISED LOGISTIC EQUATION

The dynamics of the population are assumed to be governed by the generalized logistic model:

$$N_{y+1} = N_y + rN_y(1-(N_y / K)^z) - C_y \qquad \text{(App.1)}$$

where N_y is the number of animals at the start of year y;

r is the intrinsic rate of growth;

z is the extent of compensation;

K is the (current) carrying capacity; and

C_y is the catch (in numbers) during year y.

The parameters of Equation (App.1) are r, z, and K while the data available to estimate these parameters are the estimates of abundance and their associated variance-covariance matrix. The analysis is based on the same likelihood function (Eqn (11) of the main text) and priors as the baseline analysis using the age- and sex-structured model.

Report of the Scientific Committee

The meeting was held at El Panama Hotel and Conference Centre, Panama from 11-23 June 2012 and was chaired by Debra Palka. A list of participants is given as Annex A.

1. INTRODUCTORY ITEMS

1.1 Chair's welcome and opening remarks

The Chair welcomed the participants to the 2012 IWC Scientific Committee meeting noting that the Committee faced a long and complex Agenda this year. In particular, she thanked the Government of Panama for providing the facilities for this year's meeting and the IWC Commissioner for Panama, Tomas Guardia for his assistance. The Committee paused in silence for Alexandre de Lichtervelde, the previous Commissioner from Belgium who had been deeply involved in the issue of ship strikes, and Frank Hester, a long time Scientific Committee member, who had both sadly passed away since the last meeting. They both will be greatly missed.

Simon Brockington, the Executive Secretary to the IWC, addressed the meeting on behalf of the Commission to convey a message of gratitude. He noted that the Scientific Committee is rightly regarded as one of the foremost international fora dedicated to cetaceans, and that this reputation stemmed from the quality of research conducted by the participants. He hoped that the meeting would be productive both in terms of providing advice to the Commission, but also in allowing knowledge to be gained and shared between participants so as to allow improved research in the future. He wished all participants a successful meeting.

On behalf of the Government of Panama, Giovanni Lauri, the Administrator General of the Aquatic Resources Authority of Panama (ARAP) addressed the Committee and welcomed the participants to Panama. He hoped that everyone would enjoy their time in Panama City and wished the meeting every success.

1.2 Appointment of rapporteurs

Donovan was appointed rapporteur with assistance from various members of the Committee as appropriate. Chairs of sub-committees and Working Groups appointed rapporteurs for their individual meetings.

1.3 Meeting procedures and time schedule

Brockington summarised the meeting arrangements and information for participants. The Committee agreed to follow the work schedule prepared by the Chair.

1.4 Establishment of sub-committees and working groups

As intimated last year, (IWC, 2012f, p.59) and included in the draft agenda, a pre-meeting of the Standing Working Group on Environmental Concerns met from 9-10 June 2012 in Panama City to consider interactions between marine renewable energy developments and cetaceans. Its report is given as SC/64/Rep6.

A number of sub-committees and Working Groups were established. Their reports were either made annexes (see below) or subsumed into this report (see Items 17 and 19).

Annex D – Sub-Committee on the Revised Management Procedure (RMP);
Annex D1 – Working Group on the *Implementation Review* of Western North Pacific common minke whales (NPM);
Annex E – Standing Working Group on an Aboriginal Whaling Management Procedure (AWMP);
Annex F – Sub-Committee on Bowhead, Right and Gray Whales (BRG);
Annex G – Sub-Committee on In-Depth Assessments (IA);
Annex H – Sub-Committee on Other Southern Hemisphere Whale Stocks (SH);
Annex I – Working Group on Stock Definition (SD);
Annex J – Working Group on Estimation of Bycatch and other Human-Induced Mortality (BC);
Annex K – Standing Working Group on Environmental Concerns (E);
Annex K1– Working Group to Address Multi-species and Ecosystem Modelling Approaches (EM);
Annex L – Standing Sub-Committee on Small Cetaceans (SM);
Annex M – Sub-Committee on Whalewatching (WW); and
Annex N – Working Group on DNA (DNA).

1.5 Computing arrangements

Allison outlined the computing and printing facilities available for delegate use.

2. ADOPTION OF AGENDA

The Adopted Agenda is given as Annex B1. Statements on the Agenda are given as Annex R. The Agenda took into account the priority items agreed last year and approved by the Commission (IWC, 2012a, pp.27-29). Annex B2 links the Committee's Agenda with that of the Commission.

3. REVIEW DATA, DOCUMENTS AND REPORTS

3.1 Documents submitted

Donovan noted that the pre-registration procedure, coupled with the availability of electronic papers, had again been successful. With such a large number of documents, pre-specifying papers had reduced the amount of photocopying and unnecessary paper dramatically. He was pleased to note that this year the percentage of people opting to receive their papers entirely electronically had continued to grow. As last year, the Secretariat provided participants with a memory stick with all of the papers that had been received by the official deadline. Revised or new papers and reports were uploaded onto the IWC website. The list of documents is given as Annex C. The issue of electronic papers is discussed further under Item 24.

3.2 National Progress Reports on research

The Committee is in the transition phase from receiving paper Progress Reports to online submission into a database. A Working Group was established to facilitate this process and its report is given as Annex O. The Committee **reaffirms** its view of the importance of national Progress Reports and **recommends** that the Commission continues to urge member nations to submit them following the new online system. It thanks the Secretariat and especially Tandy and Miller for their development work on the portal.

Table 1

List of data and programs received by the IWC Secretariat since the 2011 meeting.

Date	From	IWC ref.	Details
Catch data from the previous season			
08/07/11	St Vincent: R. Ryan	E103 Cat2011	Information on the St. Vincent and The Grenadines humpback harvest 2011 season.
01/03/12	Canada: A. McMaster	E103 Cat2011	Information on the Canadian bowhead harvest 2011 season.
30/03/12	Iceland: E. Thordarson	E103 Cat2011	Individual catch records from the Icelandic commercial catch 2011.
22/05/12	Russia: R.G. Borodin	E103 Cat2011	Individual catch records from the aboriginal harvest in the Russian Federation in 2011.
24/05/12	Norway: N. Øien	E103 Cat2011	Individual minke records from the Norwegian 2011 commercial catch. Access restricted (specified 14/11/00).
11/06/12	Japan: S. Hiruma	E103 Cat2011	Individual data for Japan special permit catch, 2011, N Pacific (JARPN II) and 2011/12, Antarctic (JARPA II).
Other catch data			
10/04/12	Canada: J. Ford	E105	Comparison of N Pacific catch data held by Canada with the IWC database, including 1,471 new individual records.
Sightings data			
01/12/11	K. Matsuoka	E102	2011 POWER cruise sightings data.
22/12/11	K. Matsuoka	E102	Data from the JARPN II sighting survey in the North Pacific 2011 (Matsuoka *et al.*, 2011); inc. sightings, weather, effort and distance and angle experiment data.
Other			
30/11/11	USA: D. Palka	E101	List of data for the NP gray whale *Implementation Review* in June 2012.
23/03/12	A. Punt	E104	Programs and data used in AWMP gray whale trials up to March 2012 Workshop.
23/06/12	A. Punt	E104	Programs and data used in AWMP gray whale trials at the 2012 Scientific Committee.

3.3 Data collection, storage and manipulation

3.1.1 Catch data and other statistical material

Table 1 lists data received by the Secretariat since the 2011 meeting. As requested last year, the Secretariat had contacted both Canada and Indonesia to request information on recent catches. The information received from Canada is included in Table 1, but no response has been received to date from Indonesia. The Committee **requests** that the Secretariat try again to obtain data on catches off Indonesia.

3.1.2 Progress of data coding projects and computing tasks

Allison reported that Version 5.2 of the catch database was released in November 2011 and a new release was due shortly. Work has continued on the entry of catch data into both the IWC individual and summary catch databases, including data received from the 2010 season. Sightings data from the 2010 POWER cruise (see Item 10.8) has been validated.

Programming work during the past year has focused on amending the control program and datasets for use in the North Pacific common minke whale *Implementation* trials and is discussed further under Item 6.3.

4. COOPERATION WITH OTHER ORGANISATIONS

The Committee noted the value of co-operation with other international organisations to its work. The observers' reports below briefly summarise relevant meetings of other organisations but the contributions of several collaborative efforts are dealt with in the relevant sub-committees.

4.1 Convention on the Conservation of Migratory Species (CMS)

4.1.1 Scientific Council

The report of the IWC observer at the CMS Scientific Council meeting held in Bergen, Norway from 17-18 September 2011 is given as IWC/64/4E. With relation to cetaceans, their agenda included items on critical sites and ecological networks for migratory species, impacts of marine debris on migratory species and presentation of the report of the Working Group on Aquatic Mammals. It was agreed that the narwhal and the North Pacific killer whale populations be considered for cooperative action. A draft resolution on a programme of work for cetaceans (to implement the previous CoP resolution 'Adverse human-induced impacts on cetaceans') was endorsed. Note was taken of the recent split of the finless porpoise into two species, *Neophocaena brevirostris* and *N. asiaeorientalis* and both were recommended for inclusion in Appendix II of the Convention.

The Committee thanked Perrin for his report and **agrees** that he should represent the Committee as an observer at the next CMS Scientific Council meeting. Further information can be found at *http://www.cms.int*.

4.1.2 Conference of Parties

The report of the IWC observer at the 10th Conference of Parties for CMS held in Bergen 20-25 September 2011 is given as IWC/64/4E. The Convention now has 117 Parties. Three Resolutions related primarily to cetaceans:

Resolution 10.14 *Bycatch of CMS-listed species in gillnet fisheries* called on Parties to *inter alia* assess the risk of bycatch arising from their gillnet fisheries and conduct research to identify and improve mitigation measures (including use of alternative fishing gear and methods) and instructed the Scientific Council to develop terms of reference for studies identifying the degree of interaction between gillnet fisheries and CMS-listed species;

Resolution 10.15 *Global programme of work for cetaceans* laid out tasks for the Scientific Council, Secretariat and Parties to advance the conservation of CMS-listed cetaceans, organised primarily on a regional basis; and

Resolution 10.24 *Further steps to abate underwater noise pollution for the protection of cetaceans and other migratory species* among other recommendations strongly urged the Parties to prevent adverse effects on cetaceans and other marine species by restricting the emission of underwater noise, understood as keeping it to the lowest necessary level with particular priority given to situations where the impacts on cetaceans are known to be heavy.

The resolutions can be seen in full on the CMS website (*http://www.cms.int.*).

The Committee thanked Perrin for his report and **agrees** that he should represent the Committee as an observer at the next CMS Scientific Council meeting.

4.1.3 Agreement on Small Cetaceans of the Baltic and North Seas (ASCOBANS)

There was not a meeting of parties in the intersessional period. The next meeting of parties will take place on 22-24 October 2012 in Brighton, UK. The report of the observer at the 19th meeting of the Advisory Committee to ASCOBANS held in Galway, Ireland 20-22 March 2012 is given as IWC/64/4F. Topics covered included:

(1) *Baltic Sea harbour porpoises*. Those in the Western Baltic, Belt Seas and the Kategat form a different population to those of the Baltic proper and the North Sea and since 2005 there has been a 60% decline in the population size of the former. A separate conservation plan for this area should be established.
(2) *Working Group on a Conservation Plan for Harbour Porpoises in the North Sea*. A follow-up SCANS II survey was recommended, as was bringing smaller and recreational fisheries under the reformed Common Fisheries Policy.
(3) *Working Group on Bycatch*. A review of the 1.7% removal rate was recommended.
(4) *Dogger Bank surveys*. Independent surveys, both aerial and vessel-based, indicate that the harbour porpoise is the most common cetacean in the area, with most records on the slopes of the bank.
(5) *Small cetacean hunt outside agreement area*. Tagging data indicates the pilot whale population subject to the Faroese hunt also occurs in the ASCOBANS agreement area. Because of considerable uncertainties regarding the population ASCOBANS welcomes future studies (e.g. SCANS, CODA, T-NASS).

A working group on marine debris was established and in collaboration with ACCOBAMS, the ASCOBANS Secretariat is working to acquire satellite-based data on shipping density to identify high risk areas and trends. A joint ECS/ASCOBANS/ACCOBAMS workshop on management of Marine Protected Areas (MPAs) for cetaceans will be held at the 2013 ECS conference.

The Committee thanked Scheidat for her report and **agrees** that she should represent the Committee as an observer at the next ASCOBANS Advisory Committee meeting and Meeting of Parties. Further information can be found at *http://www.ascobans.org*.

4.1.4 Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS)

No meetings of ACCOBAMS occurred intersessionally, but a Scientific Committee meeting is scheduled for November 2012. The Committee **agrees** that Donovan should represent the IWC at this meeting.

4.1.5 Memorandum of Understanding (MoU) on the Conservation of the Manatee and Small Cetaceans of Western Africa and Macaronesia

There was no report related to the MoU on the Conservation of the Manatee and Small Cetaceans of Western Africa and Macaronesia. Perrin will represent the Committee at future activities.

4.1.6 Memorandum of Understanding (MoU) for the Conservation of Cetaceans and Their Habitats in the Pacific Islands Region (MoU for Pacific Islands Cetaceans)

There was no report related to the MoU for Pacific Islands Cetaceans. Donohue will represent the Committee at future activities. Further information can be found at *http://www.pacificcetaceans.org.*

4.2 International Council for the Exploration of the Sea (ICES)

The report of the IWC observer documenting the 2012 activities of ICES is given as IWC/64/4A. The ICES Working Group on Marine Mammal Ecology (WGMME) met in February 2011. It conducted a review of the effects of tidal turbines on marine mammals and provided recommendations on research, monitoring and mitigation schemes. The working group recommended identification of sites of low risk for turbine deployments before consenting to further devices or upscaling in more sensitive sites. It also recommended extreme care when extrapolating environmental impacts between species and device types and caution when scaling up environmental lessons learned from studies of single turbines.

Marine spatial planning practices were considered by the working group. It recommended that data on cetacean presence and occurrence be incorporated at a very early stage of planning and it emphasised the importance of including information on seasonal changes in distribution. Due to the wide-ranging nature of cetaceans the relevance of 'important areas' outside MPAs should be assessed within marine spatial plans.

The working group discussed designation of MPAs. It recommended that the boundaries should be decided based on long-term data series (of at least five years). Creation of MPAs in response to public opinion without scientific evidence to support their selection risks providing false assurances and could reduce the pressure for targeted action on the most significant threats.

The Working Group on Bycatch of protected species (WGBYC) met in February 2011. It reviewed the status of information on recent bycatch estimates and assessed the extent of the implementation of bycatch mitigation measures. Reports from 15 member states indicated extrapolated estimates of bycatch for 2009 of 879 striped dolphins, 1,500 common dolphins, 11,000 harbour porpoises and at least 10 bottlenose dolphins in a variety of fisheries. Estimates are patchy and monitoring obligations not being met by several member states. Implementation of bycatch mitigation measures was also found to be poor, with few countries able to confirm that obligations for pinger deployment were being met.

The 2011 ICES Annual Science Conference (ASC) was held in Gdansk, Poland, 19-23 September 2011. Some sessions were designed with marine mammals included as an integral part. A number of sessions were of relevance to the Committee, including those describing:

(1) integration of top predators into ecosystem management;
(2) integration of multi-disciplinary knowledge in the Baltic Sea to support science-based management; and
(3) the extraction of energy from waves and tides – consequences for ecosystems.

Butterworth advised that a World Conference on Stock Assessment Methods for Sustainable Fisheries will be held from 16-18 July 2013, in Boston, USA with Steve Cadrin, Mark Dickey-Collas and Rick Methot as Conveners, as part of the ICES SISAM initiative. A Scientific Steering Group (including Butterworth of the IWC Scientific Committee), linked to SISAM, has been set up to assist the Conveners in planning the Symposium.

The symposium will be structured with presentation sessions, participatory workshops and open floor discussion groups. Further information can be found at *http://ices.dk/iceswork/symposia/wcsam.asp.*

The Committee thanked Haug for the report and **agrees** that he should represent the Committee as an observer at the next ICES meeting.

4.3 Inter-American Tropical Tuna Commission (IATTC)

The report of the observer at the 82nd meeting of the IATTC held La Jolla, USA 4-8 July 2011 is given as IWC/64/4C. The Antigua Convention came into force on 27 August 2010 and under this the IATTC is expected to give greater consideration to non-target and associated species, including cetaceans, in taking management decisions. A summary of ongoing work describing what is known about the direct impact of the fisheries on other species in the ecosystem and the environment. This ongoing work will shape future directions of AIDCP (see Item 4.4) and IATTC measures aimed at managing fisheries and conserving dolphins.

The Committee thanked Rusin for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next AIDCP meeting.

4.4 Agreement on the International Dolphin Conservation Program (AIDCP)

The report of the observer at the 24th Meeting of Parties to the AIDCP held in La Jolla, USA on 21 October 2011 is given as IWC/64/4C. The AIDCP mandates 100% coverage by observers of fishing trips by purse seiners of carrying capacity greater than 363t in the agreement area and in 2011 all trips by such vessels were sampled by independent observers.

The overall dolphin mortality limit (DML) for the international fleet in 2011 was 5,000 animals and the unreserved portion of 4,900 was allocated to 86 qualified vessels that requested DMLs. In 2010 no vessel exceeded its DML. The number of sets on dolphin associated schools of tuna made by vessels over 363t has been increasing in recent years, from 9,246 in 2008 to 10,910 in 2009 to 11,645 in 2010, however fewer were made in 2011 – 9,604. This type of set accounted for 44% of the total number of purse-seine sets made in the ETP in 2011. While fewer dolphin sets were made in 2011, this remains a frequent practice and the predominant method for catching yellowfin tuna by purse-seine in the ETP. Assessment surveys scheduled for 2009 and 2010 have been delayed so it is unclear when abundance estimates for cetaceans in the ETP will be available to update the 2006 survey data.

The Committee thanked Rusin for attending on its behalf and **agrees** that he should represent the Scientific Committee as an observer at the next AIDCP meeting.

4.5 International Commission for the Conservation of Atlantic Tunas (ICCAT)

No observer for the IWC attended the 2011 meeting of ICCAT.

4.6 Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR)

The report of the IWC observer at the 30th Meeting of the CCAMLR Scientific Committee (CCAMLR-SC), held in Hobart, Australia from 23-27 October 2011 is given as IWC/64/4J. The main items considered at the CCAMLR meeting of relevance to the IWC included: (1) fishery status and trends of Antarctic fish stocks, krill, squid and stone crabs; (2) incidental mortality of seabirds and marine mammals in fisheries in the CCAMLR Convention Area; (3) harvested species; (4) ecosystem monitoring and management; (5) management under conditions of uncertainty about stock size and sustainable yield; (6) scientific research exemption; (7) CCAMLR Scheme of International Scientific Observation; (8) new and exploratory fisheries; (9) joint CCAMLR-IWC Workshop with respect to ecosystem modelling in the Southern Ocean; and (10) the CCAMLR performance review.

The publication status of documents from the 2008 joint CCAMLR-IWC Workshop on ecosystem modelling was discussed. Almost all expert groups have completed their review papers. The review process for the papers, which will be published in either *CCAMLR Science* or the *Journal of Cetacean Research and Management*, will begin soon.

MPAs were discussed in detail. The area of the southern South Orkney shelf and the Seasonal Pack-ice Zone and part of the Fast Ice Zone south of the shelf was the first MPA designated by CCAMLR. The following milestones were previously agreed:

(1) by 2010, collate relevant data for as many of the 11 priority regions as possible;
(2) by early 2011, convene a workshop to review progress, share experience and determine a work programme for the identification of MPAs;
(3) by 2011 identify candidate areas for protection in as many priority regions as possible;
(4) by 2011, submit proposals for areas for protection to the CCAMLR-SC; and
(5) by 2012 submit proposals on a representative system of MPAs to the CCAMLR Commission.

The Committee thanked Kock for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next CCAMLR-SC meeting. In addition, Butterworth will act as an observer at meetings of the WG-EMM.

4.7 Southern Ocean GLOBEC (SO-GLOBEC)

The synthesis and analysis process under SO-GLOBEC has continued and has produced a number of papers relating cetacean distribution to prey and other environmental variables. There is no active work with respect to SO-GLOBEC at this time.

4.8 North Atlantic Marine Mammal Commission (NAMMCO)

4.8.1 Scientific Committee

The report of the IWC observer at the 18th meeting of the NAMMCO Scientific Committee (NAMMCO SC) held in Gjógv, Faroe Islands from 2-5 May 2011 is given as IWC/64/4I. The ICES-NAMMCO workshop on bycatch monitoring reviewed indirect and direct bycatch monitoring, data collection and fleet data needed for raising estimates to fleet level. It was noted that bycatch numbers could be high both in Norway and Iceland. The NAMMCO SC strongly encouraged Norway, Iceland and the Faroes to proceed with the implementation of their bycatch monitoring systems. The NAMMCO SC reiterated its recommendation to Greenland to investigate the degree to which bycatch is reported as catch.

Extensive biological sampling was conducted by Iceland from all fin whales landed in 2010. Analysis of all samples is complete and a DNA registry has been initiated.

The 2007 abundance estimates for humpback whales for all areas have now been provided to, reviewed and endorsed by the NAMMCO SC. For the first time since 1986 there was a quota for humpback whales in West Greenland and all nine whales were caught. The NAMMCO SC recommended eye sampling of the whales for age determinations, as well as tail photographs.

Corrected estimates for minke whales for the 2007 and 2009 Icelandic aerial surveys were endorsed. The best available estimate of abundance for 2007 was 48% of that for 2001. Abundance in 2009 remains the lowest yet seen in all areas. The NAMMCO SC agreed that the new evidence presented strengthened the conclusion that the observed decline in abundance was not a result of error in measuring or analyses.

A conventional distance sampling abundance estimate of pilot whales for the Iceland-Faroes shipboard area was endorsed by the NAMMCO SC. They noted the difficulties in providing abundance estimates appropriate for management of this species given the absence of adequate data.

Observations of bowhead whales around Svalbard, Norway from 1940-2009 show an increase in abundance in the last decade. This could be due to an increase in the numbers of whales or increased tourism and a dedicated reporting system. An acoustic study that will continue through 2012 has shown that bowhead whales are present in the Fram Strait throughout the winter and generally during most of the year. A satellite tracked whale from the Spitsbergen stock moved from the so-called northern whaling ground to the southern whaling ground during summer and then back north again during winter. This is opposite of the general seasonal movement patterns for other bowhead whale stocks, but in accordance with reports from whalers in previous centuries.

An aerial survey in West Greenland was scheduled for spring 2012. The primary targets were planned to be narwhals and white whales, with bowhead whales and walruses secondary targets.

The Committee thanked Walløe for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next NAMMCO SC meeting.

4.8.2 Council

The report of the IWC observer at the 20th Annual Meeting of NAMMCO held in Oslo, Norway in September 2011 is given as IWC/64/4B. All requested stock assessments for large whale species in the North Atlantic have now been finalised based on sightings data from the Trans North Atlantic Cetacean Sightings Surveys (T-NASS) in 2007 and additionally in 2009. Management procedures applied have been derived from those already developed by the Scientific Committee of the IWC using the Revised Management Procedure (RMP) approach. An RMP-like approach has been recommended by the Scientific Committee of NAMMCO for some large whale stocks in their discussions on general models to be adopted by NAMMCO. These stock assessments by the constitute the main basis for catch limits set for some baleen whale stocks (fin and minke whales) in the North Atlantic.

Based on T-NASS data, an updated abundance estimate for pilot whales has been made in the areas surveyed in 2007. Although the combined area represented is small and not directly comparable with previous surveys, the available information gives no reason to amend previous conclusions on the sustainability of the Faroese catch. The next regular NASS is scheduled to take place between 2013 and 2015 and planning is already under way.

The working group on marine mammal/fisheries interactions continued its work on development of a large international ecosystem modelling project. A network has been established between several leading scientists in this field aimed at securing funding for the project which includes applying four different modelling approaches to two data rich areas, the Barents Sea and Icelandic coastal waters.

A training course for observers appointed under the NAMMCO joint control scheme for the hunting of marine mammals is to be organised this year.

The Committee thanked Katsuyama for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next NAMMCO Council meeting. Further information on NAMMCO can be found on their website[1].

4.9 International Union for the Conservation of Nature (IUCN)

Cooke and Reeves, the IWC observers, reported on the considerable cooperation with IUCN that had occurred during the past year and this is given as IWC/64/4K.

Western gray whales

The mandate of the IUCN Western Gray Whale Advisory Panel (WGWAP) has been renewed for a further five years, under the aegis of the IUCN Global Marine and Polar Programme. The Panel has expressed concerns about plans to install a third offshore platform for oil and gas extraction just offshore of the gray whale feeding ground, but this project has now been postponed. Analyses of the data collected during a 2010 seismic survey with respect of the effects on gray whales and the effectiveness of mitigation measures are still in progress. Similar mitigation and data collection arrangements are in place for a smaller seismic survey that is currently underway and further information is given in Annex F, Appendix 9. The work of WGWAP is discussed further under Item 10.4.2.

Red List updates

A current list of all cetacean species and populations that have been assessed for the Red List, and their current Red List classification, is maintained on the Cetacean Specialist Group website[2] with links to the assessments which are held on the Red List website (*http://www.redlist.org*). Updates since the last Annual Meeting include separate assessments for the two recently recognied species of finless porpoises (*Neophocaena asiaeorientalis* and *N. phocaenoides*), both listed as Vulnerable. New assessments are underway for the dolphins in the genus *Inia*, which were recently split into two species, *Inia geoffrensis*, the Amazon River dolphin, and *I. boliviensis*, the Bolivian bufeo.

Cetacean Specialist Group

The website of the IUCN Cetacean Specialist Group (*http://www.iucn-csg.org*), contains regular updates of IUCN's cetacean-related activities and other work in which group members are involved. New items since last year relate to vaquita conservation efforts, Mekong River dolphins in Cambodia, Indus dolphins in Pakistan, new cetacean protected areas in Bangladesh.

World Conservation Congress

The IUCN 4-yearly World Conservation Congress will be held 6-15 September 2012 in Jeju, Korea with the theme 'Nature+'. The programme includes three cetacean-related events: a workshop on lessons learned from the IUCN western gray whale conservation initiative; a presentation on a local population of Indo-Pacific bottlenose dolphins found around Jeju Island; and a workshop on cetacean conservation and whale-watching in Africa[3].

The Committee thanked Cooke and Reeves for their report. It also thanked Larsen who has now left the IUCN,

[1] *http://www.nammco.no.*
[2] *http://www.iucn-csg.org/index.php/status-of-the-worlds-cetaceans.*
[3] *http://www.worldconservationcongress.org.*

for his contributions in the past and **agrees** that Cooke should continue to act as observer to IUCN for the IWC.

4.10 Food and Agriculture Organisation (FAO) related meetings – Committee on Fisheries (COFI)
No observer for the IWC attended the 2011 meeting of COFI.

4.11 Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)
No observer for the IWC attended the 2011 meeting of CITES.

4.12 North Pacific Marine Science Organisation (PICES)[4]
The report of the IWC observer at the 20th annual meeting of PICES held 14-23 October 2011 in Khabarovsk, Russia is given as IWC/64/4H. The Marine Birds and Mammals Advisory Group (AP-MBM) recommended that PICES request the IWC Scientific Committee includes a seabird observer on the IWC-POWER cruise survey vessel in the future.

Spatial ecology and conservation was selected as the basis of the new activity plan for the AP-MBM. The objectives are:

(1) synthesise distribution data on marine birds and mammals and its temporal change in the North Pacific;
(2) examine the physical and biological factors that correspond to the distribution and abundance of marine birds and mammals and their economic/ecological hot spots; and
(3) provide information on ecological areas in the PICES regions to aid understanding and sustainable use of marine resources.

Two sessions at the 2012 AP-MBM workshop were of relevance to the IWC, these were: (1) environmental contaminants in marine ecosystems: seabirds and marine mammals as sentinels of ecosystem health; and (2) the feasibility of updating prey consumption by marine birds, marine mammals and large predatory fish in PICES regions.

The Committee thanked Kato for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next PICES meeting.

4.13 Eastern Caribbean Cetacean Commission (ECCO)
No information on the activities of ECCO was provided.

4.14 Protocol on Specially Protected Areas and Wildlife (SPAW) of the Cartagena Convention for the Wider Caribbean[5]
The report of the IWC observer to SPAW is given as IWC/64/4D. The MSP LifeWeb Project was launched in October 2010, which aims to assist with the implementation of decisions from the Convention on Biological Diversity, as well as those of the Cartagena Convention and its SPAW protocol. Recent activities under this project include:

(1) a workshop on integration, mapping and GIS analysis of marine mammal migration routes, critical habitats and human threats in the wider Caribbean region (May 2011);
(2) assisting in the coordination of a conference on Marine Mammal Protected Areas (November 2011);
(3) identifying marine mammal data sources within the wider Caribbean region and collating information in an online database;
(4) a workshop on broad-scale marine spatial planning (March 2012);
(5) analysis of identified marine mammal data in order to develop data layers and maps on the critical habitats for marine mammals in the wider Caribbean; and
(6) a workshop on broad-scale marine spatial planning and transboundary marine mammal management (May 2012).

In 2011 a project focusing on marine mammal watching was implemented. It aims to improve and centralise the level of information and knowledge on the status, distribution and threats of marine mammals in the region. A related workshop was held in October 2011. The Committee thanked Carlson for attending on its behalf and **agrees** that she should represent the Committee as an observer at the next SPAW meeting.

4.15 Indian Ocean Commission (IOC)[6]
No information on the activities of IOC was provided.

4.16 Permanent Commission for the South Pacific (CPPS)[7]
No information on the activities of CPPS was provided.

4.17 International Maritime Organisation (IMO)[8]
The report of the IWC observer to the IMO is given as IWC/64/4G. The IWC has contributed to IMO discussions on addressing ship strikes and the impacts of underwater noise from shipping. The IMO has established a correspondence group to develop non-mandatory draft guidelines for reducing underwater noise from commercial ships (Donovan is a member of this group). This group will report to the IMO's 57th session of the sub-committee on ship design and equipment in early 2013.

The IMO is also working to develop a mandatory Polar Code to control the expected increase in ship traffic in polar waters (the Arctic and the Antarctic) that results from climate and other changes. The Polar Code is intended to function alongside existing IMO conventions and to augment existing measures to reduce the environmental impacts of shipping taking into account the greater environmental sensitivity of polar waters. An IMO Workshop on Environmental Aspects of the Polar Code was held in Cambridge in September 2011 where there was considerable discussion of ship strikes and underwater noise impacts on whales. The Polar Code work is also co-ordinated by the IMO sub-committee on ship design and equipment.

The Committee thanked Leaper for his report and **agrees** that the IWC Secretariat should represent the Committee at the next IMO meeting.

4.18 Conservation in the southeastern Pacific under the framework for the Lima Convention
No information on conservation in the southeastern Pacific under the framework for the Lima Convention was provided.

4.19 International Committee on Marine Protected Areas (ICMMPA)[9]
At its 60th Annual Meeting in Santiago, Chile, the Committee endorsed support for the first International Conference on Marine Mammal Protected Areas (MPAs), which was

[4] *http://www.pices.int*.
[5] *http://www.cep.unep.org/cartagena-convention*.
[6] *http://www.coi-ioc.org*.
[7] *http://www.cpps-int.org*.
[8] *http://www.imo.org*.
[9] *http://www.icmmpa.org*.

subsequently held in Hawaii in 2009. The committee that organised the conference is now a task force of the IUCN. It hopes to continue its constructive relationship with the IWC and SC/64/O1 is the summary report of the second (ICMMPA) meeting. The meeting was held in Martinique in the French Caribbean from 7-11 November 2011. The aim was to seek solutions to shared problems related to marine mammal conservation and to MMPA network and site design, creation and management. A secondary aim was to orient those working in MMPAs to set those protected areas in the broader context of marine management.

The conference theme was 'Endangered Spaces, Endangered Species' and workshops focused on monk seals, sirenians, river dolphins and other small and large cetaceans; special attention was given to the vaquita, the most endangered, space-restricted marine mammal in the world. Plenary sessions focused on:

(1) special considerations for particularly endangered marine mammals and whether MPAs are the right tool;
(2) refining understanding of marine mammal critical habitat and hotspots to inform MMPA designation;
(3) using marine spatial planning and ecosystem-based management to address broad threats to marine mammals;
(4) managing MMPAs for localised threats and mitigation by spatial protection and other means;
(5) development of MMPAs in the wider Caribbean region; and
(6) regional cooperation for MMPA scientific and technical networking.

The workshops focused on marine mammals and oil spills, decision-making with limited data, best practices for whale watching in MMPAs, integrating marine mammal data in marine spatial planning, forging agreements to establish effective MMPA networks, and the widespread mortality attributed to fisheries bycatch.

Proceedings of this second ICMMPA meeting will be available and released shortly and a third ICMMPA meeting is planned to be held in about two years' time. A proposal was received from Australian scientists and decisions on exact location and date are yet to be taken.

5. REVISED MANAGEMENT PROCEDURE (RMP) – GENERAL ISSUES

5.1 Complete the MSY rates review

Since 2007, the Committee has been discussing maximum sustainable yield rate (MSYR) in the context of a general reconsideration of the plausible range to be used in population models used for testing the *Catch Limit Algorithm* (*CLA*) of the RMP (IWC, 2008g; 2009b; 2010c; 2010i; 2011m). The current range is 1% to 7%, in terms of the mature component of the population. As part of its review, the Committee has been considering observed population growth rates at low population sizes. An important issue raised (Cooke, 2007) was that should variability and/or temporal autocorrelation in the effects of environmental variability on population growth rates be high, simple use of such observed population growth rates could lead to incorrect inferences being drawn over the lower end of the range of plausible values. In 2010, the Committee agreed a Bayesian approach (Punt, 2010) for calculating a probability distribution for the rate of increase for an 'unknown' stock in the limit of zero population size, once the inputs needed to apply it become available (IWC, 2011g).

Last year, the Committee had agreed that the review would be completed at this meeting (IWC, 2012f). However, given effectively no intersessional progress, the issue was furthered but not completed during the present meeting (Annex D, Appendix 2) as follows:

(1) values of demographic parameters to be used for the calculation of the CV and autocorrelation of the rate of increase were agreed for the 15 populations for which estimates of growth rate at low population size were available if it is assumed that only fecundity is stochastic;
(2) calculations were undertaken for the case where there is no variability in survival rate; and
(3) progress was made on the implementation of two approaches for specifying variability in survival rate; one which results in the same CV for the rate of increase for variability in survival rate as the CV implied by the variability in fecundity, and another which is based on an approach involving optimal allocation of energy between reproduction and survival.

The Committee expressed serious concern that once again the process has not been completed and it carefully examined whether it was worth continuing the process. However, given the good progress during the meeting, and the work plan developed (Annex D, item 2.1), the Committee **agrees** that no more than one further year would be allowed for this process. If the MSYR review cannot be completed at next year's meeting, the current range of MSYR rates (1% - 7% in terms of the mature component of the population) will be retained.

To ensure completion of these tasks, a three-day intersessional meeting is required, with at least five participants, ideally back-to-back with another intersessional meeting. An intersessional Steering Group, under Butterworth (Annex Q1), was appointed to co-ordinate the meeting and associated preparation. Any models related to variability in survival rate to be considered must be fully specified to the Steering Group at least one month before the intersessional meeting. The financial considerations are given under Item 23.

5.2 Finalise the approach for evaluating proposed amendments to the *CLA*

The Committee last discussed this issue in 2006 (IWC, 2007c) noting that it was originally intended that this work would occur in conjunction with the completion of the MSYR review (see Item 5.1 above). The Committee re-established a Working Group under Allison (Annex Q2) to develop trials to examine the effects of possible environmental degradation in terms of trials in which *K*, and perhaps MSYR, varies over time.

The Committee **stresses** that this work must be completed by the next Annual Meeting irrespective of the progress made under Item 5.1.

5.3 Evaluate the Norwegian proposal for amending the *CLA*

The Committee was unable to complete its evaluation of the Norwegian proposal given the discussions under Items 5.1 and 5.2 above. The Committee **agrees** that this task will be completed at the next Annual Meeting either using the revised values from the MSYR review or the existing values if the review is not completed.

5.4 Modify the 'CatchLimit' program to allow variance-covariance matrices

The 'CatchLimit' program implements the *CLA* and now allows variance-covariance matrices for the abundance estimates to be specified (IWC, 2012f). Allison noted that it includes some non-standard coding statements and she will be working with the Norwegian Computing Center during the intersessional period to develop a final version of the program.

5.5 Update the Requirements and Guidelines for Conducting Surveys and *Implementations*

The Committee's Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme (IWC, 2012x) were written when only design-based surveys were realistic. Subsequently, spatial modelling approaches have been developed as an additional realistic approach. In addition, many [quasi] design-based surveys do not formally meet design-based criteria, and there may be a question regarding on the adequacy of resultant estimates. The Committee has frequently considered model-based and quasi-design-based estimates (e.g. IDCR/SOWER and SCANS), but without explicit criteria and not necessarily in the context of the RMP. Two linked issues therefore arise: under what circumstances might approval from the Scientific Committee reasonably be given to surveys that are not design-based; and should the Guidelines should be amended to give more specific advice on the considerations for evaluating model-based estimates (including extrapolations) and/or quasi-design-based estimates.

The statistical issues involved are complex, both theoretically and in practice. A number of detailed starting points for discussion are noted in Annex D, item 2.5, and sufficient experience with model-based methods has now accumulated to warrant a review. The Committee, also recognising the importance of this work for all sub-committees that consider abundance estimates in a conservation and management context, therefore **recommends** that such a review (covering model-based abundance estimation in theory and practice, and its relation to the design-based approach), be conducted. The review (Annex D, Appendix 4) will also provide draft text for inclusion in the Committee's Requirements and Guidelines for Conducting Surveys document. The financial considerations are given under Item 23.

5.6 Evaluate the optimisation method used when conditioning trials

Punt and Elvarsson (2011) developed and compared a number of ways to improve the performance of the optimisation algorithm underlying the conditioning process, as discussed in Annex D, item 2.6. The Committee noted that the optimisation scheme used for conditioning the trials for the western North Pacific minke whales had been modified accordingly.

5.7 List of abundance estimates and their recommended uses

The list of accepted abundance estimates for those stocks that have been subject to RMP *Implementations* (and *Reviews*) are provided in Annex D, Appendix 2 along with references to discussions as to whether they are acceptable for use in conditioning, acceptable for use in trials and/or acceptable for use in applications of the *CLA*. The only exception was for western North Pacific common minke whales where evaluation is ongoing (see Item 6.3).

5.8 Work plan

The Committee's views on the work plan developed by the sub-committee on the RMP are given under Item 21 and financial matters are considered under Item 23.

6. RMP – PREPARATIONS FOR *IMPLEMENTATION*

6.1 Western North Pacific Bryde's whales

6.1.1 Prepare for 2013 Implementation Review

The Committee was informed that Japan wished to postpone the 2013 *Implementation Review* for North Pacific Bryde's whales until 2016 because:

(1) dedicated sighting surveys have been conducted in the western North Pacific since 2010 and additional surveys targeted towards Bryde's whales were planned for 2012 and beyond;
(2) lower latitudinal waters in the eastern North Pacific will be covered during the IWC-POWER research programme during 2013-15;
(3) there are currently no genetic samples for sub-area 2 (east of 180°). It is expected that biopsy samples will be collected from Bryde's whales during the IWC-POWER research programme; and
(4) new genetic samples have been obtained for sub-area 1 (west of 180°) during JARPN II as well as other sources, but the data have yet to be analysed.

6.1.2 Recommendations

Implementation Reviews should normally be scheduled not later than six years after the completion of the previous *Implementation* (or *Review*) (IWC, 2012y). The western North Pacific Bryde's whale *Implementation* was completed in 2007 (IWC, 2008f). However, the Committee **recommends** that the *Implementation Review* for western North Pacific Bryde's whales be delayed until 2016 given:

(1) the *Implementation* completed in 2007 considered a range of hypotheses related to stock structure and productivity;
(2) three more years of catches are unlikely to lead to conservation concerns given the results of the *Implementation*;
(3) that it cannot conduct more than one *Implementation Review* at a time (see Items 6.2 and 6.3 below); and
(4) a delay would allow additional sightings and genetics data to become available.

6.2 North Atlantic fin whales

In 2009, the Committee agreed (IWC, 2010e) that if the RMP is implemented for North Atlantic fin whales, certain variants (see table 4 of IWC, 2010e, p.122) could be implemented without a research programme. It also agreed that another variant would be acceptable only with an agreed research programme for the reasons given in IWC (2010e). A primary aspect of this related to whether or not a particular stock hypothesis, 'hypothesis IV', was appropriate.

SC/64/RMP3 responded to a recommendation from the Committee last year that further analysis of the Discovery marking data should be carried out within the framework of the *Implementation Simulation Trials* as detailed in Annex D, item 3.2. The Committee noted that SC/64/RMP3 provided evidence suggesting that stock structure hypothesis IV is inconsistent with existing data but recognised that making a final decision on its acceptability could also involve additional trials. This can best be achieved within the context of an *Implementation Review*.

Annex D, table 1 summarises new information available for an *Implementation Review*. The Committee **agrees** that the available information is sufficient to warrant an *Implementation Review* in 2013. It noted that while the *Implementation Review* would be focused on providing advice for the Icelandic hunt, the discussions of stock structure would also be valuable in the context of the SWG's work to develop an *SLA* for the aboriginal hunt off West Greenland (Annex E).

6.2.1 Recommendations

The Committee **recommends** that the *Implementation Review* for the North Atlantic fin whales be brought forward to 2013. The *Review* should start during a pre-meeting immediately before the 2013 Annual Meeting to ensure that it is completed in one year. An intersessional email Steering Group (Annex Q3) was established to coordinate the work prior to the 2013 meeting.

6.3 North Pacific common minke whales (continue *Implementation*)

The Committee is conducting an *Implementation Review* for western North Pacific common minke whales and is following the schedule set out in its Requirements and Guidelines (IWC, 2012i). At last year's meeting, the Committee had been unable to complete the tasks required for the First Annual Meeting, primarily because it had not been possible to complete conditioning of the *Implementation Simulation Trials*, a major task given their complexity. This meant that the two year schedule for the *Implementation Review* had been disrupted.

This year's meeting was effectively a repeat of the First Annual Meeting with the same list of tasks that had been initiated last year. There had been another intersessional Workshop in December 2011 to facilitate the work necessary to ensure that all relevant tasks could be completed at this year's meeting as described under Item 6.3.1.

6.3.1 Report of the December 2012 Intersessional Workshop

Donovan presented a summary of the report of the Intersessional Workshop held 12-16 December 2012, kindly hosted by the Government of Japan (SC/64/Rep2). The primary objective of the Workshop was to ensure completion of the conditioning of trials in time for the 2012 Annual Meeting, although a number of other topics were addressed to assist the Committee in its work to complete the *Implementation Review*. Conditioning is the process of selecting the values for the parameters of the operating models that implement the trials such that the predictions from these models are consistent with the available data.

The Intersessional Workshop covered issues relating to: stock structure and mixing matrices; conditioning; abundance estimates for use in trials; specification of these trials; plausibility of stock structure hypotheses; and data/analyses to reduce the number of stock structure hypotheses in future *Implementations*. Considerable progress was made and details are given in Annex D1, item 3 and SC/64/Rep2.

6.3.2 Conditioning

Following the Intersessional Workshop, a number of problems with the fits of the operating model to the data had been identified. Suggested changes to the trial specifications were developed, details of which are given in Annex D1, item 4.1, which the Committee **endorses**.

The Committee reviewed the results for the six baseline trials (stock structure hypotheses A, B and C with MSY rates of 1% and 4%) given in Annex D1, Appendix 2 and **agrees** that the conditioning for these trials had been acceptably achieved. There was insufficient time to evaluate the results of the conditioning of all the sensitivity tests. However the Committee **agrees** that the results for trials for which 100 simulations were available suggested that it is possible to determine whether conditioning has been achieved successfully based on the fit of the operating model to the actual data.

The Committee received a summary report from a small group appointed to review the results of trials run to date. Allison reported that all trials for stock structure hypotheses A and C with MSYR=1% had now been run with the actual data. Conditioning had been achieved for all these trials except two, for which the mixing matrices needed adjustment. Based on these results and on extensive past experience with reviewing the results of such trials, the Committee **agrees** that conditioning of the *Implementation Simulation Trials* of western North Pacific common minke whales had been acceptably achieved.

6.3.3 Update to standard datasets - abundance estimates

Abundance estimates play three roles in the *Implementation* process: (1) for use in conditioning trials; (2) for use when applying the *CLA* during *Implementation Simulation Trials*; and (3) for actual application of the *CLA*. The abundance estimates for use during conditioning were selected during the First Intersessional Workshop in December 2010 (IWC, 2012d). At this meeting, the Committee needed to select which abundance estimates to use when applying the *CLA* during *Implementation Simulation Trials*. The abundance estimates for use in actual application of the *CLA* will be finalised next year.

The Committee received a cruise report of a sightings survey in the Yellow Sea in May 2011 (SC/64/NPM6) and an estimate of abundance for minke whales from this survey (SC/64/NPM7); details are given in Annex D1, item 5.1.1. The Committee expressed its appreciation to the Government of Korea for its continued commitment to surveys for minke whales in Korean waters and to An for his role of oversight on behalf of the Committee. In discussion, the Committee raised a number of issues with the analysis that requires further work. Therefore this estimate was not accepted for use in *Implementation* of the RMP at this meeting but the Committee looks forward to the presentation of a revised estimate in the future.

The Committee received SC/64/NPM2, an updated summary of the information on survey procedures for the Japanese dedicated sighting surveys conducted by the Institute of Cetacean Research (ICR) and the National Research Institute of Far Seas Fisheries (NRIFSF), in response to a recommendation from the December 2011 Intersessional Workshop (SC/64/Rep2). The authors concluded that sighting procedures for the ICR surveys follow the RMP Requirements and Guidelines for Surveys, except that the surveys were not subject to Committee oversight, and that the survey procedures for the NRIFSF surveys met all the Requirements and Guidelines. The Committee also received SC/64/NPM3, which presented abundance estimates from JARPN II (see Item 17) sightings data for minke whales in sub-areas 7CS, 7CN, 7WR, 7E, 8 and 9 collected during 2008 and 2009. Details are given in Annex D1, item 5.1.2.

A number of issues were raised and discussed relating to survey design, survey direction relative to migration, survey protocol for responding to bad weather and achieved coverage; details are given in Annex D1, item 5.1.2. One specific point was that the estimates of abundance for 2008 and 2009 use information from other years. The Committee therefore **recommends** that variance-covariance matrices be computed for the entire time-series of abundance estimates for sub-areas 7CS, 7CN, 8, and 9.

Whether and how to use estimates with low coverage or design concerns and the treatment of JARPN and JARPN II surveys (i.e. surveys that had not originally been intended to produce estimates for use in the RMP) that did not have Committee oversight raised issues beyond the specifics of the *Implementation Review* of western North Pacific minke whales. Accordingly, the Committee had a general discussion of these issues, the report of which is given under Item 5.8.

In light of that discussion, a small group reviewed all of the available abundance estimates to determine whether or not they were acceptable for use when applying the *CLA* during *Implementation Simulation Trials*. Each available estimate was categorised as 'Yes', 'No', 'No agreement', and 'Yes*' (see Annex D1, Appendix 3). The category Yes* indicates that they can be used in the trials but that further analysis needs to be considered for the estimate to become acceptable for application of the RMP. Surveys which had been accepted for use in the trials during the 2003 *Implementation* were automatically deemed acceptable. The Committee **endorses** the categorisations given in Annex D1, Appendix 3.

Regarding those estimates for which no agreement had been reached on whether or not they were acceptable for use in trials, the Committee **agrees** that the baseline trials should be conducted for the least and most aggressive RMP variants both using and not using the 'No agreement' estimates when applying the *CLA*. If the results of the trials are sensitive to the inclusion of the 'No agreement' estimates, the proponents would be requested to justify how the 'No agreement' estimates could become acceptable with further analysis. The final decision on whether further analysis is likely to allow 'No agreement' estimates to be acceptable will be made by the Intersessional Steering Group established under Butterworth (Annex Q10).

Annotation 21A to the RMP specifications (IWC, 2012y) states that 'A part of an *Area* which is unsurveyed in a single year may count as surveyed when the data from several years are combined, provided that an appropriate multi-year regression analysis is used, and additional variance is taken into account'. In response to a recommendation in SC/64/Rep2, the Committee received SC/64/NPM5, which extrapolated abundance estimates to parts of sub-areas 8, 11, and 12NE which were not covered during some past surveys, to eliminate the bias in estimated abundance trend which arises due to variable coverage. Details are given in Annex D1, item 5.1.2.

The Committee noted that blocks B11-2 and B12NE-2 had only been surveyed once which meant that there are insufficient data to inform additional variance. The Committee **agrees** that the information for sub-area 8 satisfied the requirements for applying annotation 21A.

6.3.4 Update to standard datasets – best catch series

The Committee **agrees** with the recommendation in Annex D of SC/64/Rep2 that the 'Best' catch series was appropriate for the direct catches.

The Committee noted that a single series of bycatches would be used for all of the trials when applying the RMP, irrespective of the true values for the bycatches, which differ among trials, and simulations within trials. The Committee **agrees** that the bycatches would be set to the averages of the predicted bycatches based on the fit to the actual data of the operating model for the six baseline trials (see Annex D1, Appendix 4).

Regarding the specification of future bycatches in the trials, the Committee **agrees** that this should be achieved by assuming that the bycatch rate in the future equals the bycatch rate estimated for the trial in question averaged over the previous five years (Annex D1, Appendix 9).

6.3.5 Final consideration of plausibility

A key step in the Committee's Requirements and Guidelines for *Implementations* (IWC, 2012y) is assigning plausibility to hypotheses and, by extension, to all of the *Implementation Simulation Trials*. Trials are assigned 'low', 'medium' or 'high' weights, or are categorised as 'no agreement', which are treated as 'medium' weighted trials. Trials with 'low' weights are not considered further in the *Implementation*.

When the results of the trials are examined, for each management variant (see Item 6.3.5.1), 'acceptable' conservation performance is required for all 'high' weight trials but 'borderline' or 'unacceptable' conservation performance for a number of 'medium' weight trials, leads to further consideration of a possible 'with research' option, as detailed in IWC (2012y). Unacceptable performance of a management variant in any 'high' weight trial leads to that variant being eliminated from further consideration, including with respect to the 'with research' option.

The schedule for *Implementations* in the Committee's Requirements and Guidelines for *Implementations* (IWC, 2012y) required final decisions on the plausibility of hypotheses to be made at this year's meeting.

SC/64/Rep2 noted that the present meeting would decide whether analyses of CPUE data (or sighting per unit effort data, SPUE) could be used qualitatively to inform assignment of plausibility weights to the hypotheses (stock structure and MSYR) on which the trials are based (see Annex D1, item 3.6). The Workshop had noted that a document outlining relevant operational factors needed to be developed for the Committee to make a decision in this regard, and it had made a number of recommendations regarding such a document.

SC/64/NPM4 summarised information pertaining to catch, sightings and effort data from Japanese small-type whaling during 1977-87 in relation to minke whales. The authors concluded that CPUE or SPUE data can be useful as an index of population trend if standardised.

The Committee thanked the authors of SC/64/NPM4, which covered most of the factors identified. It noted that there was considerable variation in where individual vessels operated during the year, and that if vessel movement reflects availability of whales, CPUE or SPUE may be biased as an index of relative abundance. It was suggested that focusing on April-May only may provide more consistency.

Following the presentation of the results of additional analyses, the Committee considered that further analysis and model diagnostics would need to be provided before the resultant SPUE trends could be used to assist the assignment of plausibility to hypotheses related to stock structure and MSYR. Given the time available, this was not feasible this year. It was noted that these data could be re-analysed and presented to the next *Implementation Review*, although some members considered that use of whaling SPUE data was inherently problematic and that no analyses of these data would lead to information which could inform plausibility.

6.3.5.1 STOCK STRUCTURE

In response to a request made intersessionally, the Committee received papers from the proponents of Hypotheses A/B

(SC/64/NPM1) and of Hypothesis C (SC/64/NPM11) summarising their main features and supporting evidence. Details of these papers are given in Annex D1, item 6.2. A graphical representation of these stock structure hypotheses is given in fig.1 of IWC (2012h, p.103).

Two papers containing new genetic analyses were presented. SC/64/NPM9 used computer simulations to examine the effect of different sample sizes on the distributions of the correlations between θ and F_{IS}, following an analysis presented last year (Waples, 2011) in which it was proposed that, in a sample that contains individuals only from two distinct stocks, the largest departures from equilibrium (quantified as F_{IS}) should be seen at the loci that show the largest allele frequency differences between the two stocks (quantified as θ). Details are given in Annex D1, item 6.2. given the considerable variability seen in the simulated data, the authors of SC/64/NPM9 suggested that further evaluation is required before the results of (Waples, 2011) could be used as evidence against Hypotheses A and B.

In discussion, it was suggested that it would be useful to extend these analyses to the two-locus (linkage disequilibrium - LD) correlations that were also reported in (Waples, 2011). Additional discussion is given in Annex D1, item 6.2.

SC/64/NPM10 responded to a request from last year's meeting for follow-up analyses comparing the performance of two Bayesian clustering programs (STRUCTURE and HWLER) for detecting the number of gene pools represented in a sample. Details are given in Annex D1, item 6.2. Both programs only detected one population when true panmixia was modelled, but both also failed to detect a second population at the weakest level of differentiation (F_{ST} = 0.007). STRUCTURE reliably detected two populations at F_{ST} = 0.02 but HWLER did not, but HWLER was more consistent in resolving mixtures for $F_{ST} > 0.03$.

In discussion, the Committee noted that the results provide additional confirmation that these Bayesian clustering methods cannot detect the weakest levels of population structure, at least using currently available numbers of genetic markers. Details of additional discussion are given in Annex D1, item 6.2. Several more technical aspects of the performance of STRUCTURE at moderate levels of population differentiation (F_{ST} = 0.045-0.06) were also discussed; details are given in Annex I.

In response to a request in SC/64/Rep2, the summary information relating to key stock structure questions developed last year (Appendix 9 of Annex D1 of last year's report - IWC, 2012h) was reformatted and presented to the Committee. It was revised following discussion and a final version is given in Annex D1, Appendix 6. This table provided a useful starting point for final considerations of plausibility of stock structure hypotheses.

The Committee also received Annex D1, Appendix 7, which synthesised information relating to the relevance of departures from Hardy-Weinberg equilibrium at one and two gene loci, to distinguish between stock-structure hypotheses. The author's overall conclusion was that evidence from Hardy-Weinberg departures for more than two O+J stocks is only weak to moderate. Details of discussion are given in Annex D1, item 6.2.

Following these presentations and discussions, the Committee considered a concise overall summary by the 'G5 group' of geneticists of their interpretation of the relative support for and against the five hypothesised stocks (JE, JW, OE, OW, Y), based on the cumulative genetic information presented and discussed during the last several years. This summary table is given in Annex D1, Appendix 8.

During the discussion, there was some attempt to reduce the number of stock structure hypotheses for consideration in the *Implementation Simulation Trials*. It was noted that the conclusion in Annex D1, Appendix 8 regarding Y stock did not depend on data on conception date, which some consider the strongest evidence for Y stock. Some members suggested that as a consequence, Hypothesis A be assigned 'Low' plausibility. This was not agreed to by the proponents of that hypothesis, who pointed out that reliability of the conception date data has been questioned (e.g. IWC, 2012h) and who argued that the genetic data are too limited to be considered strong support for existence of Y stock. Similarly, assigning 'High' plausibility to a 4-stock version of Hypothesis C that includes two O stocks but only one J stock, and 'Medium' plausibility to Hypothesis C did not receive agreement.

It was not possible to reach agreement on any of these alternatives and, as a consequence, all three main stock structure hypotheses (A, B and C) were 'no agreement'. The Committee **agrees** that they should therefore be treated as if they had been assigned 'Medium' plausibility and that the *Implementation Review* should proceed on this basis.

Pastene commented that although several types of data had been considered during the *Implementation* process thus far, he felt that the conclusions on plausibility were too heavily weighted to the genetic data. The Committee reaffirms the importance of using data from a suite of techniques.

Some members expressed their concern that, despite an enormous investment in research, no consensus had been reached on according low plausibility to the hypothesis of two J stocks. They noted the conclusion of five geneticists who were not proponents of any of the hypotheses (Gaggiotti, Hoelzel, Palsbøll, Tiedemann and Waples) that, based on existing genetic data and analyses, the evidence for the two J stock hypothesis is low and the evidence against it is medium or high (Annex D1, Appendix 8). They questioned whether it would ever be possible to agree, on the basis of genetic analyses, that a hypothesis be given low plausibility if such a statement was not considered by the Committee to be sufficient.

Other members considered that the genetic data were insufficient to evaluate any of the three stock structure hypotheses. They noted that genetic data do not provide information on annual mixing rates between *Small Areas*, which has been shown to be an important consideration in the application of the RMP (Martien *et al.*, 2008). They also noted the discussion on the lack of samples from the breeding grounds and recommendations for further research to determine the levels of demographic mixing between breeding populations in relation to management outcomes.

6.3.5.2 MSYR AND OTHER FACTORS

The previous *Implementation* assigned 'high' plausibility to $MSYR_{mat}$=4% and 'medium' plausibility to $MSYR_{mat}$=1% (IWC, 2005a). It was noted that these whales are found in a region in which there are very large fisheries which might impact the prey base. However, the size of any such an effect on MSYR cannot be quantified at this time. In addition, the review of MSY rates will not be completed during the current meeting so there is effectively no new information related to MSYR for western North Pacific minke whales. The Committee therefore **agrees** to assign 'high' plausibility to $MSYR_{mat}$=4% and 'medium' plausibility to $MSYR_{mat}$=1%, as in the previous *Implementation*.

The baseline trials are based on the hypothesis $g(0)=0.8$, based on the estimate of $g(0)$ by Okamura *et al.* (2010) for the combination of top barrel and upper bridge. The December 2010 First Intersessional Workshop (IWC, 2012d) had noted that this estimate is conservative because the $g(0)$ value is to be applied identically to all surveys, including those by Korean vessels which have lower top barrels, and hence seem likely to miss a greater proportion of minke whales on the trackline. The Committee therefore **agrees** to assign 'high' plausibility to $g(0)=0.8$ and 'medium' plausibility to $g(0)=1$.

Regarding the full set of sensitivity trials, the Committee **agrees** to assign 'medium' plausibility to all except for the following three trials.

(1) Trial 24, which is based on stock structure hypothesis C, but there is a single O-stock and two J-stocks. This trial was assigned 'low' plausibility given the results of the genetics analyses (see Annex D1, Appendix 8).
(2) Trials 21 and 29, which are based on the abundance in sub-areas 5 and 6W, respectively, being set to the 'minimum' values. These trials were assigned 'low' plausibility because the Korean surveys in sub-areas 5 and 6W only cover a small fraction of the overall area of these sub-areas.

The Working Group noted that results of trials 21 and 29 might provide useful information regarding the behaviour of the trials, and **recommends** that these trials be conducted if time is available.

Annex D1, Appendix 5 lists the factors considered in the trials and the final plausibilities assigned by the Committee to each factor.

6.3.6 Specifications of operational features and management variants

In order to implement the *CLA* in trials, specifications of proposed whaling operations are required. Japan intends to conduct coastal whaling in sub-areas 7CS, 7CN and 11, and pelagic whaling in sub-areas 8 and 9. Coastal whaling will be restricted to 10 n.miles. from the coast and during August-October in sub-area 11 to minimise catches of J-stock animals. Whaling in sub-areas 8 and 9 will take place during April-October. Korea intends to conduct whaling using small-type catcher boats in sub-areas 5 and 6W from March to November. Operations will be conducted up to 60 n.miles. from the coast in sub-area 5 and up to 30 n.miles. from the coast in sub-area 6W.

It is also necessary to specify the management variants that will be implemented in the trials. A management variant defines the way the *CLA* is applied to *Management Areas*. This includes specifying *Medium Areas*, *Small Areas* and combinations of *Small Areas* (*Combination Areas*), specifying from which *Management Areas* catches are to be taken, and selecting *Catch-cascading* and/or *Catch-capping* options.

The **agreed** RMP variants and the associated *Small* and *Medium Area* definitions are given in Annex D1, Appendix 9.

The Committee noted that the trials will take longer to run than in previous *Implementations* because the *CLA* will be implemented using the Norwegian 'CatchLimit' program rather than the Cooke version of the *CLA*. The Committee **agrees** that priority should be given to running all RMP variants for the baseline trials as quickly as possible so that any of the RMP variants that are clearly likely to perform 'unacceptably' can be excluded from further consideration. The process of distributing and evaluating trials will be co-ordinated by the Intersessional Steering Group (see Annex Q2).

6.3.7 Specifications and classification of final trials

The final trial specifications are given in Annex D1, Appendix 9.

The Committee **agrees** that for running the trials it will be assumed that the proportional coverage of sub-areas will remain unchanged.

The planned future surveys and a proposal for how past surveys can be combined to calculate survey estimates for *Small Areas* are given in Annex D1, Appendix 9.

SC/64/NPM8 reported that a survey in the Yellow Sea will be conducted during spring 2013. Details are given in Annex D1, item 8.2. The Committee was pleased to hear that additional surveys would continue to be conducted in the waters off Korea and appointed An to provide oversight on its behalf. In relation to survey design, the Committee had recommended some changes to the survey design, which was subsequently modified during the meeting (see Annex D1, item 8.2).

SC/64/O9 reported on a sightings and satellite tagging survey for common minke whales in sub-area 7 in April-June 2011. Only two animals were encountered and efforts to deploy a tag were unsuccessful. SC/64/O10 reported on a sighting and biopsy sampling survey for common minke whales in the Okhotsk Sea, including the Russian EEZ, in May-June 2011. Three schools of minke whales were targeted for biopsy sampling, but no samples were obtained because of difficulties closing on the animals. The Committee expresses its support for continued efforts to collect telemetry and biopsy data to help elucidate stock structure for minke whales in this region. More details are given in Annex D1, item 9.

6.3.8 Consideration of data/analyses to reduce hypotheses in future

The Committee had a general discussion of the fact that, in spite of many years of concerted efforts and a great deal of genetic and non-genetic data, considerable uncertainties remain regarding stock structure of western North Pacific minke whales. This issue is particularly difficult because of the lack of any samples from breeding grounds. The Committee considered a number of types of genetic analyses that might help to reduce these uncertainties in the future. These included sensitivity analyses of recently-used methods and development and application of new analyses, details of which are given in Annex D1, item 9. The importance of considering further work on non-genetic data was also noted. The Committee notes that plans for international collaborative work, including a Workshop, to assist the Committee prepare for an *Implementation Review* under the RMP and the development of an AWMP *SLA* for the Greenland hunt for North Atlantic minke whales (Annex D, Appendix 6) could serve as a useful model for this.

In addition to proposed analyses specifically related to North Pacific common minke whales, the Committee considered an approach that would more broadly address core stock-structure problems that recur for many species in many areas. This general approach has two parts: (1) determining what levels of demographic mixing between breeding populations do and do not make a difference in terms of conservation goals or management outcomes; and (2) using genetic and other methods to determine whether actual levels of connectivity are above or below this threshold.

The Committee **agrees** that work towards this general approach should receive high priority. Suggestions to facilitate implementation of this approach are given in Annex D1, item 9; further discussion is given in Annex I.

It was noted that the *Implementation Review* for North Atlantic common minke whales will undertake some of this work (see Annex D, item 3.3) and that it would be desirable to coordinate efforts in that regard. It was also noted that similar work was being undertaken by scientists at the US Southwest Fisheries Science Center. Cumulative results of these analyses should make it apparent whether general rules of thumb about 'tipping point' levels of migration can be identified, or whether the outcomes are so diverse that each situation must be evaluated on its own merits.

As noted in SC/64/Rep2, in addition to issues of stock structure, other difficulties in conducting the present *Implementation Review* centred on abundance estimates, including their unavailability in some areas and the large CVs for some of the estimates that were available. The difficulties faced by the Committee in determining the acceptability of abundance estimates for use in trials (see Annex D1, item 5.1.2) amplify this concern.

The Committee **agrees** that, to avoid such difficulties in future *Implementation Reviews*, it should consider taking a more active and collaborative approach to this issue. Examination of trial results will assist in identifying the key temporal and geographical areas where new/improved abundance estimates would be most valuable. The Committee should consider developing, in conjunction with the appropriate range states, a short-medium term survey strategy (including design and required effort) and analytical approach that would improve the availability of satisfactory abundance estimates with reasonable CVs at the appropriate geographical and temporal scale to facilitate future *Implementation Reviews*. This could follow a similar process to that used to develop the IWC-POWER programme (Annex G, item 6.2).

6.3.9 Inputs for actual application of the CLA

The Committee **agrees** that the best estimates of the direct catches and the average predicted bycatch from the six baseline trial would be used for applications of the *CLA*.

The Committee did not have sufficient time to select abundance estimates for use in application of the *CLA*. This issue will need to be addressed at the Second Intersessional Workshop (see Item 20).

6.4 North Atlantic common minke whales

6.4.1 Review new information

SC/64/RMP4 summarised the results of aerial surveys covering most of the continental shelf waters of the Icelandic economic zone; the off season component was part of the Icelandic research programme on common minke whales conducted during 2003-07. The Committee noted that SC/64/RMP4 will be considered during the review of this programme in 2013 (see Item 17.1.3).

SC/64/RMP5 summarised a sighting survey conducted in the eastern Norwegian Sea in the *Small Management Area EW* during the summer 2011. Details are given in Annex D, item 3.3.1 This was the fourth year in the ongoing six-year survey programme which runs from 2008-13. The Committee **welcomes** the information provided. The data will be included in developing a future abundance estimate for North Atlantic minke whales.

6.4.2 Prepare for 2014 Implementation Review

The Committee agreed last year (IWC, 2012i) to undertake an *Implementation Review* of common minke whales in the North Atlantic in 2014. It has agreed that this will include a full review of stock structure and other issues, recognising that there has been substantial new information collected over the period since the original hypotheses were developed during the *Implementation* itself (IWC, 1993b).

The Committee recognised that it was important to begin preparations for the review in sufficient time to allow for this thorough analysis. It therefore **recommends** the work plan (including a joint intersessional Workshop with AWMP in 2014) as outlined in Annex D, Appendix 6, to consider stock structure hypotheses for North Atlantic common minke whales. It appointed a Steering Group under Palsbøll (Annex Q4).

6.5 North Atlantic sei whales

Víkingsson *et al.* (2010) represented a proposal to initiate a *pre-Implementation assessment* of sei whales in the Central North Atlantic. As required (IWC, 2005b), the paper provides a broad outline of the available data relevant to a *pre-Implementation assessment*, including historical catches, distribution and abundance from dedicated and non-dedicated sightings surveys, stock structure (Discovery marking, genetics and satellite telemetry), biological parameters, feeding ecology and pathology. The authors concluded that the data are sufficient to warrant a *pre-Implementation assessment* of sei whales in the North Atlantic.

The decision whether to initiate an *Implementation* is made by the Commission. The Committee **recommends** that an intersessional group convened by Víkingsson (Annex Q5) should be established with Terms of Reference to review the available data for North Atlantic sei whales in the context of a *pre-Implementation assessment* and provide a report to the 2013 Annual Meeting. The Committee will review the report and any new information so that the Commission can be advised whether sufficient information is available to proceed with the *pre-Implementation assessment*.

6.6 Work plan

The Committee's views on the work plan developed by the sub-committee on the RMP are given under Item 21.

7. ESTIMATION OF BYCATCH AND OTHER HUMAN-INDUCED MORTALITY (BC)

The report of the Working Group on Estimation of Bycatch and Other Human-induced Mortality is given as Annex J. This subject was introduced onto the Agenda in 2002 (IWC, 2003e) because under the RMP, recommended catch limits must take into account estimates of mortality due to *inter alia* bycatch, ship strikes and other human factors in accordance with Commission discussions at the 2000 Annual Meeting (IWC, 2001a), although of course such mortality can be of conservation and management importance to populations of large whales other than those to which the RMP might be applied. Subsequently, the issue of ship strikes has become of interest to the Commission's Conservation Committee (e.g. IWC, 2011b) while entanglement response is being considered by the Commission's Working Group on Whale Killing Methods and Associated Welfare Issues (e.g. see IWC/64/WKM&AWI Rep1).

7.1 Collaboration with FAO on collation of relevant fisheries data

There has been an ongoing effort by the Secretariat and Sea Mammal Research Unit to consolidate data on entanglements submitted in the National Progress Reports into a single database to be shared with FAO. All bycatch records reported to the IWC for the period 1967-2010 have now been entered. The IWC is currently an observer to the Fisheries Resources Management System partnership (FIRMS), a collaborative partnership organised by the FAO, which enables fishery management bodies to share information. It was hoped that FIRMS may hold data on fishing effort that could be useful in estimating bycatch but FIRMS appears to have changed its focus somewhat since initial discussions. The Committee **recommends** that the Secretariat contact FIRMS to establish whether the partnership is still attempting to collate data on fishing effort in such a way that could be of use to the Committee in estimating bycatch.

7.2 Estimation of bycatch mortality of large whales

A long-term data set on entanglements and disentanglements off South Africa showed two centres of entanglement involving humpback or southern right whales, one off the coast of KwaZulu-Natal (KZN) involving nets set to protect bathers from sharks and the second off the coast of the Western Cape involving traps and attached lines set for rock lobster. Interventions were successful in removing gear from 81% of whales entangled in shark nets off KZN (38 humpback, 17 right whales), while 11 humpback and 2 right whales were found dead. Off the Western Cape, whales were successfully disentangled in 23% of cases (n=90) and partially dis-entangled in another 12%. The trend in humpback whale entanglement since 1990 was compatible with the recorded rate of population increase. Entanglement rates of southern right whales apparently increased from 1990 and this could also be attributed to an increase in the population (Meyer *et al.*, 2011).

Entanglement data from the coasts of Newfoundland and Labrador, Canada from 1979 to 2008 included 1,209 large whale entanglements, consisting primarily of humpback whales (80%) and minke whales (15%). Reported entanglements dropped from an average of 64 prior to the moratorium on cod fisheries in 1992 to 19 afterwards (Benjamins *et al.*, 2011).

The Committee noted the value of the extensive data sets described in these studies and that they contributed to an understanding of the impacts, rates and trends over time in entanglement mortality. Both studies had been able to identify trends over time and relate these to either population size or fishing effort. The Committee **recommends** the continuation (or initiation) of these and similar studies and encourages the presentation of results at future Committee meetings.

7.3 Estimation of risk and rates of entanglement

Recent capacity building on entanglement response, conducted by the IWC working in conjunction with both national and regional authorities in Argentina, stimulated an analysis of entangled southern right whales in the province of Chubut. Of nine confirmed cases of entanglement, five involved moorings and four involved marine debris or fishing gear. Six of these whales were successfully released. Many of the mooring systems contained heavy chain and relatively thick diameter rope, but were still found to entangle whales. Whales were often seen 'playing' with mooring and anchor lines and this behaviour is believed to be a primary mechanism for entanglement in this region.

The primary focus of the second IWC Workshop on Welfare Issues Associated with the Entanglement of Large Whales held in 2011 (IWC/64/WKM&AWI Rep1) was on entanglement response and capacity building but several topics from the Workshop were also relevant to estimating risk, including the mechanisms by which large whales become entangled. The Committee noted the value of data collected during entanglement responses and welcomed the efforts at the Workshop to develop a data form to standardise the data now being collected around the world. The Workshop participants had also proposed to form a 'global network of entanglement response teams' and seek the endorsement of the IWC as an expert panel to advise member nations on issues related to large whale entanglement including setting up response networks, methodologies for understanding scope and impact on local populations, and response capacity building. The Committee **supports** the call for the proposed group and a potential database noting that this will assist the work of the Committee. In many cases there are additional data available from entanglement incidents that could supplement the summary data currently requested in National Progress Reports. The IWC could become a repository for such data through a similar effort to the ship strike database.

7.4 Review progress on including information in National Progress Reports

Due to some delays with changing to electronic submission of Progress Reports, not all of these were reviewed at the meeting. It was noted that, when complete, electronic submission will facilitate linking relevant data to the ship strike database. Suitable links within the submission system could also encourage the entry of data to the ship strike database where more detailed information is available.

7.5 Ship strikes

New information on ship strikes was received for the Arabian Sea region, South Africa and Sri Lanka. A preliminary summary of strandings, lethal entanglements and ship strikes of large whales in the Arabian Sea region, revealed seven documented ship strikes and four lethal entanglements between 2000 and 2012 and included three Arabian Sea humpback whales. The Committee has noted its concern over the status of this population and the increasing shipping traffic in this region (see Item 10.7 for further discussion).

Of 71 recorded mortalities of southern right whales off the South African coast between 1999 and 2010 five bore injuries consistent with a ship strike.

The southern coast of Sri Lanka has one of the busiest shipping routes in the world and overlaps with an area of high whale sightings. Two pygmy blue whales were struck and killed in Sri Lankan waters in early 2012. In the absence of any abundance estimates for the local population, the population impacts of ship strikes are unknown. The Committee **draws attention** to the urgent need for long-term monitoring of the blue whale population in Sri Lankan waters and elsewhere in the northern Indian Ocean. The Committee **recommends** that the Secretariat send a letter to the Sri Lankan Government, drawing their attention to its discussion of this topic and ways in which the Committee may assist.

There is a need to better understand the variables that will affect whether a ship struck whale will strand and predict where death may have occurred. A deterministic model that uses wind archives and outputs of tidal models to predict the drift of floating objects has been developed by MétéoFrance. The model can make forward calculations to predict a stranding location or backward calculations to estimate the likely origin of an object. This model had been used to predict whether small cetacean carcasses in the Bay of Biscay would reach the coast (Peltier *et al.*, 2012). It was noted that some carcasses may 'sail' across the wind to variable degrees and a large whale carcass may also 'swim' after death, because of the action of swell on its tail flukes. The Committee **recommends** further study of carcass drift, detection and deterioration for large whales that could be used to establish the location of death from a ship strike or other sources.

A better understanding of the relationship between vessel speed and collision risk is needed to assess risk. A recent study (Wiley *et al.*, 2011) evaluated the relative risk reduction that might be achieved by speed restrictions. Two studies based on the locations relative to the ship at which humpback whales were observed from cruise ships inferred greater collision risks with increases in speed (Gende *et al.*, 2011; Harris *et al.*, 2012).

A Workshop focusing on ship strikes in the Bay of Biscay was held in London in April 2012 (Bull and Smith, 2012). It made a series of recommendations, mainly dealing with mitigation measures but also related to assessing risk. In particular, the workshop considered ways in which a large data set of observations from vessels may be used. The Committee **welcomes** the approach taken by the Workshop to engage a wide variety of stakeholders, and noted that the report could also be relevant to work in other regions. The Workshop had considered what could be inferred from observations of 'near miss' incidents. The difficulties in defining a 'near miss' have been discussed before and further analyses leading to papers for next year's meeting were encouraged.

A proposal for a Workshop of cetacean and shipping experts to agree on appropriate analytical and modelling techniques to assess ship strike risks arose out of the IWC-ACCOBAMS ship strike Workshop in 2010 (IWC, 2011d). At the time there was some uncertainty about the availability and content of data on shipping density. Analysis approaches are likely to be most effective on a case by case basis and there are now commercial sources of raw data from Automatic Identification Systems (AIS). The Committee **agrees** that a dedicated Workshop is not needed at this stage but **encourages** presentation of papers examining ship strike risks based on overlap of shipping and whale density.

7.6 Continue to develop a global database of ship strike incidents

The IWC has been developing a global database of incidents involving collisions between vessels and whales since 2007.* A web based data entry system has now been in place for two years but there have been few new reports submitted. Most of the interessional database related efforts were to promote awareness, including work by Mattila who has been seconded to the Secretariat to assist with work on mitigating conflicts between whales and marine resource users. As last year, the Committee **agrees** that a more pro-active approach is needed to encourage data to be entered and it **repeats its recommendation** for the appointment of a dedicated IWC ship strike data coordinator with the tasks described in Annex J, Appendix 2 (see also Item 23). The Committee also **recommends** that the Guide for Authors for the *Journal of Cetacean Research and Management* should encourage authors of papers containing data on ship strike incidents to report these to the database.

Some members noted concern that ship strikes may increase in the Arctic as shipping begins to utilise increases in navigable waters resulting from reduced sea ice coverage. The Committee **welcomes** the offer to present new information on this issue at its next meeting.

**http://www.iwcoffice.org/sci_com/shipstrikes.htm.*

7.7 Other issues

A number of papers concerning the impacts of marine debris were considered under Item 12 (see Annex K). The Committee **encourages** further activities that could help to quantify mortality related to marine debris, noting the difficulty in determining if debris is from actively fished gear.

7.8 Work plan

The Committees discussions on the sub-committee's work plan are incorporated under Item 21.

8. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT PROCEDURE (AWMP)

This item continues to be discussed as a result of Resolution 1994-4 of the Commission (IWC, 1995b). The report of the SWG on the development of an aboriginal whaling management procedure (AWMP) is given as Annex E. The Committee's deliberations, as reported below, are largely a summary of that Annex, and the interested reader is referred to it for a more detailed discussion. The primary issues at this year's meeting comprised: (1) *Implementation Review* of eastern gray whales with special emphasis on the PCFG (the Pacific Coast Feeding Group); (2) undertaking an *Implementation Review* for B-C-B (Bering-Chukchi-Beaufort Seas) bowhead whales; (3) developing *SLA*s and providing management advice for Greenlandic hunts; and (4) review of management advice for the humpback whale fishery of St. Vincent and The Grenadines. This represented a significant workload.

8.1 Complete *Implementation Review* of eastern North Pacific gray whales with an emphasis on the PCFG

At the 2010 Annual Meeting (IWC, 2011h), the Committee agreed that the information on stock structure and hunting presented, although some of it had not met the Data Availability Guideline requirements (IWC, 2004b) for the 2010 review, warranted the development of trials as part of an immediate new *Implementation Review* to evaluate the performance of *SLA*s for hunting in the Pacific Northwest, with a primary focus on the PCFG. It had also agreed that the 2010 *Implementation Review* had shown that the population as a whole was in a healthy state, but that over the next few years, further work should be undertaken to investigate the possibility of structure on the northern feeding grounds, especially in the region of the Chukotkan hunts.

The Committee started the process of the new *Implementation Review* at an intersessional Workshop in 2011 (IWC, 2012c) and followed that with work at the 2011 Annual Meeting (IWC, 2012g). A second Workshop was held in March 2012 kindly hosted by the SWFSC in La Jolla, California (SC/64/Rep3). At that Workshop, most of the effort centred on finalising the operating model and trial structure and completing conditioning. The present meeting reviewed progress made at and since the Workshop and focused on finalising the *Implementation Review*. This summary here incorporates work from the intersessional Workshops and the present meeting.

8.1.1 Stock structure

The *Implementation Review* considers three geographic regions:

(1) the 'north' area (north of 52°N i.e. roughly northern Vancouver Island);
(2) the PCFG area (between 41°N and 52°N); and
(3) the 'south' area (south of 41°N).

The trials consider two stocks ('PCFG' and 'north'). PCFG whales, which are treated as a separate management unit, are defined as gray whales observed (i.e. photographed) in multiple years between 1 June and 30 November in the PCFG area (IWC, 2011f). Not all whales seen within the PCFG area at this time will be PCFG whales and some PCFG whales will be found outside the PCFG area at various times during the year. However, this is not problematic since the historical catches north of 52°N occurred well north of 52°N and future catches will either occur in the Bering Sea or in the Makah U&A (Makah Usual and Accustomed Fishing Grounds). The remaining animals ('north') represent the large eastern North Pacific stock (the stock to which the whales taken during the Chukotkan hunt belong).

Several papers addressed stock structure and related issues (e.g. levels of immigration) at both the intersessional Workshop (see SC/64/Rep3, item 2.4.2.2) and the present meeting (see Annex E, item 2.2.2). Notwithstanding the difficulties arising out of the complexities of the issue, the Committee was particularly pleased to see efforts to use the IWC's TOSSM framework (IWC, 2007e; Lang and Martien, 2012; SC/64/AWMP4; and see Item 11.3). In that context, it was recommended that future TOSSM analyses consider a broader range of parameter choices to explore the robustness of the conclusions to uncertainty. In concluding discussions on this issue, it was agreed that the trials (see Table 3) covered a suitably broad range of immigration rates.

8.1.2 Abundance

The Committee reviewed the mark-recapture abundance estimates provided in SC/64/Rep3 and a new paper (SC/64/AWMP10). The agreed abundance estimates from a modified Jolly-Seber approach (Laake, 2012) are provided in Table 2 for the OR-SVI region (Oregon to southern Vancouver Island ~42-49ºN) and the NCA-NBC region (northern California to northern British Columbia ~41-52ºN). Given the large bias in the first (1998) estimate, the estimates for this year are out of conditioning.

Abundance estimates for the total eastern North Pacific are those provided by Laake (2012); they are given in Annex E, Appendix 2, table 4a.

8.1.3 Catch data (direct and incidental)

The agreed catch series for the period of the trials (i.e. 1930 onwards) are given in Annex E, Appendix 2, table 1. Following work at the intersessional Workshop and further review by an intersessional group established in SC/64/Rep3, it was agreed that the average annual kills during 2000-09 were 2 for the PCFG (December-May), 1.4 for the PCFG (June-November) and 3.4 for the 'south' (December-May) and this information was used to forecast future incidental catches.

8.1.4 Mixing

Mixing relates to: (1) mixing of stocks in the three areas; and (2) the relative probability of whaling in the Makah U&A taking a PCFG whale given the number of PCFG and 'north' whales. The latter can be estimated as the proportion of PCFG whales to total whales in photographs during December-May from the outer coast of northern Washington (0.3; SC/64/Rep3). However, there are a number of uncertainties and assumptions surrounding such an analysis resulting in the need for sensitivity tests (i.e. alternative trials spanning a range of values).

Table 2

Abundance estimates (*N*) and standard errors in OR-SVI and NCA-NB(after exclusion of known calves from the year in which they were identified as calves.

Year	*N*	SE(*N*)
Region: OR-SVI		
1998	63	4.1
1999	78	8.4
2000	89	11.9
2001	117	8.9
2002	133	15
2003	151	13.7
2004	157	15.5
2005	162	15.7
2006	154	15.3
2007	152	14.5
2008	150	12.5
2009	146	14.9
2010	143	16.8
Region: NCA-NBC		
1998	101	6.2
1999	135	12
2000	141	13.2
2001	172	12.6
2002	189	9.2
2003	200	16.4
2004	206	14.9
2005	206	22.6
2006	190	18.8
2007	183	23.1
2008	191	16.1
2009	185	23.2
2010	186	18.7

Table 3

SLA variants suggested by the Makah tribe used in the *Trials*.

Variant number	PCFG limit	Struck and lost count toward APL
1	APL Formula	No
2	APL Formula	Yes
3	APL Formula	Yes
4	1	No
5	1	Yes
6	1	Yes
7	2	No
8	2	Yes
9	2	Yes
10	No limit	N/A
11	No limit	N/A

8.1.5 Biological parameters and MSYR

Biological parameter values were agreed last year (IWC, 2012j). The priors, based on the 2004 *Implementation,* are given in the trial specifications (Annex E, Appendix 2). The most likely value for $MSYR_{1+}$ for the north stock was agreed to be 4.5% i.e. the posterior median from the most recent assessment of this stock (Punt and Wade, 2012). The *Evaluation Trials* also consider a value for $MSYR_{1+}$ for the north stock of 2% (rounded lower 90% posterior bound from the Punt-Wade assessment). There are insufficient data to estimate MSYR for the PCFG and so two scenarios are considered for the Trials as discussed last year (IWC, 2012j): (1) $MSYR_{1+}$ for the PCFG stock is the same as that for the north stock and there is no immigration (this is unlikely given the data but provides a conservative lower bound); and (2) three values of $MSYR_{1+}$ but with some immigration and emigration.

Table 4
Details of factors considered in trials.

Factors	Other levels (reference levels shown bold)
MSYR $_{1+}$ (north)	**2%**, **4.5%**
MSYR $_{1+}$ (PCFG)	**1%**, **2%**, **4.5%**
Immigration rate (annual)	**0, 1, 2**, 4, 6
Pulse immigration (1999/2000)	**0**, 10, **20**, 30
Proportion of PCFG whales in PCFG area, ϕ_{fut}	0, **0.3**, 0.6, 1
Struck and lost rate (PCFG area)	0, **50%,** 75%
Northern need in final year (linear change from 150 in 2010)	**340**, 530
Historic survey bias	**None,** Increasing between 1967 to 2002 from 0.5→1 (north only), 50% (PCFG only)
Future episodic events	**None,** 3 events occur between yrs 1-75 (at least 2 in yrs 1-50) in which 20% of the animals die. Events occur every 5 years in which 10% of the animals die.
Time dependence in *K*	**Constant**, Halve linearly over 100yr, Double linear over 100yr
Time dependence in natural mortality, *M* *	**Constant,** Double linearly over 100yr
Parameter correlations	Yes, **No**
Probability of mismatching north whales, p_2	0, **0.01**, 0.01-0.05
Probability of mismatching PCFG whales, p_1	**0**, 0.5
Frequency of PCFG surveys	**Annual**, 6-year
Incidental catch	**Reference**, double reference, half reference
Future sex ratio	**0.5:0.5**, 0.2:0.8 (M:F)
Episodic events with future pulse events	**None,** 3 events occur between yrs 1-75 (with at least 2 in yrs 1-50) in which 20% of the north stock die and a pulse of 20 animals is added to the PCFG stock.

8.1.6 Variants

The management plan proposed by the Makah Tribe is given in Annex D of SC/64/Rep3 and a number of alternative *SLA*s were proposed for analysis in SC/64/Rep3 as given in Table 3. These variants explore:

(1) how the allowable bycatch of PCFG whales level[10] (APL) of PCFG whales is calculated (three options);
(2) the time of year in which the hunt is modelled to occur and hence whether struck and lost animals are counted against the APL (two options); and
(3) the effectiveness of the *SLA* if only PCFG whales are available for harvest (i.e. in effect a summer hunt).

Variants 1-3 use the APL[11] formula presented in the proposed plan, variants 4-9 have fixed bycatch limits, and variants 10 and 11 explore the impact of not having a limit on bycatch of PCFG whales (i.e. the hunt is only stopped if the total strike limit is reached, or the number of struck-and-lost animals reaches its limit, or the landing limit is reached).

8.1.7 Final trials and conditioning

The final trial structure was agreed in SC/64/Rep3. A summary of the factors considered in the trials is given as Table 4. The *Evaluation Trials* agreed are shown in Table 5 and the *Robustness Trials* are shown in Table 6. These trials were finalised at the March 2012 Workshop (SC/64/Rep3). Conditioning the trials[12] began at the Workshop and was evaluated after the meeting by an intersessional Steering Group (SC/64/AWMP11). Only three trials, B02C, I02C and P05A were eliminated after considering the conditioning results, leaving 72 *Evaluation Trials* in all.

8.1.8 Review results of trials

Evaluation of *SLA*s is based on the objectives accepted by the Commission (IWC, 1983; 1995b) which are to:

(1) ensure that the risks of extinction to individual stocks are not seriously increased by subsistence whaling;
(2) enable aboriginal people to harvest whales in perpetuity at levels appropriate to their cultural and nutritional requirements, subject to the other objectives; and
(3) maintain the status of stocks at or above the level giving the highest net recruitment and to ensure that stocks below that level are moved towards it, so far as the environment permits.

Highest priority is accorded to the objective of ensuring that the risk of extinction to individual stocks is not seriously increased by subsistence whaling.

As their name implies, *Evaluation Trials* are used to examine the performance of the variant *SLA*s against the Commission's objectives. *Robustness Trials* are more extreme trials that are primarily to ensure whether an *SLA* performs as expected in such cases.

The results of all of the trials, expressed in tabular and graphical form (see examples in Annex D, Appendices 3-5) for all agreed performance statistics (conservation and need related) are available from the Secretariat.

The SWG (Annex E, item 2.5.1) screened the trials for conservation performance to focus on those that required more detailed examination. The criteria used were:

(1) the lower 5%ile of the final depletion distribution < than 0.6 (the MSYL level) and the lower 5%ile of the rescaled final depletion is lower than 0.6 for any of variants 1-10;
(2) the trial involved episodic events; and
(3) the lower 5%ile of the trend in 1+ population size indicated a decline in population size of 5% or larger over the final 20 years of the 100-year projection period for any of variants 1-10.

After this initial evaluation a number of features became apparent (see Annex E, items 2.5.1 and 2.5.2), primarily related to conservation performance (apart from variant 5, which had poor need satisfaction) that led the Committee to eliminate further consideration of all but variants 1 and 2.

[10]The Makah Tribe has proposed a hunt management plan with time and area restrictions to target migrating ENP whales, yet there is still a chance that PCFG whales are incidentally harpooned as bycatch to the targeted ENP gray whale hunt.
[11]The APL formula is provided in Annex E, Appendix 2.
[12]Conditioning is the process of selecting the values for the parameters of the operating model such that the predictions from this model are consistent with the available data.

Table 5

The *Evaluation Trials*. Values given in bold type show differences from the base case trial. The final three columns indicate which trials apply to which 'broad' hypotheses (P=pulse, B=bias, I=intermediate – see IWC, 2012i). For 'broad' hypotheses B and I, the number given is the pulse in 1999/2000. Unless specified otherwise ϕ_{PCFG} = 0.3, the struck and lost rate is 0.5, and there are no stochastic dynamics or episodic events. *Trials B02C, I02C and P05A removed after reviewing condition results – see text.

Trial	Need to condition	Description	$MSYR_{1+}$ North	$MSYR_{1+}$ PCFG	Final need	Annual immigration	Survey frequency	Survey bias (north)	Hypothesis P	B	I
1A	Y	$MSYR_{1+}$=4.5%/4.5%	4.5%	4.5%	340 / 7	2	10 / 1	1	20	Y	10
1B	Y	$MSYR_{1+}$=4.5%/2%	4.5%	2%	340 / 7	2	10 / 1	1	20	Y	10
1C	Y	$MSYR_{1+}$=4.5%/1%	**4.5%**	**1%**	340 / 7	2	10 / 1	1	20	Y	10
1D	Y	$MSYR_{1+}$=2%/2%	**2%**	**2%**	340 / 7	2	10 / 1	**0.5→1**	20	Y	10
2A	Y	Immigration=0	4.5%	4.5%	340 / 7	**0**	10 / 1	1	20	Y	10
2B	Y	Immigration=0	4.5%	2%	340 / 7	**0**	10 / 1	1	20	Y	10
2C	Y*	Immigration=0	**4.5%**	**1%**	340 / 7	**0**	10 / 1	1	20	Y	10
2D	Y	Immigration=0	**2%**	**2%**	340 / 7	**0**	10 / 1	**0.5→1**	20	Y	10
3A	Y	Immigration=1	4.5%	4.5%	340 / 7	**1**	10 / 1	1	20	Y	10
3B	Y	Immigration=1	4.5%	2%	340 / 7	**1**	10 / 1	1	20	Y	10
4A	Y	Immigration=4	4.5%	4.5%	340 / 7	**4**	10 / 1	1	20	Y	10
4B	Y	Immigration=4	4.5%	2%	340 / 7	**4**	10 / 1	1	20	Y	10
5A	Y*	Immigration=6	4.5%	4.5%	340 / 7	**6**	10 / 1	1	20	Y	10
5B	Y	Immigration=6	4.5%	2%	340 / 7	**6**	10 / 1	1	20	Y	10
6A		High Northern Need	4.5%	4.5%	**530 / 7**	2	10 / 1	1	20	Y	
6B		High Northern Need	4.5%	2%	**530 / 7**	2	10 / 1	1	20	Y	
7A		3 episodic events	4.5%	4.5%	340 / 7	2	10 / 1	1	20	Y	
7B		3 episodic events	4.5%	2%	340 / 7	2	10 / 1	1	20	Y	
8A		Stochastic events 10% every 5 years	4.5%	4.5%	340 / 7	2	10 / 1	1	20	Y	
8B		Stochastic events 10% every 5 years	4.5%	2%	340 / 7	2	10 / 1	1	20	Y	
9A		Episodic events with future pulse events	4.5%	4.5%	340 / 7	2	10 / 1	1	20	Y	
9B		Episodic events with future pulse events	4.5%	2%	340 / 7	2	10 / 1	1	20	Y	
10A		Relative probability of harvesting a PCFG whale, ϕ_{PCFG}=0.6	4.5%	4.5%	340 / 7	2	10 / 1	1	20	Y	
10B		Relative probability of harvesting a PCFG whale, ϕ_{PCFG}=0.6	4.5%	2%	340 / 7	2	10 / 1	1	20	Y	
11A		Struck & Lost (25%)	4.5%	4.5%	340 / 7	2	10 / 1	1	20	Y	
11B		Struck & Lost (25%)	4.5%	2%	340 / 7	2	10 / 1	1	20	Y	
12A		Struck & Lost (75%)	4.5%	4.5%	340 / 7	2	10 / 1	1	20	Y	
12B		Struck & Lost (75%)	4.5%	2%	340 / 7	2	10 / 1	1	20	Y	
13A	Y	Higher 1999-2000 Pulse	4.5%	4.5%	340 / 7	2	10 / 1	1	**30**		
13B	Y	Higher 1999-2000 Pulse	4.5%	2%	340 / 7	2	10 / 1	1	**30**		
13C	Y	Higher 1999-2000 Pulse	**4.5%**	**1%**	340 / 7	2	10 / 1	1	**30**		
14A	Y	Lower 1999-2000 Pulse	4.5%	4.5%	340 / 7	2	10 / 1	1	**10**		
14B	Y	Lower 1999-2000 Pulse	4.5%	2%	340 / 7	2	10 / 1	1	**10**		

Table 6

The *Robustness Trials*.

Trial	Need to condition	Description	$MSYR_{1+}$ North	$MSYR_{1+}$ PCFG	Survey frequency	Hypothesis P	B
1A		6 year surveys	4.5%	4.5%	10 / 6	20	Y
1B		6 year surveys	4.5%	2%	10 / 6	20	Y
2A		Linear decrease in K^{1+} [K halves over years 0-99]	4.5%	4.5%	10 / 1	20	Y
2B		Linear decrease in K^{1+} [K halves over years 0-99]	4.5%	2%	10 / 1	20	Y
3A		Linear decrease in PCFG K [K halves over years 0-99]	4.5%	4.5%	10 / 1	20	Y
3B		Linear decrease in PCFG K [K halves over years 0-99]	4.5%	2%	10 / 1	20	Y
4A		Linear increase in M [M halves over years 0-99]	4.5%	4.5%	10 / 1	20	Y
4B		Linear increase in M [M halves over years 0-99]	4.5%	2%	10 / 1	20	Y
5A		Linear increase in PCFG M [M halves over years 0-99]	4.5%	4.5%	10 / 1	20	Y
5B		Linear increase in PCFG M [M halves over years 0-99]	4.5%	2%	10 / 1	20	Y
6A		Perfect detection; p_1 =0; p_2=0.01-0.05	4.5%	4.5%	10 / 1	20	Y
6B		Perfect detection; p_1 =0; p_2=0.01-0.05	4.5%	2%	10 / 1	20	Y
7A		p_1 = 0.5	4.5%	4.5%	10 / 1	20	Y
7B		p_1 = 0.5	4.5%	2%	10 / 1	20	Y
8B	Y	Survey bias PCFG + p_1 = 0.5	4.5%	2%	10 / 1	20	Y
9B	Y	Correlation (draw for N; same quantile in the range for PCFG)	4.5%	2%	10 / 1	20	Y
10B	Y	Double incidental catches	4.5%	2%	10 / 1	20	Y
11B	Y	Halve incidental catches	4.5%	2%	10 / 1	20	Y
12A		Sex ratio=0.2: 0.8	4.5%	4.5%	10 / 1	20	Y
12B		Sex ratio=0.2: 0.8	4.5%	2%	10 / 1	20	Y
13A		Relative probability of harvesting a PCFG whale, ϕ_{PCFG}=1	4.5%	4.5%	10 / 1	20	Y
13B		Relative probability of harvesting a PCFG whale, ϕ_{PCFG}=1	4.5%	2%	10 / 1	20	Y

Table 7

Final depletion and rescaled final depletion statistics for *SLA*s 1 and 2 for the trials with $MSYR_{1+}$=1% and the trials with $MSYR_{1+}$=2% for which conservation performance might be considered to be questionable.

Trial	*SLA* variant 1				*SLA* variant 2			
	Final depletion		Rescaled final depletion		Final depletion		Rescaled final depletion	
	Low 5%	Median	Low 5%	Median	Low 5%	Median	Low 5%	Median
$MSYR_{1+}$=1%								
GB01C	0.259	0.343	0.314	0.383	0.290	0.365	0.352	0.414
GP01C	0.382	0.461	0.400	0.472	0.438	0.515	0.460	0.528
GP02C	0.231	0.272	0.255	0.295	0.299	0.347	0.334	0.372
GI01C	0.378	0.446	0.399	0.459	0.434	0.497	0.457	0.513
$MSYR_{1+}$=2%								
GB08B	0.357	0.458	0.505	0.594	0.396	0.504	0.560	0.656
GB10B	0.492	0.556	0.492	0.557	0.575	0.633	0.576	0.635
GP08B	0.330	0.442	0.475	0.578	0.364	0.482	0.528	0.635
GP10B	0.475	0.536	0.476	0.538	0.556	0.619	0.557	0.621

8.1.9 Conclusions and selection of SLA*s*

In order to minimise the risk of taking PCFG whales, the management plan developed by the Makah Tribe restricts the hunt both temporally (to the migratory season for gray whales, i.e. 1 December-31 May) and geographically (to the Pacific Ocean region i.e. the Makah U&A except the Strait of Juan de Fuca). Some PCFG whales are present during the migratory season and thus the plan proposes an allowable PCFG limit (APL) during hunts that are targeting eastern North Pacific migrating whales with the aim of ensuring that accidental takes of PCFG whales do not deplete the PCFG. Whales struck in May might have a higher probability of being PCFG whales since they feed in this area in June. The management plan thus proposes an additional requirement that all animals struck-and-lost in May are assumed to be PCFG whales (i.e. count against the APL), whereas whales struck between December and April are not.

Weather conditions and availability of whales makes it likely that most hunting will occur in May. However, there are insufficient data to assess the number of strikes by month. Thus, it is not possible to reliably estimate the proportion of struck-and-lost whales that would count towards the APL. Given this uncertainty about how the plan would respond to failing to take into account struck-and-lost PCFG whales, the Tribe had proposed two *SLA* variants (1 and 2) spanning the options as to when the hunt might occur.

SLA variant 1 proposes that struck-and-lost whales do not count towards the APL i.e. there is no management response to PCFG whales struck but not landed. *SLA* variant 2 proposes that all struck-and-lost whales count to the APL irrespective of hunting month, i.e. the number of whales counted towards the APL may exceed the actual number of PCFG whales struck. A number of other *SLA* variants were proposed by the Tribe to explore additional management options. However, none of the variants precisely mimicked the final management plan proposed.

The trial results revealed:

(1) *SLA* variants 1 and 2 were potentially satisfactory and performed well in nearly all 72 *Evaluation Trials*; and
(2) *SLA* variants 1 and 2 performed acceptably for all *Robustness Trials*.

Given this, the Committee focused on those few trials for which conservation performance required further consideration. Trials with 1% $MSYR_{1+}$ are the most challenging and the conservation performance for some of these trials for both variants was not satisfactory (see Table 7). However, given the available information for the eastern North Pacific population as a whole (the observed recovery rate from severe historical depletion, as well as the current recovery rate from the 1999/2000 mortality event), the most recent assessment (Punt and Wade, 2012) resulted in an estimated MSYR rate of 4.6% [90% posterior interval 2.2%, 6.4%]. Therefore, the $MSYR_{1+}$=1% trials are at the lower bounds of plausibility and the Committee **agrees** that the conservation performance for these trials alone was not reason to preclude the conclusion that both variants have overall satisfactory conservation performance.

The Committee then focused on certain trials within the 2% $MSYR_{1+}$ set for which conservation performance might be considered questionable. Trial 8b (pulse and bias) involved 10% declines in abundance every five years as a proxy for random biological, environmental or anthropogenic events (e.g. disease or contamination). As noted in Annex E, item 2.5.1, these trials are in effect trials with lower $MSYR_{1+}$ than the nominal 2% of the trial. Given this, it **agrees** that both variants 1 and 2 had acceptable performance for these two trials.

Trial 10b (pulse and bias) involves an assumption that the relative probability of harvesting PCFG whales in the Makah U&A is double the observed ratio of PCFG whales to migrating whales observed in the available photo-identification (photo-ID) studies. The conservation performance of *SLA* variant 2 was considered acceptable for this trial but that for variant 1 was considered marginal (Table 7). In discussing the results of this trial, the Committee noted that the ratio of PCFG whales to migrating whales could be monitored directly from data collected during the hunting period allowing this assumption to be evaluated.

In conclusion, the Committee **agrees**:

(1) *SLA* variant 2 performed acceptably and met the Commission's conservation objectives for conservation while allowing limited hunting; and
(2) *SLA* variant 1 performed acceptably for nearly all the trials and could be considered to meet the Commission's conservation objectives provided that it is accompanied by a photo-ID programme to monitor the relative probability of harvesting PCFG whales in the Makah U&A, and the results presented to the Scientific Committee for evaluation each year.

The Committee **endorses** these conclusions and **recommends** them to the Commission. It also **agrees** that the *Implementation Review* is completed. Management advice is discussed under Item 9.2.3.

However, the Committee noted that the *SLA* variants tested did not correspond exactly to the management plan proposed by the Makah to the IWC. The Committee **agrees** to test such a variant intersessionally and examine the results at the next Annual Meeting.

8.1.10 Other business

Spatial mixing between eastern and western North Pacific gray whale stocks along the Pacific coast of North America outside the feeding season raises issues about the population structure within the Sakhalin feeding area (see SC/64/BRG10 and IWC, 2012k). The broad issue of stock structure of North Pacific gray whales is being addressed through a basinwide research programme (see Item 10.4). However, as noted last year, this finding raises concern about the possibility of whales feeding in the western North Pacific being taken during the proposed Makah Tribe hunt in northern Washington.

Last year (IWC, 2012f, p.16) the Committee had stressed three points.

(1) The new information on movements of gray whales highlighted the importance of further clarification of the stock structure of North Pacific gray whales. In particular, the matches of animals from the Sakhalin feeding grounds with animals seen in the PCFG area and other areas along the west coast emphasised the need for efforts to estimate the probability of a western gray whale being taken in aboriginal hunts for Pacific gray whales (noting that this did not require incorporation of western gray whales into the *Implementation Review).*
(2) It had strongly endorsed the basinwide research programme, noting that the results of the research may require further trials for future *SLA* testing; this would be a matter for consideration at the next *Implementation Review* if not before.
(3) The Committee will continue to monitor the situation and was willing to respond to any guidance or requests for further information from the Commission.

SC/64/BRG9 provided an initial modelling approach to address point (1) above. It was discussed extensively in Annex E, item 2.6 and although welcoming this work, a number of questions were raised and further work identified before any conclusions could be agreed. The Committee **recommends** that a revised document be developed for further review at next year's meeting, noting its potential importance for the provision of management advice. An Advisory Group (Annex Q6) was appointed to provide guidance to the authors of SC/64/BRG9.

8.2 Complete *Implementation Review* of Bering-Chukchi-Beaufort (B-C-B) Seas bowhead whales

The procedure and purpose of *Implementation Reviews* for aboriginal whaling *SLA*s is summarised under Item 8.4. The Committee's task is to assess whether there is any new information that would suggest that the range of trials used to evaluate the *Bowhead SLA* is no longer sufficient to ensure that the *SLA* meets the Commission's conservation and user objectives.

8.2.1 Consideration of new information with a focus on whether this implies a need for new trials

A number of papers were submitted presenting new information on a variety of scientific matters relevant to the *Implementation Review*. Full discussion of these papers is given in Annex E, item 3. The summary of discussions in the following sections is somewhat brief as it only focuses on the SWG's deliberations as to whether additional trials are required.

8.2.1.1 STOCK STRUCTURE

Four papers were relevant to stock structure issues.

SC/64/BRG1 reported on a satellite telemetry study of 57 B-C-B bowhead whales tagged during 2006-11. The Committee commended the authors for providing relevant data on bowhead whale migration patterns, and recognised the cooperation of native hunters who were closely involved in all aspects of this study and deployed most of the tags. It **recommends** that such tagging and telemetry efforts continue.

SC/64/AWMP3 compared the use of SNPs and microsatellites for studying population structure, assignment and demographic analyses of bowhead whale populations in the Sea of Okhotsk, B-C-B and eastern Canada, SC/64/AWMP9 presented sequences from three mtDNA genes from 350 bowhead whales from the B-C-B, eastern Canadian Arctic and the Sea of Okhotsk and discussed methods to calculate gene and site specific mutation rates, while SC/64/AWMP1 investigated the demographic history the B-C-B population of bowhead whales using a variety of analytical methods.

The Committee thanked the authors and **agrees** that the information in these papers provide no evidence to suggest that the trials evaluated during the previous *Implementation Review* (IWC, 2007b; 2008c; 2008h; 2008l) did not adequately address stock structure concerns.

8.2.1.2 ABUNDANCE AND RATE OF INCREASE

A new agreed abundance estimate is not required for completion of the B-C-B bowhead whale *Implementation Review*. When a new estimate becomes available it can be incorporated into the *Bowhead SLA* calculations to provide management advice.

SC/64/AWMP5 incorporates the 1985 and 2004 abundance estimates from aerial photography by Schweder *et al.* (2010) into the ice-based survey estimates to obtain an updated ROI for 1978-2004 (fig. 1 of Schweder *et al.*, 2010). The Committee **endorses** this estimate (3.5% with 95% CI of (2.2%, 4.8%)) as the best available estimate of annual rate of increase for the B-C-B bowhead whale population. It also **agrees** that the best estimate of current abundance is 12,631 (95% bootstrap percentile CI 7,900 -19,700; 5% lower limit 8,400) for 2004 (Schweder *et al.*, 2010).

The Committee was pleased to receive information from recent ice-based surveys (2011) that count whales migrating past Barrow, Alaska (SC/64/AWMP7). Full discussion of these surveys will occur in conjunction with the presentation of new abundance estimates within the next two years.

SC/64/BRG4 presented estimates of visual detection probabilities from the spring 2011 ice-based survey of bowhead whales migrating near Barrow, Alaska. The same methods will also be applied to similar data from the 2010 survey. These estimates are highly relevant since they constitute one foundation upon which a future population abundance estimate will be calculated from the 2011 survey counts. This abundance estimate will then be used as input to the *Bowhead SLA*. The authors intend to estimate 2011 abundance using detection probability estimates based only on the new independent observer data. The Committee **endorses** this approach, while also recognising that any possible implications of the shift to the superior IO method might merit future consideration in the context of long term trends. It **encourages** Committee members interested in abundance estimation to contact the authors of SC/64/BRG4 intersessionally with comments and suggestions so that the future abundance estimate for use in the *Bowhead SLA* can be based on an approved estimate of detection probabilities.

SC/64/BRG3 described an aerial photographic survey for B-C-B bowheads conducted from 19 April to 6 June 2011. The field season was very successful, both in terms of total flight days and the very large number of whale images (approximately 6,800) obtained. These photographs are a significant contribution to the bowhead whale photographic catalogue. The Committee recognised the importance of this work as potentially providing an estimate of population abundance for use with the *Bowhead SLA* that is entirely independent of the ice-based survey estimate described in SC/64/BRG4. Analyses of the photo-ID data may also provide better precision in estimates of bowhead whale life-history parameters such as adult survival rate. A detailed discussion of this paper is provided in Annex F.

8.2.1.3 CATCH DATA

SC/64/AWMP8 provides a preliminary summary of subsistence harvest of bowhead whales in Alaska from 1974 to 2011. Further discussion of the paper can be found in Annexes E and F. The Committee welcomes this information and noted that strikes have remained within the need envelope tested during development of the *Bowhead SLA*. It therefore **agrees** that no additional trials are warranted in this regard.

8.2.2 Discussion of new trials

In consideration of the evidence described above, the Committee **agrees** that there is no need for new trials or further simulation testing of the *Bowhead SLA*.

8.2.3 Conclusions and recommendations

The Committee thanked US scientists, the North Slope Borough, Alaska and the native communities for continuing to provide a considerable body of high-quality scientific work which facilitated the SWG's *Implementation Review* process. The Committee **agrees** that the *Bowhead SLA* continues to be the most appropriate way for the Committee to provide management advice for the B-C-B population of bowhead whales. This completes the *Implementation Review* for the B-C-B bowhead whales. Management advice itself is provided under Item 9.3.2.

8.3 Continue work on developing *SLA*s for the Greenlandic hunts (Annex E, Item 4)

In Greenland, a multispecies hunt occurs and the expressed need for Greenland is for 670 tonnes of edible products from large whales for West Greenland; this involves catches of common minke, fin, humpback and bowhead whales. The flexibility among species is important to the hunters and satisfying subsistence need to the extent possible is an important component of management for the hunters. For a number of reasons, primarily related to stock structure issues, development of *SLA*s for Greenland aboriginal hunts (especially for common minke and fin whales) will be more complex than previous *Implementations* for stocks subject to aboriginal subsistence whaling. The Committee has endorsed an interim safe approach to setting catch limits for the Greenland hunts in 2008 (IWC, 2009c), noting that this should be considered valid for two blocks i.e. the target will be for agreed and validated *SLA*s, at least by species, for the 2017 Annual Meeting (assuming that the Commission sets 5-year block quotas in 2012 as scheduled).

The Committee noted the benefits in previous *CLA* and *SLA* developments of a co-operative competition amongst more than one developer. Several members of the SWG indicated that they may be interested in proposing *SLA*s. The Committee noted the multi-species nature of the Greenland hunts and Greenland's desire for flexibility amongst species in meeting its subsistence needs. It **reiterates** that its approach will first be to develop *SLA*s for individual species before considering whether and how to address multispecies considerations (e.g. IWC, 2010a; IWC, 2011l).

In response to a request made at the intersessional Workshop (SC/64/Rep3), the Committee was pleased to receive four papers by Witting (SC/64/AWMP12-15) that summarised the available information on common minke, fin, humpback and bowhead whales off Greenland in the context of developing *SLA*s (summarised in Annex E, Appendix 6). In order to progress essential *SLA* development work, the Committee **agrees** that an intersessional Workshop (to be held at the end of 2012, probably in Copenhagen) was essential to maintain progress. As in previous years, the Committee also **recommends** maintenance of the AWMP Developer's Fund. Financial matters are discussed further under Item 23.

8.3.1 Common minke whales

The Committee notes that the SWG on the AWMP and the sub-committee on the RMP both have interest in North Atlantic common minke whales. It **endorses** the planned co-operative and collaborative process developed (Annex D, Appendix 6) that will culminate in a joint Workshop on the stock structure of this species in the North Atlantic in early 2014. This is planned to inform the RMP *Implementation Review* process for common minke whales in the North Atlantic scheduled for 2014, as well as the *SLA* development process. The operating models developed for the RMP *Implementation* (perhaps with minor adjustment to take account of focus on different populations) will also serve as the basis for the *SLA* development process. The Committee also notes that aspects of the work to be undertaken by Punt described in Annex E, Appendix 7 will assist developers of candidate *SLA*s for the Greenlandic hunts for common minke whales.

8.3.2 Fin whales

The Committee notes that the SWG on the AWMP and the sub-committee on the RMP both have interest in North Atlantic fin whales. A pre-meeting for the North Atlantic fin whale RMP *Implementation Review* is scheduled before the 2013 Scientific Committee meeting. The stock structure discussions at this meeting will provide useful input to the fin whale *SLA* development process. The operating models developed for the RMP *Implementation* (perhaps with minor adjustment to take account of focus on different populations) can also serve as the basis for the *SLA* development process. The Committee notes that aspects of the work to be undertaken by Punt described in Annex E, Appendix 7 will also assist developers of candidate *SLA*s for the Greenlandic hunts for fin whales.

8.3.3 Humpback whales and bowhead whales

Development of *SLA*s for these hunts is relatively simple compared to the common minke whale and fin whale cases. The Committee **agrees** that it should be possible to develop appropriate trial structures and operating models for the humpback and bowhead whale hunts before the next Annual Meeting to enable potential *SLA*s to be evaluated in the future. It **endorses** the proposal outlined in Annex E, Appendix 7 to support this work.

8.4 Guidelines for *Implementation Reviews*

An integral part of the AWMP process is the undertaking of regular or 'special' *Implementation Reviews*, as noted for example during the development process of the *Bowhead SLA* (IWC, 2003b).

The first B-C-B bowhead whale *Implementation Review* took place over two years and was completed in 2007 with most focus being on the issue of stock structure (IWC, 2007b; 2008c; 2008h; 2008l). No changes needed to be made to the *Bowhead SLA* after the review. The first *Implementation Review* for gray whales was completed in 2010 and the *Gray Whale SLA* was not changed with respect to providing advice on the Russian hunt off Chukotka (IWC, 2011h). However, as discussed above, during that review, information was received that led to the need to call for an immediate *Implementation Review* before providing advice for a potential hunt of gray whales by the Makah Tribe on the west coast of the USA. That review is now complete (see Item 8.1)

The Committee had agreed that it would be useful to develop guidelines for *Implementation Reviews*, given the experience gained thus far. The proposed guidelines are provided in Annex E, Appendix 8 and cover the following issues: (1) objectives; (2) timing of regular and special *Implementation Reviews*; (3) outcomes; (4) data availability; and (5) computer programs.

The Committee **adopts** these guidelines.

8.5 Scientific aspects of an Aboriginal Whaling Scheme (AWS)

In 2002, the Committee strongly recommended that the Commission adopt the Aboriginal Subsistence Whaling Scheme (IWC, 2003a). This covers a number of practical issues such as survey intervals, carryover, and guidelines for surveys. The Committee has stated in the past that the AWS provisions constitute an important and necessary component of safe management under AWMP *SLA*s and it **reaffirms** this view. It noted that discussions within the Commission of some aspects such as the 'grace period' are not yet complete.

8.6. Conversion factors for edible products for Greenland hunts

In 2009, the Commission appointed a small working group (comprising several Committee members) to visit Greenland and compile a report on the conversion factors used by species to translate the Greenlandic need request which is provided in tonnes of edible products to numbers of animals (Donovan *et al.*, 2010). At that time the group provided conversion factors based upon the best available data, noting that given the low sample sizes, the values for species other than common minke whales should be considered provisional. The group also recommended that a focused attempt to collect new data on edible products taken from species other than common minke whales be undertaken, to allow a review of the interim factors; and that data on both 'curved' and 'standard' measurements are obtained during the coming season for all species taken.

Last year the Committee had welcomed an initial report, recognising the logistical difficulty of collecting these kinds of data. However, it had noted that considerably more detail was needed, and requested that a detailed report be presented for consideration at the present meeting.

This year, a further report was received from the Greenlandic authorities that provided information on the data collected thus far. The Committee **welcomes** this report and the provision of data. A comparison of these values and the Recommended Conversion Factors Per Animal (RCFPA) from Donovan *et al.* (2010) showed reasonable agreement for humpback and bowhead whales (within 1 SD), but the yield for fin whales was lower than expected. It was not possible to examine this difference *inter alia* because no lengths of the animals included in the analysis were provided.

Although welcoming the report, the Committee expressed some concerns over the insufficient level of detail provided, some inconsistencies within the report, the efficiency of the sampling regime (relatively poor sample sizes) and the extrapolation procedure in which only one meat tote or bin is weighed.

In response to the concern over the lack of samples, it was noted that the Greenland Institute of Natural Resources (GINR) has been asked to investigate this and is working with the hunters and authorities to improve the sample size in the future. The Committee greatly **encourages** this and looks forward to a report on progress made. It also **encourages** the GINR to develop improved protocols including weighing as many of the meat, mattak, and qiporaq bins as possible. Providing a breakdown of products from bowhead whales would be valuable both for conversion factors and biological information.

Given these concerns, the Committee **reiterates** its recommendations from 2010 and 2011:

(1) the provision of a full scientific paper to the next Annual Meeting that details *inter alia* at least a full description of the field protocols and sampling strategy (taking into account previous suggestions by the Committee); analytical methods; and a presentation of the results thus far, including information on the sex and length of each of the animals for which weight data are available; and
(2) the collection and provision of data on Recommendation No. 2 of Donovan *et al.* (2010) comparing standard *vs* curvilinear whale lengths. This should be done for all three species on as many whales as possible. Guidelines and protocols are suggested in Donovan *et al.* (2010).

8.7 Work plan

The Committee's views on the work plan developed by the SWG on the AWMP are given under Item 21.

9. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT ADVICE

The Commission is considering a change from Annual to Biennial Meetings. This has raised the issue within two Scientific Committee working groups as to whether there are any scientific implications for the Commission moving to setting block quotas for an even number of years rather than the present five-year intervals. This issue was addressed at the intersessional AWMP Workshop (SC/64/Rep3) and that report is **endorsed** by the Committee and the conclusions incorporated below.

The Committee recalled that trials for the B-C-B bowhead and eastern North Pacific gray whale *SLA*s had shown satisfactory performance for surveys at intervals of 10 years (and even for some *Robustness Trials* for 15 years). The Committee **agrees** that there are no scientific reasons for the Commission not to set catch limits for blocks of even numbers of years up to 8 years for these stocks. However, it **draws attention** to its discussions of the AWS where it noted that despite the trial results it would not be appropriate for catches to be left unchanged if new abundance estimates were not available after 10 years (IWC, 2004b).

The Committee notes that it does not require changing its regular process of *Implementation Reviews* approximately every five years (with the provision for 'special' reviews should circumstances arise) or an annual examination of new information and provision of advice if requested.

The Committee also notes that the interim safe *SLA* for the Greenland hunts (see Item 9.1 and Items 9.4-9.6 below) had also been tested for surveys at 10-year intervals and shown satisfactory performance and had been adopted by the Commission in 2008 (IWC, 2009a). However, as noted at the time, those tests had been for a restricted number of scenarios than the wider range of hypotheses customarily considered for such trials. It had thus been agreed that this *SLA* was appropriate for the provision of advice for up to two blocks or approximately 2018. The Committee **agrees** that there are no scientific reasons why the next quota block for the Greenland hunts could not be for a 6-year period, noting that the long-term *SLA*s will be available for *Implementation* for the following block quota.

9.1 Eastern Canada and West Greenland bowhead whales

9.1.1 Review new information on eastern Canada and West Greenland bowhead whales

Discussion within the Committee in recent years has focused on stock structure and associated abundance estimates. The present working hypothesis is that bowhead whales in eastern Canada-West Greenland comprise a single stock; the alternative hypothesis assumes two stocks, one in Hudson Bay-Foxe Basin and another in Baffin Bay-Davis Strait. However, the Committee agreed on the need for further genetic analyses last year (IWC, 2012k), recognising the complications arising out of the fact that existing data pertinent to the question of stock structure are held by a non-member nation, Canada.

The Committee was pleased to receive several papers on eastern Canada and West Greenland bowhead whales and details can be found in Annex F, item 2.2.

Alter *et al.* (2012) presented a study on genetic diversity and differentiation across all five putative stocks of bowhead whales, including Baffin Bay-Davis Strait (BBDS), Hudson Bay-Foxe Basin (HBFB), Bering-Beaufort-Chukchi, Okhotsk, and Spitsbergen. Ancient specimens (500-800 years old) from Prince Regent Inlet (PRI) in the Canadian Arctic were also compared with modern stocks. Results show low differentiation between Atlantic and Pacific, consistent with high gene flow between these areas in the recent past. No difference was observed between the two putative/hypothesised Canada-Greenland populations (HBFB/BBDS), which differ from previous results with more samples and a longer fragment of mtDNA. Significant genetic differences between ancient and modern populations were observed, which suggests that PRI harbored unique maternal lineages in the past that have been recently lost, possibly due to loss of habitat during the Little Ice Age and/or whaling. Unexpectedly, samples from this location show a closer genetic relationship with modern Pacific stocks than Atlantic, supporting high gene flow between the central Canadian Arctic and Beaufort Sea over the past millennium despite extremely heavy ice cover over much of this period.

The Committee **welcomes** this work, and noted that this type of collaborative effort across research groups is valuable in advancing the understanding of bowhead whale stock structure.

Spatial overlap of the extreme summer range of bowhead whales was identified from the eastern and western Arctic in the Canadian High Arctic (Heide-Jorgensen *et al.*, 2011). In the summer of 2010, one satellite tagged bowhead whale from West Greenland and one from Alaska entered the Northwest Passage from opposite directions and spent approximately 10 days in the same area but not at the same time.

Wiig *et al.* (2011b) updated on an abundance estimate for bowhead whales in the Disko Bay area of West Greenland. The study employed multi-locus genotype and sex to identify individual bowhead whales at four localities in eastern Canada (Foxe Basin, Pelly Bay, Repulse Bay and Cumberland Sound) and at one locality in West Greenland (Disko Bay).

9.1.2 Review recent catch information

In 2011, one female bowhead whale was landed in West Greenland and none were struck and lost (SC/64/ProgRepDenmark). Two bowhead whales were found dead in West Greenland in 2011, entangled in fishing gear for crabs.

During 2011, three bowhead whales were taken in Canada. More detailed information (e.g. sex, size) was made available by Canada to the Secretariat. The Committee is pleased to receive this information including catch as well as struck and lost data. It **requests** that in the future Canada also provides information on any strandings, entanglements and ship strikes of bowhead whales.

9.1.3 Management advice

In 2007, the Commission agreed to an annual strike limit of two animals (for the years 2008-12), with a carryover provision (IWC, 2008a). The Committee agreed an approach for providing interim management advice in 2008 and this was confirmed by the Commission (IWC, 2009a). The Committee recalled that the agreed abundance estimate for eastern Canada/West Greenland is 6,344 (95% CI: 3,119-12,906; IWC, 2009d) for 2002. The most recent agreed estimate (IWC, 2012k; Wiig *et al.*, 2011b) for the spring aggregation in the West Greenland area is 1,747 (95% CI: 966-2,528) for 2010.

Using the agreed interim safe approach and the 2010 estimate for West Greenland, the Committee **repeats its advice** that an annual strike limit of two whales in West Greenland will not harm the stock.

The Committee **agrees** that it will review the updated analysis for the 2010 estimate for West Greenland (Wiig *et al.*, 2011a) at next year's meeting, noting that although slightly lower, if adopted it does not alter the management advice. The Committee is also aware that catches from the same stock have been taken by a non-member nation, Canada. Should Canadian catches continue at a similar level as in recent years, this would not change the Committee's advice with respect to the strike limits agreed for West Greenland. Given the importance of this issue, the Committee **recommends** that the IWC Secretariat continues to contact Canada requesting information about catches and domestic catch limits for bowhead whales.

9.2 Eastern North Pacific gray whales

9.2.1 New information

SC/64/AWMP2 presented the results of comparison of the genetics of gray whales sampled off Vancouver, Canada (i.e. PCFG whales), and San Ignacio Bay, Mexico. Results supported the conclusion that PCFG and the larger population are from the same breeding group. However results from other studies of photo-ID and mtDNA indicate that during the summer, whales of the PCFG represent a seasonal subpopulation driven by maternally directed site fidelity. The Committee's work (Item 8.1) is based on treating the PCFG as a separate management stock.

There are at least two sets of genetic samples for PCFG whales, one is possessed by the research group in Canada, and the other by the Southwest Fisheries Science Center in

La Jolla, USA. The Committee **recommends** that the two groups consider merging these data sets as this will result in a more robust evaluation of PCFG gray whales. The Committee also **suggests** that future work uses a greater number of microsatellites and increased mtDNA length.

The Committee received two papers on photo-ID studies undertaken in Mexican waters. SC/64/BRG14 provided information about the number of eastern North Pacific gray whales using Laguna San Ignacio, Baja California during the 2011 and 2012 winter breeding season. High counts of female-calf pairs in 2011 and 2012 suggest that more females whales are using the Laguna San Ignacio region as a winter aggregation area than during the 2007-10 period. SC/64/BRG23 presented information on a new photographic identification programme in the Bahía Magdalena lagoon complex of gray whales in 2012 (there is little recent information from there). A total of 275 individual whales were photographically identified, of which 234 were single whales and 41 were mother-calf pairs. 83% of the mother-calf pairs were sighted in waters around the López Mateos, and the majority of singles (89%) were sighted in waters near to mouth of Bahía Magdalena.

The Committee **thanks** the authors for these studies in Mexican waters which are discussed further in Annex F, item 4.3.1, It noted the value of long-term datasets and **encourages** updates in future years.

SC/64/BRG18 presented results from a linear model relating the average ice cover over the Bering Sea during the first 15 days of May with estimates of northbound gray whale calves the following spring for the years 1994-2010 (ice years 1993-2009) and further used to predict calf estimates for 2011 to 2013. There is a negative relationship between the area of the Bering Sea covered by seasonal ice during the first two weeks of May and the number of gray whale calves estimated by shore-based counts off central California the following spring (Perryman *et al.*, 2011; Perryman and Rowlett, 2002). It is not clear whether an ice-shortened feeding season has a significant impact on overall population condition or health. Measurements of southbound gray whales in vertical aerial photographs collected in 2012 indicated that overall population condition was comparable to that in previous years when the observed strandings were about average.

The Committee **thanks** the authors for this analysis of data from an extremely valuable long-term dataset. The Committee **recommends** that continued annual shore-based counts be accorded high priority. It also **recommends** aerial photogrammetric body condition studies be continued next year, and results compared to existing data to test the hypothesis that ice conditions in May influence gray whale body condition and reproductive output. The Committee also **encourages** a more integrated analysis using ice cover data for spring in the Chukchi Sea and spring and autumn for the Bering and Chukchi seas.

Last year (IWC, 2012k) the Committee had encouraged the undertaking of a more quantitative integrated analysis for the lagoon counts in Baja California, Mexico and the northbound calf counts in California, given the length of the time series. It was also suggested that correlations between calf production in western and eastern gray whales be examined. The Committee **reiterates** its advice from last year.

SC/64/BRG21 provided information about coastal counts of gray whales off Chukotka Peninsula, Russia, and monitoring of the harvest. The Committee was pleased to see a variety of biological information collected from the harvested whales and **recommends** the collection of additional data and samples, such as tissue for genetic analyses, tissue samples for understanding the cause of 'stinky whales' (see also Item 12), and photographs for comparison with catalogues. Catch data are discussed further below.

9.2.2 Review of recent catch information

The Russian Federation reported that a total of 128 gray whales were struck in Chukotka, Russia in 2011[13]; two were lost and 126 were landed. Of the landed whales, two were 'stinky' and not used for human consumption.

9.2.3 Management advice

In 2007, the Commission agreed that a total catch of up to 620 gray whales was allowed for the years 2008-12 with a maximum of 140 in any year. No new data were presented this year to change the advice for the large eastern North Pacific population and therefore the Committee **agrees** that the *Gray Whale SLA* remains the appropriate tool to provide management advice for eastern North Pacific gray whales apart from the consideration of the PCFG and the Makah hunt (see Item 8.1). The Committee **reiterates** that the current strike limits will not harm the stock.

With respect to the management plan variants provided by the Makah Tribe, the *Implementation Review* was completed this year (Item 8.1) and the Committee **agrees**:

(1) hunt variant 2 performs acceptably; and
(2) hunt variant 1 performs acceptably provided that it is accompanied by a photo-ID programme to monitor the relative probability of harvesting PCFG whales in the Makah U&A, and the results presented to the Scientific Committee for evaluation each year.

Matters related to the possibility of an animal feeding in the western North Pacific being taken in the PCFG area are discussed under Item 8.

9.3 Bering-Chukchi-Beaufort (B-C-B) Seas stock of bowhead whales

9.3.1 New information

SC/64/BRG1 provided results of seasonal movements of the B-C-B stock of bowhead whales from a satellite telemetry study of 57 tagged whales during 2006-11. All but one tagged whale migrated past Point Barrow in spring and went to Amundsen Gulf. That remaining whale was tagged at Barrow in summer, wintered in the Bering Sea and then summered along the Chukotka coast in the Chukchi Sea. While most whales summered within the Canadian Beaufort Sea, extensive summer movements included travel far to the north and northeast. Autumn movements coincided in space and time with oil and gas activities and potentially with shipping activities. Likely important feeding areas included Amundsen Gulf in spring and summer; Barrow in summer and autumn; Wrangel Island (some years) in autumn; the northern Chukotka coast in autumn; and the western Bering Sea in winter.

Full discussion of this paper can be found in Annex F, item 2. It was noted that this work indicates that earlier estimates of bowhead whales off Cape Pe'ek on the Chukchi Peninsula (Melnikov and Zeh, 2007) were probably B-C-B bowhead whales and not a separate smaller stock. The Committee **encourages** the continuation of this work, including the future analysis of other environmental covariates (e.g. physical oceanography) relating to B-C-B bowhead whale migration and distribution.

[13]This updates the information in SC/64/BRG21 for 2011.

Results of a year-long acoustic study of B-C-B stock of bowhead whales were reported (Moore *et al.*, 2012). Calls from bowhead whales were recorded in October 2008, and from March-August 2009, on a recorder deployed on an oceanographic mooring near the Chukchi Plateau (*ca*. 75°N, 168°W). The rate of bowhead whale call detection was highest from May to August, when sea ice diminished from nearly 100% surface cover to zero and corresponded to a period of very high zooplankton backscatter signal from June to August.

SC/64/BRG3 reported the results of aerial photographic surveys of bowhead whales near Point Barrow, Alaska during 2011. Aerial surveys have periodically been flown in this area since 1984. Sufficient photo recaptures from the 2011 surveys are expected to calculate a mark-recapture abundance estimate with reasonable precision. SC/64/AWMP7 provided details about a successful ice-based survey in 2011 (see Item 8.2.1.2). An ice-based estimate of abundance is expected in 2014 and the photo-ID estimate thereafter. This would provide a rare opportunity to compare two independent large-whale abundance estimates in the same season.

SC/64/BRG4 presented estimates of visual detection probabilities from the spring 2011 ice-based survey of bowhead whales migrating near Barrow, Alaska, based on a new method first discussed last year (Givens *et al.*, 2011). This paper is also discussed under Item 8.2. In discussion, it was noted that the estimates in SC/64/BRG4 were slightly lower but generally consistent with those from earlier surveys, and the precision of the new estimates was better due to the new experimental design and a larger dataset. The Committee **agrees** that the estimation approach and application of the resulting detection probabilities to applicable years of survey data represents a methodological improvement over previous efforts. As noted under Item 8.2 it **encourages** Committee members with any detailed comments to submit those to the authors intersessionally.

SC/64/BRG8 reported on progress being made to sequence the bowhead whale transcriptome. It was noted in discussion that this research has the potential to provide insights into the life history, ecology, evolution and genetics of bowhead whales, with broader implications for other great whales.

9.3.2 Management advice

SC/64/BRG2 presented information on the 2011 Alaskan hunt. A total of 51 bowhead whales were struck resulting in 38 animals landed. No bowhead whales were reported struck and lost at Chukotka.

In 2007, the Commission agreed that a total of up to 280 B-C-B bowhead whales could be landed in the period 2008-12, with no more than 67 whales struck in any year and up to 15 unused strikes being carried over each year. In the light of the *Implementation Review* completed this year (see Item 8.2), the Committee **agrees** that the *Bowhead SLA* remains the most appropriate tool for providing management advice for this harvest. It **reiterates** that the present strike and catch limits are acceptable.

9.4 Common minke whales off West Greenland

9.4.1 New information

In the 2011 season, 174 minke whales were landed in West Greenland and 6 were struck and lost (SC/64/ProgRepDenmark). Of the landed whales, there were 133 females, 39 males, and two whales of unreported sex. Genetic samples were obtained from 90 of these whales. The Committee **re-emphasises** the importance of collecting genetic samples from these whales, particularly in the light of the proposed joint AWMP/RMP Workshop (see Annex D).

9.4.2 Management advice

In 2007, the Commission agreed that the number of common minke whales struck from this stock shall not exceed 200 in each of the years 2008-12, except that up to 15 strikes can be carried forward. In 2009, the Committee was for the first time ever able to provide management advice for this stock based on a negatively biased estimate of abundance of 17,307 (95% CI 7,628-39,270) and the method for providing interim management advice which was confirmed by the Commission. Such advice can be used for up to two five year blocks whilst *SLA*s are being developed. Based on the application of the agreed approach, and the lower 5th percentile for the 2007 estimate of abundance, the Committee **repeats** its advice of last year that an annual strike limit of 178 will not harm the stock.

9.5 Common minke whales off East Greenland

9.5.1 New information

Nine common minke whales were struck (and landed) off East Greenland in 2011 and one was struck and lost (SC/64/ProgRepDenmark). All landed whales were females. Catches of minke whales off East Greenland are believed to come from the large Central stock of minke whales. No genetic samples were obtained from minke whales caught in East Greenland. The Committee **re-emphasises** the importance of collecting genetic samples from these whales, particularly in the light of the proposed joint AWMP/RMP Workshop (see Annex D).

9.5.2 Management advice

In 2007, the Commission agreed to an annual quota of 12 minke whales from the stock off East Greenland for 2008-12, which the Committee stated was acceptable in 2007. The present strike limit represents a very small proportion of the Central stock – see Table 8). The Committee **repeats** its advice of last year that the present strike limit would not harm the stock.

Table 8

Most recent abundance estimates for minke whales in the Central North Atlantic.

Small Area(s)	Year(s)	Abundance and CV
CM	2005	26,739 (CV=0.39)
CIC	2007	10,680 (CV=0.29)
CG	2007	1,048 (CV=0.60)
CIP	2007	1,350 (CV=0.38)

9.6 Fin whales off West Greenland

9.6.1 New information

A total of five fin whales (all females) were landed, and none were struck and lost, in West Greenland during 2011 (SC/64/ProgRepDenmark). No genetic samples were obtained from caught fin whales in 2011. The Committee **re-emphasises** the importance of collecting genetic samples from these whales, particularly in the light of the proposed work to develop a long-term *SLA* for this stock.

9.6.2 Management advice

In 2007, the Commission agreed to a quota (for the years 2008-12) of 19 fin whales struck off West Greenland. This was subsequently modified and at the 2010 Annual Meeting

Greenland voluntarily reduced the limit to 10 until 2012 (IWC, 2011c). The Committee agreed an approach for providing interim management advice in 2008 and this was confirmed by the Commission. It had agreed that such advice could be used for up to two blocks whilst *SLA*s were being developed. Based on the agreed 2007 estimate of abundance for fin whales (4,539 95%CI 1,897-10,114), and using this approach, the Committee **repeats** its advice that an annual strike limit of 19 whales will not harm the stock.

9.7 Humpback whales off West Greenland

9.7.1 New information

A total of eight (three males; five females) humpback whales were landed (none were struck and lost) in West Greenland during 2011 (SC/64/ProgRepDenmark). Genetic samples were obtained from three of these whales. The Committee **re-emphasised** the importance of collecting genetic samples and photographs of the flukes from these whales, particularly with respect to the YoNAH and MoNAH initiatives (Clapham, 2003; YoNAH, 2001).

9.7.2 Management advice

In 2007, the Committee agreed an approach for providing interim management advice and this was confirmed by the Commission. It had agreed that such advice could be used for up to two five year blocks whilst *SLA*s were being developed (IWC, 2008e). Based on the agreed estimate of abundance for humpback whales (3,039, CV 0.45, annual rate of increase 0.0917 SE 0.0124) and using this approach, the Committee **agrees** that an annual strike limit of 10 whales will not harm the stock.

9.8 Humpback whales off St. Vincent and The Grenadines

9.8.1 New information

Last year the SWG noted that it had received no catch data from St. Vincent and The Grenadines for 2010/11. This year the Secretariat received information from the Government that a 35-foot whale was taken on 18 April 2011 (IWC Secretariat, 2011) and a 33.75 foot female taken on 14 April 2012. After the meeting it was also informed of a struck and lost animal during the 2011 hunt. The Committee was pleased to hear that genetic samples and photographs were taken and that the USA and St. Vincent and The Grenadines are discussing the transfer of tissue samples from this whale for analysis and storage at SWFSC (the IWC archive where *inter alia* SOWER samples are stored). Iñíguez reported information on a hunt on the 11 April 2012 and a struck and lost animal on the 22 March 2012.

The Committee also repeats its previous strong **recommendations** that St. Vincent and The Grenadines:

(1) provide catch data, including the length of harvested animals, to the Scientific Committee; and
(2) that genetic samples be obtained for any harvested animals as well as fluke photographs, and that this information be submitted to appropriate catalogues and collections.

9.8.2 Management advice

In recent years, the Committee has agreed that the animals found off St. Vincent and The Grenadines are part of the large West Indies breeding population (11,570, 95% CI 10,290-13,390; Stevick *et al.*, 2003). The Commission adopted a total block catch limit of 20 for the period 2008-12.

The Committee **repeats** its advice of last year that this block catch limit will not harm the stock.

10. WHALE STOCKS

10.1 Antarctic minke whales (Annex G)

The Committee is in the process of undertaking an in-depth assessment of the Antarctic minke whale. The primary abundance data are those collected from the 1978/79 to 2003/04 IWC-IDCR/SOWER cruises (e.g Matsuoka *et al.*, 2003) that had been divided into three circumpolar series (CPI, CPII and CPIII). Two different methods for estimating minke whale abundance from the last two circumpolar data series have been developed in recent years. Although they gave different estimates of abundance, both were consistent in estimating a decline in circumpolar abundance between CPII and CPIII (IWC, 2012l). The Committee has been working to resolve the differences between the estimates for some time and last year believed that it would be possible to present an agreed abundance estimate at this year's meeting. The Committee has also been discussing uncertainties about stock structure, especially in the Indian Ocean and Pacific sectors, which are the sectors where catches have been taken in recent years (IWC, 2008d).

10.1.1 Stock structure

Two genetically distinct populations of Antarctic minke whales have been identified in the Area IIIE-VIW feeding grounds (IWC, 2008d). There is no sharp boundary between them, only a 'soft' boundary; the two populations overlap, but one predominates in the east, called the Pacific or P-stock, and the other in the west, called the Indian Ocean or I-stock. The extent and location of the overlap is an important issue for assessment.

SC/64/IA4 presented a new integrated analysis of three different sources of data: morphometrics; microsatellites; and mitochondrial DNA. The goal is to estimate longitudinal segregation of the breeding populations on the Antarctic feeding grounds. The model is intended to allow the location of the soft boundary to move from year to year. The method was applied to the extensive data for the Antarctic minke whales taken by the JARPA and JARPA II surveys. The results indicated that the spatial distribution of the two populations have soft boundary in Area IV-E and V-W, which does vary clearly and significantly by year. The results also suggest that the boundary is sex-specific.

The Committee noted that the approach used is simple and potentially powerful. Aside from the general relevance of the results to understanding Antarctic minke whale dynamics, it might in the future prove useful in allocating historical catches to stocks. The Committee **endorses** the specific investigations for further statistical analysis given in Annex G item 5.1.

10.1.2 Abundance estimation of Antarctic minke whales

In order to reach its goal of having agreed abundance estimates by the 2012 Annual Meeting, an intersessional Workshop was held in Bergen, Norway, in May 2012 (SC/64/Rep4). It made substantial progress in identifying reasons for the large differences between earlier 'trackline conditional independence' and 'hazard probability based' estimates of Antarctic minke whale abundance (the 'SPLINTR' model, Bravington and Hedley, and the 'OK' model, Okamura and Kitakado, respectively). It also identified aspects of the OK model that needed adjustment related to plausibility of mean dive-time estimates from fits of the model and the resultant effects on $g(0)$, compared to independent estimates of $g(0)$. A work programme was agreed for completion by the 2012 Annual Meeting which resulted in three papers - SC/64/IA2, SC/64/IA12 and SC/64/IA13. The Committee thanked the authors for completing the work plan. Detailed discussions can be found in Annex G, item 5.3.

SC/64/IA12 analysed data from the IWC/SOWER 2004/05 video dive time experiments. The Committee was pleased to receive these estimates, which after discussion within the intersessional Steering Group became key inputs for the OK method. SC/64/IA2 presented a revision of the 'Norwegian Product' formulation of the OK model and investigated sensitivity to a number of factors. The abundance estimates were lower than previously estimated by versions of the OK model, after incorporating the new mean dive-times and the resultant lower *g*(0) values. SC/64/IA3 presented a 'Norwegian Product' version of SPLINTR, also using the externally-estimated dive-times. The authors noted that their fits showed some problems and counterintuitive results but also noted that they had insufficient time to investigate the model. They thus considered that although the framework of the model therein seemed reasonable, the actual estimates were not ready for consideration.

Based on considerable experience from previous years, the intersessional Workshop had identified a core set of diagnostics most capable of revealing important model deficiencies when modelling IDCR/SOWER minke whale data (SC/64/Rep4). The main issue for SC/64/IA2, the OK model, was that the observed proportion of near-simultaneous compared to delayed duplicates was considerably lower than the predicted; this is potentially important in terms of estimating *g*(0) and thus overall abundance, because of the close link to mean dive-time. The likely cause of the misfit is the aggregation-over-time that is required in order to deal with rounding and measurement errors in timing and distance estimates in IDCR/SOWER, in conjunction with the clumped nature of real whale dive patterns (in contrast to the independence of successive dive-times assumed by OK models). For the reasons discussed in Annex G, however, the Committee **agrees** that the within-duplicate lack-of-fit was unlikely to imply serious bias in abundance estimates.

Given the progress made and results presented and discussed in Annex G, it was agreed that there was no need to consider further the process of averaging estimates from the two models proposed last year (IWC, 2012l). It was reassuring that two completely independent implementations of the Norwegian Product (NP) model appear to be giving consistent results and showed little sensitivity to the input values for mean dive-time in the neighbourhood of the best independent estimates of dive time from SC/64/IA12.

The starting point for determining the best available consensus estimate, was the authors' 'preferred estimates' in SC/64/IA2 using the best estimates of mean dive-time from SC/64/IA12, and then applying the appropriate adjustment factors agreed last year (IWC, 2012e) with some minor changes. All the adjustments are estimates, but are modest enough that their impact on CV can reasonably be neglected. A CPII spatial adjustment of 15% is the largest adjustment, and reflects some imbalance of coverage within survey strata in CPII, something that was much reduced in CPIII. All other adjustments are minor.

The resulting estimates are shown in Table 9. Because the northern extent of the surveyed regions differs between CPII and CPIII, two sets of estimates are given, 'survey-once' and 'CNB' (Common Northern Boundary). The survey-once estimates cover all of the surveyed regions in each CP series (using the most recent or most complete survey in cases of duplication). The CNB estimates exclude part of the surveyed regions in each series to ensure a consistent northern limit; these are the most appropriate estimates for a comparison of abundance estimates between CPII and CPIII. The CNB estimates are also the basis for the Additional Variance (AV) calculations (IWC, 2010j) which address the non-synoptic nature of the surveys, i.e. that whales may move into and out of any given surveyed area from year to year. The 'CV internal' row reflects the uncertainty associated with the abundance estimate of whales in the surveyed region at the time of the survey, whereas the 'CV with AV' row reflects the uncertainty associated with the average number of whales present in the surveyed region across the whole of that CP series, and is more useful for most subsequent analyses. CVs are approximately the same for survey-once as for CNB, so only one set is shown. Note that there are also correlations between the estimates (not shown) in different *Management Areas* within each CP (but not between CPs) since model parameters are estimated jointly for each whole CP.

The Committee **agrees** that the numbers in Table 9 represent the best available abundance estimates of Antarctic minke whales in the surveyed areas during the years of CPII and CPIII. The potential sources of bias have now been much more thoroughly addressed than in the existing 'standard method' estimates (Branch, 2006), and the results are consistent with recent external datasets (e.g. the post-2004 SOWER cruise experiments on school size estimation, video dive time and BT mode). The explanation for the large difference between the estimates from original OK (e.g. Okamura and Kitakado, 2011) and original SPLINTR (e.g Bravington and Hedley, 2009) methods has been identified as the interaction between diving behaviour and timing errors and the difference has been reduced to plausible levels by imposing direct estimates of mean dive-time in the NP models. The Committee agrees that it is unlikely that any remaining bias is substantial.

Table 9

Best estimates of Antarctic minke whale abundance by *Management Area* adjusted by the factors agreed in Table 1. See text for explanation.

		IWC *Management Area*						
CP		I	II	III	IV	V	VI	Total
II	Survey once	85,688	130,083	93,215	55,237	300,214	55,617	720,054
	CNB	84,978	120,025	86,804	51,241	285,559	49,885	678,493
	CV internal	0.16	0.14	0.20	0.17	0.13	0.22	0.08
	CV with AV	0.34	0.40	0.44	0.39	0.31	0.39	0.18
III	Survey once	38,930	57,206	94,219	59,677	183,915	80,835	514,783
	CNB	34,369	58,382	68,975	55,899	180,183	72,059	469,866
	CV internal	0.20	0.19	0.15	0.34	0.11	0.14	0.09
	CV with AV	0.39	0.38	0.35	0.49	0.36	0.37	0.18
CPIII:CPII		0.40	0.49	0.79	1.09	0.63	1.44	0.69

The new **agreed** estimates for the survey-once case are 720,000 for CPII (1985/86-1990/91) with 95% CI [512,000, 1,012,000], and 515,000 for CPIII (1992/93-2003/04) with 95% CI [361,000, 733,000]. The estimates are subject to some degree of negative bias because some minke whales would have been outside the northern and southern (surveyable, ice edge) boundaries. The improved analyses have resulted in many estimates differing appreciably from the 'Standard Method' estimates (Branch and Butterworth, 2001; IWC, 2006b, p.21). For CPII, the new best estimate of total abundance is slightly lower (720,000 compared to 769,000 standard estimate) whereas for CPIII the new best estimate is substantially higher (515,000 compared to 362,000). There are two primary reasons for the differences: (1) the spatial adjustment required for CPIII is much less than for CPII; and (2) the mean school size is appreciably smaller in CPIII than CPII which affects the net adjustment for $g(0)$. The ratio of total abundance in CPIII to CPII, formerly 0.47 with the standard method, is now estimated to be 0.69 with 95% CI [0.43, 1.13] for the 'CNB' estimates.

Annex G, item 5.3.2 identified some future work, partly to check and deal with any small remaining bias issues, and also for the benefit of other abundance estimation in general. A valuable aspect of SOWER/IDCR is the consistency of its protocols and its large sample size, unparalleled amongst cetacean sightings datasets, which allow the development of realistic tests and sophisticated estimation methods applicable to many cetacean abundance estimation cases beyond Antarctic minke whales.

The Committee **expresses** its thanks to the Abundance Estimation Working Group for its tremendous collaborative efforts in obtaining agreed estimates after several years of intensive and innovative work. The developers (Bravington, Hedley, Kitakado and Okamura) are to be particularly commended as is the recent input and enthusiasm of Butterworth, Skaug and Walløe. The Committee now has confidence in these open-water estimates and a more comprehensive understanding of the modelling requirements for IDCR/SOWER data. The Committee also places on record its considerable appreciation to all those involved in the IDCR/SOWER cruises (1978/79-2009/10) – the Japanese Government (and in the early years the government of the then USSR), the IWC, the originators of the programme, the scientists and crews of the participating vessels, the planners of the cruises and the analysts, whose dedication and hard work over many years have led to this agreed result.

10.1.3 Reasons for differences between estimates from CPII and CPIII

The confidence interval for the ratio of the total estimated abundance from CPII and CPIII included 1.0 and thus a null hypothesis of no change in overall abundance between the two periods would not be rejected. Nevertheless, the Committee considered that a change was quite likely, and discussed possible reasons for a decline in the estimated abundance of whales in the surveyed areas.

Between CPII and CPIII, the point estimates of Antarctic minke whale abundance show a large decline in three *Management Areas* (I, II, and V) and an increase in Areas IV and VI (Table 9). Overall, the circumpolar estimates are 30% lower between CPII and CPIII. Since the Committee is now satisfied that the remaining biases in the agreed estimates are unlikely to vary greatly over the duration of the CPII and CPIII cruises. Therefore the differences seen in Table 9 probably do reflect real changes in abundance in the open-water areas surveyed.

The Committee is exploring possible reasons for this. Noting that the IDCR/SOWER cruises were neither synoptic nor did they cover the entire range of potential minke whale habitat, one hypothesis is that the decline in estimated abundance was due to more whales being in unsurveyed regions during CPIII than in CPII. This suggests the following (not mutually exclusive) possibilities:

(1) a much higher proportion of whales in the pack ice or in open-water areas (polynyas) within the pack ice in CPIII, as compared to CPII;
(2) extensive longitudinal (east-west) whale movements from year to year, and surveys conducted as part of CPII happened to encounter higher densities in certain areas, as compared to those during CPIII;
(3) a much higher proportion of the total population was north of 60ºS during CPIII;
(4) intra-year movements in open water within the surveyed areas that were not adequately covered by the trackline design in space and time, with respect to environmental variables; and
(5) a genuine decrease in abundance of Antarctic minke whales.

In order to examine (1) above, an intersessional sea ice group was established last year to: (a) consider technical aspects of sea ice data which will be used to bound or estimate the abundance of Antarctic minke whales in the south of the ice edge; and (b) consider appropriate analysis methods to bound or estimate the abundance of whales south of the ice edge.

SC/64/IA3 reviews some technical aspects of the sea ice data obtained by IDCR/SOWER, ASPeCt (Antarctic Sea Ice Processes and Climate), satellite sensors and NIC (National Ice Center). The definitions of the sea ice edge vary between the different data sources because their objectives and applied techniques are different. The IDCR/SOWER definition of the sea ice edge is somewhat operational compared to that for other data sources. However, its definition is believed to be consistent for the period 1978 to 2003, and the authors believe it is the most appropriate boundary for abundance estimation in years and areas where IDCR/SOWER surveys were undertaken. They also conclude that the sea ice concentrations derived from passive microwave (PM) remote sensing are probably the best sea ice data to be used for the purpose of estimating abundance of Antarctic minke whales to the south of sea ice edge in areas where IDCR/SOWER observations are not available (the PM records date back to 1979).

SC/64/IA10 is an appraisal of methods and data to estimate abundance of Antarctic minke whales within sea ice covered areas of the Southern Ocean. With new estimates of densities of Antarctic minke whales (from aerial surveys) in certain areas of sea ice (i.e. Weddell Sea and east Antarctica), and model-based abundance methods which allow extra-polation, there is an opportunity to compare bounds and magnitudes of abundances, both inside and outside of the sea ice region, to assess how likely the 'moved-into-sea-ice' hypothesis is. In the first instance, the authors recommended that comparisons of inside/outside abundances be made for areas and years where the aerial surveys were conducted. If these analyses are inconclusive from the perspective of the 'moved-into-sea-ice' hypothesis, there is a recommendation to extend the analysis to estimating circumpolar densities, and extrapolating back over the period of CPII and CPIII. The recommended analysis will give full consideration to how variable minke whale densities can be over space and time. Furthermore it should be recognised that such analyses will involve a great deal of work and may not yield helpful results.

Since Antarctic minke whales congregate along the ice edge, potential problems in estimating abundance inside/outside of an ice region using satellite data were discussed in Annex G, item 5.3.3. The Committee **recommends** that sensitivity analyses as to the position of the sea ice boundary on Antarctic minke whale abundances derived from aerial survey data be assessed before any in-depth calibrations and analyses of operational sea ice boundaries be attempted.

It is not possible to obtain reliable absolute abundance estimates of Antarctic minke whales in sea ice regions corresponding in space and time with IDCR/SOWER surveys. The Committee thus **recommends** that relatively simple analyses be conducted to generate abundances using aerial survey data. These abundances, with a range of potential availability biases, will help in producing an overall magnitude or upper bound on the numbers of Antarctic minke whales in sea ice regions during CPII and CPIII.

At present, the Committee is unable to exclude the possibility of a real decline in minke whale abundance between CPII and CPIII. Population dynamics analyses of catch-at-age data from Area IIIE to VIW (e.g. as in SC/64/IA1) can potentially account for the changes in overall abundance in terms of variations over time in mortality and recruitment. Such explanations are descriptive but they do not attempt to explain why, for example, recruitment might have dropped commencing in the 1970s. There is a second class of more mechanistic explanations concerned with, for example, why pregnancy rates might fall; this is where ecosystem effects, competition, climate, etc. would need to be considered.

As noted in Annex G, item 5.3.3, Murase and Kitakado suggested that the difference in abundance estimates between CPII and CPIII can (to a large extent) be attributed to process error (i.e. additional variance), reflecting a large inter-annual variation in distribution of the Antarctic minke whales (Kitakado and Okamura, 2009). However, they also suggested that systematic environmental changes observed in some areas do not alone account for the process error. Others suggested that the that JARPA and JARPA II data can assist the interpretation of the CPII and CPIII differences given the long time series data in Areas IIIE, IV, V and VIW (e.g see Matsuoka *et al.*, 2011). Hakamada will present information on some diagnostics from analyses to estimate minke whale abundance from JARPA next year.

In conclusion, the Committee noted that after many years work it had now been able to **agree** on estimates of minke whale abundance within the areas surveyed in CPII and CPIII. As yet, though, there was no conclusion on whether (and if so to what extent) these numbers indicate a real decline in abundance of Antarctic minke whales between the periods of the two surveys. Time constraints meant that it was possible to have only preliminary discussions of this question this year; discussions will continue at next year's meeting.

10.1.4 Continue development of the catch-at-age models

Population dynamics modelling provides a way to explore possible changes in abundance and carrying capacity within Areas IIIE-VW, where appropriate data are available. The inputs are catch, length, age, and sex data from the commercial harvests and both JARPA programmes, as well as abundance estimates from IDCR/SOWER. Early attempts used the ADAPT-VPA approach of Butterworth and Punt (1999), Butterworth *et al.* (2002) and Butterworth *et al.* (1996). A number of issues and concerns were raised with respect to that particular modelling framework for Antarctic minke whales, and it was concluded that an integrated statistical catch-at-age (SCAA) model was the most appropriate modelling framework (IWC, 2003c). Punt and Polacheck (2005; 2006) developed such a model and it has been refined over the last few years. The SCAA approach allows for errors in catch-at-age data, more than a single stock, time-varying growth, multiple areas, environmental covariates, fleet-specific vulnerabilities and changes over time in vulnerability. The technical problems and inconsistencies identified in previous years have largely been resolved (IWC, 2012l, p.180).

SC/64/IA1 provides a summary of the specifications of the current SCAA. The approach allows for multiple breeding stocks, which can be allowed to mix across several spatial strata on the summer feeding grounds where catches are taken. It also allows carrying capacity and the annual deviations in juvenile survival to vary over time. The model is fitted to length and conditional age-at-length data collected from the Japanese commercial and scientific permit catches, as well as indices of abundance from the IDCR/SOWER and JARPA/JARPA II cruises. The results provided in the paper are illustrative primarily because the IDCR/SOWER abundance estimates used had not been finalised, and the age-at-length data for recent years from JARPA II are not yet available.

As noted in Annex G, item 5.2, a number of suggestions for further work were made in this regard. Until now, application of the SCAA has been held up by the lack of agreed IDCR/SOWER abundance estimates, but that obstacle has now been removed, and the application of the SCAA in testing hypotheses concerning changes between CPII and CPIII abundance estimates has become a high-priority task. The time series of earplug age data, which is an important input that would improve the resolving power of the SCAA, has not been updated since 2004 or 2005 although samples are available through to 2011/12, because of difficulties in finding and validating age-readers. Preliminary age readings have been made from the 2006-08 samples, but have not yet been validated. Last year, the Committee had recommended that these preliminary data be made available and included in the SCAA on a provisional basis pending validation (IWC, 2012l, p.180). This year, the Committee **reiterates** this recommendation; the recent age data should be incorporated into the SCAA model as soon as possible. The Committee recommends the SCAA modellers request the new data via the Data Availability Group and the data owners provide it as soon as possible.

10.2. Southern Hemisphere humpback whales

The IWC Scientific Committee currently recognises seven humpback whale breeding stocks (BS) in the Southern Hemisphere (labelled A to G; IWC, 2011n), which are connected to feeding grounds in the Antarctic. An additional population that does not migrate to high latitudes is found in the Arabian Sea. Assessments of BSA (western South Atlantic), BSD (eastern Indian Ocean) and BSG (eastern South Pacific) were completed in 2006 (IWC, 2007d) although it was concluded that BSD might need to be re-assessed with BSE and BSF in light of mixing on the feeding grounds. An assessment for BSC (western Indian Ocean) was completed in 2009 (IWC, 2010f) and for BSB in 2011 (IWC, 2012m).

10.2.1 Begin assessment of breeding stocks D, E and F

Last year, the sub-committee on other Southern Hemisphere whale stocks initiated the re-assessment of BSD, and the assessment of BSE and BSF (IWC, 2012m). These stocks correspond, respectively, to humpback whales wintering off Western Australia (stock D), Eastern Australia (sub-stock E1) and the western Pacific Islands in Oceania including New Caledonia (sub-stock E2), Tonga (sub-stock E3) and French Polynesia (sub-stock F2) (Fig. 1). For simplicity the combination of BSE2, BSE3 and BSF2 will be referred to as Oceania.

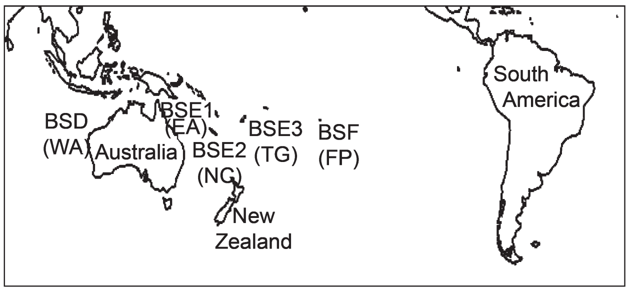

Fig 1. Distribution of Southern Hemisphere humpback whales breeding stocks grounds for BSD, BSE1, BSE2, BSE3 and BSF2 (WA = Western Australia, EA = Eastern Australia, NC = New Caledonia, TG = Tonga and FP = French Polynesia).

10.2.1.1 ABUNDANCE, TRENDS AND POPULATION STRUCTURE

SC/64/SH6 presented a POPAN open model abundance estimate of 562 whales (CV=0.19, CI 351-772) from the New Caledonia humpback whale breeding ground (BSE2) using fluke photo-ID data collected over 16 years (1996-2011). Beginning in 2006 through to the current estimate, all population models examined show a trend of increasing abundance with a large 'pulse' after 2008. Whether these whales represent part of the New Caledonia sub-stock or permanent or temporary immigration from different regions is currently unclear.

In discussion, it was noted that a phenomenon similar to that observed in New Caledonia in the late 2000s had also been recorded off Eastern Australia in the late 1980s (Chaloupka *et al.*, 1999). To attempt to examine this apparent increase, the Committee noted that a possible movement of Eastern Australia whales to New Caledonia was consistent with an observed decrease in the rate of population growth of whales migrating off the Australian coast (Noad *et al.*, 2011) and levels of F_{ST} differentiation between E1 and E2 (0.01, Olavarría *et al.*, 2006) were the lowest among any pair of populations in Oceania. However, at this time the available data are not sufficient to explain the observed patterns.

Salgado Kent *et al.* (2012) provided new estimates of abundance and trends for Western Australian humpback whales. A number of statistical issues were raised in discussion as can be seen in Annex H. The Committee **encourages** further analyses and intersessional contact with the authors and that, if necessary they are invited to SC/65 for further discussion of their work.

SC/64/SH28 reported on the outcome of a Workshop held in November, 2011 to discuss future surveys and analyses of breeding stock D humpback whales at two locations off Western Australia - North West Cape and Shark Bay. The Workshop proposed a pilot survey to trial both cue-counting and racetrack aerial abundance survey methods, in conjunction with land-based work at both locations, to determine the most appropriate survey method for a full-scale absolute abundance survey in the near future. Prior to the survey, simulation work will be conducted to determine the operational protocols for the racetrack abundance estimation method as applied to humpback whales. The Committee **concurs** that a pilot study is the appropriate next step in method development for the provision of an absolute abundance for the Western Australian stock of humpback whales.

Four documents were available for discussion of stock structure issues, SC/64/SH5, SC/64/SH15, SC/64/SH22, and Pastene *et al.* (2011). These documents were reviewed by the Working Group on Stock Definition and their conclusions are reported in Annex I, item 3.1.1.

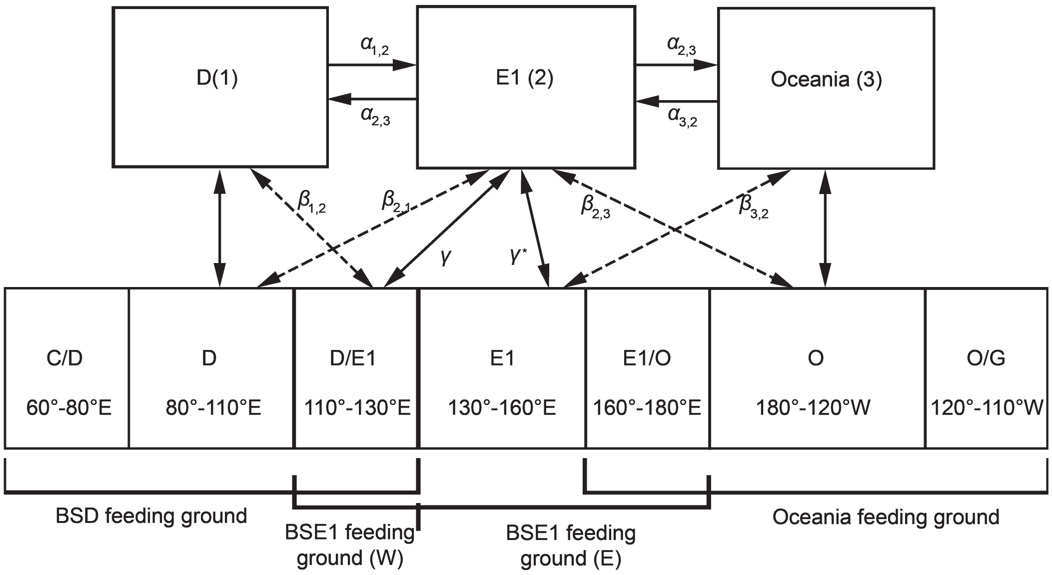

Fig. 2. Proposed model structure for breeding stocks D, E1 and Oceania. Arrows indicate possible interchange between stocks. These interchange rates will be estimated in the model, informed by data given in Table 1 of Annex H. Solid lines indicate movement of a breeding population to its own feeding ground, while dashed arrows indicate whales moving to a neighbouring feeding ground. Note that in order to avoid three breeding stocks mixing in the E1 feeding ground, an artificial boundary for catch allocation has been imposed. No catches taken east of this boundary will be allocated to BSD, while no catches taken west of the boundary will be allocated to Oceania. The longitude 130°E was chosen based on the longitudinal range of documented connections between BSD, Oceania and the Antarctic (J. Jackson, *pers. comm.*).

10.2.1.2 ASSESSMENT MODELS

In order to facilitate discussions and identification of further model runs, SC/64/SH29 provided initial results of population model fits to the Southern Hemisphere humpback whale breeding grounds D (West Australia; BSD), E1 (East Australia; BSE1) and Oceania (BSE2, BSE3, and BSF2). As anticipated, this led to considerable discussion and the details can be found in Annex H. As a result, the Committee **agrees** on a series of recommendations (details are in Annex H) regarding future work to facilitate the assessment:

(1) authors of some of the abundance estimates should be contacted to learn more about the estimates and how they might be incorporated into the assessment;
(2) a multinomial likelihood should be incorporated into the Bayesian population dynamics model;
(3) the new movement model structure (Fig. 2) should be incorporated to take into account the documented connectivity between breeding grounds in Western (D) and Eastern Australia (E1) and Oceania (E2+E3+F2) and between the breeding and feeding grounds;
(4) a two stock model for Eastern Australia and Oceania should be explored;
(5) catches should be allocated to the feeding areas associated with each of the three breeding stocks according to Hypothesis 1 of (IWC, 2010f);
(6) 'Discovery' mark data from the whaling period which contains information on movements between breeding grounds, between feeding grounds, and between breeding and feeding grounds, should be explored in the context of the assessments; and
(7) the Pastene *et al.* (2011) analysis on relative proportions of mixing in the feeding grounds should be expanded to include samples from Eastern Australia (E1).

The Committee also **endorses** the input data for the population dynamics model given in table 1 of Annex H and **agrees** that any additional datasets must be provided by 31 December 2012, after which time no more new data will be used for this assessment. The results of the analyses using the agreed model will be presented for discussion at the 2013 Annual Meeting. To ensure this work is completed, a work plan has been developed which identifies who will do each task (table 2 in Annex H) and an intersessional Working Group has been appointed, convened by Muller (Annex Q12). The Committee anticipates that the assessment of these stocks should be completed in 2014.

Reconciliation of the large photo-ID catalogue (6,500+ IDs from 1984-2011) held by Pacific Whale Foundation with existing catalogues from Western Australia, Oceania and the Antarctic Humpback Whale Catalogue is also encouraged to inform estimates of interchange for future assessments.

10.2.2 Review new information on other breeding stocks

10.2.2.1 BREEDING STOCK A

SC/64/SH17 reported 58 stranded humpback whales that were recorded between 1981 and 2011 off the coast of Rio de Janeiro, southeastern Brazil (annual mean 2.6, maximum 13 records in 2010). Reported strandings have increased over the past 20 years, which is consistent with the population increase observed for this stock. Three cases of entanglement were found (two were calves). Bacteriological agents in three live stranded whales assessed indicated evidence of animal impairment that resulted in or were associated with the cause of death.

The Committee **welcomes** this information but expressed concern that information is available from only a small part of the total Brazilian population. It **encourages** the provision of information from the full range of animals passing along the coast.

10.2.2.2 BREEDING STOCK B

SC/64/SH4 described a newly-discovered humpback whale wintering ground off northwest Africa with a seasonal signature consistent with a South Atlantic stock; the presence of adult/calf pairs suggests it may be a nursery ground. Since the observations were six months out of phase with the nearest (and only) known breeding ground in the northeast Atlantic – the Cape Verde Islands – these sightings possibly comprise the most northwestern component of the Southern Hemisphere BSB.

During a joint cruise organised by the South African Department of Environmental Affairs and the University of Pretoria in November 2011, a total of 107 biopsies were collected and numerous images obtained from humpback whales on the west coast of South Africa.

In discussion, numerous sightings of humpback whales have been made alone on the Atlantic African coast. The Committee **recommends** that the location and timing of all the existing Atlantic African records of distribution, seasonality and timing of sightings should be synthesised in a single map/database to show the extent of range and movements for humpback whales within a calendar year.

10.2.2.3 BREEDING STOCK C

SC/64/SH3 provided the first description of humpback whale movements between breeding grounds in the Comoros Islands and coastal western Madagascar. During 11-14 October 2011, five satellite transmitters were deployed on humpbacks off Moheli Island (12°24'S, 43°45'E) in the Comoros Archipelago. Three individuals were tracked successfully: mean tracking duration was 18 days (range 8-28 days); mean distance travelled was 467km (146-749km) and mean travelling speed 26.7 ± 22.3km/day. This is the first record of whales visiting different islands of the Comoros and western Madagascar in the same season.

Ersts *et al.* (2011) reported that between 1996 and 2006, nine whales (six males and three females) were identified using two breeding areas in separate years: the northern Mozambique Channel, currently the breeding region for sub-stock C2; and eastern Madagascar, currently a breeding region for sub-stock C3. This led the authors to believe that sub-stocks C2 and C3 were probably the same breeding sub-stock.

10.2.2.4 BREEDING STOCK D

Information was presented on examinations of eight neonatal humpback whales stranded on the Western Australian coast in 2011, all at least 1,000km south of the currently known major breeding grounds off the Western Australian northwest coast (see Annex H, item 2.3.4). Examinations indicated that all but one of the eight neonates was severely malnourished, and were believed to be non-viable from birth due to a lack of energy reserves and a compromised ability to thermoregulate and control buoyancy. Similar examinations are expected to be conducted on strandings on the Western Australian coast in 2012 and, hopefully, in future years.

10.2.2.5 BREEDING STOCK G

SC/64/SH16 provided information collected from whale-watching boats on distribution and behaviour of humpback whales from the south Pacific coast of Costa Rica, as discussed in Annex H, item 2.3.5.

In discussion, attention was drawn to the unusually high number of cow/calf pods reported together; nine groups with three or more adults with calves. The Committee **encourages** structured surveys to more completely document the distribution of these animals and **recommends** comparisons with catalogues from other areas, including breeding grounds, in the Southern Hemisphere.

SC/64/SH23 presented information on 1,580 individually photographed humpback whales off Ecuador that were compared with 611 animals identified in the southeast Pacific in four different catalogues. This confirmed Antarctica as the main feeding ground for humpback whales found off Ecuador and suggested that feeding areas for whales identified off Ecuador may extend as far east within Area II as the South Orkney Islands. The Committee was also informed that individual animals may migrate either to the Magellan Strait or the Antarctic Peninsula, but not to both. Comparison with the catalogue of animals found off Chiloe Island, Chile, had yet to be undertaken, and the Committee **recommends** that this comparison be undertaken and looks forward to receiving further information.

Information on 15 long-term resightings of humpback whales off Ecuador was reported in SC/64/SH24. One animal was resighted over a 26 year time span. The paper also provided the earliest connection from Ecuador to Antarctica and further supports the findings that waters around the Antarctic Peninsula are the main feeding area of humpback whales migrating to Ecuadorian waters. The Committee **endorses** plans to extend comparison of the Ecuadorian catalogue with animals from around South Georgia and Area II and looks forward to receiving a report at next year's meeting.

SC/64/O15 discussed observations from small boats during 2006-12, within the Golfo Duce, Costa Rica and the surrounding area of Osa Peninsula. It was shown the area is an important wintering ground, where the whales' distribution was determined by bathymetry, water temperature and possibly currents. For example, whales seem actively to avoid areas with eddies. The area seems to be used mainly by singing adults and there were competitive groups present in depths less than 60m, suggesting that mating occurs there.

The Committee **endorses** the view that spatial distribution information obtained from this study should be taken into account in establishing guidelines for appropriate management of this important Costa Rican marine coastal habitat.

10.2.2.6 FEEDING GROUNDS

SC/64/SH21 presented new information about abundance, population structure, demographic, and reproductive trends of humpback whales from the Strait of Magellan feeding area using long-term data on sightings, photo-ID and molecular analysis. The waters of Chilean Patagonian fjords and the Strait of Magellan remain today as the only recorded Southern Hemisphere feeding area for humpback whales of breeding stock G outside Antarctic waters.

The Committee thanked the authors for bringing this new information forward. It noted that it could not fully evaluate the abundance estimates with the information provided in the document and looked forward to seeing additional documentation next year. The Committee **expresses concern** regarding the potential for ship strikes and habitat displacement if the coal mining development results in a substantial increase of ship traffic in the region. It **recommends** that potential impacts are carefully assessed and that effective mitigation measures are adopted where necessary.

10.2.2.7 ANTARCTIC HUMPBACK WHALE CATALOGUE

SC/64/SH1 provided an update on the Antarctic Humpback Whale Catalogue (AHWC). The recent submissions bring the total number of catalogued whales identified by fluke, right dorsal fin/flank and left dorsal fin/flank photographs to 4,635, 414 and 409, respectively. Opportunistic data represent a significant portion of the AHWC. Progress continues in efforts to stimulate submission of opportunistic data from eco-tourism cruise ships in the Southern Ocean and from research organisations and expeditions working throughout this region and the Southern Hemisphere.

The Committee thanked the authors for their hard work and **recommends** that the AHWC continue. This item has financial implications as discussed under Item 23.

10.2.3 Work plan

The work plan for the assessment of Southern Hemisphere humpback whales is described in table 2 of Annex H and will be furthered by an intersessional Working Group (Annex Q12). The Committee's discussions of the work plan are discussed under Item 21 and financial implications under Item 23.

10.3. Southern Hemisphere blue whales

10.3.1 Review new information

10.3.1.1 PHOTO-ID CATALOGUES

SC/64/SH8 provided an update on the Antarctic Blue Whale Photo-ID Catalogue (ABWPIC), which includes photographs collected during 20 years of IWC IDCR/SOWER cruises (1987/88 to 2009/10). In 2011 and 2012 the photographs of eight new whales and one re-sighted whale (2007-10) were added. Currently the catalogue contains a total of 227 identified whales. Seven whales were re-sighted in multiple years. Mark-recapture analysis of Area III in the 3-year time period 2004/05-2006/07 yielded estimates of abundance ranging from 818 to 1,097 whales.

The Committee welcomed this update and recognised that the data have also been submitted to the Southern Hemisphere Blue Whale Catalogue. Photographs of blue whales from the JARPA programme has not yet been included in the ABWPIC but have been submitted to the IWC Secretariat. The Committee **reiterates** that the photographs should be added to the catalogue and reconciled and a proposal to achieve this has been developed. This is discussed further under Item 23.

SC/64/SH20 presented an update on the Southern Hemisphere Blue Whale Catalogue that holds photo-ID catalogues of research projects from major areas off Antarctica, Eastern South Pacific and the Eastern Tropical Pacific (ETP). A total of 822 and 826 individual blue whales photographed from left and right sides respectively are held in this Catalogue. Left-side comparisons have been completed and right-side comparisons are underway for ETP and the other areas. There are re-sightings both within Chile and in the Southern Ocean. However, none of the 84 whales photographed off ETP have been re-sighted within or outside of the ETP.

The Committee **encourages** contributions of regional catalogues not yet in the Southern Hemisphere Blue Whale Catalogue (e.g. eastern and western Australia) to facilitate full reconciliation of the catalogue for the Southern Hemisphere blue whales and a proposal to achieve this has been developed. This is discussed under Item 23.

10.3.1.2 ANTARCTIC BLUE WHALES

SC/64/SH14 reported methodological developments for estimating relative abundance from historic Antarctic whaling records using catch per unit effort data (CPUE). Once the work has been completed and accepted by the Scientific Committee, the Committee welcomed the commitment of the authors to submit the datasets and script to the IWC Secretariat.

SC/64/SH11 summarised two voyages conducted by the Australian Antarctic Division off southeastern Australia to refine acoustic tracking methodologies to address the aims of the Southern Ocean Research Partnership's Antarctic Blue Whale Project (see Item 19 and Annex H, item 3.1.2.1). The primary aim of this project is to estimate the circumpolar abundance of Antarctic blue whales using mark-recapture methods. The passive acoustic tracking system, using DIFAR sonobuoys, operated continuously during the voyages recording nearly 500 hours of audio, while acousticians processed over 7,000 blue whale calls in 'real-time'. The two voyages yielded 52 sightings (104 animals) of blue or like-blue whales; 48 animals were identified photographically (one on both voyages). Some blue whales that had been seen were not heard.

SC/64/SH12 summarised the methodological development of the use of DIFAR sonobouys for real-time tracking of blue whales. The results indicate that acoustic surveys may offer increased effective range over purely visual surveys of blue whales.

SC/64/SH26 presented an exploration into what encounter rates are plausible using acoustic-assisted tracking of whales, as opposed to a traditional visual-only survey (such as IDCR/SOWER). Given the lack of data, and the number of assumptions, abstractions, and approximations required in this simulation exercise, the authors stressed that the estimates in the paper should not be considered accurate or precise.

SC/64/SH10 presented a great advancement on the feasibility study of methods to obtain a new estimate of circumpolar abundance of Antarctic blue whales. Using the seasonality and location of sightings and acoustic detections from IWC-SOWER surveys, and historical catch data, it was concluded mark-recapture surveys should target putative hotspots and make use of passive acoustic tracking to increase encounter rates. With a reasonable level of effort a viable estimate of circumpolar abundance could be obtained for Antarctic blue whales within a ten-year period (and see Item 19).

The Committee recognises that the longer-term timeline to estimate abundance of Antarctic blue whales is more appropriate and logistically more feasible than the shorter periods considered earlier in the project's development. It **welcomes** the suite of papers linked to the Antarctic Blue Whale Project and the considerable advancement in the project's development. Further mark-recapture simulation studies may be valuable to investigate the effects of variability in effort between years within the suggested ten year timeframe and also to investigate the interaction between spatial variability in effort and possible population structure. This simulation could assess the consequences of only targeting 'hotspots' and the potential heterogeneity in capture probability potentially generated through this approach.

Further the Committee **encourages** ships contributing to the ABWP to, whenever possible, also collect environmental data for habitat modelling and data on other whale species sighted. In some circumstances environmental data can be collected through remote sensing but this is often problematic around Antarctica due to extensive cloud cover. Gliders and floats may provide another opportunity to collect high resolution water column data.

10.3.1.3 PLANNING OF FUTURE RESEARCH

The Committee was pleased to receive a number of papers on future blue whale research (see Annex H, item 3.1.2.2 for full discussion of these).

SC/64/SH13 presented a preliminary plan for an Australian funded voyage to contribute to the SORP Antarctic Blue Whale Project. The aim of the Antarctic Blue Whale Project is to develop technologies and collect data that will ultimately deliver a new circumpolar abundance estimate for Antarctic blue whales. The voyage will focus on blue whales in waters west of the Ross Sea (i.e. 135-175°E), an area that has been associated with higher densities of blue whales. The plan will be further developed and reviewed once the project management structure for the Antarctic Blue Whale Project is established which includes the formation of technical committees on passive acoustics, individual identification, and survey design.

The Committee **emphasises** the importance of collecting opportunistic data on other whales (sightings, faecal collection, biopsies) and environmental data, while recognising the value of clear priorities, particularly when the number of days 'on-site' in good weather can be few, even for longer Antarctic voyages.

SC/64/O16 presented the South African Blue Whale Project which is intended to initiate a long-term monitoring programme of blue whales in the Antarctic sector east of the Greenwich meridian, coupled with investigations of their seasonal pattern of abundance at lower latitudes. Acoustic technology will be combined with traditional line transect sighting survey and mark-recapture methodology to study the distribution, abundance and movements of blue whales in the southeast Atlantic. This joint study is conducted by the University of Pretoria and the University of Washington, and has received funding for 3 years from the South African National Antarctic Programme, starting in 2012/13. One team member will receive training in AAR deployment during a cruise off Greenland this summer (SC/64/O17) under the SORP programme. Although data valuable to the SORP Antarctic Blue Whale Project will be collected on this voyage (photo-ID and biopsy samples), the project is more closely linked with another SORP project 'Acoustic trends in abundance distribution and seasonal presence of Antarctic blue whales and fin whales in the Southern Ocean (see SC/64/O13).

SC/64/SH25 proposed a project on the genetics of Antarctic blue whales in part using IWC samples. The contemporary Antarctic blue whale has been described by a relatively high mitochondrial DNA (mtDNA) haplotype diversity, and may have escaped a greater loss of genetic diversity due to its long life span, overlapping generations and the brief period of the bottleneck. The impact of 20th century commercial whaling on genetic diversity can be explored through a comparison of historic and contemporary genetic diversity. The Committee **recommends** that access to the samples continues for this work and encourages further sampling in South Georgia.

The Committee **endorses** these research projects and looks forward to reviewing the results.

10.3.1.4 PYGMY BLUE WHALES

SC/64/SH27 presented a study on the identity of blue whales that are regularly sighted in the Geographe Bay region of Western Australia. Preliminary results based on measures of genetic structure indicate that the whales were all of the pygmy subspecies. Further samples from Geographe Bay are required to clarify whether these blue whales have fine scale genetic differentiation.

The Committee **welcomes** this paper which is discussed fully in Annex H, item 3.1.3, noting the contribution made by IDCR/SOWER samples to the study.

10.3.1.5 CHILEAN BLUE WHALES
The Committee was pleased to receive three papers on blue whales in Chilean waters and a full discussion can be found in Annex H, item 3.1.4.

Galletti Vernazzani *et al.* (2012) described the results of a collaborative research programme (the Alfaguara Project) conducted by Centro de Conservacion Cetacea on Chilean blue whales. From 2004 to 2010, eight aerial and 85 marine surveys were conducted off Isla de Chiloe, southern Chile, where a total of 363 individual blue whales were photo-identified. Recapture data support the hypothesis that the feeding ground off southern Chile is extensive and dynamic. Blue whale distribution off southern Chile was assessed and relative abundance, using sighting per unit effort and kernel density estimators was obtained.

SC/64/SH18 provided an update on the 2012 blue whale field season that reported the occurrence of a shift in blue whale distribution during 2012 from the southern Chile feeding area (Isla de Chiloe), as reported in previous years, to an additional feeding aggregation of blue whales in northern Chile (Isla de Chanaral). The Committee recognised the value of such long-term datasets for understanding blue whale populations and **recommends** that they continue.

SC/64/SH19 presented an abundance estimate of Chilean blue whales by mark-recapture and line-transect techniques.

The Committee recognised that the area covered by the line-transect survey does not include the entire range of the population and so will underestimate the total population size. There are also issues related to possible structure among feeding groups and sampling that require further consideration with respect to mark-recapture estimation. The Committee **encourages** further work on this and looks forward to receiving additional analyses.

10.4 Western North Pacific gray whales
10.4.1 New scientific information

Results regarding mixing of western (WNP) and eastern (ENP) North Pacific gray whales illustrate the great conservation and management importance of a more comprehensive examination of gray whale movement patterns and population structure in the North Pacific. At last year's meeting the Committee noted that for such an effort to be successful it must be international and collaborative (Weller *et al.*, 2012). To facilitate this, and noting the existing safeguards for collaborators provided under the Committee's Data Availability Agreement, it recommended that a collaborative Pacific-wide study be developed under the auspices of the IWC, recognising that *inter alia* this will contribute to the Committee-endorsed Conservation Plan for Western North Pacific Gray Whales and incorporate previous recommendations made by the Committee. Appendix 7 of Annex F provides an update on progress made to date.

The Committee **commends** the highly collaborative, international research effort for the progress made to date and look forward to future updates. The Committee also received several papers on stock structure and movements of north Pacific gray whales that resulted from this or other related programmes. Details can be found in Annex F, Item 4.1.

10.4.1.1 SATELLITE TAGGING
Mate summarised results regarding the recent collaborative efforts between Russian and US scientists to satellite track western gray whales under a programme undertaken with guidance from the IWC Scientific Committee and the IUCN WGWAP (Western Gray Whale Advisory Panel). The main goal of the project was to determine migration routes and breeding areas of tagged gray whales from the western North Pacific in order to develop improved conservation measures for this very small population. A total of seven whales were tagged in 2010 and 2011. The three longest tracked whales moved east across the Bering Sea and into the northeast Pacific where they overlapped with the range of eastern gray whales. Each animal followed a different route. The transmitter for a whale tagged in 2011 has lasted almost a year and continues to transmit. It travelled to near the southern tip of Baja California, Mexico during the winter and returned to near Sakhalin Island, Russia this spring. The autumn and spring migratory routes differed. These results, along with those from photo-ID matches from the eastern and western Pacific have caused the Committee to examine overall stock structure of gray whales in the North Pacific and to initiate the ocean wide research programme referred to above.

Mate also presented information on a plan for the A.N. Severtsov Institute of Ecology and Evolution of the Russian Academy of Science (IPEE) and Marine Mammal Institute of the Oregon State University to continue tagging western gray whales following the guidelines already developed by the IWC (IWC, 2012k). It is intended to tag up to 20 animals off Kamchatka (there is some interchange between animals off Kamchatka and Sakhalin) beginning in early July. The objective is to provide additional information on stock structure and to assist in developing conservation measures. The programme will also involve photo-ID and biopsy work. Photos will be made available to all catalogues and genetic samples will again be submitted to the IWC archive.

There was some discussion about whether tagging in Kamchatka was as beneficial as further tagging off Sakhalin as detailed in Annex F. The Committee **agrees** on the value of future telemetry work off Kamchatka and Sakhalin and **reiterates** its previous guidelines for such work (IWC, 2012k). Advice from the IWC/IUCN Steering Group chaired by Donovan on the full proposal will be provided to the research team in sufficient time to assist preparations for the field programme. The Committee also **recommends** that an evaluation of healing of the wounds caused by the satellite tags be undertaken and provided at next year's meeting.

The Committee also received information on plans for telemetry work on eastern gray whales. Quakenbush and her colleagues plan to tag up to 10 gray whales near Barrow and Saint Lawrence Island in 2012. The main goal is to document the distribution, movements, and feeding areas of gray whales relative to oil and gas activities in the Chukchi Sea. The project will include the collection of photographs and biopsies. Data will be shared with other gray whale research groups. Mate plans to tag some additional PCFG gray whales in 2012 in Oregon and northern California. The objective is to investigate if the variable migratory timing, routes, and Baja California destinations are similar to those found in 2009 and 2010.

10.4.1.2 PHOTO-IDENTIFICATION
SC/64/BRG13 provided results from a photographic comparison of gray whales off Sakhalin Island, Russia with animals in lagoons of Baja California, Mexico. Additional information about another match was reported subsequent to the submission of SC/64/BRG13. In total, photographs of 217 identified gray whales were obtained from the Sakhalin Island feeding grounds and compared with 6,546 photo-

identified individuals from the Baja California breeding lagoons. The research team found a total of 14 matches from the 217 Sakhalin whales, including six males, six females and two animals of unknown sex. Thirteen whales had sightings in Russia prior to and after their respective sighting in Mexico. Five females with calves were sighted in the winter in Mexican waters and in the next summer off Sakhalin, three of them without calves suggesting that these females had either separated from their calves or that their calves did not survive. The matches made between whales sighted off Sakhalin and the Mexican Pacific are the first results of the multinational collaboration.

The Committee **thanks** the authors and their colleagues for reconciling the Mexican photo catalogue. This will be a useful tool to address many questions, such as the relationship between Sakhalin and Mexico gray whales. The Committee also **acknowledges** the collaboration among the international group of gray whale researchers as a great example of how scientists can work together to address questions of great importance.

Another example of the multinational collaboration involves the photo comparisons being conducted among three catalogues: the Russia-US Sakhalin catalogue; the Institute of Marine Biology (IBM) Sakhalin catalogue; and the IBM Kamchatka catalogue (Appendix 9 of Annex F presents preliminary results from this study).

Updated information on research and conservation in Japan was presented in SC/64/O8. In March 2012, a gray whale was sighted on the Pacific coast of Aichi Prefecture, in the middle of Japan and some photographs of the animal were taken. No stranding or entanglement of this animal occurred. The Committee was also informed that there are some photographs (and genetic samples) in Japan that might contribute to a better understanding of stock structure of north Pacific gray whales. Japan expressed interest in joining the international collaboration and named Kato as the contact person. The Committee welcomes this news and **encourages** sharing of photographs and genetic samples with existing catalogues and genetic databases.

The Committee **commends** the above highly collaborative, international research effort for the progress made to date and **encourages** enhanced collaboration, if at all possible. The Committee **strongly recommends** the continuation of the IWC collaborative programme as outlined in Annex F, especially the plans to collect additional biopsy samples for genetic comparisons and photographs for catalogue comparisons. It was suggested that analyses be conducted to assess whether any patterns in the genetic data could be identified when Sakhalin whales known to have overwintered in the Eastern North Pacific are compared to the other sampled animals off Sakhalin as well as to those sampled in the Eastern North Pacific. The Committee also **recommends** that existing data be used to attempt to estimate the proportion of animals that regularly feed off Sakhalin and also migrate to the eastern North Pacific in the winter.

10.4.1.3 OTHER

SC/64/BRG10 provided a summary of past and current records of gray whales off the coasts of Japan, China and Korea. There are only 13 known sighting or stranding records in Japanese waters between 1990 and 2007 (Nambu *et al.*, 2003). Observations of gray whales in China are also exceptionally rare. Gray whales were once common and hunted off the coast of the Korean Peninsula but the last reported commercial catches were in 1966 and the last known sighting off Korea was in 1977. This suggests that they have abandoned the migration corridor along the Korean Peninsula or that a subpopulation using the Korean Peninsula is now extinct. The evidence that some Sakhalin animals migrate to the west coast of North America during the winter/spring, along with observations off Japan, Korea and China during the winter/spring, in combination with significant genetic differences between the eastern and western populations (Lang *et al.*, 2011) suggest that the number of whales in the western North Pacific population is potentially smaller than the currently estimated ~150 whales that use the Sakhalin summer feeding area.

This paper stimulated considerable discussion as can be seen in Annex F. The Committee emphasises the importance of the collaborative oceanwide programme and the need to review stock structure of gray whales throughout the North Pacific. It was noted that photographs (albeit low quality) of a gray whale that died in fishing gear in China in November 2011 have been compared with several catalogues (i.e. the Russia-US, IBM Sakhalin, and IBM Kamchatka) but no matches have been made.

In conclusion, the Committee **welcomes** all of the information on this critically endangered population and the broader question of stock structure. It **encourages** further work and as in previous years, **re-emphasises** the importance of continued long-term monitoring. Recognising some difficulties of interpretation given the new information on movements, the Committee also **encourages** Cooke to complete and publish his assessment of the gray whales feeding off Sakhalin using the combined photo-ID datasets. This rich dataset can provide valuable information for assessing possible anthropogenic impacts on animals feeding in the area.

10.4.2 Conservation advice

As in previous years, the Committee **acknowledges** the important work of the IUCN Western Gray Whales Advisory Panel. This year's update on the panel's activities is given in Appendix 10 of Annex F. The Committee **re-emphasises** its view of the importance of the Panel's work and reiterates its support. Furthermore, the Committee **recommends** that appropriate monitoring and mitigation plans be implemented for all oil and gas activities that occur in the range of western gray whales, especially if another platform is to be built or installed off Sakhalin.

The Committee again **recognises** that the problem of net entrapment of western gray whales is a range-wide issue. It **welcomes** Japan's administrative actions related to conservation of gray whales (SC/64/O8) and the efforts of other range states to reduce mortality, such as net entrapments that occur in other range states, including Canada, the USA and Mexico on the eastern side of the Pacific. Continued international collaboration to elucidate population identity and stock structure, as emphasised above, will provide valuable information for future management advice.

10.5 Southern Hemisphere right whales

10.5.1 Review report from intersessional Workshop

Bannister introduced the report of Workshop, held in Buenos Aires, Argentina, from 13-16 September 2011 (see SC/64/Rep5). He noted that although substantial progress had been made on much of the agenda, additional work was needed on some sections, especially the completion of analyses related to abundance and assessment. It was also noted that subsequent revisions of some analyses meant that sections of the report required clarification or amendment. As a consequence, two groups (an assessment group and a drafting group) were established to complete this work.

The Committee recognises the substantial work undertaken at the Workshop and **welcomes** the report, thanking particularly the Chair, rapporteurs and the host. It noted the large number of recommendations the report contained and prepared the following consolidated version incorporating additional comments and recommendations from the Committee as appropriate.

10.5.1.1 LONG-TERM POPULATION MONITORING

The Committee has long recognised the value of long time-series in informing, prioritising and evaluating conservation and management actions for whales, including monitoring the effectiveness of mitigation measures and Conservation Management Plans. In particular, it stresses the value of maintaining annual data sets, especially those that include information on the calving intervals of individual females, for their potential importance in analysing the influences of climate and environmental variables on southern right whale reproduction. The Committee therefore **strongly recommends** that all existing southern right whale data sets of this nature (e.g. in Argentina, Australia and South Africa) be continued on an annual basis and that similar programmes be established wherever possible for other areas.

In this connection, the Committee received a proposal requesting interim relief funding for the 2012 aerial survey off South Africa (Annex F, Appendix 2) and **recommends** its support (see Item 23). In addition, the Committee **recommends** that the annual CENPAT programme of aerial surveys around Península Valdés, which is independent of the long-term aerial photo-ID programme and substantially increases the areal and temporal survey coverage, should be continued on an annual basis.

10.5.1.2 POPULATION STRUCTURE AND LINKAGES

The population structure and stock identity of southern right whales remain incompletely described. A particular challenge is to distinguish adjacent stocks with different demographic histories and apparent rates of recovery. To address this, the Committee **recommends** that a circumpolar collaboration proceed to assemble standard genetic information from all available samples (see SC/64/Rep5, table 5), that could *inter alia* update the previous analysis by Patenaude *et al.* (2007) of the genetic structure of southern right whales on their calving/nursery grounds.

A number of standard genetics protocols are **recommended,** including standardisation of mtDNA preparation and nomenclature, standardisation of micro-satellite loci and the exchange of samples between laboratories to establish allelic standards and provide quality control (see SC/64/Rep5). Further tissue sampling is also **strongly recommended** in a number of areas including Australia, Chile/Peru, Southern Africa and Brazil (see Annex F and SC/64/Rep5 for more details). In addition, to investigate relationships with other southern populations, further analysis of existing genetic samples from South Africa (n=~600) is **recommended**.

Recognising the importance of being able to allocate offshore (‘pelagic’) catches in the Southern Ocean and in low-latitude areas to the appropriate calving/nursery/breeding grounds, the Committee **recommends** that genetic (biopsy), photo-ID and satellite tagging data are applied to identify linkages. Further investigation is **recommended** of: (a) connections between whales in the New Zealand sub-Antarctic and those in mainland New Zealand; and (b) philopatry to mainland New Zealand (for details see Annex F and SC/64/Rep3). It is also **recommended** that biopsy samples, satellite tagging data and photo-ID data be linked, where possible.

While recognising the value of genetic analyses in solving the problems of population structure and linkages, the Committee also **recommends** other approaches such as inter-catalogue comparisons. Similarly, the value of strategically deployed satellite tags in depicting movements has already been demonstrated for southern right whales, and the Committee **recommends** that such studies continue.

10.5.1.3 MODELLING

The Committee **recommends** further investigation of the conversion factor used to estimate total population size from the estimated adult female component. Such investigation needs to consider that there has been only a relatively short period of recovery and that therefore the age distribution is unlikely to be steady and the estimated survival rate is likely to be biased upwards from the average that would apply in a steady situation.

10.5.1.4 JOINT ARGENTINA/BRAZIL ASSESSMENT

Noting the preliminary nature of Cooke’s analyses, the Workshop had decided not to append the results to their report. It had recommended that progress towards the ‘joint assessment’, using data from both Argentina and Brazil, be made as quickly as possible and that an update also be presented on this work at the 2012 Scientific Committee meeting. Cooke provided an assessment of the 2010 Argentine population including a rate of increase from 2000-10 to the meeting (Annex F, Appendix 3). The Committee **welcomes** this and **agrees** to include the results in the Workshop’s assessment of the status of the southern right whale population in 2009, appreciating that until a joint Argentine/Brazilian assessment had been completed these results must be considered preliminary in nature. The Committee **recommends** that the joint Argentine/Brazilian assessment be completed as soon as possible, and the results presented to the 2013 Annual Meeting.

10.5.1.5 ASSESSMENT OF THE CHILE/PERU POPULATION

In order to obtain information on the distribution and abundance of this Critically Endangered population, to clarify its status and identify any threats and possible mitigation actions, the Committee **recommends** that surveys, photo-ID and genetic studies should be conducted as a priority. Specifically, the following steps should be taken:

(1) determine geographical/temporal areas where quantitative studies can best be conducted, through analysis of existing historical whaling and sighting data and appropriate temporal/geographical spatial modelling;
(2) design a systematic survey programme (aerial surveys may be the most efficient) to cover potential calving or nursery areas, bearing in mind logistical and practical limitations; and
(3) further consider stock structure issues by examining existing genetic samples (including museum specimens where possible) and collect new samples in southern Chile/Argentina.

10.5.1.6 IDENTIFICATION OF CONCERNS AND THEIR MONITORING

Given that there was evidence of continuing direct removals via entanglements in fishing gear and ship strikes, the Committee **recommends** all countries to include reports of ship strikes and entanglement events in their annual Progress Reports to the IWC through the new online portal (see Item 3.2).

The Committee **strongly reiterates** the research and management recommendations made at the Workshop on the Southern Right Whale Die-off (IWC, 2011k). In addition, in view of the severe impacts of gull attacks documented at Península Valdés and the risk that this learned behaviour on the part of gulls could proliferate, the Committee **recommends** that Brazilian authorities consider taking immediate action if and when similar gull behaviour is observed. Some members felt that this action should specifically include the removal of attacking gulls, following similar steps being undertaken by Argentina in the Península Valdés area.

The Committee noted that some concerns have been raised about the potential effects of fishing and climate change on krill and hence on krill predators. The Committee also noted that the CCAMLR Scientific Committee was investigating these matters and encourages further collaboration between IWC and CCAMLR on the development of relevant ecosystem models.

10.5.1.7 DEVELOPMENT OF CONSERVATION MANAGEMENT PLANS (CMPS)

The Committee **recommends** that any draft CMPs take into account the recommendations made at the Buenos Aires Workshop and the Workshop on the Southern Right Whale Die-off and use these as the basis of action development (IWC, 2011k). The Committee was pleased to note that this was the case for the two draft CMPs it received (see below).

10.5.1.8 CONCLUSION

The Committee noted that the Workshop Report (SC/64/Rep5) had reached conclusions on the current status of the overall Southern Hemisphere right whale population based on a modelling exercise undertaken during the Workshop using the best available parameter values. However, the Workshop had recognised that the calculations were very dependent on: (1) the results of the as yet incomplete analysis of the Argentinian/Brazilian population to be provided by Cooke; and (2) on different conversion factors from mature female to total population size derived from the Argentine and South African populations.

Cooke advised that the parameter values for Argentina he had provided during this meeting (Annex F, Appendix 3) still required some updating. However, he agreed that he would forward them by 1 July 2012 to Butterworth and his colleagues so that a revised circumpolar analysis using the same approach as in Buenos Aires could be completed. It was agreed that the updated analysis would be incorporated into the Buenos Aires Workshop report with an appropriate editorial note. This full report would then be circulated to Workshop participants for any final comments and included in the published version in the *Supplement* to *J. Cetacean Res. Manage.*.

Cooke reported that it was impossible to undertake the recommended joint Argentina/Brazilian assessment until matching between photo-ID catalogues had been completed. However, he confirmed that excluding Brazil from the overall assessment was unlikely to have a major effect on the resultant circumpolar estimate because of its relatively small size (some other small populations for which no estimates exist are also excluded from the assessment). It was also noted that updated calculations using the Argentina and South African data had resulted in a convergence of conversion factors (Annex F, Appendix 3) so that these are no longer a major issue in estimating total population size for use in the assessment.

10.5.2 Review new information

10.5.2.1 SOUTHWEST ATLANTIC

The Committee received three papers on this population. They are briefly summarised below but a full discussion can be found in Annex F, item 3.3.2.

SC/64/BRG12 presented updated information on the southern right whale die-offs at Península Valdés, Argentina for the 2010/11 seasons. Systematic efforts to study the strandings have continued since 2003. A total of 482 dead whales were recorded at Península Valdés between 2003 and 2011. At least 55 whales died in 2010 and 61 died in 2011. As in previous years, the vast majority of strandings were calves of the season.

SC/64/BRG7 reported an analysis of metal levels in the skin of living southern right whales at Península Valdés, Argentina, as part of efforts to investigate the recent die-offs. The levels of non-essential and essential metals in the skin of 10 animals were on the low end of the spectrum of measured concentrations when compared to other studies. The authors cautioned that these low levels should not necessarily be interpreted as being safe since the effects of metals in marine mammals are largely unknown.

There was lengthy discussion on the possible reasons for changes in the observed calving interval. In conclusion, the Committee **reiterates** the recommendations of the southern right whale die-off Workshop (IWC, 2011k) and **encourages** the continuation of the studies presented in SC/64/BRG7 and SC/64/BRG12 to better understand the mechanism(s) behind the observed mortality.

SC/64/BRG20 presented an abundance estimate of southern right whales by aerial line-transect surveys for a bay area of Bahía San Antonio, Argentina, from late summer to autumn in 2009-11. A corrected abundance estimate using $g(0)$ is 207 (CI=99-315) in 2010, which is the maximum among the three years. These aerial surveys resulted in the first specific estimates of southern right whale abundance in this north Patagonian bay although more consistent aerial surveys should be conducted.

10.5.2.2 SOUTHERN AFRICA

SC/64/BRG24rev applied the three-mature-stages (receptive, calving and resting) model of Cooke *et al.* (2003) to photo-ID data available from 1979 to 2010 for southern right whales in South African waters. The 2010 mature female population is estimated to be 1,309, the total population is 4,725, and the annual population growth rate 6.8%. Information from re-sightings of grey blazed calves as adults with calves allows estimation of first year survival rate of 0.914 and an age at 50% maturity of 6.4 years. In contrast, the relative proportions of grey blazed animals amongst calves and amongst calving adults suggest rather a value of 10% (SE 8%). If the proportion losing markings is in fact 10%, first year survival rates estimate drops to [0.859] and the population growth rate to [6.6%] per year.

Best presented an analysis in which he had assembled data from foetuses, biopsied calves and stranded calves to test the assumption that the neonatal sex-ratio in southern right whales was 50:50. The most appropriate data set suggested a ratio closer to 46 male:54 female (Annex F, Appendix 4). The base case model of SC/64/BRG24 with this alternative sex ratio of 54:46 resulted in the total population 4,359 (Annex F, Appendix 5). The main differences in the parameter estimates were a lower first year survival rate with a corresponding higher value of the estimate for the probability that a grey-blazed calf maintains its markings until becoming an adult.

10.5.2.3 SOUTHWEST PACIFIC AND NEW ZEALAND

Carroll (2012) provided results on paternity assignment and 'gametic recapture' to examine the reproductive autonomy of southern right whales on their New Zealand calving grounds. The 'gametic mark-recapture' estimate of male abundance was 1,001, directly comparable with the 'census estimate' of male abundance, n=1,085, for the stock, based on standard genotype mark-recapture modelling. Simulations indicated the assumption of equal reproductive success amongst males was not violated. Power analyses suggested that these findings would be highly unlikely if the population was open to gene flow from other, larger populations in the Indo-Pacific region. The authors concluded that these findings are consistent with the hypothesis that southern right whales returning to the New Zealand calving ground are reproductively autonomous on a generational timescale, as well as isolated by maternal fidelity on an evolutionary timescale.

10.5.2.4 AUSTRALIA
SC/64/ProgRepAustralia provides information on southern right whales obtained on survey flights off the southern Australian coast between Cape Leeuwin and Ceduna in August 2011. The most recent updated increase rate for this Australian 'southwest stock' for 1993-2011 is 6.82% for all animals (CI 4.24-9.47), and 7.21% for cow/calf pairs (CI 3.70-10.85) with current population size *ca* 2,900; including the much smaller 'south east' Australian stock, the Australian population as a whole is likely to number *ca* 3,500.

10.5.2.5 SOUTH EAST PACIFIC RIGHT WHALES
Off northwestern Isla de Chiloe, four sightings of the critically endangered Chile/Peru 'sub-population' between September and November 2011 were documented, including the first incidence of reproductive behaviour and the first resighting of a known individual in Chile. In addition, some 30km north, the southernmost record of a mother-calf pair was recorded. These observations suggest that northwestern Isla de Chiloe is part of a breeding area with undetermined boundaries. This highlights the importance of these coastal waters and the need to continue long-term studies, both dedicated and opportunistic, to monitor this critically endangered population.

10.5.2.6 GENETIC RESEARCH
SC/64/BRG15 reported on progress with the investigation of the worldwide genomic diversity and divergence of right whales. Through collaborative agreements, the investigators have obtained representative samples from all three oceanic species. The investigators have used next-generation sequencing technology to develop genomic profiles by sequencing the complete mitochondrial genomes and multiple nuclear genes for each individual. To date, the results provide greatly increased resolution of the divergence between the three recognised species, and the diversity within each oceanic population.

The Committee noted that the project was generally methodologically sound and the objectives of the study were likely to be achieved. Although some concerns were expressed about limited number of samples and a possible need for more emphasis on the nuclear aspect of the survey, the Committee **recommends** funding the final stage of the project (see Item 23).

10.5.2.7 REVIEW OF 'DRAFT CONSERVATION MANAGEMENT PLANS FOR SOUTHERN RIGHT WHALES'
The Commission has agreed that southern right whales of South America should be candidates for IWC Conservation Management Plans (IWC, 2012b). As discussed in Annex F, two draft plans were available, one for southwest Atlantic southern right whales (IWC/64/CC7rev1) and one for southeastern Pacific southern right whales (IWC/64/CC9).

The Committee examined these draft CMPs for their scientific content and related actions and found them to be in accord with the results and recommendations from the IWC Workshops on the status of southern right whales (SC/64/Rep5) and the southern right whale die-off (IWC, 2011k).

10.6 Other stocks of right whales and small stocks of bowhead whales
An update was provided on North Atlantic right whales for the period November 2010-October 2011, reflecting the work of North Atlantic Right Whale Consortium, 2011. A collaborative photographic catalogue suggested that there were 490 North Atlantic right whales in 2010. Five right whale deaths were documented during the report period. Additionally, there were 11 new entanglement cases documented. The Committee **thanks** the authors for this update and looks forward to receiving further information next year.

SC/64/ProgRepJapan reported that in February 2011, a right whale was found dead in a set net in Oita prefecture. A skin sample was sent to the Institute of Cetacean Research (ICR), where DNA was extracted and it was confirmed as a right whale. However, the ICR branch in the Tohoku region was hit by the tsunami on 11 March 2011 and the sample was lost.

SC/64/O6 reported sighting information for North Pacific right whales from sighting surveys conducted in May 2011 in the western North Pacific. A total of 13 schools (20 individuals) was sighted, from which 19 individuals were photographed and 14 biopsied successfully.

The Committee **welcomes** new information on North Pacific right whales, noting that such sightings were rare. It looks forward to receiving a fuller report of the sighting survey at the next meeting.

No update was available for the small stock of bowhead whales in the Sea of Okhotsk.

Moore *et al.* (2012) provided results of a year-long acoustic study of the Spitzbergen stock of bowhead whales from September 2008 to September 2009 in western Fram Strait (79°N, 5°W). The rate of bowhead whale call detection was high from September 2008 through May 2009, including calls detected on every day of the month from November through February when sea ice was 90-100% surface cover.

The Committee continues to **reiterate** its grave concern over these small stocks and **encourages** continued or expanded research on these small populations.

10.6.2 Work
The Committee's views on the work plan for these stocks are given under Item 21.

10.7 Arabian Sea humpback whales
10.7.1 Review intersessional progress
The Scientific Committee has in the past (most recently in IWC, 2012m), recommended further research to help address the serious conservation status of the Arabian Sea humpback whale which is recognised as an isolated resident sub-population of humpback whales with an estimated population size of 82 (95% CI 60-111; Cerchio *et al.*, 2008; Minton *et al.*, 2011).

SC/64/SH30 provided details of surveys, shore-based observations, and passive acoustic monitoring conducted in Oman during October 2011-March 2012. A total of 36 humpback whales was encountered, 33 of which were photographed and 16 were newly identified individuals. No feeding was observed in the southern survey site and there were nearly three times fewer whales encountered this year. Differences in relative density and feeding may be due to annual fluctuations in food availability as a result of variable oceanographic conditions. Three mother-calf pairs were recorded in Oman during 2011-12, one of which entered the newly operational multi-purpose Port of Duqm. These are the first documented records of humpback whale calves in Oman since 2000. Two mortalities were recorded in January and April 2012. An adult female floating at sea was photographed by local fishermen and a juvenile that stranded live on a remote stretch of shoreline and was subsequently buried by the local municipal authority before scientific investigation could be conducted.

Observations of severe entanglement scarring, as well as coastal road development, operation of a large new port at Duqm, and the planned inauguration of several fast ferry routes through known humpback whale habitat are cause for concern. Efforts are underway to highlight the population's conservation needs with local, national and regional governments as well as the general public, and progress is being made toward the formation of a network of researchers and managers responsible for the design and implementation of a Conservation Management Plan, as recommended last year (IWC, 2012f, p.25).

The Committee **expresses concern** over the relatively large number of strandings from this small population (9 over a 12-year period). Given its endangered status under the IUCN red list and the potential for growth of unregulated whale watching in the region, the Committee **recommends** that whalewatching vessel operator training Workshops should be conducted with a view to promoting best practice for whalewatching and to support the need for development of whalewatching guidelines (see Item 23).

The Committee further noted plans to produce an updated mark-recapture estimate of population size. It **reiterates** its earlier recommendation (see IWC, 2011i), regular abundance surveys to be repeated on a regular basis, with assistance in planning and analysis from relevant experts.

10.7.2 The development of a CMP

The Committee has previously noted that this population is a likely candidate for an IWC Conservation Management Plan (CMP). An intersessional Working Group was formed at last year's IWC meeting to facilitate this process in accordance with the guidelines adopted last year by the Commission (IWC, 2012b). A key component of any plan is that it is supported by a broad range of stakeholders including range state governments. The Committee welcomes the progress that has been made in assembling the documentation required to submit a proposal to the IWC for a candidate CMP. It **strongly recommends** that discussions between scientists and relevant range state governments continue to further progress the CMP process.

10.7.3 Work plan

The Committee's views on the work plan are given under Item 21.

10.8 Cruises

10.8.1 The IWC-POWER programme

10.8.1.1 PLANNING THE IWC-POWER[14] PROGRAMME

The Scientific Committee has been discussing the objectives and priorities of the IWC-POWER programme since 2009 (e.g. IWC, 2012v) and this culminated in the discussions given in IWC (2012l).

[14]North **P**acific **O**cean **W**hale and **E**cosystem **R**esearch programme.

The Committee and the Commission agreed the long-term objectives for the programme in IWC (2012l).

> 'The programme will provide information to allow determination of the status of populations (and thus stock structure is inherently important) of large whales that are found in North Pacific waters and provide the necessary scientific background for appropriate conservation and management actions. The programme will primarily contribute information on abundance and trends in abundance of populations of large whales and try to identify the causes of any trends should these occur. The programme will learn from both the successes and weaknesses of past national and international programmes and cruises, including the IDCR/SOWER programme.'

IWC (2012v) provided an extensive review of current knowledge in the region, and a list of medium-term priorities by species for the programme was developed.

SC/64/Rep1 presents the report of a meeting of the Technical Advisory Group (TAG) established last year. The report builds upon the extensive work already undertaken to provide an overall strategy and detailed 5-year plan for the IWC-POWER programme, including statistical power calculations. The TAG workshop initially focused on methodological issues to investigate distribution, abundance and trends. It made a number of practical recommendations for visual methods (SC/64/Rep1, item 3.1) regarding survey mode, track design, and angle and distance experiments. Initial power analyses suggest the need for increased future effort (at present only one vessel is available) to be able to detect trends. The results of the short-term programme (see below) will allow improved power analyses and a better determination of required effort for the medium-long-term. Other techniques examined included mark recapture and acoustic methods and recommendations for further investigative and collaborative work were made. It also examined past data to investigate the amount of effort required to obtain photo-IDs and biopsy samples; this information is valuable for both short- and medium-term planning.

After reviewing the available information, an integrated short-term strategy (for the years up to 2015) was developed in light of the medium-long-term objectives (SC/64/Rep1, item 7.1). The objective is to complete an initial survey of the remaining poorly covered areas (SC/64/Rep1, fig. 1) to facilitate choice of appropriate survey blocks and strata for a long-term monitoring plan along with the essential undertaking of a more specific power analysis of the effort required to detect trends in abundance should they occur.

The TAG also made recommendations on the need for improved data collection systems, archiving of all kinds of data collected during the programme and a mechanism to ensure prompt collaborative analyses of the data collected (SC/64/Rep1, item 6). A detailed proposal for how to address these issues will be made at the 2013 Annual Meeting.

The Committee welcomes this report and **endorses** its recommendations. Noting the valuable contributions already made by Japan, Korea, the USA and Australia, it **strongly encourages** range states and others to consider more active participation in the IWC-POWER programme.

10.8.1.2 REPORT ON THE 2011 IWC-POWER CRUISE

The 2nd annual IWC-POWER survey was successfully conducted from 11 July to 8 September 2011 in the eastern North Pacific (north of 40°N, south of the Alaskan Peninsula, between 170°W and 150°W) using the Japanese Research Vessel, the *Yushin-Maru No.3*. The cruise had five main objectives:

(1) to provide information for the proposed future in-depth assessment of sei whales in terms of both abundance and stock structure;

(2) to provide information relevant to *Implementation Reviews* of whales (e.g. common minke whales) in terms of both abundance and stock structure;
(3) to provide baseline information on distribution and abundance for a poorly known area for several large whale species/populations, including those that were known to have been depleted in the past, but whose status is unclear;
(4) to provide biopsy samples and photo-ID photos to contribute to discussions of stock structure for several large whale species/populations, including those that were known to have been depleted in the past but whose status is unclear; and
(5) to provide essential information for the intersessional Workshop to plan for a medium-long term international programme in the North Pacific.

Plans for the cruise were endorsed by the Committee (IWC, 2011f) and the Committee agrees that it was duly conducted following the guidelines of the Committee.

On behalf of the Committee, Kato thanked the Cruise Leader, researchers, captain and crew for completing the second cruise of the POWER programme. The Government of the USA had granted permission for the vessel to survey in its waters, greatly contributing to the success of the cruise. The Government of Japan generously provided the vessel and crew for the survey.

Recognising the tremendous effort and expense in conducting the IWC-POWER survey, the Committee was yet again disappointed that potentially valuable data on stock structure was not able to have been collected as it had not been possible to resolve CITES permit issues regarding collection of biopsy samples collected outside of Japanese waters. The Committee **strongly recommends** that these issues are resolved. In planning for the 2013 survey, Hiruma reported that some initial progress on this front had been made, and would continue. He hoped to be able to report a positive outcome to ongoing talks between the governments of Japan and the USA in the near future. Brownell explained that the Japanese research vessel with biopsy samples collected on the high seas can enter and exit the US EEZ without a CITES permit, but biopsy samples cannot yet be collected in the USA.

10.8.1.3 THE 2012 IWC-POWER CRUISE
SC/64/Rep7 presented the report of the detailed planning meeting for the 2012 IWC-POWER cruise that had been endorsed last year (IWC, 2012l). The cruise will take place north of 40°N to the north American coast between 140°W and 135°W. The vessel kindly supplied by Japan will depart on 13 July 2012. The Committee **endorses** the report and looks forward to receiving the report of this cruise next year.

10.8.1.4 PLANS FOR THE 2013 IWC-POWER CRUISE
SC/64/O7 presented the research plan for the fourth survey in the IWC-POWER programme. The research area will be from the area from 160°-135°W, between 30°-40°N latitude. The plan was drawn up following guidelines agreed at the 2010 and 2011 Tokyo Planning Meetings (IWC, 2012v and SC/64/Rep1) and in light of the objectives developed in SC/64/Rep1. The cruise will collect line transect data, to estimate abundance, and biopsy/photo-ID data. Biopsy sampling will be undertaken on priority species (sei, fin, right, blue and humpback whales) and on other species on an opportunistic basis. Some dedicated research time will also be allocated to photo-ID and/or video-taping of fin, right, blue and humpback whales. Final planning will take place at a planning Workshop to be held in Tokyo in October 2012.

The Committee thanks the Government of Japan for its generous offer of providing a vessel for this survey.

10.8.2 Other North Pacific cruises (and see Item 6)
10.8.2.1 REPORT OF JAPANESE CETACEAN SIGHTING SURVEYS IN THE NORTH PACIFIC IN 2011
Three systematic dedicated cetacean sighting surveys were conducted in 2011 by Japan (ICR) as a part of JARPN II to examine the distribution and abundance of large whales in the Western North Pacific. The total searching distance was 4,060.3 n.miles. The sei whale was the main species sighted. The plans for these surveys were endorsed in the last year (IWC, 2012f) and the surveys were conducted as planned (SC/64/O6).

10.8.2.2 PLANS FOR JAPANESE CETACEAN SIGHTING SURVEYS IN THE NORTH PACIFIC IN 2012
SC/64/IA6 reports on plans for three systematic dedicated sighting surveys by Japan (ICR) as a part of JARPN II in the North Pacific in 2012, the first of which is currently underway. The main objective is to examine the distribution and estimate the abundance of common minke and Bryde's whales for the management and conservation purposes. Distance and angle estimation experiments will be conducted on all cruises. Biopsy skin samples of blue, fin, humpback and right whales will be collected on an opportunistic basis. Photo-ID experiments on blue, right and humpback whales will be also conducted opportunistically. Reports of the three sighting surveys will be submitted to the 2013 Annual Meeting.

10.8.3 Cruises in the Antarctic Ocean
10.8.3.1 PROGRESS ON IDCR-SOWER CRUISES PUBLICATIONS
An intersessional email correspondence group (IWC, 2012u, Annex R) worked by correspondence and also met at this meeting. Its terms of reference were to consider:

(a) updating the IWC website; and
(b) creating a special volume of the *Journal of Cetacean Research and Management.*

Plans are already underway with respect to (a) including inclusion of photographs, video, acoustic recordings and links to key publications and reports. Pertaining to (b), the Group prepared a proposed outline for the volume, with suggested authors/lead persons for each topic identified (see Annex G).

The Committee endorses the approach proposed. It **agrees** to the appointment of Bannister to lead the creation of the commemorative volume. An Editorial Board was nominated and tasked with responsibility for the volume's preparation.

The Committee **agrees** that the work contributing to the volume would be greatly facilitated by the preparation of some standard sighting datasets (for species other than Antarctic minke whales). The Secretariat kindly agreed to prepare such datasets from DESS in collaboration with knowledgeable scientists.

10.8.3.2 REPORT OF THE 2011/12 CETACEAN SIGHTING SURVEY IN THE ANTARCTIC
Plans for a dedicated sighting survey in the Antarctic in the 2011/12 austral summer season were presented last year and subsequently endorsed by the Committee (IWC, 2012f). The research vessels *Yushin-Maru No 2* and *Yushin-Maru No 3* were to survey in Area IIIE, Area IV and western part of Area V. The survey methods were to be the same as in IWC-SOWER surveys, and trackline design was improved to provide approximately uniform coverage probability. Furthermore, the planned sighting

procedure was in accordance with the guidelines agreed by the Scientific Committee (IWC, 2012x). Unfortunately no research activity could be conducted due to external violent interference by an anti-whaling group (SC/64/IA8).

The Committee **expresses regret** that these actions had prevented the sighting survey from being conducted as reportedly planned. Following the cessation of the IDCR/SOWER programme in 2009, these surveys now provide the only dedicated cetacean sighting data in this region of the Southern Ocean that might be used for abundance estimation, and as such are extremely valuable to the work of the Scientific Committee.

10.8.3.3 PLANS FOR CETACEAN SIGHTING SURVEYS IN THE ANTARCTIC IN THE 2012/13 SEASON

A systematic two-vessel sighting survey for abundance estimation is planned in the Antarctic in the 2012/13 season (SC/64/IA7) as part of JARPA II. The research area is south of 60°S in the Antarctic, in the eastern part of Area III, throughout Area IV and in the western part of Area V, between 35°E and 175°E from December 2012 to March 2013. Details of the cruise, which also incorporates biopsy sampling and photo-ID work are incorporated in Annex G, item 6.5. The cruise report will be prepared by researchers and submitted to next year's Annual Meeting.

The Committee reviewed and endorses the plans for the proposed sightings survey. Noting the insight gained in SC/64/Rep4 on internally-estimated cue rates, it suggests that efforts be taken to ensure accurate times of sightings in IO mode, so that delayed and simultaneous duplicates could be more readily distinguished. The Committee **agrees** that this will be useful for estimating abundance from these data, and also invited any further suggestions for improved survey protocols from the developers of the methods described in SC/64/IA2 and SC/64/IA13, based on lessons learned in completing their analyses.

10.9 Progress towards an in-depth assessment of North Pacific sei whales

SC/64/IA11 presented an abundance estimate of North Pacific sei whales using data from the 2011 IWC-POWER cruise. Standard line transect methodology was applied to estimate abundance, assuming $g(0)=1$. In order to examine the robustness of the abundance estimate to alternative stratification options and detection functions, a sensitivity analysis was conducted. The abundance estimate for the surveyed area in the eastern North Pacific (north of 40°N, south of the Alaskan Peninsula, between 170°W and 150°W), was 6,587 (CV=0.420). When data from recent cruises become available, a revised abundance estimate for North Pacific sei whales will be presented using the IWC-POWER sighting data from the period 2010-12.

The Committee also received the report of the intersessional Working Group that had been appointed last year to prepare for the assessment. The group saw no impediment to conducting the In-Depth Assessment (IDA) as planned in 2013. It is anticipated that analyses of sei whale sightings from the POWER surveys through 2012 will be available for the assessment. The IDA will not address the question of suitability of data for use in the RMP.

Work on the historical catch series has proceeded. Allison has received new data on Canadian historic catches that is being entered into the IWC database. The findings of a new analysis of Soviet North Pacific catch records are also being incorporated. Sei whale catches in the IWC database are higher than the true catches because protected species like fin and humpback whales were reported as sei whales.

The Committee was informed that Mizroch and Ohsumi have recently analysed a sample of Japanese coastal whaling log books, and found that the catches of sei and Bryde's whales are differentiated in the log books, while this is not the case in the IWC individual catch database, although the total numbers agree. The Committee **recommends** that this work be extended, in collaboration with Allison, to cover the years for which the IWC and Japanese figures differ. The Committee also **recommends** that the Secretariat be requested to consolidate other historical catch series for this species, and together with the Working Group, begin collating all available information in order to complete this assessment.

The Committee **recommends** that the sei whale IDA proceed as planned at the 2013 Annual Meeting. An intersessional Steering Group was appointed to oversee preparations (Annex Q14).

11. STOCK DEFINITION

This Agenda Item was established in 2000, when a Working Group was established (IWC, 2001c). This year, updated Terms of Reference were adopted by the Working Group to reflect the evolving needs of the Committee (Annex I, Appendix 2). Continuing its original purpose, the Working Group will develop a reference glossary of stock related terms, to aid consistent definition of 'stocks' in a management context for the Committee (see Item 11.4). The Working Group will also continue to develop guidelines for preparation and analysis of genetic data within an IWC context (see Item 11.1), and software that evaluates the management utility of various population genetic analyses (see Item 11.3). A major change stems from the Committee's request for the Working Group to discuss high-priority Committee papers related to population structure. The Working Group will now provide the Committee with feedback and recommendations concerning stock structure related methods and analyses used in those papers (see Item 11.2). The Report of the Working Group is given as Annex I.

11.1 Guidelines for DNA data quality and genetic analyses

Two sets of reference guidelines have been developed and endorsed by the Committee (IWC, 2009e) and form 'living documents' that can be updated as necessary. The first set addresses DNA validation and systematic quality control in genetic studies (SC/64/SD2). The second set provides guidelines for some of the more common types of statistical analyses of genetic data used in IWC contexts, and contains examples of management problems that are regularly faced by the Committee. Substantial progress on these latter guidelines was made during a small Workshop in April, and this document will now be completed intersessionally (see Item 11.5). Both guidelines will also be published in the peer-reviewed literature.

11.2 Statistical and genetic issues related to stock definition

A number of stock related papers were discussed by the sub-group at the request of the following sub-committees and Working Groups: Revised Management Procedure (Annex D), Aboriginal Whaling Management Procedure (Annex E), *pre-Implementation Review* of western North Pacific common minke whales (Annex D1), and Other Southern Hemisphere Whale Stocks (Annex H). Technical comments on these papers are given in Annex I.

Some general comments were made which are relevant to many papers submitted to the Scientific Committee. Firstly the Committee noted that uncertainty around point estimates is not always considered and urged that, where available, confidence intervals should always be reported in order that precision of estimates can be evaluated. Secondly, failure to reject a hypothesis, e.g. panmixia, is not equivalent to support for that hypothesis; strong statements of support should not be given to any null hypothesis that has not been rejected. Thirdly, there is often inconsistent treatment and interpretation of the genetic differentiation metric 'F_{ST}' amongst papers. Simplistic interpretations of this statistic should be avoided, such as conversion into migration rates, as these can misinform management scenarios.

The Committee **agrees** to compile results from past RMP trials of various species intersessionally, in order to try to identify where there were 'tipping points' in inter-population migration rates which made significant differences to trial outcomes, i.e. at what level does migration make a difference for each species? Such information may help to better define the parameter space over which inter-population migration rates are informative to management. This work will be presented at the 2013 Annual Meeting (see Item 11.5) and can be carried out in conjunction with projects being undertaken by the sub-committee on the RMP and the SWG on the AWMP (see Annexes D and E respectively).

11.3 Progress on the Testing of Spatial Structure Models (TOSSM)

The aim of TOSSM (IWC, 2007a) is to facilitate comparative performance testing of population structure methods intended for use in conservation planning. From an IWC perspective, the TOSSM software package allows evaluation of methods for detection of genetic structure, in terms of how well the methods can be used to set spatial boundaries for management. It is available for all to use and simulated datasets exist for three of the five stock-structure Archetypes previously proposed by the Committee (IWC, 2010d, p.51).

TOSSM is also a flexible simulation tool for investigating how certain observed genetic phenomena might arise among animals such as whales whose life histories are not well described by classical genetic theory. A practical example of this is provided by the Pacific Coast Feeding Group (PCFG) of eastern gray whales (see Annex E), which appears to be genetically different from the northern Aleutian feeding ground, yet also receives immigrants from it (which would be expected to influence observed genetic differentiation). Simulation testing of various immigration scenarios in the TOSSM framework was carried out in SC/64/AWMP4 (Annex E). The Committee welcomes this paper and noted its value in exploring the range of scenarios compatible with the observed differentiation, as it investigates a range of factors, including the degree and timing of isolation and effective population size of the PCFG. The results have informed the current *Implementation Review* of gray whales (Annex E, item 2.2.2). Some longer term work items were suggested for this study: (1) to incorporate a minimum female calving interval into the most realistic (9-stage) life history model; (2) to report results using summary statistics that are as independent as possible (and therefore provide multiple checks on the similarity between the simulations and the observed data); and (3) to identify research needs for future field surveys in order to improve current parameterisation of the models.

11.4 Terminology and unit-to-conserve

Defining and standardising the terminology used to discuss 'stock issues' remains a long standing objective of the Working Group, in order to help the Committee report on these issues according to a common reference of terms. A suite of definitions for Committee terms such as 'population', 'subpopulation', 'stock', 'sub-stock' and 'management unit' was provided in SC/64/SD3 as a first effort to build a 'living' glossary of stock related terms, with reference to past discussions within the Working Group and to terminology applied in other management contexts. This glossary will be developed intersessionally by members of the Committee, who will also try to come up with a series of agreed criteria for classifying population units by these terms, with reference to their usage in other management and conservation contexts (see Item 11.5).

11.5 Work plan

The Committee's view of the work plan is given under Item 21.

12. ENVIRONMENTAL CONCERNS (E)

The Commission and the Scientific Committee have increasingly taken an interest in the possible environmental threats to cetaceans. In 1993, the Commission adopted resolutions on research on the environment and whale stocks and on the preservation of the marine environment (IWC, 1994a; 1994b). A number of resolutions on this topic have been passed subsequently (e.g. IWC, 1996; 1997a; 1998; 1999a; 1999b; 2001b). As a result, the Scientific Committee formalised its work on environmental threats in 1997 by establishing a Standing Working Group that has met every year since then. Its report this year is given as Annex K.

12.1 State of the Cetacean Environment Report (SOCER)

SOCER provides an annual update, requested by the Commission, on: (a) environmental matters that potentially affect cetaceans; and (b) developments in cetacean populations/species that reflect environmental issues. It is tailored for a non-scientific audience. The 2012 SOCER (SC/64/E2) was restricted to the Indian Ocean as the regional focus, due in part to reduced funding. A primary source of information was the International Indian Ocean Cetacean Symposium, held in 2009 in the Maldives[15]. Overall, the awareness of environment-related threats to cetaceans is high in the region, but implementation and control measures are poor. However, this provides an opportunity to introduce best practices, state-of-the-art procedures for critical issues such as fisheries interactions, ship strikes, whalewatching, and new, well-thought-out Marine Protected Areas.

During discussion, it was noted that marine research in the Indian Ocean region is focused in a few locations, despite having expanded over the past five years. Cetacean, or indeed environmental, research is scant or absent in many areas and there are few peer-reviewed reports from the region. The Committee was pleased to learn that the next issue of *J. Cetacean Res. Manage.* (published this year) contains 15 peer-reviewed papers from the Indian Ocean.

Highlighting specific issues in the region, there are clearly 'hotspots' in terms of pollution, fisheries bycatch and environmental degradation (e.g. Arabian Gulf). Reports of mass mortality events (152 small cetaceans in Iran in

[15]*http://www.mrc.gov.mv.*

September 2007, spinner dolphins and striped dolphins in two events, and 200-250 pantropical spotted dolphins in Pakistan in March 2009) on the northern coast of the Indian Ocean are particularly concerning because these three species do not usually mass strand in these numbers and the latter event occurred the day after the commencement of a multi-national naval exercise (AMAN 09) in Pakistani waters.

Next year the focus of the SOCER will be the Atlantic Ocean region and the SOCER editors request Committee members provide input, preferably in the form of pdf files, of papers published between 2011 and 2013.

12.2 Pollution

POLLUTION 2000+ is a long standing programme of the Committee. Three goals were identified at the IWC Intersessional POLLUTION 2000+ Phase II Workshop (IWC, 2011e):

(1) develop integrated modelling approaches and risk assessment framework for evaluating the cause and effect relationship between pollutant exposures and cetacean populations;
(2) identify data needs and available datasets or case studies that would be appropriate for the models that are exposure driven, source driven or effects driven; and
(3) develop a prioritisation framework to evaluate the broad number of environmental pollutants.

12.2.1 Update on POLLUTION 2000+ Phase II progress

At the intersessional POLLUTION 2000+ Phase II Workshop held in 2010 (IWC, 2011e), four objectives for the cetacean pollutant exposure and risk assessment modelling component were agreed: (1) improve the existing concentration-response function for PCB-related reproductive effects in cetaceans (completed in 2011); (2) derive additional concentration-response functions to address other endpoints (e.g. survival, fecundity) in relation to PCB exposure; (3) integrate improved concentration response components into a population risk model (individually-based model) for two case study species: bottlenose dolphin and humpback whale (completed in 2011); and (4) implement a concentration-response component for at least one additional contaminant of concern. The authors of SC/64/E5, funded by the IWC, investigated how contaminant-induced effects on immune function could be incorporated into the existing individual-based population framework constructed to assess the impact of polychlorinated biphenyls (PCBs) on cetacean populations (Objective 2).

By determining how the blubber PCB annual accumulation rates relate to concentrations in breeding females, comparisons with empirical data can be made and predictions about effects on various populations formulated. For example, based on the current blubber PCB concentrations determined in breeding females from two bottlenose dolphin populations in Sarasota Bay and St Joseph Bay, Florida, the model predicts that these populations would remain stable or increase slightly over the 50-100 year timescales projected. Conversely, the bottlenose dolphin population in Brunswick, Georgia, where PCB levels in breeding females are 10 times higher, is predicted to decline over the same period without external population inputs through immigration.

In the future, impacts on other populations and species, such as humpback whales from the Gulf of Maine will be investigated (e.g., Hall *et al.*, 2011), as additional contaminant data for females become available. In addition, future developments of this model will include a sensitivity analysis; incorporation of a bioaccumulation model to estimate blubber concentrations for populations or species in which only levels in prey are known; and making the model available online with a user-friendly interface.

During discussion (see Annex K), it was noted that body condition of cetaceans may have a significant effect on susceptibility to impacts from contaminant exposure. For example, body condition could affect immune function independently so when food is limited and animals are in poor condition this will further affect their ability to fight off pathogens. Furthermore, if PCBs are released from the blubber during periods of increased energy demand then more may be bioavailable. Although the current model does not account for body condition, the final phase of the project will incorporate a toxicokinetic model that will include body condition parameters, similar to an approach taken by Hickie *et al.* (1999).

The Committee **recognises** that cetaceans are exposed to a mixture of environmental contaminants. It **suggests** that, if possible, mixtures of contaminants should be added to the model. Due to the extremely high levels of PCBs measured in the bottlenose dolphins in Brunswick, Georgia, USA, the Committee **strongly recommends** the continued monitoring of this population. The Committee **commends** the authors for the most recent results from the IWC's POLLUTION 2000+ programme and **strongly supports** their continued work to develop the necessary tools for analyses of pollutant exposure risk to cetaceans.

12.2.2 Oil spill impacts

12.2.2.1 UPDATE ON RESPONSE TO DEEPWATER HORIZON OIL SPILL IN THE GULF OF MEXICO

An update on the 2010 Deepwater Horizon (DWH) oil spill in the Gulf of Mexico was provided, where the injury assessment for cetaceans continues. The Natural Resource Damage Assessment (NRDA), a formal process in the USA to assess damages to natural resources, has included photo-ID, remote biopsy, live capture health assessments and evaluation of stranding data for common bottlenose dolphins in nearshore waters. Analyses of tissue, blood, and urine samples from cetaceans in the Gulf of Mexico for PAHs and PAH metabolites have also continued, as outlined in the NRDA plans.[16]

In addition to the NRDA, an Unusual Mortality Event (UME) is ongoing in the northern Gulf of Mexico principally involving bottlenose dolphins[17]. The UME involved 745 cetacean strandings in the Northern Gulf of Mexico from 1 February 2010-10 June 2012, which started before the DWH oil spill. The historical average (2002-09) for this area is 74 dolphins per year. The vast majority (95%) of stranded dolphins have been found dead; however, 35 stranded alive and seven were taken to facilities for rehabilitation. The UME is still ongoing, however stranding rates in the Northern Gulf in April and May 2012 were near-average.

Although it is typical to see strandings of dolphins less than 115cm (perinates) in the spring, there was a marked increase in strandings of this age class in spring 2011. Of these perinatal dolphin strandings, most were found to have died *in utero*. Twelve of 51 cases targeted for testing were positive for *Brucella,* and 8 cases were confirmed to have died of brucellosis. Compared to 2011, the number of stranded perinatal dolphins was lower during the spring of 2012. Three additional cetacean studies related to the DWH

[16] *http://www.gulfspillrestoration.noaa.gov.*

[17] *http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico 2010.htm.*

spill are underway in the Gulf of Mexico, including two passive acoustic surveys and one tagging study of sperm whales.

The Committee **commends** this research related to the DWH oil spill and **strongly recommends** continued investigations into the impacts of the DWH oil spill on cetaceans, including exposure to oil spill related contaminants, biomarker investigations and health assessments. Furthermore, it **encourages** the early and full reporting of the findings of DWH studies into the public domain.

12.2.2.2 CAPACITY BUILDING REGARDING OIL SPILL IMPACTS ON CETACEANS

In 2011, the Committee agreed that there was significant need and interest in cross-training between the oil spill and marine mammal communities and established an intersessional e-mail group to evaluate the possibilities for such training (Annex Q19; IWC, 2012o). As part of an effort to better understand and be prepared for oil spills and their impacts on marine mammals particularly cetaceans, workshops and planning exercises are underway or have taken place including: (1) an oil spill response workshop held at the International Conference on Marine Mammal Protected Areas (ICMMPA)[18]; and (2) dissemination of information and data on marine mammals at international meetings on oil spill response or with oil spill responders.

The ICMMPA workshop included presentations from the Regional Marine Pollution Emergency Information and Training Centre (REMPEITC) in the Wider Caribbean Region and the Oiled Wildlife Care Network, industry, oil spill responders, and marine mammal scientists and managers. A number of recommendations developed at the workshop were reviewed and found similar in nature to those discussed last year (IWC, 2012o), in particular the desirability of companies, agencies, stakeholders and international organisations to work in cooperation with marine mammal specialists on oil spill response plans.

In discussion, the Committee noted that some response plans that are currently under development, especially those related to the Arctic, focus on identifying sensitive areas for marine mammals. However, in most areas, important baseline data are lacking and the Committee **recommends** that these data gaps be filled. It also **recommends** that oil spill response efforts throughout the world should include pelagic as well as coastal areas; further information on current capacities and mechanisms of oil spill recovery will be valuable. Last year, the Committee noted that a review of the capacity for oil spill response in the Arctic was an urgent priority in the aftermath of the DWH oil spill (IWC, 2012o). The Committee **agrees** that the recommendations from the 2011 MMPA workshop in Martinique will provide guidance on oil spill prevention and response in the Arctic at the upcoming intersessional Arctic Anthropogenic Impacts Workshop (see Item 12.5.3).

12.2.3 Other pollution related issues

Fossi provided information on Mediterranean odontocetes exposed to environmental stressors, in particular to persistent organic pollutants, emerging contaminants, polycyclic aromatic hydrocarbons (PAHs) and trace elements. In Panti *et al.* (2011), the response of 'gene expression biomarkers' was evaluated in Mediterranean striped dolphin in three sampling areas: the Pelagos Sanctuary (Ligurian Sea), the Ionian Sea, and the Strait of Gibraltar. The mRNA levels of five putative biomarker genes were measured for the first time by quantitative real-time PCR in cetacean skin biopsies. Striped dolphins from the Pelagos Sanctuary are more exposed to ecotoxicological hazards than those inhabiting the Ionian Sea and the Strait of Gibraltar. This evidence focuses attention on the potential risk to cetaceans inhabiting the largest pelagic MPA in Europe and the Committee **stresses** the importance of effective and long-term management of MPAs in order to preserve species in their habitats.

The sources of these contaminants in the study areas are unknown. The Committee **recommends** that the sources be identified, particularly for animals within the Pelagos Sanctuary, to enable the development and implementation of mitigation measures.

In 2005, the Conservation Committee agreed that a research programme to address the issue of inedible 'stinky' gray whales caught by the Chukotkan aboriginal subsistence hunters should be established (IWC, 2006a). This year, the Committee examined IWC/64/CC10, which presented information on the various chemical compounds measured in tissues of malodorous ('stinky') and clean gray whales collected from 2005 through 2011. These included PAHs, persistent organochlorines, benzene derivatives and chlorinated PAHs. The authors commented that the odorous carbonyl compounds measured in tissues of 'stinky' whales may be a result of slow metabolism of petroleum hydrocarbons that occur in the Pacific Ocean. They also noted concentrations of persistent organochlorines in the gray whale tissues were low or not detected (DDT).

It was noted (see Annex F) that the finding of non-detectable DDTs is in contrast to the finding of measurable DDT levels in gray whale calves and mothers sampled in the lagoons in the Baja California region reported in SC/64/E4. Differences in DDT levels among these gray whales are most likely due to differences in contaminant levels on their feeding grounds although levels are generally low. The Committee **emphasises** that a clearer indication of which samples were 'stinky' and which samples were controls would make the information provided easier to interpret. Due to the lack of clarity in this regard (IWC/64/CC10), no new conclusions could be drawn regarding 'stinky'gray whales. The Committee **reiterates** its previous **recommendations** (e.g. IWC, 2006c; 2007f; 2008j; 2009f) that futher efforts be made to determine the cause of the 'stinky' whale condition.

12.3 CERD (Cetacean Emerging and Resurging Disease)

In 2007, the Committee recognised the need for increased research and standardised reporting in a wide range of disciplines dealing with cetacean health (IWC, 2008j), which led to the creation of the Cetacean Resurging and Emerging Disease (CERD) Working Group.

12.3.1 Update from CERD Working Group

An update to the CERD Work Plan agreed last year (IWC, 2012p) was presented. This work plan included:

(1) identification of regional and national experts/points of contact via Steering Committee membership;
(2) creation of a listserve and a website;
(3) creation of a Framework Document; and
(4) identification of and contact with organisations synergistic with the goals of CERD.

The CERD working group (WG) made significant progress on all tasks, except on the Framework Document, where work is now underway to better define the long-term vision and goals for the CERD working group.

[18]*http://www.second.icmmpa.org.*

12.3.2 Progress on CERD website

The CERD website is being developed in two phases. The first phase focuses on large cetacean species and relies on a 'consultation and sharing' approach. The second phase is intended to include all cetacean species and incorporate a potential 'reporting' role. This website will have 'public' and 'registered user' levels. The public level will provide basic information on diseases in cetaceans, as well as access to selected discussion forum content. Registered users will have full access to the site, including in-depth information on cetacean disease, as well as to discussion forums with posting ability. On the main page, a 'map it' feature will allow registered users to record geographic locations of disease incidents, while a 'current events' header will alert website visitors to recent events in cetacean disease and facilitate international communication. Links will be provided for quick access to discussion boards that can be shared with groups focused on other topics such as pollution, ship strikes and marine debris.

It was noted that researchers examining photographs on the website may be able to distinguish between wounds from entanglements, ship strikes or marine debris and this discussion underlined the overlap among these areas. The Committee **agrees** that it will be useful to incorporate standardised tissue collection protocols on the CERD website. The Committee thanked the CERD WG and the Secretariat for their efforts on developing the website and **encourages** continued development of this tool.

12.3.3 Other disease related issues

SC/64/E1 presented the results of a study of six *Morbillivirus*-infected cetaceans stranded along the Italian coastline between 2009 and 2011. The authors concluded that: (1) *Morbillivirus* infection continues to represent a major threat to cetacean health and conservation in the Mediterranean Sea with an increasingly expanding 'host range' of the virus; and (2) the cases of morbilliviral infection characterised by an apparently exclusive involvement of the animal's brain tissues are a matter of concern, both from the conservation and from the comparative pathology standpoints, thereby underscoring the role of cetaceans as models for the study of their human neurological disease counterparts.

Discussion (Annex K) focused on the types of tests and assays performed on these animals and the need for increased surveillance for neurologic diseases in cetaceans. The Committee welcomed this study and **encourages** further studies on these pathogens in cetaceans.

The Committee also noted that there was worldwide press coverage over the recent (February-May) unusual mortality event (UME) of about 900 dead long-beaked common dolphins, *Delphinus capensis*, in Peru, but based on these press reports there remains considerable uncertainty about the cause of this UME. However, no scientific reports were available on this UME for the Committee to review, but the they look forward to receiving reports on the UME next year.

In SC/64/E4 preliminary results were presented on contaminant levels (Organochlorine Compounds - OCs) and biomarkers from biopsies in the San Ignacio Lagoon (Mexico). These preliminary data reveal an accumulation of OCs in gray whale calves resulting from the lactational transfer of these compounds from their mothers. Exposure to OCs (such as DDTs) at early life stages may have toxic impacts on their developing endocrine, immune and neural systems. The paper is discussed fully in Annex K.

The Committee welcomed this paper, noting its relevance to the IWC's POLLUTION 2000+ programme and **encourages** continued studies.

SC/64/E8 provided a review of diseases and micro-organisms, as well as the public health and conservation impacts from cetaceans that stranded in Costa Rica during 2004-11. Humans and cetaceans affected by marine *Brucella* can develop severe disease such as neurobrucellosis and osteomyelitis, and the authors concluded that conservation policies should support research that investigates incidence, prevalence, geographic distribution and host range of *Brucella* infection in cetaceans. The paper is discussed fully in Annex K.

The Committee **welcomes** this paper, noting that data obtained from studies such as this are part of 'The One Health' concept - a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment[19]. The Committee recognised *Brucella* as an important zoonotic pathogen and **encourages** additional research on this disease agent.

12.4 Anthropogenic sound

In 2010, the Committee reviewed evidence of masking of cetacean calls from anthropogenic sound, with an emphasis on low-frequency sounds (<1kHz) from commercial shipping and airguns used during seismic surveys (IWC, 2011j). It had recommended that: (1) the masking potential of anthropogenic sources be quantified and acoustic measurements be standardised; and (2) IWC member governments work to develop a quantitative approach for assessing cumulative impacts of anthropogenic sound on cetaceans.

12.4.1 Mitigation of effects of anthropogenic sound on cetaceans

US federal regulations require scientists and representatives of offshore industries to acquire incidental harassment authorisations for activities that may disturb marine mammals, but the potential impacts of sound are often considered on a project-by-project basis in isolation from one another. This precludes meaningful analysis of cumulative impacts from multiple sources. In response to consideration of offshore industrial activities in the Alaskan Arctic, Moore *et al.* (2012) proposed a three-step assessment framework based development of *acoustic habitats*, which constitute the aggregate sound field from multiple sources compiled at spatial and temporal scales consistent with the ecology of Arctic marine mammals. Assessment framework steps include: (1) the development of acoustic habitat maps depicting anticipated sound fields from multiple sources; (2) an overlay of acoustic-habitat maps with marine mammal seasonal distribution and density maps to identify areas or periods of concern and data gaps; and (3) development of precautionary measures to protect marine mammals from potential impact and a prioritisation of data gaps and research needed to address those gaps.

In the US, the Cetaceans and Sound (CetSound) project is now working toward mapping products envisioned in the first two steps of this framework[20]. The CetSound project consists of two working groups convened to develop mapping tools: the Underwater Sound-field Mapping (SoundMap) and the Cetacean Density and Distribution Mapping (CetMap). The overarching objective of the SoundMap group is to create maps depicting the temporal, spatial and spectral characteristics of both chronic (e.g. shipping) and episodic

[19] *http://www.onehealthinitiative.com/index.php* and *http://www.oie.int/en/.*
[20] *http://www.cetsound.noaa.gov/index.html.*

(e.g. seismic survey) underwater noise. The overarching objective of the CetMap group is to create regional cetacean density and distribution maps that are time- and species-specific, using survey data and models that estimate density using predictive environmental factors. To augment the more quantitative density mapping and provide additional context for impact analyses, the CetMap group is also identifying known areas of specific importance for cetaceans, such as reproductive areas, feeding areas, migratory corridors, and areas in which small or resident populations are concentrated. The Committee **commends** the initial development of these powerful mapping tools, **endorses** this work and **strongly recommends** support for further development and improvement of these tools.

The Committee also **welcomes** the information on work being undertaken regarding noise by IUCN's Western Gray Whale Advisory Group and especially its Noise Task Force[21] (see Annex F).

12.4.2 Other anthropogenic sound related issues

Underwater noise from commercial shipping is chronic (IWC, 2011j). The IMO has established a correspondence group (CG) to develop non-mandatory guidelines to address noise from commercial ships; the IWC Secretariat participates in this group (IWC/64/4G). The IMO CG will finish the first draft of their report by the end of 2012 and it will be presented to the IMO in early 2013. The Committee **commends** the continued discussions between the IMO and IWC regarding efforts to reduce noise of newly built vessels. Further, it noted the importance of identifying ship acoustic signatures and **encourages** the collection of these data, as well as the coupling of this information with the appropriate automatic identification system data.

At past meetings, the Committee has received updates on the development of a modelling effort to determine the Population Consequences of Acoustic Disturbance (PCAD) on marine mammals initially proposed by the US National Research Council in 2005. In 2009, the US Office of Naval Research supported a Working Group whose objectives included building a formal mathematical structure for the framework, which led to key adaptations to the original framework, including the incorporation of other sources of disturbance, physiological change and the use of health as the primary metric through which changes in individuals can potentially impact the population. Combined, this led to the framework being renamed the Population Consequences of Disturbance (PCoD). The SWG noted that PCoD is a significant improvement on the PCAD model. Although the current model focuses on single stressors, accumulative effects, behavioural responses and other factors (e.g. acoustic masking) that could potentially affect health could also be added to the model. The SWG **strongly encourages** further work on this model and looks forward to progress updates.

12.5 Climate change

12.5.1 Progress on recommendations from the 2nd climate change Workshop

At the 2nd climate change Workshop (IWC, 2010k), three themes were recommended with regard to the study of cetaceans in the Arctic: (1) single species-regional contrast; (2) trophic comparison; and (3) distribution shift. With regard to the first theme, results of passive acoustic sampling in 2008/09 provided a means to compare seasonal patterns in call detection from bowhead whales in the B-C-B and Spitzbergen stocks, providing a contrast in seasonal occurrence for this species between the Atlantic and Pacific sectors of the High Arctic (Moore *et al.*, 2012). Details of this work are discussed in Annex K.

As also discussed in Annex K, an overview of a new programme was received which was called the Synthesis Of Arctic Research (SOAR). It is a US-based activity, which aims to bring together a multidisciplinary group of Arctic scientists and Alaskan coastal community representatives to explore and integrate information from completed and ongoing marine research in the Pacific Arctic sector[22]. While SOAR is not focused specifically on cetaceans, eight projects under its auspices will focus on aspects of beluga and bowhead whale ecology, which are related to the three study themes of the 2nd climate change Workshop.

The Committee **welcomes** these updates on cetacean-related science in Arctic waters, **endorses** the work undertaken thus far and requests future updates.

12.5.2 Small cetacean restricted habitats Working Group

Building upon the work of an intersessional working group to further recommendations made at the IWC Climate Change Workshop in 2010 (IWC, 2012w), the Committee **agrees** to the following definition:

The spatial extent of the range occupied by these populations may vary by orders of magnitude, but one or more of the following conditions apply: (1) the species/population has narrow habitat requirements; (2) the habitat is bounded by physiographic or oceanographic barriers; and (3) other suitable habitat which the population might be able to access is unavailable because it is occupied by competitors. The first two conditions might apply to fixed populations, such as the vaquita - the third condition in particular requires further consideration and development. These conditions may also apply to populations of large whales (e.g. fin whales in the Mediterranean Sea and the Gulf of California) and it was agreed that large whales would be considered in future discussions on this topic.

The Committee **welcomes** this effort to further advance our understanding of the potential impacts of climate change in cetaceans. However, it also **urges** caution with regard to which populations and species should be focused upon with respect to climate change, so as not to detract from efforts to address more imminent threats and stressors such as bycatch. Creating a list of species or populations to which this definition might apply was suggested as one way to further develop the topic. The Committee also noted the importance of integrating and considering the findings of climate change-related analyses that have been conducted for other marine mammal species (e.g. polar bears and ice seals) when considering the issue for cetaceans.

12.5.3 Planning for an intersessional arctic anthropogenic impacts Workshop

In 2010, the Commission asked the Committee to develop an agenda for a Workshop on Arctic Anthropogenic Impacts on Cetaceans (IWC, 2011a). Last year, a draft agenda was completed and a Steering Group formed (IWC, 2012q) to further develop a plan for the Workshop. A revised agenda that focused on anthropogenic activities related to oil and gas exploration, commercial shipping and tourism was developed intersessionally. The Committee noted that the Workshop agenda should be expanded to include consideration of other anthropogenic activities such as commercial fishing and scientific research. Given rapid

[21] *http://www.iucn.org/wgwap/wgwap/task_forces/.*

[22] *http://www.arctic.noaa.gov/soar/.*

environmental changes and increasing human activities in the Arctic, the Committee **encourages** the continued development of an arctic anthropogenic impacts Workshop focused on climate change, but **strongly recommends** that it:

(1) carefully define the geographical area to be addressed;
(2) focus only on Arctic cetacean species (i.e. bowhead whales, white whales, and narwhals);
(3) consider a broad suite of anthropogenic activities; e.g. oil and gas development, commercial fishing, commercial shipping, tourism, continental shelf mapping and scientific studies;
(4) specifically include possible impacts from underwater sounds, spilled oil, dispersants, invasive species and discharges (including dumping of ballast water) related to exploratory drilling and shipping; and
(5) include a discussion about assessing the cumulative and synergistic impacts of anthropogenic activities.

The topic of anthropogenic impacts to cetaceans in the Arctic is broad and complex and the Committee **recommends** that the process should involve an initial scientific Workshop followed by a more inclusive Commission meeting that addresses management and policy aspects of arctic anthropogenic impacts on cetaceans. It is anticipated that final specification for the scope, agenda and schedule for the Workshop will be undertaken jointly by the Workshop Steering Group and representatives of the IWC and Secretariat.

12.5.4 Other climate change related issues

The IMO is working to develop a mandatory Polar Code to manage the increases in ship traffic in Arctic and Antarctic waters anticipated with the reduction of sea ice associated with climate change (IWC/64/4). The Polar Code work is coordinated by the sub-committee on Ship Design and Equipment, as is the work regarding ship quieting (see Item 9.2). The IWC's endorsement of noise reduction goals (i.e. 3dB in 10 years; 10dB in 30 years) advanced at an international Workshop on shipping noise and marine mammals (Wright and Okeanos Foundation for the Sea, 2008) were re-iterated in a document entitled *Status on Implementation of the Arctic Marine Shipping Assessment 2009 Report Recommendations*, available on the Arctic Council website[23]. The Committee **welcomes** this information, **reiterates its endorsement** of noise reduction goals and looks forward to continued collaborations between the IWC and the IMO on this topic.

12.6 Interactions between MREDs and cetaceans

Given information and a review provided last year, the Committee had endorsed a proposal for a Workshop on interactions between marine renewable developments (MREDs) and cetaceans. That Workshop was held immediately prior to the present Annual Meeting and its report is given as SC/64/Rep6.

Simmonds presented the report and noted that a variety of MREDs are now being deployed worldwide, with the highest concentrations in the Northern Hemisphere, especially in northern Europe. The three main forms of MREDs at this time are: (1) wind farms; (2) tidal-stream driven devices; and (3) wave energy converters. Each of these, as well as their supporting infrastructure, has the potential for interaction with cetaceans during the construction, operation and decommissioning phases (Simmonds *et al.*, 2010).

[23]*http://www.arcticcouncil.gov/pame/amsa/.*

The Workshop received detailed reports on the current state of development and management of marine renewable energy in waters of Germany, the UK, Belgium and the USA, including trans-boundary issues now arising in the busy waters of Europe (SC/64/Rep6, fig. 1). The Workshop focused on the three main types of MREDs and considered potential impact to cetaceans on aspects of 'supporting infrastructure' for MREDs. A number of papers and websites informed discussions throughout the Workshop (SC/64/Rep6, Appendix 2); of particular use was a special synthesis of the work on MREDs conducted by ICES (Murphy *et al.*, 2012).

The Committee noted that MREDs may well play a major role in the mitigation of climate change, which may profoundly affect cetacean populations as discussed at prior climate change Workshops (IWC, 1997b; 2010k). The Committee thanked Simmonds for the successful Workshop. In particular it **endorses** the Workshop's conclusions and recommendations (see especially SC/64/Rep6, item 5). These are briefly summarised below.

1. Strategy to minimise risk

Risks from both lethal and sub-lethal effects can be minimised via a series of actions; the collection, collation and analysis of appropriate baseline cetacean data and appropriate industrial data will allow the identification and quantification of threats and their potential implications for conservation objectives. All stakeholders need to be involved from the outset such that impacts from all factors are considered, ensuring that appropriate mitigation measures and associated monitoring programmes are developed. Suitable scientific evaluation and compliance mechanisms are needed to ensure that mitigation and monitoring are adequate.

2. Broad management

Governments, managers and other stakeholders need to co-operate in strategic planning for MREDs taking into account the trans-boundary nature of cetaceans. Uncertainties over the level of impacts require a staged approach to developments taking into account lessons learned from other developments and other human activities that affect cetaceans, in order to be adequately precautionary. IWC member governments can assist in encouraging the development of international collaboration in this regard, and in particular, they can assist in emphasising the importance of incorporating consideration of cetaceans from an early stage and the value of following the broad strategy and principles outlined in the Workshop report and summarised in Fig. 3.

3. 'Fundamental' research

International collaboration will be required to determine population structure, status, distribution and procedures for assessing impacts. The Committee can assist with design and evaluation of population and impact assessments. While there are established methods for assessing lethal takes, data on the effects of (sub-lethal) stressors on cetaceans are also needed.

4. Evaluation of threats

All lethal and non-lethal impacts of human activities should be considered in an integrated manner, e.g. using modelling approaches that take into account the cumulative impacts from all threats when evaluating whether conservation objectives are likely to be met.

The Committee has considerable expertise in developing management frameworks and testing their performance against specified objectives.

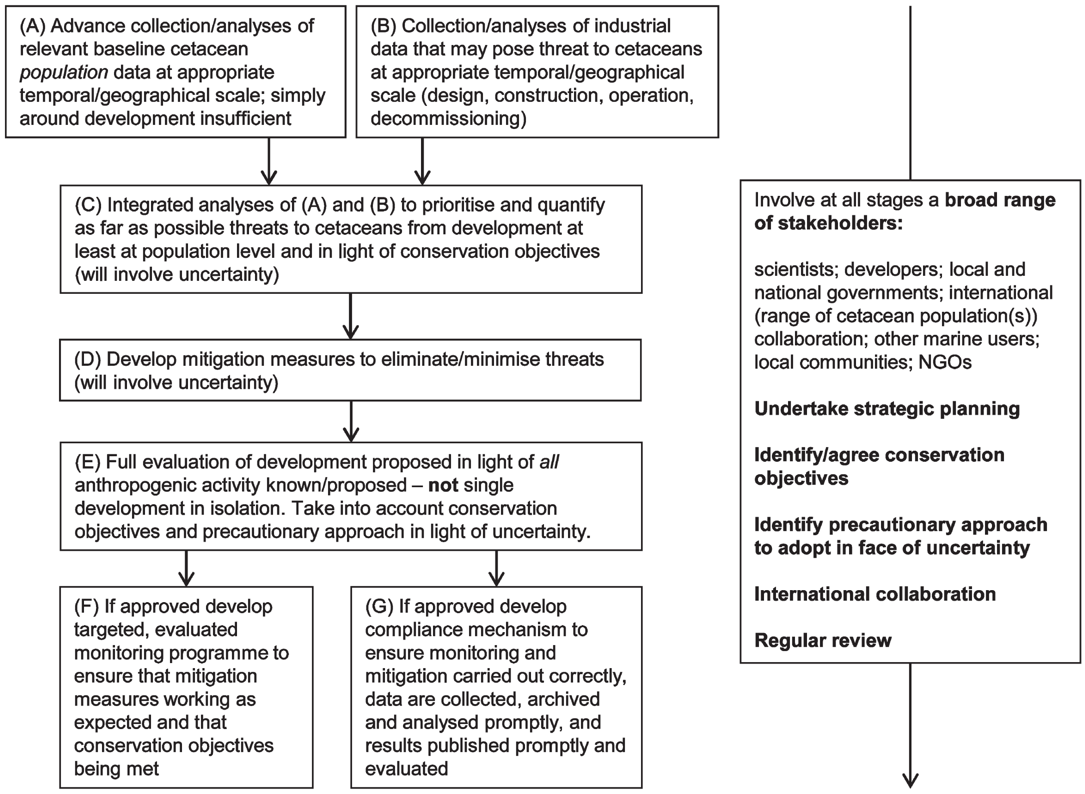

Fig. 3. Simplified schematic summary of a general strategy and principles to minimise environmental threats posed by MREDs. Some stages will occur in parallel and will involve feedback. See report for details.

5. Monitoring
Monitoring should be designed carefully, to assess impacts against pre-determined conservation objectives and to measure the efficacy of any mitigation measures that are implemented.

6. Data sharing and the future role of the IWC Scientific Committee in the consideration of MREDs
Improved information and data-sharing were identified as key and the Workshop encouraged the Committee to continue to act as a forum to review the development of MREDs and their implications for cetaceans, including promoting the sharing of data. Countries were encouraged to help in this by providing appropriate information.

In addition to the Workshop report, the Committee received information from two papers on the topic of interactions between cetaceans and MREDs focused on waters offshore of Scotland (SC/64/E3) and a preliminary assessment of the effectiveness of small Marine Protected Areas (MPAs) to protect dolphins in offshore Wales (SC/64/E6).

It also received an update on Chilean renewable energy projects (SC/64/E12) and noted that consideration should be given on the impacts of coastal wind farms, particularly in regions that support critical habitats for cetaceans. The Committee **strongly recommends** urgent development of environmental impact studies in this area of Chile and urges that a precautionary approach should be used with regard to critical cetacean habitats.

The Committee also **agrees** that there is an urgent need to develop or improve effective noise mitigation measures or quieter foundation installation methods, as noted in past reviews of anthropogenic sound (e.g. IWC, 2010g; IWC, 2012o).

12.7 Other habitat related issues
Primary papers submitted on topics related to other habitat related issues, included potential impacts of marine debris, cumulative impacts and results of a large-scale aerial survey programme in the French tropical EEZ.

12.7.1 Cetaceans and marine debris
In addition to receiving five papers on the topic of marine debris (SC/64/E7, SC/64/E10, SC/64/E13, SC/64/E15 and Fossi *et al.*, 2012), the SWG received the results from an intersessional Working Group (Debris WG) that had considered the issue of both ingestion and entanglement of cetaceans in marine debris. The intersessional group offered the following conclusions and recommendations:

(1) marine debris is a growing concern for marine wildlife in general, but its interactions with cetaceans are poorly understood;
(2) to better evaluate the potential impacts of marine debris on cetaceans and to provide a forum where relevant data can submitted, a Workshop on marine debris and cetaceans should be convened; and
(3) the primary aim of this Workshop would be to determine how to best investigate quantitatively the ways in which marine debris is affecting cetaceans and how best to monitor and mitigate for these effects. The Workshop could also consider how best to develop a centralised database to collate cases of debris interactions, including the development of standardised criteria for data to allow more certain identification of the types of debris and the interactions involved.

Two key issues fundamental to assessing impact of marine debris on cetaceans were identified: (1) how to distinguish cetaceans that have died in active fishing gear versus those entangled in debris (including abandoned, lost, discarded - or 'ghost' - fishing gear) and the need to identify the 'worst culprit' types of fishing gear causing entanglement; and (2) how to investigate the potential accumulation of debris in the deep sea feeding areas of beaked and sperm whales. In addition, more effort is needed to investigate the impacts of microplastics on cetaceans, including baleen whales, which potentially ingest micro-litter by filtration feeding (see Fossi *et al.*, 2012).

The Committee **recommends** that a Workshop on marine debris and cetaceans be held (Annex K, Appendix 3) noting also its relevance to the Working Group on Bycatch with regard to entanglement issues (see Item 7.8). A number of potential data sources for data on marine debris were identified including those of international bodies such as CCAMLR and well as national and local bodies in several countries. SC/64/Rep1 noted the work being undertaken by the USA, Korea and Japan and the Steering Group for the IWC-POWER cruises who are investigating how those cruises can contribute to international efforts to gather information on marine debris (see also Annex G).

12.7.2 Issues related to the March 2011 tsunami in the northwestern Pacific

Concerns have been raised with regard to increased marine debris transport to the eastern Pacific Ocean, as well as radioactive contamination of marine debris a result of the 2011 tsunami in Japan. Modelling efforts estimate that the bulk of the debris related to this event is probably dispersed north of the main Hawaiian islands and east of Midway Atoll[24]. Furthermore, as predicted by these modelling efforts, some buoyant debris reached the east Pacific coast from Oregon to Alaska during winter 2011-12 and continues to occur in the region. It is highly unlikely that debris transported from Japan to the eastern North Pacific poses a radioactive risk. However, transport of non-native, invasive species or pathogenic micro-organisms on tsunami-released debris could occur and pose a threat to eastern Pacific coastal ecosystems. Details of potential impacts of the tsunami-released marine debris on marine mammals and the potential increase in either ingested marine debris or risk of entanglement are summarised in Annex K. Discussion of some Japanese work related to the effects of the tsunami on the marine ecosystem also occurs under Item 17.

12.7.3 Cumulative impacts of anthropogenic activities

SC/64/E11 reported on cumulative impacts of several anthropogenic activities on cetaceans. While there are a number of quantitative processes for assessing the combined impacts of multiple stressors being developed, some are active and used in management. For example, five actions to mitigate cumulative impacts were developed during the permit cycle of the Greenland Bureau of Minerals and Petroleum for the mitigation of cetacean exposures to disturbance from seismic surveys, as given in Annex K.

The Committee **welcomes** information on efforts to develop effective tools to address concerns regarding cumulative impacts of anthropogenic activities on cetaceans. It was noted that the effects of climate change on marine ecosystems may compound the cumulative impacts of anthropogenic stressors, such as chemical pollutants and noise.

12.7.4 REMMOA aerial surveys in the French EEA

The Committee received an update of the REMMOA project (Mannocci *et al.*, Submitted; SC/64/E14), aimed at providing maps of hot spots for pelagic megafauna in the French tropical EEZ and some EEZs of neighbouring countries. The long-term objective of the REMMOA surveys are to establish a baseline of information on cetaceans and other pelagic megafauna diversity and relative abundance and to build up a monitoring strategy to be implemented in the future. Mannocci *et al.* (Submitted) presented analyses of the Caribbean-Guiana survey where the aim of the study was to document top predator communities in terms of encounter rates, composition, abundance and spatial distribution and to compare them between these two contrasting ecosystems. SC/64/E14 presented the analysis of the southwest Indian Ocean survey with a focus on comparing cetacean and other pelagic megafauna communities in areas characterised by contrasted oceanographic conditions. The Committee **welcomes** these updates and **encourages** the results of their work to be presented next year.

12.8 Work plan

The Committee expressed its great appreciation to Moore for her superb guidance and chairing of the SWG over the 5-year period of her service as Chair.

The Committee discussions of the work plan developed in Annex K are given under Item 23.

13. ECOSYSTEM MODELLING

The Ecosystem Modelling Working Group was first convened in 2007 (IWC, 2008i). It is tasked with informing the Committee on relevant aspects of the nature and extent of the ecological relationships between whales and the ecosystems in which they live. This advice is important to a number of other responsibilities of the Committee and the Commission has stated their interest in such work in a number of resolutions (IWC, 1999a; 2001b; 2002).

The Working Group's topics to address at this year's meeting were:

(1) review of ecosystem modelling efforts undertaken outside the IWC;
(2) explore how ecosystem models contribute to developing scenarios for simulation testing of the RMP; and
(3) review of other issues relevant to ecosystem modelling within the Committee.

The report of the Working Group on Ecosystem Modelling is given as Annex K1.

13.1 Review of ecosystem modelling efforts undertaken outside the IWC

13.1.1 Ecosystem modelling in the context of ecosystem-based fisheries management

SC/64/EM1 outlined several ecological questions relevant to whale populations that can be addressed by ecosystem models. These included: (1) what species and fisheries can potentially compete with whale feeding? (2) how would one evaluate the potential magnitude of such competition? (3) what are the potential indirect food web effects on whales? (4) what are the ecosystem tradeoffs that most warrant evaluation? (5) what are the best scenarios (to model) to mitigate any of these concerns? and (6) how well do such (simulated) scenarios perform? The author also provided a review of the major classes of ecosystem model being employed globally in an ecosystem-based management context, provided a map of ecosystem models as they relate to these and similar questions, and described how global best practices are being adopted in the use of these ecosystem models. A key message was that the choice of

[24]*http://www.marinedebris.noaa.gov/info/japanfaqs.html.*

model depends strongly on the questions being addressed. It is probably better to start with the simple multi-species models (with few components) or extended single-species models. The more complex multi-species models, food-web models or whole-system models are more suited to addressing broader questions.

SC/64/EM2 reported on efforts to place initial quantitative bounds on consumption estimates for a suite of marine mammals in the northeast US large marine ecosystem, including baleen whales, odontocetes and seals. Daily individual consumption rates were compiled from the literature and explored with sensitivity analyses to derive feasible ranges for each species which then could be raised to annual population-level consumption based on existing population abundance estimates. The results indicated that marine mammal consumption in this region might be similar in magnitude to commercial fishery landings for small pelagic and groundfish prey groups, although previous studies have indicated that targeted sizes may differ. Marine mammals probably consume as much prey as finfish predators, thus meriting continued evaluation despite the inherently wide confidence intervals of their consumption estimates.

The Committee **welcomes** this information, noting that with the move toward ecosystem-based management, consumption by marine mammals warrants inclusion as a source of natural mortality in assessments of mammal prey stocks. It also noted that reference points for marine mammal management, such Optimum Sustainable Production, had yet to be suitably defined in a multi-species context.

13.1.2 Ecosystem models of the effect on predators of fishing forage fish

Recent studies (Cury *et al.*, 2008; Fulton *et al.*, 2011; Pikitch *et al.*, 2012) have addressed the effects of exploitation of forage fish on their predators in several ecosystems, indicating that fishing of forage fish down to their MSY level can have major impacts on predators, including birds and marine mammals. In view of the importance of this issue to cetaceans, the Committee **agrees** that this should be a priority topic for next year.

13.1.3 Status update on NAMMCO ecosystem modelling

At last year's meeting, the Committee received an update on NAMMCO's initiative to implement a series of ecosystem modelling exercises in the Barents Sea and the waters around Iceland. This year, the Committee was informed that the efforts have been delayed due to a lack of funding. However, the Committee remains interested in receiving information on these exercises as it becomes available.

13.2 Explore how ecosystem models contribute to developing scenarios for simulation testing of the RMP

Recent discussions in the sub-committee on the RMP (e.g. IWC, 2011g) on variation of r and K values in the face of environmental variability has shown that it can be useful to try to model the effects of food availability more explicitly, because this can have implications for the effects of prey abundance on whale population dynamics. The Committee **emphasises** the value of implementing this in small steps rather than going immediately to complex models and **agrees** that consideration of simple models of whales and prey should be a priority issue for next year.

13.3 Review of other issues relevant to ecosystem modelling within the Committee

13.3.1 Update on Antarctic minke whale body condition analyses

Last year, the Committee discussed issues regarding the statistical significance of a decline (of about 0.2mm per year) in mean blubber thickness of Antarctic minke whales over the 18-year JARPA period reported by Konishi *et al.* (2008). The issues had been raised by de La Mare (2011), who found that the methods used by Konishi *et al.* (2008) could result in spurious apparent significance of trends because the nature of the sampling process and the associated components of the variance structure of the data were not taken into account. A reanalysis of the data at last year's meeting by Skaug (2012) using mixed-effect regression models to account for some of the additional variance structure resulted in a much higher variance of the estimated trend, but the point estimate changed little, and the estimated trend was still significant. Given the relevance of body condition indices to its work, the Committee agreed that further analysis of the data was warranted to determine: (1) whether the models fitted so far captured all the main features of the data; and (2) whether the estimate of trend (whose confidence limits using the best fitting model ranged from near zero to values that could be of appreciable biological significance) could be made more precise. The Committee requested, *inter alia*, results from analysing the two sexes separately and the inclusion of slopes by latitudinal band as a random effect. It also suggested that the authors of de la Mare (2011) and Konishi *et al.* (2008), apply for access to the data under Procedure B of the Data Availability Agreement, so that further analyses of these data could be reviewed by the Committee this year.

This year, de la Mare reported that he had applied for access to data through the Data Access Group but that a mutually satisfactory agreement was not reached. The generic data access questions raised in this case is discussed under Item 24. Pastene noted that Japan had offered to make available all data that had been requested by the Committee last year under the conditions of Procedure B (see Attachment B of SC/64/SCP1). De la Mare responded that conditions attached to the offer were in his opinion not in accordance with Data Access Agreement Protocol B and so were unacceptable.

In SC/64/EM3, he also presented an analysis of sex ratio and female length at 50% maturity using the JARPA data available in the IWC's catch database that showed unlikely trends and much higher levels of variability than would be expected in these parameters from a biological population. He noted that this indicated the presence of 'lurking variables' that had important effects on the dependent variable but that were not included in the predictor variables under consideration. Similar adverse effects could be present in the analyses of body condition described above, with possible sources of unaccounted variance including inter-annual variability in the locations and dates on which whales were taken, the spatial distributions of one or more biological populations and the co-effects of seasonality by sex and reproductive state. Using a statistical simulation of catches along random transects, SC/64/EM3 further showed that standard errors calculated using individual animals as the sample size underestimates the true variability because of spatial/temporal pseudo-replication, and that transects are the basic sampling units, not the individual catches.

There was considerable discussion of SC/64/EM3 and the implications for inferences on biological parameters derived from JARPA data. Some members emphasised that failing to estimate the variance associated with random transect placement means that the variances in the analyses of biological parameters will be underestimated such that hypothesis tests will be invalid. They further noted that the reported catch locations in the IWC database show that clearly identifiable transects that can be treated as replicates have not been realised and where transects are identifiable they have not been traversed in random time order. Consequently these members considered that the conditions for the appropriate analysis of the data have not been met.

Other members considered that non-independence can be accounted for by using jack-knife methods, as was done during last year's meeting with the blubber thickness data, using one year as the jack-knifing unit (IWC, 2012n). This approach showed that while the estimated SE increased from 0.0225 to 0.0836 on the regression slope (-0.213 mm/yr^{-1}), the slope estimate itself did not change and thus was still significantly different from zero at the 5% level. This jack-knife result should, according to these members, take care of concerns about dependence between observations. In addition, as mentioned above, mixed-effects models were also applied during last year's meeting to account for some of the additional variance structure resulting in a best model (based on the AIC criterion) with a slope of -0.19mm/yr^{-1} and SE=0.07; (Skaug, 2012, pp.259-62). In discussion, these members understood de la Mare to have claimed that these results did not take care of all possibilities for statistical dependence between whales (e.g. whales sampled on the same track line), but they considered it highly unlikely that such dependence could be so large as to destroy the findings of negative trends in blubber thickness, fat weight, girth or weight of stomach contents.

The Committee noted that valid conclusions can often be drawn from non-random samples as long as this is accounted for in the analysis. It further **recommends** that the authors of Konishi *et al.* (2008) investigate independence issues by using mixed-effects models with trackline as a random effect to address the concerns raised above. These authors will consider carrying out such analyses before next year's meeting.

13.3.2 Other issues

A decline in energy storage in Antarctic minke whales over almost two decades (Konishi *et al.*, 2008) suggests that food availability may have been declining recently. To test this hypothesis, at this year's meeting Konishi presented a paper (Konishi *et al.*, In review) that examined whether there was any annual trend in the stomach contents of the whales using catch data from 20 seasons in JARPA and JARPA II (1990/91-2009/10). Results from linear mixed-effects analyses showed a 39% (95% CI 3.2-47.3%) decrease in the weight of stomach contents over the 20 years. A similar pattern was found in both males and females, except in the case of females sampled at higher latitude (particularly in the Ross Sea), suggesting a decrease in the availability of Antarctic krill for Antarctic minke whales in the lower latitudinal range of the JARPA/JARPA II research area. However, prey availability has not changed in the Ross Sea, where both Antarctic krill (*Euphausia superba*) and ice krill (*E. crystallorophias*) are available. The decrease in Antarctic krill availability could be due to environmental changes or to an increase in the abundance of other krill-feeding predators. The latter appears more likely, given the rapid recovery of the humpback whale in the area and the fact that humpback whales are not found in the Ross Sea, where no change in prey availability was observed for minke whales.

There was considerable discussion of this paper, focusing on two main areas:

(1) statistical issues, similar in nature to those discussed above with respect to the blubber thickness analysis, in particular as to whether the analysis takes account of all components of variance and whether the statistical significance of the apparent trends is reliable; and
(2) the biological issues associated with the relationship between stomach fullness and food intake and between stomach fullness and prey availability.

With respect to the statistical issues, members repeated many of the points summarised above with respect to the blubber thickness analysis and made a number of suggestions regarding additional statistical treatment of the data (see Annex K1). The Committee **recommends** that these analyses be conducted if possible.

With respect to the biological issues, some members noted the importance of considering the stomach evacuation rate and its relationship to the timing of feeding. The strong decline in mean stomach contents over the day, as shown in the results, is indicative that most feeding is occurring at night. It is possible to envisage a situation where high food abundance would lead to whales being satiated relatively early in the night, such that by the next day their stomachs are not very full. Conversely, during periods of lower food abundance, feeding may be spread over a longer period, such that more food tends to be found in the stomach during the day. Thus, the direction of the relationship between food availability or intake and observed stomach content weight is not obvious *a priori*. In response, other members drew attention to information such as the negative trend in blubber thickness, which supported the lower food availability hypothesis. Data collected during JARPA on the freshness of food in the forestomach may provide further information on the timing of feeding, and the Committee **recommends** that these data be analysed.

The Committee **agrees** that for an understanding of the possible relationships between food intake and stomach fullness, analyses of the consequences of the diurnal patterns of food intake should be reported. Furthermore, alternative models for stomach evacuation (such as linear and exponential models) should be examined. The Committee **agrees** to keep the issue on the agenda for next year and **encourages** submissions on this issue.

13.4 Review new information on ecosystem model skill assessment

No new information was available for discussion on this topic.

14. SMALL CETACEANS (SM)

The Committee has been discussing issues related to small cetaceans since the mid-1970s (IWC, 1976). Despite the differences of views over competency (IWC, 1993a, p.31), the Commission has agreed that the Committee should continue to consider this item (IWC, 1995a).

14.1 Review status of ziphiid whales in the North Pacific and northern Indian Ocean

The last worldwide assessment on the status of ziphiids was in 1988 (IWC, 1989). Last year the Committee reviewed the status of ziphiids in the North Atlantic and adjacent waters (IWC, 2012r, Annex L). At this meeting, the priority is to review the status of the ten beaked whale species in the North Pacific and northern Indian Ocean (see text table over page). Considerable information was submitted for the review and details can be found in Annex L (see table overleaf for agenda items). Only a general overview is given here.

Ziphiids in the North Pacific and northern Indian Ocean.

Beaked whale species	Distribution	Item in Annex L
Cuvier's	Worldwide except polar waters	3.1
Blainville's	Tropical and warm-temperate waters worldwide	3.5
Baird's	Cold-temperate waters of the North Pacific Ocean	3.2
Hubbs'	Cold-temperate waters of the North Pacific Ocean	3.4
Stejneger's	Cold-temperate waters of the North Pacific Ocean	3.9
Pygmy	Mainly in the Eastern Tropical Pacific (ETP)	3.8
Perrin's	Poorly known – few California specimens	3.7
Ginkgo-toothed	Poorly known – tropical and warm-temperate Indian and Pacific Oceans	3.6
Longman's	Poorly known – tropical and warm-temperate Indian and Pacific Oceans	3.3
Deraniyagala's	Poorly known – tropical and warm-temperate Indian and Pacific Oceans	3.10

SC/64/SM21 analysed passive archival acoustic data from across the North Pacific. Species-specific frequency modulated (FM) echolocation pulses made by Baird's, Blainville's, Cuvier's, Longman's and Deraniyagala's beaked whales at Palmyra Atoll, have been recorded and described, with visual confirmation of species identity. The species-specific features appear to be consistent within all sequences labelled to signal type level, making possible the discrimination of species. It was agreed that Cross Seamount was a good site to identify ginkgo-toothed beaked whale call signatures.

The Committee **welcomes** the report on the spatio-temporal distribution of species-specific acoustic echo-location signals of beaked whales in the North Pacific. Future research using visual sightings with biopsies in conjunction with acoustic recordings will be necessary to link several species and signal types.

SC/64/SM11 provided estimates of abundance and trends for Baird's beaked whale, Cuvier's beaked whale and *Mesoplodon* spp. in the California Current from 1991-2008 using a Bayesian hierarchical modelling approach. The analysis indicated declining abundance for Cuvier's beaked whale (2.9% per year) and *Mesoplodon* spp. (7.0% per year) in the study area but no evidence of a trend for Baird's beaked whales. The Committee **agrees** that these results should be interpreted cautiously given the variability in ocean conditions in the region since the early 1990s. In the 1990s, both *M. stejnegeri* and *M. carlhubbsi* occurred as far south as San Diego, but since the late 1990s, previously rare warm-water ziphiids appear to have moved into the area which is thought to be near the northern end of their range. An analysis of the pattern of strandings of *Ziphius* along the US west coast might be informative for evaluating the apparent decline suggested in SC/64/SM11.

SC/64/SM13 summarised records of five documented ziphiid species in the EEZ of Costa Rica. There are only a few scattered records of all species except Cuvier's beaked whale, which is sighted relatively frequently, and *Mesoplodon* sp. A (almost certainly *M. peruvianus*), which could mean Costa Rican waters are a significant part of the range of this poorly known mesoplodont.

14.1.1 Cuvier's beaked whale (Ziphius cavirostris)

SC/64/SM34 reviewed current knowledge of Cuvier's beaked whale in the North Pacific and northern Indian Ocean. It occurs in deep waters worldwide and ranges from equatorial tropical to cold-temperate waters in the North Pacific, north to the Gulf of Alaska, along the Aleutian and Commander Islands in the Bering and Okhotsk Seas. It is commonly found where the steep continental slope occurs close to shore, such as around the Hawaiian Islands, San Clemente Island (California), Isla de Guadalupe (Mexico – see SC/64/SM18) and the Aleutian Islands.

Few estimates of density or abundance are available, primarily due to the rarity and difficulty of detecting and identifying beaked whales. In addition large-scale cetacean abundance surveys are often focused in areas such as continental shelf waters where beaked whales usually do not occur.

14.1.1.1 CONCLUSIONS AND OTHER CONSIDERATIONS OF STATUS

Cuvier's beaked whale is classified in the IUCN Red List as of Least Concern. Abundance estimates are available only for the Eastern Tropical Pacific, the Hawaii EEZ and the west coast of the USA (to 300 n.miles offshore). Numbers in the California Current appear to have declined in recent years. Some anthropogenic mortality is known from fisheries in waters off California and Japan and probably occurs elsewhere (e.g. in driftnet fisheries off Mexico). This species is vulnerable to noise produced by naval sonar and seismic research. Research priority should be given to understanding population trends off California and studying population structure. The Committee **agrees** that there is no basis for revising the status of Cuvier's beaked whale at the species or population level at this time.

14.1.2 Baird's beaked whale (Berardius bairdii)

Reviews of published (and some unpublished) information on Baird's beaked whales in the North Pacific were provided in SC/64/SM8 and by Brownell and Allen. Additional information on distribution and abundance was provided in SC/64/SM5, SM11 and SM21 and by Wade.

Baird's beaked whale is endemic to the cold temperate waters of the North Pacific. It appears to be more abundant in the western than the eastern part of the basin despite the long history of exploitation in the west and relatively little exploitation in the east.

SC/64/SM5 reported on a study of Baird's beaked whales at the Commander Islands in the western Bering Sea. Baird's beaked whales were found within about 12km of the coast, and mostly on the continental slope at depths of 100-1,000m (maximum depth at sighting about 3,000m). A total of 78 individuals was identified. Photo-ID confirmed associations over several years and the authors suggested that Baird's beaked whales live in a fission-fusion society. Evidence of killer whale predation was provided. More than half of the whales had marks the authors attributed to fishing gear and 3/75 had scars of possible anthropogenic origin, one apparently from harpooning.

Wade provided information on Baird's beaked whale sightings (n=25) made during nine killer whale surveys in nearshore waters of the Aleutian Islands, between 2001 and 2010. Baird's beaked whales were seen on every survey, generally close to the continental shelf edge break, in deeper waters on the continental slope. The extent of predation by killer whales on beaked whales might be considerable and ongoing stable fatty acid analyses may elucidate the importance of beaked whales in their diet.

14.1.2.1 LIFE HISTORY PARAMETERS

There are considerable data on life history parameters obtained from carcasses of whales taken on the Chiba ground and processed at the Wadaura station in the 1975 and 1985-

87 summer seasons (Kasuya *et al.*, 1997). This information has been interpreted assuming annual deposition of tooth growth layers (Kasuya, 1977). Full details are given in Annex L, item 3.2.4.

14.1.2.2 ABUNDANCE AND TRENDS
Abundance estimates for Baird's beaked whales are given in table 2 and item 3.2.5 of Annex L.

14.1.2.3 TAKES INCLUDING BYCATCH
Baird's beaked whales have been hunted by hand harpoon in Japan since around 1600 and by Norwegian-type whaling since 1907. Kasuya (2011) reviewed published information on the Baird's beaked whale fishery in the Chiba Prefecture.

Recent catch statistics by Japanese small-type whaling are summarised in Annex L, table 3. Official statistics since 1932, except 1943-46, are given in Annex L, Appendix 2. The reported statistics for the 1950s may be unreliable because of the likely inclusion of illegally caught and misreported sperm whales at Wadaura, Chiba between 1959 and 1974 (Kasuya, 2011). Similarly, illegal catches of sperm whales by small-type whalers in Ayukawa on the Pacific coast of northern Honshu (Kondo and Kasuya, 2002) may have been reported as Baird's beaked whales, thus contributing to the surprisingly high numbers of the latter reported in the catch statistics in the 1950s and 1960s. The reported annual take of Baird's beaked whales in Japan (mostly along the Pacific coast) ranged between 107 and 322 during the period 1950-69 (3,896 animals in 20 years).

The number of catcher boats operating for Baird's beaked whales off Chiba has been regulated by the prefectural government since 1920. The government introduced a licensing system to the small-type whale fishery in 1947 to limit the total number of boats operating. A voluntary quota system was introduced for Baird's beaked whales in 1983. The initial quota of 40 has since been increased to 66 (Annex L, table 3). In 1985, the Committee noted (IWC, 1986) that such a catch level represents about 1% of the estimated population size but was unable to determine whether this was sustainable. To investigate this question further it was agreed that studies on school structure would be desirable (IWC, 1986) - see above regarding the study in the Commander Islands. The Government of Japan has increased the quota several times and whaling operations have expanded since the late 1990s into the Sea of Japan (Appendix 1 and table 3 in Annex L).

In the eastern Pacific, small numbers of Baird's beaked whales were taken by whaling stations in California (15) and British Columbia (29) between 1956 and 1970 (Rice, 1974).

Five cases of stranded Baird's beaked whales in Japan were categorised as incidental fishery takes (table 4 in Annex L).

14.1.2.4 OTHER ACTUAL AND POTENTIAL THREATS
High concentrations of mercury, HDBPs and/or PCBs have been found in this species (Endo *et al.*, 2005; Endo *et al.*, 2003; Haraguchi *et al.*, 2006; also see SC/64/SM3). Concern has been raised since the accidents at Fukushima No.1 nuclear power plant but there is no evidence yet for exposure to Baird's beaked whales. Their range is mainly to the north of Fukushima.

14.1.2.5 CONCLUSIONS AND OTHER CONSIDERATIONS OF STATUS
The species is classified in the IUCN Red List as Data Deficient. Abundance estimates for the US west coast reported in SC/64/SM11 showed no trend for the period 1991-2008. The three populations off Japan have been assessed as Rare by the Japan Fisheries Agency and Mammalogical Society of Japan. The Committee **agrees** that there is no basis for revising the status of the Baird's beaked whale at the species or population level at this time.

The Committee **recommends** the following.

(1) It is especially important to clarify population structure and geographical boundaries of the stocks off Japan, particularly as long as hunting continues there.
(2) Improved and updated abundance estimates are needed for each population, and trends in abundance should be assessed. These needs particularly apply to exploited stocks.
(3) Better understanding is needed of the movements of animals from the respective stocks into and out of the three sea areas of Japan (Sea of Japan, Sea of Okhotsk, Pacific coast).
(4) The study in the Commander Islands (SC/64/SM5) should be expanded to include biopsy sampling for determination of sex and paternity and maternity in order to support studies of social and population structure, as well as satellite tagging to learn about movements and stock relations.
(5) The limited information suggests a peculiar life history and social structure - it is uncertain whether the characteristics of Baird's beaked whales are common, rare or even unique among the *Ziphiidae*, but further studies such as those recently initiated in the Commander and Aleutian Islands are encouraged to continue.

14.1.3 Longman's beaked whale (Indopacetus pacificus)
Published information on this species was reviewed in SC/64/SM26. It is probably endemic to tropical waters of the Indian and Pacific Oceans. The west- and southernmost record is Natal, South Africa, the northernmost is Hakodate, Hokkaido, Japan, and the easternmost is Maui, Hawaii.

Two stranded specimens in northeastern Taiwan on 22 July 2005, provided the first genetic and external morphological descriptions in the western Pacific (SC/64/SM32).

14.1.3.1 CONCLUSIONS AND OTHER CONSIDERATIONS OF STATUS
Longman's beaked whale is classified in the IUCN Red List as Data Deficient. The Committee **agrees** that there is no basis for revising the status of Longman's beaked whale at either the species or population level as no abundance estimates are available, except around the Hawaiian Islands, and there is no information on trends. The species is best known from the western North Pacific. Some anthropogenic mortality is known to have occurred in fisheries around Sri Lanka and strandings in Taiwan may have been associated with naval activities. Ingestion of plastic debris and exposure to morbillivirus are also of concern.

No high-priority research needs were identified but efforts are needed to better document the species' overall range, especially in the Indian Ocean. Continued efforts are encouraged to investigate and sample stranded animals at every opportunity following standardised protocols for beaked whale necropsy. Necropsy results should be made available in the literature and in relevant publicly accessible databases as quickly as possible.

14.1.4 Hubbs' beaked whale (Mesoplodon carlhubbsi)
SC/64/SM27 reviewed published information on Hubbs' beaked whale from the seas around Japan and from North America (<60 records). It is endemic to the North Pacific

and found in cold temperate currents off Japan and along the west coast of the USA and southern British Columbia, Canada. It has rarely been reported at sea.

14.1.4.1 CONCLUSIONS AND OTHER CONSIDERATIONS OF STATUS

Hubbs' beaked whale is classified in the IUCN Red List as Data Deficient. The Committee **agrees** that there is no basis for revising the status of Hubbs' beaked whale at either the species or population level. Some concern was expressed at the apparent decline of mesoplodonts off the US west coast (SC/64/SM11) as this probably includes Hubbs' beaked whales. No species-specific abundance estimates are available. Some anthropogenic mortality is known to occur in fisheries off both Japan and the USA and these whales may be vulnerable to anthropogenic noise from naval sonar and seismic research.

The Committee **agrees** that priority should be given to studies of possible population differences between Japan and the USA (genetics primarily but also external and internal parasites and cookie-cutter sharks scars). Acoustic studies (e.g. SC/64/SM21) may help to better determine the range of Hubbs' beaked whale, if a species-specific signal is found.

14.1.5 Blainville's beaked whale (M. densirostris)

Published information on this species (primarily from strandings) was reviewed in SC/64/SM33. This has the most extensive distribution of any *Mesoplodon*. Its acoustic signal type (the same as in the North Atlantic) was the predominant signal type in the Pacific Islands region (SC/64/SM21). It is found in tropical and warm temperate waters of all oceans, including deep offshore waters, tropical oceanic archipelagos and continental or insular coasts bordered by warm waters. There are no records from polar or other high latitude regions. It is reported infrequently at sea and positive field identification can be difficult unless key diagnostic characters of the head are observed.

14.1.5.1 CONCLUSIONS AND OTHER CONSIDERATIONS OF STATUS

Blainville's beaked whale is classified in the IUCN Red List as Data Deficient. The Committee **agrees** that there is no basis for revising the status of Blainville's beaked whale at either the species or population level. Some anthropogenic mortality is known to occur in fisheries off both Japan and the USA and this species may also be vulnerable to anthropogenic noise from naval sonar and seismic research.

In addition to the general recommendations under Annex K, item 3.12, the Committee **recommends** expanded photo-ID and tagging efforts in Hawaii to monitor movement patterns (seasonal as well as ranges) to determine whether there is site fidelity to specific types of habitat.

14.1.6 Ginkgo-toothed beaked whale (M. ginkgodens)

There is only limited information on this species which is found in warm temperate and tropical waters of the Pacific and westward into the Indian Ocean. It is classified in the IUCN Red List as Data Deficient. The Committee **agrees** that there is no basis for revising the status of the ginkgo-toothed beaked whale at either the species or population level. No abundance estimates exist. Some anthropogenic mortality is known from fisheries in at least Japan, Sri Lanka, Taiwan and Micronesia, and from anthropogenic noise from naval sonar (Wang and Yang, 2006). It is important to confirm the species identifications of all available specimens because a number have been misidentified in the past. Its status and abundance in its apparent 'hotspot' around southern Japan and Taiwan should be investigated.

14.1.7 Perrin's beaked whale (M. perrini)

SC/64/SM30 reviewed the existing information on Perrin's beaked whale. Very little is known about this species that was described in 2002 by Dalebout *et al.* (2002) based on five stranded specimens from south and central California – it remains known only from strandings in California and may have the most restricted range of any species of *Mespolodon*. Many or most of the unidentified mesoplodonts observed in ship surveys off California (SC/64/SM11) may be Perrin's beaked whales.

The species is classified in the IUCN Red List as Data Deficient. The Committee **agrees** that there is no basis for revising the status of Perrin's beaked whale at either the species or population level. As with all of the beaked whales, Perrin's beaked whales are probably at risk from anthropogenic noise produced by military sonar and seismic surveys as well as to fishery bycatch in areas of overlap. There is a need is to determine distribution and abundance in the eastern North Pacific including opportunistic biopsy sampling and correlated acoustic sampling.

14.1.8 Pygmy beaked whale (M. peruvianus)

SC/64/SM30 reviewed the existing information on pygmy beaked whales, which appear to be endemic to the eastern tropical Pacific. Most sightings are from the 'Eastern Pacific Warm Pool', an area with sea surface temperatures >27.5°C (Fiedler and Talley, 2006). It may be particularly abundant in the southern Gulf of California, Mexico (e.g. Ferguson *et al.*, 2006). There are a few records from Mexico (Urban-R, 2010) and it may be relatively common off Costa Rica (SC/64/SM13). The northernmost record is Moss Landing, California, the southernmost record in the eastern Pacific is from northern Chile (Sanino *et al.*, 2007) and the only record outside the eastern Pacific was from South Island, New Zealand (Baker and van Helden, 1999). Whether this latter specimen is indicative of a wider distribution for this species, or just an errant individual, is uncertain.

14.1.8.1 CONCLUSIONS AND OTHER CONSIDERATIONS OF STATUS

This species seems be fairly common within its range (Ferguson and Barlow, 2001). It is classified in the IUCN Red List as Data Deficient. The Committee **agrees** that there is no basis for revising the status of pygmy beaked whale at either the species or population level given the sparseness of information. Confirmation is needed that *Mesoplodon* sp. A is *M. peruvianus*; while biopsy samples (male) seem unlikely, a colour-pattern description of a freshly stranded adult male *M. peruvianus* would suffice. The southern Gulf of California seems to be a promising region for either of these events.

14.1.9 Stejneger's beaked whale (M. stejnegeri)

SC/64/SM25 reviewed information on this species, mainly from waters around Japan but including data from North America. It is endemic to the cold temperate North Pacific and has not been reported from any of the central Pacific islands. Four mass strandings occurred in Kuluk Bay, Alaska between 1975 and 1989 (Walker and Hanson, 1999). It is the most commonly stranded ziphiid in Japan although rare on the Pacific coast of Japan (Brownell *et al.*, 2004). Park (1999) reported five strandings and two incidental catches along the east coast of South Korea (35° to 38°N).

The presence of cookie-cutter shark bites on animals around the Aleutian Islands but not the Sea of Japan, suggest some population structure in the central and western North Pacific. Brownell *et al.* (2004) suggest that the northern Sea of Japan should be considered as a provisional management unit.

14.1.9.1 CONCLUSIONS AND OTHER CONSIDERATIONS OF STATUS

Stejneger's beaked whale is classified in the IUCN Red List as Data Deficient. The Committee **agrees** that there is no basis for revising the status of Stejneger's beaked whale at either the species or population level. No species-specific abundance estimates are available. Some anthropogenic mortality is known to occur in fisheries off both Japan and the USA and at least one case of a ship strike has been confirmed. The mass strandings in the Aleutian Islands were suspected of being related to naval sonar.

In addition to the general recommendations under Item 14.1.11, the Committee **recommends** regular and extensive sample collection from stranded or bycaught specimens (especially off Japan) in order to better understand the species' ecology, life history and vulnerability to threats. Genetic research is needed to determine whether western and eastern populations can be differentiated. Better understanding of its biology and abundance in the apparent 'hot spot' in the Sea of Japan off Honshu could be accomplished by: (1) strengthening the stranding programme in order to collect specimens in fresher condition; (2) acoustic monitoring; and (3) small-scale surveys to assess abundance.

14.1.10 Deraniyagala's beaked whale

SC/64/SM3 presented new genetic and morphological data supporting the recognition of a previously described but unnamed *Mesoplodon* sp. in the tropical Indo-Pacific. Genetic identification has related new specimens, including those initially described by Baker *et al.* (2007), to a type specimen in Colombo, Sri Lanka described as *M. hotaula*, in 1963. Known from at least seven specimens it is genetically distinct but closely related to (and possibly conspecific with) *M. ginkgodens.* Its distribution seems to be tropical in both the Indian and Pacific Oceans. SC/64/SM3 argued that available evidence was sufficient to accept the revised taxon as a new subspecies of *M. ginkgodens* and that further characterisation could result in the resurrection of *M. hotaula* Deraniyagala, 1963 as a full species. The Committee suggested the provisional common name 'Deraniyagala's beaked whale' for this taxon, in recognition of the original description.

Further genetic investigation, including biopsy sampling of live animals, is required to clarify the systematics and taxonomy. Visual and acoustic reports from around Palmyra Atoll have been attributed to this new taxon (see SC/64/SM21) and this area clearly provides the opportunity to collect fresh tissue samples for genome-level analyses.

SC/64/SM4 reported on the species identity and local use of Deraniyagala's beaked whales (and Blainville's and Cuvier's beaked whales) in the Gilbert Islands, Republic of Kiribati. This investigation, conducted with the help of government agencies, visited several of the outer Gilbert Islands in June-July 2009 and collected bones and artefacts.

It is important to obtain new specimen material from oceanic islands and atolls in the central tropical Pacific and and to confirming the identities and provenances of existing museum specimens attributed to *M. ginkgodens*. Consideration should be given to the possibility that there are island-associated nearshore populations that are geographically and demographically isolated or semi-isolated from offshore populations of both Deraniyagala's beaked whales and ginkgo-toothed beaked whales, as is the case with Blainville's beaked whales.

Almost nothing is known about overall distribution, population structure, life history, abundance or takes of Deraniyagala's beaked whales, with the exception of those in Kiribati (SC/64/SM4). The five beaked whale strandings from Palmyra Atoll and Kingman Reef between 2002 and 2007 is high for such a small area and high compared to the number of beaked whale strandings reported on other Pacific Islands.

14.1.10.1 CONCLUSIONS AND OTHER CONSIDERATIONS OF STATUS

No IUCN Red List entry has been made for Deraniyagala's beaked whale at either the species or population level. The Committee **agrees** that there was insufficient data to assess this status at either the species of population level. The Committee expressed concern about the apparently high numbers of strandings around Palmyra Atoll in recent years. Deraniyagala's beaked whales are probably vulnerable to sound from naval sonar and seismic research, similar to other beaked whales. Assuming that the beaked whale recorded both acoustically and visually around Palmyra Atoll is Deraniyagala's beaked whale, the first priority is to make this determination genetically.

14.1.11 Common issues and threats

14.1.11.1 MILITARY SONAR AND OTHER NOISE SOURCES

Evidence of gas bubble lesions (gas embolism) and fat emboli have been reported at necropsy in beaked whales from atypical mass stranding events (MSEs), which were coincidental with nearby use of mid-frequency sonar (Fernandez *et al.*, 2004). Exposure to sonar may alter the behaviour and/or physiology of beaked whales, potentially resulting in decompression sickness (DCS) in some circumstances.

Bernaldo de Quirós and Fernandez Rodriguez (2011) studied gas presence and composition in order to compare decompression vs. decomposition gases present at necropsy. Bubbles alone cannot be used to determine cause of death and it is important to differentiate between gas embolism and putrefaction gases. They recommended scoring gas bubble presence and sampling bubbles for gas composition analysis within 24 hours, but preferably within 12 hours, to minimise the masking effects of putrefaction gases.

The Committee **recommends** that groups working on mass strandings make all reasonable efforts to examine dead animals within 12 hours (or at most 24 hours) after death. Response teams should, if at all possible, include a veterinarian, a veterinary pathologist or a responder with experience in necropsy and sample collection. Routine necropsy protocols should include examination of bubbles present in tissues, scoring relative prevalence and sampling for gas composition analysis, particularly to detect and describe intravascular and peri-renal subcapsular emphysema bubbles.

The Committee took note of the latest investigations of MSEs in the Canary Islands, Spain associated with the use of naval sonar (Fernandez *et al.*, 2004). No further atypical MSEs have occurred since international naval exercises ended in 2004 following a recommendation of the parliament of the European Union and a Spanish government resolution banning the use of military sonar around the Canary Islands. This supports the inference that the atypical MSEs before the ban were caused by mid-frequency sonar.

Noting the ample evidence about the vulnerability of beaked whales to military sonar and seismic surveys and the potential for impacts at the population level (including not only animals that strand and are detected but also the potentially large number that die at sea and do not strand), the Committee **strongly recommends** that military exercises and seismic surveys should avoid areas of important habitat for beaked whales; that further effort should be made to mitigate their impacts; and that further efforts should be made to identify such areas (MacLeod and Mitchell, 2006; Cañadas *et al.*, 2011).

The Committee also reiterates two previous recommendations.

(1) The continuation and expansion of studies of how anthropogenic noise, especially from naval sonar and seismic survey airguns, affects ziphiids. These should include efforts to determine if and how vulnerability differs between species, habitat types, animal activities (e.g. travelling, foraging) etc.
(2) Collaborative arrangements with military and industry authorities should be made to ensure researchers have advance notice of sonar exercises, seismic surveys and other activities so that the possibility of beaked whale stranding events can be anticipated with enhanced beach surveillance etc.

14.1.11.2 MARINE DEBRIS
Available data from the North Pacific and northern Indian Ocean (SC/64/E10; Simmonds, 2012) indicates that beaked whales may be especially vulnerable to the ingestion of plastics and other marine debris; this can cause pathology and mortality. The population-level and long-term implications of the ingestion of plastic debris are unknown. The Committee **recommends** that this issue is further investigated via the collection, collation and analyses of relevant data from around the world concerning ingestion rates, debris types and associated pathology. It also **recommends** that standardised protocols are developed for pathology investigations. Consideration should also be given to investigating marine debris accumulation and associated processes in areas of important habitat for small cetaceans.

14.1.11.3 GENERAL RECOMMENDATIONS
The Committee **recommends** that for all North Pacific and northern Indian Ocean ziphiid species, further efforts are made to define population structure, delineate population boundaries, obtain estimates of abundance and identify and rank threats. Attention should be given to populations known or suspected to be small and/or exploited. The available evidence suggests that most ziphiid species occupy relatively narrow ecological niches and occur as local, largely isolated groups, which should be regarded as putative subpopulations (in the IUCN Red List sense).

The Committee **recommends** that more effort be made to investigate and validate methods of estimating population size for ziphiids, including those that incorporate passive acoustics for application in areas where the local species are acoustically distinguishable. Further data are needed to adjust density estimates from line transect surveys to account for visibility bias (given that these deep-diving whales spend relatively little time at the surface and species are difficult to distinguish) and for responsive movement. Consideration should also be given to interrupting line transect surveys (closing mode) in order to obtain photographs and biopsies as a way of reducing the 'unidentified ziphiid' component of abundance estimates.

Initial efforts have been made to map high-use areas for ziphiids on a global scale (MacLeod and Mitchell, 2006) to provide guidance for mitigation measures to reduce the risks from naval sonar and seismic survey operations. However, a more detailed examination is needed of these 'hotspots', including fine-scaled habitat characterisation and predictive habitat modelling. The Committee **recommends** that collaborative efforts similar to those described last year in Cañadas *et al.* (2011) be made by the relevant scientists and research groups in the North Pacific and northern Indian Ocean where anthropogenic sound is considered a problem.

Ziphiids are at risk of entangling in nets, especially pelagic driftnets, which tend to be deployed in or near their habitat. They are also known to get hooked or entangled in longline gear. The Committee **recommends** that methods be developed and applied to estimate fishery-related mortality, giving special attention to areas where there is direct evidence of incidental mortality as well as to areas where driftnetting and longlining operations overlap known concentrations of ziphiids.

Evidence of beaked whale population decline along the North American coast (SC/64/SM11) raised concern that beaked whales, and particularly resident populations, may be negatively affected by large-scale environmental change. The Committee **recommends** efforts be devoted to understanding impacts of changes in habitat on the distribution and abundance of beaked whales. This could involve pursuing an improved understanding of beaked whale feeding ecology and deep-water oceanographic processes as well as prey-community dynamics.

The Committee further **recommends** broad-scale collaborations to generate integrated results from analyses of genetic material, photograph collections and survey data. Particularly for *Mesoplodon* species, biopsies should be obtained from live animals to verify species identification. This is especially important for females and young males. Efforts are also needed to validate acoustic signatures of *Mesoplodon* species by collecting biopsies (and good photographs) along with acoustic recordings at sea.

14.2 Report on the voluntary fund for small cetacean conservation research

14.2.1 Status of the voluntary fund for small cetacean conservation research
In 2009, Australia made a generous donation toward the IWC Small Cetacean Conservation Research Fund of about £250,000 which enabled eight grant awards to research and conservation projects on small cetaceans (IWC, 2012r). At the Commission meeting in 2011 and during the interessional period, France, Italy, the UK and a number of NGOs provided extra funding of £73,000 which allowed: (1) the full funding of the two remaining projects recommended by the Committee in 2011; (2) support for invited participants in 2011 and 2012; and (3) a chance to start rebuilding the Fund. The Committee **thanks** the above governments and the NGOs for their generous contributions to the fund and hopes that the next Conservation Committee and Commission meetings will generate new funding that will allow another call for projects by the end of 2012.

14.2.2 Review on progress on funded projects
The Committee reviewed brief project reports on five of the nine projects selected in 2011 and received more extensive reports on three of them, which are presented in Annex L (Solomon Islands, under this item; franciscana, Item 14.3.3; Atlantic humpback dolphin, Item 14.3.5).

SC/64/SM23 presented preliminary results of an assessment of dolphins in the Solomon Islands where there is a long history of exploiting dolphins through traditional drive-hunts. More recently, the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), has been live-captured for export, with a current annual export quota of 50. This Committee as well as several intergovernmental bodies (CITES, CMS, IUCN, SPREP) have expressed concern in the past about the potential conservation implications of these removals.

The Committee expresses its appreciation for this work and acknowledges the constructive involvement of the Solomon Islands Fisheries and Environment Ministries in collaborating and providing support. The preliminary results reinforce previously expressed concerns regarding the sustainability of past and ongoing live-capture removals of *T. aduncus* from what appear to be small island-associated populations. The Committee **encourages** the authorities responsible for conservation management (e.g. under CITES) to carefully consider the information from this study. It recommends that efforts to integrate the current and historical photo-ID catalogues be pursued as a priority.

14.3 Progress on previous recommendations

14.3.1 Vaquita

The Committee has expressed its grave concern over the status of this species and its continuing decline over many years. Last year, the Committee was informed about the pilot phase of implementation of an acoustic monitoring programme to track future changes in vaquita abundance in the Upper Gulf of California (IWC, 2012y). SC/64/SM19 provided further information on the implementation of the scheme in the first full sampling season. An overall loss rate of 44% of the detectors resulted in data being available for 38 sampling sites within the refuge. Deployment of buoys is the only way to obtain year-round information so an alternative method of deployment that reduces loss must be found. An analysis of the acoustic encounter rates in 2008 (0.74 encounters/day, CV 0.44) compared to those from the current study in 2011 (0.58 encounters/day, CV 0.05) is indicative of further decline of the population since 2008, i.e. when strategies to reduce fishing effort by the Federal Government were already being implemented.

Jaramillo-Legorreta noted that redeployment of the array in late spring of 2012 was delayed because the presence of 87 boats fishing illegally within the refuge at that time presented too great a risk of loss of equipment; deployment was underway at the time of the Committee meeting.

The sub-committee considered the report[25] of the fourth Meeting of the International Committee for the Recovery of Vaquita (CIRVA) held in Ensenada, Mexico from 20-23 February 2012. The role of CIRVA has been recognised by the Government of Mexico in the agreement for the creation of the Vaquita Protection Refuge and in the current federal Action Program for the Conservation of Vaquita (PACE-Vaquita). Hence, the recommendations of CIRVA are important in terms of driving recovery actions. The report notes that the population has continued to decline, with an estimated reduction of nearly 60% between 1997 and 2008 and possibly as few as 220 porpoises remaining in 2008 (CIRVA, 2012). The report is discussed in detail in Annex L.

CIRVA's assessment of progress is that switch-out programmes (conversion to vaquita-safe gear) have been poor with only a very small proportion of the total fleet using such gear. Fishermen using such alternative trawl gear would have great difficulty operating safely in the middle of the large gillnet fleet. A working group has been engaged in a public process to amend the Mexican Official Standard 002-PESCA that regulates shrimp fishing. A three-year process beginning in 2013/14 to ban shrimp gillnets and exchange them for the new small artisanal trawl net design has been approved but not yet published in the Federal Register.

Details on the CIRVA recommendations are given in Annex L and the Committee **strongly endorses** these recommendations.

At last year's meeting the Committee concluded, as it has in several previous meetings, that the only reliable solution for vaquita conservation is to eliminate vaquita bycatch by replacing gillnets with alternative fishing gear. In a detailed recommendation, the Committee strongly supported robust gear trials to assess alternative gear effectiveness and economic viability (IWC, 2012r).

The Committee again **reiterates its extreme concern** for the status of this species and, as stated in 2011 (IWC, 2012r), **reaffirms** that the only reliable approach for saving the species is to eliminate vaquita bycatch by removing entangling gear from areas where the animals occur. It **strongly recommends** that, if extinction is to be avoided, all gillnets should be removed from the upper Gulf of California immediately. This is in accord with the Committee's strong recommendation made in 2009 (IWC, 2012f, p.66) regarding the extinction of the vaquita.

In light of reports on the successful development of an alternative shrimp trawl and the CIRVA recommendations summarised in Annex L, the Committee also **recommends** that vaquita conservation efforts focus on:

(1) expedited approval and adoption of the small shrimp trawls as an alternative to gillnets and prohibition of shrimp fishing with gillnets throughout the entire range of the vaquita; and
(2) continued research on technologies to replace gillnetting for finfish or otherwise to remove all gillnets from the vaquita's entire range.

In this regard the Committee **notes** the ongoing project funded under the Voluntary Fund for Small Cetacean Conservation Research 'Supporting the assessment of alternative fishing gears for replacing gillnets that cause bycatch of vaquita (*Phocoena sinus*) in the Upper Gulf of California, Mexico' and **looks forward** to a progress report at next year's meeting.

14.3.2 Harbour porpoise

In 2001, the Committee acknowledged the efforts by ASCOBANS to address serious harbour porpoise bycatch problems in the Baltic, Kattegat/Belt and North Sea areas and encouraged further efforts in that regard (IWC, 2010h). Since then, the ASCOBANS Jastarnia Group has met and considered new analyses of survey and bycatch data, which have had the effect of reinforcing and increasing concern about sustainability of bycatch as well as other factors potentially affecting the porpoise populations in the region, including declines in availability of prey, ship traffic, construction work, seabed exploitation, contaminants, and diseases.

The Committee remains concerned about the status of harbour porpoises in the western Baltic, the Belt Seas and the Kattegat ('Gap' area, also known as Belt Sea stock according to the ASCOBANS Jastarnia Group). Although the abundance estimates for harbour porpoises from SCANS

[25] *http://www.iucn-csg.org/index.php/downloads/.*

and SCANS II were almost identical for the wider North Sea area, there was a southward shift in density distribution of porpoises between SCANS and SCANS II. However, there are indications of a possible decline in abundance in the Gap area. Bycatch is the major source of anthropogenic mortality and should be monitored and mitigated. EC Regulation 812/2004 does not adequately protect harbour porpoises from bycatch in this area because it requires bycatch monitoring only on boats >15m and pinger use only on boats >12m.

In the current state of scientific uncertainty, the Committee looks forward to receiving the results of a planned dedicated shipboard survey to be conducted in the Gap area in the summer of 2012 with the intention of obtaining a new abundance estimate.

The Committee recommends with regard to the Gap area to:

(1) assess porpoise bycatch levels;
(2) monitor porpoise abundance on a regular basis;
(3) introduce measures to mitigate bycatch and other anthropogenic mortality;
(4) monitor the health status of the porpoises;
(5) ensure all bycaught and stranded animals are reported and delivered to qualified institutions for necropsy and sampling; and
(6) implement the recovery plan for harbour porpoises which is currently being developed by ASCOBANS for the Gap area.

The Committee also repeats its longstanding concern regarding the critically endangered harbour porpoise population in the inner Baltic ('Baltic proper') and encourages all possible efforts to eliminate the bycatch there and address other factors that may be preventing this very small population's recovery. The current process of developing management plans for Special Areas of Conservation under the European Habitats Directive, offers a concrete chance to implement monitoring and mitigation as foreseen by the Jastarnia Plan. The Committee urges that effective monitoring and mitigation measures focusing on harbour porpoises be included in such national management plans.

14.3.3 Franciscana

SC/64/SM17 describes results of a project conducted with funding from the IWC Small Cetacean Conservation Fund. The main goal of the study was to assess distribution and obtain an abundance estimate of franciscanas inhabiting the region known as Franciscana Management Area I (FMA I), as recommended in IWC (2004a). In December 2011 and January 2012, design-based aerial surveys were conducted to assess distribution and to estimate abundance of franciscanas in FMA I. The fully corrected abundance estimate was 1,998 (CV=0.48, 95% CI: 796-5,013). The most recent (2001-02) estimate of incidental mortality in FMA I (Di Beneditto, 2003) corresponds to 5.5% of the estimated population size presented here. This indicates high and unsustainable bycatch if current mortality is similar to that in the early 2000s.

The Instituto Chico Mendes para a Conservacao da Biodiversidade (ICMBio) is the government agency responsible for establishing management and conservation strategies for endangered species in Brazil. In 2010, ICMBio published the 'National Action Plan for the Conservation of the Franciscana' (Di Beneditto *et al.*, 2010) and made a series of general recommendations for research and monitoring (summarised in Annex L) which the Committee endorsed.

The Committee further recommends the following with respect to FMA 1.

(1) Additional aerial surveys with increased sampling effort in order to:
    (a) produce more robust (lower CVs, estimates for the northern range of FMA I) population estimates;
    (b) further assess distribution (e.g. offshore limits, discontinuity); and
    (c) evaluate potential habitats that could be protected (e.g. by one or more no-take zones, marine protected areas) to improve conservation.
(2) Resume systematic and long-term bycatch monitoring in northern Rio de Janeiro and Espírito Santo, in order to produce more up-to-date mortality estimates.
(3) Studies should be conducted to assess areas within the range of the species where other human activities could pose a threat to the long-term viability of franciscanas in FMA I.

Melcon *et al.* (2012) illustrated the potential for the use of autonomous acoustic detectors or towed arrays designed specifically for the identification of porpoise-like signals (e.g. C-PODs or A-tags) in franciscana research.

14.3.4 Narwhal and white whale

Bjørge reported on progress towards organising and convening a proposed global review of the monodontids (IWC, 2001d, p. 279). The NAMMCO Secretariat has indicated interest in organising and convening such a review jointly with the IWC Scientific Committee and the intersessional correspondence group has identified a list of scientists interested in attending from four of the five range states (Norway, USA, Canada, Russia). Broader involvement of other scientific groups and individual scientists for a range-wide workshop or symposium on monodontid science may be appropriate. The involvement of groups as disparate as oceanaria and environmental NGOs as co-conveners might bring greater organisational motivation and financial resources to support such a workshop or symposium. The Committee recommends that a steering committee (Bjørge, Reeves, Suydam, a scientist from Canada, Donovan, and Aquarone from the NAMMCO Secretariat) be established to meet intersessionally to discuss these issues and report back at next year's meeting.

14.3.5 Atlantic humpback dolphin

SC/64/SM22 presents a brief update on the project funded by the IWC Small Cetacean Conservation Research Fund for Atlantic humpback dolphins in Gabon and Congo. There have been some challenges and shifts in focus and priorities over the last year, given boat failures and the discovery of a significant bycatch problem in Congo. As the project is ongoing, more complete reporting will be provided next year. The Committee thanks the authors for this preliminary report and expresses its appreciation for their perseverance in the face of the difficult challenges faced to date in this research.

14.3.6 River dolphins

IWC (2001d) recommended that 'scientists with appropriate theoretical and/or analytical skills should be directly involved in river cetacean studies, so that surveys result in statistically robust estimates of abundance'. In 2002, two biologists and two statisticians led a pilot survey (line and strip transect data and some photo-ID data) of boto (*Inia geoffrensis*) and tucuxi (*Sotalia fluviatilis*) in portions of the Amazon in Colombia and Peru (IWC, 2003d). SC/64/SM24 revisited this dataset and reported on preliminary analyses.

Participants drew attention to the existence of both older and more recent abundance estimates for the study area and suggested that a three-way comparison of abundance estimates would be of great value. The Committee expresses its appreciation to the Government of Brazil for supporting a proposed PhD studentship to work on this issue.

14.3.6.1 BOTO AND TUCUXI

Two largely sympatric endemic cetaceans, the tucuxi and the boto, inhabit the Amazon basin and both are increasingly killed for use as bait in the piracatinga (*Calophysus macropterus*) fishery (IWC, 2007g; 2008k; 2009g; 2012r). Catches in this fishery, primarily for export to Colombian markets but also for sale in domestic markets, have increased in Brazil in recent years. Alves *et al.* (2012) reported on an interview study with fishermen and traders, to elucidate interactions between fishermen and river dolphins, including the occurrence of illegal, indiscriminate killing and the growing trade in dolphin carcasses. In the view of fishermen, botos damage gear and steal (and also probably damage) catches. Botos are negatively portrayed in numerous traditional Amazonian folk myths and superstitions. These factors make them extremely unwanted or even hated and they are considered as pests. Now they have also become an economic resource as bait in the increasing piracatinga fishery. Additional information suggests that the true extent of the area of the piracatinga fishery and the area of direct takes is unclear, although the reported expansion of the piracatinga market and fishing effort add to concerns regarding the impacts on dolphins.

As previously noted (IWC, 2001d), the population status of botos and tucuxis has been assessed in only relatively small portions of their Amazonian range. The Committee reiterates its serious concerns with the potential population implications of the intentional killing of botos and tucuxis for use as bait in the piracatinga fishery. It welcomes the information provided at this year's meeting but notes that the true extent of this exploitation throughout Amazonia is poorly understood. It also emphasises that this relatively new and rapidly growing problem is in addition to other historical and ongoing threats to these dolphins, e.g. from incidental mortality in fisheries, vessel traffic, construction of hydroelectric dams, mining and other development.

In view of these concerns and the information gaps, the Committee recommends the organisation of an international scientific workshop involving scientists and managers from the range states, with the goals of addressing research and conservation priorities, standardising methodologies and planning long-term strategies. The following specific topics could be discussed at the workshop:

(1) geographic and temporal extent of the piracatinga fisheries and associated dolphin use;
(2) methods to assess abundance and mortality (rapid assessment as well as longer-term approaches);
(3) improved understanding of dolphin movements and habitat use (including population structure); and
(4) ways to reduce (or preferably eliminate) the pressure on dolphin populations from exploitation as bait for the piracatinga fishery.

The Committee agrees that the status of the boto and tucuxi should be added as a recurrent item on its agenda.

14.3.6.2 INDUS RIVER DOLPHIN

WWF-Pakistan hosted the Indus River Dolphin Conservation Strategy Planning Workshop in Lahore (Pakistan) last April. The objective was to lay the groundwork for development of a ten-year strategic action plan for conservation of endangered Indus River dolphins (*Platanista gangetica minor*), which are restricted to the Indus River system in Pakistan. Details can be found in Annex L, section 5.6.2.

14.3.6.3 MEKONG RIVER POPULATION OF IRRAWADDY DOLPHINS

A Mekong Irrawaddy Dolphin Conservation Workshop was held in Kratie, Cambodia, last January. The workshop was jointly hosted by the Commission for Dolphin Conservation and Development of Mekong River Dolphin Ecotourism, the Fisheries Administration of the Ministry of Agriculture, Forestry and Fisheries, and WWF-Cambodia. Participants reviewed the available evidence on possible causes of mortality of Irrawaddy dolphins in the Mekong in particular, the high and as-yet-unexplained level of calf mortality. Details can be found in Annex L, item 5.6.3.

All freshwater populations of Irrawaddy dolphins (*Orcaella brevirostris*) are listed on the IUCN Red List as Critically Endangered. The Mekong River population is estimated at 85 individuals (95% CI 78-91), excluding young calves (Ryan *et al.*, 2011) with recruitment close to zero. Although births occur, few animals survive to adulthood. The available information, suggests a slow decline (2.2^{-1} during the study period). If confirmed, the current population composition has serious implications for the long-term viability of the Mekong River population.

Last year, the Committee expressed grave concern about the rapid and at least partially unexplained decline of this riverine population. Unfortunately, the high mortality of young calves has continued as has the occasional mortality of adults from entanglement. The Committee **recognises** and **commends** Cambodian government agencies and WWF-Cambodia for making serious, concerted efforts since the last meeting to diagnose the cause(s) of calf mortality and further reduce the risk of entanglement. The Kratie Declaration[26] is a major step forward and the Committee recommended that it be fully implemented as quickly and as effectively as possible.

14.3.7 Killer whales

The Committee was pleased to receive information on the first photo-ID catalogue of killer whales in Adélie Land, East Antarctica (SC/64/SM6) as discussed in Annex L. This catalogue will be augmented in coming years and made available for regional matching and for a global Antarctic killer whale catalogue.

14.3.8 Clymene dolphin

The Committee was pleased to receive information a study underway on the first molecular characterisation of the Clymene dolphin (*Stenella clymene*) a recently rediscovered dolphin species. It has been suggested that the species could have had a hybrid origin, with *S. coeruleoalba* and *S. longirostris* acting as parental species (see Annex L).

14.4 Takes of small cetaceans

Annex L, Appendix 3 presents information on catches and associated quotas for small cetaceans from 1997-2010 obtained by Funahashi from the Japanese National Research Institute of Far Seas Fisheries website. The Secretariat developed the summary of catches of small cetaceans in 2009-11 from this year's national Progress Reports, where available.

[26]*http://www.iucn-csg.org/wp-content/uploads/2010/03/Kratie-Declaration-signed-with-appendices-1.pdf.*

The importance of these reports was noted, but concern was expressed that the Committee was not doing enough to take advantage of the significant information therein. The Committee **agrees** to explore intersessionally more specific terms of reference for evaluating direct take data, including the idea of developing case studies (e.g. assessing sustainability of bycatch in Europe) or other analyses from this information.

The Committee **thanks** Funahashi and the Secretariat for their work in compiling this information for the Scientific Committee each year and reiterated the importance of having complete and accurate catch and bycatch information and encourages all countries to submit data, appropriately qualified and annotated.

The Committee **expresses** its continuing concern about the lack of assessment of the exploited stock or stocks of killer whales in Greenland where reported catches were 14 in 2009 and 15 in 2010.

14.5 Local studies

SC/64/SM20 reported on the presence of long-beaked common dolphins in coastal waters of northern Colombia for the first time. These sightings extend the known range in the Caribbean, previously known primarily from the eastern Caribbean, some 700-800km.

Bolaños-Jiménez reported on: (1) work to gather records and sightings of killer whales in the Caribbean Sea and adjacent waters in collaboration with other North Atlantic killer whale studies and databases; (2) preliminary abundance estimates of Atlantic spotted and common bottlenose dolphins in the State of Aragua, central Venezuela, on the basis of mark-recapture models and photo-ID techniques as part of efforts to provide a stronger foundation for proper management and monitoring of dolphin-watching activities; and (3) new records of common dolphins in central-western Venezuela. Common dolphins have recently been recorded on the Colombian side of the Guajira Peninsula (SC/64/SM20).

SC/64/BC2 reported on unusual strandings of two species of oceanic dolphins on the Pacific coast of Costa Rica. The first was a mass stranding of 38 rough-toothed dolphins in 2002, 34 of which were returned to the sea. The second was of an adult female Fraser's dolphin in 2006. Both strandings are the only ones known for each of these species in Costa Rica.

SC/64/SM10 reported on studies to identify critical habitats for coastal pantropical spotted dolphins in Golfo Dulce, Costa Rica, as the foundation of the design and implementation of Marine Spatial Planning and Marine Protected Areas. The current study investigates the underlying behavioural mechanisms that govern patterns of niche differentiation and the resulting conservation implications.

The Committee expresses its gratitude to the presenters of local research papers and noted that such work to establish baselines, distribution records, and habitat requirements is essential to addressing the concerns of the Committee.

14.6 Hector's dolphins

Slooten reported on a number of recent findings and processes in New Zealand concerning Hector's dolphins. Bycatch in gillnet and trawl fisheries is the most serious threat to this endangered species. A substantial increase in survival rates (5.4%yr^{-1}) has been detected in one of the protected areas created to reduce the overlap between dolphins and these fishing methods (Gormley *et al.*, 2012). The Banks Peninsula population was declining at approximately 6%yr^{-1} before 2008 and is now declining at about 1%yr^{-1} (Gormley *et al.*, 2012; Slooten and Dawson, 2010). The population was predicted to recover if the boundaries of the protected areas were extended to the 100m depth contour. Slooten explained that the survival rate increase demonstrates that protected areas can work if: (1) they are large enough and in the right place; (2) key threats are managed by removing rather than displacing them; (3) no new threats are added (e.g. in this example marine mining, tidal energy generation); and (4) effective monitoring and enforcement is in place.

Bycatch in 'exemption' areas without protection measures, and in areas with incomplete protection, is causing continued population declines and population fragmentation (Davies *et al.*, 2008; DOC and MoF, 2007; Slooten and Dawson, 2010; SC/64/ProgRepNewZealand). Weak protection on the west coast of South Island, a lack of protection on the north coast of South Island and 'exemption' areas in other regions are slowing or preventing species recovery (Davies *et al.*, 2008; Slooten and Dawson, 2010). There is also continued bycatch from illegal setnetting inside protected areas.

Full details are given under item 7.2 of Annex L.

The Committee expresses particular **concern** about the low abundance of Maui's dolphins (North Island subspecies of Hector's dolphin). The latest abundance estimate of 55 individuals over one year old (CV 0.15) was calculated from a genetic mark-recapture analysis (Hamner *et al.*, 2012).

The Committee **recommends** the immediate implementation of the proposal by the New Zealand Ministry for Primary Industries to extend the North Island protected area to approximately 80km south of the latest dolphin bycatch site (Maunganui Bluff to Hawera), offshore to the 100m depth contour, including the harbours, for gillnet and trawl fisheries. This would protect part of an area with high gillnet and trawl fishing effort between the North and South Islands. Further population fragmentation could be avoided by also protecting the north coast of the South Island, providing safe 'corridors' between North and South Island populations (Hamner *et al.*, 2012).

Adequate observer coverage across all inshore trawl and gillnet fisheries is important in order to obtain robust scientific data on continuing bycatch as a means of assessing the effectiveness of protection measures.

14.7 Work plan

The Committee's views on the work plan for the sub-committee on small cetaceans are given under Item 21.

The sub-committee reviewed its schedule of priority topics which currently includes:

(1) status of ziphiids in the Southern Hemisphere; and
(2) systematics and population structure of *Tursiops*.

There is a need for extensive preparatory work for the proposed *Tursiops* review. Therefore the Committee agrees that the review of the systematics and population structure of *Tursiops* should be conducted in 2014 and an *ad hoc* group (Brownell, Perrin, Fortuna) was established to prepare for this. The Committee will need to carefully manage other agenda items to allow sufficient focus on the priority topics.

The Committee agrees that ziphiids of the Southern Hemisphere will be the priority topic at the 2013 Annual Meeting.

The sub-committee on small cetaceans convened an intersessional group evaluating the feasibility of having the so-called 'marine bushmeat' issue as a future priority topic. The group agreed on a number of attributes important for defining and delineating the issue (see Annex L). The Committee agrees to proceed with planning for a workshop characterised along the lines of 'poorly documented hunts of small cetaceans for food, bait or cash' although this may change somewhat at the discretion of the Convenor. It was emphasised that terminology and definitions as well as the scope and purpose of any workshop should be clarified in advance. A Steering Group was established under Ritter (Annex Q26).

15. WHALEWATCHING

The report of the sub-committee on whalewatching is given as Annex M. Scientific aspects of whalewatching have been discussed formally within the Committee since a Commission Resolution in 1994 (IWC, 1995c). The Commission also has a Standing Working Group on Whalewatching (IWC/64/CC6) that reports to the Conservation Committee (see Item 15.4.1).

15.1 Assess the impacts of whalewatching on cetaceans

SC/64/WW1 reviewed recent advances in whalewatching research. Steckenreuter *et al.* (2012a) investigated the impact of vessel interactions on the behaviour of a genetically distinct population of Indo-Pacific bottlenose dolphins; Steckenreuter *et al.* (2012b) examined the effectiveness of two Speed Restriction Zones (SRZs) in a dolphin-watching area; and Harris *et al.* (2012) documented interactions between cruise ships and humpback whales at Glacier Bay National Park (GBNP) in Alaska. Summaries are presented in Annex M, item 5.

SC/64/WW2 reported on a resident population of bottlenose dolphins in Bocas del Toro, Panama, of 100-150 animals. Their predictability and site fidelity has encouraged the development of several dolphin-watching operations. Resolution ADM/ARAP No. 01 (2007) regulates whalewatching activities but few operators are well-informed about the regulations and their importance. This preliminary study found that group size and group presence decrease with increasing number of dolphin-watching boats (although this trend was not statistically significant) and that overall, dolphins interacting with boats showed more avoidance behaviour. Future studies in the region will increase survey effort and include new data collection parameters to better characterise effects of dolphin-watching boats on these animals. Discussion and concerns expressed by some members of the sub-committee regarding SC/64/WW2 are detailed in Annex M, item 5.

The discussion further noted that one factor influencing the high volume of operators watching dolphins at the same time is that all operators have similar tour schedules. This results in competition among boat captains, little compliance with the regulations, and an increased risk of boat strikes (three dolphins were killed by dolphin watching boat strikes in 2011). The Committee **draws attention** to the need for developing strategies that minimise the impact of dolphin watching on the dolphin population, including staggering departure times to even out boat presence at any one time of day.

The Committee thanks the author for her presentation regarding a relevant situation in the host country and expressed concern regarding the intense and uncontrolled dolphin watching in Bocas del Toro. The Committee **strongly recommends** that Panamanian authorities enforce the relevant whalewatching regulation (ADM/ARAP No. 01) and in particular promote adherence to requirements regarding boat number and approach speed and distances. It also **welcomes** the continuation of the Cooperative Agreement between Argentina and Panama to develop and conduct operator training workshops. The Committee **recommends** continued research to monitor this dolphin population and the impacts of tourism on it.

SC/64/WW7 presented a controlled study on the swim-with-whale operations targeting humpback whales in Tonga. Up to five swimmers approached the whales while behaving in one of three ways: quietly slipping into the water and approaching at the surface making minimal noise; approaching whales at the surface making loud vigorous splashes; or, approaching whales with surface swimming and subsurface diving. The control treatment involved the boat approaching whales with no swimmers entering the water. The measure of disturbance was the time until the whales moved from their original location. Preliminary analyses suggest there was no significant difference between the quiet approach and the control, whereas there was a significantly shorter time to departure when the swimmers were loud and splashing, suggesting the management of swimmer behaviour could reduce the disturbance. Discussion is detailed in Annex M, item 5.

SC/64/WW3 presented a modelling approach to examine the potential effects of dolphin watching. Health was used to link individual behavioural changes to vital rates, since health can moderate survival and reproduction. Behaviours had a cost-benefit relationship with dolphin motivations (e.g. foraging reduces hunger), and health was linked to hunger to avoid biologically unrealistic variation. Trade-offs between motivations (e.g. hunger versus fear) then determines behaviour. Application to a bottlenose dolphin population in New Zealand found increased time foraging and decreased time resting leading to a negative shift in the population's health. A theoretical, larger population was then considered, looking at the potential loss of foraging time due to whalewatching vessels. Population-level impacts were dependent on population size and the intensity of whalewatching activities: larger populations required greater disturbance intensity to realise a population-level effect. These results highlight the need to consider whalewatching impacts and management at the population level. Short-term changes in behaviour can be significant, but do not automatically indicate a threat to the population's long-term health. Discussion and concerns over some aspects of SC/64/WW3 are detailed in Annex M, item 5.

The Committee **welcomes** the use of modelling to address the effects of whalewatching on cetaceans. It was suggested that Bocas del Toro, Panama, might be a location where this model could be tested.

15.2 Review whalewatching off Central America

SC/64/SH16 reported on whalewatching operations used as platforms of opportunity in Costa Rica, mainly offering trips to Marino Ballena National Park and Isla del Caño Biological Reserve, areas used by humpback whales during the winter. It was noted that this is a location where, without action, whalewatching could expand without sufficient oversight or control. It was suggested that this could be an important location for future focused work to assess the development and evaluation of regulations, monitoring efficacy and compliance. The Committee **expresses concern** that whalewatching operators appear to target mothers and calves, especially as the season progresses.

A survey investigating whalewatching tourists' attitudes toward cetacean conservation issues was undertaken in Blackbird Caye, Turneffe Atoll, Belize in 2007 and 2008

(Patterson, 2011), an area that provides year-round habitat to approximately 200 coastal bottlenose dolphins. Two main types of whalewatching were identified: dedicated cetacean research and incidental cetacean watching. Information relevant to the Committee is detailed in Annex M, item 6.

Annex M, Appendix 2 presents information summarising the known whalewatching operators, areas and targeted species in Central America. All Central American countries have whalewatching activities, primarily concentrated in the Pacific, but only Costa Rica and Panama have organised their industries with tour operator associations. In the south Pacific coast of Costa Rica, workshops to train and certify operators in best practices are being held twice a year. In Panama, operator training started in 2006 and will continue this year. In Guatemala and Nicaragua, whalewatching operators are becoming organised. Belize, Honduras, and El Salvador do not yet have organised whalewatching operators or associations or whalewatching regulations.

The Committee **welcomes** the information provided in Annex M, Appendix 2. It was noted that more whalewatching may be occurring in the region, but it is likely to be incidental or opportunistic.

15.3 Reports from intersessional working groups

15.3.1 Large-scale whalewatching experiment (LaWE) Steering Group

The Convenor for this intersessional correspondence group was unable to attend this year's meeting. A detailed progress report of this group's intersessional work is provided in the appendix of SC/64/WW6.

SC/64/WW6 introduced a meta-analysis to test for significant changes in speed, activity budget, inter-breath intervals and cetaceans' paths during whalewatching events. These changes could lead to increased energy expenditure and reduced foraging. In a call for participants, 10 ultimately provided data, after accounting for quality assurance and control procedures. A random effects model allowed for incorporation of heterogeneity due to moderators, such as study quality and body size. Only presence versus absence of vessels was modelled due to data limitations. Whalewatching activities had an impact in all studies, although the magnitude of the response varied. The only consistent response across species was path linearity and changes in resting behaviour. The only significant moderator was the effect of body size: smaller species and populations were less likely to rest in whalewatching vessels' presence. Researchers were receptive to suggested protocols meant to improve the quality of data collected.

15.3.2 LaWE budget development group

This intersessional group was unable to make progress. The Convenor sought information on budget requirements from the LaWE principals, but did not receive sufficient information to develop a budgetary framework. The Committee **strongly recommends** that the principal researchers on the LaWE Steering Group provide concrete information on budget requirements to the Convenor of the budget development intersessional group well before the next Annual Meeting, to allow this group's work to progress.

15.3.3 Online database for worldwide tracking of commercial whalewatching and associated data collection

Work continued intersessionally to develop a database to keep track of the details of whalewatching operations worldwide. The database developer is working towards putting the current version on the Commission's server for evaluation by the Committee.

15.3.4 Swim-with-whale operations

The questionnaire for operators (Rose *et al.*, 2007) was field-tested on three companies in the Dominican Republic in early 2012. Their responses indicated that the questionnaire was appropriate and sufficient to present more widely to operators. Further work will be undertaken intersessionally to distribute the questionnaire to more operators. The Committee thanks Rachel Ford, who conducted the field test of the questionnaire and the Pacific Whale Foundation which funded Ford's trip to the Dominican Republic.

15.3.5 In-water interactions

The Committee discussed the issue of human-cetacean in-water interactions in the wild in 2011 and an intersessional correspondence group was established (see IWC, 2012s). In order to examine potential risks to both cetaceans *and* humans, key points will be to identify for whom these in-water interactions are dangerous and what is considered dangerous. Definitions are elaborated in Annex M, item 7. In its work plan, the group proposes to work on a comprehensive list of human-cetacean in-water interactions, based on Scheer (2010), and to elaborate a list of areas and operations where in-water interactions take place.

In discussion, the Committee noted that the Commission's Five Year Strategic Plan for Whalewatching (see Item 15.4.1) may not adequately account for swim-with-whale and in-water interactions as forms of whalewatching. The Committee **recommends** that the Commission address issues that arise uniquely from operations that allow customers to swim with or feed cetaceans. It was suggested that the Commission refer to the Committee's definitions of types of whalewatching, as reported in Parsons *et al.* (2006), as well as the General Guidelines[27] as it progresses its work on whalewatching.

15.4 Other issues

15.4.1 Review scientific aspects of the Commission's Five Year Strategic Plan for Whalewatching

The Committee **agrees** that the goal of its review was to offer the Commission advice that will lead to results that benefit both the work of the Conservation Committee's SWG on whalewatching as well as the Scientific Committee's work. It was clarified that while the Committee focused its input on Objectives 1 (Research) and 2 (Assessment), all five objectives of the Strategic Plan could benefit from further cooperation between the two Committees, particularly in regards to elements such as regulatory frameworks, where this Committee could contribute expertise, data, and other work.

The Committee again recognises the ambitious scale of the science-related work programme found in the Strategic Plan and noted that the Commission should consider which actions would require additional time to address (see Annex M, Appendix 3). A Working Group was convened to formulate the Committee's comments back to the Commission. The Committee **endorses** the results of their consultation, which can be found in Annex M, Appendix 3.

An intersessional correspondence group (see Annex Q29) was established to discuss and develop guiding principles per Action 1.1 in the Strategic Plan. Action 1.2 should be completed intersessionally, with results reported to the next meeting.

[27]*http://www.iwcoffice.org/conservation/wwguidelines.htm.*

15.4.2 Consider information from platforms of opportunity of potential value to the Scientific Committee

The United Nations Environment Programme-Caribbean Environment Programme (UNEP-CEP), through the Specially Protected Areas and Wildlife Protocol and with the support of the National Environmental Authority of the Government of the Republic of Panama, convened a regional Workshop on marine mammal watching on 19-22 October 2011 in Panama City, Panama (Anon., 2011), bringing together marine mammal tour operators and government regulators from across the wider Caribbean region (WCR). The participants concluded that the data collected during marine mammal watching operations have the potential to answer questions about marine mammal populations in the WCR. Furthermore, these data should involve a network of collectors that cover larger field areas and should be archived so that they can be accessed and facilitate collaborations. Acknowledging the importance of standardised data, a template data form was developed. A copy of the proposed data form for the WCR may be found in Appendix V of the Workshop report.

The Committee **welcomes** this report on UNEP-CEP's activities and encouraged the submission of work related to this initiative to future meetings (and see Item 15.4.3)

Sollfrank and Ritter (2012) presented results from a study conducted on La Gomera (Canary Islands). Boat-based studies have been ongoing for several years, but little effort has been made to observe cetaceans systematically from land. This study demonstrated that it is possible to direct whalewatching boats to cetaceans spotted from land, allowing comprehensive and simultaneous data collection from land-based stations and boat-based platforms of opportunity. Land-based observations are the best way to monitor compliance with whalewatching regulations and to measure impacts from whalewatching vessels, as the presence of a research vessel does not influence operators or confound impact results.

M.E.E.R. (2012) laid out a model for a marine protected area (MPA) for sustainable whalewatching in the Canary Islands. Almost 15 years of cetacean data collected exclusively on whalewatching vessels (platforms of opportunity) were used to elaborate a marine protected area model. With anthropogenic threats increasing, the MPA model is especially designed for long-term development of whalewatching and other uses in a sustainable way. It is hoped that this report will contribute to the process of designating effectively managed marine protected areas within the European Union and elsewhere.

The Committee **welcomes** this presentation, as it represents the type of data most relevant to this agenda item and the work of the Committee as it can be applied toward science-based management decisions and actions.

SC/64/O12 reported on the situation in Samaná Bay, Dominican Republic, part of a national marine mammal sanctuary (along with the Navidad and Silver Banks). The Samaná Bay Boat Owners Association provides space aboard whalewatching vessels as platforms of opportunity. Data obtained over a period of 12 years were analysed to determine the spatial and temporal distribution of humpback whales in Samaná Bay. This information has played a vital role in the marine spatial planning of Samaná Bay and the creation of a conservation zone with restricted fisheries and tourism activities during the whale calving season. Details on the results of the study and discussion are found in Annex M, item 8.2

In particular given the expanding development of tourism in Samaná Bay, the Committee **recommends** that monitoring and research continue, especially in light of the increasing number of cruise ships entering the bay during the calving season.

SC/64/SH16 reported that along the South Pacific coast of Costa Rica, whalewatching boats have been used as platforms of opportunity to collect data on distribution and behaviour of humpback whales from breeding stock G from 2009-11. The results indicated a high number of mother-calf pairs and the use of coastal waters as a breeding ground. It was suggested that this location might be a good place to study the efficacy of an MPA by conducting research on the behaviour of animals inside and outside the MPA.

15.4.3 Review whalewatching guidelines and regulations

Carlson noted that the compendium of regulations and guidelines[28] on the Commission website was open, as always, to additions and updates. The Committee thanks Carlson for her committed work in this regard and **agrees** that the compendium is a valuable tool and should be continued. SC/64/WW5 analysed the compendium. The analyses, like the compendium, are intended as a reference, in this case to demonstrate both the diversity and similarities in existing rules. The Committee **agrees** that this analysis would also be a useful reference for the Commission and **recommends** that it also be posted on the Commission website.

The Committee reviewed the General Principles[29] and considers them robust. However, it **recommends** that they be renamed 'General Guidelines' (to avoid confusion with the term 'guiding principles'). It **agrees** to revisit them on a more regular basis to ensure they remain representative of 'best practices' and to address them under the standing agenda item on reviewing whalewatching guidelines and regulations.

SC/64/WW1 reviewed several studies that addressed whalewatching guidelines and regulations: Howes *et al.* (2012) investigated the effectiveness of the Ticonderoga Bay Sanctuary Zone to mitigate pressures of dolphin-swim operations on a small population of bottlenose dolphins; Alves *et al.* (2011) report on tourists swimming with and feeding Amazon river dolphins in Brazil; Ponnampalam (2011) collected baseline data on the nature of whalewatching in the Sultanate of Oman; and Pacheco *et al.* (2011) describe the success rate of sighting humpback whales from a marine wildlife-watching vessel operating in the coastal waters off northern Peru. Summaries are found in Annex M, item 8.3.

A product of the regional Workshop on marine mammal watching held in Panama (Anon., 2011) was the development of overarching principles and best practice guidelines for marine mammal watching in the WCR (UNEP-CEP, 2011a; 2011b). These principles and guidelines take into consideration pre-existing codes of conduct and regulations from countries within, and outside, the WCR and closely follow the steps and language used in the document *Pacific Islands Regional Guidelines for Whale and Dolphin Watching* (IFAW, 2008). All of the principles and guidelines developed for the WCR were agreed upon by the tour operators and regulators present at the Workshop and may serve as the basis upon which each country's own codes of conduct and regulations may be developed.

Galletti reported that the Chilean Government enacted whalewatching regulations in 2012. Many of the

[28]*http://www.iwcoffice.org/conservation/whalewatching.htm#regulations.*
[29]*http://www.iwcoffice.org/conservation/wwguidelines.htm.*

recommendations made by the Scientific Committee in 2007 were included, such as a maximum 300m approach distance for blue whales and allowing only land-based whalewatching for critically endangered southern right whales. Regulations will be translated into English and submitted for the compendium. The Committee **welcomes** this news.

15.4.4 Review of collision risks to cetaceans from whale-watching vessels
No new information was presented under this item.

15.4.5 Swim-with-whales operations
SC/64/WW1 presented information on swim-with programmes: Mangott *et al.* (2011) reported on swim-with dwarf minke whales on the Great Barrier Reef. The summary is found in Annex M, item 8.5. The Committee **reiterates its recommendation** from Item 15.3.5.

15.4.6 Emerging whalewatching industry in Oman
Oman's whalewatching industry has experienced gradual growth over the last 10 years, reflecting a steady increase in tourism and a growing awareness of cetacean fauna. The Arabian Sea humpback whale has recently become a target of opportunistic and unregulated whalewatching in southern Oman. The Committee has previously expressed concern over the status of this population which is discussed further under Item 10.7; unregulated whalewatching represents an additional potential threat to this population.

Existing, unofficial whalewatching guidelines in Oman are now over 10 years old. Progress has been made on updating these guidelines as well as gathering data on whalewatching operations, but further technical support is required to finalise the new guidelines as well as to assist with the training of operators.

The Committee **strongly recommends** that operator training workshops should be conducted with a view to promoting best practice for whalewatching and to aid the interpretation and implementation of revised whalewatching guidelines (see also Item 21).

15.5 Work plan
This is discussed under Item 21.

15.6 Other matters
It was noted that the development of general data requirements on the effects of whalewatching would be valuable in situations where a country is considering whether it would be sustainable to increase the level of whalewatching (e.g. a proposed increase in whalewatching permits for Kaikoura, New Zealand). The concept of assessing 'whalewatching carrying capacity' is of interest in the management and scientific communities and the Committee **encourages** presentation of a paper outlining the situation in New Zealand at the next meeting of the Committee to facilitate its discussions of the broader issue.

16. DNA TESTING

The report of the Working Group on DNA is given as Annex N. This particular agenda item has been considered since 2000 in response to a Commission Resolution (IWC, 2000).

16.1 Review genetic methods for species, stock and individual identification
No documents were presented this year. The Committee encourages the preparation of technical documents on methods for species, stock and identification for discussion at the next year meeting (see also Item 16.5).

16.2 Review results of the amendments of sequences deposited in GenBank
During the first round of sequence assessment (IWC, 2009h, p.347) some inconsistencies were found that appeared to be due to a lag in the taxonomy recognised by *GenBank* or uncertainty in taxonomic distinctions currently under investigation: 23 labelled as *Balaenoptera acutorostrata* in *GenBank* were identified as *B. bonaerensis*, 9 labeled as *B. edeni*, and 10 labeled as *Eubalaena glacialis* were identified as *E. australis* and *E. japonica*. The Committee had recommended notifying the original submitter about the inconsistency and encouraging an amendment to be made to the entry.

Following 2010/11 intersessional work, amendments were made for four cases of Bryde's whale and one case of minke whale, respectively (IWC, 2012f, p.52). In view of the limited responses, the Committee had requested that an official letter be sent from the Secretariat requesting the submitters to make the amendments in *GenBank*. This was done for three scientists for which addresses were available, involving nine cases of right whale (one scientist), one case of right whale (one scientist) and one case of Bryde's whale (one scientist). Unfortunately no responses have yet been received and thus no amendments have been made in *GenBank* during the intersessional period.

In view of this, for the next period, the Committee **reiterates** its previous suggestion on the addition of a field in *GenBank* where comments on taxonomy updates of the entries can be made (IWC, 2012f; p.52). The Committee **agrees** that Cipriano should make a request to *GenBank* and that he should inform the IWC Secretariat and the Convenor of the DNA Testing Group if a more formal request is required.

16.3 Collection and archiving of tissue samples from catches and bycatches
Last year, the Committee endorsed a new format for the updates of national DNA registers to assist with the review of such updates (IWC, 2012f, p.53). The updates of the DNA registers by Japan, Norway and Iceland this year were based on this new format.

The collection of tissue samples in Japan is from special permit whaling in the North Pacific (JARPN-JARPN II) and Antarctic (JARPA-JARPA II), and from bycatches. It includes coverage for 1994-2011 (JARPN-JARPN II), 1987/88-2011/12 (JARPA-JARPA II). In the case of bycatches it includes coverage for 2001-11 (see Annex N, Appendix 2).

The collection of tissue samples in Norway is from the commercial catches of North Atlantic common minke whales. It includes coverage for the period 1994 to 2011 (see Annex N, Appendix 3).

The collection of tissue samples in Iceland is from scientific whaling and from commercial catches. It includes coverage for 2003-07 (permit whaling) and 2006-11 (commercial whaling) (see Annex N, Appendix 4).

16.4 Reference databases and standards for diagnostic registries
In the Japanese register, almost all common minke whale sampled by JARPN-JARPN II in 1994-2011 were screened for mtDNA and microsatellites. Almost all minke whales

bycaught in 2001-10 were screened for mtDNA and microsatellites. For animals bycaught in 2011, the percentage for microsatellite is lower (77.8%). This lower percentage is a result of the loss of 26 samples after the 2011 tsunami in Japan (see Annex N, Appendix 2).

Almost all Bryde's whales sampled by JARPN II in 2000-11 were screened for mtDNA and microsatellites. Genetic work for mtDNA and microsatellite was completed for four whales bycaught in 2001-10. Almost all sei whales sampled by JARPN II in 2002-11 were screened for mtDNA and microsatellites (see Annex N, Appendix 2).

Almost all sperm whales sampled by JARPN II in 2000-10 were screened for mtDNA and microsatellites. The single animal sampled in 2011 was screened for mtDNA. Microsatellite work has not been completed yet. All sperm whales bycaught in 2001-10 were screened for mtDNA and microsatellites (see Annex N, Appendix 2).

In the case of Antarctic minke whales, 16.5% and 92.3% of the whales sampled by JARPA in 1987/88-2004/05 were screened for mtDNA and microsatellites, respectively. Work for mtDNA is ongoing. Many of the samples of JARPA II (2005/06-2010/11) were lost after the 2011 tsunami in Japan. DNA work is ongoing on the recovered samples. For animals sampled in 2011/12, the mtDNA and microsatellite work has not yet been completed. For Antarctic fin whales, the 17 samples collected by JARPA II in 2005/06-2010/11 were screened for mtDNA and microsatellites. The DNA work on the single animal sampled in 2011/12 is ongoing (see Annex N, Appendix 2).

All North Pacific humpback whales bycaught in 2001-11 were screened for mtDNA and microsatellites. Two North Pacific right whales and three North Pacific fin whales bycaught from 2001-10 were screened for both mtDNA and microsatellites (see Annex N, Appendix 2).

Almost all samples in the Japanese DNA registry have been sexed (see Annex N, Appendix 2).

A suggestion was made that the genetic data of bycaught humpback whales could be of use for testing hypotheses on stock structure of this species in the western North Pacific.

In the Norwegian register, after discounting for duplicates, missing samples and laboratory problems, 100% of the North Atlantic common minke whale caught in 1997-2011 were screened for mtDNA and microsatellite (see Annex N, Appendix 3). The Committee **commends** the analyses on quality control carried out on the Norwegian DNA register (Glover *et al.*, 2011).

In the Icelandic registry, all common minke whales sampled under scientific permit whaling in 2003-07 were screened for mtDNA and microsatellites. The percentage for both markers is 6.1% for whales taken by commercial whaling in 2007-10. The percentage is 3.5% for whales taken by commercial whaling in 2011. All fin whales caught by commercial whaling in 2006-10 were screened for both mtDNA and microsatellites (see Annex N, Appendix 4). A question was raised on the low percentage for the commercial samples of common minke whale. In response, Víkingsson noted that while not required by IWC rules or regulations, tissue samples had been collected for the DNA register from all animals caught in the Icelandic commercial hunt. The delay in the laboratory analyses of samples collected since 2007 is due to funding restrictions but these will be completed before the *Implementation Review* of North Atlantic common minke whales scheduled for 2014.

The Committee appreciates the efforts of Japan, Norway and Iceland in compiling and providing detailed information on their registries in the new format. The Committee **agrees** that the information provided in the new format greatly facilitated the annual review.

16.5 Work plan

The Committee **encourages** the submission of papers in response to requirements placed on the Committee by IWC Resolution 1999-8 (IWC, 2000). Relevant information in documents submitted to other groups and sub-committees of the Committee will be reviewed next year. Results of the 'amendments' work on sequences deposited in *GenBank* will be reported next year.

17. SCIENTIFIC PERMITS

This Agenda Item was discussed by the Working Group on Special Permits in two late afternoon sessions to enable all Committee members who wished so to attend. Bjørge was elected Chair of the Working Group. Weller acted as Rapporteur, and the Working Group report has been directly incorporated here.

17.1 Review of results from existing permits

As in previous years, the Committee received short cruise reports on activities undertaken but spent relatively little time on discussion of the details. For long-term programmes the Committee has agreed that regular periodic detailed reviews (following 'Annex P') were more appropriate.

17.1.1 JARPN II

17.1.1.1 AUTHORS' SUMMARIES

SC/64/O3 presented the results of the 2011 Japanese Whale Research Program under Special Permit in the Western North Pacific - Second Phase (JARPN II) offshore component survey in sub-areas 7, 8 and 9 of the western North Pacific. There were three main research components: the whale sampling survey; the dedicated sighting survey; and the whale prey species survey. Two sighting/sampling vessels (SSVs), one research base vessel (NM whale sampling survey component), one whale prey survey vessel equipped with scientific echo sounder (PSV) and three dedicated sighting vessels (SVs) were used. The whale sampling survey took place from 11 June to 5 September 2011. A total of 5,156 n.miles was surveyed in 76 days (by the SSVs and NM) sightings included, 53 common minke, 476 sei, 149 Bryde's, 295 sperm, 66 fin and eight blue whales. A total of 49 common minke, 95 sei, 50 Bryde's and one sperm whale were sampled by the SSVs. Sampled whales were examined on board the research base vessel. In July, common minke whales fed mainly on Japanese anchovy near Syiriya and they fed mainly on walleye pollock around the east of Hokkaido. There were geographical changes of prey species of minke whales in sub area 7. Sei whales fed mainly on copepods and Japanese anchovy from June to August in sub areas 8 and 9. Bryde's whales fed mainly on krill in sub area 7 in July. Dominant prey species in the stomach of the sperm whale included mid- and deep-water squid. The dedicated sighting surveys took place from 28 April to 6 June 2011 in sub areas 8 and 9. During 4,060 n.miles surveyed three common minke, 51 sei, six Bryde's, 116 sperm, 31 fin and four blue whales were sighted. The prey species survey was carried out from 13 to 28 June in 2011. In parts of sub areas 8 and 9 by the PSV. Its objective was to estimate sei whale habitat and prey preference in relation to oceanographic and prey environments as well as productivity in early summer. Data obtained in this research will be used to elucidate the role of whales in the marine ecosystem through the study of whale feeding ecology in the western North Pacific.

SC/64/O4 presented the results of the 2011 JARPN II - coastal component - survey in spring. Usually the coastal spring survey is carried out in the locality of Ayukawa. On March 11 2011 the Ayukawa town, including all research facilities of JARPN II there, was destroyed by a large earthquake and tsunami. For this reason, the 2011 spring coastal survey was conducted in Kushiro, from 25 April to 10 June, using three vessels. Sampling occurred within 50 n.miles from Kushiro port, and animals were landed at the JARPN II research station. A total of 3,867.4 n.miles was surveyed and 36 schools (43 individuals) of common minke whales were seen and 17 common minke whales were sampled. Average body length was 6.70m (SD=0.84, *n*=9) for males and 6.29m (SD=1.02, *n*=8) for females. Dominant forestomach prey species were walleye pollock (*Theragra chalcogramma*) throughout all of the survey period, and krill (*Euphausia pacifica*) which was observed less frequently. Walleye pollock is one of the most important food items for common minke whales in Kushiro in both spring and autumn seasons. Distribution of common minke whales appears to differ between spring and autumn surveys in Kushiro, at least for some years.

SC/64/O5 outlined the results of the autumn survey of the JARPN II coastal component off Kushiro, northeast Japan (the sub-area 7CN) in 2011. The survey was conducted from 9 September to 30 October 2011, using four vessels. During 5,367.8 n.miles searched, 144 schools and 150 individual common minke whales were sighted and 60 whales were sampled. Average body length was 6.24m (SD=1.06, *n*=35) for males and 6.05m (SD=1.08, *n*=25) for females. Overall, 19 of the 35 males (54.3%) and three of the 25 females (12.0%) were sexually mature. The dominant forestomach prey species was Japanese anchovy (*Engraulis japonicas*) (61.7%), followed by walleye pollock (26.7%), and krill (8.3%). Pacific saury (*Cololabis saira*) and Japanese common squid (*Todarodes pacificus*) were not observed. The frequent sightings of whales in combination with the slightly higher ratio of mature and larger whales in the 2011 survey, as compared to the 2010 survey, as well as more whales comsuming Japanese anchovy suggested that the abundance and distribution of this prey item may have attracted whales to the coastal waters off Kushiro in autumn 2011. During the survey, no apparent impact due to the earthquake in March 2011 was detected in the distribution, density or catch composition of common minke whales. This implied that effect of the earthquake on the migration of common minke whales in the coastal waters off Kushiro might be negligible.

17.1.1.2 DISCUSSION

Following the cruise report presentations, there was some discussion of how the cruise tracks for the coastal survey off Kushiro were designed and if the intent was to obtain a representative sample or rather to increase the probability of encountering whales. The authors of SC/64/O5 explained that survey vessels used during the coastal component of the programme departed port each day following a number of predetermined lines with 15° radials that were selected on a daily basis after review of weather, oceanographic conditions and the distribution of whales. Survey tracks were concentrated relative to whale distribution and differed from standard line transect methods in that the first 30 n.miles were dedicated to survey search mode followed then by the vessels moving freely within the study area.

In further discussion, the Working Group was reminded that at last years meeting it was suggested that whales taken during coastal operations be examined for radionuclides, especially caesium-137, for use in stock elucidation (IWC, 2012f). The authors of SC/64/O4 stated that one of the three objectives of the JARPN II programme was to monitor environmental pollutants in cetaceans and the marine ecosystem. Data collection for radionuclide assessment is being undertaken and data are available on the website of the Fisheries Agency of Japan.

17.1.2 JARPA II

17.1.2.1 AUTHORS' SUMMARY

SC/64/O2 presented the results of the 2011/12 survey of the Second Phase of the Japanese Whale Research Program under the Special Permit in the Antarctic (JARPA II). Two dedicated sighting vessels (SV), one sighting and sampling vessel (SSV) and one research base vessel engaged in the research for 66 days, from 1 January to 6 March 2012 in Areas V (130°E-170°W) and VI West (VIW: 170°W-145°W). Unfortunately, the research activities were interrupted several times by the violent sabotage activities of an anti-whaling group. The planned dedicated sighting survey had to be cancelled so that the vessels could undertake security tasks. The research activity of the SSV was also interrupted several times. The total search distance by the SSV of 3,040.5 n.miles, was approximately one-third of the search distance in 'normal' years. Eight species including six baleen whales (blue, fin, sei, Antarctic minke, humpback and southern right whale) and two toothed whales (sperm and southern bottlenose whales) were seen. The most common species seen (284 schools, 684 individuals) was the Antarctic minke whale followed by the humpback (112 schools, 208 individuals) and fin whales (11 schools, 31 individuals). A total of 266 Antarctic minke whales (99 males and 167 females) and one fin whale (female) were sampled examined on the research base vessel. A total of five blue, six humpback and four southern right whales were photo-identified. Two biopsy samples were collected from humpback whales and four from southern right whales. In March, satellite tags were deployed on two southern right whales. Oceanographic surveys to investigate vertical sea temperature profiles were also implemented using XCTD. In summary:

(1) whale composition in the research area was stable compared to previous JARPA and JARPA II surveys in the same area;
(2) the ice-free extent in Area VIW was substantially larger than in previous seasons;
(3) high density areas of Antarctic minke whales were observed near the ice edge;
(4) mature female Antarctic minke whales were dominant in the southern part of Area VIW (66.8%); and
(5) Antarctic minke whales in the 'transition area between 130°E and 165°E (area of stocks mixing), were successfully sampled.

17.1.2.2 DISCUSSION

Following the presentation of the 2011/12 JARPA II cruise report, it was noted that the lack of discussion did not imply there is agreement on the issue of scientific whaling under special permits. Differing views on this activity remain and the Working Group was referred to the statements made in Annex P1 and Annex P2.

17.1.3 Planning for a final review of results from Iceland - North Atlantic common minke whale

The results from the Icelandic programme on common minke whales will be subject to final review during the coming intersessional period. 'Annex P' (IWC, 2009i) documents the review process. The only time this procedure has been used was to review the JARPN II Special Permit in 2009 (IWC, 2010b). While the process worked well in general (IWC, 2010d), improvements on some aspects of the implementation of the process have been agreed and are detailed in Annex P4 of last year's report (IWC, 2012t). One change in implementing the 'Annex P' procedure (IWC, 2009i) will be the presence of observers. The general outline of the Workshop includes an initial session where a restricted number of scientists associated with the proposal will present results of their research and answer questions. Then the main part of the review Workshop will be closed sessions where the expert panel evaluates the results. At the end of the Workshop there will be a short open session where the expert panel can ask scientists associated with the proposal questions for clarification. Observers will be allowed to the open sessions. In light of these modifications, the timetable to be used for the Iceland and JARPA II reviews is presented in Table 3 of Annex P4 (IWC, 2012t).

Víkingsson stated that Iceland will meet the requirements of the time schedule of Annex P4 (IWC, 2012t) for a review in 2013. The Working Group **agrees** that the review of results from Iceland will occur in February/March 2013.

SC/64/SCP1 addressed the data availability under Procedure B of the Data Availability Agreement. A small group was set up to consider this document. The Committee **agrees** the clarifications to 'Annex P' (IWC, 2009i) included as Annex P3.

17.1.4 Planning for a periodic review of results from JARPA II

The Working Group **agrees** that the review of results from JARPA II will occur in February/March 2014.

17.2 Review of new or continuing proposals

17.2.1 JARPA II

Japan reported that there was no plan to change the JARPA II programme.

17.2.2 JARPN II

Japan reported that there was no plan to change the JARPN II programme.

18. WHALE SANCTUARIES

The Committee received no new proposals for sanctuaries this year. The report of an international Workshop on Marine Protected Areas (SC/64/O20) was discussed in Annexes K and M.

19. SOUTHERN OCEAN RESEARCH PARTNERSHIP (SORP)

The Southern Ocean Research Partnership (SORP) was proposed by the Australian Government to the IWC in 2008 (IWC, 2008b) with the aim of developing a multi-lateral, non-lethal scientific research programme to improve the coordinated and cooperative delivery of relevant scientific information to the IWC. The Partnership now includes ten countries: Argentina, Australia, Brazil, Chile, France, Germany, New Zealand, Norway, South Africa, and the USA. A framework and set of objectives for SORP have been endorsed by the Committee (IWC, 2011f) and six SORP research projects were endorsed last year (IWC, 2012f). Progress of these research projects was reviewed this year. The IWC has a budget specifically related to the work of SORP established with a contribution from Australia in 2008 and supplemented by additional voluntary contributions from Australia and the USA in 2011. This budget is administered by the IWC Secretariat.

SORP was originally discussed in an open session, chaired by Gales and rapporteured by Bell. The report of that session is incorporated directly into the Plenary report here.

The Committee noted that in April 2012, Bell was appointed the Southern Ocean Research Partnership coordinator replacing Childerhouse and Wadley was appointed the Antarctic Blue Whale Project coordinator.

19.1 Review of progress since IWC/63

SC/64/O13 summarised the progress of SORP since IWC/63. Progress was made on the following major items.

(1) *Overall support and progress of the six SORP research projects* – progress reports for the 2011/12 period are available in SC/64/O13.
(2) *Provision of interim funding* – funding was provided for all six SORP projects to support research during 2011/12 (IWC, 2011f).
(3) *Further development of the* SORP Antarctic Blue Whale Project *(formerly known as the SORP Year of the Whale Project)*.
(4) *Planning and implementation of collaborative SORP Antarctic blue whale expeditions* – two expeditions led by Australia were undertaken in the austral summer of 2011/12 (SC/64/SH11) to develop and test methodologies that will be employed during the SORP Antarctic Blue Whale Voyage planned for early 2013 (SC/64/SH13). Further development of acoustic methods (SC/64/SH12) and survey design (SC/64/SH10, SH14, SH26) was also undertaken.
(5) *Completion of the core SORP project*: the Living Whales Symposium and Workshops, held in Chile in March 2012 (SC/64/O14).

These items are covered in more detail below. The Committee was **pleased** to note that SORP is being successfully implemented and **welcomes** the results.

19.1.1 SORP Antarctic Blue Whale Project

The title 'Antarctic Blue Whale Project' (ABWP) now replaces 'The Year of the Whale' (YOTW) to reflect the fact that the proposed research will require a multi-year, multi-platform, integrated and coordinated research effort. This became clear following discussions within the Committee and intersessionally, particularly given the extensive methodological development (IWC, 2012m; Kelly *et al.*, 2011; SC/64/SH10-14, SC/64/SH26) reported. A single season effort is not an appropriate strategy to deliver an estimate of circumpolar abundance, given logistical constraints and the preferred sampling regime under a mark-recapture approach.

The specific objectives of this initiative are to:

(1) provide a circumpolar abundance estimate for Antarctic blue whales;
(2) improve understanding of Antarctic blue whale population structure;
(3) improve understanding of connectivity between blue whale feeding and breeding grounds; and
(4) characterise foraging habitat of blue whales.

SC/64/O13, SC/64/SH10-14 and SC/64/SH26 were discussed in Annex H. The project was very well received as an investigation to determine the viability of ideas and methods. Gales welcomed the maturing ideas and methods under development and their implementation in the Southern Ocean during 2012/13. Results from the ABWP have been presented at international scientific meetings, including the International Polar Year conference in Montreal, April 2012.

The importance of SORP as a means to engender international cooperation was noted. There are encouraging signs that estimating the circumpolar abundance of blue whales will be possible.

19.1.2 Ways to expand Antarctic Blue Whale Project (ABWP) work

SC/64/O16 provided information about the South African Blue Whale Project (SABWP) and it was discussed in Annex H. Despite evidence of recent increase, the population of Antarctic blue whales remains severely depleted from commercial whaling. Both the high concentrations of sightings of Antarctic blue whales in the 0-20°E sector of the Antarctic in recent years (IDCR/SOWER sighting records) and the high historic catches of some 12,000 probable Antarctic blue whales off the west coast of South Africa, Namibia and Angola prior to 1930, suggest that the southeastern Atlantic Ocean and neighbouring Southern Ocean region should provide exciting opportunities for research on Antarctic blue whales. The South African Blue Whale Project (SABWP) has been recently funded by the South African National Antarctic Programme (SANAP) and the National Research Foundation (NRF) to investigate the seasonality, distribution and relative abundance of this species in these areas with the long-term aim of determining relative abundance indices to measure the population trend. Research efforts will be concentrated in two regions; 67°S to the ice edge and 0-20°E region in summer, and off the south-western Cape coast in winter. Autonomous Acoustic Recorders (AARs) will be deployed in both the high and low latitude regions to determine distribution and seasonality patterns of this migratory species. Line-transect surveys (incorporating photo-ID, biopsy sampling and ship-based passive acoustic monitoring) will be carried out in the Antarctic region during summer to provide abundance and call-rate measurements for 'broadbrush' ground-truthing of Antarctic AAR data. Low-latitude AAR data will provide information on where and when to concentrate future research efforts off the southwestern Cape coast. Data from this voyage will contribute to the ABWP and other SORP projects. A proposal for one of the team to receive training in AAR deployment during a cruise off Greenland this summer (SC/64/O17) has been adopted.

Norway joined SORP two years ago. Norway may contribute to SORP in the following manner.

(1) Financially: upon provision and favourable review of a budget and research proposal from existing or new SORP projects, Norway would be willing to fund research. Norway does not have to be involved in the research proposal.
(2) In kind support: annually, Norway sends scientists on fishing vessels that work in the Southern Ocean, in 2012/13 primarily around the South Orkney Islands. Biannually, the Norwegian vessel R/V *G O Sars* operates in the Southern Ocean I.A. in the area around Bouvet Island. This is a dedicated research vessel that can be directed to other areas. It will next sail in 2013/14 (to be confirmed). Berths on these vessels could be made available to SORP researchers.
(3) Personnel: the expertise of Norwegian scientists could be provided for collaboration on SORP research projects.

Particular interest was expressed in contributing to the Antarctic Blue Whale Project. The Committee **greatly welcomes** Norway's offer of monetary, in kind and personnel support for SORP and **agrees** that it will be resolved intersessionally how it will be managed and administered.

The Committee was informed of France's intention to use the R/V *l'Astrolabe* to carry out a photo-ID and sightings surveys of blue whales in Terre Adelié. Surveys will be carried out over the next two years and it is hoped it can be continued for up to four years. A marine science voyage is also being considered in the southern Indian Ocean, south of Kerguelen on the Marion Dufresne. It is hoped that time may be allocated on this to perform blue whale research but it is a highly competitive process.

The Committee was informed of Germany's intention to perform its fifth cetacean survey from January to mid-March 2013 in the western Weddell Sea. This will be a repeat of the 2006/07 survey. The aim is to relate krill abundance to hydrography and oceanography. Helicopters will be used as the survey platform.

The Committee was also informed of plans by the International Fund for Animal Welfare for a Southern Ocean voyage that may be able to contribute to the Antarctic Blue Whale Project through combined acoustic surveys and photo-ID.

It was noted that collaboration with the wider Antarctic community is underway with SCAR, COMNAP, IAATO and CCAMLR to pursue the objectives of the ABWP.

The Committee **encourages** international involvement in the SORP Antarctic Blue Whale Project in the form of research, ship time or personnel. The Committee also stressed the importance of standardised protocols and shared data access across a range of data types, and **encouraged** their adoption across international cetacean research programmes.

19.1.3 Killer whales in the Southern Ocean

The principal investigators once again participated as 'visiting scientists' on board the tour vessel M/V *National Geographic Explorer*, during four consecutive trips to the Antarctic Peninsula from 7 January to 15 February 2012; approximately 3,000 photo-ID images of over 200 individually-recognisable animals for future mark-recapture analyses were obtained; two skin biopsy samples were obtained (samples archived at SWFSC), and three individuals were satellite-tagged. Data are presented in the full project report in Annex 1 of SC/64/O13. Other tour ships operating in the Antarctic Peninsula area were also canvassed for killer whale photographs and thousands of images were obtained from over two dozen killer whale encounters. The principal investigators feel confident that within the next year or two they should have enough images to estimate population sizes for the three types of killer whales that are recognised in the Peninsula Area.

The Committee **commends** the work of the principal investigators.

The Committee was also informed of new killer whale photo-ID data from the Institut Polaire Française (IPEV) Cétacés Terre Adélie project that is available for 35 individuals in Terre Adélie, eastern Antarctica (SC/64/SM6).

19.1.4 Foraging ecology and predator prey interactions of baleen whales and krill

During the funding period, significant progress was made towards the overall goal of understanding the foraging ecology and predator-prey interactions between baleen whales and krill in the waters around the Western Antarctic Peninsula. Analysis was completed describing the diving behaviour of humpback whales from suction-cup tags deployed in 2009 and 2010. These results were presented at numerous scientific meetings including the Biennial Conference on the Biology of Marine Mammals (Tampa, FL, November 2011), and the recent SORP Workshop on non-lethal research techniques for studying cetaceans (Puerto Varas, Chile, March 2012). A full project report is included in Annex 1 of SC/64/O13.

The main findings of the project to date are summarised below.

(1) Humpback whales were found to feed almost exclusively during night-time hours in late autumn (May/June), spending daylight hours either resting or travelling. The initiation of feeding was often proceeded by deep exploratory dives that are hypothesised to sample the water column to determine where prey are distributed.
(2) Humpback whales appear to achieve or conform to ecological predictions of optimal foraging theory in two significant ways: by increasing the number of feeding lunges executed per dive with increased dive depth; and by targeting higher densities of krill as feeding depth increases.
(3) While both of these findings are significant, the fact that the principal investigators have been able to quantify increases in prey density concurrent to whale feeding is novel. The information provided from this relationship will be a substantial component of the manuscripts that are currently in preparation to be submitted for peer review.
(4) Humpback whales vary the depth of their feeding in relation to the diel vertical movement of krill in the water column.

The Committee **welcomes** these results and **encourages** further work to enhance understanding of humpback whales that overwinter in Antarctica. Gales noted that additional satellite and datalogger work on humpback and minke whales was planned.

19.1.5 Oceania humpback whale mixing
The focus of this project has been on preparing for the proposed 2013 satellite tagging work at the Kermadec Islands and American Samoa (Childerhouse, 2011). The Oceania humpback whale population estimate has been published (Constantine *et al.*, 2012) with a sex-specific POPAN super-population model, which accounted for residents and whales migrating through the survey areas, giving an estimate of 4,329 whales (3,345-5,313) in 2005.

In the winter of 2011, satellite tagging work was undertaken in New Caledonia (Garrigue in collaboration with Zerbini and Clapham) adding to the 2007 (Garrigue *et al.*, 2010) and 2010 tagging efforts. The general trend observed was for the majority (~75%) of whales to head in a south-southeasterly direction once they left the New Caledonia breeding grounds. Some whales stopped at seamounts or other undersea geographic features along the way for varying lengths of time.

The Raoul Island (Kermadec group) single day four hour survey conducted between 08:00 and 12:00hrs was conducted on the 8 October 2011. This adds to the previous three years of October surveys using a standard set of seven land-based locations (Brown, 2009; 2010; Potier, 2008)[30]. Previous whale-counts from these surveys have ranged from 62-153 whales and the 2011 survey counted 126 individual whales (Potier and Shanley, 2012)[30]. The consistently high number of humpback whales observed migrating past Raoul Island, peaking in October, confirms the Kermadec Islands as the southernmost location in Oceania with regular whale sightings and the ideal site to attach satellite tags as the whales migrate south. Constantine will visit the Kermadec Islands in August 2012 to consider this research site. Research in American Samoa conducted in the 2011 field season continued preparation for the planned satellite tagging in 2013.

Future work will focus on addressing two questions.

(1) What is the connection between the humpback whales from Area V feeding grounds and their migratory corridors and breeding grounds in Australia and Oceania?
(2) Do whales from Area V represent a single breeding ground or are they a mix of individuals from several distinct breeding grounds?

A full project report is included in Annex 1 of SC/64/O13.

19.1.6 Fin and blue whale acoustics
Understanding baleen whale distribution and abundance in the Antarctic, particularly blue and fin whales, is complicated by the pelagic distribution of both species, the difficulty of working in the Southern Ocean (SO) and the massive decline of both due to commercial whaling. After a half-century of protection, little is known about the present-day status of each species. Blue and fin whales are congeners that are the largest mammals on earth. Both occur in all oceans of the world with similar distribution patterns. In particular, each species occurs in high latitudes in the Southern Hemisphere. In the Antarctic, blue whales are generally thought to occur closer to the ice edge than fin whales. Blue whales are designated as different subspecies, i.e. Antarctic (*B. m. intermedia*) and pygmy types (*B. m. brevicauda*), and Chilean blue whales are also considered an unnamed subspecies, or at least a separate management unit. In the case of fin whales in the Southern Hemisphere, two subspecies have been considered: *B. physalus quoyi* for the Southern Ocean form; and the pygmy fin, *B. p. patachonica,* found in the northern parts of the Southern Hemisphere.

Both blue and fin whales were targets of commercial whaling, particularly from the early 1900s through the 1930s, leading to heavy depletion. Blue whales were protected internationally from whaling in 1966 and fin whales in 1985. At present, both species are listed as Endangered by the IUCN and there are no reliable population estimates for either species globally. A recent examination of almost 40 years of sighting data resulted in an estimate of 2,280 (CV=0.36) Antarctic blue whales, which is less than 1% of the original population (Branch, 2007). There are no equivalent estimates for Southern Hemisphere fin whales.

From 1978 to 2010 the IWC supported the annual IDCR/SOWER Antarctic cruises that consisted of three circumpolar sets of cruises over multiple years that focused primarily on minke whale abundance but that also provided an estimate of abundance for Antarctic blue whales (Branch, 2004). Only two of the recent cruises focused on fin whales (Ensor *et al.*, 2006; 2007). Given the amount of effort, ship time, high risk of poor weather and cost of sighting cruises, it is unlikely that the tremendous shipboard effort of IDCR/SOWER will be repeated. In order to continue to monitor Antarctic blue and fin whales, the use of a network of long-term passive acoustic recorders has been proposed *in lieu* of dedicated circumpolar visual surveys.

Passive acoustic monitoring is a robust means of monitoring blue and fin whales in remote areas over long time periods, including around the Antarctic. The present analysis of all the available data shows the geographic and seasonal occurrence of blue and fin whales around the Antarctic. However the lack of overlap in the years and

[30]Unpublished field reports.

locations monitored, the differences among instruments and analysis methods used, underlines the need for coordinated effort. To best exploit passive acoustic data long term, a pan-Antarctic monitoring system needs to be put in place and maintained. Thus far there has been a positive response from many countries regarding this project. In the near term the principal investigators need to find the finances and continue instrument development to facilitate a coordinated research effort. Further a single method either for each species or for both needs to be adopted for analysing the data. A review of existing methods for estimating relative abundance from passive acoustic sensors demonstrates that the scientific question of interest will drive the analysis methods chosen. The principal investigators suggest that the Australian Marine Mammal Centre, based at the Australian Antarctic Division, Hobart, maintain a database of the metadata and data from hydrophones and make these freely available if possible.

Acoustic data from a single hydrophone present unique challenges to density estimation: to overcome these, the principal investigators need to improve their knowledge of call rate, acoustic behavior and source level of whales; detection distance and sound propagation (environmental parameters and ambient noise level). Methodology to estimate the density of whales from acoustic data is advancing rapidly and it is anticipated that if understanding of the parameters above is improved, density estimation using passive acoustic data will become the state of the art for monitoring Antarctic blue and fin whales. A full project report is included in Annex 1 of SC/64/O13.

The Committee **commends** the work of the principal investigators and it was noted that this project addresses the research priorities identified by SORP to meet the overall objectives of the IWC.

It was highlighted that it will provide valuable data for blue whales and may provide the only practical way to obtain data about fin whale abundance, information that the scientific community currently does not have. From this data it may be possible to estimate trends in blue and fin whale populations over decadal scales.

This work is closely aligned with the objectives of the Antarctic Blue Whale Project. It was also noted that that the global economic situation is very likely to reduce the amount of ship time available to researchers in the future, therefore the development of acoustic methods such as these are essential for continued, non-lethal cetacean research.

19.1.7 Living Whales Symposium and non-lethal research techniques Workshops

SC/64/O14 summarised the SORP Symposium and Workshops entitled 'Living whales in the Southern Ocean: advances in methods for non-lethal cetacean research'.

The Symposium and accompanying Workshops were held in Puerto Varas, Chile from 27-29 March 2012, to discuss recent advances in methods for non-lethal research on whales in the Southern Ocean. The Symposium was attended by 124 registered participants from 16 countries and was also live streamed on the web, allowing 1,553 simultaneous viewers.

The first day was an open Symposium with invited experts who showcased new non-lethal research methods for whales in the Southern Hemisphere. The Symposium talks were divided across five sessions that covered an overview of the history of whaling, evolution of non-lethal techniques and the role of whales in Southern Ocean ecosystem. These were followed by sessions on molecular techniques, biologging, remote sensing and long-term non-lethal research. A PDF of the talks are already available[31] and videos of each talk, in English and Spanish, will soon be available.

The Symposium was followed by two days of Workshops that covered specific research areas. The Workshops were each one day in duration and covered the following topics:

(1) health assessment of live cetaceans;
(2) advances in long term satellite tagging techniques for Cetaceans;
(3) population dynamics and environmental variability; and
(4) estimation of diet and consumption rates from non-lethal methods.

The Workshop health assessment of live cetaceans reviewed several techniques obtained from blow samples, biopsy samples, collection of faeces, visual health assessment, photogrammetry, blow intervals and respiration rates, among others. The Workshop identified two main aspects:

(1) health assessment data and studies should be integrated with population dynamics data, where possible; and
(2) integration of live animal health assessment with studies on dead and stranded animals, particularly within the same geographical region, is highly informative and should be a priority. The priority areas for further consideration in health assessment include nutritive stress and body condition; feeding and fasting or starvation state; skin lesions; stress; emerging issues and exposures; and particularly, standardisation of methodologies.

The Workshop on large whale population dynamics and environmental variability explored which life history parameters can be connected with environmental variability and highlighted the need for researchers to collect data on body condition, mortality and reproductive output, among others. The Workshop also evaluated different analytical and simulation techniques to incorporate environmental variability into population models and recognised the need of long term data sets to detect such effects. The Workshop recommended that long-term studies, photo-ID and biopsy sampling be routinely collected and promoted the use of geochemical tracers (e.g. stable isotopes) and other 'eco-markers', including DNA, since this approach can help to identify foraging locations of populations.

The Workshop 'Advances in Long-Term Satellite Tagging Techniques for Cetaceans and their Application to Address Research Questions in the Southern Ocean' reviewed advances on tag development and dedicated studies to address possible physical and physiological effects of satellite tags on cetaceans. The Workshop highlighted that effort could be directed to minimise the size and diameter of body-penetrating satellite tags in order to minimise trauma of implant and water ingress and promoted the use of an alternative to body-penetrating tags, such as new designs with external electronics and a long anchoring system. It was agreed that new designs for cetacean tags ought to be developed and that priority should be given to accelerometer and dive/surface interval data and to the development of algorithms that can compress data for transmission via ARGOS. The Workshop also recognised that some devices have the potential to cause considerable tissue damage and that studies on carcasses derived from incidental mortality should be conducted, as well as monitor tagged animals. Finally, the

[31]*http://www.simposioballenas.cl.*

Table 10

SORP funding requests and allocations for 2012/13.

Project	PI	Line item	Requested (GBP)	Allocated (GBP)
SABWP	Best	Travel	2,500	2,500
SORP 1: ABWP	Wadley	-	0	11,700
SORP 2: Killer whales	Pitman	Travel	2,235	2,235
		6 x wildlife computers on location-only tags	10,360	10,360
		6 Wildlife Computers depth and location tag	17,267	0
SORP 3: Baleen whales	Friedländer	Coordinator's salary#	13,430	0
SORP 4: Blue and fin whales	Stafford	Salary	7,963	7,963
		Support for coordination and development activities	15,926	15,926
		Steering Committee meeting*	4,778	0
SORP5: humpback whales	Constantine	Photo-ID and tissue sampling	9,548	9,548
		Project assistant**	6,376	6,376
		Steering Committee meeting*	3,819	0
SORP 6: Symposium	Baker/Galletti	-	0	0
Total requested 2012/13			94,202	
Total allocated 2012/13				**66,608**

#The Committee requested clarification of the use of the money requested for consideration intersessionally. *No money was allocated to individual projects for Scientific Steering Committee meetings because of proposals to hold a SORP conference in 2013 (see work plan item 6). **The principal investigators also requested £182,748 GBP to support research in 2013/14. It was noted that SORP cannot support such large requests for money. Therefore, the Committee **encourages** that SORP funds allocated for 2012/13 be used in part to allow the project assistant to write proposals for additional project funding.

Workshop highlighted the need to create awareness on the use of these techniques within local communities, regulatory agencies and the general public prior to any tagging project.

The Workshop on 'Estimation of Diet and Consumption Rates' highlighted several techniques that might be used to achieve this difficult objective. Tagging studies could provide information about foraging effort, photogrammetric techniques about individual fitness and steroid-hormone samples (from faeces or biopsy) about reproductive status. Understanding interspecific differences in prey preference will help to predict how climate driven changes affect krill and, ultimately whales. The value of understanding how local oceanographic conditions and prey availability affect the foraging behaviour and distribution was highlighted. Also recognised was the need to improve understanding of foraging strategies, prey choices, feeding destinations, etc. and recommended the use of several dietary tracers, such as stable isotope analysis, and molecular techniques, for diet reconstruction alongside fecal sampling and fatty acid analysis.

In summary, the Symposium and Workshops were very successful. The event drew a large audience and the Symposium organisers recommend the use of live broadcast technologies alongside simultaneous translation as a means to reach a wider audience in future events. The Workshops gave an excellent overview of existing and new research techniques and contributed enormously toward setting guidelines and prioritising research needs for improving our current scientific understanding and techniques.

The Symposium organisers and the SORP Scientific Steering Committee thanked the sponsors of the Symposium and Workshops: the Ministry of Foreign Affairs, Chile; the directorate of Maritime Territory and Merchant Marine of Chile; the Australian Government; the National Oceanic and Atmosphere Administration of the United States (NOAA); Oregon State University; the International Fund for Animal Welfare; the South Pacific Research Whale Consortium; Altavoz; and the Cetacean Conservation Center Chile. The Symposium and Workshops represent a completed Southern Ocean Research project. The full report can be found in SC/64/O14.

The Committee **thanks** the Symposium organisers, in particular Galletti, Baker and their teams for their work and congratulated them on their success. The usefulness of the Symposium and Workshops for improving current non-lethal techniques for cetacean research was stressed. It was noted that some of these will be applied to research to be conducted in the coming field season, e.g. by Argentinean researchers. It was also noted that useful recommendations came out of the Workshops with regard to research on climate change impacts on cetaceans, e.g. southern right whales in the southwest Atlantic, in line with wider SORP objectives.

19.2 Budget

The IWC has a budget specifically related to the work of SORP established with a contribution from Australia in 2008 and supplemented by additional voluntary contributions from Australia and the USA in 2011. This budget is administered by the IWC Secretariat.

19.2.1 Budget overview

Bell presented a summary of the SORP money spent to date and remaining funds. A total of £76,947 remains unallocated and unspent. A figure of approximately £37,730[32] remains in the SORP budget allocated but unspent.

19.2.2 Request for funds from projects

Table 10 summarises the requests for SORP funds received from existing SORP projects for 2012/1.

SC/64/O17 requested £2,500 for the South African Blue Whale Project (SABWP; SC/64/O17) to support travel for one investigator, Meredith Thornton, from South Africa to Greenland to participate in a week-long cruise cruise in which five Autonomous Acoustic Recorders (AARs) will be deployed west of Disko Bay in August 2012. The cruise will be led by the Greenland Climate Research Centre and Applied Physics Laboratory of Washington University. The intention is that the investigator gain the necessary technical experience in deployment of AARs at sea, that otherwise might entail an experienced person accompanying a long supply voyage from Cape Town to the ice and back just for a few days' work. An official response from the organisers of the cruise has still not been received.

[32]This figure has not been finalised because of possible outstanding invoices from the 2011/12 allocation to SORP Project 6.

The Committee **approved** this request for funding.

Funding requests from existing core SORP research projects for 2012/13 are outlined in Table 10 alongside the agreed allocations.

19.2.3 Reallocation of funds

A small group was formed consisting of the SORP Scientific Committee and other interested parties to discuss reallocations of remaining SORP funds to projects in 2012/13.

A figure of £37,730 remains in the SORP budget allocated but unspent. The Committee **agrees** that £11,700 of this be reallocated to the Antarctic Blue Whale Project and the remaining £26,030 be rolled-over into the general SORP budget for reallocation in the future.

19.2.4 Allocation of funds

The Committee **agrees** to allocate SORP funds for 2012/13 as outlined in Table 10.

19.2.5 Seeking additional funding

Following the reallocations and 2012/13 allocations, £48,069 will remain in the SORP budget administered by the IWC Secretariat.

The Committee **thanks** the Governments of Australia and the USA for their generous contributions to the SORP and **encourages** support and voluntary contributions from other nations to ensure the continuation of this exciting initiative.

19.3 Requirements for formalising participation in SORP and development of new projects

The Committee is keen to promote continued and new involvement in SORP. Partners are **encouraged** to formalise their involvement in the form of a letter to the SORP Secretariat. If Partners require more formal protocols, such as a Memorandum of Understanding, this can be arranged by the SORP Secretariat. The Committee **encourages** the involvement of new and existing Partners in SORP scientific steering committees, working groups and technical committees.

19.4 Work plan

The work plan is discussed under Item 21. The Committee **agrees** that data management and sharing was an important issue to consider. Gales reiterated the importance of work plan item 7.

20. RESEARCH AND WORKSHOP PROPOSALS AND RESULTS

20.1 Review results from previously funded research proposals

Research results from previously funded proposals are dealt with under the relevant agenda items.

20.2 Review proposals for 2012/13

No unsolicited research proposals were received this year. Proposals for the voluntary fund for small cetaceans were discussed under Item 14.3 and those relating to SORP are discussed under Item 19.

Table 11 lists the proposed intersessional meetings and Workshops. Financial implications and further details are dealt with under Item 23.

21. COMMITTEE PRIORITIES AND INITIAL AGENDA FOR THE 2013 MEETING

As in recent years and with the Scientific Committee's agreement, the Convenors met after the close of the Committee meeting and finalised the following basis for an initial agenda for the 2013 meeting. The same criteria as previous years were taken into account and this was based on the recommended work plans developed by sub-committees and the general discussion of these within the Committee. The Committee **recognises** that it is the Commission who establishes the Committee's overall priorities. Thus priorities may have to be reviewed in light of decisions made by the Commission. Items of lower priority on sub-committee agendas will only be discussed if time allows. Therefore, the Committee **stresses** that papers considering anything other than priority topics will not be addressed at next year's meeting. This information will be included on the website when the information about document submission is published next year. Convenors will receive timely information on the titles of papers intended for the discussion within their groups, and may contact authors if they believe the papers are unlikely to be discussed.

Revised Management Procedure (RMP)

The following issues are high priority topics:

(1) review new information on western North Pacific Bryde's whales;
(2) conduct an *Implementation Review* for North Atlantic fin whales starting during a pre-meeting before SC/65 and continuing during the 2013 Annual Meeting;
(3) prepare for the 2014 *Implementation Review* for the North Atlantic minke whales; and
(4) review information available for North Atlantic sei whales in the context of a *pre-Implementation assessment.*

Western North Pacific common minke whales (NPM)

Complete *Implementation Review* (including hold inter-sessional Workshop).

Bycatch and other human induced mortality (BC)

The focus of the group will remain in estimating mortality due to bycatch and ship strikes. The work plan will include:

Table 11

Proposed Workshops for the intersessional period.

Subject	Agenda item	Venue	Dates
Review of MSYR Workshop and WNP common minke whale Second Intersessional Workshop	5.1; 6.6	La Jolla, CA, USA	Late Feb.-Apr. 2013
AWMP Greenland hunt *SLA* development	8.3	Copenhagen, Denmark	3 days within 12-18 Dec. 2012
Planning for the 2013 IWC-POWER cruise	10.8.1.3	Tokyo, Japan	25-27 Oct. 2012
Workshop on Arctic anthropogenic impacts on cetaceans	12.5.3	Anchorage, Alaska	Late Feb.-Mar. 2013
Workshop on assessing the impacts of marine debris	12.7	Korea (SC meeting venue)	4 day pre-meeting; mid-May-mid Jun 2013
'Marine bushmeat' Workshop	14.6	Korea (SC meeting venue)	2 day pre-meeting; mid-May-mid Jun. 2013
Icelandic Special Permit expert panel review Workshop	17.1.3	Reykjavik, Iceland	Feb.-Mar. 2013

(1) reviewing progress in including information in online National Progress Reports;
(2) estimating risk and rates of bycatch and entanglement;
(3) development of methods to estimate mortality from ship strikes;
(4) continuing development and use of the international database of ship strikes; and
(5) review of information on other sources of mortality.

Special Permits
(1) Review results of the expert Workshop on the Icelandic special permit programme;
(2) plan for expert Workshop on JARPA II; and
(3) review new and existing proposals as appropriate.

Bowhead, right and gray whales (BRG)
High priority items will include:
(1) perform the annual review of catch information and new scientific information for B-C-B stock of bowhead whales and eastern gray whales;
(2) review any new information on all stocks of right whales, especially results of assessments for southern right whales;
(3) review North Pacific gray whale stock structure and movement; and
(4) review any other new information on western and eastern North Pacific gray whales and other stocks of bowhead whales.

Environmental concerns (E)
(1) Receive the SOCER (focus: Atlantic Ocean);
(2) pollution issues;
(3) Cetacean Resurging and Emerging Diseases (CERD);
(4) impacts of anthropogenic sound;
(5) climate change issues;
(6) marine debris and cetaceans (including report from the marine debris Workshop);
(7) other habitat-related issues:
MREDs;
cumulative impacts; and
(8) unusual mortality events including Peru.

Ecosystem modelling (EM)
(1) Modelling of the direct relationship between baleen whale populations and the abundance of their prey; and
(2) coordination with CCAMLR's Ecosystem Monitoring and Management Programme will also be sought on its efforts to advance krill-predator models.

Aboriginal Subsistence Whaling Management Procedure (AWMP)
(1) Highest priority will be to work towards the development of long-term *SLA*s for the Greenland hunts:
   (a) develop trial structures and operating models for the Greenland hunts of bowhead and humpback whales to be presented initially at an intersessional Workshop;
   (b) develop an AWMP/RMP-lite program to assist developers of *SLA*s for the Greenland hunts of fin and common minke whales; and
   (c) review a full scientific paper on the work in Greenland related to the collection of information on conversion factors;
(2) present *Evaluation* and *Robustness Trial* results to the SWG of an *SLA* variant that corresponds exactly to the management plan proposed by the Makah Tribe to the US Government;
(3) review a revised document on the probability of a gray whale that regularly feeds in the western North Pacific being taken in a Makah hunt; and
(4) review a document that provides advice on the development of *SLA*s and their evaluation.

In-depth assessment (IA)
High priority will be given to:
(1) the development and application of the SCAA models to the agreed estimates and the most recent aging data;
(2) further work examining reasons for the differences between estimates from CPII and CPIII; and
(3) further development of the IWC simulated datasets, specifically to:
   (a) provide a testing framework for hazard probability models for internally-estimated cue rates from Antarctic minke whale schools; and
   (b) provide one realistic scenario for testing variance estimation.

Now that minke whale abundance estimates had been agreed, the main remaining issues are listed as follows:

(4) modify the Hazard Probability model to cope better with real diving patterns;
(5) improve remaining misfits, for example, to the way that the simultaneous/delayed duplicate fit changes with school size (linked to item 4 above); and
(6) embed refined Hazard Probability models into a spatial framework.

Lower priority items are:

(7) data management:
   (a) further validation of IDCR/SOWER data;
   (b) curation of experimental IDCR/SOWER data;
   (c) production of standard datasets for analyses of species other than Antarctic minke whales; and
(8) review of abundance estimation data collected during CPII and CPIII; their utility for estimating abundance of Antarctic minke whales; and review of data insights.

Southern Ocean Research Partnership (SORP)
Work plan items include:
(1) establishment of ABWP management structure and Committee;
(2) establishment of intersessional technical committees for methodological development;
(3) refinement of the ABWP survey plan for the 2013 ABW voyage(s);
(4) development of uniform sampling protocols for ABW sampling and voyage(s);
(5) continuation of five ongoing SORP research projects;
(6) planning and implementation of an intersessional SORP conference prior to the next annual meeting; and
(7) intersessional development of a paper on data management and legacy.

22. DATA PROCESSING AND COMPUTING NEEDS FOR 2012/13

The Committee agrees the requests for intersessional work by the Secretariat given in Table 12.

23. FUNDING REQUIREMENTS FOR 2012/13

Table 13 summarises the complete list of recommendations for funding made by the Committee. The total required to meet its preferred budget is £327,000. The Committee recommends all of these proposed expenditures to the Commission.

Table 12

Computing tasks/needs for 2012/13.

RMP – PREPARATIONS FOR *IMPLEMENTATION*
(1) Work with the Norwegian Computing Centre to modify the Norwegian CatchLimit program so that only standard FORTRAN-95 statements are used (Annex D, item 2.4).
(2) Work to specify and run additional trials for testing amendments to the *CLA* (Annex D, item 2.2).
(3) Work related to the *Implementation Review* for North Atlantic fin whales (Annex D, item 3.2)
(4) Run a full set of trials using the Norwegian 'CatchLimit' program for North Atlantic fin whales, western North Pacific Bryde's whales; and North Atlantic minke whales and place the results on the IWC website (carried over from last year).
NPM
Complete conditioning of the North Pacific minke whale trials and run a full set of trials (Annex D1).
AWMP
Work arising from the proposed workshop (see Annex E, item 4).
IN-DEPTH ASSESSMENT
Prepare a catch series for North Pacific sei whales including incorporation of additional information from Japanese log book records and a new analysis of Soviet North Pacific catch records (see Annex G, item 7).
Validation of the 2011 POWER cruise data (see Annex G, item 8).
Complete validation of the 1995-97 blue whale cruise data and incorporate into the DESS database.
WHALE STOCKS
Documentation of the catch data available for Antarctic minke whales in preparation for the *pre-Implementation assessment* (see item 10.1, carried over from last year).

However, it understands that the projected amount available for funding is about £315,000. Following some initial suggestions produced by the Convenors group, the Committee therefore carefully reviewed the proposed full list, taking into account its work plan, priorities and the possibility that some of the work requiring funding could be postponed to a future year or years. Such considerations are difficult and the Committee **stresses** that projects for which it has had to suggest reduced funding are still important and valuable. Should the Commission be unable to fund the full list of items in Table 13 the Committee agrees that the final column given in the table represents a budget that will allow progress to be made by its sub-groups in its priority topics. Progress will not be possible in some important areas, as outlined below and the Committee **strongly request** that the Commission or individual member governments provide additional funding in these areas. The Committee **strongly recommends** that the Commission accepts its reduced budget of £315,000.

A summary of each of the items is given below, by sub-committee or standing Working Group. Full details can be found under relevant Agenda Items and Annexes as given in Table 13.

Aboriginal Whaling Management Procedure (AWMP)

(1) DEVELOPMENT OF AN OPERATING MODEL FOR WEST GREENLAND HUMPBACK AND BOWHEAD WHALES

The Committee developed interim *Strike Limit Algorithms* (*SLA*s) for the minke, fin, humpback and bowhead whales off West Greenland. These *SLA*s need to be reviewed and perhaps revised, ideally by the 2017 Annual Meeting. Development of *SLA*s for the hunts of minke and fin whales can be coordinated with the *Implementation Reviews* for these whales which are being conducted by the RMP sub-committee. In contrast, the situations for humpback and bowhead whales are relatively straightforward (essentially single-stock situations), but without a fully-specified and coded operating model progress on these cases will be limited. The first step in the process of developing *SLA*s is constructing an operating model and associated trials, and this project aims to make sufficient progress that an AWMP Workshop (in late 2012) could finalise trials and initiate testing.

The key activities covered by the proposal:

(1) extend the single-stock gray whale trials so that trials can be conducted for humpback and bowhead whales;
(2) outline a set of *Evaluation* and *Robustness Trials* which could form the basis for the evaluation of *SLA*s for these two groups of whales;
(3) present the trial specifications and results for: (a) the interim *SLA*s; and (b) an alternative *SLA* at an intersessional AWMP Workshop; and
(4) develop an AWMP/RMP-lite to assist developers of *SLA*s for the cases of fin whales and common minke whales.

(2) WORKSHOP ON DEVELOPMENT OF *SLA*S FOR GREEN-LANDIC HUNTS

The existing interim safe procedure for the Greenlandic hunts agreed in 2008 (IWC, 2009c) was agreed to be valid for quota blocks up to 2018. The Committee has identified completion of the development of long-term *SLA*s for these hunts as high priority work. With the completion of the B-C-B bowhead and gray whale *Implementations* this year, the SWG on the AWMP will give highest priority to the Greenland work, particularly for the complex cases of common minke whales and fin whales. In addition to the proposal for work by Punt (Annex E, Appendix 6), to meet the proposed timeframe an intersessional Workshop is required. The objectives of the Workshop are to: (1) review the work undertaken by Punt to develop proposed operating models and trial structures for the relatively easy cases of the bowhead and humpback whale hunts with a view to finalising these at the 2013 Annual Meeting; and (2) review the work undertaken by Punt to develop simple (AWMP/RMP-lite programs) to facilitate initial work on developing potential *SLA*s to allow the development of *SLA*s for West Greenland fin and common minke whales in light of the current operating models used in RMP *Implementations*. The Workshop will be held in winter 2013 for four days in Copenhagen, Denmark and the costs are for IP travel.

(3) AWMP DEVELOPERS FUNDS

The developers fund has been invaluable in the work of *SLA* development and related essential tasks of the SWG. It has been agreed as a standing fund by the Commission. The primary development tasks facing the SWG are for the Greenlandic fisheries. As noted above these tasks are of high priority to the Committee and the Commission. The fund

Table 13

Budget requests (see text). Note that in addition, the budget request for SORP is given in Table 10.

Title		Agenda Item	Full (£)	Reduced (£)
(1)	Development of an operating model for West Greenland humpback and bowhead whales	8. AWMP	5,000	5,000
(2)	Workshop on development of *SLA*s for Greenlandic hunts	8. AWMP	8,000	8,000
(3)	AWMP developers funds	8. AWMP	3,000	3,000
(4)	Ship strike database coordinator	7.8 Ship strikes	10,000	8,000
(5)	Right whale survey off of South Africa	10.5 SH right whales	21,730	21,730
(6)	Genomic diversity and phylogenetic relationships among right whales	10.6 N Pacific right whales	7,000	0
(7)	Photographic matching of gray whales	9.2 E Pacific gray whales	9,000	9,000
(8)	Contribution to the preparation of the State of the Cetacean Environment Report (SOCER)	12.1 SOCER	3,000	3,000
(9)	Pre-meeting Workshop on assessing the impacts of marine debris	12.8 Habitat related issues	20,500	20,500
(10)	Develop simulation of Southern Hemisphere minke line transect data	10.1 Antarctic minke whales	9,000	5,000
(11)	IWC-POWER cruise	10.8.1 IWC-POWER cruise	60,754	60,754
(12)	Preparation for the application of the statistical catch-at-age assessment method for Southern Hemisphere minke whales	10.1 Antarctic minke whales	4,000	4,000
(13)	'Second' intersessional workshop on the *Implementation Review* for WNP common minke whales	6.3 N Pacific common minke whale *Implementation Review*	20,000	18,500
(14)	Essential computing for RMP/NPM and AWMP	22. Data processing and computing needs	25,000	25,000
(15)	MSYR review Workshop	5.1 MSY rates review	5,000	5,000
(16)	Review and guidelines for model-based and design-based line transect abundance estimates	5.7 Abundance estimates	5,000	5,000
(17)	Modelling of Southern Hemisphere humpback whale populations	10.2 SH humpback whales	3,000	3,000
(18)	Antarctic humpback whale catalogue	10.1 Antarctic minke whales	15,000	13,000
(19)	Photo matching of Antarctic blue whales	10.3 SH blue whales	3,000	3,000
(20)	Southern Hemisphere blue whale catalogue 2012/13	10.3 SH blue whales	3,000	3,000
(21)	Expert Workshop for final review of Iceland's Special Permit programme on common minke whales	17.1 Review of existing scientific permits	30,000	24,000
(22)	Whalewatching guidelines and operator training in Oman	10.7 Arabian Sea humpback whales	3,500	3,500
(23)	Invited Participants (IPs) funds	All	64,000	64,000
Total			337,484	314,984

is essential to allow progress to be made. It now stands at £12,000 and a request of £3,000 is made to restore it to the initial target level of £15,000.

Bycatch and other human-induced mortality

(4) SHIP STRIKE DATABASE COORDINATOR

The ongoing development of the IWC ship strike database requires data gathering, communication with potential data providers and data management. The Working Group on Bycatch and Other Human Induced Mortality recommended a part-time post initially for three months a year to undertake the tasks described in Annex J. This includes:

(1) identify national contact points, organisations or groups that hold data on ship strikes that have not been contributed to the database and facilitate and encourage contributing data to IWC database;
(2) monitor and respond to emails addressed to the *shipstrikes@iwcoffice.org* email address, including reports of new incidents, giving feedback to data providers and dealing with requests for summary information from the database;
(3) keep IWC ship strike website pages up to date including updating publicly available summaries from the database;
(4) develop and document a communication strategy;
(5) provide an annual update to the Scientific Committee;
(6) data entry of new records including data presented in meeting papers and National Progress Reports at Annual Meetings of Scientific Committee;
(7) work with the data review group to ensure that all new records are appropriately reviewed including identification of potential duplicate reports;
(8) further development of database handbook including criteria for determining whether ship strike was a cause of death;
(9) ensure database documentation remains up to date; and
(10) maintain database and data entry system, making adjustments as appropriate in response to user problems and suggestions.

Bowhead, right and gray whales

(5) RIGHT WHALE SURVEY OFF SOUTH AFRICA

The southern right whale population visiting the South African coastline (arguably the largest in the Southern Hemisphere) has been monitored annually by aerial surveys since 1971 and since 1979 by a photo-ID survey. The results have been presented to several meetings of the Scientific Committee, such as the Buenos Aires Workshop in September 2011, where four papers were presented (Best, 2011; Brandão *et al.*, 2011; Butterworth *et al.*, 2011; Roux *et al.*, 2011). Since its inception the photo-ID surveys have concentrated on adult females with calves: the catalogue (at 2010) stands at 1,217 adult females, of which resighting rates average 70% annually, leading to very precise estimates of population size and growth rate, adult survival rate, age at first parturition and juvenile female survival rate. The application of an individual-based model has now allowed estimation of the probability of females calving at various intervals (SC/64/BRG24), which can be correlated in turn with the occurrence of oceanographic anomalies to determine the influence of environmental variation on reproductive success. The project has been funded domestically almost since its inception and has just completed a 3-year funding cycle. Unfortunately an application to the South African National Antarctic Programme for renewed funding was rejected as being geographically inappropriate, so interim funding is being sought to enable the 2012 survey to take place while an application is made for a new cycle commencing in 2013. The survey is scheduled to take place in mid-October. All images should be matched by 1 April 2013 and results ready for the 2013 Scientific Committee meeting.

(6) GENOMIC DIVERSITY AND PHYLOGENETIC RELATIONSHIPS AMONG RIGHT WHALES

The investigators request supplemental funding, as described in SC/64/BRG15, to do the following:

(1) assess genetic diversity and estimate N_{min} within the central North Pacific right whale population, represented by 27 individuals (including three from Russia), using complete mitochondrial genomes and sequence from 23 nuclear loci;
(2) compare mtDNA diversity in eastern North Pacific right whales with other oceanic populations based on complete mitochondrial genomes (16,386 base pairs), rather than the limited resolution currently based on control region sequences (286 base pairs); and
(3) confirm reciprocal monophyly and phylogenetic relationships among right whale species using sequence from complete mitochondrial genomes and 23 nuclear loci.

The primary funding for this project, provided by the Pacific Life Foundation, has support the development of the primary datasets but this funding is now exhausted. This proposal seeks supplemental support for two months for a postdoctoral fellow to complete analysis of the primary dataset and estimation of N_{min} for the central population of the North Pacific right whale.

(7) PHOTOGRAPHIC MATCHING OF GRAY WHALES

Results regarding mixing of western (WNP) and eastern (ENP) gray whales illustrate the great conservation and management importance of a more comprehensive examination of gray whale movement patterns and population structure in the North Pacific. The Committee noted that for such an effort to be successful it must be international and collaborative. To facilitate this, and noting the existing safeguards for collaborators provided under the Committee's Data Availability Agreement, it recommended that a collaborative Pacific-wide study be developed under the auspices of the IWC, recognising that *inter alia* this will contribute to the Committee-endorsed Conservation Plan for Western North Pacific Gray Whales and incorporate previous recommendations made by the Committee. Such a study should involve collaborative analysis and sharing of existing data as well as the collection of new data (IWC, 2011f). This is the second year of the project. The report of the results of the first year was presented in the document SC/64/BRG13. The funds requested for this year are to match gray whale photographs to photographs from Sakhalin and Kamchatka.

Environmental concerns

(8) CONTRIBUTION TO THE PREPARATION OF THE STATE OF THE CETACEAN ENVIRONMENT REPORT (SOCER)

SOCER is a long-standing effort to provide information to Commissioners and Scientific Committee members on environmental matters that affect cetaceans in response to several Commission Resolutions. The focus for 2012 will be on the Indian Ocean. Funds are for salaries, library services and printing.

(9) PRE-MEETING WORKSHOP ON ASSESSING THE IMPACTS OF MARINE DEBRIS

In 2011, the IWC agreed to: (1) endorse the Honolulu Commitment; (2) establish a standing item on marine debris on the Conservation Committee agenda; and (3) request the Scientific Committee continue reviewing potential threats to cetaceans arising from marine debris. It is proposed that a Workshop be held on marine debris and cetaceans where the primary aim is to develop tools that allow quantification of whether or how marine debris is affecting cetaceans and how best to monitor and mitigate for these effects.

The objectives of the Workshop are to:

(1) better understand the effects of debris interactions at an individual and population level;
(2) identify and classify key types and sources of debris that contribute to entanglements, or are ingested by cetaceans and examine the mechanisms by which they arrive in the marine environment, with the goal of identifying possible mitigation measures;
(3) design and develop a centralised database to collate cases of debris interactions to obtain more accurate estimates of the incidence of mortality and injuries, help detect trends over time and identify hotspots; and
(4) contribute towards a quantitative assessment of the extent of the threats for cetaceans.

The report of the Workshop will, in addition to providing the analyses, review and recommendations listed under item 2 above, develop: (1) a series of research and conservation actions that will include a rationale, actions required and proposed responsible persons/groups; and (2) a two-year work plan to be considered. The report will be submitted to the IWC and made publicly available on the website. It is proposed to publish the results of the Workshop in a peer-reviewed journal. Funds are to assist some of the expected 20 participants for a four-day pre-meeting held before the 2013 Scientific Committee meeting.

In-depth assessments

(10) DEVELOP SIMULATION OF ANTARCTIC MINKE WHALE LINE TRANSECT DATA

This year an abundance estimate for Antarctic minke whales had been agreed upon. As discussed this estimate had to use externally-estimated cue rates from a small sample of Antarctic minke whales, though an internally estimated cue rate would be preferred to estimate a more accurate and perhaps precise estimate. However, additional methodological development is needed to achieve this. To test these newly developed methods, it was proposed to use simulated line transect data where the true abundance estimate is known to validate the new methods are working correctly. These funds are proposed to further develop the IWC simulated datasets to: (a) provide a testing framework for hazard probability models for internally-estimated cue rates from Antarctic minke whales schools; and (b) provide a realistic scenario to test variance estimation methods.

(11) IWC-POWER CRUISE

The Committee has strongly advocated the development of an international medium- to long-term research programme involving sighting surveys to provide information for assessment, conservation and management of cetaceans in the North Pacific, including areas that have not been surveyed for decades. The finalisation for the integrated mid-long-term program (IWC-POWER; the Pacific Ocean Whales and Ecosystem Research programme) that will provide information on stock structure, abundance and ultimately trends has been completed. The focus of the 2013 cruise is defined as the area bounded by longitudes 135°W and 160°W, and latitudes 30°N and 40°N. Line transect sightings, abundance data collection, biopsy sampling, and photo-ID of cetaceans is planned. The cruise will last approximately 60 days between July and August 2013. By far the most important component of the cost, the provision of a research vessel, crew and fuel (up to US$1m) and that is generously being provided by Japan. The IWC funding will provide for international researchers, equipment and a meeting to finalise the details of the 2013 cruise.

(12) PREPARATION FOR THE APPLICATION OF THE STATISTICAL CATCH-AT-AGE ASSESSMENT METHOD FOR ANTARCTIC MINKE WHALES

This year the Committee received a full description of the statistical catch-at-age (SCAA) developed by Polacheck and Punt, along with initial suggestions for a baseline analysis and sensitivity tests (SC/64/IA1). This approach allows for errors in CAA data, more than a single stock, time-varying growth, multiple areas, environmental covariates, fleet-specific vulnerabilities, and changes over time in vulnerability. The SCAA can be used to evaluate various hypotheses regarding the reason (or reasons) for the change in abundance estimates from CPII to CPIII, as well as other questions regarding the dynamics of the Antarctic minke whale, such as whether growth and carrying capacity have changed. This proposal is to obtain the latest datasets and update the outputs and reference models to conduct baseline and key sensitivities. A final report will be presented to the 2013 Annual Meeting and the final code, data sets and documentation will be lodged with the Secretariat.

North Pacific minke whales

(13) 'SECOND' INTERSESSIONAL WORKSHOP ON THE *IMPLEMENTATION REVIEW* FOR WESTERN NORTH PACIFIC COMMON MINKE WHALES

The *Implementation Review* for western North Pacific minke whales is more complex than any previous *Implementation*. The Committee is one year behind the normal Schedule for *Implementations*. The Committee is not ready to undertake the tasks allocated to the 'second' intersessional Workshop according to its guidelines (IWC, 2012h). The priority tasks are to run and evaluate all trials in accordance with guidelines and present the results at the 2013 Annual Meeting to enable the Committee to complete its review in 2013.

Revised Management Procedure

(14) ESSENTIAL COMPUTING FOR RMP/NPM AND AWMP

The approach used to evaluate RMP variants during *Implementations* as well as candidate *SLA*s involves two main steps: (1) specification and conditioning of trials; and (2) projecting simulated populations forward under alternative RMP variants/*SLA*s. The complexity of the operating models on which simulation evaluations are conducted has increased in recent years. Unfortunately, the relatively simple optimisation methods included in current control programs (which was more than adequate in the past), combined with a complicated objective function, has led to problems producing conditioned trials quickly. This proposal will provide the Secretariat with the essential support required to complete this issue during the intersessional period. It will also continue the arrangement of recent years by which essential support is provide to the Secretariat, particularly in the key area of estimating stock mixing proportions in input to the trials, both intersessionally, and during meetings. Without this support it will be impossible for the Committee to undertake its present work on RMP *Implementations* and development of *SLA*s.

(15) MSYR REVIEW WORKSHOP

Since 2007 the Committee has been discussing maximum sustainable yield rate (MSYR) in the context of a general review of the plausible range to be used in population models used for testing the *Catch Limit Algorithm* (*CLA*) of the RMP. The Committee has agreed that it will finish work on this topic in 2013 whether or not the review can be completed. It has developed a work plan to try to ensure completion of the review. As part of this it is essential that a three-day intersessional meeting be held, with at least five participants, ideally back-to-back with another intersessional meeting, thus reducing overall costs of this Workshop.

All sub-groups using abundance estimates

(16) REVIEW AND GUIDELINES FOR MODEL-BASED AND DESIGN-BASED LINE TRANSECT ABUNDANCE ESTIMATES

The RMP's 'Requirements and Guidelines for Conducting Surveys' (IWC, 2012x) were written when the only realistic paradigm for planning and analysing good sighting surveys was the design-based approach. However, there is now potentially a legitimate alternative to design-based estimates; model-based estimates using spatial modeling (smoothers), which unlike design-based approaches, also give some basis for limited spatial extrapolation. In addition, many surveys resemble design-based surveys but do not strictly meet the design-based criterion, and in such cases there is a question regarding the adequacy of design-based estimates. The Committee has frequently considered model-based and quasi-design-based estimates, but without explicit criteria and not necessarily in the context of the RMP. This proposal will: (1) review statistical aspects of design-based estimators for surveys which do not strictly adhere to design-based principles; and (2) review past and current issues related to model-based abundance estimators, drawing on examples from experience with these types of models. Empirical and simulation-based diagnostics will be suggested, and a quantitative description of pitfalls when extrapolating estimates beyond the surveyed area will be given. The intended outcome of the project is: (1) propose a basis to assess the reliability of an abundance estimate either from a design-based analysis for which the statistical criteria are not met, or from a model-based analysis; and (2) provide draft text for inclusion in the 'Requirements and Guidelines for Conducting Surveys' document. The work will be presented to the 2013 Annual Meeting and the request is for salary to complete this project.

Other Southern Hemisphere whale stocks

(17) MODELING OF SOUTHERN HEMISPHERE HUMPBACK WHALE POPULATIONS

The project will focus on a combined assessment of Southern Hemisphere humpback breeding stocks D, E and Oceania using the model proposed at this year's meeting, SC/64. Methods used will be based upon the Bayesian methodology as developed and presented for breeding stock C and breeding stock B comprehensive assessments recently completed. Initial results will utilise the data agreed at SC/64, and results will be presented at the 2013 Annual Meeting. Further model developments and refinements in association with the final set of agreed data (and their sensitivities) would be presented at the 2014 Annual Meeting should the Scientific Committee decide to so request.

(18) ANTARCTIC HUMPBACK WHALE CATALOGUE

The Antarctic Humpback Whale Catalogue collates photo-ID information from Southern Hemisphere humpback whales. Increasing awareness of the project among research organisations, tour operators and other potential contributors has widened the scope of the collection; research efforts in areas that had not previously been sampled have extended the geographic coverage. This catalogue has grown by 25% in the last two years, adding 1,127 new individuals and increasing the time required to analyse photographs. In addition to these requested IWC funds will also be sought from other sources to provide the remaining funds required. Additional resources are provided by College of the Atlantic, including equipment, student assistants and time donated by principal investigators of this proposal. As a result this catalogue is in an excellent position to make a substantial contribution to SORP and other research and management initiatives.

(19) PHOTO MATCHING OF ANTARCTIC BLUE WHALES

The goal of this project is to compare the existing IWC-SOWER Antarctic blue whale catalogue (about 160 individuals) and the existing photo-ID material collected from JARPA which are already digitised. This project may add new individuals to the Antarctic blue whale catalogue and provide new data on the movements of Antarctic blue whales both within and between years. The Committee has requested for several years that this work be undertaken.

(20) SOUTHERN HEMISPHERE BLUE WHALE CATALOGUE 2012/13

The Southern Hemisphere Blue Whale Catalogue is an international collaborative effort to facilitate cross-regional comparison of blue whale photo-ID catalogues. Results of comparisons among different regions in Southern Hemisphere will improve the understanding of basic questions relating to blue whale populations in the Southern Hemisphere such as defining population boundaries, migratory routes and model abundance estimates. In 2008, the Committee endorsed a proposal to establish a central web-based catalogue of blue whale identification photographs, known as the Southern Hemisphere Blue Whale Catalogue (IWC, 2008e).

Currently this catalogue holds photo-ID catalogues of researchers from major areas off Antarctica, Australia, eastern South Pacific and the eastern Tropical Pacific (IWC, 2011i). Comparisons among catalogues off Chile found one match over ten years (Vernazzani and Cabrera, 2011). Preliminary results of the 2011/12 catalogue comparisons between the eastern South Pacific Ocean, Eastern Tropical Pacific Ocean (ETP) and Southern Ocean found no matches (SC/64/SH20).

During 2012/13 it is expected that comparisons between Australian catalogues and with the ETP, southeast Pacific and Antarctica will be finalised. Results of these comparisons will be presented to the 2013 Annual Meeting.

Special Permits

(21) EXPERT WORKSHOP FOR FINAL REVIEW OF ICELAND'S SPECIAL PERMIT PROGRAMME ON COMMON MINKE WHALES

Activities under Article VIII of the Convention should be reported to the Committee for review. The Committee has agreed a procedure for periodic and final reviews of results from Special Permit research (IWC, 2009i). This procedure outlines an intersessional review meeting by an expert panel. The report from the intersessional expert meeting will be reviewed and discussed at the 2013 Annual Meeting, SC/65. The Icelandic Special Permit progamme on common minke whales is complete and thus is subject to a review by an expert panel during the 2012/13 intersessional period. The experts to the review Workshop will be identified by September 2012 and the expert Workshop will be convened during four days in February/March 2013. The requested funds are for travel for the invited experts.

Whalewatching

(22) WHALEWATCHING GUIDELINES AND OPERATOR TRAINING IN OMAN

Oman's whalewatching industry has experienced gradual growth over the last 10 years reflecting a steady increase in tourism in the country and a growing awareness of the rich and accessible cetacean fauna, especially around the capital city of Muscat. Currently, dolphins are the main target of the industry, whilst sperm whales and other large whales are increasingly sighted as operators become more knowledgeable of their presence and distribution. The Arabian Sea humpback whale has recently become a target of opportunistic whale watching by a SCUBA dive operator in southern Oman. The precarious status of this species, represented by a resident and discreet sub-population numbering fewer than 100 individuals, and the identification of escalating anthropogenic impacts and threats has led to expression of serious concern by the IWC and recommendation for the development of a Conservation Management Plan (work in progress). Unregulated whale-watching represents another potential threat to Arabian Sea humpback whales.

Most operators are currently unaware of (unofficial) guidelines for whalewatching in Oman. Recognising the need to complete the drafting of new guidelines for Oman with appropriate technical assistance, and to train operators to enable interpretation and implementation of guidelines, this proposal includes a request for funding to complete the revision of whalewatching guidelines in Oman and to hold a training workshop for operators on the interpretation and implementation of the guidelines to promote best practice in the industry. Travel for relevant experts to Oman has already been secured and expert and other participant time will be donated and/or covered by other on-going projects.

All groups

(23) INVITED PARTICIPANTS (IPS) FUND

The Committee **draws attention** to the essential contribution made to its work by the funded IPs. The IWC-funded IPs play an essential role in the Committee's work, including the critically important role of Chairs and rapporteurs. They represent excellent value as they receive only travel and subsistence costs and thus donate their time, which is considerable. As was the case for previous meetings, where possible, effort will be made to accommodate scientists from developing countries.

24. WORKING METHODS OF THE COMMITTEE

24.1 Reducing the costs of Committee meetings

In 2011 the Commission asked the Secretariat to continue exploring opportunities for cost savings. One source of cost savings is to reduce freight charges and increase use of electronic documents at Annual Meetings of the Scientific Committee and Commission. A review of expenditures in 2011 indicated the costs of maintaining a paper based infrastructure for the meetings was around 5% of the IWC core budget. Particular costs arise because of packing and air freight of the pigeonholes and pre-prepared documents which are both heavy and bulky and also the hire of high volume copiers which are usually dramatically more expensive than low volume copiers.

The Committee discussed the advantages and dis-advantages of moving to electronic distribution of primary papers, working papers and reports. If there was to be electronic distribution of paper, then the memory sticks with the primary documents will need to still be available in a timely manner. Members would be encouraged to submit meeting papers as soon as possible to allow other members to make their own copies at home before the meeting. There would also need to be a number of modern desktop laser printers available to members and especially a local high bandwidth secure wi-fi network and document server that would be available to only the Committee members and so would be independent to local internet access and thus be robust to local IT issues.

After much discussion, the Committee **agrees** that primary documents should be distributed wholly electronically both on the IWC website and on memory sticks. In contrast, the Committee **agrees** that draft and final reports of sub-groups and plenary should be distributed by paper to ensure these reports are properly edited. The Committee also **agrees** that working papers should, at least for a trial period, be distributed mostly by paper, with the option of some working papers, particularly very long ones, be distributed mostly electronically. To reduce freight costs of the pigeonholes, the Committee suggests the Secretariat consider having pigeonholes for sub-groups as a means to distribute working papers rather than having personal pigeonholes.

24.2 Clarifying information on data availability for Procedure B requests

The present description of the process for obtaining data for issues that fit under Procedure B is described in the Data Availability Agreement (DAA; IWC, 2004c). SC/64/SCP1 described a recent incident where it became evident that the DAA process needed additional clarification. The Committee notes that the DAA process has generally worked well and especially so when the Committee has been able to properly specify the data request during the Committee meeting. Procedure B is designed for cases where the Committee itself believes that particular analyses (whether completely new analyses or revised analyses) are important in providing advice to the Commission. In such cases, it is important that the Committee takes the necessary time to complete and explicitly including the following within the report: objectives of the data request; details of the data required addressing the objectives; broad overview of the methods; and the principal investigators recommended by the Committee. With such report text, the Data Availability Group (DAG) can then complete and endorse a DAA request following the appropriate protocol in a timely manner. This would have, for example, removed the ambiguity that arose out of interpretation of the recommendation made last year on the blubber thickness analysis (IWC, 2012n).

As the requests under Procedure B relate to Committee recommendations, it also seems appropriate that all correspondences between researchers and data holders are channelled through the DAG until a request has been granted. It should also be emphasised that DAG involvement in data requests applies only to requests based on recommendations by the Committee. Requests by individual scientists should occur at the bilateral level without DAG involvement.

In addition, there appears to have been some uncertainty over what is meant by collaboration and offers of co-authorship under the DAA. This has also been considered under Item 17, Special Permit reviews and ‘Annex P’.

The Committee has always encouraged collaboration in all research projects. In the context of Annex P this was clarified in a footnote. For a more formal clarification, the Committee recommends an additional point be added to the DAA Procedure B text as follows, where the text under Item 2 is new:

Procedure B

This applies to data required for analyses deemed important in providing advice to the Committee other than catch limits (e.g. on the status of stocks not subject to whaling). For data not subject to Procedure A, the data owners shall produce, in collaboration with the Committee, a published protocol for data access that applies to requests generated by the Committee, to ensure clarity and a mutual understanding of the process.

(1) The Committee shall specify the nature of the work and the data required during the meeting at which the recommendation is made, to the fullest extent possible in the time available at the meeting and in accordance with the published protocol. It should also name the appropriate scientists to undertake the work and designate an appropriate timeline.
(2) The Committee encourages collaboration between the data requestors and data providers, although this is not mandatory. As a minimum, data requestors and providers should discuss the data sufficiently to avoid misinterpretations over the nature of the data themselves. When the data requestors send their draft paper to the data providers in accordance with the timetable, they must provide an offer of co-authorship to them. The data providers may or may not accept this offer. If data requestors and data providers do not agree with the contents of the paper then they may present separate analyses or comments to the Committee. This then allows the Committee to review all analyses. The Committee will then get a balanced single conclusion from the analyses for advice to the Commission. This is in line with the spirit of collaboration the Committee encourages.
(3) Applications to the data owners following the published protocol referred to above, should be submitted by the Data Availability Group assisted by a nominated member of the relevant delegation or institute. The Data Availability Group will consult with relevant members of the Committee if further explanation or clarification is required.
(4) If the above process is followed, then the data owners will normally approve the applications within a specified time period in accordance with the published protocol.
(5) Applications shall only be granted under the conditions given above.

24.3 Updating the Committee’s guidelines and Handbook

After discussion last year, the Committee agreed that the Chair of the Scientific Committee should develop a review document for consideration at this year’s meeting that discusses whether or not there is a need to expand on the guidelines related to Convenors, in particular with respect to further details about the roles of Convenors and co-Convenors, time frames of service etc., as well as the roles of Heads of Delegation and, if so, to provide proposed text. This review document provided background information that clarified some of these issues and suggested additional text to be considered by the Committee that could be added to the Scientific Committee’s Handbook (SC/64/SCP2).

This year the Committee discussed this review document and **recommends** the basic responsibilities of Convenors and co-Convenor’s as described in the Handbook did not need changing. However, it **recommends** that the full Committee should receive the list of proposed projects to be funded by the Commission in a timely manner to allow everyone to fully consider the prioritised list. Following this recommendation, the guidelines on the role of Convenors should include a new item ‘f’ and move the present ‘f’ to ‘g’, where the new item ‘f’ should read:

'To develop with other members of the Convenors' Group a prioritised list for funding that should to be made available to the full Committee at least by 6pm on the penultimate day of the Scientific Committee Annual Meeting.'

Co-Convenors were created three years ago to assist some of the busier sub-groups and provide an opportunity to create a pool of experienced people that could become future Convenors. This concept has worked well, so the Committee recommends the following text on the eligibility of Convenors and co-Convenors be added to the Handbook:

'All Committee members are eligible to become Convenors or co-Convenors. A co-Convenor may be appointed to assist the Convenor of a sub-group, gain experience in chairing and learn Committee procedures. Requirements include appropriate scientific background and/or chairing experience, knowledge of Committee procedures and appropriate communication skills.'

The Committee discussed at length the time frame of Convenors' service. Some members suggested a general, though flexible, time frame could be added to the Committee's guidelines, where this time frame would not a fixed length and would not be mandatory. However, other members considered the existing guidelines were sufficient and have worked effectively in the past and so did not need to be modified. Consequentially no changes to the Committee's guidelines were recommended this year. However, as noted in the existing guidelines, it was agreed that the Chair of the Committee would take carefully into account the length of service when choosing Convenors. If necessary this issue can be revisited in future years.

The roles of Heads of Delegations were also discussed and the Committee agrees that the present guidelines are adequate as provided in the Handbook. The Committee also agrees that the Handbook, when updated, will also be available as a pdf file.

24.4 Assistance to new members on the working of the Committee

In order to assist new members, the Committee recommends that an introductory lecture should be given during the first or second day for new (and indeed any) members that would cover primarily practical issues including: methods of working; background history of the sub-groups; and commonly used acronyms (the latter will also be added to the Handbook). In addition, the Committee **recommends** that all attendees are reminded of the website location of the Scientific Committee's Handbook when registering for the Annual Meeting.

24.5 Other

Galletti noticed that while management recommendations are widely given in some sub-committees, especially when addressing whaling issues, in other sub-committees and/or standing working groups, the attention seems to be more focused on scientific recommendations and only a few conservation recommendations arise. She believed that his was particularly true for small cetaceans, where there have been differences throughout the years. In this sense, the practice of the Scientific Committee should be reviewed and when there is concern over the status of any cetacean species or threats are identified, there should also be a focus on providing conservation recommendations.

Given the limited time available at this meeting, the Committee **agrees** that this matter should be placed on the agenda for discussion at next year's meeting.

25. ELECTION OF OFFICERS

This is the third and last year in the terms of the Committee's Chair (Palka - USA) and Vice-Chair (Kitakado - Japan). Kitakado has agreed to assume the position of Chair of the Scientific Committee at the end of the 2012 Annual Meeting. To fill the vacant Vice-Chair position, the Heads of Delegations were happy to unanimously nominate Caterina Fortuna (Italy). Fortuna accepted the Vice-Chair position. The Committee stood in acclaim to thank Palka for her great contribution to the Committee's work during the past three years and congratulated Kitakado and Fortuna on their new positions.

26. PUBLICATIONS

This had been a difficult year for the *Journal* with staff limited by maternity leave, reduced hours, illness and a change in staff. Despite that the department produced:

(1) the 520 page *Supplement*;
(2) 3 issues of the *Journal* (two are at the printers) with one more almost complete; and
(3) the Special Issue on Southern Hemisphere humpback whales.

Illness to Donovan resulted in less progress than anticipated on the Special Issue devoted to the RMP but the timetable for its publication has been finalised and it should be available in early 2013. Most of the chapters written by Hammond and Donovan are nearing completion and will be ready for formal review in autumn 2012. These include: (1) an introductory guide to the RMP; (2) a history of the scientific approach to whale management within the IWC prior to the RMP development; (3) a history of the RMP development process including the development of various Requirement and Guidelines; (4) a history of the *Implementation* (and *Implementation Review)* process summarising the cases for western North Pacific common minke whales, western North Pacific Bryde's whales, North Atlantic common minke whales, and North Atlantic fin whales; and (5) a concluding overview. In addition, the volume will include the papers from all of the original developers summarising their work in the format determined by Kirkwood. Allison is preparing the appropriate graphs and tables in the new format, including the results of the cross validation trials developed after the *CLA* was adopted.

The special volume commemorating the IDCR/SOWER cruises will be undertaken under an Editorial Board under Bannister as reported elsewhere.

The testing and trial process for the online submission, review and finalisation process has been recently completed and has recently become operational – thanks are due to those members of the Committee who kindly acted as 'guinea pigs' and have helped shape the site and develop the online instructions.

All of the *Journal* volumes are now available as pdf files and the *Journal* will become available in that format either directly via the new IWC website or through an existing company; we are in the process of examining the practical and financial implications of this and will report back to the Committee next year, after consultation via a questionnaire by email. This issue has become particularly important given the difficulties with printers that have occurred over the past two years and the recent news that the Cambridge University Press printing division is likely to be taken over by another company.

The Committee thanked Donovan and his team for the excellent work on publications. It **reiterates the importance** of these to its work as well as providing outside scientists the opportunity to benefit from the Committee's work and to encourage co-operation.

27. OTHER BUSINESS

No other business was discussed.

28. ADOPTION OF REPORT

The report was adopted at 17:00 on 23 June 2012. As is usual final editing was carried out by the Convenors after the meeting. In closing the meeting the Chair thanked the Secretariat for carrying out its duties in its customary friendly and efficient manner, as well as once again thanked the Government of Panama and other Panamanian contributors for their hosting of the meeting and for providing snacks and lunches for us, which greatly enhanced productivity and mental health.

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Report of the Scientific Committee
Annual Meeting 2013

Held on Jeju Island, Republic of Korea from 3-15 June 2013

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Report of the Scientific Committee

Contents

The meeting was held at the Shilla Jeju Hotel, Republic of Korea from 3-15 June 2013 and was chaired by Toshihide Kitakado. A list of participants is given as Annex A.

1. INTRODUCTORY ITEMS

1.1 Chair's welcome and opening remarks

Kitakado, the Committee Chair for the first time, welcomed the participants to the 2013 Annual Scientific Committee meeting. He thanked the Government of Korea for hosting the meeting and for providing the excellent facilities and an opening reception. He also expressed his thanks to the IWC Commissioner of Korea, Mr. Bok-Chul Chung, for his assistance. The Committee then paused for a moment of silence, with great sorrow, for those who had passed away since the last meeting.

Graham Chittleborough died in October 2012. He gained an international reputation for his work on humpback whales based on the commercial catches off Australia and in the Antarctic following World War II. Graham contributed his knowledge of humpback whales to the work of the 'Committee of Three Scientists on the Special Scientific Investigation of the Antarctic Whale Stocks', attending meetings to review its progress and findings in Rome, 1961 and Seattle, 1963. He was also the first scientist to recognise the extent of illegal hunting of humpback whales taking place in the Antarctic in the late 1950s-early 1960s.

Malcolm Clarke died in May 2013. He was recognised internationally for his work on oceanic squid, and was well known to and respected by many members of the Scientific Committee for his investigations of squid as the food of sperm whales, in particular his *Discovery Report* based on stomach contents of sperm whales in Southern Hemisphere catches. He also undertook ground-breaking research on sperm whale anatomy, including the use of the spermaceti organ in diving.

Rebecca Leaper died unexpectedly just before the meeting, well before her time. She was a dedicated and passionate marine conservation scientist and spent two years on the Australian delegation as an ecosystem modeller. She had been a key member of science teams at the Australian Antarctic Division, the Tasmanian Aquaculture and Fisheries Institute, CSIRO and most recently at the University of Tasmania's Institute of Marine and Antarctic Science, working on issues that ranging from the role of whales in their marine ecosystems through to conservation mechanisms for marine biodiversity. Her passion for her work was matched only by her generosity of spirit.

Captain Leif Petersen, who died in March 2013, never attended the Scientific Committee. However, his dedication, skill and courage as a pilot for pioneering aerial surveys beginning in Greenland and Iceland in the 1980s and eventually for many parts of northern Europe including the more recent SCANS and NASS programmes meant that he contributed as much to conservation and management as any of the scientists who participated. It is important that scientists never underestimate the contribution of pilots, skippers and crews to their work. Leif became an indispensable colleague and lasting friend to many scientists attending the Scientific Committee meeting; several of us are still alive because of him.

Vyacheslav Alekseevich Zemsky died at the age of 93 after a distinguished career in the Soviet Union and the Russian Federation. In the 1970s, he was very active in IWC related issues and the new Russia-US marine mammal working group. Between 1993 – 2000, Zemsky, with a number of members of the Soviet whaling expeditions, collated all the materials and documents preserved in the departmental archives to create a corrected catch history of the whales hunted in the Southern Hemisphere.

1.2 Appointment of rapporteurs

Donovan was appointed rapporteur with assistance from various members of the Committee as appropriate. Chairs of sub-committees and Working Groups appointed rapporteurs for their individual meetings.

1.3 Meeting procedures and time schedule

The Committee agreed to the meeting procedures and time schedule outlined by the Chair.

1.4 Establishment of sub-committees and working groups

As agreed last year (IWC, 2013c, p.59) and included in the draft agenda, a pre-meeting of the sub-committee on the Revised Management Procedure (RMP) met in Jeju to begin the *Implementation Review* for North Atlantic fin whales. Its report is given as Annex D, Appendix 2.

A number of sub-committees and working groups were established. Their reports were either made annexes (see below) or subsumed into this report (see items 19 and 21).

Annex D – sub-committee on the RMP;
Annex D1 – Working Group on Western North Pacific common minke whales;
Annex E – Standing Working Group on an Aboriginal Whaling Management Procedure;
Annex F – sub-committee on Bowhead, Right and Gray Whales;
Annex G – sub-committee on In-Depth Assessments;

Annex H – sub-committee on Other Southern Hemisphere Whale Stocks;
Annex I – Working Group on Stock Definition;
Annex J – Working Group on Estimation of non-deliberate Human-Induced Mortality;
Annex K – Standing Working Group on Environmental Concerns;
Annex K1– Working Group to Address Multi-species and Ecosystem Modelling Approaches;
Annex L –sub-committee on Small Cetaceans;
Annex M – sub-committee on Whalewatching;
Annex N – Working Group on DNA;
Annex O – Working Group on National Progress Reports;
Annex P - Working Group on Special Permits;
Annex Q - *Ad hoc* working group on abundance estimates

1.5 Computing arrangements

Allison outlined the computing and printing facilities available for delegate use**.**

2. ADOPTION OF AGENDA

The adopted agenda is given as Annex B.

3. REVIEW OF AVAILABLE DATA, DOCUMENTS AND REPORTS

3.1 Documents submitted

The documents available are listed in Annex C. As agreed last year, for the first time, primary papers were only available in electronic format (IWC, 2013c, p.78-9).

3.2 National Progress Reports on research

As agreed last year, all information usually submitted in paper form was submitted electronically through the IWC National Progress Reports data portal (IWC, 2013c, p.1). Developing such a portal and then expanding it to allow multiple data entry users for each country (the latter had not originally been envisaged two years ago when the portal was agreed) was a major undertaking. The Committee **thanks** Miller of the Secretariat for the considerable amount of work he had undertaken during the year to make this possible. Inevitably, a number of issues to be addressed and potential improvements to be made arose during the year as the portal began to be used. These were referred to a Working Group and the Committee **endorses** the report of that Group (Annex O) and its recommendations. It again **recommends** that all member states submit national progress reports through the IWC portal.

3.3 Data collection, storage and manipulation

3.1.1 Catch data and other statistical material

Table 1 lists data received by the Secretariat since the 2012 meeting.

3.1.2 Progress of data coding projects and computing tasks

Allison reported that Version 5.5 of the catch databases was released in February 2013. Work has continued on the entry of catch data into both the IWC individual and summary catch databases, including data received from the 2011 season and some additional information for records from Durban in the 1960s and 70s. Sightings data from the 2011 POWER cruise (see Item 10.12.1) are being validated.

Programming work during the past year has focussed on completing the North Pacific common minke whale *Implementation* trials including amending the control program and conditioning and running trials. Further details are given under Item 6.1.

Table 1

List of data received by the IWC Secretariat since the 2012 meeting.

Date	From	IWC ref.	Details
Catch data from the previous season:			
25-04-13	Norway: N. Øien	E108 Cat2012	Individual minke records from the Norwegian 2012 commercial catch.
1-06-13	Japan: T. Sakamoto	E108 Cat2012	Individual data for Japan special permit catch 2012 North Pacific (JARPN II) & 2012/3 Antarctic (JARPA II).
2-06-13	Russia: V. Ilyashenko	E108 Cat2012	Individual catch records from the aboriginal harvest in the Russian Federation in 2012
3-06-13	Iceland: G. Vikingsson	E108 Cat2012	Individual catch records from the Icelandic 2012 commercial catch
Sightings data:			
17-04-13	Japan: K. Matsuoka	E106	POWER North Pacific cruise sightings data 2012
17-04-13	Japan: K. Matsuoka	E107	Data from dedicated sightings Surveys in 2012 in the North Pacific under JARPN II

4. COOPERATION WITH OTHER ORGANISATIONS

The Committee noted the great value of co-operation with other international organisations to its work (IWC/65/4(2013)). The observers' reports below briefly summarise relevant meetings of other organisations and the contributions of several collaborative efforts are dealt with in the relevant sub-committees.

4.1 Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR)

The report of the IWC observer at the 31st Meeting of the CCAMLR Scientific Committee (CCAMLR-SC), held in Hobart, Australia from 22-26 October 2012 is given as IWC/65/4(2013)A. The main items considered at the CCAMLR meeting of relevance to the IWC included: (1) fishery status and trends of Antarctic fish stocks, krill, squid and stone crabs; (2) incidental mortality of seabirds and marine mammals in fisheries in the CCAMLR Convention Area; (3) harvested species; (4) ecosystem monitoring and management; (5) management under conditions of uncertainty about stock size and sustainable yield; (6) scientific research exemption; (7) CCAMLR Scheme of International Scientific Observation; and (8) new and exploratory fisheries; (9) joint CCAMLR-IWC Workshop with respect to ecosystem modelling in the Southern Ocean.

Reports of the Scientific Committee (SC-CAMLR) and its Working Groups on Ecosystem Monitoring and Management (WG-EMM) and Fish Stock Assessment (WG-FSA) and their various subgroups are available through the CCAMLR secretariat and on the CCAMLR web site[1].

The CCAMLR Working Group on Incidental Mortality in Fisheries (WG-IMAF) did not meet in 2012 and no new information on cetacean-fisheries interactions in the Southern Ocean became available to CCAMLR. The next meeting of the Working Group is likely to take place prior to the annual meeting of CCAMLR in 2013.

The Committee thanked Kock for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next CCAMLR-SC meeting.

4.2 Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)[2]

The Committee did not receive a report from an observer at the 2013 meeting of the Conference of the Parties (3-14 March 2013).

4.3 Convention on the Conservation of Migratory Species (CMS)[3]

4.3.1 Scientific Council
There was no meeting of the Scientific Council during the intersessional period.

4.3.2 Conference of Parties (COP)
There was no meeting of the parties during the intersessional period.

4.3.3Agreement on Small Cetaceans of the Baltic and North Seas (ASCOBANS)[4]
The report of the IWC observer at the 7th Meeting of the Parties (MoP) to ASCOBANS, held in Brighton, UK from 22-24 October 2012 is given as IWC/65/4(2013)G. The main results from the meeting are summarised below:

(1) The Conservation Plan for the Harbour Porpoise Population in the Western Baltic, the Inner Danish Waters and the Kattegat was adopted. The main aim of the plan is to intensify research and conservation efforts for harbour porpoises in this area.

(2) Work on the Baltic Sea Recovery Plan (Jastarnia Plan) and the North Sea Conservation Plan were reviewed. The implementation of these will continue to be of importance over the next three years.

(3) Bycatch and underwater noise were identified as future priorities. The impact of marine debris on cetaceans will also be considered.

(4) A better understanding of how new and often lesser-studied contaminants affect individuals and populations is needed. Limiting the introduction of chemical substances into the marine environment should be considered.

(5) The western part of the ASCOBANS area has a large diversity of whale and dolphin species, but knowledge of their abundance and distribution as well as the magnitude of different threats remains scarce. Collaboration for research and conservation action in this area is needed.

(6) In general, cooperation and interaction with the European Commission, other international organisations, fishery and other economic sectors, NGOs and non-Party Range States should be strengthened.

(7) The 4th ASCOBANS Outreach and Education Award 2012 was given to Mats Amundin of Kolmården Djurpark in Sweden for his work in promoting the conservation of harbour porpoises.

No observer for the IWC attended the 20th meeting of the Advisory Committee to ASCOBANS.

The Committee thanked Scheidat for her report and agrees that she should represent the Committee as an observer at the next ASCOBANS Meeting of Parties and Advisory Committee meeting.

4.3.4 Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS)[5]
Donovan attended the 2012 meeting of the ACCOBAMS Scientific Committee (ASC) held in Monaco from 13-15 November 2012. The report can be found on the ACCOBAMS website.

[1] www.ccamlr.org/
[2] www.cites.org
[3] www.cms.int
[4] http://www.ascobans.org

[5] http://www.accobams.org

A number of recommendations were made. The first concerned the long-standing (nine year) recommendation, also endorsed by the IWC Scientific Committee, for an ACCOBAMS Survey Initiative. The ASC strongly endorsed an updated basinwide survey plan, agreed on the need for synergies with other efforts in the North Atlantic and on the need to hire a co-ordinator. It noted news of a survey funded by DG-Mare that will cover about 25% of the Black Sea in summer 2013. However, it strongly recommended that the whole of the Black Sea be covered synoptically and urged ACCOBAMS to do all it could to ensure this and not miss a unique opportunity.

A second recommendation addressed the continued live removals of bottlenose dolphins in the Black Sea. The ACCOBAMS Secretariat was asked to send a letter of concern to the Georgian and Ukrainian governments (copied to the Bern Convention Secretariat, the Black Sea Commission and the CITES Secretariat) recalling the illegality of live removals of cetaceans from the Black Sea and asking them to carry out an inventory and thorough assessment of individual identity of all bottlenose dolphins kept in captivity by means of genetic, morphological and photo-ID methods and to provide appropriate administrative measures in order to prevent substitution of dolphins that die in captivity by animals taken from the wild. The ASC noted that the IWC Scientific Committee has guidelines on the practical aspects of the use of DNA registers for cetaceans.

The ASC also agreed to work towards a Conservation Plan for fin whales of the Mediterranean. It noted: (1) the importance of continuing work to elucidate the stock structure and movements of fin whales in the ACCOBAMS area; (2) the importance of the ACCOBAMS Survey initiative to provide a summer snapshot of distribution throughout the whole region as well as a reliable estimate of total abundance; (3) that all of the groups working in the area be asked to update available information on fin whales, including those related to potential threats (e.g. see the work of Fossi on micro plastics) to consult on priorities for future work with a focus on conservation; and (4) that an outline draft conservation plan be developed for consideration at the next ASC, with a view to reviewing whether the time is ripe to engage with stakeholders to develop a full plan.

The ASC also developed a statement of concern over the ongoing seismic survey work in the area of the Hellenic Trench. In particular, it requested all involved in the planned surveys to provide information to the ASC and take urgent precautionary action to protect the local cetaceans. The ASC offered to provide advice and drew attention to the ACCOBAMS guidelines for seismic surveys, and urged that: duplicate surveys should be avoided across the same area; alternative approaches to seismic airgun survey should be sought and deployed; and efforts should be made to avoid ensonifying adjacent areas simultaneously.

ACCOBAMS and the IWC have been working together on ship strikes for some time. ACCOBAMS agreed that the work should continue, welcomed the appointment of the ship strikes co-ordinators (one of whom is the Chair of the ASC ship strikes working group) and reiterated its support for the global database and existing monitoring and mitigation efforts. The ASC ship strikes working group will continue to work on these issues and foster collaboration with IWC, ASCOBANS, CMS and IMO and develop priority actions and studies, including the consideration of a project to develop a standard training module.

Finally, the ASC developed a recommendation on scientific aspects of whalewatching. It noted that an 'ACCOBAMS certificate of accreditation for whale watching' will be developed and agreed that this should take into account the ACCOBAMS Whale Watching Guidelines. It also supported the continuation and expansion of national or regional training courses (based on the PELAGOS expertise) for operators covering the biology of animals, risks, boat behaviour around the animals, how to achieve ACCOBAMS accreditation, involvement in scientific research, etc. The ASC will continue to consider potential adverse effects on cetaceans and means to mitigate these. It also urged monitoring the activity of whale-watching operators in each country in order to obtain information on growth and development to try to identify potential problems before they become too difficult to manage. Finally it agreed to assist in the development of methods to better inform the general public about responsible boat behaviour around cetaceans. The ASC noted the importance of continued co-operation with IWC and others on this issue.

The Committee thanked Donovan for his report and **agrees** that he should represent the IWC at the next ACCOBAMS meeting.

4.4 Food and Agriculture Organisation of the United Nations (FAO)

No observer for the IWC attended the 2012 meeting of FAO.

4.5 Inter-American Tropical Tuna Commission (IATTC)

The reports of the observer at the 83rd and 84th meetings of the IATTC held in La Jolla, USA 25-29 June 2012 and 24 October 2012 respectively are given as IWC/65/4(2013)E. The Antigua Convention came into force on 27 August 2010 and under this the IATTC is expected to give greater consideration to non-target and associated species, including cetaceans, in taking management decisions. A summary was given of ongoing work describing what is known about the direct impact of the fisheries on other species in the ecosystem and the environment. This ongoing work will shape future directions of AIDCP (see Item 4.6) and IATTC measures aimed at managing fisheries and conserving dolphins.

The Committee thanked Rusin for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next AIDCP meeting.

4.6 Agreement on the International Dolphin Conservation Program (AIDCP)

The report of the observer at the 25th and 26th Meetings of the Parties to the AIDCP held in La Jolla, USA on 19 June 2012 and 23 October 2012 respectively is given as IWC/65/4(2012)E. The AIDCP mandates 100% coverage by observers of fishing trips by purse seiners of carrying capacity greater than 363t in the agreement area and in 2012 all trips (746) by such vessels were sampled by independent observers.

The overall dolphin mortality limit (DML) for the international fleet in 2012 was 5,000 animals and the unreserved portion of 4,900 was allocated to 84 qualified vessels that requested DMLs. In 2012, no vessel exceeded its DML. The number of sets on dolphin associated schools of tuna made by vessels over 363t has been increasing in recent years, from 9,246 in 2008 to 10,910 in 2009 to 11,645 in 2010, however fewer were made in 2011 – (9,604) and 2012 (9,220). While fewer dolphin sets were made in 2011 and 2012, this remains a frequent practice and the predominant method for catching yellowfin tuna by purse-seine in the ETP. There have been insufficient resources to conduct a dolphin and ecosystem assessment surveys since 2006 so it is unclear when updated abundance estimates for cetaceans in the ETP will be available.

In 2011 and 2012, the AIDCP focused significant discussion on consideration of reducing observer coverage and developing an 'Ecosystem Friendly' certification scheme for tuna caught in association with dolphins. Due to the increasing sentiment among some Parties that the dolphin problem has been solved and that dolphin-fishing methods are better economically and environmentally than dolphin-safe methods, in 2013 the AIDCP Parties are expected to continue consideration of these proposals and others that have the potential to increase fishing effort on dolphins and the magnitude of associated direct and indirect effects of this practice

The Committee thanked Rusin for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next AIDCP meeting.

4.7 International Committee on Marine Protected Areas (ICMMPA) and IUCN Marine Mammal Protected Areas Task Force

The International Committee for Marine Mammal Protected Areas was formed as an international committee of experts in 2006 to address common issues and challenges faced by scientists and managers using spatial management tools to manage and conserve important cetacean habitats or populations. In 2008, the IWC endorsed and supported a proposal by ICMMPA to host the first international conference on marine mammal protected areas, in 2009. Since that time, the ICMMPA has undertaken several initiatives and has co-hosted, with France, a second conference in Martinique, 2011[6]. In October, 2012 the ICMMPA met in La Rochelle, France, hosted by l'Université de La Rochelle. The primary agenda for the meeting was to develop the mission statement, terms of reference and structural organization of the newly approved IUCN arm of ICMMPA. This partner organisation is a Task Force on Marine Mammal Protected Areas. These documents were developed and will be available from the new TF co-chairs Erich Hoyt and Giuseppe Notarbartolo di Sciara, once the TF is officially announced. The IUCN MMPA TF membership includes all of the ICMMPA members, with several IUCN member additions. The ICMMPA remains a non-governmental partner for the TF and, amongst other tasks, will convene conferences and other initiatives that may not fit the IUCN TF terms of reference. The IUCN MMPA TF will be officially announced at IMPAC3, October, 2013.

ICMMPA is currently working with the Government of Australia, who will host the third International Conference on Marine Mammal Protected Areas, at a venue in Adelaide in November 2014.

4.8 International Council for the Exploration of the Sea (ICES)[7]

The report of the IWC observer documenting the 2012 activities of ICES is given as IWC/65/4(2013)B. The ICES Working Group on Marine Mammal Ecology (WGMME) met 5-8 March 2012.

The WGMME built on the work of the ASCOBANS/HELCOM small cetacean population structure workshop to determine Management Units (MUs) for the more common species as such information is relevant to the development of biodiversity indicators. Based on the available information, there were single MUs in European North Atlantic for common dolphins, white beaked dolphins, white sided dolphins and common minke

[6] http://second.icmmpa.org

[7] http://www.ices.dk

whale. For bottlenose dolphins there are ten separate units closely associated with the mainly resident inshore populations in the European North Atlantic and a separate MU for the wider ranging mainly offshore animals. For harbour porpoises, MUs are proposed for the Iberian Peninsula, Bay of Biscay, Celtic Sea and NW Ireland/West Scotland and the North Sea. The MUs for harbour porpoises will need to be revisited as indicators for the marine Strategy Framework Directive (MSFD) become better defined.

The WG considered biodiversity indicators and bycatch was the only indicator suggested that had a clear link with a particular human activity. The indicator metric proposed by ICG-COBAM was very clearly linked to OSPAR's EcoQO on harbour porpoise bycatch in the North Sea. With pressure for the rapid development of biodiversity indicators for good environmental status through the Marine Strategy Framework Directive (MSFD), it is essential that they are based on sound science and take a pragmatic approach to the incorporation of fisheries data. As such, it was proposed that a management framework approach is adopted (rather than the EcoQO approach) and further developed in 2013 for relevant species.

WGMME conducted a review of the effects of wave energy converters on marine mammals and provided recommendations on research, monitoring and mitigation schemes. These are at a relatively early stage of development when compared to other renewable energy technologies and this is reflected in the lack of knowledge of their effects on the marine environment. It is essential that full advantage is taken of test deployments and early arrays to gather information on the actual interactions between devices and wildlife. A review of such work is being undertaken during 2013.

The Working Group on Bycatch of protected species (WGBYC) met 7-10 February 2012. It reviewed the status of information on recent bycatch estimates and assessed the extent of the implementation of bycatch mitigation measures. Reports from 17 member states indicated extrapolated estimates of bycatch for 2010 of about 870 cetaceans. The species involved were striped dolphins, common dolphins, harbour porpoises and bottlenose dolphins. Estimates are patchy and monitoring obligations not being met by several member states. Implementation of bycatch mitigation measures was also found to be poor, with few countries able to confirm that obligations for pinger deployment were being met.

The 2012 ICES Annual Science Conference (ASC) was held in Bergen, Norway 17-21 September 2011. Some sessions were designed with marine mammals included as an integral part. A number of sessions were of relevance to the Committee, including those describing:

(1) bycatch and discards;
(2) consequences of improved survey performance on assessments and management advice; and
(3) how does renewable energy production affect aquatic life?

The Committee thanked Haug for the report and **agrees** that he should represent the Committee as an observer at the next ICES meeting.

4.9 International Maritime Organization (IMO)[8]

The report of the IWC observer to the IMO is given as IWC/65/4(2013)J. The IWC has contributed to IMO discussions on addressing ship strikes and the impacts of underwater noise from shipping. In December 2012 IMO adopted changes to the shipping lanes in the Santa Barbara Channel, and off San Francisco, California, USA in order to reduce ship strike risk to blue whales (COLREG.2/Circ.64).

The IMO has been developing non-mandatory technical guidelines to minimise underwater noise from commercial ships. These include available options for ship-quieting technologies and operational practices. In April 2013, the IMO correspondence group working on the issue (including participation by the IWC Secretariat) presented draft guidelines to the IMO sub-committee on ship design and equipment (DE57/17). The guidelines help establish a consistent approach to assist designers, ship owners and ship operators in evaluating how much noise reduction is possible for new and existing ships when compared to existing ships of similar type, size and propulsion system. The IMO Marine Environment Protection Committee (MEPC) is expected to approve the guidelines in early 2014 and make them available as an MEPC circular.

The IMO also continued to develop a mandatory Polar Code. This is intended to augment existing measures to reduce the environmental impacts of shipping in polar waters, taking into account their greater environmental sensitivity. This work will continue through 2013.

The Committee thanked Leaper for his report and **agrees** that he or the Secretariat should represent the Committee at the next IMO meeting.

4.10 International Union for the Conservation of Nature (IUCN)[9]

Cooke and Reeves, the IWC observers, reported on the considerable cooperation with IUCN that had occurred during the past year and this is given as IWC/65/4(2013)I.

[8] www.imo.org

[9] www.iucn.org/

World Conservation Congress
The World Conservation Congress was held on Jeju Island, Korea in September 2012. There were three cetacean-related events at the Congress: a workshop on lessons learned from the IUCN western gray whale conservation initiative; a poster presentation on the local population of Indo-Pacific bottlenose dolphins found around Jeju; and a workshop on cetacean conservation and whalewatching in Africa. IUCN issued a number of statements on Korean environmental issues, including on the possible resumption of whaling in Korean waters.

Western gray whales
Two further meetings of the IUCN Western Gray Whale Advisory Panel have been held in the past year, in November 2012 in Korea and in May 2013 in Japan. At the time of writing the report of the May meeting is not yet available but a summary of results can be found in Annex F, appendix 5. An updated population assessment was received by the Panel but the data from the two independently collected series of photo-ID data yielded apparently discrepant results, one indicating an increasing population and the other indicating a stable or declining population. An assessment based on one of these data sets is available as SC/65a/BRG27.

Red List updates
Updates since the last Annual Meeting include listing of the Mediterranean 'subpopulations' of the following species: sperm whale (Endangered), fin whale (Vulnerable), striped dolphin (Vulnerable), common bottlenose dolphin (Vulnerable), Cuvier's beaked whale (Data Deficient), long-finned pilot whale (Data Deficient) and Risso's dolphin (also Data Deficient).

A current list of all cetacean species and populations that have been assessed for the Red List, and their current Red List classification, is maintained on the Cetacean Specialist Group site at *www.iucn-csg.org/index.php/status-of-the-worlds-cetaceans* with links to the assessments which are held on the Red List site *www.redlist.org*.

Cetacean Specialist Group
Cetacean Specialist Group members have continued to actively assist with cetacean conservation and research projects around the world. Of particular current interest is the ongoing project on study of the status and management options for the Critically Endangered Mekong river population of Irrawaddy dolphins run by WWF Cambodia in co-operation with relevant public authorities. The website of the IUCN Cetacean Specialist Group (*http://www.iucn-csg.org/*) contains regular updates on IUCN's cetacean-related activities and other work in which group members are involved.

The Committee thanked Cooke and Reeves for their report and **agrees** that Cooke should continue to act as observer to IUCN for the IWC.

4.11 North Atlantic Marine Mammal Commission (NAMMCO)[10]

4.11.1 Scientific Committee
The report of the IWC observer at the 19th meeting of the NAMMCO Scientific Committee (NAMMCO SC) held in Tasiilaq, East Greenland from 19-22 April 2012 is given as IWC/65/4(2013)K.

A joint Norwegian-Russian Ecosystem Survey examined habitat use and prey associations of white-beaked dolphins in late summer. Dolphins used the southern Atlantic water and the Polar Front area farther north, with a general overlap with most prey species and positive association with blue whiting in the southern habitat.

Catch and bycatch data from 2006-08 from a monitored segment of the Norwegian fleet of coastal gillnetters were used to estimate bycatch rates of harbour porpoises in Norway. Landings statistics were used to extrapolate to the entire fishery, estimating a total annual bycatch of 6,900 porpoises by the two fisheries. The by-catch numbers of harbour porpoises could also be high in Iceland, based on preliminary information presented to the NAMMCO-ICES workshop in 2010. The NAMMCO-SC recommended that total bycatch estimates be attempted and that assessments of sustainability proceed through the relevant WGs.

Narwhals-West Greenland/Canada
The NAMMCO-SC agreed on the metapopulation structure for narwhals in Baffin Bay, Hudson Bay and adjacent waters as a useful approach for identifying summer aggregations as management units in narwhals. Satellite tracking of whales that return to summering grounds the following year suggest interannual site fidelity, with summer aggregations to some extent being demographically-independent sub-populations with minimal or no exchange of animals. Narwhals in Canada constitute five separate stocks with some limited exchange between three of the stocks.

There had been an overall increase in West Greenland narwhal catches during the 20th century which was especially pronounced after 1950. However since 1993, a significant decline in overall catches has been observed. Aerial surveys conducted in the North Water in May resulted in fully corrected abundance estimates of 10,677 (95% CI: 6,120-18,620) narwhals in 2009 and 4,775 (95% CI: 2,417-9,430) in 2010.

[10] http://www.nammco.no/

Age estimation by racemization was used to estimate biological parameters of narwhals, including a maximal lifespan expectancy of ~100 years of age.

Narwhal-East Greenland
Satellite tracking showed that narwhals in East Greenland have a yearly migration where they leave the fjords and move off the coast in winter. Whales from the Scoresby Sound area seem to belong to a stock separate from other narwhal aggregations in East Greenland. Age-structure data from Ittoqqortormiit was applied to assessments of both East Greenland areas, and the harvest was found to select for older animals. The current annual growth rate in the absence of harvest was estimated between 1.2% (95% CI:0–3.5) and 3.7% (95% CI:1.6–5.9), depending upon model and area.

It was noted that there is little information on the predicted response of marine mammals to changing Arctic conditions including changes in sea ice, climate and prey species as well as increased human development activity as seismic, shipping, and drilling. The NAMMCO-SC recommended holding an international symposium on the effect of seismic and other development activities on Arctic marine mammals with a focus on white whales and narwhals.

White whales
Aerial surveys conducted in the North Water in May resulted in fully corrected abundance estimates of 2,008 (95% CI 1,050-3,850) white whales in 2009 and 2,482 (95% CI 1,439-4,282) in 2010.

The assessment of West Greenland white whales was updated with age-structured data, recent abundance estimates and catches. Results from different scenarios provided annual growth rate estimates from 3.2% to 5%, in the absence of harvest. The depletion ratio for 2012 was estimated as 44% (95% CI: 16%-88%), with a yearly replacement of 510 (95% CI:170-780) individuals. The NAMMCO-SC agreed that the revised assessment confirmed that the current removals based on the 2009 advice are sustainable. Based on a 70% probability of population increase, it concluded that a total annual removal of 310 white whales in West Greenland is sustainable (excluding Qaanaaq).

No specific advice was given on the North Water (Qaanaaq), since the current removals remain at a low level relative to the population size. No advice was given for the harvest in Canada.

Age determination workshops
Recognising that there are a number of problems with age determination for white whales and narwhals, three age determination workshops were organised. The first in Tampa (FL, USA) examined the state of the art of general ageing techniques; the second in Beaufort (NC, USA) focussed on age estimation of belugas using teeth; and the third in Copenhagen focussed on the use of tusks for age estimation in narwhals.

The NAMMCO-SC agreed that an annual deposition rate of tooth GLG was to be the accepted standard in white whales, and it recommends that Aspartic Acid Racemisation is applied to white whales, including fore known history/age animals in the analyses in order to calibrate the technique and provide an alternative ageing method.

Pilot whales
The NAMMCO-SC agreed that it was unlikely that a full pilot whale assessment could be attempted in the near future. It was noted that both an adapted 'AWMP' procedure as well as the PBR approach could be used for an inverse advice calculation of the minimum abundance required to sustain the average take by the Faroese.

With the average annual catch by the Faroese since 1997 being 678, and the CV of the latest abundance estimate being 0.27, the AWMP procedure estimates that an abundance estimate around 50,000 pilot whales and a similar precision is required to sustain the catch. In comparison, the PBR approach calculates an abundance estimate around 80,000 whales. These calculations reflect precautionary estimates of the minimum abundance estimates required to sustain the Faroese hunt. However, the geographical range of the stock(s) that supply the Faroese hunt is unknown, and it is unresolved how the calculated estimates compare with the accepted estimate of 128,000 (95% CI: 75,700-217,000) pilot whales from the Icelandic and Faroe Islands area of T-NASS.

The average annual catch of long-finned pilot whales in West Greenland during 1993-2007 was 126 whales and an aerial survey estimated 7,440 (95% CI 3,014-18,367) animals in 2007. Applying a PBR approach, the sustainable harvest level of pilot whales would be around 50 whales per year. An estimate based on the AWMP procedure, suggests that an annual take 70 whale is sustainable. However, the survey did not cover the entire range of pilot whales in West Greenland and the summer aggregation cannot be considered an isolated stock. Instead, it is likely connected to pilot whales along Labrador and at Newfoundland.

The NAMMCO-SC noted that humpback whales are present in previously unsurveyed areas off East Greenland, in agreement with information provided by observers on seismic surveys.

The average annual catch of white-beaked dolphins in West Greenland during 1993-2007 was 30 dolphins. An aerial survey estimated 11,801 (95% CI 7,562-18,416) animals in 2007. Applying a PBR approach suggests that the sustainable harvest level would be around 125 whales per year.

A bowhead whale male tagged in Disko Bay in May 2010 moved into the Northwest Passage where it spent about two weeks in September 2010 in close proximity to a bowhead whale tagged in Alaska in spring the same year. Both returned to their normal seasonal range, but the excursions suggest that bowhead whales from the Pacific and the Atlantic occasionally may be connected in years with little sea ice in the Northwest Passage.

Based on an increase in sightings, the NAMMCO-SC recommended monitoring of trends and abundance of the Spitsbergen population of bowhead whales. Norway will continue passive acoustic monitoring with two extra devices in the northern Fram strait and north of Svalbard.

Survey planning
A new large-scale T-NASS survey of cetaceans in the North Atlantic is desirable within the near future, and the NAMMCO-SC discussed how best to approach such a large scale survey effort. The most optimal year for a large scale coordinated survey is 2015. The survey plans for the different countries are generally similar to those of the last T-NASS survey.

4.11.2 Council
The report of the IWC observer at the 21st Annual Council Meeting of NAMMCO held in Svolvær, Norway in September 11-13 September 2012 is given as IWC/65/4(2013)C. In 2010, the Council approved the go-ahead for a manual on hunting. It will be the first comprehensive manual for hunters that details weaponry and ballistics information with a focus on safety.

An international expert group on killing methods for small cetaceans met in November 2011. Significant reductions in killing times have been recorded in recent years in Faroe Islands, Greenland, Japan and Nunavut Canada, due to development of new equipment and practices. Several recommendations were made regarding further improvement in killing methods, safety and training of hunters.

The Council has concluded that an abundance of pilot whales in the range of 50,000-80,000 animals will sustain the annual Faroese drive hunt. The most recent abundance estimate for the pilot whale stock is 128,000 in the Iceland-Faroese survey area. This means that the annual Faroese catch of pilot whales is well within sustainable limits.

Based on a NAMMCO initiative, a project has been designed to test different modelling approaches of interaction between marine mammals and fisheries. The project, which includes scientists both from NAMMCO and other relevant countries, will start as soon as funding is obtained.

The Committee thanked Sakamoto for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next NAMMCO Council meeting.

4.12 North Pacific Marine Science Organisation (PICES)[11]
The report of the IWC observer at the 21st annual meeting of PICES held 12-21 October 2012 in Hiroshima, Japan is given as IWC/65/(2013)H. The Marine Birds and Mammals Advisory Group (AP-MBM) requested that a seabird observer be included in the IWC POWER cruise and it also revised its terms of reference as follows:

(1) provide information and scientific expertise to BIO and the FUTURE Program, and, when necessary, to other scientific and technical committees with regard to the biology and ecological roles of marine mammals and seabirds in the PICES region;

(2) identify important problems, scientific questions, and knowledge gaps for understanding the impacts of climate change and anthropogenic factors on MBMs in ecosystems of the PICES region through Workshops, Theme Sessions and Science Reports;

(3) assemble information on the status and key demographic parameters of marine mammals and seabirds and contribute to the Status Reports; and

(4) improve collaborative, interdisciplinary research with marine mammal and seabird researchers and the PICES scientific community;

Two sessions at the 2012 AP-MBM workshop were of relevance to the IWC, these were: (1) the feasibility of updating prey consumption by marine birds, marine mammals, and large predatory fish in PICES regions; and (2) environmental contaminants in marine ecosystems: Seabirds and marine mammals as sentinels of ecosystem health.

The Committee thanked Kato for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next PICES meeting.

4.13 Protocol on Specially Protected Areas and Wildlife of the Cartagena Convention for the Wider Caribbean (SPAW)[12]
The report of the IWC observer to SPAW is given as IWC/65/4(2013D). At its 5th meeting of the Scientific and Technical Advisory Committee, held

[11] http://www.pices.int/

[12] http://www.cep.unep.org/cartagena-convention

22nd October 2012, SPAW recommended that collaboration with the IWC should be strengthened through the possible conclusion of a Memorandum of Cooperation.

The three-year Spain-UNEP LifeWeb Project comes to an end in December 2013. Under this, a number of activities have been completed including:

(1) broad-scale regional mapping of migration routes, critical habitats and human threats after compilation of available information and datasets; and
(2) a regional workshop on integration, mapping, GIS analysis of marine mammal migration routes, critical habitats and human threats in the wider Caribbean region held in Miami, Florida, 9-11 May 2011.

As a result of this work, regional maps and factsheets have been produced on the following issues:

(1) distribution of the 25 marine mammals species that occur regularly in the WCR (24 cetaceans and the West Indies manatee);
(2) species' richness;
(3) main threats and human impacts faced by marine mammals: pollutions, interactions with fisheries, maritime traffic etc.; and
(4) existing policies, marine protected areas and governance for the conservation of marine mammals.

SPAW has developed a management plan for the Marine Mammal Sanctuary of the Dominican Republic and a learning exchange on the economic benefits of whale-watching was organised in March 2013 in Samana, Dominican Republic.

A workshop on broadscale marine spatial planning and transboundary marine mammal management was held in Panama in May 2012. Participants were trained in marine spatial planning applied to marine mammals. As a result of this workshop, two sub-regional areas have been approved for the future scenario work in the WCR, due to their importance as habitats for marine mammals and to existing work and ongoing cooperation dynamics on marine mammals. The first sub-region proposed ranges from the Dominican Republic down to Trinidad and Tobago through the Lesser Antilles, with a focus on strengthening the links between existing or projected marine mammal sanctuaries and on developing other cooperation activities with the neighbouring islands.

The second sub-region encompasses the continental coast of Latin America from Venezuela to the border between Brazil and French Guiana, together with the Dutch Caribbean islands of Aruba, Bonaire and Curacao being included in the area. The scenario work in this second area will foster support to the already started cooperation between these countries and territories, particularly through a technical workshop held in Suriname in March 2013.

The IWC and Caribbean Environmental Programme (CEP) Secretariats have partnered in order to convene three workshops on the topics of entanglement and ship strike for the wider Caribbean countries. It was recognised that the IWC has the international technical expertise in understanding and responding to these human impacts and as such can provide the countries of the Wider Caribbean region access to this expertise through capacity building training and workshops. The first of two capacity building trainings on determining human impact and entanglement response training was conducted in English and Spanish in Mexico in November 2012.

The Committee thanked Carlson for attending on its behalf and **agrees** that she should represent the Committee as an observer at the next SPAW meeting.

4.14 Commission of the South Pacific (CPPS, Comisión Permanente del Pacífico Sur)

The report of the observers at the Meeting of the Parties to CPPS, held in Guayaquil, Ecuador, 10-12 April 2013 is given as IWC/65/4(2013)F. Mattila presented an overview of the global scope of the large whale entanglement issue and described the training currently offered through the IWC by the technical adviser and other members of the IWC expert advisory panel on this topic. Subsequently, the national representatives of the CPPS countries consulted with the Government of Ecuador, which had made an earlier formal request of the IWC Secretariat for National training for Ecuador. As a result of these consultations Ecuador has agreed to host an IWC entanglement response training that will include participation by up to three participants from the other CPPS countries. Ecuador, CPPS and NGOs will provide the logistical and financial support for the training, and the IWC will provide the trainers and curriculum. The training will be held in Salinas, Ecuador, 27-28 June 2013.

It is anticipated that this training may stimulate requests for full national training from some other CPPS member countries. It may also represent a model or mechanism by which the two Conventions can conduct cooperative work in order to advance common goals to reduce human impact to cetaceans.

The Committee thanked Mattila and Félix for their joint report and also Mattila for attending on its behalf and **agrees** that he should represent the Committee at the next CPPS meeting.

5. REVISED MANAGEMENT PROCEDURE (RMP) – GENERAL ISSUES

5.1 Complete the MSY rates review
Since 2007, the Committee has been discussing maximum sustainable yield rates (MSYR) in the context of a general reconsideration of the plausible range to be used in population models used for testing the *Catch Limit Algorithm* (*CLA*) of the RMP (IWC, 2008b; 2009a; 2009c; 2010b; 2010c; 2010e; 2011c; 2011d; 2012b). The current range is 1% to 7%, in terms of the mature component of the population. Last year, the Committee agreed that no more than one further year should be allowed to complete the review, and that if it could not be completed this year, the current range (MSYR 1-7% in terms of the mature component of the population) would be retained.

5.1.1 Report of the intersessional workshop
As part of the workplan agreed last year to complete the review, an intersessional workshop was held in La Jolla, USA in March 2013 and a detailed summary and review of its report (SC/65a/Rep5) is given in Annex D, item 2.1.1. While the Workshop made considerable progress, it was not able to develop recommendations on the appropriate range of MSYR rates. Rather, it identified four areas of work that would assist discussions at this Annual Meeting. It also identified three main issues requiring discussion at the Annual Meeting:

(1) limitations of the modelling approach itself;
(2) limitations within the approach (e.g. paucity of data); and
(3) interpretation of the results in the context of the RMP.

The Committee thanked Donovan for chairing the intersessional workshop and the participants for their work during it and subsequently, without which it would not have been possible to conclude the MSYR review at this meeting (see below).

5.1.2 Discussion including work completed since the workshop
SC/65a/RMP09 presented results from an energetic model presented to the MSYR Workshop. The model was used to predict variability in the realised rate of increase (*r*0) in a generic depleted whale population given estimates of the variability and autocorrelation in birth-rates. The Committee thanked de la Mare for conducting the analyses. The individual-based population dynamics model was reviewed by the EM group.

None of the model runs conducted in SC/65a/RMP9 led to estimates of MSYL that were 0.6 or larger. In addition, Cooke (2007) had shown that MSYL was closer to 0.5 than to 0.6 based on simulations in the context of a model with environmental effects for a wide range of parameter values. The Workshop had identified two scenarios for consideration with respect to the relationship between $MSYR_{1+}$ and r_0: $MSYR_{1+} = r_0/2$ and $MSYR_{1+} = r_0/1.619$. The latter scenario corresponds to $MSYL_{1+}$=0.6. Given the results in SC/65a/RMP9 and in Cooke (2007), the Committee **agrees** that $MSYR_{1+} = r_0/2$ was more appropriate for drawing inferences regarding the range of MSY rates for use in trials.

A key component of the work over the period of the review had been directed at a meta-analysis of observed rates of increase at low population size. SC/65a/RMP8 provided the results of a final sensitivity test for the Bayesian hierarchical meta-analysis using the data for rates of increase for the 13 baleen whale stocks selected in SC/65a/Rep5. The extent of environmental variation in r_0 as a function of r_0/r_{max} in SC/65a/RMP8 was determined from Equation 2 in SC/65a/RMP9. The lower 5% and 10% points of the posterior predictive distribution for r_0/r_{max} for an unknown stock for this sensitivity test were 0.419 and 0.512 respectively. SC/65a/RMP2 constructed a posterior predictive distribution for an unknown stock for *r*0 rather than r_0/r_{max}. The lower 5% and 10% points of this posterior predictive distribution were 0.029 and 0.037 respectively. The Committee thanked Punt for his work in undertaking these analyses.

The Committee recognised the considerable additional work that had been undertaken since the current range for (1% to 7% in terms of the mature component of the population) was selected in 1993 (IWC, 1994). In particular, since 2007, the Committee had *inter alia* (1) assembled and evaluated information on rates of increase for stocks at low population size, (2) explored some of the impacts of environmental effects on r_0 relative to r_{max} and the shape of the yield curve for exploited baleen whales, and (3) developed a meta-analysis framework to integrate this information, along with information on demographics, to derive a probability distribution for r_0 and r_0/r_{max}. Given the available information and knowledge, the Workshop had explored the sensitivity of the distribution for r_0/r_{max} to a number of factors, including choices of stocks from amongst those for which suitable data were available and to the potential effects of environmental variation on rates of increase (see Annex D, Table 4). The Committee recognised that while the meta-analysis was an important advance, it was inevitably limited for a number of unavoidable reasons including uncertainty over a number of factors, as described in Annex D, Item 2.1.3.

In conclusion, despite these uncertainties, the Committee **agrees** that it has a better basis to select the range for MSYR for use in trials than when the 1% to 7% choice had been made in 1993. In completing the review this year it recognised that this did not mean that additional work should not continue and be periodically reviewed by the Committee, both in a general sense and as part of *Implementations* and *Implementation Reviews.*

Given its importance in terms of meeting conservation objectives, discussion focussed on the lower bound for MSYR for use in trials, based on the assumption MSYR ~ $r_0/2$. A number of options were considered when examining the results of the meta-analysis relating to choice of percentile (5% or 10%), the value for $r_{\max}$, and whether the meta-analysis should be based on r_0 or $r_0/r_{\max}$. A broad consideration of the full set of sensitivity tests in SC/65a/Rep5, SC/65a/RMP2 and SC/65a/RMP8, suggests a range of 1% to 2.5% for the lower bound for MSY rate expressed in terms of the age 1+ component of the population (during the RMP development process and to date, MSYR has been expressed in terms of the mature component of the population; the AWMP development process by contrast expresses MSYR in terms of the 1+ component).

Recognising the uncertainties in the meta-analysis and the need for precaution, the Committee **recommends** that $MSYR_{1+}$=1% be adopted as a pragmatic and precautionary lower bound for use in trials. The value corresponds to the lower of the two percentiles in table 5 of SC/65a/Rep5, and the lowest of the $r_{\max}$ values; all of the point estimates of r_0 used in the meta-analysis correspond to $MSYR_{1+}$ values larger than 1% under $MSYR_{1+}$~$r_0/2$. In essence, $MSYR_{1+}$=1% is roughly the equivalent of 1.5% $MSYR_{mat}$. The Committee also **recommends** that the current upper bound of $MSYR_{mat}$=7% be changed to the roughly equivalent $MSYR_{1+}$=4%. These recommendations have the additional practical advantage of unifying the MSYR 'currencies' of the RMP and AWMP processes.

In making this practical recommendation, the Committee **recognises** that much remains to be learnt regarding MSYR for baleen whales and that the issue of the appropriate range for MSYR should be continue to be reviewed as new information becomes available. In particular, should data become available for more species and populations, the meta-analysis should be revisited with a view to making it more representative. The Committee **emphasises** in particular the need for information relating to stocks of species of interest for the RMP, including fin, sei, Bryde's and minke whales (although of course information on MSYR is important in assessing the status of all species within the Committee's work). Work should also continue to better understand the impact of environmental variation on MSYR and the biological and ecological processes leading to density-dependence, together with the shape of yield curves and hence the relationship between r_0 and $MSYR_{1+}$. As is already the case, consideration of MSYR for particular species and stocks should also occur during *Implementations* and *Implementation Reviews,* particularly where other information for the stock or species concerned suggests alternative plausible values to those discussed above.

The Committee also **recommends** that the "*Requirements and Guidelines for Implementations under the RMP*" (IWC, 2012) be updated as given in Annex D, Item 2.1.3.

The Committee thanked Brandon, Butterworth, Cooke, de la Mare, Donovan, Kitakado and Punt, as well as the other participants of the many intersessional meetings without whom it would not have been possible to complete the MSYR review. Above all, it acknowledged the contribution and dedication of the field researchers, whose data, particularly on bowhead, blue, right and humpback whales, collected over periods of up to 40 years, formed the backbone of the meta-analysis and the MSYR review.

5.2 Finalise the approach for evaluating proposed amendments to the *CLA*

In 2006, the Committee agreed that two steps needed to be completed in order to finalise the approach for evaluating proposed amendments to the *CLA*: the review of MSY rates, completed this year (see Item 2.1 above), and specification of additional trials for testing the *CLA* and amendments to it. Last year, the Committee re-established a working group under Allison to develop and run such trials for consideration at this year's meeting. However, Allison reported that there had been insufficient time during the intersessional period to conduct the work.

The Committee noted that the Working Group on Ecosystem Modelling had identified a set of possible issues to be addressed using individual-based simulation and other models (see Item 3 of Annex KI). These issues could form the basis for additional trials to further explore the behaviour of the RMP. The Committee **agrees** to re-establish the working group under Allison (Annex R) to formulate and run trials related to environmental degradation, taking account of the discussions in Annex K1, and to report the results to the next Annual Meeting.

5.3 Evaluate the Norwegian proposal for amending the *CLA*

In 2004, Norway had indicated that it might submit a proposal for the revision of the *CLA* and the base-case and *Robustness Trials* (IWC, 2006a, pp.79-80). In 2006, the Committee received a paper (SC/59/RMP4) documenting the results for all single stock trials for a proposed alternative *CLA*, as required for consideration of a proposed revision of this nature (IWC, 2007d, p.89).

The Committee noted in the past that evaluation of this proposal required: (a) completion of the MSYR review, (b) review of the trials conducted in SC/59/RMP4, and (c) review of additional trials which explore the performance of the RMP given environmental degradation. This year, the Committee has completed the MSYR review (see Item 2.1), but it was not able to complete the trial specifications related to environmental degradation (item 5.2) and it did not have time to review SC/59/RMP9.

The Committee **agrees** that (a) SC/59/RMP4 should be a primary document for SC65b, and (b) it would not be necessary to have all of the trials related to environmental degradation completed before a decision on amending the *CLA* could be made, given the time required to parameterise trials based on individual-based models. It also **agrees** that the *Implementation Review* for the North Atlantic common minke whales could take place even though a decision had yet to be made regarding the Norwegian proposal to amend the *CLA*.

5.4 Modify the 'Catch Limit' program to allow variance-covariance matrices

Last year, it was noted that the Norwegian 'CatchLimit' code for the current CLA allows variance-covariance matrices for the abundance estimates to be specified, and Allison was tasked to work intersessionally with the Norwegian Computing Center to develop a final version of the program. She reported that the Norwegian version of the current *CLA* version was used in the trials for western North Pacific minke whales, although some coding issues remain. The Committee **recommends** that Allison contact the Norwegian Computing Center to resolve any final coding issues.

5.5 Update Requirements and Guidelines for conducting surveys and *Implementations*

Last year, the Committee recommended that a review covering model-based abundance estimation in theory and practice, and its relation to the design-based approach, be conducted. The review was to provide draft text for inclusion in the Requirements and Guidelines for Conducting Surveys (IWC, 2012g). Hedley was contracted to conduct the review, but was unable to complete it on time. The Committee **looks forward** to receiving the review at the 2014 Annual Meeting.

5.6 Update the list of accepted abundance estimates to include western North Pacific common minke whales

The Committee noted that last year it had developed a list of accepted abundance estimates last year related to RMP stocks (IWC, 2013). It **agrees** that the list of accepted abundance estimates for the RMP be updated using the values provided by the Working Group western North Pacific minke whale (see Annex D1, Item 10). The broader question of accepted abundance estimates is addressed under Item 22.

5.7 Other business

A number of issues arose during the 'second' western North Pacific common minke whale *Implementation Review* workshop (SC/65a/Rep4) that were of general relevance to the RMP process and required the Committee's attention. The issues, and the rationale for the sub-committee's recommendations, are given in Annex D, Item 2.7. Here the issues are identified, with the relevant recommendations.

(1) Imbalanced sex ratio in incidental catches: the Committee **agrees** to consider this matter at the 2014 Annual Meeting and encourages papers on this topic.
(2) Review of abundance estimates in an RMP context: the Committee **endorses** the recommendation that the specified set of associated information be provided along with abundance estimates in its *Requirements and Guidelines for Implementations and Implementation Reviews*.
(3) Changing survey coverage in time-series of abundance estimates: the Committee **agrees** to consider the matter at the 2014 Annual Meeting and encourages papers on the topic. It will at that time re-examine the set of core robustness trials which relate to this issue.
(4) Use of surveys carried out in different months in both the *Implementation* process and in actual implementation of the RMP: the Committee **agrees** to consider the matter at the 2014 Annual Meeting and encourages papers on the topic.

5.8 Work plan

The Committee's views on the work plan developed by the RMP sub-committee are given in Item 24, and the financial implications in Item 26.

6. RMP – IMPLEMENTATION-RELATED MATTERS

6.1 North Pacific common minke whales

Since 2010, the Committee has been following the process of an *Implementation Review* for western North Pacific common minke whales according to its Requirements and Guidelines for *Implementations* under the RMP (IWC, 2012b). The scheduled period for an *Implementation* or *Implementation Review* is normally 2 years but, given the complexities of this particular *Implementation Review*, it has not been possible to keep to this schedule. This year's Annual Meeting was thus the third of the *Implementation Review*, but its objectives were those of the 'Second Annual Meeting' described in the Requirements and Guidelines for *Implementations*, which are to complete the *Implementation Review* by examining the results of the final *Implementation Simulation*

Trials and agreeing recommendations for implementation of the RMP.

6.1.1 Review report of intersessional workshop

The Committee reviewed the report of the intersessional workshop held in La Jolla, California in March 2013 and chaired by Donovan (SC/65a/Rep04). The workshop is referred to as the '2nd Intersessional Workshop', although it is actually the third such workshop because of the extended schedule of this *Implementation Review*.

The Workshop was primarily a technical workshop, the objectives of which were to review the results of work agreed at the 2012 Annual Meeting of the Scientific Committee (IWC, 2013c) and to consider the results of the final trials using the agreed approach that forms part of the *Implementation* process (Internation Whaling Commission, 2012). The ultimate objectives were to develop recommendations for consideration by the Committee on: management areas; RMP variants (e.g. catch-cascading, catch-capping); suggestions for future research to narrow the range of plausible hypotheses or eliminate some hypotheses; and 'less conservative' variants(s) with their associated required research programmes and duration.

A detailed summary of the workshop report is given in Annex D1, item 2. A map defining the sub-areas used for the *Implementation Review* is given as Fig. 1.

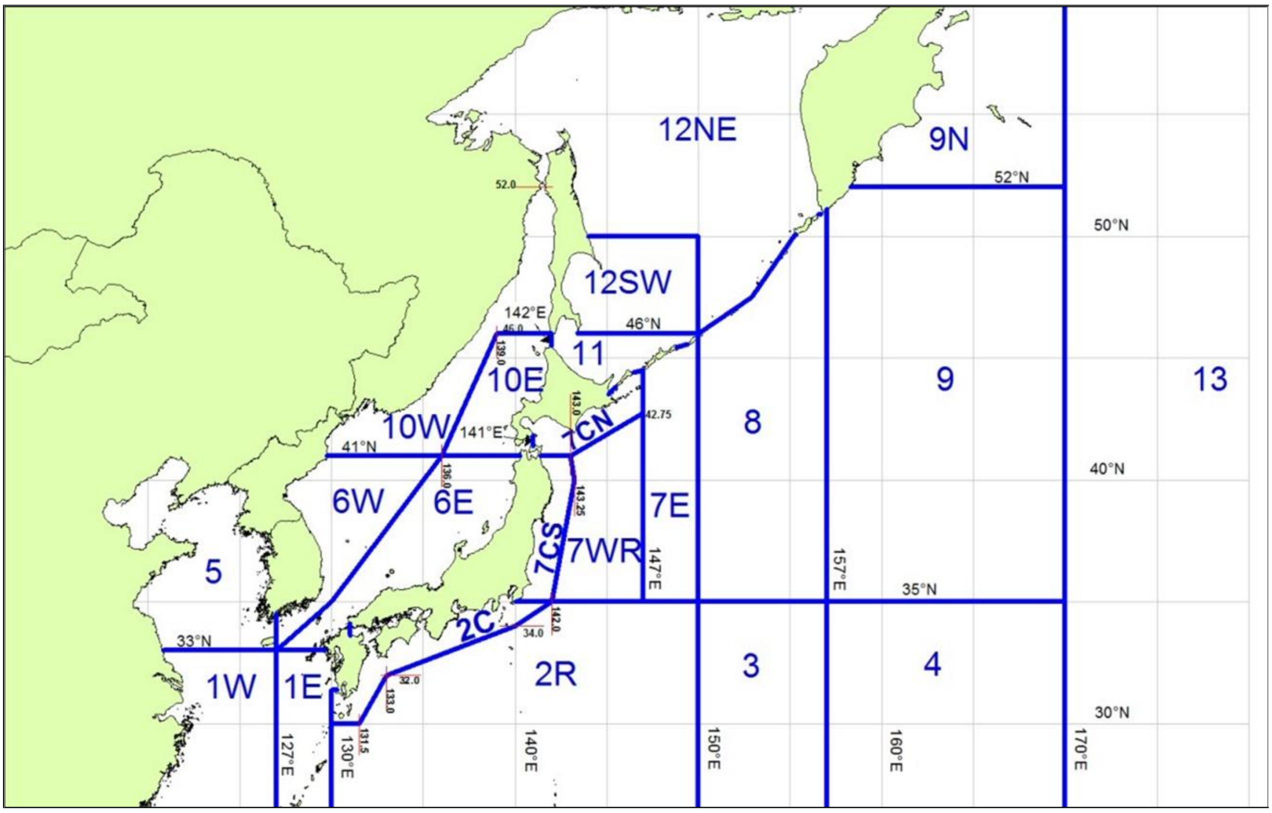

Fig. 1. The 22 sub-areas used for the *Implementation Simulation Trials* for North Pacific minke whales

The Workshop made considerable progress but it had not been possible to consider final trial results because decisions necessary for finalising the trials were only able to be taken at the Workshop. However, some preliminary results for some trials were available and review of these led to refinement and reduction of the total number of management variants (see Item 6.1.3.1) to be considered at this Annual Meeting.

The Workshop had developed a workplan for the remainder of the intersessional period aimed at completing the final trials and providing results well in advance of this Annual Meeting. Considerable progress was made but because of the complexities of this *Implementation Review* it had not been possible to complete this work prior to the Annual Meeting. The Workshop had also identified a number of generic issues related to conducting trials which were referred to the RMP sub-committee (see Annex D, Item 2.7).

The Committee **endorses** the conclusions and recommendations from the Workshop report (SC/65a/Rep04) and expressed its thanks to Donovan and all participants for their hard work and progress.

6.1.2 Progress since intersessional workshop

6.1.2.1 UPDATE TO TRIAL SPECIFICATIONS

Changes since the 2nd Intersessional Workshop to the trial specifications and the code implementing these specifications are described in Annex D1, item 3.1. The Committee **endorses** these changes to the trial specifications; the final trial specifications are given in Annex D1, Appendix 2.

6.1.2.2 REVIEW OF FINAL CONDITIONING RESULTS

Regarding conditioning the *Implementation Simulation Trials*, the Committee had reviewed the fit diagnostics for the base-case trials and those for many of the sensitivity tests implemented in other trials at the 2012 Annual Meeting (IWC, 2013c). Work on conditioning trials continued during the intersessional period and the conditioning diagnostics for all trials conducted during this period had been reviewed by Punt. The Committee **had agreed** that the *ad hoc* Working Group established under the Working Group on the *Implementation Review* for Western North Pacific Common Minke Whales to review trial results should check the conditioning of any trials that may be influential in the final decisions regarding the selection of RMP variants. The Committee **confirms** that conditioning had been successfully achieved for all influential trials (Annex D1, item 3.2).

6.1.3 Complete Implementation Review

According to the Requirements and Guidelines for *Implementations,* completing the *Implementation Review* involves reviewing the results of the final *Implementation Simulation Trials* and making recommendations on: Management Areas; RMP variants; and inputs to the *CLA* for use in actual applications of the RMP.

6.1.3.1 REVIEW RESULTS OF FINAL *IMPLEMENTATION SIMULATION TRIALS*

The procedure for reviewing results of the final trials is given in the Committee's Requirements and Guidelines for *Implementations* (Internation Whaling Commission, 2012). A very brief summary is given below.

Fig. 2 shows a flow chart of the decision process to be followed.

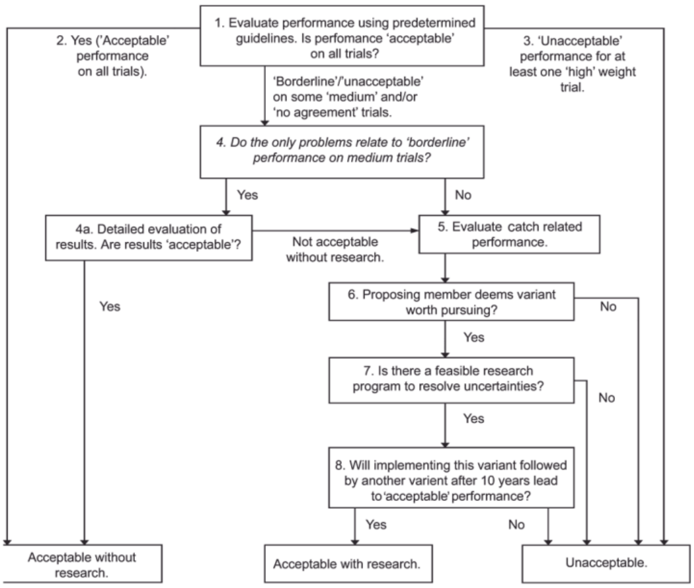

Fig. 2. Flowchart summarising the procedure for review of *IST*s (from IWC, 2005)

The procedure first involves consideration of specified diagnostics to evaluate conservation performance generated from trial results, and determining from them whether the performance of each trial is 'acceptable', 'borderline' or 'unacceptable' under each of the defined RMP variants (see Annex D1, item 4.1). The style in which these results should be presented is detailed in Annex D1, item 4.2. RMP variants are defined by the *Management Areas* to be used (*Small Areas*, etc) and how any catches are to be taken from them (see Annex D1, item 5). This part of the procedure is a technical exercise that follows directly from the results and requires no judgement.

The second stage is to evaluate each RMP variant by considering the results of all trials together in order to decide whether each variant is 'acceptable without research', 'acceptable with research' or 'unacceptable' (see Annex D1, item 5). This part of the procedure does require judgement because consideration is needed of the overall balance of the trials and the characteristics of any specific trials for which performance is questionable. The process for evaluating each variant can be summarised as follows:

(1) if the performance is close to 'acceptable' for a small number of 'borderline' trials then the Committee may agree that the variant is 'acceptable without research';
(2) if the performance is close to 'unacceptable' or is 'unacceptable' for a number of trials based on a specific hypothesis, then the Committee may agree that this is a candidate for the 'acceptable with research';
(3) if the performance is close to 'unacceptable' or is 'unacceptable' for a number of trials under several hypotheses, then the Committee may agree that the variant is 'unacceptable' and thus eliminated from further consideration.

Ten RMP variants to be evaluated had arisen from the 2nd Intersessional Workshop:

(1) *Small Areas* equal sub-areas. For this option, the *Small Areas* for which catch limits are set are 5, 6W, 7CS, 7CN, 7WR, 7E, 8, 9*, and 11;
(2) Sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* and catches are taken from sub-areas 5, 6W, 7CN, 9, and 11;
(3) Sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* and catches are taken from sub-areas 5, 6W, 7CS, 9, and 11;
(4) Sub-areas 5, 6W, 7CS, 7CN, 7WR+7E+8, 9* and 11 are *Small Areas* and catches are taken from sub-areas 5, 6W, 7CS, 7CN, 7WR, 9 and 11;
(5) Sub-areas 5 and 6W are *Small Areas* and catches are taken from sub-areas 5 and 6W. Sub-areas 7+8+9*+11+12 form a combination area and catches are cascaded to the sub-areas within the combination area. The catch limits for sub-areas 12SW and 12NE are not taken;
(6) Sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* except that the catches from the 7+8 *Small Area* are taken from sub-areas 7CS and 7CN using the same method as for catch cascading to allocate the catch across the two sub-areas;
(7) Sub-areas 5+6W+6E+10W+10E and 7+8+9*+11 are *Small Areas*; catches from the 5+6W+6E+10W+10E *Small Area* are taken from subareas 5 and 6W using the same method as for catch cascading to allocate the catch across those five sub-areas, and catches from the 7+8+9+11 *Small Area* are taken in sub-area 7CN;
(8) Sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* and catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 8 and 9 using the same method as for catch cascading to allocate the catch across the two sub-areas;
(9) Sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* and catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8 and 9 using the same method as for catch cascading to allocate the catch across these sub-areas; and
(10) Sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* and catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8, 9 and 11 using the same method as for catch cascading to allocate the catch across these sub-areas. Catches from sub-area 11 occur in May and June only;

After reviewing the initial results at the meeting, Japan requested that an 11th variant be evaluated:

(11) Sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* and catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8 and 9 using the same method as for catch cascading to allocate the catch across these sub-areas, except the catches from sub-areas 7CS, 7CN, 7WR and 7E are reduced by 50% after first subtracting the bycatches in these sub-areas.

The Committee's Requirements and Guidelines for *Implementations* allow for additional variants to be proposed for evaluation during the 2nd Intersessional Workshop as part of the *Implementation* process. However, due to the complexities of this *Implementation Review*, the results of only a few trials had been available during the 2nd Intersessional Workshop rather than the complete set as envisioned in the Requirements and Guidelines. Recognising these exceptional circumstances, the Committee **decided** to evaluate this additional variant noting that it was in accord with the RMP in that catches from all *Small Areas* cannot exceed the RMP catch limit (except when the bycatch exceeds the RMP catch limit when the commercial catch is set to zero).

In doing so, the Committee **reiterates** that, under normal circumstances, proposal and evaluation of additional variants should not take place at the 2nd Annual Meeting.

Annex D1, Table 2 lists the factors considered in the trials and the plausibility assigned to each. Some of the factors were assigned 'medium' plausibility because the Committee had not been able to reach agreement on whether they should be 'low', 'medium' or 'high'(IWC, 2013c, p.11). A list of all the trials is given in Annex D1, Table 1. In all there were 66 trials of which none were given 'high' weight. More details are given in Annex D1, item 5.

Annex D1, Tables 3 and 4 summarise the application of the procedure for evaluating conservation performance. Results are shown in Annex D1, Table 3 by stock-structure hypothesis and in Annex D1, Table 4 by RMP variant. Annex D1, Table 5 lists the average catches by sub-area for each RMP variant for the six base-case trials, reported for years 1-10 and for the entire 100-year projection period. The results in this table are illustrative only; the actual catches will depend on the application of the *CLA* to the abundance estimates and catches selected by the Committee (Items 6.1.4.2 and 6.1.4.3).

The full set of trial results is available from the Secretariat upon request. Results for each variant are given in Annex D1, item 5 and are summarised below.

Variants 1, 2, 3, 4 and 6
These variants did not have 'unacceptable' performance for any trials, but had 'borderline' performance for one trial (B04) as shown in Annex D1, Fig. 3. Given that the 'borderline' performance was close to 'acceptable', and that 'borderline' performance occurred only once out of 66 trials, these variants can be considered as candidates 'acceptable without research' (step 4a in Fig. 2).

Variant 5
Variant 5 had 'unacceptable' performance for trial B04 (Annex D1, Fig. 3). It had 'borderline' performance for trials A04 (Annex D1, Fig. 4), B03 (Annex D1, Fig. 5), C03 (Annex D1, Fig. 6), and C04 (Annex D1, Fig. 7). Given that this variant fails for only one trial (B04) and is 'borderline' on four trials in which it is close to 'acceptable' for trial A04, this variant can be considered 'acceptable with research' because it fails only for stock structure hypothesis B (step 4a in Fig. 2).

Variant 7
Variant 7 performed 'unacceptably' on 22 out of 27 trials for stock-structure hypothesis C and 'borderline' on two (C14, C17). It also had 'borderline' performance for two trials based on stock-structure hypotheses A and B (A04, B04). This variant was close to 'acceptable' for these two trials (Annex D1, Figs 3 and 4). This variant can thus be considered as a candidate for 'acceptable with research' because it was 'borderline' for only two out of 39 trials for hypotheses A and B, while its performance was 'unacceptable' for hypothesis C; that is, this variant fails for only one stock structure hypothesis (step 4a in Fig. 2).

Variant 8
Variant 8 was acceptable for all 'medium' weight trials. Therefore this variant can be considered to be 'acceptable without research' (steps 1 and 2 in Fig. 2).

Variant 9
Variant 9 performed 'unacceptably' on 20 out of 27 trials for stock-structure hypothesis C, and had 'borderline' performance for four trials (C11, C14, C17 and C30). It had 'borderline' performance on only two out of 39 trials based on stock-structure hypotheses A and B (A04, B04). This variant can thus be considered as a candidate for 'acceptable with research' because it fails only for stock structure hypothesis C (step 4a in Fig. 2).

Variant 10
Variant 10 performed 'unacceptably' on 23 out of 27 trials for stock-structure hypothesis C and had 'borderline' performance for two (C17 and C27). It also performed 'unacceptably' for one trial for stock structure hypothesis B (B04) and 'borderline' for 8 trials (B03, B05, B06, B09, B18, B20, B22, B28). 'Borderline' performance was also observed for three trials for stock structure hypothesis A (A03, A04, A28). This variant is therefore 'unacceptable'.

Variant 11
Variant 11 performed 'unacceptably' on three out of 27 trials for stock-structure hypothesis C (C13, C20, C23) and had 'borderline' performance for 16 stock structure hypothesis C trials. The conservation performance of this variant is between that of variants 5 and 9, which were both considered to be candidates for variants with research. Therefore, this variant can be considered as a candidate for 'acceptable with research'.

Variants with research
With respect to variants that are candidates for 'acceptable with research', it is the responsibility of relevant government(s) to inform the Committee whether it wishes additional trials to be run to determine the conservation performance of proposed 'hybrid variants'. A 'hybrid variant' is one for which catches for the first 12 years are set using the candidate 'acceptable with research' variant followed by a 6-year phase down/phase out period and then catches set by an 'acceptable without research' variant. The conservation performance of the 'hybrid variant' must be 'acceptable' under the criteria described above.

If the 'hybrid variant' performs acceptably then, before it can be recommended, the Committee must agree a research programme that it believes has a realistic chance of determining whether the trial(s) for which this variant performed poorly should be accorded low weight. The Committee will review progress with the research programme annually and may recommend early reversion to the 'acceptable' variant if progress is not sufficient.

The Committee noted that any research proposal submitted would be reviewed at next years' meeting.

6.1.4 Recommendations

6.1.4.1 RMP VARIANTS
Under the management options recommended (see below), the Management Area designations for each RMP variant are as follows:

(1) Variant 1: sub-areas 5, 6W, 7CS, 7CN, 7WR, 7E, 8, 9* and 11 are *Small Areas*;

(2) Variant 2: sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* (all of the catch from the 7+8 *Small Area* is taken from sub-area 7CN);
(3) Variant 3: sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* (all of the catch from the 7+8 *Small Area* is taken from sub-area 7CS);
(4) Variant 4: sub-areas 5, 6W, 7CS, 7CN, 7WR+7E+8, 9* and 11 are *Small Areas* (all of the catch from the 7WR+7E+8 *Small Area* is taken from sub-area 7WR);
(5) If Variant 5 proves to be acceptable with research: sub-areas 5 and 6W are *Small Areas* and catches are taken from sub-areas 5 and 6W. Sub-areas 7+8+9*+11+12 form a Combination Area (catch limits for sub-areas 12SW and 12NE are not taken);
(6) Variant 6: sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* (catches from the 7+8 *Small Area* are taken from sub-areas 7CS and 7CN using the same method as for catch cascading);
(7) If Variant 7 proves to be acceptable with research: sub-areas 5+6W+6E+10W+10E and 7+8+9*+11 are *Small Areas*; (catches from the 5+6W+6E+10W+10E *Small Area* are taken from sub-areas 5 and 6W using the same method as for catch cascading ; catches from the 7+8+9+11 *Small Area* are taken in sub-area 7CN);
(8) Variant 8: sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* (catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 8 and 9 using the same method as for catch cascading);
(9) If Variant 9 proves to be acceptable with research: sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* (catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8 and 9 using the same method as for catch cascading); and
(10) If Variant 11 proves to be acceptable with research: sub-areas 5, 6W, and 7+8+9*+11+12 are *Small Areas* (catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8 and 9 using the same method as for catch cascading).

The Committee **agrees** that, according to the Committee's Requirements and Guidelines for *Implementations* (IWC 2012a):

(1) variants 1, 2, 3, 4, 6 and 8 are 'acceptable without research';
(2) variants 5, 7, 9 and 11 are candidates for 'acceptable with research'; and
(3) variant 10 is 'unacceptable'.

Some members stated that with only two exceptions, all of the 'unacceptable' trials were under stock structure hypothesis C. Under the Committee's current Requirements and Guidelines for *Implementations* under the RMP, when there is no agreement on plausibility of the hypotheses, the plausibility is automatically assigned as 'medium'. In the case of stock structure hypothesis C, there was no agreement and therefore the plausibility became 'medium' as for the other stock structure hypotheses. However these members reiterated their view that the plausibility of stock structure hypothesis C is 'low' (Appendix 7 in JCRM 12 (Suppl.): 138). Whilst agreeing that the review of trials had appropriately followed the Committee's current Requirements and Guidelines for *Implementations*, under these circumstances they could not accept the recommendations on management based on the conservation performance of the *Implementation Simulation Trials* using hypothesis C reviewed at this meeting. They pointed out that the problem of assigning plausibility has been an ongoing problem and suggested that it is necessary to review the method of determining plausibility.

6.1.4.2 ESTIMATES OF ABUNDANCE

The Committee did not have sufficient time to finalise the estimates of abundance for use in actual applications of the RMP. Annex D1, Table 6 summarises the current status of abundance estimates for use in the trials and in actual applications of RMP. Work to determine whether the abundance estimates that need further consideration can be accepted for use in actual applications of the RMP is included in the workplan (see item 6.1.5). Final decisions regarding which abundance estimates can be used in actual applications of the RMP will be made at next year's meeting, taking into account any revision to the Requirements and Guidelines for Conducting Surveys (item 5.5, Annex D, item 2.5)

6.1.4.3 HISTORICAL AND FUTURE REMOVALS

The Committee has previously agreed that the best estimates of the direct catches and the average predicted bycatch from the six baseline trials would be used in actual applications of the RMP (IWC, 2013c). The calculated average predicted bycatch from the six baseline trials are given in Annex D1, Appendix 2.

6.1.4.4 CONSIDERATION OF DATA/ANALYSES TO REDUCE HYPOTHESES IN FUTURE

The Committee did not have sufficient time to discuss this item fully. It **encourages** those contracting governments which are contemplating application of the RMP to review previous discussions on this matter in the Committee.

The Committee highlighted that the *Implementation Simulation Trials* structure provided a way to identify the value of information to resolve uncertainties. In particular, analyses could be undertaken to assess where data on mixing proportions and abundance would be most informative in terms of resolving the plausibility of various hypotheses. The Committee recognised that becoming familiar with how to use the

Implementation Simulation Trials structure to evaluate the value of information could be complicated, and **encourages** members of the Committee to work with the Secretariat to develop the ability to condition and run trials.

6.1.5 Surveys and estimates of abundance

6.1.5.1 RESULTS FROM RECENT SURVEYS

SC/65a/NPM1 presented the results of satellite tracking of common minke whales in the Sea of Japan in autumn 2012. Little information on migration behaviour was obtained because of the short transmission duration (14 days). More details are given in Annex D1, item 8. The Committee welcomes this information and **recommends** that researchers conducting tagging studies on North Pacific minke whales work together with those conducting similar work in other areas, particularly in relation to tag technology and deployment.

SC/65a/NPM4 provided a cruise report on a sighting survey in the East Sea in spring 2012. More details are given in Annex D1, item 8.1.

6.1.5.2 PLANS FOR FUTURE SURVEYS

SC/65a/NPM2 presented the research plan for a sighting survey for common minke whales in the Sea of Okhotsk, including the Russian EEZ, in summer 2014. The primary objective of the survey is to obtain a new estimate of abundance for sub-areas 11 and 12. The secondary objective of the survey will be biopsy sampling and satellite tagging for common minke whales, if permission is obtained from the Government of the Russian Federation. This latter objective is important given the need to obtain information on the mixing rate of J- and O-stocks, and the distribution of J-stock in the Okhotsk Sea. Further details are given in Annex D1, item 8.2.

SC/65a/NPM5 reported that a sighting survey for common minke whale will be conducted in the Yellow Sea in spring 2014. This survey is part of a four-year programme to survey the waters of sub-areas 5 and 6W and increase survey coverage from 13% to 35%. Further details are given in Annex D1, item 8.2.

The Committee welcomes these plans and noted that there have been no surveys in sub-area 12 in recent years. It appointed Mayashita and An to provide oversight of these surveys on behalf of the Committee. The Committee **strongly recommends** that the Government of the Russian Federation give permission for the survey to take place in its EEZ in the Sea of Okhotsk throughout sub-area 12, given the importance of abundance estimates for sub-area 12 to the understanding of the status of common minke whales in the western North Pacific.

6.1.5.3 UPDATED LIST OF ACCEPTED ABUNDANCE ESTIMATES

Annex D1, Appendices 3 and 4 summarise information on primary effort, primary sighting position, survey blocks, sub-areas and area definitions for surveys for western North Pacific minke whales. The Committee thanked Miyashita, Hakamada and An for providing this information, which had been requested by the 2nd Intersessional Workshop.

Annex D1 Table 7 lists these estimates of abundance in a format consistent for collation with estimates from other species and areas.

6.1.6 Conclusions

The Committee re-established the Intersessional Steering Group (See Annex D1, item 11 for membership) to co-ordinate intersessional work and prepare for the 2014 Annual Meeting.

The Committee recognised that this *Implementation Review* had been the most complicated to date and thanked all those who had contributed over the last three years to its completion, especially Hammond and Donovan who chaired the Working Group and intersessional workshops, respectively. In particular, the Committee expressed its appreciation for the large amount of work done by Allison and de Moor without which it would not have been possible to complete the *Implementation Review*. The Committee noted that the need to take 3 years to complete this complicated *Implementation Review* may have implications for conducting other *Implementations* and *Implementation Reviews.* The Committee **agrees** to review its Requirements and Guidelines for *Implementations* under the RMP in this context at next year's meeting.

6.2 North Atlantic fin whales

6.2.1 Implementation Review

The Committee reviewed the report of the pre-meeting to initiate the *Implementation Review* (see Annex D, Appendix 2) and **endorses** its conclusions, recommendations and workplan. It established an intersessional group (Annex R) under Elvarsson to develop revised specifications for the trials. It **recommends** that a two-day workshop is held back-to-back with an AWMP intersessional workshop in early 2014 to reduce travel costs

6.3 North Atlantic common minke whales

6.3.1 Review new information

The Committee received five papers which had been either been presented to the Special Permit Review workshop held in Iceland (SC/65a/Rep3), or were revised versions of papers presented then. Details are given in Annex D, Item 3.2.1.

The Committee **welcomes** the information in SC/F13/SP17 and SC/F13/SP20Rev. It should be useful for the upcoming *Implementation Review*, and, in particular, the work of the joint AWMP/RMP Working Group on stock structure.

The Committee recognised the value of the satellite tracking of minke whales, reported in SC/F13/SP18, for the development of *Implementation Simulation*

Trials. It **reiterates** the recommendations of the the Special Permit Review that such tagging should continue, as much information as possible should be collected from each tagged individual, and that the results from the various stock definition approaches should be integrated

The Committee **agrees** that data from satellite tracking could be used in *Implementation Simulation Trials* both qualitatively and quantitatively. There would be benefits in identifying the analysis methods to apply to data from satellite-tagged animals to determine the minimum number of animals needed for meaningful quantitative estimates and the point at which tagging additional animals leads to minimal additional information. If such analysis methods are developed, they should be reviewed by the Working Group on Stock Definition.

The Committee noted that SC/F13/SP06 stated the main objective of the aerial survey component of the research programme is to obtain a seasonal profile of relative abundance in coastal Icelandic waters in the off-season. This is discussed in Annex D, Item 3.2.1.

6.3.1.1 NEW SURVEYS

SC/65a/RMP10 presented Norway's plans to conduct a new series of annual partial surveys over the period 2014-2019 to collect data for a new estimate of minke whale abundance in the Northeast Atlantic in accordance with the requirements of the RMP. The survey and analytical methods will follow the procedures used in the previous survey cycles.

The Committee noted that the upcoming *Implementation Review* could lead to changes to the definitions of the *Small Areas*. It recognised that there are some advantages in agreement between survey and *Small Area* boundaries, but **agrees** that an approach has been developed which can address changes in *Small Area* boundaries.

6.3.2 Prepare for 2014 Implementation Review

The Committee was informed that the joint AWMP/RMP group is coordinating discussions and analyses on using genetics to examine stock structure for North Atlantic minke whales. It reviewed the report of the group (Annex D, Appendix 3) and **endorses** its recommendations. It **reiterates** its recommendation from last year that the work plan for the group (IWC, 2013; Annex D, Appendix 6) be completed, and **recommends** the holding of a joint AWMP/RMP intersessional Workshop to consider stock structure hypotheses for common North Atlantic minke whales. It **recommends** a research proposal to conduct simulation analyses to support the deliberations of the intersessional Workshop (Annex D, Appendix 4) and future considerations of stock structure for other populations (see item 26).

6.3.3 Recommendations

The Committee **recommends** that a Steering Group under Walløe be established to co-ordinate planning for the 2014 *Implementation Review* (Annex R). It **recommends** that a three day pre-meeting be held prior to the 2014 Annual Meeting to ensure that sufficient progress is made on the *Implementation Review*, noting that this *Implementation Review* could be more complicated than previous ones because the original *Implementation* was not conducted under the current *Requirements and Guidelines for Implementation.*

6.4 North Atlantic sei whales

Last year, the Committee established an intersessional group to review the available data for North Atlantic sei whales in the context of a possible *pre-Implementation Assessment* and provide a report to the 2013 Annual Meeting. Unfortunately, insufficient progress was made during the intersessional period to warrant starting the *pre-Implementation Assessment* at this year's meeting. The Committee therefore **recommends** that the intersessional group be re-established and progress evaluated at the 2014 Annual Meeting. The decision whether to initiate an *Implementation* after a *pre-Implementation Assessment* is made by the Commission. The Committee noted that this procedure might lead to delays now that the Commission will meet biennially; it may consider possible recommendations to the Commission at next year's meeting.

6.5 Western North Pacific Bryde's whales

6.5.1 Prepare for 2016 Implementation Review

The Committee received an update on progress and plans for the 2016 *Implementation Review* (Annex D, item 3.4). A sighting survey will be conducted in western North Pacific minke whales sub-areas 7 and 8 in 2013. IWC-POWER cruises will also take place in 2013 and 2014. Sightings data will be collected and attempts will be made to biopsy Bryde's whales. Bryde's whale genetic samples were collected during JARPN II cruises in 2012 and additional samples will be collected during the 2013 JARPN II cruises.

6.6 Work plan

The Committee's views on the work plan for the sub-committee on the RMP are given in Item 24, and the financial implications in Item 26.

7. NON-DELIBERATE HUMAN-INDUCED MORTALITY OF LARGE WHALES

The report of the Working Group on Non-deliberate Human-induced Mortality of Large Whales is given as Annex J.

7.1 Criteria for determining cause of death

The objective of this item is to assist the Committee in its general attempts to assess human caused mortality and in particular to agree to specific criteria by which the ship strike data review group can assess ship strikes reported to the ship strike database. If standardised criteria became internationally accepted, this will also assist countries as they report ship strikes through their national progress reports.

Moore *et al.* (2013b) report on a workshop held in the US that defined criteria for degrees of confidence in the diagnosis of sharp or blunt vessel trauma, and peracute or chronic fishery trauma in cetaceans. The amount of data needed to make an adequate diagnosis depends on the scenario as is discussed in the paper and summarised in Annex J (item 6). Their criteria are for 'Confirmed', 'Probable' and 'Suspect' outcomes and this approach had been used to examine large whale mortalities in the NW Atlantic in the context of management strategies designed to mitigate these impacts (Van der Hoop *et al.*, 2012). They found that trends in numbers (and location) of reports of vessel strikes and entanglements did not differ significantly before or after 2003, when a number of management mitigation initiatives were begun along the Atlantic coast of the USA.

Moore and Barco (2013) present a handbook for recognising, evaluating and documenting human interactions in stranded cetaceans and pinnipeds. The Committee **recognises** the value of standardising approaches to enable more consistent data collection which in turn can assist in obtaining information on the likely extent of causes of death and necessary priorities for mitigation. Details are provided in Annex J (item 6).

The above two papers describe complementary actions and criteria and represent important tools for stranding networks globally. While a full forensic necropsy is often very difficult this should nevertheless be the goal to aim for. The two papers provided a progression of data collection options, and the visual options in the handbook should be feasible almost anywhere. Data collected using these protocols are being archived with the ultimate intent of making some images available for consultations and training. The Committee **encourages** this work and broader use of the handbook.

Criteria for categorising reports of ships strikes as well as 108 ship strike reports in Alaskan waters between 1978-2011 are described in Neilson *et al.* (2012). In order to assess the reliability of these reports, which ranged from well documented with full necropsies to second hand reports with sparse documentation, the authors developed 'confidence criteria'. The Committee **welcomes** this report and noted that this information will provide valuable input into the IWC's ship strikes database.

The criteria developed in these papers have been used to develop the criteria and definitions in Annex J, Appendix 2. The Committee **recommends** that these be adopted for the IWC ship strike database.

7.2 Reporting to National Progress Reports

This matter is discussed under Item 3.2.

7.3 Entanglement of large whales

7.3.1 Estimation of rates of entanglement, risks of entanglement and mortality

SC/65a/HIM02 describes a recent incidental catch of a baleen whale in a long-line fishery off the Brazilian coast. The incident demonstrate the need for more investigation of such interactions in the Southwest Atlantic Ocean. A large long-line fleet operates out of ports along Brazil's southern coast in the path of migratory whales. The fleets are not monitored and they are unlikely to report whales entangled in their gear since, while it is forbidden to entangle a whale, there are regulations requiring that they are reported, but they are not effective. In September 2012, just south of this area, a meeting was held to develop an action plan to mitigate bycatch and entanglement in similar Argentine fisheries. It is hoped that a report of the action plan developed will be available at next year's meeting. The Committee **looks forward** to receiving a report of the plan.

7.3.2 Methods to estimate time-series of bycatches

This item was not discussed this year but will be considered next year in light of discussions in Annexes D1 and E for example.

7.3.3 Collaboration with FAO and FIRMS

The IWC is currently an observer to the FIRMS partnership (Fisheries Resources Management System). It had been hoped that FIRMS may hold data on fishing effort that could be useful in estimating bycatch but FIRMS appears to have changed its focus somewhat since initial discussions with the IWC. Leaper will follow up on any new developments intersessionally to see if there is progress to discuss next year.

7.3.4 Collaboration with Commission initiatives on entanglement, including consideration of mitigation measures

Much of the work of the Secretariat's technical advisor, Mattila, generously seconded by the USA since 2012, has been devoted to capacity building on the issue of large whale entanglement. The strategy has provided an overview for over 500 scientists and government managers from 20 countries, followed by detailed training and assistance with setting up entanglement response networks. Over the remainder of 2013, training is scheduled for Ecuador (with participants from the Permanent Commission for the South Pacific (CPPS) countries), Panama, and a joint IWC-UNEP-SPAW session for the French and English Caribbean. The Committee **commends** this work, noting that besides assisting countries to establish relatively safe entanglement response capabilities which have already released a number of individual whales, it has stimulated other local and national initiatives on the issue of entanglement, including actions intended to both understand and mitigate them. The Committee **reiterates** that prevention rather than disentanglement is the ultimate solution. It **encourages** members submit information and papers on prevention studies to next year's meeting.

7.4 Ship strikes

7.4.1 Progress on the global database

Last year, in response to a Committee recommendation (IWC, 2013f), Ritter and Panigada had been contracted jointly as co-ordinators for the ship strikes database. The primary objective was to raise awareness about the ship strike data base and to stimulate its use. Outreach activities have resulted in a large number of new data entries compared to previous years. Data from around 100 incidents have been entered in the last year and the data from around a further 200 incidents are expected to be incorporated during the rest of 2013. These data cover areas not previously covered including the Gulf of St. Lawrence (Canada) and Alaskan waters. Contact was also made with researchers and authorities in Sri Lanka. A total of 111 entries of collisions between sailing vessels and cetaceans are expected to be entered by the end of 2013. A new edition of the multi-lingual IWC ship strike leaflet, supported by Belgium, has been distributed to a range of stakeholders. A self-standing banner display has been developed and two copies were produced; one was displayed at the recent European Cetacean Society conference in Portugal.

The Committee **commends** this work, noting that a modest financial investment by the IWC has produced good results. It noted the value of the leaflet to highlight the issue and create an ongoing dialog on whale avoidance in the maritime industry – for example, Neilson *et al.* (2012) had recommended its wide distribution. The Committee **recommends** that this work continues and is funded (see Item 26). The Committee also **agrees** that the co-ordinators should give priority to populations identified for CMPs for proactive data gathering outreach efforts.

The Committee noted that Australia and the USA have ship strike databases and have worked to ensure that these are compatible with the IWC database, and that data fields can be accurately mapped between them to facilitate data exchange. The Committee **reiterates** previous recommendations that member nations should submit data to the IWC's global database as soon as possible.

7.4.2 Estimating rates of ship strikes, risk of ship strikes and mortality

SC/65a/HIM1 provided information from the Canary Islands. A large fleet of commercial ferries operates on a year-round basis in the area and ship strikes are a known problem. Different ferry types exhibit distinct noise spectra. Based on certain assumptions, especially on hearing thresholds, the authors concluded that whales may be capable of hearing approaching vessels at distances that should enable them to react fast enough to avoid a collision. However, numerous factors need to be considered in evaluating the actual collision risk. Jet-driven ferries travelling at high speed, combined with comparably low intensity bow-radiated noise, result in an especially high risk of collision. These results confirm the role of vessel speed and the need to reduce vessel speed so as to minimise the risk of collision.

SC/65a/HIM03 reported that two pygmy blue whales were struck and killed in Sri Lankan waters in early 2012. The southern coast of Sri Lanka is one of the busiest shipping routes in the world and overlaps with an area of high whale sightings. The reported deaths can only be considered minimum values. These deaths and the unknown population size highlight the urgent need for long-term monitoring of the blue whale population in Sri Lankan waters and elsewhere in the northern Indian Ocean.

Vaes and Druon (2013) presented a novel approach to consider the seasonal ship strike risk to fin whales in the Western Mediterranean Sea in that it used satellite-derived data (surface temperature & chlorophyll-a content) as a proxy for fin whale habitat in addition to using AIS data for vessel traffic. The Committee agreed that further comparisons using this approach with contemporary whale sighting data are required to assess its value.

Neilson *et al.* (2012) reported data on collisions in Alaska between 1978 and 2011; these have been made available to the IWC database as noted above. There were 108 reports classified as definite, probable or possible ship strikes, mostly from collisions witnessed at sea. It was noted that even in this relatively large data set there were only a few cases in which the circumstances of the collision and outcome could be related to the size, speed and type of the vessel involved. This highlights the need of the central global database which will increase the likelihood of obtaining a sample size sufficiently robust for meaningful analyses of factors related to risk.

7.4.3 Collaboration with the Commission's ship strikes working group including consideration of mitigation measures

An IWC-endorsed ship strike mitigation workshop was held in Tenerife in October, 2012 (Tejedor *et al.*, 2013). This was primarily aimed at management and mitigation. There was broad recognition and acceptance that currently the best way to avoid collisions with whales is to avoid areas of high density, but if this is not possible then ships should maintain a vigilant watch and slow down as appropriate. Several participants from the industry agreed that they would prefer to know of a whale 'hot spot' well in advance, and be able to plan their routes accordingly, rather than getting a message upon arrival in an area that they need to re-route.

The apparent willingness of key stakeholders at this workshop to investigate the feasibility and utility of voyage planning to avoid high density areas represents an opportunity for the Committee to play an important role in this effort. The Committee **agrees** that this is a productive way forward on this issue and **recommends** that the topic of defining and identifying critical whale 'hot spots' and engaging the shipping industry in the process should be an agenda item for the Commission's next ship strike workshop. The Committee recognised that the Tenerife workshop was primarily concerned with management and mitigation, and as such, **recommends** that the Commission's next ship strike workshop reviews the report in full, and considers endorsing it and seeking partnerships with stakeholders to carry out appropriate recommended actions.

Bryde's whales in the Hauraki Gulf, New Zealand were also discussed. The population is believed to be less than 200 individuals and there have been 16 confirmed ship strike mortalities between 1996 and 2013. A proposal for funding an aerial survey to provide an abundance estimate for Bryde's whales throughout their primary range in New Zealand and to use this and data on distribution to inform mitigation measures to reduce ship-strike mortality was received. This is discussed under Item 26 (funding).

7.5 Marine debris

7.5.1 Report of the intersessional workshop

A summary of the first IWC Marine Debris Workshop (SC/65a/Rep06), held from 13-17 May 2013 at Woods Hole Oceanographic Institution, was presented. The original objectives are outlined in IWC (2013h).

Thirty-eight participants presenting 8 countries attended the workshop. The first day of the workshop included a public seminar consisting of keynote presentations which illustrated the ways in which debris and cetaceans interact, including the long lingering deaths that can result from entanglement, and a growing realisation that ingestion of plastics, including microplastics, may be a significant problem. In 2012, 280 million tonnes of plastic were produced globally, less than half of which was consigned to landfill or recycled. If current rates of consumption continue, the planet will hold another 33 billion tonnes of plastic by 2050 (Rochman, 2013). The keynote presentations also highlighted the need for improved international cooperation.

The participants recognised the potential significant impacts that marine debris has on both cetacean habitat and cetaceans through both macrodebris (such as fishing gear, plastic bags and sheeting) entanglement and ingestion and through microplastics and their associated chemical exposures through ingestion or inhalation. The workshop encouraged debris sampling when conducting observational cetacean research at sea (i.e. water sampling and visual observations during cetacean sightings surveys) and recommended that industry partners be involved in marine debris prevention, research and response to ensure success in reducing marine debris impacts on cetaceans.

Finally, the workshop agreed that ingestion and inhalation of marine debris may sometimes be lethal, that sub-lethal impacts may also occur with long term negative consequences and that intake of debris is a problem, both as an individual welfare concern and potentially for some populations and species. Therefore more research was encouraged. The workshop recommended that the IWC Scientific Committee should evaluate the risks of ingestion and inhalation based upon (1) the spatial distribution of microplastics and macro debris and (2) the feeding strategies and location of feeding areas of cetaceans. It also recommended that the Scientific Committee prioritise studies of those cetaceans that are likely at greatest risk of ingesting or inhaling macro- and micro- debris and associated pollutants (Fossi *et al.*, 2012). The workshop thus recommended that the initial focus of research be on three species of Baleen Whale: the North Atlantic right whale, the fin whale in the Mediterranean Sea and the gray whale in the eastern North Pacific. The workshop noted that none of its recommendations required the lethal collection of cetaceans.

7.5.2 Committee discussion

A full discussion of the workshop report can be found in Annex K, Item 11.2. For a full list of scientific recommendations see SC/65a/Rep06. Information was also presented on the marine debris in the stomach contents of common minke, sei, Bryde's and sperm whales sampled by JARPN II (SC/65a/O3, O6, O7). No marine debris was observed in the stomachs of Antarctic minke whales (SC/65a/O9). After review of the workshop report and other papers, the Committee **endorses** the recommendations of the workshop (see SC65a/Rep06 for full details), including its recommended pathology protocol and **agrees** that:

(1) legacy and contemporary marine debris have the potential to be persistent, bioaccumulative and lethal to cetaceans and represent a global management challenge; and

(2) entanglement in and intake of active and derelict fishing gear and other marine debris have lethal and sub-lethal effects on cetaceans.

Therefore the Committee **strongly agrees** that marine debris and its contribution to entanglement, exposures including ingestion or inhalation, and associated impacts, including toxicity, are welfare and conservation issues for cetaceans on a global scale and a growing concern. The Committee **recommends** that the Commission and the Secretariat take prompt action to help better understand and address this growing problem, including:

(1) providing data on rates of marine debris interactions with cetaceans into the national progress reports and supporting the second marine debris workshop (which will have mitigation and management as its focus);
(2) strengthening capacity building in the IWC entanglement response curriculum and adding information on marine debris;
(3) building international partnerships with other relevant organisations and stakeholders including an effective transfer of information about on-going research and debris-reduction and removal programmes and the international and national marine debris communities;
(4) developing programmes to remove derelict gear and schemes to reduce the introduction of new debris; and
(5) incorporating consideration of marine debris into IWC conservation management plans were appropriate and consider making it the focus of a plan in its own right.

The Committee thanked the workshop convenor, the Woods Hole Oceanographic Institution for hosting the workshop and the tremendous work done by the workshop organisers and participants. The Committee also appreciates the funds provided by the various organisations in support of this workshop.

The Committee **agrees** to establish an intersessional group (see Annex R) to review and prioritise the research-related recommendations from the workshop. It was noted that this review should give consideration to: (1) the evaluation of the efficacy of fishing practices that pose a lower risk of entanglement or loss of gear, given that active and derelict fishing gear are a major cause of injury and mortality in cetaceans, and (2) further investigations into microplastics, their associated chemical pollutants and microbes, and macrodebris ingestion. Further work on microplastics has been taken up by the POLLUTION 2020 workplan (see Annex K, Appendix 2). The intersessional correspondence group will also liaise with the steering group for the second marine debris workshop.

7.6 Work plan

The Committee's views on the work plan developed by the Working Group are given in Item 24, and the financial implications in Item 26.

8. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT PROCEDURE (AWMP)

This item continues to be discussed as a result of Resolution 1994-4 of the Commission (IWC, 1995a). The report of the SWG on the development of an aboriginal whaling management procedure (AWMP) is given as Annex E. The Committee's deliberations, as reported below, are largely a summary of that Annex, and the interested reader is referred to it for a more detailed discussion. The primary issues at this year's meeting comprised: (1) finalising work on the PCFG (the Pacific Coast Feeding Group) of gray whales; (2) developing *SLAs* and providing management advice for Greenlandic hunts; and (3) reviewing management advice for the humpback whale fishery of St. Vincent and The Grenadines. Considerable progress on items (1) and (2) was made as a result of an intersessional workshop (SC/65a/Rep2).

8.1 Matters arising out of the *Implementation Review* for eastern North Pacific gray whales

8.1.1 SLAs for the potential Makah hunt
In 2010, the Committee agreed that PCFG (Pacific Coast Feeding Group) whales should be treated as a separate management unit. The Makah tribe would like to take gray whales in the Makah usual and accustomed fishing grounds (U&A) in the future and the objective of the *SLA*s tested during the *Implementation Review* process was to minimise the risk to the PCFG whales and meet the Commission's conservation objectives.

Last year, the Committee had agreed that two *SLA* variants met the conservation objectives of the Commission (IWC, 2013):

(*1) SLA* variant 1: struck-and-lost whales do not count towards the APL (the 'allowable PCFG limit' – a protection level) i.e. there is no management response to PCFG whales struck but not landed;

(2) SLA variant 2: all struck-and-lost whales count towards the APL irrespective of hunting month i.e. the number of whales counted towards the APL may exceed the actual number of PCFG whales struck.

SLA variant 2 was only acceptable if it was accompanied by a research programme (i.e. a photo-identification programme to monitor the relative probability of harvesting PCFG whales, the results of which are presented to the Scientific Committee for evaluation each year).

However, the Committee also noted that the two variants did not exactly mimic the proposed hunt and expressed concern that the actual conservation outcome of the proposed hunt had not been fully tested. The reason for this relates to how strikes in May are treated in *SLA* calculations. No hunting is allowed after May since that is when the proportion of PCFG whales to migrating whales is highest (PCFG whales are defined as those photographed in multiple years from 1 June to 30 November within the PCFG area).

After discussions at the intersessional workshop (SC/65a/Rep2), results were received for six new variants to cover the full range of possible strikes occurring in May or prior to May, i.e., variants allowing x strikes prior to May where $x = 1,\ldots,6$ (SC/65a/AWMP6). In summary, the performance of all the new variants was no worse than for Variant 1 and no better than for Variant 2.

In conclusion, the Committee **agrees** that the conservation performance of the proposed Makah whaling management plan has now been fully examined within the *SLA* evaluation framework. It **confirms** that the proposed management plan meets the conservation objectives of the Commission provided that if struck and lost animals are not proposed to be counted toward the APL, then a photo-identification research programme to monitor the relative probability of harvesting PCFG whales in the Makah U&A is undertaken each year and the results presented to the Scientific Committee for evaluation. In other words, only Variant 2 above meets the Commission's conservation objectives without the research requirement.

The Committee noted that the intersessional workshop (SC/65a/Rep2) had recommended that the Photo-ID catalogue for the Eastern North Pacific gray whales that will be used to assess whether landed whales are from the PCFG be made publicly available as it is a key component of the management approach. Weller reported that NOAA still has funds available to digitise the catalogue of PCFG whales. Scordino noted that work is underway to compile photographs from a few key contributors for a photo catalogue of PCFG whales to be held at NOAA's National Marine Mammal Laboratory; this catalogue, at least initially, will not be publicly available.

SC/65a/AWMP3 presented an update on the availability of PCFG whales in the Makah U&A based on photo-identification surveys. The results (1) supported the proposed prohibition of hunting in the Strait of Juan de Fuca; and (2) confirmed that the availability of PCFG gray whales in Pacific Ocean waters of the Makah U&A was not appreciably different to the 30% availability used in the 2012 *Implementation Review*. An updated paper next year will also include an examination of possible trends.

8.1.2 Potential for western gray whales to be taken during aboriginal hunts

Given the ongoing concern about status of the gray whales that summer in the Western North Pacific (WNP), in 2011 the Scientific Committee emphasised the need to estimate the probability of a western gray whale being killed during aboriginal gray whale hunts (IWC, 2012a). The Committee noted that the work described in SC/65a/AWMP3 above can assist in this work. This year, Moore and Weller (2013) updated the analysis of mortality risk to WNP whales from the proposed Makah hunt by incorporating Committee feedback last year (IWC, 2013c, p.20). Based on their preferred model, depending on assumptions, the probability of striking at least one WNP gray whale during a five-year period ranges from 0.036 to 0.170. The authors concluded that this represents a conservative initial step in assessing the potential risk.

The Committee welcomed this paper, recognising that it represents an initial approach. As detailed under item 2.2.2 of Annex F, it also received information on an ongoing telemetry study of PCFG whales and considered the report of a US scientific task force that assessed gray whale stock structure in the light of US domestic legislation.

The Committee **agrees** that all of this information will make a valuable contribution to the recommended rangewide workshop (Appendix 2, Annex F) described under Item 26.

Finally, in regard to questions on whether it should consider conducting an *Implementation Review* to evaluate the potential impacts of the Makah hunt on whales identified in the western North Pacific, the Committee **agrees** that ideally before an *Implementation Review* is conducted, the recommended rangewide workshop be held (see Item 26).

8.2 Guidelines for *SLA* development and evaluation

Considerable effort was put into general consideration of the development of *SLA*s at the beginning of the AWMP process (e.g.(International Whaling Commission, 2000; IWC, 2001b; 2001c; 2002b). This year, the Committee briefly outlined some guiding principles for *SLA*s to assist developers of candidate *SLA*s for the Greenland hunts. These are summarised below.

(1) The primary objective of any *SLA* is to meet the objectives set by the Commission with respect to need satisfaction and conservation performance, with priority given to the latter.
(2) *SLAs* must incorporate a feedback mechanism.
(3) Once need has been met for the 'high' need envelope while giving acceptable conservation performance, then there is no need to try to improve the performance of an *SLA* further.

(4) Simple *SLAs* are to be preferred, providing this simplicity does not compromise achieving the Commission's objectives.
(5) With respect to (d), empirical procedures may prove preferable to population model based procedures because (1) they are more easily understood by stakeholders and (2) there is little chance for significant updating of population model parameters (e.g. MSYR) over time as the extent of additional data will probably be limited for populations subject to aboriginal whaling only. Nevertheless, the choice of the form for any candidate *SLA* lies entirely in the hands of its developer, with selection amongst candidates to be based on performance in trials.
(6) If in developing *SLAs*, a situation arises where relatively simple *SLAs* fail on one or a few trials where the circumstances which might lead to the failure occur only many years in the future, rather than attempt to develop more complex *SLAs* to overcome this problem, a simpler *SLA* could be proposed despite this failure, and the difficulties dealt with by means of an *Implementation Review* should there be indications in the future that the circumstances concerned are arising. This principle applies only to: (1) circumstances in a scenario that are external and independent of the hunting/quota feedback loop, such as very high values of the future need envelope; and (2) are judged to be very unlikely to occur in the next few decades. Failure of an *SLA* to perform acceptably in some circumstance is not in itself a reason to apply this principle.

The Committee also reviewed and discussed the performance statistics, tables and plots that are required to evaluate conditioning and trial results. The discussion can be found under item 3.2.3 of Annex E. The Committee **endorses** this approach.

8.3 Progress on *SLA* development for the Greenlandic hunts

In Greenland, a multispecies hunt occurs and the expressed need for Greenland is for 670 tonnes of edible products from large whales for West Greenland; this involves catches of common minke, fin, humpback and bowhead whales. The flexibility among species is important to the hunters and satisfying subsistence need to the extent possible is an important component of management. For a number of reasons, primarily related to stock structure issues, development of *SLA*s for some Greenland aboriginal hunts (especially for common minke and fin whales) is more complex than previous *Implementations* for stocks subject to aboriginal subsistence whaling. The Committee has endorsed an interim safe approach to setting catch limits for the Greenland hunts in 2008 (IWC, 2009b), noting that this should be considered valid for two blocks i.e. the target will be for agreed and validated *SLA*s, at least by species, for the 2018 Annual Meeting.

8.3.1 Common minke whales and fin whales off West Greenland

The Committee's discussions were informed by the work of the intersessional workshop (SC/65A/Rep2) as well as those in Annex E. There is potential overlap between RMP and AWMP management with respect to common minke whales and fin whales in the North Atlantic. The process of developing *SLAs* and RMP *Implementations* for stocks in regions where both commercial and aboriginal catches occur should include the following steps: (a) development of a common trials structure which adequately captures uncertainties (regarding stock structure, mixing, MSYR, etc.); (b) identification of an *SLA* which performs as adequately as possible if there are no commercial catches; and (c) evaluation of the performance of RMP variants given the *SLA* selected at step (b).

With respect to common minke whales, the Workshop **reiterates its support** for a joint AWMP/RMP stock structure workshop which will be essential to the *SLA* development process and the simulation framework (see Annex D, Appendix 2).

With respect to fin whales, in addition to working closely with intersessional work being undertaken within an RMP context (see Annex D), the Committee also noted that it may be possible to base the *SLA* for fin whales off West Greenland on operating models which considered West Greenland only. This will be investigated further (including at the intersessional RMP workshop on fin whales) as it requires careful evaluation as to whether there may be more than one stock mixing off West Greenland.

In order to progress development work, the Committee last year funded a new computer program called RMP/AWMP-lite. It uses an age-aggregated rather than an age-structured model to considerably speed up calculations; this will allow developers more easily to explore the properties of candidate *SLA*s before they are submitted to rigorous full testing. It allows for multiple stocks of whales being exploited by a combination of commercial and aboriginal whaling operations. This was first reviewed at the intersessional workshop and SC/65a/RMP5 implements the improvements suggested there.

The current approach to evaluating *SLA*s for the Greenlandic hunts treats each species independently even though need is expressed as a total amount of edible products over multiple species. The Committee **reiterates** that work on single-species *SLA*s should be completed before multi-species considerations are examined.

8.3.2 Humpback whales

The Committee's discussions were informed by the work of the intersessional workshop (SC/65A/Rep2) as well as those in Annex E. Development of an *SLA* for humpback whales had been identified as one of the priorities for the workshop and considerable progress was made.

8.3.2.1 STOCK STRUCTURE AND MOVEMENTS

The Committee has already agreed that the West Greenland feeding aggregation was the appropriate management unit to consider when formulating management advice. Whales from this aggregation mix with individuals from other similar feeding aggregations on the breeding grounds in the West Indies, (IWC, 2008a, p.21).

In order to investigate whether West Greenland humpback whales are subject to mortality in other parts of the range then it is important to examine the available information from telemetry and photo-identification data. Considerable telemetry work has been undertaken off West Greenland (e.g. SC/D12/AWMP5) and similarly there has been extensive photo-identification work. This has been used to inform how ship strike and bycatch data will be incorporated into the trials. This work is ongoing and Greenlandic scientists will work with the College of the Atlantic to present a review of the photo-identification data in time for an intersessional workshop (see item 26).

8.3.2.2 ABUNDANCE

The Committee has relative abundance data available from aerial surveys (see S/65a/Rep 2 and Annex E, Appendix 2). It **agrees** to use the estimates of relative abundance from aerial surveys to condition the trials. The mark-recapture studies cover a shorter period and are heavily correlated so they will only be used in a *Robustness Trial*. However, given that mark-recapture abundance estimates may become common in the future for both humpback and bowhead whales, the Committee **agrees** that efforts should be made to develop ways to better integrate them into the operating models for the *SLA* trials.

With respect to absolute abundance, SC/65A/AWMP01 used information from 31 satellite-linked time-depth-recorders to address the question of availability bias for the 2007 aerial survey. Fully corrected abundance estimates of 4,090 (CV=0.50) for mark-recapture distance sampling analysis and 2,704 (CV=0.34) for a strip census abundance estimate were developed. The estimated annual rate of increase was 9.4% per year (SE 0.01) is unchanged from (Heide-Jørgensen *et al.*, 2012).

The Committee noted that the methods behind the new estimates had been discussed fully at previous meetings when considering the 2007 survey. The revised estimate was based on updated and improved information on the diving behaviour of whales from additional satellite tag data. It therefore **accepts** the new strip census abundance estimate as the best estimate. This information is also included in the trial specifications (see Annex E, Appendix 2).

8.3.2.3 REMOVALS

The Committee **agrees** that given past difficulties in modelling the full western North Atlantic (including allocation of past catches) and the decision to treat the feeding aggregation as the appropriate management unit, trials will begin in 1960 under an assumption that the age-structure in that year is steady. The direct catch series for this period is known (Annex E, Appendix 2). However, given possible migration routes (e.g. from telemetry data), it was noted that known direct catches occurred from whaling stations off the east coast of Canada after 1960 that may have included some 'West Greenland' animals. An approach to account for this has been developed. The Committee **agrees** that this will be incorporated into the catch series in the revised trial specifications, but that no future direct catches off Canada will be simulated.

In addition to direct catches, the question of bycatches in both West Greenland and of West Greenland animals elsewhere in their range needs investigation. For West Greenland, noting that the crab fishery which was primarily responsible for bycatches has now peaked, a conservative (from a conservation perspective) method for generating future bycatches has been developed. A similar method for accounting for bycatches outside West Greenland has been developed for bycatches and ship strikes. The Secretariat will work with Canadian scientists and others to investigate the available information on bycatches and ship strikes and develop a final removals table for consideration.

8.3.2.4 BIOLOGICAL PARAMETERS

Prior distributions need to be specified for three biological parameters: (a) non-calf survival rate, (b) age-at-maturity and (c) maximum pregnancy rate. The values for these parameters used in the actual trials will encompass a narrower range than these priors because the priors will be updated by the data on abundance and trends in abundance during the conditioning process. Considerable discussion of this took place at the intersessional workshop based on the range of estimates in the literature. The Committee **endorses** the priors shown in Annex E, Appendix 2. Recognising the considerable uncertainty, *Robustness Trials* have been developed to investigate the sensitivity to these priors.

8.3.2.5 NEED

Need envelopes are an important component of developing a trial structure and are the responsibility of the relevant Governments. They are used to allow for advice to be provided in the future on any increased need requests without having to conduct major *Implementation Reviews* or new *SLA* development. The need 'envelope' usually includes maintenance of the current limit, is bounded by a 'high need' case and then includes a middle option. A need envelope for humpback whales was submitted to the intersessional workshop by Greenland (SC/D12/AWMP4) and these reflected the Greenlandic preference for humpback whales over fin whales and Greenland's desire for flexibility and a 'backup' to account for any unforeseen decline in the common minke whale strike limits. The need envelope is summarised in Annex E.

8.3.2.6 SLAS TO BE CONSIDERED

All trials will be conducted for a bounding case and for two 'reference *SLA*s', in addition to any other *SLA*s which might be proposed by developers:

(1) the *Strike Limit* is set to the need;
(2) the *Strike Limit* is based on the interim *SLA* (IWC, 2009b); and
(3) the *Strike Limit* is based on a variant of the interim *SLA* which makes use of all of the estimates of abundance, but downweights them based on how recent they are.

Guiding principles for *SLA*s are discussed under Item 8.2 above.

Developers are provided with the following information: total need for the next block; catches by sex; mortalities due to bycatch in fisheries and ship strikes; and estimates of absolute abundance and their associated CVs.

8.3.2.7 TRIAL STRUCTURE

After considering the report of the intersessional workshop and the new information available at this meeting, the Committee agrees to the detailed trial specifications given in Annex E, Appendix 2. Some further discussion and parameterisation of one of the trials (that on asymmetric environmental stochasticity) is required and an intersessional steering group has been established to oversee this (Annex R). The factors considered in the trials are summarised in Table 2 while the trials themselves are given in Annex E, Appendix 2, Tables 5 and 6. The Committee **endorses** the trial specifications.

As noted under Item 8.2, the Committee also **endorses** the performance statistics, tables and plots proposed.

Table 2

Factors tested in the trials

<table>
<tr><th>Factors</th><th colspan="2">Levels (Reference levels shown underlined)</th></tr>
<tr><th></th><th>Humpback whales</th><th>Bowhead whales</th></tr>
<tr><td>$MSYR_{1+}$</td><td>1%, 3%, 5%, 7%</td><td>1%, 2.5%, 4%</td></tr>
<tr><td>$MSYL_{1+}$</td><td>0.6</td><td>0.6, 0.8</td></tr>
<tr><td>Time dependence in K *</td><td colspan="2">Constant,
Halve linearly over 100yr</td></tr>
<tr><td>Time dependence in natural mortality, M *</td><td colspan="2">Constant,
Double linearly over 100yr</td></tr>
<tr><td>Episodic events *</td><td colspan="2">None,
3 events occur between yrs 1-75 (with at least 2 in yrs 1-50) in which 20% of the animals die,
Events occur every 5 years in which 5% of the animals die</td></tr>
<tr><td>Need envelope</td><td>A: 10, 15, 20; 20 thereafter
B: 10, 15, 20; 20->40 over years 18-100
C: 10, 15, 20; 20->60 over years 18-100
D: 20, 25, 30; 30->50 over years 18-100</td><td>A: 2, 3, 5; 5 thereafter
B: 2, 3, 5; 5 -> 10 over years 18-100
C: 2, 3, 5; 5 -> 15 over years 18-100</td></tr>
<tr><td>Future Canadian catches</td><td>N/A</td><td>A: 5 constant over 100 years
B: 5-> 10 over 100 years
C: 5-> 15 over 100 years
D: 2.5 constant over 100 years?</td></tr>
<tr><td>Survey frequency</td><td colspan="2">5 yr, 10 yr, 15 yr</td></tr>
<tr><td>Historic survey bias</td><td>0.8, 1.0, 1.2</td><td>0.5, 1.0</td></tr>
<tr><td>First year of projection, τ</td><td>1960</td><td>1940</td></tr>
<tr><td>Alternative Priors</td><td>S_{1+} ~ U[0.9, 0.99]; f_{max} ~ U[0.4, 0.6];
a_m ~ U[5, 12]</td><td>N/A</td></tr>
<tr><td>Strategic surveys</td><td colspan="2">Extra survey if a survey estimate is half of the previous survey estimate</td></tr>
<tr><td>Asymmetric environmental stochasticity parameters</td><td colspan="2">To be finalised by an intersessional group</td></tr>
</table>

* Effects of these factors begin in year 2013 (i.e. at start of management). The adult survival rate is adjusted so that in catches were zero, then average population sizes in 250-500 years equals the carrying capacity. Note: for some biological parameters and levels of episodic events, it may not be possible to find an adult survival rate which satisfies this requirement.

8.3.3 Bowhead whales

8.3.3.1 STOCK STRUCTURE

The current working hypothesis in the Scientific Committee is a single Baffin Bay-Davis Strait stock of bowhead whales (see Annex E, fig. 2). However, pending the availability of some genetic analyses, the Scientific Committee had agreed that the possibility that there are in fact two different stocks present in the overall area, with the second located in the Foxe Basin-Hudson Strait region, cannot be ruled out (e.g. see IWC, 2009b).

Given that the objective is to develop an *SLA* for the Greenland hunt of bowhead whales, the Committee **agrees** to proceed first on a conservative basis that assumes that the absolute abundance of bowhead whales on the West Greenland wintering area is informed by abundance estimates from data for that region only (see below). Only if such an *SLA* proved unable to meet need would abundance estimate information and stock structure considerations from the wider area be taken into account.

8.3.3.2 ABUNDANCE

The absolute abundance estimates can be found in Annex E, table 3. It is not possible to combine the Foxe Basin-Hudson Bay 2003 survey with the 2002 Prince Regent Inlet survey to obtain an estimate for the entire Davis Strait-Baffin Bay-Foxe Basin area. The Committee therefore **agrees** to condition the operating model using data for Davis Strait-Baffin Bay stock only.

It is not known whether the 2002 survey in Prince Regent Inlet will be regularly conducted, although a new survey is anticipated, whereas it is known that regular surveys will be conducted off West Greenland. The Committee therefore **agrees** to conduct trials (a) in which the estimate for Prince Regent Inlet is treated as an estimate of absolute abundance and (b) in which the estimates from West Greenland are treated as estimates of absolute abundance.

With respect to relative estimates of abundance, the Committee **agrees** that they should be considered in a similar manner to those for humpback whales. Details can be found in Annex E, item 3.3.1.2. These estimates are also included in the trial specifications (Annex E, Appendix 2).

While the sex ratio of animals in West Greenland is ~80:20 in favour of females (Heide-Jørgensen *et al.*, 2010), it is expected that the sex ratio for the total population is 50:50 (based on historic catches over the whole region and present Canadian catches). The trials will assume that the proportion of males available to the surveys will be the observed average male/female ratio in the biopsy samples.

The Workshop **agrees** that the information provided to the *SLA* will be the results of surveys off West Greenland (relative indices if the operating model is conditioned to the estimate of abundance for Prince Regent Inlet and absolute if the operating model is conditioned to the estimate of abundance for West Greenland).

8.3.3.3 REMOVALS

For reasons similar to those agreed for humpback whales above, the Committee **agrees** that population projections should begin from a recent year (1940). This is earlier than for humpback whales because of the extended age-structure of the population. All post-1940 direct catches of bowhead whales by Canada and Denmark (Greenland) are at present assumed known and thus that there may be no need to consider an alternative catch series. The Secretariat will consult with Reeves on post-1940 Canadian catches.

The Secretariat is consulting with Canada with respect to the agreed allowance for the hunters, to determine whether it applies to landed whales only or includes strikes.

The Workshop agreed that four scenarios regarding future Canadian catches should be considered as detailed in Annex E, item 3.3.1.3 and included in the trial specifications. The sex-ratio for the West Greenland catches will be set to the sex ratio observed in the biopsy samples taken off West Greenland over the 2002-11 period while that for the Canadian catches will be set to the observed sex-ratio which is being confirmed by the Secretariat).

Known bycatches of bowhead whales in this stock's range and further information on bycatches or ship strikes that can be found by the Secretariat in consultation with Canadian scientists will be included in the revised trials specification. The Committee noted that if the number of ship strikes increases as the Northwest Passage opens up, this could trigger an *Implementation Review*.

8.3.3.4 BIOLOGICAL PARAMETERS

In the absence of information for this region, the Workshop agreed to use the priors for f_{max}, S_{1+}, and a_m used for the *Implementation* for the Bering-Chukchi-Beaufort Seas bowhead whales, noting that these incorporate considerable uncertainty for all three parameters.

8.3.3.5 NEED

SC/D12/AWMP3 presented by Greenland had proposed three scenarios, each of which involves an increase to the need from 2 to 5 at the start of the projection period followed by either (1) no increase of need, (2) a doubling and (3) a tripling of need in a linear fashion over the total time period. This is shown in Annex E.

8.3.3.6 TRIALS

After considering the report of the intersessional workshop and the new information available at this meeting, the Committee **agrees** to the detailed trial specifications given in Annex E, Appendix 2. As for the humpback whale case, some further discussion and parameterisation of one of the trials (that on asymmetric environmental stochasticity) is required and an intersessional steering group has been established to oversee this (Annex R). The factors considered in the trials are summarised in Table 2 while the trials themselves are given in Annex E, Appendix 2, Tables 5 and 6. The Committee **endorses** the trial specifications.

As noted under Item 8.2, the Committee also **endorses** the performance statistics, tables and plots proposed.

A number of the preliminary results considered under Item 8.3.4 illustrated that it would be difficult to meet conservation objectives satisfactorily when the need level was high, especially if Canadian catches (which are taken by a non-IWC member country) increase. The SWG discussed whether it would be advisable to reconsider how strike quotas and incidental removals (i.e., by Canadian hunters) are accounted for in the *SLA* computations. However, the Committee **agrees** to continue with the current framework but also **agrees** that this topic should be further considered at the next intersessional workshop.

8.3.4 Results of initial work on SLAs

The Committee welcomed papers SC/65a/AWMP2, 4 and 5 that produced initial exploratory results by to sets of developers based on the draft trial specifications developed at the intersessional workshop. It was noted that at this stage, each set of developers had developed their own approaches to choose amongst the *SLA* candidates which they had tested. The Committee noted that this was an acceptable approach for developer to take when investigating the performance of their initial *SLA*s before deciding to put 'official' candidates forward but re-iterated that final choices would need to be based on the full set of performance statistics agreed for the trials.

8.4 Scientific aspects of an aboriginal whaling scheme

In 2002, the Committee **strongly recommends** that the Commission adopt the Aboriginal Subsistence Whaling Scheme (IWC, 2003). This covers a number of practical issues such as survey intervals, carryover, and guidelines for surveys. The Committee has stated in the past that the AWS provisions constitute an important and necessary ing component of safe management under AWMP *SLA*s and it **reaffirms** this view as it has for the previous 11 years.

8.5 Greenland conversion factors

In 2009, the Commission appointed a small scientific working group (comprising several Committee members) to visit Greenland and compile a report on the conversion factors used by species to translate the Greenlandic need request which is provided in tonnes of edible products, to numbers of animals (Donovan *et al.*, 2010). At that time, the group provided conversion factors based upon the best available data, noting that given the low sample sizes, the values for species other than common minke whales should be considered provisional. The group also recommended that a focused attempt to collect new data on edible products taken from species other than common minke whales be undertaken, to allow a review of the interim factors; and that data on both 'curved' and 'standard' measurements are obtained during the coming season for all species taken. The group's report was **endorsed** by the Committee (IWC, 2011b, p.21).

Since then, the Committee has received progress reports but has commented that more detail and information is required. Last year, the Committee recommended (IWC, 2011b, p.21):

(1) the provision of a full scientific paper to the next annual meeting that details *inter alia* at least a full description of the field protocols and sampling strategy (taking into account previous suggestions by the Committee); analytical methods; and a presentation of the results thus far, including information on the sex and length of each of the animals for which weight data are available;

(2) the collection and provision of data on Recommendation No. 2 of Donovan *et al.* (2010) comparing standard versus curvilinear whale lengths. This should be done for all three species on as many whales as possible.

8.5.1 New information

SC/65a/AWMP07 reported on the collection of weights and length measures from fin, humpback and bowhead whales caught in West Greenland. To improve the data collection process, information meetings involving biologists, hunters, wildlife officers and hunting license coordinators were held in the larger towns in 2012, and an information folder was produced and distributed to the hunters. The data collection process was also combined with an existing research project on hunting samples in order to get a stronger involvement of biologists. When researchers participate in hunts they train the hunters in measuring the lengths (curved and standard) and they make sure that the meat is weighed.

Until now the reporting rate has been lower than expected, with the data obtained in 2012 being from only one fin whale and one humpback whale, and the total number of reports since 2009 being from 6 bowhead whales, 6 humpback whales and 3 fin whales. These data provide preliminary yield estimates for all edible products of 9,014 kg (SE:846) per humpback whale, of 6,967 kg (SE:2.468) per fin whale, and of 8,443 kg (SE:406) per bowhead whale. These numbers are all somewhat lower than the suggested yield in IWC/62/9, and this is especially pronounced for fin whales. Nevertheless, the obtained estimates for fin whales fall within the range of previous yield weight estimates for fin whales in West Greenland.

A major reason for the low reporting rate has been the almost complete absence of weighing equipment where the whalers could weigh the different products. To increase the reporting rate, the Greenland Institute of Natural Resources has now purchased and distributed weighing equipment that can be fitted to cranes in major towns for the hunters to use for weighing when landing a catch. It was also realised that the 'bin system' described in previous reports (e.g. IWC/64/ASW10) is more complicated than first anticipated because there is a large variation in the size of the bins used within the same hunt and between hunters. It is therefore now recommended that hunters weigh all edible products with the crane weight when they land the meat. This approach will be investigated further in 2013 and discussed with the hunters. Owing to the logistical difficulties involved with whale hunts in Greenland (which are widespread along the huge coastline and occur at unpredictable times during a long season) and the required change in the reporting system and subsequent need for training, it is likely that it will take several years to collect sufficient data on edible products.

8.5.2 Discussion
In response to questions, a number of clarifications were made. The original intention of weighing ten boxes had been so that an average weight per box could be developed to be multiplied by the total number of boxes to obtain an estimated total weight. However, with the efficient crane weights that are now in place in three cities, and with the finding that hunters may use different sized boxes even for the same whale, it has now been decided to weigh all boxes.

There were only five cases when scientists were able to be present at a humpback catch, and the low number illustrates the logistical difficulties in having scientists present at hunts. Witting did not have the precise details of this work or of the number of wildlife officers who may be able to assist in the work but will consult in Greenland. Efficient reporting requires not only training of hunters, but also the distribution of weighing equipment, so that hunters can report on their own.

In conclusion, the Committee **agrees** that the report was an advance on those previously received (and provided the first information on curvilinear lengths). However, it also **agrees** that it still did not provide sufficient information to fulfil the recommendations of last year. While aware of the logistical difficulties involved in obtaining these data, it **repeats its recommendations** of last year given in the second paragraph of this section. It **encourages** Witting to assist in the writing of such a report to ensure that it better meets the request of the SWG next year.

9. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT ADVICE

9.1 Eastern Canada and West Greenland bowhead whales

9.1.1 New information
No new information was presented.

9.1.2 New catch information
No bowhead whales were taken off West Greenland in 2012. Official catch data have not yet been received from the Canadian Government for 2012. The Secretariat reported that it is in contact with the Canadian authorities who have acknowledged but not yet sent the catch data. The Committee also **encourages** the Government of Canada to continue research on Eastern Canadian bowheads.

9.1.3 Management advice
Using the interim safe approach endorsed by the Commission (IWC, 2009b, p.16), the Committee **agrees** that the current annual limit of 2 strikes for Greenland will not harm the stock. It was also aware that catches from the same stock have been taken by a non-member nation, Canada. Should Canadian catches continue at a similar level as in recent years, this would not change the Committee's advice with respect to the strike limits agreed for West Greenland.

9.2 Eastern North Pacific gray whales

9.2.1 New Information
SC/65a/BRG02 presented new estimates of abundance for eastern North Pacific gray whales. Shore-based counts of southbound migrating whales off California have formed the basis of abundance estimation since 1967. A new observation approach has been used and evaluated in four recently monitored migrations (2006/7, 2007/8, 2009/10 and 2010/11). The summed estimates of migration abundance ranged from 17,820 (95% HPDI = 16,150-19,920) in 2007/8 to 21,210 (95% HPDI = 19,420-23,230) in 2009/10, consistent with previous estimates and indicative of a stable population size.

The Committee **welcomes and accepts** the new population estimates.

SC/65a/BRG05 reported on photographic identification research in Laguna San Ignacio, Laguna Ojo de Liebre and Bahia Magdalena, Mexico, during the 2012 and 2013 winters. These results demonstrate a greater amount of movement between different breeding and calving lagoons for female-calf pairs than for single adult whales.

SC/65a/BRG05 summarised the results of a standard boat census of gray whales in Laguna San Ignacio and Laguna Ojo de Liebre during the winters from 2007 to 2013. In Laguna San Ignacio, counts of female-calf pairs increased during January and February to their highest numbers in March and April. During the 2011 to 2013 winters the average number of pairs was 108 and numbers remained high in the lagoon in April; by contrast, this number was only 40 pairs during the 2007 to 2010 winters and they were no pairs in April. In Laguna Ojo de Liebre in 2013 numbers of adults increased from January to February and declined to mid-April. Single animals only use the lagoon for 3-5 days. Females with calves use lagoons for up to 18 days. In one season with the highest counts, there was an estimated total of approximately 2,500 whales that used Laguna San Ignacio.

The Committee thanked Urban and his colleagues for the interesting results from the studies in the breeding lagoons and **encourages** the continuation of those studies that will contribute greatly to the proposed intersessional rangewide gray whale workshop (see Items 23 and 26).

SC/65a/BRG21 presented information on the body condition of gray whales in northwestern Washington, USA, from 2004-2010 to examine whether this can provide insights into the variability of gray whale fidelity to the region. Of particular interest was a comparison with similar studies for the animals feeding off Sakhalin Island (Bradford *et al.*, 2012) that suggested that body condition in north western Washington is generally not as good as at Sakhalin. The reasons for this are not clear.

SC/65a/BRG28 presented information on harvested gray whales in 2012. In June and September 2012, scientists examined 23 gray whales caught near Mechigmensky Bay. Females averaged about 10m in length. Animals between 7.7m and 9.5m were sub-adults. Yearlings had the highest body condition index (blubber thickness/body length) and immature animals had the lowest; some 67% of the examined animals had complete or half-full stomachs. There were no “stinky” gray whales in Mechigmensky Bay. An immature, 7.7m female had traces of milk in an almost empty stomach. The hunters did not see a large whale escorting this small one and believed it was feeding independently. In discussion it was noted that milk might remain in the stomach for several hours or a little more.

SC/65a/BRG29 reported on the stomach contents of 82 gray whales taken in Mechigmensky Bay (63 from Lorino) from 2007-2009; amphipods and polychaetes predominated by biomass and frequency of occurrence. Information was also presented on coastal counts.

The Committee thanked the authors for this interesting and important work examining harvested gray whales. It encouraged work on photo-identification of harvested whales which is now beginning.

9.2.2 Catch information

SC/65a/BRG24 and 25 presented catch data for gray and bowhead whales in Russia. The quota is expressed in terms of landed animals not strikes and the 2007-12 block quota was for 620 gray whales (maximum 140 in any one year). A total of 143 gray whales were struck in 2012 of which 139 were landed (50 males and 89 females); eight were inedible (‘stinky’ whales). Body length and weight data were presented. In general some 10% of the whales are stinky. While stinky whales can sometimes be detected at sea and avoided, sometimes the whale has to be butchered before it is found to be stinky. For the period 2008-2012, 638 gray whales were struck, 11 were lost and 627 whales were landed of which 24 were inedible i.e. 603 edible whales were landed. Ilyashenko stated that stinky whales were not counted against the quota by the Russian authorities, since they do not meet the food needs of the indigenous people.

The Committee noted that the total number of gray whales struck during the 2008-2012 period was 638 animals of which 24 of the 627 whales landed were inedible ('stinky') whales. The Commission expressed its limits for the 2008-2012 period in terms of whales taken (620). While matters related to struck, landed and 'stinky' whales are matters for the Commission, the Committee noted that from an *SLA* perspective, all struck whales are considered removals.

9.2.3 Management advice

As was the case last year, the Committee **agrees** that the *Gray Whale SLA* remains the appropriate tool to provide management advice for eastern North Pacific gray whales taken off Chukotka; the question of the Makah hunt and whales from the Pacific Coast Feeding Group is considered under Item 8.1. The Commission adopted catch limits for a six-year block in 2012 i.e. 2013-2018. The total number of gray whales taken shall not exceed 744 with a maximum in any one year of 140. The Committee **agrees** that these limits will not harm the stock.

9.3 Bering-Chukchi-Beaufort Seas Bowhead whale (BRG)

9.3.1 New information

Three papers (SC/65/BRG11; BRG9 and BRG1) presented the improvements in field methods, the details of the acoustic and visual field observations and the new estimation method that underlie a new abundance estimate of this bowhead stock for 2011. The 2011 survey was among the most successful. The details are discussed fully in Annex F, item 2.1 and only a short summary is provided here.

SC/65/BRG11 presented an overview of the spring 2011 bowhead whale abundance survey conducted near Point Barrow Alaska. The 2011 survey was unique in that it included multiple simultaneous data collection efforts, these included: ice-based visual observations, an independent observer (IO) survey (to estimate detection probabilities), acoustic surveillance and an aerial photo identification survey. A total of 3,379 new whales *was* seen from the primary perch. This is close to the record (3,383 in 1993); however in that year it was estimated that 93% of the whales passed within view of the perch in contrast to 58% in 2011. Information was also provided on extensive photo-identification effort (aerial) and acoustic work.

SC/65a/BRG09 reported much higher levels of bowhead acoustic activity in comparison to recording efforts in past seasons that included high rates of singing and call sequences. The mean rate of acoustically located events in 2011 (calls/hr) was some 5.7 times higher than in 1993. Viewing conditions were similar to past surveys including substantial periods of watch missed due to poor visibility and closed leads. Telemetry and acoustic data suggest several hundred whales passed without the possibility of being seen.

SC/65a/BRG01 presented a new estimate of the total abundance for this population. The estimate is based on two large datasets: visual sightings and acoustic locations from spring 2011. A Horvitz-Thompson type estimator was used, based on the numbers of whales counted at ice-based visual observation stations. It divided sightings counts by three correction factors: (1) for detectability (and see Givens *et al.*, 2012; discussed by the Committee last year); (2) for whale availability using the acoustic location data (2013; SC/65a/BRG09); and (3) for missed visual watch effort. The mean correction factors are estimated to be 0.501 (detection), 0.619 (availability) and 0.520 (effort). The resulting 2011 abundance estimate is 16,892 with a 95% confidence interval of (15,704, 18,928). The annual increase rate is estimated to be 3.7% with a 95% confidence interval of (2.8%, 4.7%). These abundance and trend estimates are consistent with previous findings.

The Committee thanked the authors, recognising the substantial field and analytical work that underlies the new abundance estimate. Discussion of the analytical approach can be found in Annex G, item 2.1. In conclusion, the Committee **accepts** this estimate and **endorses** it for use with the *Bowhead SLA*. It further notes that under the guidelines outlined in the proposed Aboriginal Whaling Management Scheme (see item 8.4), which has not been agreed by the Commission, a new survey would be required by 2021.

In discussion, it was noted that ice-based surveys depend very much on the availability of suitable ice conditions. The ice conditions may change within and between years and may become more difficult in the light of the climate changes observed in the Arctic. Aerial photographic surveys, which also were conducted during 2011, can form the basis of an independent mark recapture estimate of abundance (Koski *et al.*, 2010) although their precision is less than ice-based surveys.

SC/65a/BRG22 presented a study of DNA sequence variation for X- and Y-chromosome linked genes (USP9X and USP9Y) in bowhead whales using two methods to discover variable sites. The authors noted that with the PCR and sequencing primers reported, the X and Y chromosomes could be used to assess population variation in bowheads and other great whales to provide new perspectives on genetic issues such as stock structure, male reproductive success, gene flow, and evolution. In the discussion it was noted that bowhead whales have a relatively low level of variation in the Y chromosome due to skewness in male reproductive success. Population studies are underway.

9.3.2 New catch information

SC/65a/ BRG19 provides harvest data for the Alaska hunt. In 2012, 69 bowhead whales were struck resulting in 55 animals landed. Total landed of the hunt for 2012 was higher than the past 10 years (2002-2011: mean of landed = 38.9; SD = 7.1) but similar for efficiency (# landed / # struck; mean of efficiency = 77%; SD = 0.07). Of the landed whales, 29 were females, 24 were males, and sex was not determined for two animals. Based on total length, six of the 29 females were presumed mature (>13.4m in length). All five of the mature females that were examined were pregnant.

SC/65a/BRG25 reported the results of the Russian aboriginal whaling in the Chukota region for the period of 2008-2012: 4 bowhead whales were struck and landed out of a possible quota of 25 animals for that period. No bowhead whales were reported as struck and lost.

9.3.3 Management advice

The Committee **endorses** the abundance estimate of 16,892 (95% CI: 15,704 -18,928) for spring 2011. It was noted that next survey should be completed by 2021 based on the provisional guidelines in the Aboriginal Whaling Scheme (see Item 8.4).

The Committee **agrees** that the *Bowhead SLA* continues to be the most appropriate way for the Committee to provide management advice for this population of bowhead whales. The Commission adopted catch limits for a six-year block in 2012 i.e. 2013-2018. The total number of strikes shall not exceed 336 with a maximum of 67 in any one year (with a carryover provision). The Committee **agrees** that these limits will not harm the stock.

9.4 Common minke whale stocks off Greenland (AWMP)

The Committee noted that the Commission had not reached agreement on strike limits for Greenland at the 2012 Annual Meeting (IWC, 2013a). It based its management advice on the same limits considered last year. In providing this advice it noted that the Commission has endorsed the interim safe approach (based on the lower 5th percentile for the most recent estimate of abundance) for providing advice for the Greenland hunts developed by the Committee in 2008 (IWC, 2009b, p.16); it was agreed that that this should be considered valid for two blocks i.e. up to the 2018 Annual Meeting. This applies to all of the Greenland hunts below (Items 9.4-9.6).

9.4.1 West Greenland

NEW INFORMATION

In the 2012 season, 144 minke whales were landed in West Greenland and 4 were struck and lost. Of the landed whales, there were 109 females, 33 males and 2 of unknown sex. Genetic samples were obtained from 112 of these whales. Last year, the Committee re-emphasised the importance of collecting genetic samples from these whales, particularly in the light of the proposed joint AWMP/RMP workshop (see Annex D). The Committee **welcomes** the fact that nearly 80% of the catch had been sample in 2012 and **encourages** continued sample collection.

This year, the Committee adopted a revised estimate of abundance for the 2007 survey. The revised published estimate (16,100 CV=0.43) was slightly lower than that first agreed in 2009. The Committee noted that this estimate is an underestimate of the total population by an unknown amount.

MANAGEMENT ADVICE

In 2009, the Committee was for the first time able to provide management advice for this stock. This year, using the agreed interim approach and the revised estimate of abundance given under Item 9.4.1, the Committee **advises** that an annual strike limit of 164 will not harm the stock. It **draws attention** to the fact that this is 14 whales fewer than its advice of last year due to the revised 2007 abundance estimate.

9.4.2 East Greenland

NEW INFORMATION (INCL. CATCH DATA AND AGREES ABUNDANCE ESTIMATES)

Four common minke whales were struck (and landed) off East Greenland in 2012. Two were females and the sex of the other two was unknown. The Committee was **pleased** to note that genetic samples were obtained from all of minke whales caught in East Greenland (these could be used *inter alia* to determine the sex of the unknown animals). The Committee **again emphasises** the importance of collecting genetic samples from these whales, particularly in the light of the proposed joint AWMP/RMP workshop (see Annex D).

MANAGEMENT ADVICE

Catches of minke whales off East Greenland are believed to come from the large Central stock of minke whales. The most recent strike limit of 12 represents a very small proportion of the Central Stock – see Table 3. The Committee **repeats** its advice of last year that the strike limit of 12 will not harm the stock.

Table 3

Most recent estimates of abundance for the Central stock of common minke whales

Small Area(s)	Year(s)	Abundance and CV
CM	2005	26,739 (CV=0.39)
CIC	2007	10,680 (CV=0.29)
CG	2007	1,048 (CV=0.60)
CIP	2007	1,350 (CV=0.38)

9.5 Fin whales off West Greenland (AWMP)

9.5.1 New information

A total of four fin whales (all females) were landed, and one was struck and lost, off West Greenland during 2012. The Committee was **pleased** to note that genetic samples were obtained from three whales. It **re-emphasises** the importance of collecting genetic samples from these whales, particularly in the light of the proposed work to develop a long-term *SLA* for this stock.

9.5.2 Management advice

Based on the agreed 2007 estimate of abundance for fin whales (4,500 95%CI 1,900-10,100), and using the agreed interim approach, the Committee **repeats** its advice that an annual strike limit of 19 whales will not harm the stock.

9.6 Humpback whales off West Greenland

9.6.1 New information

A total of seven (two males; four females; one unknown sex) humpback whales were landed (three more were struck and lost) in West Greenland during 2012. The Committee was **pleased** to learn that genetic samples were obtained from all of these whales and that Greenland was contributing fluke photographs to the North Atlantic catalogue – four have been submitted from whales taken since 2010. The Committee again **emphasises** the importance of collecting genetic samples and photographs of the flukes from these whales, particularly with respect to the YoNAH and MoNAH initiatives (Clapham, 2003; YoNAH, 2001).

This year, the Committee **accepts** the revised fully corrected abundance estimate for West Greenland from the 2007 survey of 2,704 (CV=0.34) for the strip census abundance estimate (see Item 8.3 above). The agreed annual rate of increase of 0.0917 (SE 0.0124) remains unchanged.

9.6.2 Management advice
Based on the revised agreed estimate of abundance for humpback whales given above and using the agreed interim approach, the Committee **agrees** that an annual strike limit of 10 whales will not harm the stock.

9.7 Humpback whales off St. Vincent and The Grenadines

9.7.1 New information
No new information or catch data were provided in time for consideration by the Committee although information has been requested by the Secretariat. There is one sample collected from a humpback whale taken on 11 April 2012 in the SWFSC tissue archive. The Committee **welcomes** this information.

Iñíguez reported information obtained from local newspapers on hunts on St Vincent and the Grenadines: a 35 foot male (8 March 2013); a 41 foot female and a 35 foot male (both 18 March 2013); and another whale with no length or sex information (12 April 2013).

Regarding the same stock, he referred to reports that residents of Petite Martinique, Grenada, spent hours attempting to drive a mature whale onto a beach using five inflatable boats, two large trader boats and a speedboat on 22 November 2012. The whale finally escaped but was harpooned four times. He has no further information on the fate of this whale.

9.7.2 Management advice
The Committee repeated its previous strong recommendations that St. Vincent and the Grenadines

(1) provide catch data, including the length of harvested animals, to the Scientific Committee; and
(2) that genetic samples be obtained for any harvested animals as well as fluke photographs, and that this information be submitted to appropriate catalogues and collections.

The Committee has agreed that the animals found off St. Vincent and the Grenadines are part of the large West Indies breeding population (abundance estimate 11,570 95%CI 10,290-13,390). The Commission adopted a total block catch limit of 24 for the period 2013-2018 for Bequians of St. Vincent and The Grenadines. The Committee **repeats** its advice that this block catch limit will not harm the stock.

The Committee **draws the Commission's attention** to the unofficial reports of attempts to land a humpback whale in Grenada; the Schedule specifies that the quota applies only to Bequians of St. Vincent and The Grenadines. It requests that the Secretariat contacts the Government of Grenada to obtain official information on this incident.

10. WHALE STOCKS

10.1 Antarctic minke whales
The Committee is undertaking an in-depth assessment of the Antarctic minke whale. Details of the discussions summarised below can be found in Annex G. The primary abundance data are those collected from the 1978/79 to 2003/04 IWC-IDCR/SOWER cruises (e.g. Matsuoka *et al.*, 2003) that had been divided into three circumpolar series (CPI, CPII and CPIII). Two methods for estimating abundance from CPII and CPIII have been developed in recent years. Last year, the Committee formally agreed abundance estimates (IWC, 2013c). These were developed by basing the estimates on one method (the OK model, Okamura and Kitakado, 2012) and applying adjustment factors based on analyses from the other method (the SPLINTR model, e.g. Bravington and Hedley, 2012).

While the agreed estimates were suggestive of a decline in abundance between CPII and CPIII, the decline was not statistically significant either at a circumpolar level or at a *Management Area* level, given the inferred amount of annual variability in distribution (see Item 10.1.2). The Committee has been working for some time on explaining variability in abundance of Antarctic minke whales, both by the development of population dynamics models (Item 10.1.3) and by examining possible changes in environmental conditions during the period of the CPII and CPIII surveys (Item 10.1.2). Regarding the latter, the Committee has been investigating possible ways to estimate abundance of Antarctic minke whales within the unsurveyed pack ice region (since the IWC-IDCR/SOWER cruises were only able to survey in open water), and to discover the extent to which changes in sea ice concentration and many other environmental processes may have been affecting the open water abundance estimates.

10.1.1 Consideration of technical aspects of the agreed abundance estimates for CPII and CPIII
No further developments were presented to the Committee this year, although the items identified last year (IWC, 2013c) remain pertinent. The model refinements required will be assisted by the recent work described in SC/65a/IA15, in which a new IWC simulated data scenario is developed based on empirical data from Antarctic minke whale video dive time experiments conducted on the 2004/05 IWC SOWER cruise.

The Committee welcomed the new datasets, recognising that it was unlikely that improved methods would be available next year, but that further progress was expected by the meeting after. The results of this exercise (improved simulated datasets and estimation methods) should be of value not only to this species but also to many abundance estimation tasks faced by the Committee.

The estimates agreed last year were presented as two sets of numbers with two sets of CVs; Annex G, item 2.2.2, clarifies the reasons why the estimates were presented this way, and what the limitations are when interpreting these numbers.

In summary and also to provide clarity on what can be said at this stage in relation to trends, the Committee noted the following issues:

(1) At the scale of the circumpolar surveys, there is no statistically significant difference between the two population estimates. This of course does not mean that the number of Antarctic minke whales did not change at all. Rather, the uncertainty around the two estimates is sufficiently large that it is not possible to conclude with confidence whether the abundance increased, decreased, or remained about the same.

(2) The same is true at the scale of the six IWC Management Areas; there are no statistically significant trends detected.

(3) Nevertheless, the point estimate of change at a circumpolar level is quite large, and the same is true for some of the Management Areas. While not significant statistically, the differences are suggestive that some real changes in abundance may have occurred, particularly in areas near the large embayments of the Ross and Weddell Seas. The Committee is continuing to investigate issues of habitat utilisation and movement patterns of Antarctic minke whales which may further inform its understanding and ability to interpret these survey results (see Item 10.1.2).

10.1.2 Continue to examine reasons for the difference between abundance estimates from CPII and CPIII

10.1.2.1 AERIAL SURVEYS

The Committee has for some years been working towards explaining a putative decline in Antarctic minke whale abundance between CPII and CPIII. Aside from the statistical catch-at-age modelling work described in Item 10.1.3, a particular focus has been on investigating possible changes in the relative proportions of whales within the pack ice, since such regions were inaccessible to the IDCR/SOWER vessels. Papers describing Australian surveys using fixed-wing aircraft (Kelly *et al. 2011[SC/63/IA3]*.2012*[SC/64/IA10]*) and German surveys from a vessel-based helicopter (Willliams *et al. 2011 [SC/63/IA14]*) have been considered by the Committee at previous meetings, and although no new work on these surveys was presented at SC65a, further analyses are expected to be received next year.

10.1.2.2 NEW MODELLING WORK

Without further information from direct observations, the Committee is restricted to analyses based on extrapolations of sightings in open water areas to within-ice regions for investigating the relative proportions of whales that may have been within the ice regions during the CPII and CPIII period. SC/65a/IA11 presented one such approach for doing so, using models which assumed a relationship between whale abundance and ice concentration. It also examined causal relationships between Antarctic minke and humpback whale distribution; the Committee considered that this approach was more promising for open water areas than within pack ice regions where humpback whales do not enter.

10.1.2.3 NEW INFORMATION

SC/65a/IA12 described a study of Antarctic minke whales in their sea ice habitat during the austral summer of 2012-2013, in two regions of the Antarctic: the Ross Sea and the Western Antarctic Peninsula. In less than a month of field work (of which only a portion was dedicated to Antarctic minke whale research), the researchers deployed 16 satellite-linked data recorders and 2 short-term archival data recorders; they also collected biopsy samples and took a large number of photo-identification images of well-marked individuals.

In discussion of SC/65a/IA12, the Committee congratulated the authors on their achievement: this is the first time that reliable tag deployment has been achieved on this species. For investigation of differences in abundance estimates between CPII and CPIII, the Committee noted that the diving data collected from one type of tag deployed is also directly relevant to the interpretation of aerial survey estimates of abundance in different sea-ice conditions. The Committee **recommends** that this work should continue (and see Item 26).

There was considerable discussion (see Annex G, item 2.3) about *inter alia*: the particular conditions, location and group size and behaviour needed for successful tag deployment or biopsy sampling; the utility of photo-identification for abundance estimation; the feeding behaviour inferred from the telemetry result; and the relative merits and demerits of lethal and non-lethal sampling for in-depth assessment of Antarctic minke whales.

10.1.2.4 DID MINKE WHALE ABUNDANCE DIFFER BETWEEN CPII AND CPIII?

The Committee noted the apparent contradiction in retaining this item on its agenda when the difference in point estimates of abundance are not statistically significant at the usual 5% level (item 10.1.1; see also Annex G, Item 2.4). There is some evidence of differences (for example as seen consistently from the integrated statistical catch-at-age (SCAA) modelling – see Item 10.1.3 below), but the wide uncertainty around the estimates cannot exclude the possibility that overall abundance has not changed between CPII and CPIII. The Committee **agrees** to rename this item as: 'What are the factors that drive minke whale distribution and abundance?'

10.1.3 Apply statistical catch-at-age models

Population dynamics modelling provides a way to explore possible changes in abundance and demographic parameters within Areas IIIE-VW, where appropriate data are available. The inputs are catch, length, age, and sex data from the commercial harvests and both JARPA and JARPA II programmes, as well as abundance estimates from IDCR/SOWER. For over a decade, the Committee has been developing population dynamics models of Antarctic minke whales, and following early attempts using an ADAPT-VPA approach (e.g. Butterworth *et al.*, 2002), the Committee concluded that SCAA modelling was the most appropriate framework, since *inter alia*, the latter approach is able to incorporate variability in age-reading (and consequent errors in age-at-length). Following the abundance estimates agreed from IDCR/SOWER last year, this year it has been possible for the first time to study the performance of the models using a fairly complete set of agreed inputs.

SC/65a/IA04 presented an updated statistical method for quantifying age-reading error, i.e. the extent of bias and inter-reader variability among age-readers. The method was applied to data for Antarctic minke whales taken during Japanese commercial (1971/72-1986/87) and scientific (1987/88-2004/05) whaling.

The methodology and conclusions of SC/65a/IA04 were based on a careful experimental study to compare readers (see Annex G, item 2.1). To estimate the bias and variance, the method needs to assume that at least one of the readers produces age estimates which are either unbiased or have a known degree of bias, and that ageing errors between readers but on the same earplug are independent. These assumptions are unavoidable for any analysis of ageing error where no absolute ground-truth is available, and the Committee **agrees** that the approach and results of SC/65a/IA04 provide useable input data for the SCAA analysis in SC/65a/IA01.

SC/65/IA01 reported on the most recent application of SCAA to data for Antarctic minke whales, thus incorporating the agreed IDCR/SOWER abundance estimates and the age-at-length data for recent years of JARPA II, neither of which had been available when results from these models have been presented previously to the Committee. This work has been directed by the Committee and funded through the Committee's budget. The SCAA approach allows for multiple breeding stocks, which can be allowed to mix across several spatial strata on the summer feeding grounds where catches are taken. It also allows carrying capacity and the annual deviations in juvenile survival to vary over time. Most analyses indicated that Antarctic minke whale abundance in Antarctic Areas III-E to VI-W increased from 1930 until the mid-1970s and declined thereafter, with the extent of the decline greater for minke whales in Antarctic Areas III-E to V-W than for those further eastward.

In discussion of SC/65/IA01, the Committee noted that the modifications to the SCAA model suggested last year – plus the addition of the new data – had now produced largely acceptable fits (see also table 1 of Annex G, page 2. The SCAA has received extensive scrutiny and improvement over the years of its development (far more than is usual for similar fishery assessment models used in management), and appears to have stood up well. Nonetheless, some issues do remain; detailed technical suggestions to investigate these are given in the meeting Annex G, item 8. The Committee considered the interpretation of the current results in SC/65/IA01 (plus additional runs of the model made during the meeting), bearing in mind also the numerous sensitivity analyses and alternative formulations explored in previous years. Overall, some conclusions appear to be quite robustly supported, while others are more sensitive to details of model formulation or data selection. Resolution of the issues identified will allow more confident interpretation of the results next year.

10.1.4 Work plan

The Work Plan for the in-depth assessment of Antarctic minke whales is described in section 8 of Annex G and will be furthered by two intersessional Working groups – one on SCAA issues for further investigation, and one on remaining IDCR/SOWER data management. The Committee's views on the work plan for the sub-committee on in-depth assessments is given under Item 24.

10.2 Southern Hemisphere humpback whales

The report of the IWC Scientific Committee on the assessment of Southern Hemisphere humpback whales is given in Annex H. The Committee currently recognises seven humpback whale breeding stocks (BS) in the Southern Hemisphere (labelled A to G; (IWC, 1998b)), which are connected to feeding grounds in the Antarctic. An additional population that does not migrate to high latitudes is found in the Arabian Sea. Assessments of BSA (western South Atlantic), BSD (eastern Indian Ocean) and BSG (eastern South Pacific) were completed in 2006 (IWC, 2007), although it was concluded that BSD might need to be re-assessed with BSE and BSF in light of mixing on the feeding grounds. An assessment for BSC (western Indian Ocean) was completed in 2009 (IWC, 2010d) and for BSB in 2011 (IWC, 2012c).

10.2.1 Assessment of Breeding stocks D, E and F

In 2011, the Committee initiated the re-assessment of BSD, and the assessment of BSE and BSF. As shown in Fig. 3, these stocks correspond, respectively, to humpback whales wintering off Western Australia (BSD), Eastern Australia (sub-stock BSE1) and the western Pacific Islands in Oceania including New Caledonia (sub-stock BSE2), Tonga (sub-stock BSE3) and French Polynesia (sub-stock BSF2). For simplicity, the combination of BSE2, BSE3 and BSF2 will be referred to as Oceania.

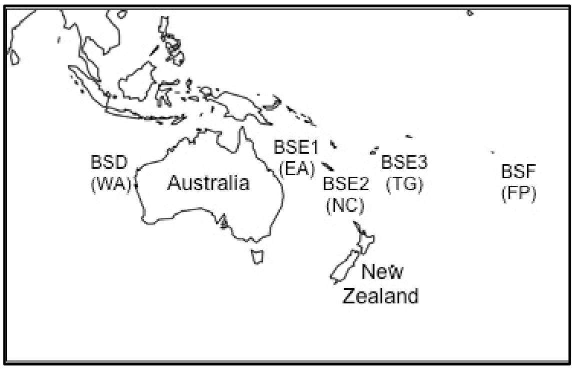

Fig. 3. Distribution of Southern Hemisphere humpback whales breeding stocks grounds BSD, BSE1, BSE2, BSE3 and BSF2. Note the following abbreviations: WA = Western Australia, EA = Eastern Australia, NC = New Caledonia, TG = Tonga and FP = French Polynesia.

10.2.1.1 NEW INFORMATION

SC/65a/SH13 presented the results of an updated analysis recommended last year by the Committee (IWC, 2013e p. 217). It analysed mixing proportions of humpback whale breeding stocks BSD, BSE and BSF in Antarctic Areas IIIE to VI. The analysis was based on 575 samples obtained in the Antarctic during JARPA/JARPA II and IDCR/SOWER and 1,057 samples from low latitudes of the South Pacific and eastern Indian Ocean. Analysis of approximately the first half of the mtDNA control region yielded 137 haplotypes, and mixing proportions and Fst were analysed under two stock structure hypotheses. Under the most general hypothesis of six breeding stocks, BSD predominated in Areas IIIE, IV-W and IV-E. BSE1 predominated in Area V-W, BSE2 dominated in Area V-E and BSE3 dominated in Area VI. BSF sub-stocks did not predominate in any Antarctic area, although BSF1 was partially represented in Area VI.

The Committee thanked the authors for completing the work in time for on-going assessment modelling. Technical aspects of the paper were discussed by the Working Group on Stock Definition (see Annex I) and mixing proportions for alternate Antarctic area boundaries were calculated for the assessment models (see Item 10.2.1.2).

SC/65a/SH08 described the first photo-ID and biopsy sampling surveys for humpback whales and small cetaceans around nine islands in eastern French Polynesia's Tuamotu and Gambier Islands (BSF2). The Committee welcomed this information on BSF2 and **recommends** additional sampling in this remote area of the South Pacific from which few data are available.

Rankin *et al.* (In press) estimated calving intervals of humpback whales at Hervey Bay, East Australia based on a long-term photo-ID catalogue of 2,973 individuals. Two methods of calculation (multi-event mark-recapture modelling and truncation) led to similar estimates of calving intervals: 2.98 years (95% Credibility Interval: 2.27-3.51) and 2.78 years (95%CI: 2.23-3.68) respectively.

The technical details of this paper were not presented, but the Committee noted that these calving intervals do not strongly suggest a population undergoing a high rate of population increase (e.g., Noad *et al.*, 2011). The cause of this apparent discrepancy requires further evaluation.

10.2.1.2 REVIEW ASSESSMENT MODELS

The Committee reviewed the progress of assessment modelling of breeding stocks BSD, BSE and BSF. Last year, a three-stock model with feeding and breeding ground interchange was proposed to address two inconsistencies that arose in single-stock assessments: (1) the model-predicted population trajectory for BSD was unable to simultaneously fit the absolute abundance estimate of 28,830 whales in 2011 (Hedley et al. 2011) and the high growth rate suggested by the relative abundance series; and (2) the model-predicted minimum population size in Oceania violated the N_{min} constraint informed from haplotype data.

Intersessionally, three-stock (BSD+BSE1+Oceania) and two-stock (BSD+BSE1) models were developed that included mixing on the feeding grounds. These did not substantially improve model fit unless customary Antarctic stock boundaries were shifted eastward to allow for more Antarctic catches to be allocated to BSD and fewer to Oceania. SC/65A/SH01 presented the results of single-stock, two-stock and three-stock models that used the original Antarctic boundaries, as well as new proposed boundaries based on this finding.

During the meeting, further model runs were attempted to improve model fits to the BSD data. An examination of the BSD absolute abundance estimate (Hedley *et al.*, 2011a) identified irregularities in the underlying survey data which called into question the validity of the estimate. This could not be resolved during the meeting, but given this, and the strong influence of this estimate on the model results, single-stock BSD models were used to explore the effects of a lower, fixed abundance estimate and a model that was not fitted to absolute abundance but included an uninformative prior on this value. These models for BSD produced relatively good fits to all the relative abundance series (see Fig. 4). The Committee recognised that any abundance measurement method that could provide a lower bound to this prior (i.e. a value other than zero) would be useful in improving future model fits to BSD, and **recommends** that analyses to achieve this be attempted.

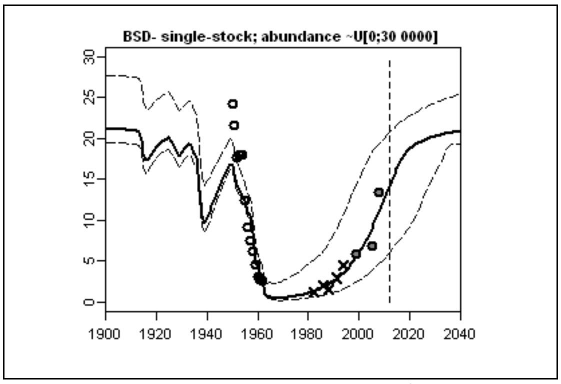

Fig. 4. Posterior median population trajectories for BSD, showing the trajectories and the 90% probability envelopes. Results are shown for a single-stock model using the original catch boundaries. Plots show fits to the Chittleborough (1965) CPUE series (open circles), the Bannister and Hedley (2001) and relative abundance series (crosses), the Hedley et al. (2011b) relative abundance series (grey circles). The model is fit to both the Hedley et al. (2011b) and Bannister and Hedley (2001) relative abundance series only. The BSD abundance prior is set at U[0; 30,000]). The Chittleborough (1965)CPUE series is shown as consistency check. The trajectory to the right of the vertical dashed 2012 line shows projection into the future under the assumption of zero catch.

Three-stock models were also run using mixing proportions calculated with revised Antarctic area boundaries (Annex H, Appendix 2). One key result was that in order to fit the BSD relative abundance trends, the model removed more westerly Antarctic catches from BSE1, which in turn led to the removal of Antarctic catches from Oceania to allocate to BSE1. Even so, the whales removed from BSE1 by the model did not deplete the population enough by the late 1960s (when most harvesting ceased) to reflect the rapid recent increases shown later by the east Australian surveys (Noad *et al.*, 2011). Use of an uninformative prior abundance on BSD in these models (with and without new Antarctic boundaries) did not improve the fit of the model to the BSE1 relative abundance data (see Fig. 5). Furthermore, none of the model formulations were consistent with the mixing proportions estimated by genetic data from the feeding grounds. Additional details of these results are provided in Annex H.

Other potential explanations for poor model fit were explored. Cooke (2009) describes situations in which attempts to fit a deterministic density-dependent population model to a recovering whale stock sometimes fail, because there are insufficient historic catches to account for the recent increase. His analyses suggested that lack of model fit should not be regarded as an anomaly to be explained, but a normal situation that is to be expected beyond a certain level of recovery and can be better fitted by accounting for environmental variability. Attempts to repair the lack of fit by allowing an arbitrary increase in carrying capacity could be expected to make the overestimation worse. Possible ways of addressing this in the current assessment models were discussed.

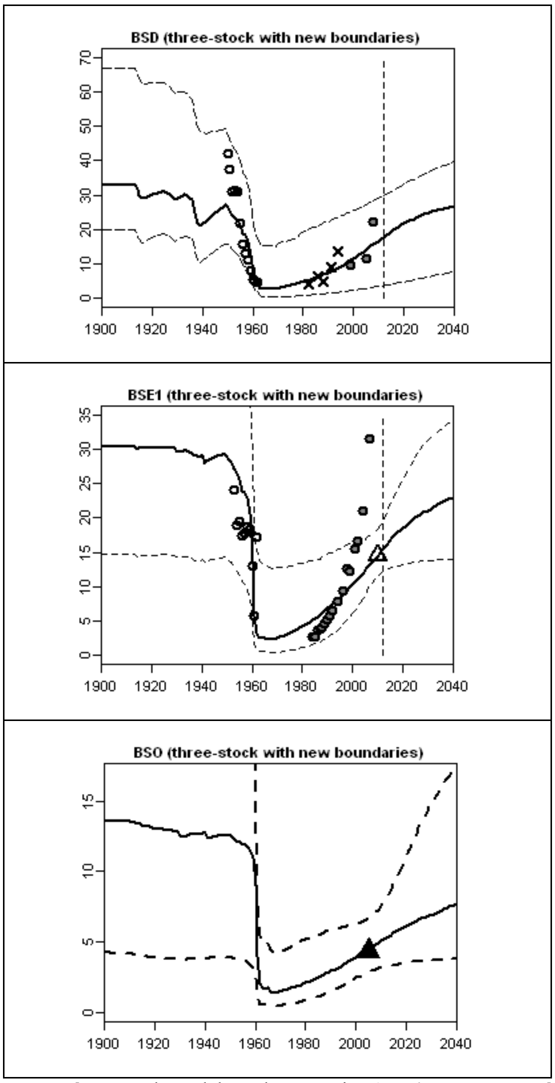

Fig. 5. Three-stock model results assuming 'new' Antarctic catch boundaries proposed in SC/65A/SH01. The BSD abundance prior is set at U[0; 30,000]). BSO refers to Oceania (New Caledonia (E2)+Tonga (E3)+French Polynesia (F2)). SC/65a/SH01 details the data fitted for each breeding stock but in essence these are the Bannister and Hedley (2001) and Hedley *et al*. (2011b) relative abundance series for BSD (crosses and grey circles, respectively), the Noad *et al*. (2011) abundance estimate and relative abundance series for BSE1 (open triangles and grey circles, respectively), and the Constantine *et al*. (2011) photo-ID mark-recapture data for Oceania. The black triangle for Oceania is the separate abundance estimate from mark-recapture data reported by Constantine *et al*. (2011) and the open circles for BSD and BSE1 are the CPUE data from Chittleborough (1965); these data are not fitted directly, but shown as consistency checks.

With respect to model fits to Oceania in SC/65a/SH01, the Committee **recommends** replacing the photo-ID mark-recapture data with genetic mark-recapture data.

SC/65a/SH07 presented other progress toward modelling the population dynamics for East

Australia and Oceania. This paper used logistic Bayesian FITTER models to co-measure population trajectories for pairs of South Pacific breeding grounds which share common high latitude feeding grounds. Two stock models were undertaken for East Australia (BSE1)/New Caledonia (BSE2), Tonga (BSE3)/ French Polynesia (BSF2) and East Australia (BSE1)/Oceania (BSE2+BSE3+BSF2). In these preliminary results, East Australia carrying capacity varied between models (medians 26-42,000) while population increase rates were uniformly high. Median estimates of carrying capacity for New Caledonia ranged from 5,200-6,100, for Tonga 5,600-8,700 and for French Polynesia 4,000-5,700, with median recovery levels of 13-33%, 31-44% and 24-32% respectively.

The Committee thanked the authors for this work and noted several technical issues that still need to be addressed, including the use of a uniform prior on carrying capacity which leads to a biased estimate of MSYR.

In conclusion, the Committee **strongly agrees** that the assessment of breeding stocks D, E and F should be completed at next year's meeting. The following final **recommendations** were made to complete this work:

(1) a lower bound on the BSD abundance estimate should be obtained;
(2) a single-stock model for BSD will be run for a range of choices of the Antarctic feeding ground catches between 120E and 150E;
(3) two stock BSE1-Oceania models (with further breeding stock division within Oceania) will be explored;
(4) if time permits after sufficient exploration of the models above, more complex options may be examined. These could include a three-stock model covering all of BSD, BSE1 and Oceania, together perhaps with more complex models for the dynamics of BSD, as discussed above.

The work plan for completing this work is provided in Item 10.2.3.

10.2.1.2 FUTURE WORK

SC/65a/SH09 described efforts by the South Pacific Whale Research Consortium to plan future sampling in Oceania with a view toward a future humpback whale assessment. Simulations and power analyses were used to evaluate planned field research in light of three main objectives: (1) to determine population size with a coefficient of variation of less than 20%; (2) to determine if the population is increasing or decreasing; and (3) to detect if population growth is significantly different from that of East Australia. Details are available in Annex H. The Committee welcomed this work, noting the importance of such planning and the value to future assessments of BSE2 and BSE3.

A modified POPAN model (Carroll *et al.*, In press) was discussed that explicitly accounts for heterogeneity in capture probability related to breeding cycles. The latter can cause substantial positive bias (+19%) in female abundance estimates and may be a consideration in the mark-recapture modelling of many cetacean species.

10.2.2 Review new information on other breeding stocks

New information was available for humpback whale Breeding Stocks B, C and G.

10.2.2.1 BREEDING STOCK B

SC/65a/SH24 collated humpback whale data from small boat surveys off Namibia (~23°S), 2005-2012. Photo identification images were compared with catalogues from Gabon (2000-2006) and West South Africa (WSA, 1983-2007). No confirmed matches were found, likely due to catalogue size and sampling period. However, a study of wounds from cookie cutter sharks (*Isistius brasiliensis*) and killer whales was used to infer relationships among these three areas in BSB.

The Committee welcomed this study, noting the potential utility of indirect indicators of stock structure for the Namibia region, where insights from photo-ID and genetic data are still limited.

SC/65a/IA13 reported on cetacean sighting survey results in Gabon coastal waters from 4-10 September, 2011 and in the Gulf of Guinea (Côte d'Ivoire, Ghana, Togo and Benin) from 23 March to 6 April, 2013. The committee thanked the authors for presenting these survey data. More information is available in Annex H, Item 3.2.

10.2.2.2 BREEDING STOCK C

Two papers were received on satellite tagging projects to study the movements of humpback whales in this breeding stock. SC/65a/SH22 reported movements of twelve humpback whales satellite tagged off northeast Madagascar (BSC3). A wide range of movements were observed, including use of areas not previously recognised as preferred habitat. No tagged whales travelled to the west coast of Madagascar, Mozambique or the Mascarene Islands, where breeding aggregations are well documented. Observed movements between Madagascar and central-east Africa were likely not detected previously because of a lack of surveys in northern BSC1.

The Committee welcomed this work and noted its value for helping to clarify stock structure within BSC. Details of further discussion are available in Appendix H.

SC/65a/SH02 described the results of satellite tagging eight humpback whales in the Comoros

Islands (BSC2) in 2011 and 2012. Whales eitherremained at their breeding site for several weeks after tagging (*n*=3), dispersed to the northwest (*n*=2) or to southwest (*n*=3) coast of Madagascar. Of those tracked toward the Antarctic, one moved south-eastward towards the French Sub-Antarctic Islands and the other travelled to Antarctic Area III. These are the first detailed reports of humpback whale movement for this breeding sub-stock.

10.2.2.3 BREEDING STOCK G

SC/65a/SH04 described the results of small-boat surveys in the Gulf of Chiriqui (western Panama) during the austral winter season from 2002 through 2012. Initial catalogue comparisons have established matches to southern Costa Rica, and to feeding areas off Chile and Antarctica. Future plans include genetic analysis, comparing mother-calf habitat use to other breeding areas and long term acoustic monitoring. Discussion of this paper focussed on the prevalence of mother/calf pairs in the area, which will be investigated further by the authors. This discussion can be found in Annex H.

10.2.3 Review new information on feeding grounds

Three studies (SC/65a/SH10, SC/65a/SH20 and SC/65a/O9) reported sightings of humpback whales during surveys in the Antarctic. Further details can be found in Annex H, item 3.3.

10.2.4 Antarctic Humpback Whale Catalogue

SC/65a/SH15 presented the interim report of IWC Research Contract 16, the Antarctic Humpback Whale Catalogue (AHWC). During the contract period, the AHWC catalogued 938 images representing 774 individual humpback whales submitted by 36 individuals and research organisations. Catalogue details are provided in Annex H, Item 3.4.

The Committee recognises the contribution of the AHWC to humpback whales studies in the Southern Hemisphere and **recommends** its continuation (and see Item 26).

10.2.5 Other new information

SC/65a/SH05 reported on a study of Type 1 satellite tag performance and health impacts in humpback whales. This study has already informed tag modifications that have substantially increased tag duration, and are expected to reduce impacts on individuals. The Committee **thanks** the authors for this work, noting its value to future satellite tagging research.

10.2.6 Work plan

The Committee **confirms** that it will complete its assessment of Breeding Stocks D/E/F at next year's meeting, and thus also the Comprehensive Assessment of Southern Hemisphere Humpback Whales. Further details are given under Items 23 and 24.

10.3 Southern Hemisphere blue whales (SH)

10.3.1 Review new information

10.3.1.1 ANTARCTIC BLUE WHALES

Several papers reported results from the SORP Antarctic Blue Whale Project. SC/65a/SH21 provided an overview of activities undertaken on the Antarctic blue whale voyage between January and March 2013. This 47-day voyage focussed on an area south of 60°S between 135°E and 170°W. Acousticians processed 26,545 Antarctic blue whale calls in 'real-time' and acoustically 'targeted' 51 groups of vocalising animals for photo-ID and biopsy sampling. Further detail on tracking, sampling and other activities are provided below and in Annex H (Item 5.1.1).

SC/65a/SH18 summarised the long-range acoustic tracking undertaken during the Antarctic Blue Whale Project. DIFAR sonobuoys were used to detect, localise and track Antarctic blue whales. In total, 85% of acoustic targets resulted in visual encounters and yielded 32 encounters with groups of blue whales. The project demonstrated the ability of acoustic tracking to locate Antarctic blue whales that are widely dispersed over a large area as well as the capacity to acoustically track whales for days at a time.

SC/65a/SH11 reported on the 50 Antarctic blue whales photo-identified as a result of acoustic-tracking during the 2013 voyage. The re-sighting rate of individuals during the voyage was similar to recent IWC SOWER cruises. Time between re-sights ranged from 1 to 27 days and straight-line distances ranged from 15km to 1,172km. Three individuals were matched to the Antarctic Blue Whale Catalogue and one had moved a minimum of 6,550km and 145° of longitude. Photo-identification data collected during the voyage will contribute towards a new abundance estimate of Antarctic blue whales using mark-recapture methods.

SC/65a/SH3 reported on the movements of satellite tagged Antarctic blue whales on their feeding grounds in 2013. Two tags collected movement data for 14 and 74 days, over 1,433km and 5,300km, respectively. Both whales performed long-scale movements interspersed with patches of searching, often in close association with the ice edge. Additional satellite tag deployments are planned to increase understanding of fine and large scale movements of Antarctic blue whales.

The Committee discussed these papers largely in the context of the ultimate aim of the Antarctic Blue Whale Project to estimate abundance through mark-recapture methods. It also highlighted the success of the SORP Antarctic Blue Whale Project to date and the significant advance it represents in non-lethal research on blue whales in the Southern Ocean.

Additional details of this discussion can be found in Annex H, Item 5.1.1.

SC/65A/O9 summarised sightings of blue whales during JARPAII of 2012/13. Details can be found in Annex H, Item 5.1.1.

10.3.1.2 PYGMY BLUE WHALES

Three papers provided new information on blue whales off New Zealand. SC/65a/SH12 reported on blue whales observed and photo-identified in the coastal waters of New Zealand from 2004-2013. Of 18 whales identified, 14 were observed during the SORP Antarctic Blue Whale Voyage in 2013, on transit to the Antarctic. Further details are available in Annex H.

SC/65a/SH19 reported additional findings from a combination of acoustics and visual observations at New Zealand, including data obtained during the 2013 SORP Antarctic Blue Whale Voyage noted above. Acoustic tracking confirmed blue whales to be the source of low frequency sounds recorded in this area. Comparison to recordings from 1964 and 1997 suggested that song types have persisted over several decades, are distinct from the Antarctic blue whales, and indicate a year-round presence around New Zealand. Blue whale song in this region has changed slowly, but consistently, over the past 50 years.

Torres (2013) presented evidence that the South Taranaki Bight is a blue whale foraging habitat and called for a greater understanding of their habitat use patterns to manage anthropogenic activities.

The Committee discussed the taxonomic status of blue whales in New Zealand waters. Based on available data on morphology, timing, distribution and acoustics, these whales are most likely to represent a form of pygmy blue whales. This is consistent with a growing body of evidence that populations of pygmy blue whales show considerable variation across the Southern Hemisphere.

The Committee **reiterates** that the relationship among pygmy blue whales in different areas is unclear and merits further investigation.

10.3.1.3 BLUE WHALES OFF CHILE

SC/65a/SH17 provided an update on surveys, photo-identification and biopsy research off the north-western Isla de Chiloe and Isla de Chañaral (northern Chile) in 2013. Research at multiple sites has highlighted the importance of continued monitoring and increased photo-identification efforts to better understand the dynamics of the blue whales in this area. Concerns were also raised about the overlap of blue whales and vessels at the mouth of Chacao Channel. One blue whale stranding was documented north of this area in 2013, but cause of death was not determined.

The taxonomic status of Chilean blue whales was discussed by the Committee. They are intermediate in size between Antarctic and pygmy blue whales (Branch *et al.*, 2007). Furthermore, blue whales off Chile and Australia are as different genetically from each other as each is from Antarctic blue whales. Ongoing genetic analyses using additional samples from the Southern Hemisphere, Eastern Tropical Pacific and North Pacific will be undertaken to try to resolve their taxonomic status (see SC/65a/SH25).

10.3.1.4 PHOTO-IDENTIFICATION CATALOGUES

SC/65a/SH16 reported on the comparison of Antarctic blue whale photographs from JARPA to the Antarctic Blue Whale Catalogue (ABWC). Thirty-one individual Antarctic blue whales were photo-identified during JARPA cruises in the Antarctic during 12 austral summer seasons between 1992/1993 and 2004/2005. Photos were obtained in IWC Management Areas III, IV, V and VI. No new matches were found. This work brings the ABWC catalogue total to 305 individuals and notably increases available coverage from Area III (n=165) and in Area V (n=93). The Committee **recommends** that the 380 additional JARPA II blue whale photographs be compared to the ABWC.

SC/65a/SH23 describes efforts to consolidate all blue whale catalogues in the Southern Hemisphere. The Southern Hemisphere Blue Whale Catalogue (SHBWC) now contains 884 individual blue whales. Catalogues from South America, the Eastern Tropical Pacific (ETP) and Antarctica are now included and catalogues from the Indonesia/Australia/New Zealand area are in the process of being added. Comparisons between the eastern South Pacific and ETP have been completed and no matches were found. Comparisons between ETP and the Southern Ocean, as well as those from eastern South Pacific and the Southern Ocean are approximately 50% complete, with no matches found. The Committee **recommends** that the SHBWC continue its work and that all relevant data holders submit their photos to the catalogue.

10.3.1.5 NEW GENETIC INFORMATION

Attard *et al.* (2012) reported on hybridisation between pygmy and Antarctic blue whales, and a genetic estimate of the proportion of blue whale sub-species in the Antarctic. Further details and the discussion of the Committee is provided in Annex H, Item 5.1.5.

10.3.2 Work plan

The Committee's views on the workplan are given under Item 24

10.4 North Pacific sei whale in-depth assessment (Annex G)

10.4.1 Review intersessional progress

Last year, an issue had been identified with the division of Japanese catch records between sei and Bryde's whales in the period 1955-1972. This year the Committee heard that this had been a misunderstanding: the division of the catch figures had already been accomplished in the context of the Bryde's whale assessment.

Owing to other Committee priorities, it had not been possible to complete the incorporation of the Soviet and Canadian catch records intersessionally; this remains on the Work Plan for the forthcoming year (see 10.4.3).

10.4.2 Assessment

Although it was not possible to proceed with the assessment, analyses were presented that will inform the assessment when it is undertaken. Relating to stock structure, SC/65a/IA05 described the results of microsatellite DNA analysis conducted on North Pacific sei whale samples obtained from the 2010-2012 IWC-POWER surveys (Annex G, item 5.2). The genetic data from 14 microsatellite loci from these samples were compared with previously reported genetic data from JARPN II (from 2002-2007) and from commercial whaling samples (from 1972-1973) across a range of locations within the North Pacific. The study supports the author's previous view that the open waters of the North Pacific were occupied by the individuals from a single stock of sei whales. This paper was discussed extensively by the Working Group on Stock Definition (Annex I), which made three recommendations for further analyses: (i) estimate the power of the data set to detect subtle population structure that might nevertheless be important for management; (ii) undertake a clustering analysis using STRUCTURE or a similar approach; and (iii) undertake a relatedness analysis when the sample size is sufficient to expert to find a reasonable number of close relatives.

It was reported that the recommended studies will be carried out, but not before 2016 because of other priorities. The Committee did not expect that these analyses would materially change the current understanding of stock structure; it **agrees** that it is not necessary to await the results before proceeding with the in-depth assessment.

Two preliminary analyses using sightings data from IWC-POWER were presented. SC/65a/IA09 provided a standard line transect analysis to estimate abundance of sei whales from the 2012 IWC-POWER survey (see Annex G, item 3 for a map showing the survey area). SC/65a/IA10 modelled the spatial distribution of fin, sei and humpback whales using data from the first three IWC-POWER surveys (2010-12). The Committee welcomed this analysis, and made a number of technical suggestions. Updated and revised analyses from both SC/65a/IA09 and SC/65a/IA10, using all available data, will be undertaken intersessionally; the Committee looks forward to receiving these and considering them in more detail at the in-depth assessment next year.

10.4.3 Workplan

Corrected Soviet catch data are documented by Ivashchenko *et al.* (JCRM, in press). The Committee **agrees** that these represent the best possible reconstruction of the Soviet catch history in the North Pacific at this time, and that they should be incorporated into the IWC database (if this has not already been done). The Committee requests that Allison complete the remaining catch history additions or revisions (such as the revised Canadian catch data) during the coming intersessional period.

10.5 North Pacific gray whales

10.5.1 New information on stock structure and movements

There was considerable discussion of genetic information (see especially SC/65a/BRG16) on gray whale stock structure for the North Pacific both within the working group on stock definition (see Annex I, item 3.1.3) and the sub-committee on bowhead, right and gray whales (Annex G, item 3.1.2). Considerable attention was paid to developing the range of plausible hypotheses about the gray whales that summer in the Sea of Okhotsk near Sakhalin Island. The outcome of these discussions was the development of a list of seven hypotheses presented in Appendix 4 to Annex F.

SC/65a/BRG04 summarises the results of the second year of the collaborative Pacific-wide study developed under the auspices of the IWC. The paper reported on the comparison of the gray whales photo-identified off Sakhalin Island (n-=232) and the Kamchatka Peninsula (n=150) with the Mexican gray whale catalogue (n=4,352). A total of 9 confirmed matches was found. Two whales were observed in the three places, three in Sakhalin and Mexico and four in Kamchatka and Mexico. These results provide new information important to the evolving understanding of gray whale population structure in the North Pacific.

The Committee thanks all the collaborators for the excellent progress on this project. The comparison of photographs between Sakhalin Island and Kamchatka, Russia with photos from lagoons in Baja California Sur, Mexico provides improved understanding of the connections between feeding and breeding/calving areas and interactions between western and eastern gray whales.

The Committee received papers summarising the work of two ongoing photo-identification and biopsy programmes off Sakhalin Island. Details are given in Annex G, item 3.2.1 and only a short summary is provided here. SC/65a/BRG03 reviewed findings from the ongoing 18-year collaborative Russia-US research programme on western gray whales summering off north eastern Sakhalin Island, Russia. When 2012 data are combined with results from 1994-2011, a catalogue of 214 photo-identified individuals has been compiled.

SC/65a/BRG08 reported on the programme being undertaken by the Russian IBM team that has been working off Sakhalin Island since 2002 and Kamchatka since 2004. The Sakhalin photo catalogue now contains 219 individual gray whales over the period of 2002-2012. At present, the Kamchatka Gray Whale catalogue contains 155 gray whales identified in 2004 and 2006-2012 of which 85 were also photographed offshore Sakhalin. Information on body condition was also presented. While the population remains small and therefore vulnerable, individual animals appeared to be in good body condition in 2012 compared with indicators from previous years. Few skinny whales were observed and those that were, had restored their body condition to normal over the course of the summer feeding season.

SC/65a/BRG18 reported on the results of the shore- and vessel-based surveys conducted in August-September 2012 under the Western Gray Whale Monitoring Program funded by Exxon Neftegas and Sakhalin Energy. The authors concluded that the results of the 2012 distribution surveys and photo-identification studies indicate that the Sakhalin gray whale feeding aggregation is gradually increasing in size and that the distribution of the whales remains similar to previous years.

The Committee welcomed these papers, recognising the importance of long-term monitoring of the animals off Sakhalin. It **strongly recommends** that the studies continue.

In addition to the work in Russia, the Committee received information from Japan and Korea. SC/65a/BGR20 reported on the status of conservation and research on North Pacific gray whales from May 2012 to April 2013 in Japan (including sightings surveys and morphological comparisons), while SC/65a/BRG26 reported on sighting surveys in Korean waters from 2003 to 2011. Neither the Japanese nor the Korean surveys saw any gray whales.

The Committee thanks Japan and Korea for providing this information and continuing work on gray whales. It **encourages** further comparison of skeletal morphology of gray whales across the North Pacific. It also thanked Japan for providing photographs of a juvenile gray whale sighted off Japan in March 2012; comparison with both Sakhalin and eastern catalogues produced no matches.

Given the large amount of new information related to population structure of gray whales in the North Pacific and the potential implications of this for conservation and management advice (see also Annex E, item 2), the Committee **endorses** a proposal for a rangewide review of the population structure and status of all North Pacific gray whales with an initial focus on an international workshop (Annex F, Appendix 2).

10.5.2 Conservation advice

SC/65a/BRG27 presented an updated population assessment of the Sakhalin gray whale aggregation using photo-id data collected from 1994 to 2011 in the Piltun area by the Russian-US team. Details are provided in Annex G, item 3.2.1. The results showed evidence for between-year variability in calving rates and calf survival rates. The calving rate was found to be correlated with the calf survival rate with a two-year time lag. Under the assumptions made, no immigration in recent years was detected, suggesting that the population has been demographically self-contained, consistent with a high degree of maternally-directed feeding site fidelity. The 1+ (non-calf) population size in 2012 is estimated at 140 (±6) whales, increasing at 3.3 (± 0.5) % per annum.

A number of matters for further consideration were raised. Work is underway to incorporate both Sakhalin catalogues into the assessment but certain issues needed to be resolved first. The Committee **agrees** that if possible both datasets should be included in a final assessment. Given the implications for conservation, a more thorough investigation of immigration should occur and the the incorporation of body condition information into the model was also encouraged.

Annex G, Appendix 5 provided an update on the progress of the Western Gray Whale Advisory Panel (WGWAP), which is convened by IUCN.

10.5.4 Conservation advice

The Committee **reiterates** its support for the important work of the IUCN. As previously, the Committee **recommends** that oil and gas development activities (including exploratory seismic surveys) in areas used by gray whales be undertaken only after careful planning for mitigation and monitoring, noting the guidance provided by the WGWAP in this regard[13].

[13] www.iucn.org/wgwap/wgwap/seismic_survey_monitoring_and_mitigation_plan/

10.6 Southern Hemisphere right whales

The Committee completed an assessment of Southern Hemisphere right whales last year and the report is published as IWC (2013d).

10.6.1 Review new information

The Committee received a number of papers providing new information on southern right whales and details can be found in Annex G, item 4. A short summary of this work is provided below.

SC/65a/BRG10 reported on the results of the aerial survey for right whales in South African waters in October 2012 funded by the IWC and part of a long-term monitoring programme. The number of identified cow-calf pairs was the fifth highest since surveys began in 1979, and an exponential fitted to the data over the 34-year period provides a significant rate of increase (0.0625 ± 0.0035 SE per annum).

SC/56a/BRG17 extended the analyses of Brandão *et al.* (2012) which applied the three-mature-stages (receptive, calving and resting) model of Cooke *et al.* (2003) to photo-identification data from the long-term monitoring programme available from 1979 to 2010 for southern right whales in South African waters, by taking two further years of data into account. The 2012 number of parous females was estimated to be 1,321, the total population (including males and calves) 5,062, and the annual population growth rate 6.6%.

Carroll *et al.* (2013) provided information of a return of southern right whales to former habitat around the main islands of New Zealand including the first evidence of female site fidelity to the mainland New Zealand calving ground. There was some discussion as to whether this represented a re-establishment of primary habitat by a remnant stock that survived in the New Zealand sub-Antarctic.

Carroll *et al.* (In press) reported on methods to extend the 'superpopulation' capture-recapture model (POPAN) to explicitly account for heterogeneity in capture probability linked to reproductive cycles, such as the 2-5 year birth intervals observed in southern right whales. This model extension, referred to as POPAN-τ, has potential application to a range of species that have temporally variable life stages. The authors demonstrate the utility of this model in simultaneously estimating abundance and annual population growth rate (λ) in the New Zealand southern right whale from 1995-2009, with a total 'superpopulation' estimate from the best model of around 2,100 (95% CL1,836 – 2,536).

SC/65a/O9 reported that four schools and five individuals of southern right whales were sighted in 2012/13 of JARPA II in the Antarctic. One southern right whale was photographed for Photo-Identification.

10.6.2 Complete assessment

SC/65a/BRG15 reported on a workshop on the ongoing southern right whale die-off at Península Valdés. The 2010 IWC workshop on this topic (SC/62/Rep1) reviewed the significant number of right whale calf deaths and *inter alia* drew attention to the increasing incidence of parasitic behaviour of kelp gulls which peck at the outer skin and then feed on the blubber of live whales, and recommended that management measures be taken with respect to kelp gulls displaying this behaviour.

SC/65a/BRG15 also reviewed the most recent information on gull lesions and calf mortality. There is a strong signal of gull attacks as a unique, increasing, and acute element of the lifecycle of young right whale calves. The participants developed hypotheses on the mechanisms by which these attacks and injuries can lead to death and agreed to continue to work on these. The workshop commended the work of the SRHWHP team.

Solving the kelp gull harassment problem is a priority action within the CMP developed for this region. Information was received on a feasibility study was carried out last year testing the use of different gun types - a 12-gauge shotgun was deemed to be the most successful. The reactions of the southern right whales to gun discharge were also recorded and no changes in their behaviour were observed. For the 2013 southern right whale season the objective is to continue this programme.

The Committee **expresses** concern over the continued large annual mortality of calves at Península Valdés, and its potential significance to the population. The increase in gull populations is driven by anthropogenic factors such as open landfills and discharge from fisheries. It **recommends** that investigation of the causes of this mortality, including the hypothesis that gull attacks are contributing to calf deaths, should continue as a matter of priority and **recommends** that strategies and actions to reduce the risk of gull attacks on southern right whales at Península Valdés should be further developed and implemented. The Committee **commends** the SRWHMP for their hard work and diligence in trying to resolve this situation and **encourages** continuation and further support of this important work.

The Committee received information on progress with the IWC Conservation Management Plan for the Southern Right Whale Southwest Atlantic Population as a result of a Workshop held in Argentina (SC/65a/BRG7). The overall objective of the CMP is to protect SRW habitat and minimise anthropogenic threats to maximise the likelihood that SRW will recover to healthy levels and recolonise their historical range. The CMP (details in Annex G, item 4.4) developed nine high priority actions, ranging from public awareness and capacity building through research to mitigation. Iniguez has been appointed co-ordinator of the programme for a 2-year period and a Steering Committee has been established including range state representatives, the Chairs of the Conservation Committee, Scientific Committee and the CMP SWG and the IWC Head of Science. A panel of experts will also be established.

The Committee **welcomes** the progress with the CMP and is willing to assist with scientific advice if required.

The Committee also **endorses** the holding of a workshop to develop and implement a strategy to minimise kelp gull harassment on southern right whales as proposed by the CMP. Such a workshop would be held in early 2014 and developed in consultation with the Province of Chubut. A budget request for partial funding is given under Item 26.

SC/65a/BRG14 noted that the southern right whale is listed as "least concern" in the IUCN Red List of Threatened Species. Although not a threatened species, data from a review of strandings and sightings reveal a real reduction in southern right whales records for the southeast coast of Brazil. The authors stated that this should be considered as a cause of conservation concern**.**

Galletti Vernazzani *et al.* (2013) reported on behaviour and habitat use patterns of eastern South Pacific southern right whale sub-population. This population is likely to contain less than 50 mature individuals, has been classified as critically endangered by IUCN. In 2012, the IWC endorsed a CMP to promote its long-term recovery. One of the highest priorities of the CMP is to identify the breeding area(s) which is difficult given the length of the coastline and and the low number of individuals. The first resighting between years of a known individual, the southernmost sighting of a cow-calf pair and the first documented record of likely reproductive behaviour in these whales has been reported in a small area off coastal waters off northwestern Isla Grande de Chiloe (Isla de Chiloe), southern Chile. This new information highlights the importance of this area for this population and suggests that it is part of a breeding area. Isla de Chiloe is the northern limit of the Chilean fjord system and was a former whaling ground for southern right whales, therefore it seems that whales are reoccupying their former range. However, a large wind farm project and associated port is being proposed to be built at northwestern Isla de Chiloe and it is likely it will affect this important habitat for this critically endangered population.

The Committee welcomed this information and, in light of this critically endangered status and the importance of this area for the recovery of the population, it **strongly recommends** relocation of the wind farm project away from shore, and **reiterates** the need for the urgent development of an environmental impact assessment that considers possible impacts on cetacean habitats.

10.7 North Atlantic right whales

10.7.1 Review any new information

No new information was presented

10.7.2 Conservation advice

The Committee **repeats** it concern over North Atlantic right whale stocks and notes that it is a matter of urgency that every effort be made to reduce anthropogenic mortality (e.g. see IWC, 2012a). It requests that updated information on the status of any of these stocks be provided to the next annual meeting.

10.8 North Pacific right whales

10.8.1 New information

The Committee welcomed new information of sightings of North Pacific right whales: (1) one animal amongst several bowhead whales in July 2011in the Western Okhotsk Sea; (2) two separate animals in 2012 as part of the JARPN II programme (both photographed and one biopsy sample); (3) one animal (photographed) southeast of Kodiak Island during the 2012 IWC-POWER cruise.

10.8.2 Conservation advice

The Committee **reiterates** its previous concern over the status of this endangered species throughout the North Pacific. Noting that significant new data has accumulated from survey work in recent decades, especially in the western North Pacific and Sea of Okhotsk, the Committee **recommends** that the survey data on North Pacific right whales (including search effort, sightings, photo-identification and biopsy results) be synthesised and presented by Matsuoka and colleagues to next year's meeting.

10.9 North Atlantic bowhead whales

10.9.1 Review any new information

No new information was presented

10.10 Okhotsk Sea bowhead whales

10.10.1 New information

The Committee received considerable new information on bowhead whales from Ulbansky Bay in the Okhotsk Sea in 2011 and 2012 (SC/65a/BRG28 and 29). Details can be found in Annex F, item 2.2. Local observations indicate bowhead whales appeared in early May and were present in the area during the study from early July to early September. Large groups (up to 43 in 2011 and 51 in 2012) were seen. An individual biopsied in 2001 was recaptured in 2012. Approximate abundance based on the 2012 genetic recaptures (105 whales genotyped in 1995-2011 with 5 recaptures in 31 whales biopsied in 2012) suggest values about twice that of the earlier estimate of about 300 animals. However, false negatives resulting from differences in lab analyses for earlier samples could result in fewer recaptures and cause positive bias to any estimates. For mtDNA analyses, complete sequences of the control region were obtained for 64 individuals. Seven haplotypes were found including one not found in the earlier study by MacLean (2002), whom also identified seven haplotypes.

In discussion, the Committee **commends** Shpak and colleagues for their excellent work. It **strongly encourages** further research on this small and little-studied stock, including (1) continue biopsy collection in the Shantar region during summer; (2) calibration of samples collected in 1994-2001 and 2011-2012 via an exchange of samples between US and Russian laboratories; (3) determining if whales in the various Bays of the Shantar region represent an homogeneous group; and (4) examining the relationship between bowhead whales observed in spring in the Shelikhov Bay and those from the Shantar region.

It was further noted that combining data from bowhead genetic studies conducted in the 1990s would allow updated capture-recapture (minimum) population estimates.

Brownell reported on new plans for offshore oil and gas development in the Northern Okhotsk Sea. It was noted that oil and gas exploration lease blocks were purchased offshore of the city of Magadan approximately 50 to 14 km in water depths of 120 to 180m. It is expected that exploration will start in 2017 and drilling by mid-2020s. This area is north of Sakhalin Island and likely in the areas used by Okhotsk Sea bowhead whales when they migrate back and forth across the north Okhotsk Sea. In discussion it was noted that bowhead whales use the Shelikov region in spring but that there have been no reported sightings of bowhead whales off Magadan there have been sightings of gray whales.

10.11Arabian Sea humpback whales

10.11.1 Review new information

SC/65a/SH06 reported recent information on a discrete and non-migratory population of humpback whales in the Arabian Sea. A small vessel survey was conducted in Oman in 2012, and made three humpback whale sightings (5 individuals) in 1250-km of survey effort. Sightings occurred in the Gulf of Masirah, which was previously identified through habitat modelling as a critical area for the population. Passive acoustic data are pending analysis and units will be re-deployed over the next year. Photo-ID data were not adequate to revise population estimates as requested last year. Fishing and shipping in the region were reported in the context of potential threats to this population.

Information was also provided on progress toward the regional conservation initiative mentioned in SC/65a/SH06. Members of the intersessional correspondence group on the Arabian Sea population, together with regional NGO partners have begun work to establish a regional research and conservation programme for this population. The programme would help to initiate and foster collaborative research amongst range state partners, increase local capacity and generate awareness of Arabian Sea humpback whale conservation issues. Additional details are available in Annex H, Item 4.

The Committee welcomed these important updates on the Arabian Sea humpback whale population. Given the critical status of this population, it **recommends** that this research be allocated a high priority. The regional conservation initiative was strongly supported as a positive opportunity for range states to work together towards improving the status of this population. Such work could also benefit a CMP, should one ultimately be established for this population (see Item 10.11.2).

Plans were described to satellite tag Arabian Sea humpback whales with implantable tags. Tagging would involve no more than 20% of the population, which has most recently estimated at 84 individuals (Minton *et al.*, 2011), and would address priority research questions identified previously by the Committee. The proponents stated that they have carefully reviewed the present state of tag development and will be following international best practice including using a well-designed and tested tag and an expert tagging team. Further project details and precautions are outlined in Annex H, Item 4.

The Committee noted the importance of the proposed work, given how little is known about the Arabian Sea humpback whale population. While the proposed sample size is modest, even a small number of tags has the potential to significantly increase what is known about this population. At least 7 dead humpbacks have been detected in the last 10 years and this casts doubt on the sustainability of the population, e.g. it exceeds the estimated Potential Biological Removal for this population (PBR, Wade, 1998). As noted above, Oman has experienced a rapid increase in the development of fisheries, high speed ferries and coastal infrastructure projects, many of which overlap with known humpback habitat. Given the observed mortality and known threats, there is an urgent need for better information on movement and habitat use. This project has the potential to considerably improve knowledge in the short term and is in fact the only way to collect this information given the nature of this population and the available resources.

It was noted in discussion that the results of recent satellite tag assessment studies on the health of animals (SC/65a/SH05) will be available in the next few years and that consideration should be given to waiting for those results. However, the Committee also recognised the urgency of this issue and the potential benefit to the conservation management of this critically endangered population. The Committee **recommends** that this work be undertaken as a high priority. An important caveat is that any untested tag modifications should be evaluated on other populations and not used first on Arabian Sea humpbacks.

10.11.2 Progress toward the development of a Conservation Management Plan

In 2010, the Committee recommended the development of a Conservation Management Plan (CMP) for Arabian Sea humpback whales. A CMP could address concerns for this population as well those for other species of large whale. To date, neither of the two range state members of the IWC (India, Oman) has yet volunteered to lead the development of a CMP, although there is some recognition of urgent conservation concerns and research needs.

10.12 International Cruises (IA)

10.12.1 IWC-POWER cruises in the North Pacific

The Committee has now agreed objectives for the IWC-POWER programme, and this year reviewed the results of the 2012 cruise (10.12.2), the Planning Meeting report for the 2013 survey (10.12.3) and discussed plans for the 2014 cruise (10.12.4).

The 2014 cruise will mark the end of the short-term phase of the programme, completing coverage of a large area of the North Pacific (see Fig. 2 in Annex G). This phase had been designed to cover the whole survey area in as short a time as possible to provide baseline information on distribution and abundance for several large whale species/populations. Alongside sightings data, dedicated time for biopsy sampling and photo-identification work has been allocated, providing information on stock structure, movements and potentially further information on abundance.

10.12.2 Review of the 2012 IWC-POWER sighting survey

The 3rd IWC-POWER cruise was successfully conducted from 13 July-10 September, 2012, in the eastern North Pacific using the Japanese Research Vessel *Yushin-Maru No.3* (SC/65a/IA08). The cruise was organised under the auspices of the IWC. Researchers from Japan, Korea and the US participated in the survey. The cruise had main objectives (see Annex G, item 3.1) and the survey plans had been endorsed by the Committee (IWC, 2012). The Committee **agrees** that it was duly conducted following the guidelines of the Committee.

Further details of the cruise, including summaries of the sightings made, may be found in Annex G, item 3.1. The Committee, **thanks** the Cruise Leader, researchers, captain and crew for completing the third cruise of the IWC-POWER programme. The Governments of Canada and the US had granted permission for the vessel to survey in their respective waters, without which this survey would not have been possible. The Governments of the Republic of Korea and the USA provided one scientist each, and the Government of Japan again generously provided the vessel and crew, as it had done for the 2010-2011 cruises. The Committee recognised the value of the data contributed by this and the other IWC-POWER cruises, collected in accordance with survey methods agreed by the Committee, covering many regions not surveyed in recent decades, and addressing an important information gap for several large whale species.

In discussion of the 2012 POWER cruise results, the Committee heard that weather conditions in the North Pacific in summer tend to be poor. For future planning of the medium- and long- term phases of the programme, the Committee agreed that the sighting conditions during the 2010-2014 cruises should be investigated. This is relevant both to the feasibility of estimating abundance of various whale species from current North Pacific surveys, and also for considering any changes in design required for subsequent cruises after 2014. These considerations were referred to the IWC-POWER Technical Advisory Group (TAG) workshop scheduled for later in 2013 (see Annex G, Appendix 2).

10.12.3 Planning for 2013 IWC-POWER cruise

SC/65a/Rep1 presented the report of the detailed Planning Meeting for the 2013 IWC-POWER cruise that had been endorsed last year (IWC, 2012a, pp. 39-40). The Meeting received preliminary results from the 2012 IWC-POWER cruise and these were used, along with overall objectives of the first phase of the IWC-POWER surveys, to formulate a plan for the 2013 cruise, which will take place between 30-40ºN, and from 135-160ºW. The vessel (kindly supplied by Japan) will depart shortly on 12 July, 2013. The Meeting also agreed to a suggestion to highlight the IWC-POWER surveys on the IWC website with the ultimate aim of inspiring multinational collaboration in the survey programme. Fortunately, there will be no problems arising from requirements for CITES permits during the 2013 survey as the tracklines do not enter any EEZs; this issue, however, the problems will return in 2014, when the planned survey design will take the vessel into US waters (see item 10.12.1 below). The Committee was informed that the Japanese and US authorities are working to solve this issue. SC/65a/Rep1 also covered a number of items related to the short, medium and long-term objectives of IWC-POWER, which were later discussed by the IWC-POWER TAG (Appendix 2, Annex G).

The Committee **thanks** the members of the Planning Meeting for their report and **endorses** their recommendations.

10.12.4 Recommendations for 2014 cruise
SC/65a/O5 outlined the plan for the IWC-POWER cruise in 2014. The proposed research area is the eastern north Pacific, between 170ºE and 160ºW, from 30ºN to 40ºN (Figure 2, Annex G). Photo-ID and biopsy experiments are also planned. The plan was drawn up following general guidelines agreed 2012 Tokyo Planning Meeting (SC/65a/Rep1). Information collected from this survey will provide essential information for the intersessional workshop to plan for a medium-long term international survey programme in the North Pacific.

On receiving these plans, the Committee **recommends** that permission be sought to operate in the US EEZ far enough in advance for the 2014 cruise. The Committee was informed that the Japanese and US governments are working to solve the problems before the 2014 survey. It thanked the Government of Japan for its generous offer of providing a vessel for this survey.

The Steering Group for IWC North Pacific Planning appointed last year was re-established, convened by Kato (see Annex R). Final planning will take place at a planning workshop to be held in Tokyo (see Item 26).

10.12.5 IWC-SOWER cruises (progress on website, publications, analyses)
Last year, the Committee nominated an Editorial Board, and tasked it with responsibility for the preparation of a commemorative IDCR/SOWER volume. As convenor, Bannister reported that in accordance with the Committee's wishes, a timetable has been developed, a contents list has been proposed and authors have been approached to prepare brief outlines of their contributions.

The volume is intended to be a book reviewing the cruises: not a series of original scientific papers, but rather a series of review chapters bringing together all the work that has been accomplished so far (Annex G, item 4.1). The volume will provide an introduction to the IDCR/SOWER programme and its fieldwork, including its original aims and objectives, and cruise narratives. There will be major chapters on whale distribution and movements, particularly of minke and blue whales, on taxonomy and population structure, on acoustics, and on abundance (including the development of DESS). An extremely important chapter will be devoted to conclusions and lessons for the future, with emphasis on achievements and lessons learned.

The Committee thanked Bannister and the Editorial Board, and looked forward to an update next year.

In order to facilitate analyses for some of the planned contents, the Committee considered that the production of standard datasets (similar to those produced for the analysis of Antarctic minke whales) would be useful. The secretariat will make the data available when requested although additional information must be provided if any additional verification is needed to that already incorporated into IWC-DESS.

10.12.6 Other cruises

10.12.6.1 REPORT OF JAPANESE CETACEAN SIGHTING SURVEYS IN THE NORTH PACIFIC IN 2012
SC/65a/O4 reported on three systematic dedicated sighting surveys conducted in 2012 summer by Japan (ICR) as a part of JARPN II to examine the distribution and abundance of large whales in the western north Pacific. Over 8,700n.miles were searched in total, and of the baleen whales, Bryde's whales were most frequently encountered, with only 5 individual minke whales observed in the offshore strata.

The Committee welcomed this report and **recognises** the value of the data. As noted under Item 10.12.2, sighting conditions might need to be accounted for when estimating abundance in the North Pacific (particularly for common minke whales), and indeed when designing surveys for that purpose. Although the small number of sightings of common minke whales in the offshore strata might well be largely due to poor weather, it was considered premature to conclude that no abundance estimate could be made without first seeing a weather-stratified analysis.

10.12.6.2 PLANS FOR A JAPANESE CETACEAN SIGHTING SURVEYS IN THE NORTH PACIFIC IN 2013
Plans for a systematic dedicated sighting survey in the North Pacific by Japan (ICR) as part of JARPNII in 2013 are described in SC/65a/IA03; the survey is currently underway. The main objective is to examine the distribution and estimate the abundance of common minke and sei whales for management.

Notwithstanding a possible minor trackline design issue, the Committee **endorses** the proposal.

10.12.6.3 REPORT OF CETACEAN SIGHTING SURVEYS IN THE ANTARCTIC IN 2012/13
Plans for a dedicated sighting survey in the Antarctic in the 2012/13 austral summer were presented last year and subsequently endorsed by the Committee (IWC, 2012a, p. 41). Two research vessels were to survey Area III E, Area IV, and the western part of Area V, using the same methods as in the IWC-SOWER surveys, and in accordance with the guidelines agreed by the SC (IWC, 2005). Unfortunately the research could not be conducted due to violent interference from an anti-whaling NGO (SC/65a/IA07).

The Committee noted and expressed its concurrence with the Commission's previous consideration of this issue and its 2011 Resolution on Safety at Sea (2011-2) in which the Commission and its Contracting Governments condemned any actions that were a risk to human life and property in relation to the activities of vessels at sea. In particular, the Committee expressed its regret that the actions prevented the sighting survey from being conducted, just as in 2011/12. Following the cessation of the IDCR/SOWER programme in 2009 (and notwithstanding smaller-scale national projects to collect sightings data in particular regions), surveys such as in SC/65a/IA07 provide the only dedicated cetacean sightings that are synoptic over a wide area, and as such are extremely valuable for the work of the Scientific Committee.

10.12.6.4 PLANS FOR CETACEAN SIGHTING SURVEYS IN THE ANTARCTIC IN 2013/14

A systematic cetacean sighting survey for abundance estimation is planned in the Antarctic in the 2013/2014 austral summer, as part of JARPA II (SC/65a/IA06). The planned research area comprises Area IV, Area V and the western part of Area VI, from December 2013 to March 2014. Details of the cruise, which also incorporates biopsy sampling and photo-id work, are incorporated in Annex G, item 4.3.

In discussion, the Committee recognised the difficulty of fully reviewing a proposal without detailed design information, but noted that this seems unavoidable given security considerations (see 10.12.6.3). The use of consistent protocols over time makes this series of cruises a valuable resource, not least for analysing ice effects. The Committee recalled that photo-IDs of blue, right, and humpback whales from similar surveys in the past have been submitted to the relevant catalogue-holders for those species (and will continue to be submitted in future). The Committee broadly **endorses** the proposal, **recommending** that the proposed trackline design be changed if a survey of the Ross Sea was actually able to proceed.

10.13 Other

10.13.1 Photographic archiving

SC/65a/IA14 presented a progress report of a major archiving and cataloguing exercise for the photographic collections arising out of the IDCR/SOWER and continuing IWC-POWER cruises being undertaken by the Secretariat. The photographs have a wide range of potential uses ranging from photo-identification through education to contributing to assessments of human impacts.

The Committee **expresses** its appreciation for the efforts of Taylor and Donovan in archiving and cataloguing the collections and looks forward to a further update next year.

10.13.2 Sperm whales

SC/65a/SH14 investigated the potential recovery of sperm bulls off Albany, Western Australia. This segment of the population was reduced by commercial whaling by 74% between 1955 and 1978. In 2009, an aerial survey was undertaken to replicate the behaviour of the 'spotter' planes employed by the Albany whaling fleet from 1968-1978. The mean number of sperm bulls seen on transect per day (morning) in 2009 was substantially lower than the mean number seen in any of the years between 1968 and 1978. The authors emphasised the preliminary nature of the results, but considered them indicative of a lack of increase in the number of sperm whales frequenting this area compared to when whaling was taking place.

The Committee discussed possible interpretations of these findings, including the potential for population shifts due to ecological changes. It also noted a relevant discussion on sperm whales off New Zealand in Annex M, item 8.8. However, the possibility of population decline led the Committee to discuss the feasibility of undertaking a future assessment of sperm whales. There was general agreement that such an assessment would concentrate on sperm whales in the Southern Hemisphere, but include equatorial nursery groups and the Arabian Sea. The Committee discussed the availability of data on (1) population structure within ocean basins, (2) population size within ocean basins (and abundance in smaller areas), (3) catch history and (4) considerations in the development of a new assessment model (Annex H, Item 6.1).

The Committee **agrees** that data availability and feasibility of future assessment would continue to be evaluated intersessionally and reported to the Committee next year. It **recommends** that a dedicated agenda item be added for this species for next year's meeting. More details can be found in Annex H, Item 6.1.

11. STOCK DEFINITION

This agenda item was established in 2000, and has been handled since then by a Working Group. The Terms of Reference for this Working Group were changed in 2012 to reflect the evolving needs of the Committee. During this meeting, the Working Group continued to develop guidelines for preparation and analysis of genetic data within the IWC context (see Item 11.1), provided the Committee with feedback and recommendations concerning stock structure related methods and analyses presented to other sub-committees (see Item 11.2), and developed a draft reference glossary of stock related terms, to aid consistent definition of 'stocks' in a management context for the Committee (see Item 11.4 and Appendix 5 of Annex I). The Report of the Working Group is given as Annex I.

11.1 Guidelines for DNA data quality and genetic analyses

Two sets of reference guidelines have been developed and endorsed by the Committee (IWC, 2009d) and form 'living documents' that can be updated as necessary[14]. The first set addresses DNA validation and systematic quality control in genetic studies. The second set provides guidelines for some of the more common types of statistical analyses of genetic data used in IWC contexts, and contains examples of management problems that are regularly faced by the Committee. Three new sections were added to the data quality guidelines during SC65a. Substantial progress on the genetic analysis guidelines was also made during this meeting and this document will now be completed intersessionally (see Item 11.5). Both guidelines will also be published in the peer-reviewed literature.

11.2 Statistical and genetic issues related to stock definition

A number of Committee stock related papers were discussed by the Working Group. These were submitted to the following sub-committees: Revised Management Procedure (Annex D), Bowhead, Right and Gray Whales (Annex F), In-Depth Assessments (Annex G), Other Southern Hemisphere Whale Stocks (Annex H) and Review of Special Permit Proposals (Annex P). Technical comments on these papers are given in Annex I.

Gray whale stock structure was discussed in the context of SC/65a/BRG16 and Appendix 2 (Annex I). An initial set of hypotheses were developed from these documents to describe the stock structuring of western and eastern gray whales, with particular reference to the Sakhalin Island feeding ground. These initial hypotheses are shown in Appendix 3 (Annex I). They will be further developed intersessionally and assigned levels of plausibility. This will contribute to the proposed rangewide workshop on gray whale stock structure and status (see Item 26).

A general comment was raised that is relevant to many discussions of stock related papers presented to the Committee. With new 'next-generation' DNA sequencing (NGS) techniques, it is now relatively inexpensive to increase the number of genetic markers analysed, so that more information can be gained from each sample in a population study. More genetic markers are often called for in circumstances where the existing marker set cannot detect population differentiation, either due to lack of discriminatory power or lack of population subdivision. Increasing the number of genetic markers increases the power to detect subtle population structuring and can facilitate future studies of relatedness patterns among sampled animals. Simulation analysis of the power of DNA markers to measure departures from panmixia and to reject demographically significant (i.e. sufficiently high) migration rates between putative differentiated populations can provide a useful means of measuring whether the existing DNA marker dataset is sufficient to answer the management question being posed. In all Committee studies, it is important to consider the level at which structure population needs to be detected in order for it to be of management concern. Increased numbers of loci can increase power to detect subtle population structure and also allow for improved inference of the population history underlying the substructure. However, they can also increase resolution to the point where even individuals can be discriminated and can also amplify spurious signals from genotype errors and small departures from random sampling. With the rapid recent developments in NGS technology and analysis, there are some emerging issues of relevance to the Scientific Committee, in terms of: (1) assessment of NGS data quality, and how best to curate such data, and (2) new methods for measuring stock structuring and measurement of other statistical quantities of interest to the Committee. New and published papers on this topic are therefore solicited for submission next year, where they will be considered in the context of the existing Committee guideline documents on DNA analysis and quality (see Item 11.5).

11.3 Testing of Spatial Structure Models (TOSSM)

The aim of TOSSM is to facilitate comparative performance testing of population structure methods intended for use in conservation planning. From the Committee's perspective, the IWC-developed TOSSM software package allows evaluation of methods for detection of genetic structure, in terms of how well the methods can be used to set spatial boundaries for management. It is available for all to use and simulated datasets exist for three of the five stock-structure archetypes previously proposed by the Committee (IWC, 2009b, p. 51). Progress has been made on the work items suggested at last year for the Pacific Coast Feeding Group of gray whales (see Item 8.1) and will be presented at the 2014 Annual Meeting.

The Committee noted that the potential for using simulated datasets generated by TOSSM for work to evaluate dispersal rates and new methods for genetic clustering, as proposed under RMP (Annex D, Appendices 3 and 4), particularly in relation to stock hypothesis under review for the Scientific Committee.

11.4 Terminology and unit-to-conserve

Defining and standardising the terminology used to discuss 'stock issues' is still a long standing objective of the Working Group on Stock Definition, in order to help the Committee report on these issues according to a common reference of terms. Appendix 5 of Annex I has been developed by the

[14] http://iwc.int/scientific-committee-handbook#ten

Working Group with the aim of encouraging consistent use of stock related terms within Committee reports and in papers submitted to the Committee. The Appendix provides initial draft definitions of Committee terms such as 'biological stock', 'sub-stock', 'population' and 'management stock' which will be further discussed and refined intersessionally by members of the Committee. A list of agreed terms will be finalised next year. A challenging example set of cetacean populations that have been discussed by the Scientific Committee over the last five years will be chosen and their stock 'definitions' agreed intersessionally, also for presentation and discussion at next year.

11.5 Workplan

The Committee's workplan for this item is given under Item 24.

12. ENVIRONMENTAL CONCERNS

The Commission and the Committee have increasingly taken an interest in the possible environmental threats to cetaceans. In 1993, the Commission adopted resolutions on research on the environment and whale stocks and on the preservation of the marine environment (IWC, 1994a; 1994b). A number of resolutions on this topic have been passed subsequently (e.g. IWC, 1996b; 1997; 1998a; 1999a; 1999b; 2001a). As a result, the Committee formalised its work on environmental threats in 1997 by establishing a standing working group that has met every year since.

12.1 The State of the Cetacean Environment Report (SOCER)

SOCER provides an annual update, requested by the Commission, on: (a) environmental matters that potentially affect cetaceans and (b) developments in cetacean populations/species that reflect environmental issues. It is tailored for a non-scientific audience. The 2013 SOCER (Annex K, Appendix 4) had the Mediterranean and Black Seas as the regional focus. Publications summarised ranged from impacts of fisheries removals on cetacean prey to strategies aimed at reducing bycatch in the severely reduced population of common dolphin, to contaminants in Mediterranean cetaceans. Disease continued to be an important issue in the Mediterranean. Finally, an overview published by ACCOBAMS identified the main threats to cetaceans in the Mediterranean and Black Seas.

Globally, numerous studies on climate change and ocean acidification are starting to show impacts on marine species. Data on the impacts of underwater noise are increasing with new models becoming available on stress responses in cetaceans linked to underwater noise.

The Committee encourages continued contributions to this effort. Next year, the focus of the SOCER will be on the Atlantic Ocean region.

12.2 Pollution

12.2.1 Update on POLLUTION 2000+ Phase II progress

At the intersessional POLLUTION 2000+ Phase II workshop, held in 2010 (IWC, 2011a), four objectives for the cetacean pollutant exposure and risk assessment modelling component were agreed: (1) improve the existing concentration-response function for PCB-related reproductive effects in cetaceans (completed in 2011); (2) derive additional concentration-response functions to address other endpoints (e.g., survival, fecundity) in relation to PCB exposure (completed in 2012); (3) integrate improved concentration response components into a population risk model (individual-based model) for two case study species: bottlenose dolphin and humpback whale; and (4) implement a concentration-response component for at least one additional contaminant of concern.

SC/65a/E04 provided a summary of the intersessional work that was completed in POLLUTION 2000+, Phase III. The objective of this work was to develop a framework for assessing the health risks associated with contaminant exposure on cetacean populations. Two previous papers on the first phases of this work can be found in Hall *et al.* (2011) and Hall *et al.* (2012).

Bioaccumulation of contaminants and their population level effects were explored using a stochastic model that integrates measured tissue concentrations with a dose-response relationship to estimate potential impact on population dynamics. Two examples were examined using this framework: bottlenose dolphins and humpback whales. One of the model outputs was an annual accumulation rate for blubber PCB levels (e.g. 1.2 mg/kg lipid for female bottlenose dolphins and 0.2 mg/kg lipid for Gulf of Maine humpback whales). These exposure levels would produce no discernible effects on population growth. Analyses of model parameter sensitivity and uncertainty indicate that the model is reasonably robust and would be acceptable for making population inferences and management decisions.

An approach that would allow concentrations of total blubber PCBs in cetaceans to be estimated from data on concentrations in their prey was also explored, assisting in situations where biopsy samples are not obtainable. In an example again using bottlenose dolphins, data on energy requirements and consumption rates on concentrations of total PCBs in prey were combined in a physiology-based toxicokinetic model.

These modelling approaches provide a risk assessment tool that can be used to determine the population consequences of exposure to contaminants. The model framework also has the potential for investigating the impact of a variety of stressors on cetaceans and is currently being converted into a web-based program with a user-friendly interface that will be accessible from the Commission website.

Since the Pollution 2000+ Phase III risk assessment work plan is near completion, the Committee began planning the next phase. The Committee established a Pollution 2020 steering group, which will next focus on assessing the toxicity of microplastics (see Annex K, Item 11.2) and polycyclic aromatic hydrocarbons and dispersants in cetaceans (see Annex K, Appendix 2).

The Committee **commends** the progress on Pollution 2000+ Phase III objectives and **strongly supports** its continued work to further develop the necessary tools to assess cetacean pollutant exposure risk. The Committee **agrees** to the Pollution 2020 framework plan.

12.2.2 Oil spill impacts

After the Deepwater Horizon oil spill in April 2010, oil spill response began, followed immediately thereafter by a Natural Resource Damage Assessment (NRDA) to investigate the injuries and impacts to cetaceans in the Gulf of Mexico. The NRDA investigation has included stranding response in the northern Gulf of Mexico; photo-ID and biopsy surveys for bay, sound and estuary dolphins; aerial and boat-based surveys, including biopsy and tagging activities, for cetacean abundance and distribution in coastal and offshore habitats; and live capture/release health assessments.

An Unusual Mortality Event (UME) was declared in November 2010 for cetaceans in the northern Gulf of Mexico that started in February 2010 and now includes over 1000 cetacean strandings. The Deepwater Horizon oil spill has not been ruled out as a possible contributing factor to this UME, which is the longest lasting and largest dolphin mortality event in U.S. recorded history. In addition to the UME investigations, live capture/release health assessments of bottlenose dolphins from Barataria Bay, Louisiana (oiled area) and Sarasota Bay, Florida (reference site) were performed in 2011. Dolphins from Barataria Bay showed significant health issues, including pulmonary lesions and adrenal abnormalities, as compared to animals in Sarasota Bay. Chemical analyses associated with these stranded and live-capture dolphin studies have been completed and are currently being validated. In addition, a number of monitoring and assessment efforts on cetaceans have been conducted in offshore areas, including photo-ID, passive acoustic monitoring, and tagging studies on pelagic species (e.g. sperm whales), as well as aerial and boat-based surveys.

The Committee **expresses great concern** about the continued high number of dolphin strandings in 2013. The Committee **agrees** that funding gaps are problematic for long-term monitoring projects, recognising that 3-5 year funding cycles are not geared toward such studies. The Committee welcomes the new information on marine mammal studies in the Gulf of Mexico and **encourages** scientists to provide restoration ideas for cetaceans to NOAA.

Information on oil spill preparedness was also presented. Details were provided on the Arctic Council's efforts to address oil spill preparedness (and response) based on the 1990 International Convention on Oil Pollution Preparedness Response and Cooperation (OPRC), administered by the International Maritime Organization (IMO), to which all eight Arctic States are Parties[15]. Additionally, the Committee was given details on the U.S. National Research Council's review of the capabilities, limitations, and needs for responding to an oil spill in the Arctic[16], as well as the U.S. Arctic Research Commission's recently published white paper examining the state of oil spill preparedness, response and damage assessment in the Arctic[17].

Several workshops focused on Arctic resource development and policy will be held in the next year. Developing recommendations related to cetacean conservation and management may provide the convenors of these workshops with information necessary for sound decision-making. The Committee **reiterates** its previous conclusion (IWC, 2011b) that a review of the capacity for oil spill response in the Arctic was an urgent priority in the aftermath of the Deepwater Horizon oil spill. The Committee **concludes** that it would be useful to know more about the current capacities and mechanisms of oil spill recovery. Given the amount of activity occurring related to oil spill preparedness and the fact that oil spill preparedness and response plans are being developed, the Committee **recommends** an increased exchange of information between the IWC Secretariat and the Arctic Council's Emergency Prevention, Preparedness, and Response Working Group (EPPR WG).

12.2.3 Other pollution-related issues

In response to the statement in Resolution 2012-1 encouraging the World Health Organization (WHO) to conduct reviews of recent scientific publications regarding contaminants in certain cetacean products

[15] www.Arctic-council.org/index.php/en/reources/news-and-press/press-room/733-press-release-15-may-kiruna-2

[16] http://dels.nas.edu/study-in-progress/responding-spills-Arctic/DELS-OSB-09-02

[17] www.Arctic.gov/publications/oil_spills.2012.html

and give updated advice for consumers, the Committee **recommends** that the Secretariat reinitiate discussions with the WHO as a preliminary step, to ensure that they are in need of this information and would be willing to receive it, prior to moving forward on this Item.

Following on from the workshop, in which recent advances in methods for non-lethal sampling were discussed (SC/64/O14), Hunt *et al.* (2013) focussed on methods that can produce information on parameters relevant to stress physiology, reproductive status, nutritional status, immune response, health, and disease (see Annex K, item 7.2.3). Field application of these techniques has the potential to improve our understanding of the physiology of large whales, better enabling assessment of the relative impacts of many anthropogenic as well as ecological pressures. SC/65a/BRG23 reported on the progress of a programme to analyse biopsy samples of gray whales feeding off of Sakhalin Island, Russia that will include pregnancy testing, determination of stable isotope ratios and genetic analyses.

The Committee **commends** the recent advances in methods for non-lethal sampling, noting that information on stress physiology, reproductive status, nutritional status, immune response, health, and disease are valuable to health assessment efforts. The Committee **endorses** this work and **strongly recommends** further development and improvement of these methodologies. The Committee **commends** the application of such techniques to the gray whales feeding off of Sakhalin Island, Russia.

The Committee received several contaminant-related papers, including those reporting concentrations of legacy persistent organic pollutants, trace elements, radioactivity and new contaminants of concern in Icelandic minke whales, associated with the Icelandic Research Programme. A summary of the findings of these studies is listed in Annex K, item 7.3.2. The Committee thanked the Icelandic scientists for summarising these findings.

12.3 CERD (Cetacean Emerging and Resurging Disease)

In 2007, the Committee recognised the need for increased research and standardised reporting in a wide range of disciplines dealing with cetacean health (IWC, 2008d), which led to the creation of the Cetacean Resurging and Emerging Disease Working Group (CERD).

12.3.1 Update from CERD Working Group

An update to the CERD Work Plan agreed in 2011 (IWC, 2012e, Appendix 3) included: (i) identification of regional and national experts/points of contact via Steering Committee membership; (ii) creation of a listserve and a website; (iii) creation of a Framework Document; and (iv) identification of and contact with organizations synergistic with the goals of CERD.

12.3.2 CERD Website and Workplan

Data on infectious and non-infectious diseases, general cetacean disease, nutritional disorders and biotoxins have been compiled and await entry onto the CERD website. Additional input on skin diseases, visual health assessment and mortality events or unusual mortality events (UMEs) is needed. It was noted that an internship program with projects aimed at expanding specific sections related to skin diseases, mortality events and visual health assessment would aid in this process.

The Committee **agrees** that supporting the aggregation of website information and input, and the ability to post and manipulate high-resolution images and video, are critical to the success of the CERD website. The Committee also **agrees** that there is value in linking to social websites in order to direct inquiries and information to the CERD website (for appropriate material). The Committee **encourages** continued development of the website.

12.3.3 Strandings and mortality events

SC/65a/SM27 reported on a mass stranding event (MSE) in which 20-30 short-beaked common dolphins stranded on a beach in the Rio de Janeiro State, Brazil, and were returned to the water by tourists. The authors proposed that these pelagic dolphins were probably acoustically trapped or restricted by some noise source that caused them to panic and swim toward the beach and strand. An update also was received on a highly unusual event involving the long-term displacement and mass stranding of approximately 100 melon-headed whales that occurred in May-June 2008 in northwest Madagascar. An Independent Stranding Review Panel was formed to review all the information and a report is expected in a few months. Details of the response can be found in Annex K, Item 8.3. The Committee **commends** industry and response organisations for a tremendous and successful effort in responding to and investigating this event.

Park (2012) reported on a mass mortality of 249 finless porpoises that occurred on 3 February 2011 at a dyke in the Saemangeum Sea, Korea. This MSE was due to freezing surface water in the enclosed area and the animals died of suffocation. The Committee **expresses concern** about this MSE, especially with respect to the potential impact of dykes and encouraged the continued evaluation of animals in this area. The Committee **commends** the efforts made to investigate the stranding event.

SC/65a/BRG15 reported on a workshop held in April 2013 dealing with the ongoing southern right whale die-off at Península Valdés, Argentina. A previous IWC workshop on the southern right whale die-off in 2010 (SC/62/Rep1) drew attention to the increasing incidence of parasitic behaviour of kelp gulls, which peck at the outer skin and then feed on the blubber of live whales at Península Valdés. The recent workshop developed an additional hypothesis on the possible contribution of gull attacks to calf mortality at Península Valdés (see Annex F, Item 4.4 for additional details).

The Committee **commends** the investigative team in Argentina for their thorough investigation. The Committee **encourages** continued work to evaluate the cause(s) of these mortalities, the implications to the population and the effectiveness of planned gull mitigation measures (and see Item 26).

Information on the International Workshop for Capacity Building on Marine Mammal Stranding (NOAA – IMARPE) was also received. The Government of Peru requested this workshop to help increase capacity for cetacean stranding response after a large die-off of common dolphins occurred in early 2012, in northern Peru. For more details see Annex K, item 8.3. Additional information on strandings and the detection of human-induced mortality was provided to a joint meeting of the SWG on Environmental Concerns and the Working Group on non-deliberate Human Induced Mortality. Furthermore, two papers on categorisation of human-induced trauma and interactions in cetaceans (Moore and Barco, 2013; Moore *et al.*, 2013a) were presented. Summaries of these papers can found in Annex J, Item 6.

12.3.4 Other disease-related issues

The Committee received a summary of three disease-related papers reporting on the occurrence and prevalence of parasitic organisms and pathogens in Icelandic minke whales, associated with the Icelandic Research Programme. Discussion points related to these papers are listed in Annex K, Item 8.3.4. The Committee thanked the Icelandic scientists for summarising these findings.

12.4 Anthropogenic sound

12.4.1 New information on the effects of anthropogenic sound on cetaceans

SC/65a/HIM1 discussed underwater bow-radiated ship noise in the Canary Islands (Spain), where a large fleet of commercial ferries operates on a year-round basis, and at the same time a high number of stranded cetacean carcasses in the area have shown injuries typically attributed to ship strikes. Whales may be capable of hearing approaching vessels at reasonable distances, enabling them to react fast enough to avoid collision; however, there are numerous factors to be considered in evaluating the actual collision risk. Overall, ferry traffic appears to contribute significantly to noise pollution in the Canary Islands archipelago.

SC/65a/E3 reported that significant progress has been made on the issue of marine noise pollution beginning in the mid-1990s. Within a few years, agencies such as the US Marine Mammal Commission had acknowledged the significance of marine noise pollution, as did some regional conventions, and later other legislative measures, such as the EU Marine Strategy Framework Directive – which specifically addresses noise – were developed.

New tools are under development to assess cumulative effects of noise such as cumulative noise and cetacean distribution mapping. Marine Spatial Planning and Marine Protected Areas are increasingly considering noise and disturbance and industry is investing in noise reduction and alternative technologies. For at least some noise sources, there seems to be a general consensus that time-area closures represent one of the most effective available means of reducing impacts on marine mammals. Ship-quieting technologies for commercial vessels are also being developed. For further details see Annex K, Item 9.1.

The Committee **encourages** time/area closures and new quieting technologies to address noise pollution. The Committee **encourages** further scientific investigations to better understand the effects of sound on cetaceans and their habitats and to better understand the effectiveness of mitigation measures.

12.4.2 Update on new tools and approaches to mitigate effects of anthropogenic sound on cetaceans

The status of current noise management is one of traditional focus on relatively short-term and relatively small-scale human activities, emphasising thresholds of noise exposure from high intensity and short duration sources, with limited abilities to incorporate knowledge of background noise or look at the broader cumulative impacts. However, recently there has been a shift underway to focus on more ecologically-relevant spatial and temporal scales, in order to address chronic, perhaps lower intensity, sources.

Work being undertaken on soundscape mapping was presented last year. An update on progress on soundscape mapping intersessionally was provided and a joint IWC/IQOE (International Quiet Ocean Experiment) technical workshop on soundscape modelling to address this was proposed (see Annex K Item 9.2.1; the full proposal can be found as Appendix 3). The goals of the workshop are to exchange, evaluate, and analyse soundscape modelling methodologies, examine and assess priority regions and important sound sources, and develop scientific recommendations.

The Committee **commends** the work on soundscape modelling. The creation of 'soundscapes' and noise maps was considered a valuable initiative. The Committee **encourages** the workshop planners to consider not only the identification of sites of highest noise impacts, but also the direct benefits that could be realised by the reduction of noise impacts. A direct link to conservation outcomes such as reducing noise impacts on cetaceans could be of particular interest to the Commission. For additional discussion of the proposed workshop, see Annex K, Item 9.2.1.

The Committee **strongly supports** this proposal for a workshop to be held intersessionally and reported to the Committee next year (Item 26).

12.5. Climate change

12.5.1. Update on recommendations from previous climate change workshops

No updates on previous climate change workshop recommendations were submitted for review and no papers were submitted under this topic.

12.5.2. Other climate change-related issues

The Committee recognised that climate change is an issue of increasing importance and should be kept on the agenda. In order to better identify topics for future climate change studies, the Committee **agrees** to the formation of an intersessional correspondence group (Annex R). The Committee **agrees** to use the outputs of the intersessional group to develop future priorities under this topic.

12.5.3. Planning for Intersessional Arctic Anthropogenic Impacts Workshop

In 2010, the Commission requested that the Committee develop an agenda for a workshop on Arctic Anthropogenic Impacts on Cetaceans. The Committee drafted an agenda and formed a workshop steering group to further develop a plan for the workshop (IWC, 2012f). A revised agenda that focused on anthropogenic activities related to oil and gas exploration, commercial shipping and tourism was developed by the workshop steering group and presented last year (see Annex K, Item 10.2).

In discussion, it was noted that this will be a Commission workshop and is planned for the next intersessional period. The agenda, venue, timing and participant list are still being developed.

The Committee recognises that the topic of anthropogenic impacts to cetaceans in the Arctic is broad and complex and **encourages** further efforts to address these impacts. The Committee noted that the activities recommended above under Item 12.2.1 on oil spill preparedness and responses represent one immediate effort to better coordinate with Arctic IGOs.

12.6 Other habitat-related issues

12.6.1 Interactions between Marine Renewable Energy Devices (MREDs) and cetaceans

SC/65a/E2 reviewed public knowledge of the Marine Renewable Energy Devices (MRED) workshop report from last year (IWC, 2013b), as well as its larger impacts, to better understand whether the recommendations from such reports are reaching the appropriate audiences and providing them with useful information. Workshop participants were surveyed and whilst the respondents found the workshop useful personally and the meeting generally well run, the replies provided little evidence yet that the workshop has had any influence on policy-making or other processes related to marine renewables. There is also little sign of any footprint of the workshop in any recent scientific or other related literature. Related to this, several participants raised concerns about the inability to find and access the report, as well as how to cite it.

The Committee **agrees** that the visibility and accessibility of its reports needs to be improved and **encourages** the Secretariat and the Committee to consider additional mechanisms to enhance access to, and distribution of, Committee reports.

12.7 Workplan

This is discussed under Item 24.

13. ECOSYSTEM MODELLING

The Ecosystem Modelling Working Group was first convened in 2007 (IWC, 2008c). It is tasked with informing the Committee on relevant aspects of the nature and extent of the ecological relationships between whales and the ecosystems in which they live.

Each year, the Working Group reviews new work on a variety of issues falling under three areas:

(1) reviewing ecosystem modelling efforts undertaken outside the IWC;
(2) exploring how ecosystem models can contribute to developing scenarios for simulation testing of the RMP; and
(3) reviewing other issues relevant to ecosystem modelling within the Committee.

The report of the Working Group on Ecosystem Modelling is given as Annex K1.

13.1 Review ecosystem modelling efforts undertaken outside the IWC

13.1.1 Modelling of the direct relationship between baleen whale populations and the abundance of their prey

Two invited presentations were made on ecosystem models of the effects on predators of fishing on forage fish, summarising the results of two large studies commissioned by the Marine Stewardship Council, MSC (Smith *et al.*, 2011) and the Lenfest Ocean Program (Pikitch *et al.*, 2012), that were completed in recent years. An important message from these studies is that fishing of forage fish down to their MSY level may have major impacts on predators, including birds and marine mammals, in some ecosystems. SC/65a/EM03, which summarised the MSC study, explored the effects of different levels of depletion of forage fish in five different ecosystems (the southern Benguela Current, the northern Humboldt Current, the California Current, the North Sea, and southeastern Australia) using three modelling frameworks (Ecopath with Ecosim (EwE), OSMOSE, and Atlantis). The results showed a trade-off between yield from the forage fish species and impacts on the rest of the ecosystem. Although the broad results were relatively robust to the type of model used, predictions about impacts of and on particular species or groups varied considerably between models, suggesting that their use for 'tactical purposes' is not yet warranted.

SC/65a/EM05, which summarised the Lenfest study, conducted a meta-analysis of 72 published studies that used Ecopath models on a variety of marine ecosystems, with the goals of characterising the role of forage fishes and fisheries, and of providing general recommendations for conservative fisheries management. Further analyses using EwE models for 10 ecosystems suggested that minimum biomass levels to avoid predator declines should be about 75% of the unfished biomass – much higher than those predicted by single-species, MSY-based management. A tiered management approach was recommended where more conservative harvest limits are applied when there is high uncertainty about forage fish dynamics or predator dependencies. This study did not evaluate the impacts on marine mammals, and the general approach would need modification to address important aspects of whale populations which do not exhibit the high degree of variability that is characteristic of forage fish populations, or the effects of 'prey switching' that occurs when several forage species are present in an ecosystem.

The Committee **concurs** with the authors of the presented studies that the models used in the studies to date are useful for their broad-scale strategic conclusions, but are not yet suitable guides for short-term tactical management decisions. The Committee **agrees** that, in broad terms, the case has been established that forage fisheries are expected to impact predator populations including cetaceans, and considers that the priority for this Group should now be on more detailed models for specific cases involving whales, with more attention being paid to the dynamics, including stochastic factors. The Committee **agrees** that the framework discussed in section 13.2 is a promising basis for modelling the effect of changes in prey species on whale populations.

13.1.2 Update from CCAMLR's Ecosystem Monitoring and Management Programme (WG-EMM) on krill and its dependent predators

The Committee held a joint workshop with CCAMLR in 2008 (IWC and CCAMLR, 2010). Since then, the Committee has identified significant knowledge gaps in aspects such as spatial variability and trends in prey species, on the relationships between predators and prey, and on the effects of environmental variability on predators. Given CCAMLR's considerable expertise on these aspects, the Committee **agrees** that the Chair of the Committee should write to CCAMLR in time for the meeting of the WG-EMM in Bremerhaven, Germany, in early July 2013, to discuss how to establish future collaborations.

13.2 Explore how ecosystem models can contribute to developing scenarios for simulation testing of the RMP

SC/F13/MSYR2 described a modelling framework originally presented at the Fourth MSYR Workshop (SC/65a/Rep5) that uses spatially resolved individual animal behaviour and detailed energy budgets to determine reproductive success and mortality in an environment where food has a patchy spatial distribution. One immediate application relates to the characterisation of yield curves for populations in stochastic environments, including assessing the relative advantages of defining yield curves in terms of number or biomass.

The Committee identified nine issues – listed in Annex K1 – relating to ecosystem effects and the RMP that could be usefully explored either with this individual-base model (IBM) or with simplified emulator models that mimic the behaviour of the IBM. The Committee appointed a correspondence group under de la Mare to develop specific trials for the RMP for one of these issues (characterisation of yield curves for populations in stochastic environments) and **agrees** to make two of the remaining items a high priority for next year:

(1) effects of competition, including effects on whales from fisheries on prey species; and
(2) observable environmental and population characteristics likely to be indicators of ecosystem effects.

The Committee **encourages** analyses on these issues and **agrees** to invite outside expertise as needed.

13.3 Review of other issues relevant to ecosystem modelling within the Committee

13.3.1 Update on Antarctic minke whale body condition analyses

For the last three years, the Committee has discussed apparent declining trends in blubber thickness and body condition in Antarctic minke whales (Konishi *et al.*, 2008) over the 18 years (1987-2006) of the JARPA special permit programmes (e.g. IWC, 2013g). At the heart of the discussion has been the validity of the statistical methods that were used to derive these trends and more specifically whether the models fitted so far adequately captured the main sources of variability in the data, given the nature of the sampling (de La Mare, 2011; 2012). This discussion is relevant to ecosystem modelling because the findings have implications for energetics, reproductive fitness, foraging success and the prey base itself, all of which are important as input in models.

Previously, the Committee has requested further analyses of the data, including:

(1) determining whether the models fitted so far capture all the main features of the data,
(2) determining whether the estimate of trend could be made more precise,
(3) analysing the two sexes separately,
(4) including the interaction of slopes by latitudinal band with year as a random effect, and
(5) investigating independence issues by using mixed-effects models with trackline as a random effect (IWC, 2011; 2012).

Two reanalyses of the data were conducted at the 2011 meeting, one using the jack-knife method with one year as the unit on the published regression model (IWC, 2012d), the other using mixed-effect models to account for some of the variance structure (Skaug, 2012). Both reanalyses resulted in a much higher variance of the estimated trend, but the point estimates were little changed and were still significant.

This year, SC/65a/EM04 presented jack-knife estimates of the variance of the trend by taking individual years or groups of up to three years as the jack-knifing unit. Unexpectedly, the variance of the trend estimate was much less than the variance calculated by Skaug (2012) from the model itself. This led to considerable discussions within the Working Group on the appropriate statistical procedures to use. These are detailed in Annex K1 under item 4.1 and are not repeated here. In addition, a new analysis of total body fat was also presented (Annex K1, Appendix 6) that the authors believed supported the earlier conclusion of a decline in energy storage in Antarctic minke whales during the JARPA period but that others questioned.

The Committee **reiterates** its recommendations from previous years that the outstanding issues raised at recent meetings should be examined (for details see Annex K1, item 4.1). A number of additional suggestions were also made this year. The Committee **encourages** additional analyses to be undertaken on both the blubber thickness and body fat data and noted that papers should ideally be submitted to the forthcoming JARPA II review (see Item 17.3).

13.3.2 Other, if new information is available

SC/65a/EM02 outlined plans for conducting ecosystem modelling for baleen whale species in Antarctic Area IV, based on data from the JARPA and JARPA II programs. Two types of approaches will be employed; one is a comprehensive, ‘whole ecosystem’ model (EwE), and the other is a ‘model of intermediate complexity’ for ecosystem assessments (a multi-species production model). Baleen whales and krill play key roles in both, and the results will be applied to available time series data of baleen whales, seals and krill. Results from these two approaches will be reported at the JARPA II review.

The Committee **welcomes** these plans but suggested that the aims of the modelling exercise be better clarified. The author explained that one aim is to compare the results from a broad-sweep model such as EwE that encompasses most components of the ecosystem with those from a model that includes more detail on the dynamics of the main species of interests. Documentation of the input sources will be provided and options for diagnostic tests of the predictions should be developed. This information should be included in any paper presented to the forthcoming JARPA II review.

SC65a/EM01 presented a preliminary report from a multi-species modelling effort to study the role of minke whales in the marine ecosystem around Iceland, including consumption of sand eel and cod. In its initial phase the focus is on implementing single-species models in the Gadget statistical framework, but the medium to long-term plans are to build multi-species models and to compare different modelling approaches such as Gadget, FishSums, EwE and Atlantis, in order to assess their value to the management of living resources in Icelandic waters as part of the MareFrame project.

The Committee **welcomes** these efforts and **encourages** further refinements to include the effects of environmental variability on prey species and to incorporate prey switching in the next version. It was also noted that these exercises typically require a substantial amount of exploration to determine what is driving the observed trends in the predicted abundance of the target species.

SC/F13/SP02Rev, SP03Rev and SP04Rev were initially presented at the Icelandic Special Permit Expert Panel Review Workshop in February 2013 and then revised in the light of comments made by the expert panel (SC/65a/Rep3). These papers presented new information on the feeding ecology of common minke whales based on analyses of stomach contents, fatty acid profiles in blubber and blood tissues, and stable isotopes measured in blood, muscle, and skin tissues. The studies showed pronounced spatial and temporal variations. The fatty acid and stable isotope analyses further revealed tissue specificity, indicating that the results need to be interpreted with their limitations in mind. Together, these papers indicated that the differences between the stomach contents, fatty acid and stable isotope analyses can best be explained by the different time periods reflected by these methods, such that the stomach content analysis represents the most recent feeding and is therefore the best measure for local diet composition within the time-frame of their model, while the other two methods reflect feeding before arrival on the Icelandic feeding grounds in spring.

Tamura and Murase welcomed the information on diet data from these studies stating that they are useful in ecosystem models. Detecting changes in prey requires long time-series of data and fatty acid analyses complement data from stomach analyses.

SC/65a/O02 presented estimates of seasonal energy deposition in minke whales from Icelandic waters, based on measured increase in weight and energy of different tissues. Minke whales increase their weight by 27% over the feeding season, but due to increases in energy density of tissues, the total increase in energy content of the body is around 90%. Most of the energy is stored in adipose tissue (blubber and visceral fat), but posterior dorsal muscle and bone tissue are also important sites for energy storage.

13.4 Development of a list of priority populations as candidates for Conservation Management Plans

The Committee **agrees** that the Ecosystem Modelling Working Group can best assist in this process in the context of provide specific advice once CMPs have been identified (see Item 21).

13.5 Work plan

The Committee's views on the workplan for Ecosystem Modelling can be found under Item 24.

14. SMALL CETACEANS

14.1 Review current status of selected populations of small cetaceans in East Asian Waters [China (including Taiwan), Korea, Japan and Russia (white whales only)]

This year, the priority topic was to review the current status of selected populations of small cetaceans in east Asian waters (Fig. 1, Annex L). The selection of species was based primarily on concerns about conservation status and the expectation that new information would be available.

14.1.1 Narrow-ridged finless porpoise (Neophocaena asiaeorientalis)

14.1.1.1 TAXONOMY AND NOMENCLATURE

SC/65a/O1 proposed that the general acceptance of two identified species in the genus *Neophocaena* – the narrow-ridged finless porpoise (*N. asiaeorientalis*) and the Indo-Pacific finless porpoise (*N. phocaenoides*) – should be recognised by the IWC. The change in taxonomy was based on clear morphological differences, genetic data and partial sympatry of the two forms in the Taiwan Strait (Jefferson and Wang, 2013).

The Committee **endorses** the updating of the IWC list of recognised species (see Item 20).

SC/65a/SM24 presented a genetic analysis of finless porpoises in Japanese waters. The Committee **agrees** that these results confirmed previous ecological, morphological and molecular studies showing that there are at least five separate local populations of finless porpoises in Japanese waters that should be treated as different management units.

14.1.1.2 BYCATCH: REPUBLIC OF KOREA

Korea reported a total bycatch of more than 1,000 finless porpoises in 2011, including 249 that died under ice after being trapped inside a newly constructed 33km dike within the Saemangeum reclamation project (Yellow Sea). In 2012, Korea reported bycatches of 2,050 finless porpoises in the Yellow Sea and 128 in the Sea of Japan/East Sea (see details in Table 1 of Annex L).

Deliberate killing of cetaceans has been illegal in Korean waters since 1986 and a requirement has been in place since 1996 to monitor whale meat coming from incidental catches. This was amended in 2011 to intensify monitoring of the circulation of whale meat in markets. Currently, every incidental catch must be reported to the Korean Coast Guard and a tissue sample from each animal must be submitted to the Cetacean Research Institute for its DNA registry established to detect and trace illegal catches. The Korean government has intensified its monitoring effort since 2011 and consequently the reported number of finless porpoises bycaught in the Yellow Sea has increased dramatically. Korea will prepare a mitigation programme to reduce the finless porpoise bycatch, including consideration of gear modifications, changes to fishing practices and 'pingers'.

Zhang *et al.* (2005) provided uncorrected (and thus minimum) estimates of finless porpoises of 21,532 animals in offshore waters and 5,464 animals in near-shore waters along the west coast of the Korean Peninsula (South Korean waters) to Jeju Island. At that time, the Committee had welcomed the studies and looked forward to their future refinement (IWC, 2006). The Committee also noted that the current bycatch of 2,000 porpoises would be about 7.4% of an estimate of total uncorrected abundance of 27,000 porpoises in 2004.

The Committee **appreciates** the valuable information on finless porpoise bycatch provided by the Korean scientists. It **encourages** researchers and managers to continue their efforts to improve reporting and investigate ways to assess and manage the bycatch, particularly given the uncertainty regarding sustainability. The Committee **recommends** that an analysis be conducted to estimate past bycatches of finless porpoises using data on historical and recent fishing effort together with recently documented bycatch levels. It further **recommends** that available abundance data on finless porpoises in Korean waters be summarised for consideration at next year's meeting together with bycatch data to allow a better evaluation by area. The Committee **commends** the Korean authorities for their efforts to reduce this bycatch and **requests** that a report summarising progress on bycatch mitigation measures be submitted next year.

14.1.1.3 BYCATCH: JAPAN

Reported bycatch in Japan is low; a provisional figure of only 15 finless porpoises were reported as bycaught for January-December 2011[18]. Provisional data on strandings in Japan over the same time period indicated a total of 181 finless porpoises of which 178 were necropsied; it is not known to what extent the strandings were a result of bycatch.

14.1.1.4 IUCN RED LIST STATUS[19]

In 2012, IUCN listed *N. asiaeorientalis* as Vulnerable (see Annex L, section 3.1.4, for full details). Reeves reported that a new assessment of the Yangtze subspecies *N. asiaeorientalis asiaeorientalis* will soon be published listing the subspecies as Critically Endangered.

14.1.2 Populations of Tursiops aduncus *in Korean and Japanese waters*

Wang JY and colleagues (Wang *et al.*, 1999, 2000a, 2000b) distinguished the Indo-Pacific bottlenose from the common bottlenose dolphin using genetic, osteological and external morphological data. Around Japan, Kurihara and Oda (2006, 2007) concluded that the Indo-Pacific bottlenose dolphin occurs in at least three locations: (1) Amami Islands, (2) Amakusa-Shimoshima Island and (3) Mikura Island. Kim *et al.* (2010) confirmed the presence of this species around Jeju Island, Korea.

14.1.2.1 JAPAN

SC/65a/SM26 summarised the abundance of, and threats to, nine populations of Indo-Pacific bottlenose dolphins in the Japanese Archipelago – details are given in Annex L, item 3.2.1. The Committee **notes with concern** an apparently serious bycatch problem around Amakusa-Shimoshima Island (Shirakihara and Shirakihara, 2012). It **recommends** that this problem is monitored closely and that efforts are made to reduce bycatches.

SC/65a/SM29 reported on a stranding of a 2.7m male Indo-Pacific bottlenose dolphin in Kagoshima for which gross and histological examinations suggested the animal had a Lobomycosis-like disease. Analyses are underway to confirm this diagnosis.

The Committee **agrees** that it is important to understand the origins and routes of spreading of this disease and **recommends** further investigation and continued close monitoring of the population around Amakusa-Shimoshima Island in western Kyushu.

While recognising the responsibility of the range state for the conservation and management of small cetacean species, Japan reconfirmed its position on the involvement of IWC in the management of small cetaceans and reserved its position on all management recommendations regarding small cetaceans.

14.1.2.2 KOREA

Korean scientists provided information on the year-round resident population of Indo-Pacific bottlenose dolphins in coastal waters of Jeju Island. The total population was estimated[20] as 124 (95% CI = 104-143) in 2008 and 114 (95% CI = 109-133)[2] in 2009 using photo-identification mark-recapture methods. The animals are most regularly observed along the northern coast of the island. Bycatch has been investigated since 2009 and the annual bycatch rate was estimated at 7%, with most of the animals being trapped in pound nets (a type of set net or trap). More than 80% of the dolphins have been alive when found in pound nets; if released alive a gradual increase in the local dolphin population might be expected.

An effort is underway to release three dolphins back into the wild in summer 2013 after being instrumented with satellite tags in the area of Jeju Island where they were caught before being sold illegally to Korean oceanaria. They are among at least 11 bottlenose dolphins brought into captivity from the Jeju population in the last four years.

The Committee thanked H-W Kim and colleagues for providing information on the small local population of bottlenose dolphins around Jeju. It **encourages** their work to continue and **requests** updates on this including the satellite-tagged released animals and efforts to release dolphins in fishing gear.

*14.1.3 Short-finned pilot whales (*Globicephala macrorhynchus*) in Japan*

SC/65a/SM12 reviewed available information on the status of the southern and northern form short-finned pilot whales in Japan. Available abundance estimates of both forms are more than twenty years old. Catches have declined but the cause or causes are uncertain. Changes in catch composition of the northern form in the 1980s, with a declining proportion of old and large individuals (probably

[18] http://www.jfa.maff.go.jp/j/whale/w_document/pdf/130531_progress_report.pdf

[19] www.iucnredlist.org/

[20] The Committee did not review this estimate.

mostly males) observed in the catch, was inferred to indicate a decline in the population (IWC, 1987). No recent information has been published on the catch composition of either form. In the absence of an analysis of relevant data on effort, catch locations etc., the most parsimonious assumption would be that the decline in catches has been due to a decline in the availability of pilot whales in the whaling areas.

In the absence of new information, the Committee **recalls** its previous concerns regarding these stocks (IWC, 1987; 1992). A **recommendation** relating to catches of small cetaceans by Japan including this species is given under Item 14.4.1.

Morishita stated that the declines in catches of small cetaceans in Japan are largely attributable to economic factors such as low prices of the products, high fuel prices and the effects of the 2011 earthquake and tsunami.

14.1.4 Dall's porpoise (Phocoenoides dalli)
SC/65a/SM11 reviewed available information on the status of Dall's porpoise populations taken in hand harpoon hunts in Japan. Detals are given in Annex L. item 3.4. The most recent available abundance estimates of the hunted *dalli*-type population date from 2003 (Miyashita *et al.*, 2007)[21]. The Committee previously recommended that a complete survey of the ranges of the populations be undertaken as soon as feasible (IWC, 2009e).

Catches of both forms have declined, particularly those of the *dalli* form, with only 16% of the quota taken in 2010. Available data are insufficient to determine the cause of catch declines and no up-to-date information on catch composition has been published for either form of the species. In 2012 - 2013 the catch limits were set at 7,147 *dalli*-type and 6,908 *truei*-type porpoises; around 4% of the 2003 abundance estimates.

The Committee notes that abundance estimates are now ten years old and catch limits are still probably unsustainable (Wade *et al.*, 2008). The Committee **reiterates** its previous concerns (IWC, 2002a, pp.57-8; 2008a, p. 51). A **recommendation** relating to catches of small cetaceans by Japan including this species is given under Item 14.4.1.

14.1.5 White whales of the Okhotsk Sea
SC/65a/SM23 summarised available information on population structure, abundance and historical catches of white whales in the Okhotsk Sea. Based on aerial surveys in 2009-2010, the entire population was estimated to be a minimum of 6,113 (CV = 0.068), and when corrected for availability bias was estimated at 12,226 (see Appendix 2 for more details). Two-thirds of satellite-tagged animals (2007-2010, n=22) that summered in the Sakhalin-Amur region stayed in or visited the eastern part of the Shantar region in the autumn. In the winter, the whales travelled northward and offshore, where they used different wintering grounds. None of the 22 animals went to the area which a single tagged animal from western Kamchatka visited in winter.

SC/65a/SM23 also reported genetic data that suggested the existence of at least two Okhotsk populations: northeastern Okhotsk Sea and western Okhotsk Sea. Animals from the western population have been subject to live-capture for the last 30 years under an annual quota system. The average annual catch from 2000-2012 was 23 (range 0 to 44). In 2012, the quota for the North-Okhotsk subzone was increased by a factor of five (to 212) and then in 2013 to 263; 44 were live-captured in 2012. There is a quota of 45 for the West-Kamchatka subzone in 2013.

After reviewing the information both SC/65a/SM23 and a recent assessment by Reeves *et al.* (2011) the Committee **concludes** that the Russian domestic quota of 263 for the North-Okhotsk subzone was at least 6 to 8 times higher than that likely to be sustainable for the Sakhalin-Amur portion of the total regional population. In practical terms, the live captures are likely to be conducted at a single site which means they will target only the Sakhalin-Amur summer aggregation which raises concerns about local depletion (Reeves *et al.*, 2011; SC/65a/SM23).

Given this, the Committee **recommends** that the live-capture quota for the North-Okhotsk subzone be reduced to a level that is consistent with available scientific data and that at least four summer aggregations in the North-Okhotsk subzone should be managed separately such that the total allowable quota is broken down into separate quotas for Sakhalin-Amur, Ulbansky Bay, Tugursky Bay and Udskaya Bay (a fifth aggregation, in Nikolaya Bay, should have a zero quota as the number of animals using that bay is very small; SC/65a/SM23).

The Committee further **recommends** that no removals are authorised for the West-Kamchatka subzones, until sufficiently rigorous analyses of sustainability are provided that are at least as rigorous to those currently available for the North-Okhotsk subzone.

14.2 Report on the Voluntary Fund for Small Cetacean Conservation Research

14.2.1 Update on the 2011 awarded projects
Of the nine projects awarded in 2011, four were completed in 2012, two projects will be completed in 2013 and a further three will end at the beginning of 2014. See details in Annex L, section 7.1.

[21] The estimates were not assessed by the Committee.

At this meeting, information was received from five projects (Annex L, Item 8). The Committee was informed that the Secretariat is preparing a dedicated section for the IWC website on projects funded by the Small Cetacean Conservation Research Fund that will summarise projects' main achievements and ongoing activities.

14.2.2 Update on the 2013 selection process

Thanks to recent voluntary funding from Italy, the Netherlands, UK, USA, WWF-International and World Society for Protection of Animals, the Small Cetacean Conservation Research Fund was replenished sufficiently to allow funding of a few new projects, fully or partially depending on their budget requests. A new call for proposals was announced by the Secretariat in April 2013. A total of 19 proposals were received by the deadline. In accordance with the agreed procedure, the Review Group (Bjørge, Donovan, Fortuna, Gales, Reeves, Rojas-Bracho) recommended five projects from this year's call for proposals (Table 4). The Committee **endorses** these five projects.

Table 4
Summary of projects recommended to be funded and their principle investigators (PI)

PI	Project title
Chen	Defining the units of conservation and historic population dynamics for two small cetacean species affected by directed and incidental catches in the North Pacific. (F)
Kelkar	Strengthening the meaning of a freshwater protected area for the Ganges River dolphin: looking within and beyond the Vikramshila Gangetic Dolphin Sanctuary, Bihar, India. (P)
Mustika	A pilot study to identify the extent of small cetacean bycatch in Indonesia using fisher interview and stranding data as proxies. (P)
Rajamani	Capacity building in conducting cetacean abundance surveys in Southeast Asia through a training workshop and actual surveys. (P)
Wakid	Investigating the abundance of Ganges River Dolphin (*Platanista gangetica gangetica*) and factors affecting their distribution in Indian Sundarban. (F)

Key: F=full funding, P=partial funding.

Given the large number of requests and the limited funding available, for future calls for proposals the Review group had recommend that priority is given to projects with clear potential for effective conservation outcomes in areas of particular need (e.g. critical conservation problem known or suspected, but not likely to be addressed without support). The Committee **agrees** with this recommendation.

14.3 Progress on previous recommendations

14.3.1 Vaquita

The plight of the critically endangered vaquita has been discussed by this Committee and the International Committee for the Recovery of the Vaquita (CIRVA) for many years. In recent years, the focus of the recommendations has been that the only way to prevent the extinction of this species is to eliminate gillnets from its entire range.

SC/65a/SM13 provided information on the continuation of the Acoustic Monitoring Scheme for Vaquita. Preliminary analyses show with 60% credibility that the acoustic encounter rate has decreased between the sampling periods, indicating continued decline of the population.

The new Mexican Administration established the 'Advisory Commission to the Presidency of Mexico for the Recovery of Vaquita' which includes the Minister of Environment, the National Commissioner of Fisheries, two members of Congress, NGO representatives, four scientific advisors, fishing representatives and the Navy. At its first meeting in February 2013, one key agreement was to eliminate gillnets and other entangling nets throughout the vaquita's range and to establish a compensation programme for fishermen. At its second meeting in March 2013, it was agreed that Federal and State Government officials and representatives of civil society would visit the fishing communities to inform the fishermen of the alternatives that the federal government has prepared to address the social problems arising from vaquita conservation measures in the region. It was also agreed that the head of the National Institute of Ecology and Climate Change would explore the feasibility of carrying out a new vaquita population survey cruise in Autumn 2013.

On 6 June 2013, the Mexican government approved the new Mexican Official Standard NOM-002-PESC that requires fishermen to switch from shrimp gillnets to alternative fishing gear (specifically purpose-built light trawls) over a three-year period (30, 30 and 40% annual reduction over the three-year period).

The Committee **commends** the Government of Mexico for establishing the Advisory Commission to the Presidency of Mexico for the Recovery of Vaquita and for the final approval of the Mexican Official Standard NOM-002-PESC.

CIRVA members produced an analysis, required by the Government of Mexico, which uses a Bayesian model to estimate current (2013) abundance of the vaquita population. The posterior distribution for 2013 abundance indicates a best estimate of 189 individuals. This result confirms the urgent need to remove all entangling nets from the vaquita range to allow the population to recover.

In light of the significance of this updated estimate, the Committee **agrees** to include the full analysis as an appendix to its report (Annex L, Appendix 3). The Committee **notes with great concern** the model's prediction that if the status quo is maintained, the species population will continue to decline towards extinction.

It is a recurring problem that the rarer a species is, the harder it becomes to collect sufficient sightings to generate robust abundance estimates and detect population declines. As a result, the Committee **strongly endorses** the decision to embed empirical estimates of vaquita abundance and trends (such as in this case the acoustic monitoring data) into rigorous statistical models, using all available relevant data and information to predict population trajectories. The Committee **expresses** confidence that the best estimate of vaquita abundance in 2013 is **189 individuals** (see Appendix 3, Annex L).

In addition, the Committee **reiterates its previous recommendations** that further actions to eliminate bycatch should **not** be delayed in favour of efforts to collect more population survey data.

14.3.2 Hector's dolphin
SC/65a/SM7 reported on efforts to improve estimates of abundance for local populations of Hector's dolphins using capture-recapture (CR) methods based on genotyping and photo-identification. The authors presented three consistent abundance population estimates: (1) a genotype CR (Lincoln-Petersen estimator with Chapman Correction); (2) a photo-identification CR; and (3) a single-sample, linkage disequilibrium method, giving the effective number of breeding individuals in the parental generation. All details are given in Annex L, section 8.1.

14.3.2.1 MAUI'S DOLPHIN
Maui's dolphin is the North Island (New Zealand) coastal endemic sub-species of Hector's dolphin. The Committee was informed that the management measures it recommended last year were incorrectly attributed to a proposal by the New Zealand Government. The Committee **acknowledges and regrets** this mistake.

SC/65a/SM06 presented an update on the status of Maui's dolphins. The population has declined significantly with the latest genetic mark-recapture analysis in 2010/11 estimating a population size of 55 individuals one year and older (Hamner *et al.*, 2012). The author suggested that unless their full range out to the 100m depth contour (including harbours) is protected against gillnetting and trawling (95.5% of human-caused mortality; Currey *et al.*, 2012), Maui's dolphins will decline to 10 adult females in six years and become functionally extinct (<3 breeding females) in less than 20 years, even under maximum population growth (0.018 according to Slooten and Lad, 1991). Additional threats to Maui's dolphins (besides bycatch) include seismic survey work in or near their habitat and a plan to begin development of the world's largest marine iron sand mining operation.

SC/65a/SM22 reviewed the response of the New Zealand Government to the 2012 recommendations of the Committee for urgent action. Although some measures were taken to limit bycatch, the author considered that they were insufficient because they did not cover the entire range. The paper stated that the protected area should be expanded, all gillnetting and trawling should be banned within it (including harbours), and restrictions should be placed on oil and gas development and on other potentially harmful activities where the dolphins are found, including a buffer zone.

Currey *et al.* (2012) described the risk assessment undertaken in June 2012 to inform the Maui's Dolphin Threat Management Plan. The risk assessment identified 23 activities or processes that pose a threat to the sub-species, with bycatch in commercial set net, commercial trawl, and recreational/customary set net fisheries assessed as likely to have the greatest impacts. The risk posed by the cumulative impact of all threats was assessed as significant, resulting in a high likelihood of, and a potentially rapid rate of, population decline. The spatial overlap between dolphin distribution and commercial fishing effort helped to identify specific areas where risk posed by commercial fishing activities remained given management measures already in place. There was a reported capture of a dolphin in the south end of the Maui's range in January 2012 but no specimen was available to determine whether it was a Maui's dolphin or a specimen of the other Hector's dolphin subspecies. In response, interim measures were put in place in July 2012 that either restrict fisheries activities or require 100% observer coverage in the set net fishery in much of the area where the risk assessment indicated a continuing risk to Maui's dolphins from commercial fisheries.

Maas stated that the 100m depth contour is used to define the offshore limit of the range for Maui's dolphins; this ranges from 4 to 39 n.miles. However, Currey noted that the risk assessment expert panel estimated the offshore distribution as out to 7 n.miles based modelling, public sightings, strandings and historical information on the dolphins' alongshore range. The fishery restrictions are based on distance from shore and vary between 2 to 7 n.miles.

New Zealand has a limited observer programme for Maui's dolphins in the trawl fisheries and the limited data suggests some risk of bycatch in trawl gear. The great uncertainty surrounding aspects of Maui's dolphin ecology and distribution makes evaluation of the efficacy of management very difficult.

Emergency measures could be triggered by further bycatch.

The Committee **agrees** that management measures must be precautionary. If any fisheries with the potential for bycatch were to remain active within the range of Maui's dolphins, 100% observer coverage would maximise the chance of identifying any bycatch and providing information that might trigger immediate further area closures.

In conclusion, the Committee **reiterates its extreme concern** about the survival of Maui's dolphin given the evidence of population decline, contraction of range and low current abundance. The Committee **agrees** that the human-caused death of even one dolphin in such a small population would increase the extinction risk for this subspecies.

The Committee therefore **recommends** that rather than seeking further scientific evidence, the highest priority should be given to immediate management actions that will lead to the elimination of bycatch of Maui's dolphins. This includes full closures of any fisheries within the range of Maui's dolphins that are known to pose a risk of bycatch of small cetaceans.

The Committee **commends** the New Zealand Government on its initial and interim measures to protect Maui's dolphins. However, the Committee **emphasises** that the critically endangered status of this sub-species and the inherent and irresolvable uncertainty surrounding information on small populations require the immediate implementation of precautionary measures. Ensuring full protection of Maui's dolphins in all areas throughout their habitat, together with an ample buffer zone, will minimise the risk of bycatch and maximise the chances of population increase.

14.3.3 Irrawaddy dolphins

SC/65a/SM05 presented work on Irrawaddy dolphins in Laos where on the Laos-Cambodia border only six individuals remain in the trans-boundary pool, compared to at least 17 present in 1993. Despite efforts at protection on both sides of the border, the continuing use of gillnets, explosives and electric fishing gear as well as the proposed Don Sahong dam will very likely cause the extirpation of this small group of dolphins.

The Committee **agrees** that the situation in Laos was of serious concern and that without urgent conservation measures in the trans-boundary pool and the surrounding area as recommended in SC/65a/SM5, the remaining dolphins will not persist for much longer.

Porter reported that individuals from six populations of Irrawaddy dolphins in Malaysia, India and Bangladesh had developed cutaneous nodules. Disease prevalence ranged from 2.2% to 13.9% with the two most affected populations inhabiting the most polluted of the six areas. In India, prevalence was significantly higher in 2009-2011 than in 2004-2006. The emergence of this disease in several populations is of concern given the possible link to degraded environmental conditions and the vulnerability of this species to other threat factors.

The Committee thanked Porter for this information and **encourages** further investigation in collaboration with health experts and biologists working in these (and other) regions.

14.3.4 Atlantic humpback dolphin

SC/65a/SM16rev provided an update on an IWC Small Cetacean Research and Conservation Fund (SCRCF) project on the Atlantic humpback dolphin in Congo and Gabon. All details can be found in Annex L, item 5.4.

The Committee **welcomes** the important contribution to research and conservation made by this project and looks forward to receiving further information in future meetings.

14.3.5 Indo-Pacific humpback dolphin

Updates from three projects fund under the IWC SCRCF were presented at this meeting (see Annex L, item. 5.5 for details): Smith *et al.* (2013) provided an update on their project to determine the population identity for animals in the northern Bay of Bengal, Bangladesh and to contribute to the resolution of taxonomy within the genus *Sousa*; Wang (2013) reported on progress on photo-identification monitoring of the Eastern Taiwan Strait Population and information was presented on the project on the ecology, status, fisheries interactions and conservation of coastal Indo-Pacific humpback and bottlenose dolphins on the west coast of Madagascar.

The Committee **welcomes** the important contribution to research and conservation made by these projects and looks forward to receiving further information in future meetings.

14.3.6 Harbour porpoise

SC/65a/SM21 reported on a ship board double-platform line-transect survey to assess harbour porpoise abundance in the 'GAP area' between the North Sea and the Baltic Proper. Details can be found in Annex L Appendix 2. The abundance of harbour porpoises within the survey area was estimated at 40,475 animals (95% CI: 25,614–65,041, CV=0.235). Large areas of the northern part of the study region were not surveyed due to poor weather. The GAP plan identifies key areas for porpoises and focuses conservation measures on special areas of conservation for porpoises.

The Committee **welcomes** this work and **accepts** the abundance estimate.

SC/65a/SM25 reported on a National Programme in Mauritania ("Biodiversité, Gaz, Pétrole", BGP) that includes monitoring beaches for stranded cetaceans four times/year. Between November 2012 and May 2013, high numbers of stranded harbour porpoises and other species were found. The Northwest African population of harbour porpoises is probably reproductively isolated from the Iberian and other European populations (Van Waerebeek and Perrin, 2007). No abundance estimates are available but the population is believed to be small. Of ten individuals for which the cause of death could be established (from a total of 27 examined) all appeared to be bycaught.

Based on sightings recorded from 2003-2011, SC/65a/SM20 provided an uncorrected abundance estimate of 683 animals (95% CI: 345-951) of harbour porpoises in northern Spanish waters that are considered part of the separate Iberian Peninsula Management Unit (ICES 2013). The Committee **endorses t**he authors view of the need for unbiased estimates of both abundance and bycatch for this area in order to provide reliable advice for conservation and management actions. It **strongly encourages** Portuguese and Spanish authorities to promote collaborative research projects towards this end.

14.3.7 Solomon Islands update on both live-capture and drive fisheries

Oremus *et al.* (2013) contained the final report to the Government of the Solomon Islands on small boat surveys, photo-identification and genetic sampling to assess the population status of Indo-pacific bottlenose dolphins which are subject to live capture for international trade. Since 2003, more than 100 Indo-Pacific bottlenose dolphins have been shipped from the Solomon Islands to facilities around the world. The Committee **notes** that the new survey results presented by Oremus *et al.* (2013) reinforce previously expressed concerns regarding the sustainability of live-capture removals from this small island-associated population of Indo-pacific bottlenose dolphins. This project was partially funded by the IWC SCRCF. Details are given in Annex L, item 5.7.

In conclusion, the Committee:

(1) **emphasises** the importance of verifying the true number of live-captures and associated dead dolphins -the new survey results **reinforce** previously expressed concerns regarding the sustainability of live-capture removals from this small island-associated population;

(2) **endorses** the recommendation of Oremus *et al.* (2013) calling for development of a DNA register, i.e. genetic samples of all dolphins captured should be collected systematically and archived to allow verification of their origin and legitimacy; and

(3) **reiterates its previous encouragements** for comparison of existing photo-id catalogues (e.g. that of RH Defran and this study) in order to produce a synthesis of sighting information.

SC/65a/SM08 described efforts to document the numbers and species of dolphins killed recently in the traditional drive hunts on the island of Malaita in early 2013. The Committee thanked the authors for this report. In conclusion it:

(1) **commends** the Government of the Solomon Islands and the Ministry of Fisheries and Marine Resources for the substantial funding provided to conduct the surveys and for facilitating the work on the traditional drive hunts;

(2) **agrees** that there is an urgent need for estimates of the abundance of small cetaceans around Malaita and, if possible, the Solomon Islands as a whole; and

(3) **expresses concern** regarding the potential depletion of local populations given the scale of the recent (and historical) catches.

In this context, the extensive programme of aerial surveys for cetaceans and other megafauna in the South Pacific being undertaken by the French Government can provide valuable and reliable baseline estimates of abundance for previously unsurveyed or little surveyed areas. It was noted that this programme is planning to survey the New Caledonia area in 2014. The Committee **recognises** the great potential conservation value that would result if it was possible to extend the surveyed area to include the Solomon Islands. The Committee therefore **recommends** that the Secretariat forward a letter on behalf of the Committee expressing its appreciation for the current survey programme, explaining the benefits of extending the 2014 survey to the Solomon Islands and respectfully requesting this to be considered if at all possible.

The Committee also **encourages** the Australian Museum, Sydney to grant the authors of SC/65a/SM08 access to pantropical spotted dolphin teeth and teeth from other specimens from the Solomon's hunt that could be used to compare past and modern genetic diversity.

Finally, the Committee **endorses the recommendations** of SC/65a/SM08 encouraging the Solomon Islands Ministry of Fisheries and Ministry of Environment to:

(1) collect information on all future hunts and, if possible, provide some verification of species and numbers through independent observers or photographs;

(2) collect genetic samples (e.g. skin, meat, teeth) from each hunt, to confirm species identification and monitor changes in diversity and population identity over time; and

(3) support further surveys of waters around Malaita (and other islands, if possible) to estimate the abundance of small cetaceans.

14.3.8 Boto and tucuxi

Recalling last year's recommendations regarding the illegal capture and use of botos and tucuxis for fishing within Brazilian territory, the Brazilian Government has been taking steps to counteract this activity through enforcement actions. Details of these actions can be found in Annex L, section 8.8.

The Committee **commends** Brazil for its National Action Plan for the Conservation of Aquatic Mammals and Small Cetaceans, and **welcomes** the report on implementation relative to these two species.

The Committee also **reiterates its previous recommendation** that an international scientific workshop be organised involving scientists and managers from the range states, with the goal of addressing research and conservation priorities, standardising methodologies and planning long-term strategies.

SM/65a/SM17 reported on the distribution of botos in the Amazon delta; they are regular and widespread in Marajó Bay and the surrounding coastline of Marajó Island. To investigate genetic variation in Amazon river dolphins and make inferences about possible subspecies of boto, analyses of the control region and cytochrome b were conducted. One specimen from the east coast of Pará state appeared to represent an isolated geographic form, genetically distinct from other known subspecies.

Iriarte and Marmontel (2013) reported that interactions of botos and tucuxis with fishing activities are common in the western Brazilian Amazon, but the prevalence of incidental and intentional catches is not known.

Williams and others conducted analyses to infer trends in boto and tucuxi numbers in the Colombian Amazon. They estimated an 87% chance that the boto is declining and an 80% chance that the tucuxi is stable or increasing.

The Committee **expresses its appreciation** to the authors of these papers on the boto and tucuxi.

14.4 Takes of small cetaceans

14.4.1. New information on takes

Funahashi provided the Committee with a translation of the records of directed catches and associated quotas for small cetaceans from 1997-2011 obtained from the Japanese National Research Institute of Far Seas Fisheries website (Annex L, Appendix 4).

The Committee also received from the Secretariat the summary of catches of small cetaceans in 2012 extracted from this year's national Progress Reports (Annex L, Appendix 4). The Committee agreed to further explore, intersessionally, more specific terms of reference for evaluating direct take data, including the idea of developing case studies or other analyses from this information.

The Committee thanked Funahashi and the Secretariat for their work in compiling this information for the Scientific Committee each year and reiterated the importance of having complete and accurate catch information, encouraging all countries to submit appropriately qualified and annotated catch data.

SC/65a/SM12 presented information on small cetaceans targeted by direct hunts in Japan. In 2012 there was an increase in the hunting season for Baird's beaked whales in some areas. With respect to drive hunts of other species in Taiji, the number of live captures has increased in the last decade whilst the number of animals killed has gradually declined. The increase in live captures has been accompanied by an increase in exports.

Catch limits for all species were established in 1993 and remained largely constant until 2007. Since then catch limits for most species have been reduced, with the exception of Baird's beaked whales, Pacific white-sided dolphins and northern form short-finned pilot whales which have remained constant. The catch limit for false killer whales has increased. A recent assessment submitted to the 2011 society for Marine Mammalogy Conference indicated that for all species assessed, catch limits were above sustainable levels (Funahashi and Baker, 2011), with those of striped and spotted dolphins and false killer whales particularly high, exceeding calculated PBR values by a factor of more than five.

For all species reviewed, with the exception of Baird's beaked whales, Risso's dolphins and the Pacific white-sided dolphins (which was only recently added to the quota scheme), catches have declined and have not filled the reduced quotas. See Annex L, section 6.1 for more details.

Published assessments of the abundance of targeted populations of are now ten years old or older and exceed the maximum period for which a population estimate should be considered reliable (Moore and Leaper, 2011). Given the indications of population decline in some species (IWC, 1992; 1993; 1998c; Kasuya, 1985; 1999), the long history of intensive exploitation, the lack of information on changes in catch composition and that catch limits and catches remain above sustainable levels, SC/65a/SM12 concluded that there is an urgent need to suspend catches of species taken in direct hunts in Japan and conduct up to date assessments of the exploited populations.

Regarding the species that are subject to direct exploitation in Japan (i.e. common bottlenose dolphins, striped dolphins which apparently experienced a collapse of the coastal population, spotted dolphins, Risso's dolphins, false killer whales and Pacific white-sided dolphins), the Committee expresses **concern** that catch limits exceed sustainable levels and that abundance estimates of all species are now more than ten years old, particularly given the indications of population decline in a number of the species (IWC, 1992; 1993; 1998c; Kasuya, 1985; 1999). The Committee therefore **re-iterates** its previous concerns (IWC, 1992; 1993; 1998c) and **recommends** that:

(1) up-to-date assessments of these exploited populations be undertaken, including studies of population structure and life-history;
(2) up-to-date data on struck and lost rates, bycatch rates, directed hunting effort, stock identity and reproductive status and age composition of catches be collected and made available; and
(3) catch limits take into account struck and lost and bycatch rates and be based on up-to-date population assessments, and be sustainable with allowance for population recovery.

Some members expressed a different view concerning the problems mentioned above, for example regarding the existence of coastal populations of common bottlenose dolphins and striped dolphins (see Annex L).

14.4.2 Follow up on the Workshop on 'poorly documented hunts of small cetaceans for food, bait or cash'

Ritter presented a proposal on the growing and emerging problem of poorly documented hunts of small cetaceans for food, bait or cash (sometimes referred to as the 'marine bushmeat' problem). A provisional agenda was provided for an open symposium and a two-day workshop (Annex L, Appendix 5). The scope was limited to Africa, Madagascar, Sri Lanka and SE Asia.

It was agreed that the workshop steering group shall focus its initial work on:

(1) appointing new members to be included in steering group (September 2013)-new members shall be experts working in the areas the workshop focuses on that are not related to cetacean assessment;

(2) producing a final draft budget (September 2013), including costs for the venue and for (French) interpretation;

(3) determining additional expertise to be invited to the workshop (October 2013);

(4) identifying a definitive venue (December 2013);

(5) liaising with international organisations dealing with bushmeat and emerging infectious diseases (e.g. Eco Health Alliance (US) and others).

The steering group shall at the same time start finding funds from NGOs and other organisations. The progress on the work on the above points shall be referred to the co-convenors of the sub-committee on small cetaceans and the Head of Science for consideration.

14.4.3 Significant direct and incidental catches of small cetaceans: an update

Donovan drew attention to the Committee's 'Report on Significant Direct and Incidental Catches of Small Cetaceans' that was prepared for the United Nations Conference on Environment and Development (UNCED) in 1992 (Bjørge *et al.*, 1994). Whilst recognising that this was a major undertaking, he suggested that there was a need for a single, up-to-date, authoritative reference on this topic and that the sub-committee on small cetaceans was an appropriate group for producing such a document.

After a short discussion on the merit and the difficulties of this idea, the Committee **agrees** to consider it in more detail next year.

14.5. Update on proposed joint workshop on monodontids

In 2012, the Committee established a Steering Group (Bjørge (convenor), Acquarone, Donovan, Ferguson, Reeves, Suydam) to plan for a global review of monodontids (IWC, 2013i, p.296). The terms of reference were: (1) continue planning for a joint Workshop on monodontids with NAMMCO SC, the Canada-Greenland Joint Commission on Narwhal and Beluga (JCNB), the Alaska Beluga Whale Committee, and others; (2) prepare a proposal for global review with a Workshop to be held in the autumn of 2013; and (3) facilitate exchange of data between the involved groups.

After consultation with NAMMCO, the deadline of autumn 2013 was considered unrealistic. However, the NAMMCO Secretariat, with the IWC Scientific Committee as co-sponsor, has indicated it can convene a global review workshop back-to-back with the joint meeting of the NAMMCO SC Working Group on Belugas and Narwhals and the JCNB, to be held in Copenhagen in the second half of 2014 (or first half of 2015). Experts from all range states (Greenland, Canada, USA, Russia, Norway) should be invited and a list of possible participants in the workshop has been developed. NAMMCO has indicated that it is prepared to cover part of the costs for invited participants and funding for this workshop will be sought from the IWC. Suydam noted that with the workshop and funding coming together, other interested organisations would help support participant travel. In response to a question on participation of observers, Bjørge noted that he was not familiar with NAMMCO procedures but that observer participation should be possible.

The Committee **welcomes** this report and thanked the NAMMCO Secretariat for its willingness to host the meeting and help fund invited participants. Bjørge and Fortuna (the SM Convener) will work with the Secretariat to ensure that the request for IWC funding of this workshop is considered in a timely manner. The Steering Group will continue to advance the workshop intersessionally and report back at next year's meeting.

14.6 Other information on small cetaceans

The sub-committee reviewed information in several additional papers that were not relevant to its priority topics. Details are given in Annex L, item 8.

14.7 Workplan

The Committee's workplan is given under Item 24.

15. WHALEWATCHING

The report of the sub-committee on whalewatching is given as Annex M. Scientific aspects of whalewatching have been discussed formally within the Committee since a Commission Resolution in 1994 (IWC, 1995). The Commission also has a Standing Working Group on Whalewatching that reports to the Conservation Committee (see Item 15.4.1).

15.1 Assess the impact of whalewatching on cetaceans

SC/65a/WW01 summarised four papers addressing the impacts of whalewatching on cetaceans: Peters *et al.* (2013) documented the effects of swim-with-dolphin tourism on the behaviour of the 'burrunan dolphin' (*Tursiops australis*[22]) in South Australia; Lundquist *et al.* (2012) sought to estimate the potential impact of dolphin watching and swimming on dusky dolphins in Kaikoura, New Zealand; Dans *et al.* (2012) investigated changes in behavioural budget of dusky dolphins in Golfo Nuevo, Patagonia, Argentina; and Ayres *et al.* (2013) collected data on hormone levels from the faeces of southern resident killer whales to assess factors in population decline. Summaries are found in Annex M, item 5.

The Committee noted that hormone analysis, using faecal and blow sampling, is a potentially valuable methodology for examining impacts of whalewatching. Clearly the efficacy of these methods will be species-specific. A third methodology to measure stress responses is telemetry using tags that can monitor heart rates The impact of research vessels (for all these sampling methods) can be significant and a good experimental design is needed to control for this.

The Committee **agrees** that a joint session on stress responses related to vessel presence and shipping noise be held next year by the sub-committee on whalewatching and the SWG on environmental concerns, provided sufficient information is available. The Committee **requests** the Convenors of those two sub-groups to invite experts to submit papers next year on the use of faecal and blow sampling to measure stress hormones in relation to whalewatching, as well as in relation to other stressors where the methodology could be applied to whalewatching.

New provided an update on the mathematical models for the behavioural, social and spatial interactions of bottlenose dolphins first described in SC/64/WW03. The model has been adapted to incorporate ecological and geographical features and also has the potential to assess the relative impact of different vessel types, as well as their cumulative effects. The model is an individual-based model, so it can also be modified to assess individual characteristics. The Committee **welcomes** this work and **encourages** future development and its use in case studies.

15.2 Review whalewatching in the Republic of Korea

Whalewatching from one vessel began in 2009 in Ulsan. Species encountered include long-beaked common dolphins, common minke whales, Pacific white-sided dolphins, false killer whales, common bottlenose dolphins and occasional finless porpoises. Tourism numbers are increasing and are expected to reach 20,000 in 2013.

There is a resident population of *T. aduncus* in the waters of Jeju Island; however, the Ministry of Oceans and Fisheries has advised against developing boat-based dolphin watching due to this population's small size, which led to a protected species designation in 2012. The local government has decided to pursue land-based dolphin watching only. The Committee **commends** the Jeju government and the Ministry of Oceans and Fisheries for their precautionary approach and **recommends** that research be continued on the bottlenose dolphin population of Jeju.

Guidelines are being developed for Korean whalewatching and the Committee **refers** the developers to the Commission's guiding principles and the Compilation of Worldwide Whalewatching

[22] The Committee has not included *Tursiops australis* in its list of recognised species

Regulations[23]. Ulsan, given the early stages of its whalewatching development, may be a suitable location for a study under the Modelling and Assessment of Whalewatching Impacts (MAWI) project (see item 15.3.1 and Annex M, item 7.1).

15.3 Progress on Commission's 5-year strategic plan including guidelines and regulations

15.3.1 Large-scale whalewatching experiment (LaWE) steering group

There was no intersessional communication or formal update on LaWE submitted to this year. Consequently the Committee **agrees** to re-evaluate the project.

The primary objectives of LaWE were to assess the population-level impacts of whalewatching and determine the effectiveness of suggested mitigation measures in avoiding any potential negative effects of the activity. These objectives remain relevant to the work of the sub-committee; it is important that research addressing these objectives continues. The Committee **agrees** to establish a new intersessional working group, with New as convenor, tasked with developing a revised workplan to move forward with this project, now named the Modelling and Assessment of Whalewatching Impacts (MAWI), which will seek to build on what was learned in LaWE (see Annex M). The group, using the 5-Year Strategic Plan research objectives and actions as guidance, will seek to define the specific research questions and hypotheses that will most benefit understanding of the impact of whalewatching, identify those whalewatching locations that would be suitable and amenable for targeted studies addressing these questions, and summarise the current modelling tools available to analyse the data that will be collected. Once these issues have been addressed, it will be possible to identify a timeline, benchmarks, budgets and any additional resource or support needs.

15.3.2 LaWE budget development group

This item was not discussed, as there was no intersessional communication with this working group.

15.3.3 Swim-with-whale operations

A questionnaire seeking more detail on these operations was successfully beta-tested in the Dominican Republic in early 2012 and was distributed to operators in Tonga and New Caledonia in May 2013. A summary of results from these surveys will be presented at next year (see Annex M).

15.3.4 In-water interactions

A scientific study was conducted in October 2012 off La Gomera (Canary Islands), where in-water interactions with different small cetacean species were examined. During experimental in-water encounters, specific behaviours exhibited by the animals were observed, recorded and videotaped. Results from this study will be presented at next year (see Annex M).

15.3.5 Guiding principles development

SC/65a/WW03 was a draft of the guiding principles produced per Action 1.1 of the Commission's 5-Year Strategic Plan for Whalewatching. The principles include general management considerations and guidelines for cetacean watching. These guiding principles are fundamental to the development of Handbook as part of the Commission's 5-Year Strategic Plan for Whalewatching.

The Committee **agrees** to develop a 'background document' to annotate the guiding principles, with an explanation of their origin and evolution, as well as definitions of terms and other explanatory background (which might include illustrations of descriptive content). A draft of this document will be presented next year (see Annex M).

The Committee **endorses** the guiding principles, which can be found in Annex M as Appendix 2, and **recommends** that they are posted on the Commission website.

15.4 Other issues

15.4.1 Review scientific aspects of the Commission's Five Year Strategic Plan for Whalewatching

The Committee reviewed elements of the 5-Year Strategic Plan for Whalewatching and the Commission's Whalewatching Handbook relevant to its work. Objective 1, Research, details three action items tasked to the Committee:

1.1 Develop (and/or review), pending further comprehensive scientific research and assessment (refer to action 1.3), guiding principles to be followed in whalewatching operations including swim with and provisioning programs to minimise potential adverse impacts;

1.2 Identify data deficient and critically endangered populations likely to be subject to whalewatching. Develop precautionary guidance and advice on additional mitigation measures that may be required for whalewatching operations on such populations; and

1.3 Consider an integrated research program (a form of long term experiment) to better understand the potential impacts of whalewatching on the demographic parameters of cetacean populations. Seek to:

- demonstrate a causal relationship between whalewatching exposure and the survival

[23] http://iwc.int/whalewatching

and vital rates of exposed cetacean individuals;

- understand the mechanisms involved in causal effects, if they exist, in order to define a framework for improved management; and
- establish standard methodologies for the conduct of assessments.

Action item 1.1 is addressed in SC/65a/WW03 and Parsons agreed to collate data for action item 1.2 and report to the Committee next year. The Committee noted that the MAWI intersessional working group will address action item 1.3 (see Annex M, item 7.1).

15.4.2 Report of 2013 IWC Whalewatch Operator's Workshop

The Whalewatch Operator's Workshop, funded by the Governments of Australia and the USA, was held in Brisbane, Australia on 24-25 May 2013. The main objective of the workshop, attended by over 60 representatives of industry, science and government, was to get input from operators and industry representatives for the Whalewatching Handbook to be posted on the Commission's website, with continued oversight by the Commission's Standing Working Group on Whalewatching and an on-going and iterative monitoring, evaluation and review of the 5-Year Strategic Plan for Whalewatching. In addition, the workshop sought to help the Commission understand what role it can play in identifying and promoting 'best practices' and responsible whalewatching, what the industry might like to see or have in an online Whalewatching Handbook, actions in the plan that might require further engagement with industry and how to continue to integrate work at the Commission with industry expertise.

The Committee **agrees** to establish an intersessional working group, with Rojas-Bracho as convenor, to determine how the Committee can best assist and contribute to the Whalewatching Handbook (see Annex R).

15.4.3 Consider information from platforms of opportunity of potential value to the Scientific Committee

A 'citizen science' handout drafted by the Tonga Whalewatching Operators Association was examined (see details in Annex M, item 8.3).

The Committee noted that this type of handout could allow 'citizen scientists' to provide data directly to research groups and **suggests** that the simple data form developed in (the Data Reporting Scheme) is revived and made available as a resource through the Commission's website.

In late 2009, researchers began collecting data from whalewatching vessels as platforms of opportunity in Ballena Marine National Park in Costa Rica. Tour operators were trained in the use of data forms and GPS. The first year of data collection by operators has been completed and these data will be compared with data collected by researchers, to determine if there are significant differences in data quality. A paper will be prepared for next year's meeting.

Denkinger *et al.* (2013) studied cetacean presence and diversity in the Galápagos Marine Reserve (GMR) during El Niño, La Niña, and neutral conditions, using wildlife viewing vessels as platforms of opportunity. These data showed that most species seem to move out of the GMR during El Niño years.

SC/65a/SH25 reported on a meeting of the Southern Ocean Research Partnership (SORP) held on Jeju Island, Republic of Korea, on 31 May-2 June 2013. The meeting's primary objective was to present the scientific results stemming from the five on-going SORP research projects. Recommendation 4 of the meeting report asked partners in SORP to employ all platforms of opportunity and, where applicable, 'citizen science', to collect data for inclusion in SORP research projects, thereby reducing the logistical constraints of circumpolar coverage and overall expenditure. Recommendation 5 was to store and archive data collected from international, collaborative research efforts such as SORP in open-access, central repositories that have the capacity to handle both primary scientific data and information derived from 'citizen science', e.g. image catalogues.

SORP is coordinating with the International Association of Antarctic Tour Operators to solicit data from platforms of opportunity. Cruise ships were identified as excellent potential platforms, as experienced biologists are often on board as naturalist guides, making them a potential source of good-quality data. 'Citizen science' efforts should be coordinated, because photographs in particular often come from tourists and key matches can come from this source.

15.4.4 Review whalewatching guidelines and regulations

SC/65a/WW01 reviewed two studies that addressed compliance with whalewatching guidelines and regulations: Kessler and Harcourt (2013a) studied the levels of compliance with regulations by commercial and recreational whalewatching boats off Sydney, Australia; and Chinon *et al.* (2013) looked at the effectiveness of a proposed regulation for white whale watching in the Saguenay-Saint Lawrence marine park, Quebec, Canada, using an agent-based modelling approach. Summaries are presented in Annex M, item 8.4.

The Committee noted that this modelling approach is a technique that could be applied to other locations to assess the effectiveness of whalewatching regulations.

The 2013 Compilation of Worldwide Whalewatching Regulations[24] is almost complete and should be online by August 2013.

15.4.5 Review of collision risks to cetaceans from whalewatching vessels

SC/65a/WW04 investigated the probability of vessel collisions with humpback whales in the waters of Maui County, Hawaii, USA. Surprise encounters and near-misses, defined as a group of whales sighted (at abeam and forward angles) within 300m and 80m of a vessel respectively, were used as proxies for probability of whale-vessel strikes. The rate of surprise encounters increased with vessel speed, from 1.5 encounters/hr at 5 knots to 4.2 encounters/hr at 20 knots. No near-misses occurred at 5 knots. Calves were present in 28.3% of surprise encounters and 58.3% of near-misses, which coincides with previous reports that calves may be more susceptible to vessel collisions. Continued research will contribute to developing a predictive model of vessel strikes for management purposes.

The Committee noted that risk of vessel collision should be factored into models developed under MAWI. The model to be developed in Hawaii will be compared to data from the Hawaiian reporting network for ship strikes, which also reports 'encounters' (the equivalent of near misses), to see if the model matches the network's reports.

Ritter presented relevant aspects of Neilson *et al.* (2012), which analysed all reported whale-vessel collisions in Alaska between 1978 and 2011. Many types and sizes of vessels collided with whales; however, small recreational vessels as well as commercial vessels were most commonly involved in collisions. When vessel speed was known, 49% of the collisions occurred at vessel speeds ≥12knots.

15.4.6 Swim-with-whale operations

SC/65a/WW01 summarised four papers addressing swim-with-whale operations: Curnock *et al.* (2013) explored effort and spatial distribution of tourists swimming with dwarf minke whales across time on the Great Barrier Reef, Australia; Kessler and Harcourt (2013) studied human-whale value transition in Tonga across time and the current impact of humpback whale tourism; Kessler *et al.* (2013) documented humpback whale responses to experimental swim-with-whale encounters in Tonga; and Lundquist *et al.* (2013) documented responses by southern right whales in Argentina to simulated swim-with-whale encounters. Summaries are presented in Annex M, item 8.6.

The Committee noted that Hervey Bay, Australia, is an important resting area for humpback mother-calf pairs. Currently swimming with whales is not occurring but tour operators there are interested in conducting such encounters, The Committee **recommends** that the IWC's guiding principles (Annex M, Appendix 2) be applied to any management decisions in Hervey Bay.

SC/65a/SM26 refers to swim-with-cetacean excursions in Japan and recommends monitoring the situation. The Committee **agrees** to add this to its agenda in 2014 and invites submissions on this situation at next year's meeting.

15.4.7 Emerging whalewatching industry in Oman

The Committee received an update on the emerging whalewatching industry in Oman and an initiative to guide and regulate the industry, as previously recommended (IWC, 2013c, p. 64).

The objectives of the new initiative to educate the industry are to protect whales and habitat from impact whilst raising the industry's 'best practice' standards. Progress has been made with securing support of ministries, developing an inventory of operators, assessing operator performance and drafting a set of whalewatching guidelines. Operator workshops are planned for the last quarter of 2013.

The Committee **welcomes** the progress demonstrated by this initiative, and invites the continued submission of updates on this emerging situation. It encouraged local stakeholders, including non-governmental organisations, to continue their commitment to taking this initiative forward. In addition, the Committee **recommends** that the whalewatching guidelines in Oman consider the growing body of research on swim-with-whale encounters and the guiding principles (Annex M, Appendix 2), which discourage this activity.

15.4.8 Assessing 'whalewatching carrying capacity'

Childerhouse reported on the situation in Kaikoura, New Zealand and whalewatching targeting sperm whales. A moratorium on new commercial whalewatching permits for sperm whales at Kaikoura expired on 1 August 2012. Thus, the New Zealand Government commissioned a 2-year research programme into the impact of commercial whalewatching on sperm whales at Kaikoura (Markowitz *et al.*, 2011). The research identified a decline in the abundance of sperm whales over the period since whalewatching started, although the cause of the decline is unknown. After public consultation, another 10-year moratorium was recommended and has been implemented. A 10-year period will allow for meaningful monitoring of the effects of whalewatching activity on sperm whales.

In discussion, other plausible hypotheses for the decline were suggested (see Annex M, item 8.6).

The Scientific Committee **welcomes** this research and **commends** New Zealand for active assessment and management of whalewatching in this region.

[24] http://iwc.int/whalewatching

15.4.9 IWC Conservation Management Plans
This is discussed under Annex M, item 8.9 and Item 21.

15.5 Work plan
This is discussed under Item 24.

15.6 Other matters
SC/65a/WW05 reported on results from a survey of whalewatching passengers designed to identify causes of a decline in the number of whalewatchers in Hervey Bay, Australia. Details are found in Annex M, item 10.

SC/65a/SM15 summarised a genetic analysis of bottlenose dolphins in Bocas Del Toro, Panama, which showed that this small population (~150 dolphins) has a unique haplotype not seen elsewhere in the Caribbean, confirming its genetic isolation. Last year (IWC, 2013c, p.61), the Committee strongly recommended that the Panamanian authorities enforce national whalewatching regulations and recommended continued research to monitor this dolphin population and the impacts of dolphin watching. However, the Committee received information that enforcement has not happened, and that there has recently been a confirmed report of a dolphin watching vessel striking a dolphin. In light of this observed mortality, the Committee **strongly reiterates** its previous recommendations.

16. DNA TESTING

The report of the Working Group on DNA is given as Annex N. This particular agenda item has been considered since 2000 in response to a Commission Resolution (IWC, 2000).

16.1 Review genetic methods for species, stock and individual identification
SC/65a/SD1 was prepared in response to a recommendation from the Icelandic Scientific Permit Review Workshop (SC/65a/Rep5) to provide details of the protocol used for the genetic analyses presented to the Workshop, to ensure that genetic sampling and analysis followed the IWC guidelines for genetic research. SC/65a/SD1 provided a comprehensive and clear description of the Icelandic DNA registry protocol, on which the genetic analyses presented to the Review Workshop were based. The Committee **welcomes** this document and **agrees** that it responded appropriately to the recommendation from the Icelandic Scientific Permit Review Workshop.

The Committee **encourages** the preparation of technical documents on methods for species, stock and identification for discussion at the next year meeting under this agenda item.

16.2 Review results of the 'amendments' of sequences deposited in GenBank
During the first round of sequence assessment in *GenBank* (IWC, 2009f, p. 347) some inconsistencies were found but these appear to be due to a lag in the taxonomy recognized by *GenBank* or uncertainty in taxonomic distinctions currently under investigation (IWC, 2013j, pp.330). After the assessment, some of the inconsistencies were corrected but further corrections have been hampered by the fact that only the original submitter can alter taxonomy fields in *GenBank*. Last year, the Committee agreed that Cipriano should make a request to *GenBank* to add an additional field for comments (IWC, 2013c, p.64).

Cipriano contacted *GenBank* during the intersessional period and received a response that *GenBank* is willing to work with the IWC on this. They requested that a list of accession numbers associated with problematic taxonomic designations be provided. This would help *GenBank* to understand the scope of the problem while considering a mechanism to allow taxonomy corrections and notations by request.

The Committee **agrees** that the list of accession numbers involving inconsistencies (Annex N, Appendix 2) should be sent to *GenBank* by Cipriano with a letter explaining the background and the main reasons for the inconsistencies, which include:

(1) species for which the taxonomy is still being worked out (e.g. the 'Brydes whale' species complex);
(2) species that have been recently split into new (or redescribed) species (e.g. the right whales and minke whales);
(3) subspecies for which the taxonomy is still being investigated (e.g. the recognised sub-species of blue whales and minke whales).

Cipriano will also communicate about the need for an annotation indicating uncertainty in subspecies identity for a specimen.

16.3 Collection and archiving of tissue samples from catches and bycatches
The Committee previously endorsed a new standard format for the updates of national DNA registers to assist with the review of such updates (IWC, 2013c, p.53), and the new format worked well last year. This year the updates of the DNA registers by Japan, Norway and Iceland were based on this new format. Details are given in Appendices 3-5 of Annex N for each country, respectively, covering the period up to and including 2012. The Committee **thanks** the countries involved for providing this information.

16.4 Reference databases and standards for diagnostic DNA registries

Appendices 3-5 of Annex N summarises the status of mtDNA and microsatellite analyses of the stored samples for Japan, Norway and Iceland, respectively. In almost all cases, the great majority of samples have been analysed for at least one of either mtDNA or microsatellites and in most cases both. Work on unanalysed samples is continuing although in Japan's case 100% coverage was not possible because many samples were lost in the 2011 tsunami. Details on the exact number of samples collected and analysed are provided in Annex N.

The Committee **appreciates** the efforts of Japan, Norway and Iceland in compiling and providing this detailed information of their registries. The Committee **reiterates** its view that the information provided in the new format greatly facilitated the annual review.

16.5 Work plan

The workplan is discussed under item 24.

Members of the Committee are encouraged to submit papers in response to requirements placed on the Committee by the IWC Resolution 1999-8 (IWC, 2000). Relevant information in documents submitted to other groups and sub-committees of the Committee will be reviewed next year. Results of the 'amendments' work on sequences deposited in *GenBank* will be reported next year.

17. SCIENTIFIC PERMITS

This Agenda Item was discussed by the Working Group on Special Permits and its report is given as Annex P. In order to assist the reader, this section provides a summary of Annex P and it also includes a summary of the expert workshop (SC/65a/Rep3) on the Icelandic permit held in accordance with the Committee's guidelines (IWC, 2013k).

17.1 Review report of workshop for Icelandic Scientific Permit whaling

In 2003, Iceland presented and the Committee reviewed a special permit research programme to the Committee for review that had included proposed takes of 200 fin whales, 100 sei whales and 200 common minke whales spread over a two-year period that was intended as feasibility study (IWC, 2004). In the event, the programme was reduced to considering only common minke whales and the catch period was extended such that the 200 common minke whales were taken from 2003-2007. Due to practical difficulties in Iceland, review of the final results from the programme was delayed. Following the Committee's revised guidelines and timetable for such a review (IWC, 2013k), the expert panel meeting took place in February 2013. All due dates for availability of data, documents, reports and revised documents were met.

17.1.1 Panel Chair's summary of the panel report

The Panel was chaired by Kitakado and its composition was decided upon by a steering group comprising the past four Scientific Committee chairs and the Head of Science. Difficulties in the availability of proposed candidates meant that participation by scientists who had no connection with the Committee proved very difficult. In the event, the Panel comprised the present Committee Chair and the Head of Science (in accord with the guidelines), two ex-Committee Chairs, one current member of the Committee, one scientist who has not participated in the Committee for several years and two scientists who have never participated. Expertise in all areas of the research programme was available. In addition to the proponents, four observers were present. Thirty papers were submitted by proponents (SC/F13/SP1-30) and three additional papers were submitted by other scientists (SC/F13/O1-3).

The Panel report (SC/65a/Rep3) is divided into sections based on the stated objectives of the programme: abundance; stock structure; biological parameters, feeding ecology; energetics; pollution; parasites and pathology. Each of these contained the proponents' summary of their results followed by an analysis of the results by the Panel including conclusions and specific recommendations. The final section (pages 29-33) presents the Panel's general overview and conclusions followed by a summary of all of the recommendations divided into short, medium and long-term.

The report is a long and detailed review. What follows here is a short Panel Chair's summary of only the broad conclusions (pp. 29-33 of SC/65a/Rep03); it does not provide a substitute for reading the full report. In reaching its conclusions and recommendations, the Panel noted that no further special permit programme was envisaged by Iceland at present. With respect to consideration of the effect of the catches on stocks, it noted that the level of catches was considerably below the level for the CIC *Small Area* that would have been allowed under the RMP (IWC, 2011b, p. 64). The Panel emphasised that its task was to provide an objective scientific review of the results of the Icelandic programme; its task was not to provide either a general condemnation or approval of research under special permit. Consideration of that would require examination of some issues way beyond the purview of a scientific panel.

The Panel made a number of general points in addition to its review of individual topics. The first related to the objectives of the programme. The general nature of the objectives of the original proposal and its characterisation as a feasibility/pilot study made it difficult for the Panel to fully review how well the programme could be said to have met its own objectives. It agreed that it is important that any special permit programme provides careful objectives and sub-objectives for which performance can more easily be assessed, as is now the case in the guidelines for proposed permits in (IWC, 2013k), developed since the Iceland permit was presented in 2003.

The Panel also commented that better information on sampling design and an evaluation of sample size and representativeness at the local and population level was required. While the method used was probably sufficient for a feasibility study, it would not be the case for a full programme.

A common thread throughout the report related to the need for integrated analyses of the individual components of the programme; it regarded such work as essential and this was the subject of several recommendations. Given the objective of multi-species modelling to improve management, this should also include consideration of the results in the context of a modelling framework. The Panel noted that the programme had tried to maximise the information obtained from the whales taken. It stressed the importance of archiving material collected as well as storing analytical results and data in a relational database linked to the tissue archive.

With respect to abundance, the Panel agreed that the Icelandic survey data have improved knowledge about the abundance and distribution of the common minke whale in Icelandic waters both for use in the RMP and for input to potential multispecies modelling. Despite the logistical difficulties, the spring and autumn surveys provided valuable new information, especially in the context of any future multi-species modelling.

With respect to stock structure, the Panel agreed that the data will assist in the Committee's work on this topic. With respect to feasibility component, it was of course already well-known that it is possible to collect samples to better understand stock structure from carcases (as well as from biopsy samples as the proponents' note). It welcomed the efforts to compare genetic data across the North Atlantic but recommended further effort to integrate information regarding stock structure from the variety of genetic and non-genetic sources.

With respect to biological parameters, the Panel recognised the extensive amount of field and laboratory work that had been undertaken and presented. It noted that evaluating the feasibility of collecting information on biological parameters of sufficient precision and accuracy to inform multi-species modelling requires examining the sensitivity of model results to the parameters concerned. As the modelling was not as advanced as had been originally planned, this evaluation cannot yet be conducted. One of the most important feasibility questions relates to the issue of ageing common minke whales and the Panel commended the work to examine a new approach for common minke whales, recognising that further work needs to be undertaken.

With respect to feeding ecology, a primary component of the programme, the Panel acknowledged the large amount of effort undertaken and the generally thorough analyses using a variety of techniques. The temporal changes observed as a result of the extension of the sampling period could be related to climate change or a regime shift in the waters around Iceland and this is an important issue for further research. The general nature of the objectives made evaluation of the success of the feasibility study more complex but the Panel agreed that knowledge of the general feeding ecology of common minke whales around Iceland has been advanced. It also acknowledged the efforts to collect data in such a way as to allow a more systematic than usual examination of the results that can be obtained from lethal and non-lethal methods (see Table 4 of SC/65a/Rep3). Finally, the Panel strongly recommended that integrated analyses including comparison of the information from each approach be developed and submitted to the Scientific Committee.

With respect to energetics, again the Panel recognised the considerable field, laboratory and analytical effort. These provided valuable insights into aspects of the energetics of common minke whales around Iceland but further effort is required to integrate the various analyses to provide quantitative input to energetics models and multispecies modelling and allow an evaluation of the sensitivity of the results to the inevitable uncertainty.

With respect to modelling, the Panel recognised the practical difficulties explained by the proponents but concluded that this important part of the programme is as yet poorly developed. In particular, a simple preliminary model should have been developed to inform discussions of which are key parameters with respect to obtaining robust results, evaluating how sensitive results are to different levels of uncertainty and determining appropriate sample sizes. This was a major weakness in the programme. However, the Panel welcomed the modelling work presented to the Workshop as a small but valuable initial step toward the programme's overall objective.

With respect to pollutant studies, the Panel acknowledged the considerable field, laboratory and analytical work that had resulted in a number of published papers. It also appreciated the effort made to compare results across the North Atlantic and to examine relationships between concentration levels in different tissues including 'pseudo' biopsy samples. However, it agreed that the objective of assessing health status had not been fully addressed and cautioned against broad assumptions that low levels necessarily indicate no effect. The sample size of the feasibility study was insufficient to properly address any toxic-related cause-effect relationships.

With respect to parasites and pathology, the objective had been to investigate the feasibility of monitoring and evaluating the morbidity of potential pathogens. The Panel recognised the difficulty of conducting full post-mortems of animals and undertaking thorough examination for parasites and pathogens at sea. While the study of the epibiotic macro fauna has resulted in a good baseline for future analyses, overall, the Panel concluded that the approaches adopted in the feasibility study would be insufficient to achieve the objective outlined.

The Panel briefly noted that the Commission had passed several resolutions relevant to research on the ecosystem, contaminants and environmental change. It agreed that many aspects of the programme were relevant to these topics and that the information had been made available to the Scientific Committee.

With respect to the utility of lethal and non-lethal techniques the Panel referred to extensive discussions at the JARPN II review (IWC, 2010a) and the SORP conference (Baker *et al.*, 2012). The Panel welcomed the efforts of the programme to provide data to allow a more thorough and quantitative comparison of some lethal and non-lethal techniques than has previously been possible (see recommendation in IWC, IWC, 2010a). The Panel developed a simple qualitative table to summarise the situation for North Atlantic common minke whales but stressed that is not intended to represent a complete or comprehensive evaluation of lethal or non-lethal techniques, either in general or for this specific programme and drew attention to a number of caveats.

Finally the report provided a summary of its recommendations. Seventeen addressed specific issues that might be termed 'short-term' while twelve addressed 'medium to long-term' issues.

In conclusion, the Panel's Chair thanked the Panel, the proponent scientists and the observers for their constructive and patient approach to the workshop and the Marine Research Institute for providing excellent facilities.

17.1.2 Proponents response to the Panel report

SC/65a/SP1 provides an overview of the response of scientists from the Icelandic research programme (IRP) to the report of the Panel (SC/65a/Rep3). The IRP scientists consider that in general the evaluation of the IRP by the Panel was constructive, objective and balanced.

Table 5

IRP scientists' summary of status of progress (based on table 2 in SC/65a/SP1) in responding to the Panel's recommendations (SC/65A/Rep3), including the list of papers submitted to the Committee in response to SC/65A/Rep3 and the sub-groups at which they were presented.

Recommendations (Sub-group) (Item no. in SC/65a/Rep3)	Status of work
Abundance (RMP)	
12.1.1.1	To be addressed in the near future. Further recommendations may be needed as to the approach to take (before the North Atlantic common minke whale *Implementation Review*).
Stock structure (RMP, SD)	
Short term recommendations	
12.1.2.1	A fully integrated stock structure paper was submitted (SC/65A/SD2).
12.1.2.2	A paper describing the genetic protocols employed during the IRP was submitted (SC/65A/SD1).
12.1.2.3	This has been dealt with in the fully integrated stock structure paper (SC/65A/SD2).
12.1.2.4	This has been partly dealt with in the fully integrated stock structure paper (SC/65A/SD2).
12.1.2.5	To be addressed in the near future.
Biological parameters (EM)	
Short term recommendations	
12.1.3.1	Addressed in SC/F13/SP15_Rev.
12.1.3.2	Addressed; changes in reproductive status considered in SC/F13/SP10_Rev, SC/F13/SP5_Rev.
12.1.3.3	To be addressed in the near future.
Feeding ecology (EM)	
Short term recommendations	
12.1.4.1	To be addressed in the near future.
12.1.4.2	A revised paper on the diet composition was submitted (SC/F13/SP2_Rev).
12.1.4.3	An update of status and response to specific recommendations is given in SC/65A/EM1 and SC/65A/ForInfo31.
Energetics (EM)	
Short term recommendations	
12.1.5.1	A fully integrated paper was submitted (SC/65A/O2).
12.1.5.2	The revised paper was submitted (SC/F13/SP10_Rev).
12.1.5.3	The revised paper was submitted (SC/F13/SP5_Rev).
Pollution (E, EM)	
Short term recommendations	
12.1.6.1	Addressed in SC/F13/SP22_Rev and SP23_Rev.
12.1.6.2	Addressed in SC/F13/SP23_Rev.

SC/65a/SP1 also responded to the Panel's request to provide further documentation of the sampling design. The authors emphasised that the objective was to cover the Icelandic continental shelf area and not to be representative of the Central stock of common minke whales. Sampling was distributed in relation to relative abundance in nine small areas used as part of the Bormicon framework for multispecies modelling of boreal systems. In addition, sampling was stratified seasonally into five units. The purpose of such a fine-scale stratification in this feasibility study was to ensure good distribution of the sampling around Iceland and to allow for post-stratification as appropriate for the different sub-projects.

While agreeing with most of the suggestions and recommendations of the Panel, as can be seen in Table 5, the IRP scientists have not been able to fully respond to all of these within the short period determined by the review process protocol (40 days). However, the IRP plan to conclude most of these before the 2014 Annual Meeting with a particular emphasis on those considered relevant for the upcoming RMP *Implementation Review* of North Atlantic common minke whales and the joint AWMP/RMP workshop on the stock structure of North Atlantic common minke whales (Annex D). For example, collaboration has already been established to investigate the isotope ratios in baleen plates.

SC/65a/SP1 also noted additional collaborations and studies that were initiated during the project on subjects outside the original objectives (brain anatomy, radioactivity, climate change aspects, genetic relatedness methodology, and analysis of additional pollutants).

In conclusion, the IRP scientists noted that the Panel had acknowledged the quality and scientific relevance of the presented results to common minke whale research, while identifying areas where further work was required. IRP scientists had responded positively to the comments and recommendations of the Panel as shown in Table 1. They also noted that the guidelines for review of scientific permit programs call for special considerations of the utility of non-lethal and lethal research techniques. This comprised a special objective of the IRP and the Panel had welcomed the efforts of the IRP to provide data to allow a more thorough and quantitative comparison of some lethal and non-lethal techniques than has previously been possible. This is relevant for other populations and species. The Panel had also noted that the level of catches was considerably below the level that would have been allowed under the RMP. Finally the IRP scientists noted the relevance of the research programme to the work of the Scientific Committee and the RMP in particular.

17.1.3 Committee's discussion

The Committee **thanks** the Panel for its thorough review of the Icelandic programme. It also **acknowledges** the work of the IRP scientists in producing revised papers after the Workshop so that they were available 40 days prior to the Annual Meeting.

In discussion, some members noted that while the Panel had agreed that 'many aspects of the Icelandic programme were directly relevant' to a number of Commission Resolutions on the environment and climate change, they believed that it was more appropriate to say that they were 'potentially' relevant to Commission Resolutions. They also believed that the Icelandic Programme fell short of meeting the Resolution on Whaling under Special Permit (IWC, 1996a).

Some members, having taken account of the expert review, expressed some broader critical views of the Icelandic programme and these are provided in Annex P1. This was not discussed and neither was the response from the proponents given in Annex P2. Noting the previous discussions on special permit whaling, the Committee did not discuss an overall evaluation of the Icelandic program.

Without questioning the quality of the members of the Panel, the future need for increased participation from experts outside of the Scientific Committee was noted. The Steering Group explained that this was the intention but despite a long list of potential candidates developed, the availability and/or interest of outside scientists in participating in the review had proved extremely challenging.

A large number of scientific papers originated from the Icelandic programme. Several of these papers were presented to the relevant sub-committees and working groups (RMP, SD, EM and E) as shown in Table 1. However, some members of the Committee suggested that further consideration be given to how to manage the time allocated to review such papers in the future, as they felt that not enough time was available for review in some sub-groups.

17.2 Review of results from ongoing permits

As in previous years, the Committee received short cruise reports on activities undertaken but spent relatively little time on discussion of the details. For long-term programmes, the Committee has agreed that regular periodic detailed reviews (following its guidelines, IWC, 2013k) were more appropriate.

17.2.1 JARPN II

SC/65a/O3 presented the results of the 2012 JARPN II (Second Phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific) offshore component. A detailed summary is given in Annex P. There were three main research components: whale sampling survey, dedicated sighting survey and whale sighting and prey survey.

A total of five research vessels were used: two sighting/sampling vessels (whale sampling survey component), one research base vessel (whale sampling survey component), three dedicated sighting vessels (dedicated sighting survey component) and one whale sighting and prey survey vessel (whale sighting and prey survey component). Catches occurred between 16 May and 3 August 2012 (74 common minke, 100 sei, 34 Bryde's and 3 sperm whales). Sightings surveys covered over 2,300 n.miles and eight species of large whales were seen including 5 blue and 2 North Pacific right whales. Preliminary results of biological and feeding ecology analyses are presented in this document. Data obtained during the 2012 JARPN II survey will be used in the elucidation of the role of whales in the marine ecosystem through the study of whale feeding ecology in the western North Pacific.

SC/65a/O6 presented the results of the 2012 JARPN II coastal component off Kushiro, northeastern Japan (middle part of sub-area 7CN). A more detailed summary is given in Annex P. Research occurred from 9 September to 28 October 2012, using four small sampling vessels. Catches (48 common minke whales) occurred within 50 n. miles of Kushiro port, and animals were landed at the JARPN II research station for biological examination. The frequency of whales feeding on Japanese anchovy was much lower in 2012 than in previous Kushiro surveys.

In discussion, it was clarified that search areas and vessel course were determined from weather conditions, whale distribution and information on fishing ground of coastal fisheries.

SC/65a/O7 presented results of the 2012 JARPN II coastal component off Sanriku (northeastern Japan, corresponding to a part of sub-area 7). A more detailed summary is given in Annex P. Research occurred from 12 April to 26 May 2012. Catches (60 common minke whales) occurred within 50 n. miles of Ayukawa port and all animals collected were landed at the JARPN II research station for biological examination. Information on sighting distribution, biological characteristics and prey species of whales collected during the 2012 survey was similar to that recorded before the 2011 earthquake and tsunami.

In response to a question, Sakamoto explained that samples from 32 individuals of four species from 2012 JARPN II were screened for radioactivity for the purpose of food safety. Ten of them were below the detection limit and the other 22 were well below the National Food Safety Limit set by the ministry of Health, Labor and Welfare. This information is available on the website of The Fisheries Agency of Japan[25].

17.2.2 JARPA II

SC/65a/O9 presented results of the eighth cruise of the JARPA II (Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic) survey in the 2012/13 austral summer season. A more detailed summary is given in Annex P. Research was conducted from 26 January to 14 March 2013 in Areas III East, IV, V West and part of Area V East. Four research vessels were used: three sighting/sampling vessels (SSVs) and one research base vessel. The SSVs surveyed a total of 2,103.3 n.miles in a period of 48 days. Unfortunately, the research activities were interrupted several times by the Sea Shepherd, which directed violent sabotage activities against Japanese research vessels. A total of 103 Antarctic minke whales were caught and examined on board the research base vessel. Photo-identification, biopsy sampling and oceanographic work was also conducted. The main results of were as follows: (1) humpback whales were widely distributed in the research area with a higher density index than that of the Antarctic minke whales in all areas except in Prydz Bay; (2) the ice-free extent of the research area was substantially larger than in past seasons; (3) mature female Antarctic minke whales were observed only in Prydz Bay; and (4) all Antarctic minke whales sampled in Area IV east were immature animals.

17.3 Planning for periodic review of results from JARPA II

JARPA II is due for a periodic review during the next intersessional period. According to revised guidelines (IWC, 2013k), the proponents should submit a document explaining the data to be made available to the workshop one annual meeting prior to the review workshop. This information is provided in SC/65a/O8.

SC/65a/O8 summarised the data available for the next JARPA II review workshop to be held early in 2014. The summary was made for the six first surveys of JARPA II (2005/06-2010/11). The summary of the data followed the revised guidelines: (IWC, 2013k): (a) outline of the data that will be available; (b) references to data collection and validation protocol; (c) references to documents and publications of previous analyses and d) contact details. Data in SC/65a/O8 were summarised into the following sections: a) data for abundance estimate for several baleen and toothed whale species, b) ecological data, c) biological, feeding ecology, pollutant and stock structure data of Antarctic minke whale, d) biological, feeding ecology, pollutant and stock structure data of fin whale; and (e) stock structure data of other species. Details of these data are given in Annex P5.

[25] http://www.jfa.maff.go.jp/e/inspection/

The next step of the review process is that the proponents make data available in electronic form 1 month after the end of the Annual Meeting. Then the proponents will send a document to the Secretariat describing the analytical methods to be discussed at the workshop. This will happen 9 months prior to the next Annual meeting; i.e. the beginning of September. Based on the description of analytical methods, the Steering Group (Chair[26], Vice Chair, Head of Science and the last four Scientific Committee chairs) will begin the process of identifying experts to participate in the workshop. The need to try to find experts from outside the Committee was stressed. The full timetable for the process is summarised in Table 6 and details can be found in (IWC, 2013k).

Table 6

Timetable for the periodic review of JARPA II assuming that the Annual Committee meeting is on 1 June

Item	Schedule	Date
Information on likely analytical methods to be used in the documents to the Workshop	9 months before Ann. Mtg	1 Sep.
Distribute documents to Vice Chair, Head of Science and Standing Steering Group (SSG).	1 week later	8 Sep.
SSG suggest names for the Specialist Workshop. Announcement of review to IWC and call for observers	2 weeks later	22 Sep.
Chair, Vice Chair and Head of Science develop draft list of specialists and reserves	2 weeks later	6 Oct.
Final comments from SSG	1 week later	13 Oct.
Invitation and documents to Specialists	1 week later	20 Oct.
Receipt and circulation of results/review documents from Special Permit research (including to IWC Scientific Committee members)	>6 months prior to Ann. Mtg	1 Dec.
Observer reviews/papers due at the Secretariat		30 Dec.
Observer's reviews sent to Specialists and Proponents		6 Jan.
Hold Workshop	>100 days prior to Ann. Mtg	23 Feb.
Final Workshop Report made available to Proponents	>80 days prior to Ann. Mtg	13 Mar.
Distribution of result documents, Workshop Report and comments from Proponents to the Scientific Committee	>40 days prior to Ann. Mtg	22 Apr.
Discussion and submission of documents to the Commission	Annual Meeting	1 Jun.

The Committee **reaffirms** its guidelines (IWC, 2013k) that when members submit substantive analyses for a review panel, the Panel Chair, in exercising their discretion, may allow presentation of such analyses in the same manner allowed for proponents.

17.4 General comments regarding Special Permit whaling

Some members of the Committee stressed that the lack of review and comment outside the periodic reviews under the Committee's revised guidelines should not be interpreted as an indication that any of the serious scientific concerns expressed about Special Permit whaling programmes have been addressed. This statement is included as Annex P3. Other members opposed this view and their statement is included as Annex P4.

17.5 Review of new or continuing proposals

17.5.1 JARPA II

Japan reported that there was no plan to change the JARPA II programme.

17.5.2 JARPN II

Japan reported that there was no plan to change the JARPN II programme.

18. WHALE SANCTUARIES

There were no new proposals for IWC Sanctuaries this year. The Committee **agrees** to keep this item on the Agenda. General matters relevant to marine protected areas were dealt with by relevant sub-groups (and see Item 4.7).

[26] Given his involvement in the program, the Committee Chair, Kitakado, will not take part in the Steering Group. Palka (as immediate past chair) will act on his behalf.

19. SOUTHERN OCEAN RESEARCH PARTNERSHIP

SC/65a/SH25 reported on a Southern Ocean Research Partnership (SORP) meeting (31 May – 2 June 2013). The aims of the conference were to: (1) present the scientific results from the five ongoing SORP research projects; (2) update the existing project plans and discuss new research proposals (refer to Annex 1 of SC/65a/SH25Rev for details of these plans); and (3) make recommendations for the continuation and development of the SORP.

The pre-meeting made key recommendations in relation to the SORP initiative:

(1) to ensure all SORP Partners are seeking funding from all suitable sources to ensure the five existing SORP research projects are resourced adequately;
(2) to improve communication with the Commission on SORP-related outcomes to ensure that they are aware of the scientific products and to encourage financial support;
(3) to improve the dissemination of information on SORP projects and initiatives;
(4) for SORP Partners to encourage all platforms of opportunity and, where applicable, citizen science, to collect data for inclusion in SORP research projects, thereby reducing the logistic constraints of circumpolar coverage and overall expenditure;
(5) that all data and samples collected from international, collaborative research efforts such as SORP are stored and archived in recognised central repositories; and
(6) that the holders of large, long-term datasets that contain valuable information relevant to SORP, particularly acoustic data, should be strongly encouraged to analyse and publish these data as soon as possible.

The Committee **congratulates** the many scientists engaged in SORP for the significant progress and new information presented to the Scientific Committee. It **endorses** the recommendations above and notes that the scientific results were being integrated into the broader work of the Committee.

The Committee **agrees** that the preliminary objective of the Antarctic blue whale project had now been met; the identification of the most appropriate survey design method. The project has also developed a passive acoustic tracking technique that has ramifications for all future whale surveys in Antarctica. The Committee **agrees** that the data from this SORP project are key to the assessment of the Antarctic blue whale population.

The Committee also **recognises** that the acoustic trends project is extremely ambitious; it will take many years to complete but may be the only way to assess the recovery of fin whales. In time it may become the most efficient way to describe the abundance and distribution of many Antarctic whale species.

The first objectives of the Oceania humpback whale project have been completed through the collaborative analysis of biopsy and photo-identification data and those results are being used in the current assessment of Breeding Stock E humpback whales. The results of SC/65a/SH13 are also informative to this project.

The Committee **agrees** that the collection of data through platforms of opportunity may be a highly effective way to collect data in the remote Southern Ocean.

20. IWC LIST OF RECOGNISED SPECIES

The recent literature in cetacean taxonomy (SC/65a/O1) was reviewed and discussed (see Annex L) and it was agreed to add two newly recognised species to the List. *Inia geoffrensis* has been split into the Amazon river dolphin, *I. geoffrensis* and the newly recognised Bolivian bufeo, *I. boliviensis* (Ruiz-García and Shostell, 2010). *Neophocaena phocaenoides* has been split into the Indo-Pacific finless porpoise, *N. phocaenoides* and the newly recognised narrow-ridged finless porpoise, *N. asiaeorientalis* (Jefferson and Wang, 2011). New analyses based on the cytochrome b gene (SC/65A/SM03) have confirmed the split of the finless porpoises. The Burrunan dolphin *Tursiops australis* was recently described (Charlton-Robb *et al.*, 2011) but its validity is uncertain (Committee on Taxonomy, Society for Marine Mammalogy, 2012) and the Committee **agrees** to not add it to the List at present, pending further studies. It was noted that the extent of sympatry of the two finless porpoise species (Taiwan Strait) is thought to be small, and further sampling (molecular and morphological) to investigate possible divisions within the two recognised species is encouraged.

The Committee also recalled the open questions remaining about the taxonomy of the Bryde's whale species complex and the holotype of the common minke whale. With respect to the former, the genetic identity of the holotype specimen of *Balaenoptera edeni* remains to be identified; the Committee **reiterates** its previous recommendation that this be done.

21. CONSERVATION MANAGEMENT PLANS

Conservation Management Plans (CMPs) and their role in the IWC was first discussed by the Committee in 2008 (IWC, 2009). A key feature of CMPs is that they provide a framework for international collaboration to address threats to populations that occur within the waters of more than one country and in offshore waters i.e. they are complementary or supplementary to individual national initiatives.

The IWC has identified some key components of CMPs (see IWC/63/CC5). These are:

(1) the focus should be on practical and achievable actions (including protection for critical habitats) that have the greatest chance of resulting in improved conservation status; actions fall broadly under a number of headings (co-ordination, research, monitoring, public awareness, mitigation) all of which must be driven by the need for positive conservation outcomes.

(2) CMPs are living documents that are to be reviewed periodically against measureable milestones based on monitoring, assessment, and compliance with agreed measures.

(3) CMPs are designed to complement existing measures (e.g. national recovery plans or other national or regionally agreed measures) not to replace them; in particular they can fill identified gaps given the geographical and seasonal range of the populations involved. IWC involvement can *inter alia* bring in additional range state support, the involvement of other IGOs and scientific/technical expertise.

The approach for identifying populations for which CMPs can be developed will depend on the level of information that is available on abundance, status and threats. In addition, CMPs will only be effective where there are identified threats that are practicable to address. If management measures to address threats are already being taken by the range states involved, or if there is only one range state, then there may be little additional benefit in coordinated action through a CMP. In addition, the IWC will need to give consideration as to how CMPs might interact with other efforts such as that of the Convention on Biological Diversity for defining 'Ecologically or Biologically Significant Areas (EBSAs)' or regional agreements such as ACCOBAMS.

The Committee noted that there were different approaches to identify whether a population that meets at least one of the following criteria (1)-(4) might be considered as a candidate: population status (i.e. knowledge of where the population is now in relation to its unexploited abundance, with an estimate of future trend) has been assessed and is of concern, and actual or likely human activities that can threaten the population have been identified;

(1) population status has not been assessed but the impacts of human activities are believed by the Committee to be substantial and thus of concern;

(2) present abundance is known and actual or likely human activities that can threaten the population have been identified;

(3) present abundance and trend are not well known but abundance is believed by the Committee to be small such that any adverse impacts as a result of human activity may be critical.

The approach taken, for example whether the primary motivation is driven by concerns over status or the level of threat, will depend on what data are available. The Committee discussed CMPs during the work of different sub-committees, some of which considered the issue from the perspective of threats while others from the perspective of population status. The Committee **agrees** that the focus for initial discussions this year is on large whales; it is a much larger and more complex task for small cetaceans. The Committee **seeks guidance** from the Commission on whether or not it wishes the Committee to develop a priority list of populations of small cetaceans for which CMPs might be of value. The Committee **recognises** that consultation with range states is an essential first step in developing a CMP.

The Committee **agrees** that those populations with draft CMPs already in place (western gray whales – collaboratively with IUCN; Southwest Atlantic population of southern right whales; and Southeast Pacific population of southern right whales) remain a high priority for CMPs.

The Committee also identified the populations that could be considered for a CMP if supported by the range states. This list illustrates different examples, including agreement that populations were high priorities for a CMP, populations where their status would merit a CMP but it is difficult to identify practicable conservation measures, and populations where there were different views on whether the conservation status required a CMP.

Populations considered based on assessments by the Scientific Committee

Arabian Sea humpback whales
This population was first suggested as a possible priority candidate by the Committee in 2010. It is believed to have numbered as few as 82 individuals in 2004 (95% CI 60-111) based on dorsal fin and fluke photo identification work around Oman. No trend information is available and there are few data available from other range states (India, Pakistan, Sri Lanka, with occasional sightings for Iran and Iraq) to be sure to whether this reflects total abundance of the humpback whales in the Arabian

Sea or just around Oman. Known and likely threats include entanglement in fishing gear and ship strikes but the full extent of these is unknown.

The Committee **agrees** that the Arabian Sea population remains a high priority for a CMP if support was provided by the range states.

Common minke whales in the coastal waters of China, Japan (especially the west coast) and Republic of Korea
Of the common minke whale populations in the North Pacific considered by the Committee, only common minke whales in the coastal areas of Japan, China and the Republic of Korea might satisfy the guidelines for populations which could be subject to a CMP. China, Republic of Korea, North Korea, Japan, Russian Federation are the range states. Information on the animals in these waters comes primarily from the discussions of stock structure and the modelling work undertaken as part of the RMP *Implementation Review* (Annex D1, item 10). The stock structure issue led to no agreement within the Committee: there are three hypotheses (A, B, C of increasing numbers of stocks or sub-stocks). Stock structure hypothesis C leads to most concern for the 'J-like stocks' and the 'Y-stock'; the high levels of incidental take, in particular, cause substantial projected future decline (see Annex D1). In addition to the stock structure discussions, a major information gap is the poor survey coverage, particularly the sub-areas 5 and 6W.

Despite the uncertainties, some members believed that the results from assessments underlying the *Implementation Simulation Trials* undertaken during the *Implementation Review* were sufficient to warrant consideration of the value of a CMP, given the projected impact of incidental bycatch. Other members believed that it was premature to put this proposal forward given the uncertainty regarding stock structure and the poor survey coverage in some areas.

North Atlantic right whales
The Committee reiterated its concerns over the status of North Atlantic right whales, a small population subject to high levels of human impacts from entanglement and ship strikes. However, the two range states (USA and Canada) are already taking management action and the Committee did not identify any specific ways in which a CMP would assist their conservation efforts.

North Pacific right whales
The Committee noted concern over the small size of this population, particularly in the eastern part of the species' range, and the need for more research to understand distribution, assess threats and identify actions that could be taken to reduce these. It was also noted that the range states for right whales in the North Pacific were the same as for gray whales and so there may be options for integrating North Pacific right whales with the current western gray whale CMP.

Populations considered based on knowledge of threats

Blue whales in the northern Indian Ocean
The Committee noted that there are no population estimates for blue whales in the northern Indian Ocean but there have been a number of reported ship strikes of blue whales off Sri Lanka. This highlights the urgent need for long-term monitoring of the blue whales in Sri Lankan waters and elsewhere in the northern Indian Ocean. Further assessment is needed on whether this population may benefit from a CMP.

Fin whales in the Mediterranean
This population is red listed as *Vulnerable* by IUCN and is known to be subject to a high level of ship strikes. The IWC and ACCOBAMS have a joint work plan to address ship strikes in the Mediterranean. Further evaluation is required as to whether an IWC CMP would assist in the current work by IWC, ACCOBAMS and range states.

Sperm whales in the Mediterranean
This population is considered as *Endangered* by IUCN and is at risk from driftnet entanglement and ship strikes. As for fin whales in the Mediterranean, further evaluation is required to determine whether an IWC CMP would assist in the current work by IWC, ACCOBAMS and range states.

Other populations that were tentatively considered in some sub-group reports as potentially benefitting from a CMP in the future include: Antarctic blue whales; a small southeast Pacific (Isla de Chiloe) group of blue whales; and a small southeast Pacific group of 'pygmy' fin whales. However, the current information on status and/or threats in these cases was not adequate to support a recommendation at this time. In particular, in the case of these blue whale and fin whale populations, no major threats amenable to practical management action have been identified. The Committee **agrees** that other populations will be re-evaluated for priority listing as additional information becomes available.

Entanglement and ship strikes are the highest cause of non-deliberate anthropogenic mortalities for large whale populations. In addition to assessments including abundance and status, the Committee has discussed ways of estimating the numbers of entanglement and ship strike mortalities and evaluating mitigation measures. The Committee also noted that any population which is known to spend significant time in areas of high entanglement risk or high density shipping may be considered, even with a low number of reports. This is especially true if there is no local stranding network or ship strike reporting infrastructure. The Committee **agrees** that it is not currently in a position to propose any populations for CMPs based only on risk analysis where reporting is very limited.

Once a CMP is developed, the mitigation aspects of measures considered within it will need to be evaluated to assess what risk reduction is expected or being achieved. The Committee therefore **encourages** studies that fill any data gaps regarding ways that entanglement or ships strikes may be reduced, for input into CMPs. This may be in areas where CMPs have already been developed (western gray whales; Southwest Atlantic population of Southern right whales; and Southeast Pacific right whales); are currently under consideration as candidates (Arabian Sea humpback whales) or are high on the list of priority candidates. Recognising that CMPs continue to evolve, the Committee **agrees** that it would welcome requests for further scientific input into existing CMPs.

For ship strikes, the IWC has consultative status to the International Maritime Organization (IMO) and so can assist with IMO involvement. The IMO is responsible for all measures outside of national waters that affect shipping and so an effective dialogue with IMO is critical for all measures related to ship strikes. In addition it was noted that as part of the CMP for the Southwest Atlantic population of Southern right whales, the range states have agreed to collect information on ship strikes with this species and report them to the IWC.

For entanglements, the IWC has established a large whale entanglement expert advisory group, with members from Australia, Canada, New Zealand, South Africa and the USA, to advise countries on the issue, and has initiated a programme to build capacity in prioritised areas, when requested (IWC, 2013a). In addition, the Committee **recommends** that the Secretariat bring the IWC's most current scientific and mitigation information to the relevant bodies within the FAO.

22. COMPILATION OF AGREED ABUNDANCE ESTIMATES

The Committee has recognised the need for consistency in evaluating abundance estimates across sub-groups, recognising that to some extent 'acceptance' depends on the use to which the estimate is being put. It is also valuable for the Commission to have an updated overview of how many whales there are by broad ocean area. This year the Committee began a process to develop such lists and summaries by placing this as an item on the agendas of the relevant sub-groups. It established an *ad hoc* working group whose report is given as Annex Q.

The Committee **agrees** with the *ad hoc* group that the most appropriate way to make progress on further development of developing summary tables for both its use and that of the Commission is to establish an intersessional Working Group that will consider doubtful and potentially missing estimates, compile and summarise existing estimates and report to next year's Annual Meeting (Annex R).

The membership of this Working Group should comprise members representative of the Committee's relevant sub-groups and those familiar with methods for estimating abundance. It will also produce a draft strategy for discussion at the next Annual meeting for a process to ensure:

(a) regular updating of the tables; and

(b) a strategy to ensure consistency of the review of abundance estimates across sub-committees and working groups.

The objective is for this group to complete its work and circulate draft tables by the beginning of January 2014.

Table 7
Progress on research proposals and workshops funded last year

Title		Status
(1)	Development of an operating model for West Greenland humpback and bowhead whales	Completed (SC/65a/Rep2)
(2)	Workshop on development of SLAs for Greenlandic hunts	Completed (SC/65a/Rep2)
(3)	AWMP developers funds	Used to fund work in SC/65a/AWMP2
(4)	Ship strike database coordinator	Completed (SC/65a/HIM4)
(5)	Right whale survey off of South Africa	Completed (SC/65a/BRG10)
(6)	Genomic diversity and phylogenetic relationships among right whales	Not funded
(7)	Photographic matching of gray whales	Completed (SC/65a/BRG4)
(8)	Contribution to the preparation of the State of the Cetacean Environment Report (SOCER)	Completed (SC/65a/E1)
(9)	Pre-meeting workshop on assessing the impacts of marine debris	Completed (SC/65a/Rep6)
(10)	Develop simulation of Southern Hemisphere minke line transect data	Completed (S/65a/IA15)
(11)	IWC-POWER cruise	Completed (SC/65a/Rep1 and IA8)
(12)	Statistical catch-at-age assessment method for Antarctic minke whales	Completed (SC/65a/IA1)
(13)	"Second' *Implementation Review* workshop for WNP common minke whales	Completed (SC/65a/Rep4)
(14)	Essential computing for RMP/NPM and AWMP	Completed (Annexes D, D1, AWMP)
(15)	MSYR review workshop	Completed (SC/65a/Rep5)
(16)	Review and guidelines for model-based and design-based line transect abundance estimates	Postponed until this year
(17)	Modelling of Southern Hemisphere humpback whale populations	Completed (SC/65a/SH1 and 7)
(18)	Antarctic humpback whale catalogue	Completed (SC/65a/ SH15)
(19)	Photo matching of Antarctic blue whales	Completed (SC/65a/SH16)
(20)	Southern Hemisphere blue whale catalogue 2012/13	Completed (SC/65a/SH23)
(21)	Expert workshop for review of Iceland's Special Permit programme	Completed (SC/65a/Rep3)
(22)	Whalewatching guidelines and operator training in Oman	Completed

Table 8

Summary of proposed workshops and pre-meetings

Subject	Annex	Dates	Venue
IWC-POWER Technical Advisory Group meeting	Annex G	September 29-30	Tokyo, Japan
IWC-POWER planning meeting for the 2014 cruise	Annex G	October 2-3	Tokyo, Japan
Oman whalewatching workshop	Annex M	October	Oman
IWC/IQOE soundscape workshop	Annex K	'Winter'	The Netherlands
Workshop on developing *SLA*s for the Greenland hunts	Annex E	Early January (*)	Copenhagen, Denmark
Workshop on the North Atlantic fin whale *Implementation Review*	Annex D	Early January	Copenhagen, Denmark
International gray whale workshop on stock structure and status	Annex F	March/April	TBD
Workshop on the problem of kelp gulls and southern right whales	Annex F	April	Puerto Madryn, Argentina
AWMP/RMP NA minke stock structure	Annex D, E	April	CPH (or Bergen)
JARPA II review	Annex P	Late February	Japan
North Atlantic common minke whale *Implementation Review*	Annex D	Pre-meeting (3days)	TBD
Southern Hemisphere humpback whale assessment	Annex H	Pre-meeting (2days)	TBD

23. RESEARCH AND WORKSHOP PROPOSALS AND RESULTS

23.1 Review results from previously funded research proposals

Table 7 shows the progress of funded proposals from last year (IWC, 2013).

23.2 Review workshop proposals for 2013/14

Table 8 summarises the Workshop proposals agreed at this year's meeting. Information on funding is given under Item 26.

24. COMMITTEE PRIORITIES AND INITIAL AGENDA FOR THE 2014 MEETING

The Committee **notes** that the Commission's decision to move to biennial meetings means that it will need to develop a two-year proposed workplan at next year's meeting. The Committee **agrees** the following priorities below based on consideration in the plenary of the recommended work plans of the sub-committees and working groups. In addition, al l relevant sub-groups will continue to consider updated abundance estimates and CMPs. Given its workload, the Committee **stresses** that papers considering anything other than priority topics will not be addressed at next year's meeting. The new online system for submitting papers will be updated during the year such that Convenors will be notified directly when papers are submitted for their sub-group; they may then contact authors directly if they believe that the papers are unlikely to be discussed.

Revised Management Procedure (RMP)

The following issues are high priority topics:

General issues

(1) finalise the approach for evaluating proposed amendments to the *CLA*;
(2) evaluate the Norwegian proposal for amending the RMP;
(3) update the requirements and guidelines for conducting surveys to reflect considerations related to model-based methods for abundance estimation;
(4) specify how to deal with imbalanced sex ratios in incidental catches under the RMP;
(5) develop guidelines for handling situations in which survey coverage in time-series of abundance estimates changes over time; and
(6) Consider the use of surveys carried out in different months in the *Implementation* process and in actual implementation of the RMP.

Implementation related issues

(1) Finalise work on western North Pacific common minke whales:
 (a) review results from 'hybrid' variants with respect to variants with research
 (b) review any research proposals with respect to variants with research
 (c) agree estimates of abundance for use in actual applications of the RMP
(2) complete the *Implementation Review* for the North Atlantic fin whales;
(3) begin preparations for a focussed basin-wide stock structure study for North Atlantic fin whales to be completed in time to inform the next *Implementation Review*;
(4) start an *Implementation Review* for the North Atlantic minke whales starting with a three day pre-meeting (Convenor Walløe) including review report of the joint AWMP/RMP workshop on the stock structure of common minke whales ;
(5) review the information available for North Atlantic sei whales in the context of a *pre-implementation assessment*; and
(6) review new information on western North Pacific Bryde's whales.

Aboriginal Whaling Management Procedure
The following issues are high priority topics:

(1) participate in the North Atlantic fin whale RMP process and review the implications of this for *SLA* development for the Greenland hunt;
(2) hold joint AWMP/RMP workshop on the stock structure of common minke whales in the North Atlantic;
(3) submit need envelopes for West Greenland fin and common minke whales;
(4) finalise the trials for the West Greenland humpback and bowhead whales (including coding) to allow developers to work intersessionally. Ensure that standard software is available to produce agreed performance statistics, as well as tabular and graphical output
(5) present overview of photo-identification work with respect to movements to inform stock structure and human induced mortality outside West Greenland;
(6) finalise removals series including consideration of human-induced mortality outside the West Greenland area
(7) continue initial exploration of potential SLAs for the Greenland humpback and bowhead whale hunts; and
(8) Produce full report on Greenlandic conversion factor programme.

Bowhead, right and gray whales
The following issues are high priority topics:

(1) Review report from workshop on the rangewide review of the population structure and status of North Pacific gray whales
(2) perform the annual review of catch information and new scientific information for BCB stock of bowhead whales;
(3) perform the annual review of catch information and new scientific information for eastern gray whales;
(4) review any new information on all stocks of right whales, especially results of assessments for southern right whales and the kelp gull workshop;
(5) review any other new information on western North Pacific gray whales and other stocks of bowhead whales.

In-depth assessment
The following issues are high priority topics:

(1) further investigation and application of the SCAA models;
(2) further work examining the factors which drive Antarctic minke whale distribution and abundance;
(3) complete preparations for an In-depth Assessment on North Pacific sei whales, specifically
    (a) update the IWC catch data to include new data from Canadian and Soviet catches;
    (b) analyse available survey and genetic data from the North Pacific, including from the IWC-POWER surveys;
(4) investigate the distribution and density of baleen and toothed whales in the Antarctic relative to spatial and environmental covariates; and
(5) plan and undertake the 5th IWC-POWER survey in the North Pacific;
(6) plan the next phase of the POWER cruises in the light of the Technical Advisory Group report

Non-deliberate human-induced mortality
The following issues are high priority topics:

(1) review progress in including information in National Progress Reports;
(2) entanglement;
(3) ship strikes;
(4) review of information on other sources of non-deliberate human induced mortality; and
(5) develop five year plan for suggestions for priority work by the Committee to estimate and address non-deliberate human induced mortality; review work of intersessional group.

Stock Definition
The following issues are high priority topics:

(1) genetic Analysis guidelines;
(2) stock definition terminology
(3) statistical and genetic issues concerning stock definition
(4) testing of spatial structure models (develop new terms of reference); and
(5) providing advice to sub-groups as appropriate.

DNA
The following issues are high priority topics:

(1) review genetic methods for species, stocks and individual identifications;
(2) review of results of the ‘amendments’ work on sequences deposited in GenBank;
(3) examine the technical information relevant to the TORs of the Group,
(4) collection and archiving of tissue samples from catches and bycatches; and
(5) reference databases and standard for diagnostic DNA registries.

Environmental Concerns
The following issues are high priority topics:

(1) SOCER;
(2) pollution (including POLLUTION 2020)
(3) Cetacean Emerging and Resurging Diseases (CERD) and mortality events;
(4) effects of anthropogenic sound on cetaceans and approaches to mitigate these effects (including the results of the intersessional joint workshop);
(5) climate change

(6) Other habitat related issues including the report of the Conservation Committee's workshop on marine debris; and
(7) Conservation Management Plans.

Ecosystem modelling
The following issues are high priority topics:

(1) review ecosystem modelling efforts undertaken outside the IWC (competition and environmental variability);
(2) explore how ecosystem models contribute to developing scenarios for simulation testing of the RMP (linking individual based models to the RMP); and
(3) review other issues relevant to ecosystem modelling within the Committee.

Southern Hemisphere whales other than Antarctic minke whales and right whales
The following issues are high priority topics:

(1) complete assessment of Breeding Stocks D/E/F humpback whales - this will complete the Comprehensive Assessment of Southern Hemisphere Humpback Whales;
(2) review new information on Southern Hemisphere blue whales in preparation for assessment; and
(3) consider the feasibility of undertaking a future assessment of sperm whales.
(4) Arabian Sea humpback whales

Small cetaceans
The following issues are high priority topics:
(1) voluntary funds for small cetacean conservation research;
(2) review of small cetaceans in the eastern Mediterranean and Red Seas and
(3) progress on previous recommendations.

Whalewatching
The following issues are high priority topics:

(1) assess the impacts of whalewatching on the physiology, behaviour, and fitness of cetaceans (individuals and populations) and their habitats;
(2) review reports from Intersessional Working Groups;
(3) review progress on 5-Year Strategic Plan for Whalewatching;
(4) review whalewatching in the region of the next meeting;
(5) consider information from platforms of opportunity of potential value to the Scientific Committee;
(6) review whalewatching guidelines and regulations; and
(7) consider emerging whalewatching industries of concern.

Scientific Permits
The following issues are high-priority topics:

(1) review results of specialist JARPA II meeting
(2) review of activities under existing permits; and
(3) review of new or continuing proposals.

25. DATA PROCESSING AND COMPUTING NEEDS FOR 2013/14

Allison reported on the computing needs and requirements identified for the forthcoming year. These are summarised in Table 8.

Table 9

Computing tasks for the coming year.

Group		ITEM
RMP		
	(1)	Complete final compilation of tables and plots from the *Implementation Review* of North Pacific minke whales.
	(2)	Run hybrid trials (variants with research) of North Pacific minke whales as required.
	(3)	Redo conditioning and rerun existing trials of North Atlantic fin whales.
	(4)	Other work related to the *Implementation Review* of North Atlantic fin whales (e.g. revision of the control program; conditioning and running of final trials to be specified by the intersessional Workshop (Annex D Appendix 2)
	(5)	Run a full set of trials using the Norwegian 'CatchLimit' program for Western North Pacific Bryde's whales and North Atlantic minke whales and place the results on the IWC website
	(6)	Work with the Norwegian Computing Centre to standardise the Norwegian catch limit program code (Annex D Item 2.4)
	(7)	Work to specify and run additional trials for testing amendments to the CLA (Annex D Item 2.2)
AWMP		
	(1)	Finalise the catch and other removals series for use in trials including ship strikes and other human induced mortality outside West Greenland and data from Canada (see Annex E Item 3.2 and 3.3)
	(2)	Work on the control program for the West Greenland humpback and bowhead whales (see Annex E Item 3.2 and 3.3)
IN-DEPTH ASSESSMENT		
	(1)	Prepare catch series for North Pacific sei whales including inclusion of revised Canadian catch data and new analysis of Soviet North Pacific catch records to extent possible in time available, noting any discrepencies (see Annex G Item 5.1)
	(2)	Validation of the POWER cruise data and work towards standard IDCR/SOWER dataset (see Annex G Item 5.3)
	(3)	Complete validation of the 1995-97 blue whale cruise data and incorporate into the DESS database (carried over).
	(4)	Documentation of the catch data available for Antarctic minke whales in preparation for the pre-implementation assessment (carried over)
BRG		
	(1)	Update the catch series for North Pacific gray whales (Annex F).

26. FUNDING REQUIREMENTS FOR 2013/14

This year, the sub-groups of the Committee's recommended projects for funding greatly exceeded (>£180,000) the allocated funding by the Commission within the two-year budget (Table 9). Reducing the budget to within the Commission's allocation was therefore a much greater task than is usually the case. For example, last year the full budget request was less than £24,000 over the available budget. The Scientific Committee's handbook states that one of the tasks for a Convenor is to:

'f.'To develop with other members of the Convenors' Group a prioritised list for funding that should to be made available to the full Committee at least by 6pm on the penultimate day of the Scientific Committee Annual Meeting.'

Given the difficult situation this year, the Convenors circulated to the Committee the full budget request and the full background information on the 13 June i.e. two days before the close of the meeting, before it had managed to meet to discuss a 'prioritised list' for circulation.

After a suggested budget had been developed on the afternoon of 14 June but before a document including the suggestions and rationale could be circulated to the full Committee, it was agreed to hold a Heads of Delegation meeting in the late afternoon of 14 June; this was followed by another on the morning of 15 June. During the second meeting, it was agreed that the option for a reduced budget developed by the Convenors should be submitted to the full Committee, noting that it had been seen by the Heads of Delegations but that there had been insufficient time for them to fully review it. In doing so, it was recognised that the Convenors had given full consideration to the reduced budget; the revised budget discussion document was annotated with comments made by individual Heads of Delegations.

The Committee **agrees** that it is important to consider possible new systems for future budget allocations; it will add this topic to its agenda next year. In this regard it also noted the need to develop a two-year budget request next year. The Heads of Delegations **requested** that the Secretary review the governance rules, procedures and practices of the Scientific Committees of the other inter-governmental organisations and report back to the Scientific Committee in 2014 in order to assist discussions of the working methods of the Committee. They also requested a more substantial role in Committee governance. Recognising that these are funds provided by the Commission, the Committee **agrees** that *inter alia* Heads of Delegations should play a substantial role in discussions of how the budget should be allocated in future. Convenors should continue to play an important role since they are familiar with the research needs and priorities of each sub-group. The advice of the Commission will also be sought on both the process and its priorities.

As noted above, trying to balance the budget this year was an extremely difficult task. The approach taken by the convenors for the discussion document is summarised below.

Check the feasibility of voluntary reductions: each budget line was examined to see if any proposal could be lowered (based on the knowledge of single projects, discussions with proposers where possible or discussions within the sub-committee itself) e.g. by reducing the number of participants to workshops/meetings, finding external founders (for research, WS or participants), removing part of the research programme, etc

Checking the feasibility of projects' postponement, in the light of the sub-group priorities: in some cases the amount was either lowered or cut, according to the feasibility to defer some work by one year

Final cuts based on the strength of recommendations in sub-group reports and an assessment by all convenors of overall Committee priorities: this was by far the most difficult part of the process, given a remaining overrun of more £100,000.

Table 10 summarises the complete list of recommendations for funding made by the Committee as well as the reduced budget developed in light of the known available funding. The Committee **recommends** all of these proposals to the Commission. In **recommending** its reduced budget, the Committee **stresses** that projects for which it has had to suggest reduced or no funding are still important and valuable.

(1) AWMP-1 INTERSESSIONAL WORKSHOP ON DEVELOPING *SLA*S FOR THE GREENLAND HUNTS

The Committee has identified completion of the development of long-term *SLA*s for these hunts as high priority work. In order to meet the proposed timeframe, an intersessional Workshop is required. The focus of the proposed Workshop is to: (1) to review the results of the developers of *SLA*s for humpback whales and bowhead whales; (2) finalise the modelling framework/trial structure for these hunts; (3) develop a workplan to try to enable completion of work on *SLA*s for these two hunts at the 2014 Annual Meeting; and (4) consider possible input (e.g. using AWMP/RMP-lite) for the joint AWMP/RMP workshop on North Atlantic common minke whale stock structure. The Workshop will be held in early 2014 in Copenhagen, Denmark. It is intended to hold this back-to-back with the RMP workshop on fin whales to save travel costs given some common participants.

Table 10

Budget requests (see text). Note that the Committee's agreement on the Small Cetacean conservation research fund is given under Item 14.2. Asterisks indicate alternative funding found.

Number	Summary of item	Plenary Agenda Item. Annex item	Full Cost (£)	Reduced budget (£)
AWMP-1	AWMP Intersessional Workshop on developing *SLA*s for the Greenlandic hunts	Item 8.3. Annex E item 9.2	8,000	8,000
AWMP-2	AWMP developers fund	Item 8.3. Annex E item 9.2	7,000	7,000
BRG / AWMP/SD-1	Gray whale rangewide workshop	Items 8.1.2, 9.2.1, 10.5.3, 11. Annexes E, F and I	15,000	10,000
BRG-1	Southern Right Whale Kelp Gull Workshop	Item 10.6.2. Annex F, item 4.4	6,000	6,000
BRG-2	Southern Ocean right whale survey	Item 10.6. Annex F, item 4.1	23,000	*
E-1	State of the cetacean environment report (SOCER)	Item 12.1. Annex K, item 6	5,000	4,000
E-2	POLLUTION 2020	Item 12.2.1. Annex K, item 7.1	27,000	20,000
E-3	Complete implementation of the CERD Website	Item 12.3.2. Annex K, item 8.2	5,000	4,000
E-4	Joint IWC/IQOE Workshop predicting soundfields-global soundscape modelling	Item 12.4.2. Annex K, item 9.2	26,900	19,700
E-5	2nd Phase Workshop on Marine Debris	Item 7.5.1. Annex K, item 11.2	5,000	*
HIM-1	Ship strike data coordinator	Item 7.4. Annex J, item 8.1	10,000	8,000
HIM-2	Bryde's Whale Abundance, Distribution & Risk of Ship-strike in the Hauraki Gulf	Item 7.4.3. Annex J, item 8.3	27,1	0,000
IA-1	Satellite tagging of Antarctic minke whales to provide information on breeding grounds, habitat utilisation and availability bias	Item 10.1.2. Annex G, item 8	69,500	0,000
IA-2	Statistical catch-at-age issues for further investigation	Item 10.1.3. Annex G, item 2.1	12,500	12,500
IA-3	2014 IWC-POWER North Pacific survey	Item 10.12.1 Annex G, item 3.3	62,600	58,600
RMP-1	Intersessional workshop on North Atlantic fin whales	Items 6.2.1, 8.3.1. Annex D, item 5	4,000	4,000
RMP-2	Pre-meeting North Atlantic minke implementation review	Item 6.3.2. Annex D, item 3.2	2,000	2,000
RMP/AWMP /SD	Simulations to evaluate power and precision of genetic clustering at critical [demographic] dispersal rates	Items 6.3.2, 8.3.1. Annex D, Appendix 3 adjunct 2	15,000	15,000
RMP/AWMP-1	Joint AWMP-RMP workshop on stock structure hypotheses for North Atlantic minke whales.	Items 6.3.2, 8.3.1. Annex D, item 3.2	10,000	10,000
RMP/AWMP-2	Computing support for RMP and AWMP	Item 22. Annexes D and E	8,000	4,000
SH-1	Minimum abundance estimates of Breeding Stock D humpback whales from Western Australian aerial surveys	Item 10.2.1.2. Annex H, item 3.1	4,000	4,000
SH-2	Modelling work to complete assessments of Breeding Stocks D, E and F	Item 10.2.1.1. Annex H, item 3.1	3,000	3,000
SH-3	Antarctic Humpback Whale Catalogue	Item 10.2.4. Annex H, item 3.4	15,000	10,000
SH-4	Comparison of photographs from JARPA II to the Antarctic Blue Whale Catalogue	Item 10.3.1.4. Annex H, item 5.1.4	7,500	5,000
SH-5	Southern Hemisphere Blue Whale Catalogue 2012/2013	Item 10.3.1.4. Annex H, item 5.1.4	15,000	5,000
SH-6	Pre-meeting workshop to complete the assessment of humpback whale breeding stocks D/E/F	Item 10.2.1. Annex H, item 3.1	7,000	7,000
SP-1	Expert Workshop to review JARPA II	1Item 17.3. Annex P, item 7.3	30,000	25,000
IPs	IP's	all	64,000	64,000
TOTAL			498,000	315,800

(2) AWMP-2 AWMP DEVELOPERS' FUND

The developers fund has been invaluable in the work of *SLA* development and related essential tasks of the SWG. It has been agreed as a standing fund by the Commission. The primary development tasks facing the SWG are for the Greenlandic fisheries. These tasks are of high priority to the Committee and the Commission. The fund is essential to allow developers to work and thus allow progress to be made.

(3) BRG/AWMP/SD RANGEWIDE GRAY WHALE WORKSHOP ON STOCK STRUCTURE AND STATUS

Recent information has led to the need for a reappraisal of the population structure and movements of North Pacific gray whales. Sufficient new information exists to justify an international workshop dedicated to developing new models to evaluate the question of North Pacific gray whale stock structure, and to better assess the potential impact of human activities on the status and develop appropriate strategies and mitigation measures. It will also suggested revisions to the background information sections of CMP. The issue has been an important part of discussions in AWMP, BRG, SD and is also relevant to CMPs and it is hoped the results will inform discussions at the 2014 Commission Meeting. The funding is for 8 IPS.

(4) BRG-1 SOUTHERN RIGHT WHALE KELP GULL WORKSHOP

The mass mortality of southern right whale calves has been an important issue for the Committee. This year, The Committee expressed concern and recommended that investigation of the causes of this mortality, and actions to reduce the risk of gull attacks on southern right whales at Península Valdés should be further developed and implemented. This is also a high priority action for the CMP.

(5) BRG-2 SOUTHERN RIGHT WHALE SURVEY

After consultation with the proposer this was reduced to zero as outside funding is expected.

(6) E-1 SOCER REPORT

SOCER is a long-standing effort to provide information to Commissioners and Committee members on environmental matters that affect cetaceans in response to several Commission resolutions. Funds are for salaries, library services, and printing.

(7) E-2 POLLUTION 2020

POLLUTION 2000+ has been a flagship programme of the Committee and the Commission has supported it and continued work on pollution in several Resolutions. POLLUTION 2020 is in effect Phase III of POLLUTON 2000+ and has two main priority areas of research; the toxicity of microplastics and the impact of polyaromatic hydrocarbons on cetaceans.

(8) E-3 COMPLETE IMPLEMENTATION OF CERD WEBSITE

The CERD website is being developed in two phases. The first phase focuses on large cetacean species and relies on a 'consultation and sharing' approach. The second phase is intended to include all cetacean species and incorporate a potential 'reporting' role. This website will have 'public' and 'registered user' levels. The public level will provide basic information on diseases in cetaceans, as well as access to selected discussion forum content. Registered users will have full access to the site, including in-depth information on cetacean disease, as well as to discussion forums and posting ability. Links will be provided for quick access to discussion boards that can be shared with groups focused on other topics such as pollution, ship strikes and marine debris.

(9) E-4 JOINT IWC/IQOE ACOUSTIC WORKSHOP

This is a co-sponsored workshop dealing with global soundscape modeling to inform management of cetaceans and anthropogenic noise. Noise has been an important topic for the Committee since a 2004 workshop. An increasing number of scientific efforts (International Quiet Ocean Experiment (IQOE), U.S.'s National Oceanic & Atmospheric Administration CetSound effort) directed at this topic reflect this broader scope. In September 2011, the IQOE held an open science planning meeting where research into soundscape characterization and modelling were identified as one of the four key themes to be contained in the IQOE's draft Science Plan. This proposal for a joint IWC/IQOE workshop will work to expand these tools and their application to a more global scale where they can be used to inform management of potential impacts on cetaceans.

(10) E-5 FUNDING FOR INVITED PARTICIPANTS FOR THE 2ND PHASE WORKSHOP ON MARINE DEBRIS

The Committee is working on this issue with the Conservation Committee. The first workshop has taken place and the second is due. This is a high priority issue. The money (£5,000) was for two SC participants at the 2nd workshop. The funds are available from an alternative source.

(11) HIM-1 SHIP STRIKE DATA COORDINATOR

The ongoing development of the IWC ship strike database requires data gathering, communication with potential data providers and data management. Co-ordinators were appointed last year and HIM agreed this should continue and a list of tasks was developed. It relates directly to the Commission's Conservation Committee working group on the topic.

(12) HIM-2 BRYDE'S WHALE ABUNDANCE, DISTRIBUTION & RISK OF SHIP-STRIKE IN THE HAURAKI GULF

This money was requested to partially fund an aerial survey to estimate abundance of a small stock of Bryde's whales around New Zealand where the number of ship strikes has been giving cause for possible conservation concern.

(13) IA-1 DETERMINATION OF BREEDING GROUNDS, HABITAT UTILISATION & AVAILABILITY BIAS IN ANTARCTIC MINKE WHALES

Habitat utilisation, location of breeding grounds and diving behaviour of Antarctic minke whales represent major data gaps in the Committee's knowledge in relation to four major issues. Research reported in SC/65a/IA12 has demonstrated that the deployment of these types of tags is practical and efficient and can provide a great deal of valuable data. Tags are intended to be deployed in the Ross

Sea in December 2013/January 2014. One researcher has a pending research proposal with the US NSF that would provide ship time for tag deployment later in 2014-15 in the Ross Sea. The cost is for 15 Splash MK10A Satellite-linked time-depth recording LIMPET tags (location and dive data) 10 Spot 5 Satellite-linked LIMPET Tags (location only data).

(14) IA-2 DISTRIBUTION OF BALEEN AND TOOTHED WHALES RELATIVE TO SPATIAL AND ENVIRONMENTAL COVARIATES

This was reduced to zero as alternative funding was found.

(15) IA-3 STATISTICAL CATCH-AT-AGE (SCAA) ISSUES FOR FURTHER INVESTIGATION

This approach is one that has been guided and funded by the Committee for several years. The SCAA can be used to evaluate various hypotheses regarding the dynamics of Antarctic minke whales, such as whether growth and carrying capacity have changed. The Committee has identified where further work might solidify some of the conclusions, and a number of detailed technical suggestions were made by the Committee. This proposal addresses the main remaining suggestions made. The Committee also suggested that work be made available for the JARPA II review. The funds will allow the recommended analytical work to be completed.

(16) IA-4 2014 IWC-POWER NORTH PACIFIC SURVEY

The Committee has strongly advocated the development of an international medium- to long-term research programme involving sighting surveys to provide information for assessment, conservation and management of cetaceans in the North Pacific, including areas that have not been surveyed for decades. The Committee developed objectives for the overall plan and this will fund the final leg of the initial phase. The money is for (1) IWC researchers and equipment as the vessel is provided free by Japan, and (2) to allow the Committee's Technical Advisory Group to meet to review the multi-year results thus far and develop the plans for the next phase of POWER based on the results obtained from Phase I and (3) to enable analyses to completed price to the 2014 Annual Meeting.

(17) RMP-1 INTERSESSIONAL RMP WORKSHOP ON NORTH ATLANTIC FIN WHALES

The objective of this short workshop is to review the results of conditioning and trials for North Atlantic fin whales, modify these if necessary and determine an intersessional workplan to ensure that the *Implementation Review* can be completed at the 2014 Annual Meeting. It is also relevant to developing *SLA* s for the Greenland hunt. It will be held back-to-back with the AWMP workshop to save costs. Costs are for 5 IPs. This work should allow the *Implementation Review* to be completed in 2014 and greatly assist the work on the AWMP.

(18) RMP-2 PRE-MEETING NORTH ATLANTIC MINKE IMPLEMENTATION REVIEW

The Committee has agreed to undertake a full *Implementation Review* of common minke whales in the North Atlantic. This is a large exercise that will build upon discussions at the joint AWMP/RMP workshop on stock structure. A pre-meeting will maintain progress such that it should be able to be completed within two years.

(19) RMP/AWMP/SD SIMULATIONS TO EVALUATE POWER AND PRECISION OF GENETIC CLUSTERING AT CRITICAL [DEMOGRAPHIC] DISPERSAL RATES

On many occasions the Committee has found that identifying stocks from genetic analyses often yielded ambiguous results because the values of key parameters at which management recommendations change are not defined. Realising that such "tipping points" are likely to be case specific it has been agreed to use the North Atlantic minke whale as a case study. This study will (1) conduct demographic simulations under reasonable range of stock hypotheses and management scenarios to determine the dispersal rates such that management performance is acceptable from a conservation point, (2) The second step is to conduct genetic simulations to assess the ability of genetic clustering methods to robustly determine the number of breeding populations and assign individuals to a breeding population. It will enable similar work to be undertaken for other large whale species of conservation and management concern.

(20) AWMP/RMP-1INTERSESSIONAL JOINT AWMP-RMP MEETING ON STOCK STRUCTURE HYPOTHESES FOR NORTH ATLANTIC MINKE WHALES

This workshop addresses common issues for AWMP/RMP and will use the work of proposal 19 above. It was discussed and agreed last year. The cost are for 8 invited participants.

(21) AWMP/RMP-2 ESSENTIAL COMPUTING FOR RMP & AWMP

This is to provide assistance to the Secretariat with the large computing tasks it is facing in the coming year.

(22) SH-1 OBTAINING MINIMUM ABUNDANCE ESTIMATES OF BREEDING STOCK D HW FROM WESTERN AUSTRALIAN AERIAL SURVEYS,

This work was identified as of great importance if the Assessment of Breeding Stock D is to be completed. The cost for new analyses of data from western Australian aerial surveys, 1999, 2005 and 2008. The observers' search pattern during these aerial surveys had not followed conventional protocols for conducting aerial surveys. The effect of such search patterns on the estimates is unknown, but sufficient concerns about their effect reduces confidence in the use of the resulting abundance estimates as absolute (rather than relative) estimates within the modelling exercise being undertaken (see next project).

(23) SH-2 MODELLING OF SOUTHERN HEMISPHERE HW POPULATIONS

The project will focus on a combined assessment of humpback breeding stocks D, E1 and Oceania using a three-stock model which allows for mixing on the feeding grounds. Methods used will be based upon the Bayesian methodology as developed and presented for BS C and BS B comprehensive assessments recently completed. Exploration of alternative models which may be able to explain the observed data will be explored. These will include models that address anomalies identified regarding the population model fit to data for breeding stock D, and approaches suggested there to account for them, such as use of **AN** environmental variation model and changes in carrying capacity over time.

(24) SH-3 ANTACTIC HUMPBACK WHALE CATALOGUE

The Antarctic Humpback Whale Catalogue collates photo-identification information from Southern Hemisphere humpback whales. Increasing awareness of the project among research organizations, tour operators and other potential contributors has widened the scope of the collection; research efforts in areas that had not previously been sampled have extended the geographic coverage. This catalogue has grown by 25% in the last two years, adding 1,127 new individuals, and increasing the time required to analyse photographs. In addition to these requested IWC funds, additional funds from other sources will be sought.

(25) SH-4 COMPARISON OF ANTARCTIC BLUE WHALE IDENTIFICATION PHOTOGRAPHS FROM JARPA II TO THE ANTARCTIC BW CATALOGUE

This work follows on from previous recommendations and work by the Committee on the assessment of Southern Hemisphere blue whales. It is also be of relevance to the SORP blue whale project. The sighting histories of individual Antarctic blue whales from photo-ID provide data for a mark-recapture estimate of abundance as well as information on the movement of individual blue whales within the Antarctic region. The addition of more samples to the collection of Antarctic blue whale identification photographs would be extremely useful for these analyses. A total 380 blue whale identification photographs were collected during JARPA II cruises but need to be compared to the Antarctic Blue Whale Catalogue (305 individuals) and the associated sighting data added to the sighting history database.

(26) SH-5 SOUTHERN HEMISPHERE BLUE WHALE CATALOGUE 2012/2013

The Southern Hemisphere Blue Whale Catalogue (SHBWC) is an international collaborative effort to facilitate cross-regional comparison of blue whale photo-identifications catalogues. In 2006, the Committee of the agreed to initiate an in-depth assessment of Southern Hemisphere blue whales and in 2008, it endorsed a proposal to establish the SHBWC. Currently the SHBWC holds photo-identification catalogues of researchers from major areas off Antarctica, Australia, Eastern South Pacific and the Eastern Tropical Pacific. A total of 884 blue whales are catalogued. Results of comparisons among different regions in Southern Hemisphere will improve the understanding of population boundaries, migratory routes and model abundance estimates. In addition, assessment of blue whales and estimates abundance of populations will require improving software capabilities to access encounter histories of individuals.

(27) PRE-MEETING WORKSHOP TO COMPLETE THE ASSESSMENT OF HUMPBACK WHALE BREEDING STOCKS D/E/F

This pre-meeting is required to facilitate the timely completion of the assessment of humpback whales breeding stocks D, E and F (Item 3.1.2). These are the last stocks remaining in the in-depth assessment of Southern Hemisphere humpback whales. The Committee has agreed that this assessment should be completed in SC65b, as a matter of high priority. The meeting will evaluate the results of intersessional modelling efforts. Costs are for 8 IPs.

(28) EXPERT WORKSHOP TO REVIEW JARPA II

The Committee has agreed a procedure for periodic and final reviews of results from Special Permit research (revised Annex P, IWC 2013). This procedure outlines an intersessional review meeting by an expert panel. The report from the intersessional expert meeting will be reviewed and discussed at the 2014 Committee Annual Meeting, SC65B. The experts to the review workshop will be identified by September 2013 and the expert workshop will be convened during four days in February/March 2014. The requested funds are for travel for the invited experts. The Committee noted that after discussion at the Commission Meeting last year, a budget for the review of the Icelandic permit was approved.

27 WORKING METHODS OF THE COMMITTEE

27.1 Annual meetings

Last year (IWC, 2013c, pp. 78-9), after considerable discussion of the balance between cost savings and the efficiency of the Committee, it was agreed that primary documents would be distributed only electronically at Scientific Committee meetings thereby making significant cost savings in terms of freight (paper and pigeon holes) and copying (paper, Xeroxing and staff).

This year, the Committee continued to review its procedures both in terms of efficiency and cost savings. As part of this, careful consideration was given as to whether it might be possible to reduce the number of days of the Committee's meetings (e.g. removing the initial reading day from the start of the meeting, removing the rest day, reducing the length of Plenary, reducing the number of sub-committees, reducing sub-committee agendas or having some sub-committees meet only biennially). With its present workload and agenda, the Committee agrees that changing the number of days in an already full schedule was not practical at this time. However, it **agrees** to keep this item on its Agenda. In particular, it **agrees** to a trial period of introducing an earlier deadline for paper submission.

At present, authors are requested to submit at least preliminary titles, authors and ideally an abstract about 6 weeks before the meeting using an online system. Whilst authors are strongly encouraged to submit papers as early as possible, the final deadline is that primary papers must be submitted by the end of the first day of the Annual Meeting. This procedure recognises that participants voluntarily submit papers and most have other responsibilities than the IWC; some papers are also the result of recommendations made by the Committee or intersessional Workshops and are essential to the Committee's progress in a timely fashion. After considerable discussion, the Committee **agrees** to establish a deadline for primary papers as a trial for the 2014 Annual Meeting of 7 days before the start of the meeting. In doing so it **agrees** that this has the potential to improve the Committee's efficiency in a number of ways; however, at least as a measure on its own, it will not result in cost savings but will provide information to inform discussions of cost savings next year.

The Committee will review the trial next year in the light of information to be provided on a number of factors to be finalised by the convenors intersessionally including: improvements to efficiency of convenors in terms of developing annotated agendas; number of papers available by the deadline; timing of overall submission in the weeks leading up to the meeting; download data; questionnaire to the Committee.

The Committee also agreed to improvements with the National Progress Reports database as discussed under Item 3.2 and Annex O.

27.2 Increasing the support of Scientific Committee on conservation related issues

The Committee welcomed information that a number of scientists (Galletti Vernazzani, Iñiguez, Luna, Marzari, Peres and Rodriguez-Fonseca) will present next year a review of the Committee's reports, IWC resolutions and information on population status since 1986. The review will highlight *inter alia* when the Committee has commented/recommended on as scientific matters (when a comment/conclusion is aimed to continue gathering scientific information), whaling management matters (when a comment/conclusion is aimed towards whaling management) and conservation matters (when a comment/conclusion is aimed to call the attention on threats and/or status, or improve the conservation of a species/subspecies/population). The objective of this work is to stimulate discussion within the Committee as to how best to improve communications on conservation matters to the Conservation Committee and Commission, in order to better contribute to the long term survival of cetacean species, sub-species and populations.

The Committee **agrees** that this item will be placed on its Agenda next year.

28. ELECTION OF OFFICERS

This is the first year for both the Chair and the Vice-Chair and so no elections were necessary.

29. PUBLICATIONS

The Committee was pleased to hear that the *Journal* was now to become open access and freely available. It **agrees** that the *Supplement* should continue to be available in hard copy for participants given its central role at the meeting. The Committee **re-emphasises** the importance of the *Journal* to its work and **thanks** the Secretariat and the Editorial Board for its work.

30. OTHER BUSINESS

There was no other business.

31. ADOPTION OF REPORT

The completed parts of the report were adopted at 1710hrs. As is customary, those parts that were only discussed on the final afternoon were agreed by the Chair, rapporteur and convenors. The Chair thanked all of the participants for their co-operative attitude on this his first meeting, the rapporteurs, Secretariat and especially the host government and the hotel for their provision of excellent facilities. The meeting thanked the Chair for his expert and fair handling of the meeting.

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Report of the Scientific Committee

The meeting was held at the Shilla Jeju Hotel, Republic of Korea from 3-15 June 2013 and was chaired by Toshihide Kitakado. This meeting is SC/65a. The next meeting of the Scientific Committee in May or June 2014 will be SC/65b, and the next meeting of the Commission (IWC/65) will take place during September or October 2014. A list of participants is given as Annex A.

1. INTRODUCTORY ITEMS

1.1 Chair's welcome and opening remarks

Kitakado, the Committee Chair for the first time, welcomed the participants to the 2013 Annual Scientific Committee meeting. He thanked the Government of Korea for hosting the meeting and for providing the excellent facilities and an opening reception. He also expressed his thanks to the IWC Commissioner for Korea, Mr Bok-Chul Chung, for his assistance. The Committee then paused for a moment of silence, with great sorrow, for those who had passed away since the last meeting.

Graham Chittleborough died in October 2012. He gained an international reputation for his work on humpback whales based on the commercial catches off Australia and in the Antarctic following World War II. Graham contributed his knowledge of humpback whales to the work of the 'Committee of Three Scientists on the Special Scientific Investigation of the Antarctic Whale Stocks', attending meetings to review its progress and findings in Rome (1961) and Seattle (1963). He was also the first scientist to recognise the extent of illegal hunting of humpback whales taking place in the Antarctic in the late 1950s-early 1960s.

Malcolm Clarke died in May 2013. He was recognised internationally for his work on oceanic squid, and was well known to and respected by many members of the Scientific Committee for his investigations of squid as the food of sperm whales, in particular his *Discovery Report* based on stomach contents of sperm whales in Southern Hemisphere catches. He also undertook ground-breaking research on sperm whale anatomy, including the use of the spermaceti organ in diving.

Rebecca Leaper died unexpectedly just before the meeting, well before her time. She was a dedicated and passionate marine conservation scientist and spent two years on the Australian delegation as an ecosystem modeller. She had been a key member of science teams at the Australian Antarctic Division, the Tasmanian Aquaculture and Fisheries Institute, CSIRO and most recently at the University of Tasmania's Institute of Marine and Antarctic Science, working on issues ranging from the role of whales in their marine ecosystems through to conservation mechanisms for marine biodiversity. Her passion for her work was matched only by her generosity of spirit.

Captain Leif Petersen, who died in March 2013, never attended the Scientific Committee. However, his dedication, skill and courage as a pilot for pioneering aerial surveys beginning in Greenland and Iceland in the 1980s and eventually for many parts of northern Europe including the more recent SCANS and NASS programmes meant that he contributed as much to conservation and management as any of the scientists who participated. It is important that scientists never underestimate the contribution of pilots, skippers and crews to their work. Leif became an indispensable colleague and lasting friend to many scientists attending the Scientific Committee meeting; several of us are still alive because of him.

Vyacheslav Alekseevich Zemsky died at the age of 93 after a distinguished career in the Soviet Union and the Russian Federation. In the 1970s, he was very active in IWC related issues and the new Russia-US marine mammal working group. Between 1993-2000, Zemsky, with a number of members of the Soviet whaling expeditions, collated all the materials and documents preserved in departmental archives to create a corrected catch history of the whales hunted in the Southern Hemisphere.

1.2 Appointment of rapporteurs

Donovan was appointed rapporteur with assistance from various members of the Committee as appropriate. Chairs of sub-committees and Working Groups appointed rapporteurs for their individual meetings.

1.3 Meeting procedures and time schedule

The Committee agreed to the meeting procedures and time schedule outlined by the Chair.

1.4 Establishment of sub-committees and working groups

As agreed last year (IWC, 2013c, p.59) and included in the draft agenda, a pre-meeting of the sub-committee on the Revised Management Procedure (RMP) met in Jeju on 1-2 June 2013 to begin the *Implementation Review* for North Atlantic fin whales. The report of the pre-meeting is given as Annex D, Appendix 2.

A number of sub-committees and Working Groups were established. Their reports were either made Annexes to this report (see below) or subsumed into the main text of this report.

Annex D – Sub-Committee on the Revised Management Procedure;
Annex D1 – Working Group on the *Implementation Review* for Western North Pacific Common Minke Whales;
Annex E – Standing Working Group on Aboriginal Subsistence Whaling Management Procedures;
Annex F – Sub-Committee on Bowhead, Right and Gray Whales;
Annex G – Sub-Committee on In-Depth Assessments;
Annex H – Sub-Committee on Other Southern Hemisphere Whale Stocks;
Annex I – Working Group on Stock Definition;
Annex J – Working Group on Non-deliberate Human-Induced Mortality of Large Whales;
Annex K – Standing Working Group on Environmental Concerns;
Annex K1– Working Group to Address Multi-species and Ecosystem Modelling Approaches;
Annex L – Sub-Committee on Small Cetaceans;
Annex M – Sub-Committee on Whalewatching;
Annex N – Working Group on DNA;
Annex O – *Ad hoc* Working Group on National Progress Reports;
Annex P – Working Group on Special Permits; and
Annex Q – *Ad hoc* Working Group on Abundance Estimates.

Table 1

List of data received by the IWC Secretariat since the 2012 meeting.

Date	From	IWC ref.	Details
Catch data from the previous season:			
25/04/13	Norway: N. Øien	E108 Cat2012	Individual minke records from the Norwegian 2012 commercial catch.
01/06/13	Japan: T. Sakamoto	E108 Cat2012	Individual data for Japan special permit catch 2012 North Pacific (JARPN II) and 2012/13 Antarctic (JARPA II).
02/06/13	Russia: V. Ilyashenko	E108 Cat2012	Individual catch records from the aboriginal harvest in the Russian Federation in 2012.
03/06/13	Iceland: G. Víkingsson	E108 Cat2012	Individual catch records from the Icelandic 2012 commercial catch.
Sightings data:			
17/04/13	Japan: K. Matsuoka	E106	POWER North Pacific cruise sightings data 2012.
17/04/13	Japan: K. Matsuoka	E107	Data from dedicated sightings surveys in 2012 in the North Pacific under JARPN II.

1.5 Computing arrangements

Allison outlined the computing and printing facilities available for delegate use**.**

2. ADOPTION OF AGENDA

The adopted agenda is given as Annex B.

3. REVIEW OF AVAILABLE DATA, DOCUMENTS AND REPORTS

3.1 Documents submitted

The documents available are listed in Annex C. As agreed last year, for the first time, primary papers were only available at the meeting in electronic format (IWC, 2013c, pp.78-9).

3.2 National Progress Reports on research

As agreed last year, all National Progress Report information usually submitted in paper form was submitted electronically through the IWC National Progress Reports data portal (IWC, 2013c, p.1). Developing such a portal and then expanding it to allow multiple data entry users for each country (the latter had not originally been envisaged two years ago when the portal was agreed) was a major undertaking. The Committee thanked Miller of the Secretariat for the considerable amount of work he had undertaken during the year to make this possible. Inevitably, a number of issues to be addressed and potential improvements to be made arose during the year as the portal began to be used. These were referred to an *ad hoc* Working Group and the Committee **endorses** the report of that Group (Annex O) and its recommendations. It again **recommends** that all member states submit National Progress Reports through the IWC portal (*http://portal.iwc.int*).

3.3 Data collection, storage and manipulation

3.1.1 Catch data and other statistical material

Table 1 lists data received by the Secretariat since the 2012 meeting.

3.1.2 Progress of data coding projects and computing tasks

Allison reported that Version 5.5 of the catch databases was released in February 2013. Work has continued on the entry of catch data into both the IWC individual and summary catch databases, including data received from the 2011 season and some additional information for records from Durban in the 1960s and 1970s. Sightings data from the 2011 POWER cruise (see Annex G, Appendix 2) are being validated.

Programming work during the past year has focused on completing the North Pacific common minke whale *Implementation* trials including amending the control program and conditioning and running trials. Further details are given under Item 6.1.

4. COOPERATION WITH OTHER ORGANISATIONS

The Committee noted the great value of co-operation with other international organisations to its work. The observers' reports below briefly summarise relevant meetings of other organisations. The contributions of several collaborative efforts are dealt with in the relevant sub-committees.

4.1 Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR)

The report of the IWC observer at the 31st Meeting of the CCAMLR Scientific Committee (CCAMLR-SC), held in Hobart, Australia from 22-26 October 2012 is given as IWC/65/4(2013)A. The main items considered at the CCAMLR meeting of relevance to the IWC included: (1) fishery status and trends of Antarctic fish stocks, krill, squid and stone crabs; (2) incidental mortality of seabirds and marine mammals in fisheries in the CCAMLR Convention Area; (3) harvested species; (4) ecosystem monitoring and management; (5) management under conditions of uncertainty about stock size and sustainable yield; (6) scientific research exemption; (7) CCAMLR Scheme of International Scientific Observation; (8) new and exploratory fisheries; and (9) joint CCAMLR-IWC Workshop with respect to ecosystem modelling in the Southern Ocean.

Reports of the Scientific Committee (SC-CCAMLR) and its Working Groups on Ecosystem Monitoring and Management (WG-EMM) and Fish Stock Assessment (WG-FSA) and their various subgroups are available through the CCAMLR secretariat and on the CCAMLR website[1].

The CCAMLR Working Group on Incidental Mortality in Fisheries (WG-IMAF) did not meet in 2012 and no new information on cetacean-fisheries interactions in the Southern Ocean became available to CCAMLR. The next meeting of the Working Group is likely to take place prior to the annual meeting of CCAMLR in 2013.

The Committee thanked Kock for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next CCAMLR-SC meeting.

4.2 Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)[2]

The Committee did not receive a report from an observer at the 2013 meeting of the Conference of the Parties (3-14 March 2013).

4.3 Convention on the Conservation of Migratory Species (CMS)[3]

4.3.1 Scientific Council

There was no meeting of the Scientific Council during the intersessional period.

[1] *http://www.ccamlr.org/.*
[2] *http://www.cites.org.*
[3] *http://www.cms.int.*

4.3.2 Conference of Parties (COP)

There was no Meeting of the Parties during the intersessional period.

4.3.3 Agreement on Small Cetaceans of the Baltic and North Seas (ASCOBANS)[4]

The report of the IWC observer at the 7th Meeting of the Parties (MoP) to ASCOBANS, held in Brighton, UK from 22-24 October 2012 is given as IWC/65/4(2013)G. The main results from the meeting are summarised below.

(1) The Conservation Plan for the Harbour Porpoise Population in the Western Baltic, the Inner Danish Waters and the Kattegat was adopted. The main aim of the plan is to intensify research and conservation efforts for harbour porpoises in this area.
(2) Work on the Baltic Sea Recovery Plan (Jastarnia Plan) and the North Sea Conservation Plan were reviewed. The implementation of these will continue to be of importance over the next three years.
(3) Bycatch and underwater noise were identified as future priorities. The impact of marine debris on cetaceans will also be considered.
(4) A better understanding of how new and often lesser-studied contaminants affect individuals and populations is needed. Limiting the introduction of chemical substances into the marine environment should be considered.
(5) The western part of the ASCOBANS area has a large diversity of whale and dolphin species, but knowledge of their abundance and distribution as well as the magnitude of different threats remains scarce. Collaboration for research and conservation action in this area is needed.
(6) In general, cooperation and interaction with the European Commission, other international organisations, fishery and other economic sectors, NGOs and non-Party Range States should be strengthened.
(7) The 4th ASCOBANS Outreach and Education Award 2012 was given to Mats Amundin of Kolmården Djurpark in Sweden for his work in promoting the conservation of harbour porpoises.

No observer for the IWC attended the 20th meeting of the Advisory Committee to ASCOBANS.

The Committee thanked Scheidat for her report and **agrees** that she should represent the Committee as an observer at the next ASCOBANS Meeting of Parties and Advisory Committee meeting.

4.3.4 Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS)[5]

Donovan attended the 2012 meeting of the ACCOBAMS Scientific Committee (ASC) held in Monaco from 13-15 November 2012 and his report is given as IWC/65/4(2013) L. The full report of the meeting can be found on the ACCOBAMS website.

A number of recommendations were made. The first concerned the long-standing (nine-year) recommendation, also endorsed by the IWC Scientific Committee, for an ACCOBAMS Survey Initiative. The ASC strongly endorsed an updated basinwide survey plan, agreed on the need for synergies with other efforts in the North Atlantic and on the need to hire a co-ordinator. It noted news of a survey funded by DG-Mare that will cover about 25% of the Black Sea in summer 2013. However, it strongly recommended that the whole of the Black Sea be covered synoptically and urged ACCOBAMS to do all it could to ensure this and not miss a unique opportunity.

A second recommendation addressed the continued live removals of bottlenose dolphins in the Black Sea. The ACCOBAMS Secretariat was asked to send a letter of concern to the Georgian and Ukrainian governments (copied to the Bern Convention Secretariat, the Black Sea Commission and the CITES Secretariat) recalling the illegality of live removals of cetaceans from the Black Sea and asking them to carry out an inventory and thorough assessment of individual identity of all bottlenose dolphins kept in captivity by means of genetic, morphological and photo-id methods and to provide appropriate administrative measures in order to prevent substitution of dolphins that die in captivity by animals taken from the wild. The ASC noted that the IWC Scientific Committee has guidelines on the practical aspects of the use of DNA registers for cetaceans.

The ASC also agreed to work towards a Conservation Plan for fin whales of the Mediterranean. It noted: (1) the importance of continuing work to elucidate the stock structure and movements of fin whales in the ACCOBAMS area; (2) the importance of the ACCOBAMS Survey initiative to provide a summer snapshot of distribution throughout the whole region as well as a reliable estimate of total abundance; (3) that all of the groups working in the area be asked to update available information on fin whales, including those related to potential threats (e.g. see the work of Fossi on micro-plastics, Fossi *et al.*, 2012) and to consult on priorities for future work with a focus on conservation; and (4) that an outline draft Conservation Plan be developed for consideration at the next ASC, with a view to reviewing whether the time is ripe to engage with stakeholders to develop a full plan.

The ASC also developed a statement of concern over the ongoing seismic survey work in the area of the Hellenic Trench. In particular, it requested all involved in the planned surveys to provide information to the ASC and take urgent precautionary action to protect the local cetaceans. The ASC offered to provide advice and drew attention to the ACCOBAMS guidelines for seismic surveys, and urged that: duplicate surveys should be avoided across the same area, alternative approaches to seismic airgun survey should be sought and deployed and efforts should be made to avoid ensonifying adjacent areas simultaneously.

ACCOBAMS and the IWC have been working together on ship strikes for some time. ACCOBAMS agreed that the work should continue, welcomed the appointment of the ship strikes co-ordinators (one of whom is the Chair of the ASC ship strikes working group) and reiterated its support for the global database and existing monitoring and mitigation efforts. The ASC ship strikes working group will continue to work on these issues and foster collaboration with IWC, ASCOBANS, CMS and IMO and develop priority actions and studies, including the consideration of a project to develop a standard training module.

Finally, the ASC developed a recommendation on scientific aspects of whalewatching. It noted that an 'ACCOBAMS certificate of accreditation for whale watching' will be developed and agreed that this should take into account the ACCOBAMS Whale Watching Guidelines. It also supported the continuation and expansion of national or regional training courses (based on the PELAGOS expertise) for operators covering the biology of animals,

[4]*http://www.ascobans.org.*
[5]*http://www.accobams.org.*

risks, boat behaviour around the animals, how to achieve ACCOBAMS accreditation, involvement in scientific research, etc. The ASC will continue to consider potential adverse effects on cetaceans and means to mitigate these. It also urged monitoring the activity of whale-watching operators in each country in order to obtain information on growth and development to try to identify potential problems before they become too difficult to manage. Finally it agreed to assist in the development of methods to better inform the general public about responsible boat behaviour around cetaceans. The ASC noted the importance of continued co-operation with IWC and others on this issue.

The Committee thanked Donovan for his report and **agrees** that he should represent the IWC at the next ACCOBAMS meeting.

4.4 Food and Agriculture Organisation of the United Nations (FAO)

No observer for the IWC attended the 2012 meeting of FAO.

4.5 Inter-American Tropical Tuna Commission (IATTC)

The reports of the IWC observer at the 83rd and 84th meetings of the IATTC held in La Jolla, USA 25-29 June 2012 and 24 October 2012 respectively are given as IWC/65/4(2013)E. The Antigua Convention came into force on 27 August 2010 and under this the IATTC is expected to give greater consideration to non-target and associated species, including cetaceans, in taking management decisions. A summary was given of ongoing work describing what is known about the direct impact of the fisheries on other species in the ecosystem and the environment. This ongoing work will shape future directions of AIDCP (see Item 4.6) and IATTC measures aimed at managing fisheries and conserving dolphins.

The Committee thanked Rusin for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next AIDCP meeting.

4.6 Agreement on the International Dolphin Conservation Program (AIDCP)

The report of the IWC observer at the 25th and 26th Meetings of the Parties to the AIDCP held in La Jolla, USA on 19 June 2012 and 23 October 2012 respectively is given as IWC/65/4(2013)F. The AIDCP mandates 100% coverage by observers of fishing trips by purse seiners of carrying capacity greater than 363t in the agreement area and in 2012 all trips (746) by such vessels were sampled by independent observers.

The overall dolphin mortality limit (DML) for the international fleet in 2012 was 5,000 animals and the unreserved portion of 4,900 was allocated to 84 qualified vessels that requested DMLs. In 2012, no vessel exceeded its DML. The number of sets on dolphin associated schools of tuna made by vessels over 363t has been increasing in recent years, from 9,246 in 2008 to 10,910 in 2009 to 11,645 in 2010, however fewer were made in 2011 (9,604) and 2012 (9,220). While fewer dolphin sets were made in 2011 and 2012, this remains a frequent practice and the predominant method for catching yellowfin tuna by purse-seine in the ETP. There have been insufficient resources to conduct dolphin and ecosystem assessment surveys since 2006 so it is unclear when updated abundance estimates for cetaceans in the ETP will be available.

In 2011 and 2012, the AIDCP focused significant discussion on consideration of reducing observer coverage and developing an 'Ecosystem Friendly' certification scheme for tuna caught in association with dolphins. Due to the increasing sentiment among some Parties that the dolphin problem has been solved and that dolphin-fishing methods are better economically and environmentally than dolphin-safe methods, in 2013 the AIDCP Parties are expected to continue consideration of these proposals and others that have the potential to increase fishing effort on dolphins and the magnitude of associated direct and indirect effects of this practice.

The Committee thanked Rusin for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next AIDCP meeting.

4.7 International Committee on Marine Protected Areas (ICMMPA) and IUCN Marine Mammal Protected Areas Task Force

The International Committee for Marine Mammal Protected Areas was formed as an international committee of experts in 2006 to address common issues and challenges faced by scientists and managers using spatial management tools to manage and conserve important cetacean habitats or populations. In 2008, the IWC endorsed and supported a proposal by ICMMPA to host the first international conference on marine mammal protected areas, in 2009. Since that time, the ICMMPA has undertaken several initiatives and has co-hosted, with France, a second conference in Martinique, in 2011[6]. In October 2012 the ICMMPA met in La Rochelle, France, hosted by l'Université de La Rochelle. The primary agenda for the meeting was to develop the mission statement, terms of reference and structural organisation of the newly approved IUCN arm of ICMMPA. This partner organisation is a Task Force on Marine Mammal Protected Areas. These documents were developed and will be available from the new Task Force co-chairs Erich Hoyt and Giuseppe Notarbartolo di Sciara, once the Task Force is officially announced. The IUCN MMPA Task Force membership includes all of the ICMMPA members, with several IUCN member additions. The ICMMPA remains a non-governmental partner for the Task Force and, amongst other tasks, will convene conferences and other initiatives that may not fit the IUCN Task Force terms of reference. The IUCN MMPA Task Force will be officially announced at IMPAC3 in October 2013.

ICMMPA is currently working with the Government of Australia, who will host the third International Conference on Marine Mammal Protected Areas, at a venue in Adelaide in November 2014.

4.8 International Council for the Exploration of the Sea (ICES)[7]

The report of the IWC observer documenting the 2012 activities of ICES is given as IWC/65/4(2013)B. The ICES Working Group on Marine Mammal Ecology (WGMME) met 5-8 March 2012.

The WGMME built on the work of the ASCOBANS/HELCOM small cetacean population structure workshop to determine Management Units (MUs) for the more common species as such information is relevant to the development of biodiversity indicators. Based on the available information, there were single MUs in the European North Atlantic for common dolphins, white-beaked dolphins, white-sided dolphins and common minke whale. For bottlenose dolphins there are ten separate units closely associated with the mainly

[6]*http://second.icmmpa.org.*
[7]*http://www.ices.dk.*

resident inshore populations in the European North Atlantic and a separate MU for the wider ranging mainly offshore animals. For harbour porpoises, MUs are proposed for the Iberian Peninsula, Bay of Biscay, Celtic Sea and northwest Ireland/west Scotland and the North Sea. The MUs for harbour porpoises will need to be revisited as indicators for the Marine Strategy Framework Directive (MSFD) become better defined.

The WGMME considered biodiversity indicators and bycatch was the only indicator suggested that had a clear link with a particular human activity. The indicator metric proposed by ICG-COBAM was very clearly linked to OSPAR's EcoQO on harbour porpoise bycatch in the North Sea. With pressure for the rapid development of biodiversity indicators for good environmental status through the Marine Strategy Framework Directive (MSFD), it is essential that they are based on sound science and take a pragmatic approach to the incorporation of fisheries data. As such, it was proposed that a management framework approach is adopted (rather than the EcoQO approach) and further developed in 2013 for relevant species.

WGMME conducted a review of the effects of wave energy converters on marine mammals and provided recommendations on research, monitoring and mitigation schemes. These are at a relatively early stage of development when compared to other renewable energy technologies and this is reflected in the lack of knowledge of their effects on the marine environment. It is essential that full advantage is taken of test deployments and early arrays to gather information on the actual interactions between devices and wildlife. A review of such work is being undertaken during 2013.

The ICES Working Group on Bycatch of Protected Species (WGBYC) met on 7-10 February 2012. It reviewed the status of information on recent bycatch estimates and assessed the extent of the implementation of bycatch mitigation measures. Reports from 17 member states indicated extrapolated estimates of bycatch for 2010 of about 870 cetaceans. The species involved were striped dolphins, common dolphins, harbour porpoises and bottlenose dolphins. Estimates are patchy and monitoring obligations not being met by several member states. Implementation of bycatch mitigation measures was also found to be poor, with few countries able to confirm that obligations for pinger deployment were being met.

The 2012 ICES Annual Science Conference (ASC) was held in Bergen, Norway 17-21 September 2011. Some sessions were designed with marine mammals included as an integral part. A number of sessions were of relevance to the Committee, including those describing:

(1) bycatch and discards;
(2) consequences of improved survey performance on assessments and management advice; and
(3) how does renewable energy production affect aquatic life?

The Committee thanked Haug for the report and **agrees** that he should represent the Committee as an observer at the next ICES meeting.

4.9 International Maritime Organization (IMO)[8]

The report of the IWC observer to the IMO is given as IWC/65/4(2013)J. The IWC has contributed to IMO discussions on addressing ship strikes and the impacts of underwater noise from shipping. In December 2012, IMO adopted changes to the shipping lanes in the Santa Barbara Channel, and off San Francisco, California, USA in order to reduce ship strike risk to blue whales (COLREG.2/Circ.64).

The IMO has been developing non-mandatory technical guidelines to minimise underwater noise from commercial ships. These include available options for ship-quieting technologies and operational practices. In April 2013, the IMO correspondence group working on the issue (including participation by the IWC Secretariat) presented draft guidelines to the IMO sub-committee on ship design and equipment (DE57/17). The guidelines help establish a consistent approach to assist designers, ship owners and ship operators in evaluating how much noise reduction is possible for new and existing ships when compared to existing ships of similar type, size and propulsion system. The IMO Marine Environment Protection Committee (MEPC) is expected to approve the guidelines in early 2014 and make them available as an MEPC circular.

The IMO also continued to develop a mandatory Polar Code. This is intended to augment existing measures to reduce the environmental impacts of shipping in polar waters, taking into account their greater environmental sensitivity. This work will continue through 2013.

The Committee thanked Leaper for his report and **agrees** that he (or the Secretariat) should represent the Committee at the next IMO meeting.

4.10 International Union for the Conservation of Nature (IUCN)[9]

Cooke and Reeves, the IWC observers, reported on the considerable cooperation with IUCN that had occurred during the past year and this is given as IWC/65/4(2013)I.

World Conservation Congress

The World Conservation Congress was held on Jeju Island, Korea in September 2012. There were three cetacean-related events at the Congress: a workshop on lessons learned from the IUCN western gray whale conservation initiative; a poster presentation on the local population of Indo-Pacific bottlenose dolphins found around Jeju; and a workshop on cetacean conservation and whalewatching in Africa. IUCN issued a number of statements on Korean environmental issues, including on the possible resumption of whaling in Korean waters.

Western gray whales

Two further meetings of the IUCN Western Gray Whale Advisory Panel have been held in the past year, in November 2012 in Korea and in May 2013 in Japan. At the time of writing, the report of the May meeting is not yet available but a summary of results can be found in Annex F, Appendix 5. An updated population assessment was received by the Panel but the data from the two independently collected series of photo-id data yielded apparently discrepant results, one indicating an increasing population and the other indicating a stable or declining population. An assessment based on one of these data sets is available as SC/65a/BRG27.

Red List updates

Updates since the last Annual Meeting include listing of the Mediterranean 'subpopulations' of the following species: sperm whale (Endangered), fin whale (Vulnerable), striped dolphin (Vulnerable), common bottlenose dolphin (Vulnerable), Cuvier's beaked whale (Data Deficient), long-finned pilot whale (Data Deficient) and Risso's dolphin (also Data Deficient).

[8] *http://www.imo.org.*

[9] *http://www.iucn.org/.*

A current list of all cetacean species and populations that have been assessed for the Red List, and their current Red List classification, is maintained on the Cetacean Specialist Group site[10] with links to the assessments which are held on the Red List website[11].

Cetacean Specialist Group
IUCN Cetacean Specialist Group members have continued to actively assist with cetacean conservation and research projects around the world. Of particular current interest is the ongoing project on study of the status and management options for the Critically Endangered Mekong river population of Irrawaddy dolphins run by WWF Cambodia in co-operation with relevant public authorities. The website of the IUCN Cetacean Specialist Group[12] contains regular updates on IUCN's cetacean-related activities and other work in which group members are involved.

The Committee thanked Cooke and Reeves for their report and **agrees** that Cooke should continue to act as observer to IUCN for the IWC.

4.11 North Atlantic Marine Mammal Commission (NAMMCO)[13]

4.11.1 Scientific Committee
The report of the IWC observer at the 19th meeting of the NAMMCO Scientific Committee (NAMMCO SC) held in Tasiilaq, East Greenland from 19-22 April 2012 is given as IWC/65/4(2013)K.

A joint Norwegian-Russian Ecosystem Survey examined habitat use and prey associations of white-beaked dolphins in late summer. Dolphins used the southern Atlantic waters and the Polar Front area farther north, with a general overlap with most prey species and positive association with blue whiting in the southern habitat.

Catch and bycatch data from 2006-08 from a monitored segment of the Norwegian fleet of coastal gillnetters were used to estimate bycatch rates of harbour porpoises in Norway. Landings statistics were used to extrapolate to the entire fishery, estimating a total annual bycatch of 6,900 porpoises by the two fisheries. The bycatch numbers of harbour porpoises could also be high in Iceland, based on preliminary information presented to the NAMMCO-ICES workshop in 2010. The NAMMCO-SC recommended that total bycatch estimates be attempted and that assessments of sustainability proceed through the relevant Working Groups.

NARWHALS-WEST GREENLAND/CANADA
The NAMMCO-SC agreed on the metapopulation structure for narwhals in Baffin Bay, Hudson Bay and adjacent waters as a useful approach for identifying summer aggregations as management units in narwhals. Satellite tracking of whales that return to summering grounds the following year suggest interannual site fidelity, with summer aggregations to some extent being demographically-independent sub-populations with minimal or no exchange of animals. Narwhals in Canada constitute five separate stocks with some limited exchange between three of the stocks.

There had been an overall increase in West Greenland narwhal catches during the 20th century which was especially pronounced after 1950. However since 1993, a significant decline in overall catches has been observed. Aerial surveys conducted in the North Water in May resulted in fully corrected abundance estimates of 10,677 (95% CI: 6,120-18,620) narwhals in 2009 and 4,775 (95% CI: 2,417-9,430) in 2010.

Age estimation by racemization was used to estimate biological parameters of narwhals, including a maximal lifespan expectancy of ~100 years of age.

NARWHALS IN EAST GREENLAND
Satellite tracking showed that narwhals in East Greenland have a yearly migration where they leave the fjords and move off the coast in winter. Whales from the Scoresby Sound area seem to belong to a stock separate from other narwhal aggregations in East Greenland. Age-structure data from Ittoqqortormiit was applied to assessments of both East Greenland areas, and the harvest was found to select for older animals. The current annual growth rate in the absence of harvest was estimated between 1.2% (95% CI:0-3.5) and 3.7% (95% CI:1.6-5.9), depending upon model and area.

It was noted that there is little information on the predicted response of marine mammals to changing Arctic conditions including changes in sea ice, climate and prey species as well as increased human development activity such as seismic, shipping, and drilling. The NAMMCO-SC recommended holding an international symposium on the effect of seismic and other development activities on Arctic marine mammals with a focus on white whales and narwhals.

WHITE WHALES
Aerial surveys conducted in the North Water in May resulted in fully corrected abundance estimates of 2,008 (95% CI 1,050-3,850) white whales in 2009 and 2,482 (95% CI 1,439-4,282) in 2010.

The assessment of West Greenland white whales was updated with age-structured data, recent abundance estimates and catches. Results from different scenarios provided annual growth rate estimates from 3.2% to 5%, in the absence of harvest. The depletion ratio for 2012 was estimated as 44% (95% CI: 16%-88%), with a yearly replacement of 510 (95% CI:170-780) individuals. The NAMMCO-SC agreed that the revised assessment confirmed that the current removals based on the 2009 advice are sustainable. Based on a 70% probability of population increase, it concluded that a total annual removal of 310 white whales in West Greenland is sustainable (excluding Qaanaaq).

No specific advice was given on the North Water (Qaanaaq), since the current removals remain at a low level relative to the population size. No advice was given for the harvest in Canada.

AGE DETERMINATION WORKSHOPS
Recognising that there are a number of problems with age determination for white whales and narwhals, three age determination workshops were organised. The first in Tampa (FL, USA) examined the state of the art of general ageing techniques; the second in Beaufort (NC, USA) focused on age estimation of belugas using teeth; and the third in Copenhagen (Denmark) focused on the use of tusks for age estimation in narwhals.

The NAMMCO-SC agreed that an annual deposition rate of tooth GLG was to be the accepted standard in white whales, and it recommends that aspartic acid racemisation is applied to white whales, including fore known history/age animals in the analyses in order to calibrate the technique and provide an alternative ageing method.

PILOT WHALES
The NAMMCO-SC agreed that it was unlikely that a full pilot whale assessment could be attempted in the near future.

[10]*http://www.iucn-csg.org/index.php/status-of-the-worlds-cetaceans.*
[11]*http://www.redlist.org.*
[12]*http://www.iucn-csg.org/.*
[13]*http://www.nammco.no/.*

It was noted that both an adapted 'AWMP' procedure as well as the PBR approach could be used for an inverse advice calculation of the minimum abundance required to sustain the average take by the Faroese.

With the average annual catch by the Faroese since 1997 being 678, and the CV of the latest abundance estimate being 0.27, the AWMP procedure estimates that an abundance estimate around 50,000 pilot whales and a similar precision is required to sustain the catch. In comparison, the PBR approach calculates an abundance estimate around 80,000 whales. These calculations reflect precautionary estimates of the minimum abundance estimates required to sustain the Faroese hunt. However, the geographical range of the stock(s) that supply the Faroese hunt is unknown, and it is unresolved how the calculated estimates compare with the accepted estimate of 128,000 (95% CI: 75,700-217,000) pilot whales from the Icelandic and Faroe Islands area of T-NASS.

The average annual catch of long-finned pilot whales in West Greenland during 1993-2007 was 126 whales and an aerial survey estimated 7,440 (95% CI 3,014-18,367) animals in 2007. Applying a PBR approach, the sustainable harvest level of pilot whales would be around 50 whales per year. An estimate based on the AWMP procedure suggests that an annual take of 70 whales is sustainable. However, the survey did not cover the entire range of pilot whales in West Greenland and the summer aggregation cannot be considered an isolated stock. Instead, it is likely connected to pilot whales along Labrador and at Newfoundland.

The NAMMCO-SC noted that humpback whales are present in previously unsurveyed areas off East Greenland, in agreement with information provided by observers on seismic surveys.

The average annual catch of white-beaked dolphins in West Greenland during 1993-2007 was 30 dolphins. An aerial survey estimated 11,801 (95% CI 7,562-18,416) animals in 2007. Applying a PBR approach suggests that the sustainable harvest level would be around 125 whales per year.

A bowhead whale male tagged in Disko Bay in May 2010 moved into the Northwest Passage where it spent about two weeks in September 2010 in close proximity to a bowhead whale tagged in Alaska in spring the same year. Both returned to their normal seasonal range, but the excursions suggest that bowhead whales from the Pacific and the Atlantic occasionally may be connected in years with little sea ice in the Northwest Passage.

Based on an increase in sightings, the NAMMCO-SC recommended monitoring of trends and abundance of the Spitsbergen population of bowhead whales. Norway will continue passive acoustic monitoring with two extra devices in the northern Fram Strait and north of Svalbard.

SURVEY PLANNING

A new large-scale T-NASS survey of cetaceans in the North Atlantic is desirable within the near future, and the NAMMCO-SC discussed how best to approach such a large-scale survey effort. The most optimal year for a large scale coordinated survey is 2015. The survey plans for the different countries are generally similar to those of the last T-NASS survey.

4.11.2 Council

The report of the IWC observer at the 21st Annual Council Meeting of NAMMCO held in Svolvær, Norway from 11-13 September 2012 is given as IWC/65/4(2013)C. In 2010, the Council approved the go-ahead for a manual on hunting. It will be the first comprehensive manual for hunters that details weaponry and ballistics information with a focus on safety.

An international expert group on killing methods for small cetaceans met in November 2011. Significant reductions in killing times have been recorded in recent years in the Faroe Islands, Greenland, Japan and Nunavut Canada, due to development of new equipment and practices. Several recommendations were made regarding further improvement in killing methods, safety and training of hunters.

The Council has concluded that an abundance of pilot whales in the range of 50,000-80,000 animals will sustain the annual Faroese drive hunt. The most recent abundance estimate for the pilot whale stock is 128,000 in the Iceland-Faroese survey area. This means that the annual Faroese catch of pilot whales is well within sustainable limits.

Based on a NAMMCO initiative, a project has been designed to test different modelling approaches of interactions between marine mammals and fisheries. The project, which includes scientists both from NAMMCO and other relevant countries, will start as soon as funding is obtained.

The Committee thanked Sakamoto for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next NAMMCO Council Meeting.

4.12 North Pacific Marine Science Organisation (PICES)[14]

The report of the IWC observer at the 21st annual meeting of PICES held from 12-21 October 2012 in Hiroshima, Japan is given as IWC/65/(2013)H. The Marine Birds and Mammals Advisory Group (AP-MBM) requested that a seabird observer be included in the IWC-POWER cruise and it also revised its terms of reference as follows:

(1) provide information and scientific expertise to BIO and the FUTURE Program, and, when necessary, to other scientific and technical committees with regard to the biology and ecological roles of marine mammals and seabirds in the PICES region;
(2) identify important problems, scientific questions, and knowledge gaps for understanding the impacts of climate change and anthropogenic factors on MBMs in ecosystems of the PICES region through Workshops, Theme Sessions and Science Reports;
(3) assemble information on the status and key demographic parameters of marine mammals and seabirds and contribute to the Status Reports; and
(4) improve collaborative, interdisciplinary research with marine mammal and seabird researchers and the PICES scientific community.

Two sessions at the 2012 AP-MBM workshop were of relevance to the IWC, these were:

(1) the feasibility of updating prey consumption by marine birds, marine mammals, and large predatory fish in PICES regions; and
(2) environmental contaminants in marine ecosystems: seabirds and marine mammals as sentinels of ecosystem health.

The Committee thanked Kato for attending on its behalf and **agrees** that he should represent the Committee as an observer at the next PICES meeting.

[14]*http://www.pices.int/.*

4.13 Protocol on Specially Protected Areas and Wildlife of the Cartagena Convention for the Wider Caribbean (SPAW)[15]

The report of the IWC observer to SPAW is given as IWC/65/4(2013)D. At its 5th meeting of the Scientific and Technical Advisory Committee, held 22nd October 2012, SPAW recommended that collaboration with the IWC should be strengthened through the possible conclusion of a Memorandum of Cooperation.

The three-year Spain-UNEP LifeWeb Project comes to an end in December 2013. Under this, a number of activities have been completed including:

(1) broad-scale regional mapping of migration routes, critical habitats and human threats after compilation of available information and datasets; and
(2) a regional workshop on integration, mapping, GIS analysis of marine mammal migration routes, critical habitats and human threats in the wider Caribbean Region (WCR) held in Miami, Florida, 9-11 May 2011.

As a result of this work, regional maps and factsheets have been produced on the following issues:

(1) distribution of the 25 marine mammals species that occur regularly in the WCR (24 cetaceans and the West Indies manatee);
(2) species' richness;
(3) main threats and human impacts faced by marine mammals: pollutions, interactions with fisheries, maritime traffic, etc.; and
(4) existing policies, marine protected areas and governance for the conservation of marine mammals.

SPAW has developed a management plan for the Marine Mammal Sanctuary of the Dominican Republic and a learning exchange on the economic benefits of whalewatching was organised in March 2013 in Samaná, Dominican Republic.

A workshop on broadscale marine spatial planning and transboundary marine mammal management was held in Panama in May 2012. Participants were trained in marine spatial planning applied to marine mammals. As a result of this workshop, two sub-regional areas have been approved for the future scenario work in the WCR, due to their importance as habitats for marine mammals and to existing work and ongoing cooperation dynamics on marine mammals. The first sub-region proposed ranges from the Dominican Republic down to Trinidad and Tobago through the Lesser Antilles, with a focus on strengthening the links between existing or projected marine mammal sanctuaries and on developing other cooperation activities with the neighbouring islands.

The second sub-region encompasses the continental coast of Latin America from Venezuela to the border between Brazil and French Guiana, together with the Dutch Caribbean islands of Aruba, Bonaire and Curacão being included in the area. The scenario work in this second area will foster support to the already started cooperation between these countries and territories, particularly through a technical workshop held in Suriname in March 2013.

The IWC and Caribbean Environmental Programme (CEP) Secretariats have partnered in order to convene three workshops on the topics of entanglement and ship strike for the wider Caribbean countries. It was recognised that the IWC has the international technical expertise in understanding and responding to these human impacts and as such can provide the countries of the WCR access to this expertise through capacity building training and workshops. The first of two capacity building trainings on determining human impact and entanglement response training was conducted in English and Spanish in Mexico in November 2012.

The Committee thanked Carlson for attending on its behalf and **agrees** that she should represent the Committee as an observer at the next SPAW meeting.

4.14 Commission of the South Pacific (CPPS, Comisión Permanente del Pacífico Sur)

The report of the observers at the Meeting of the Parties to CPPS, held in Guayaquil, Ecuador from 10-12 April 2013 is given as IWC/65/4(2013)F. Mattila presented an overview of the global scope of the large whale entanglement issue and described the training currently offered through the IWC by the technical adviser and other members of the IWC expert advisory panel on this topic. Subsequently, the national representatives of the CPPS countries consulted with the Government of Ecuador, which had made an earlier formal request of the IWC Secretariat for National training for Ecuador. As a result of these consultations, Ecuador has agreed to host an IWC entanglement response training that will include participation by up to three participants from the other CPPS countries. Ecuador, CPPS and NGOs will provide the logistical and financial support for the training, and the IWC will provide the trainers and curriculum. The training will be held in Salinas, Ecuador, 27-28 June 2013.

It is anticipated that this training may stimulate requests for full national training from some other CPPS member countries. It may also represent a model or mechanism by which the two Conventions can conduct cooperative work in order to advance common goals to reduce human impact to cetaceans.

The Committee thanked Mattila and Félix for their joint report and also Mattila for attending on its behalf and **agrees** that he should represent the Committee at the next CPPS meeting.

5. REVISED MANAGEMENT PROCEDURE (RMP) – GENERAL ISSUES

5.1 Complete the MSY rates review

Since 2007, the Committee has been discussing maximum sustainable yield rates (MSYR) in the context of a general reconsideration of the plausible range to be used in population models used for testing the *Catch Limit Algorithm* (*CLA*) of the RMP (IWC, 2008b; 2009a; 2009c; 2010b; 2010c; 2010e; 2011d; 2011g; 2012b). The current range is 1% to 7%, in terms of the mature component of the population. Last year, the Committee agreed that no more than one further year should be allowed to complete the review, and that if it could not be completed this year, the current range (MSYR 1-7% in terms of the mature component of the population) would be retained.

5.1.1 Report of the intersessional Workshop

As part of the work plan agreed last year to complete the review, an intersessional Workshop was held in La Jolla, USA in March 2013 and a detailed summary and review of its report (SC/65a/Rep5) is given in Annex D, item 2.1.1. While the Workshop made considerable progress, it was not able to develop recommendations on the appropriate range of MSYR rates. Rather, it identified four areas of work that would assist discussions at this meeting. It also identified three main issues requiring discussion at the Annual Meeting:

[15]*http://www.cep.unep.org/cartagena-convention*.

(1) limitations of the modelling approach itself;
(2) limitations within the approach (e.g. paucity of data); and
(3) interpretation of the results in the context of the RMP.

The Committee thanked Donovan for chairing the intersessional Workshop and the participants for their work during it and subsequently, without which it would not have been possible to conclude the MSYR review at this meeting (see below).

5.1.2 Discussion including work completed since the Workshop

SC/65a/RMP09 presented results from an energetic model presented to the MSYR Workshop. The model was used to predict variability in the realised rate of increase (r_0) in a generic depleted whale population given estimates of the variability and autocorrelation in birth-rates. The Committee thanked de la Mare for conducting the analyses. The individual-based population dynamics model was reviewed by the EM group (see Annex K1).

None of the model runs conducted in SC/65a/RMP09 led to estimates of MSYL that were 0.6 or larger. In addition, Cooke (2007) had shown that MSYL was closer to 0.5 than to 0.6 based on simulations in the context of a model with environmental effects for a wide range of parameter values. The Workshop had identified two scenarios for consideration with respect to the relationship between $MSYR_{1+}$ and r_0: $MSYR_{1+}=r_0/2$ and $MSYR_{1+}=r_0/1.619$. The latter scenario corresponds to $MSYL_{1+}=0.6$. Given the results in SC/65a/RMP09 and in Cooke (2007), the Committee **agrees** that $MSYR_{1+}=r_0/2$ was more appropriate for drawing inferences regarding the range of MSY rates for use in trials.

A key component of the work over the period of the review had been directed at a meta-analysis of observed rates of increase at low population size. SC/65a/RMP08 provided the results of a final sensitivity test for the Bayesian hierarchical meta-analysis using the data for rates of increase for the 13 baleen whale stocks selected in SC/65a/Rep05. The extent of environmental variation in r_0 as a function of r_0/r_{max} in SC/65a/RMP08 was determined from Equation 2 in SC/65a/RMP09. The lower 5% and 10% points of the posterior predictive distribution for r_0/r_{max} for an unknown stock for this sensitivity test were 0.419 and 0.512 respectively. SC/65a/RMP02 constructed a posterior predictive distribution for an unknown stock for r_0 rather than r_0/r_{max}. The lower 5% and 10% points of this posterior predictive distribution were 0.029 and 0.037 respectively. The Committee thanked Punt for his work in undertaking these analyses.

The Committee recognised the considerable additional work that had been undertaken since the current range for (1% to 7% in terms of the mature component of the population) was selected in 1993 (IWC, 1994c, p.57). In particular, since 2007, the Committee had *inter alia:*

(1) assembled and evaluated information on rates of increase for stocks at low population size;
(2) explored some of the impacts of environmental effects on r_0 relative to r_{max} and the shape of the yield curve for exploited baleen whales; and
(3) developed a meta-analysis framework to integrate this information, along with information on demographics, to derive a probability distribution for r_0 and r_0/r_{max}.

Given the available information and knowledge, the Workshop had explored the sensitivity of the distribution for r_0/r_{max} to a number of factors, including choices of stocks from amongst those for which suitable data were available and to the potential effects of environmental variation on rates of increase (see Annex D, table 4). The Committee recognised that while the meta-analysis was an important advance, it was inevitably limited for a number of unavoidable reasons including uncertainty over a number of factors, as described in Annex D, item 2.1.3.

In conclusion, despite these uncertainties, the Committee **agrees** that it has a better basis to select the range for MSYR for use in trials than when the 1% to 7% choice had been made in 1993. In completing the review this year it recognised that this did not mean that additional work should not continue and be periodically reviewed by the Committee, both in a general sense and as part of *Implementations* and *Implementation Reviews.*

Given its importance in terms of meeting conservation objectives, discussion focused on the lower bound for MSYR for use in trials, based on the assumption MSYR $\sim r_0/2$. A number of options were considered when examining the results of the meta-analysis relating to choice of percentile (5% or 10%), the value for r_{max}, and whether the meta-analysis should be based on r_0 or r_0/r_{max}. A broad consideration of the full set of sensitivity tests in SC/65a/Rep05, SC/65a/RMP02 and SC/65a/RMP08, suggests a range of 1% to 2.5% for the lower bound for MSY rate expressed in terms of the age 1+ component of the population (during the RMP development process and to date, MSYR has been expressed in terms of the mature component of the population; the AWMP development process by contrast expresses MSYR in terms of the 1+ component).

Recognising the uncertainties in the meta-analysis and the need for precaution, the Committee **recommends** that $MSYR_{1+}=1\%$ be adopted as a pragmatic and precautionary lower bound for use in trials. The value corresponds to the lower of the two percentiles in table 5 of SC/65a/Rep05, and the lowest of the r_{max} values; all of the point estimates of r_0 used in the meta-analysis correspond to $MSYR_{1+}$ values larger than 1% under $MSYR_{1+}\sim r_0/2$. In essence, $MSYR_{1+}=1\%$ is roughly the equivalent of 1.5% $MSYR_{mat}$. The Committee also **recommends** that the current upper bound of $MSYR_{mat}=7\%$ be changed to the roughly equivalent $MSYR_{1+}=4\%$. These recommendations have the additional practical advantage of unifying the MSYR ‘currencies’ of the RMP and AWMP processes.

In making this practical recommendation, the Committee **recognises** that much remains to be learnt regarding MSYR for baleen whales and that the issue of the appropriate range for MSYR should continue to be reviewed as new information becomes available. In particular, should data become available for more species and populations, the meta-analysis should be revisited with a view to making it more representative. The Committee **emphasises** in particular the need for information relating to stocks of species of interest for the RMP, including fin, sei, Bryde’s and minke whales (although of course information on MSYR is important in assessing the status of all species within the Committee’s work). Work should also continue to better understand the impact of environmental variation on MSYR and the biological and ecological processes leading to density-dependence, together with the shape of yield curves and hence the relationship between r_0 and $MSYR_{1+}$. As is already the case, consideration of MSYR for particular species and stocks should also occur during *Implementations* and *Implementation Reviews,* particularly where other information for the stock or species concerned suggests alternative plausible values to those discussed above.

The Committee also **recommends** that the '*Requirements and Guidelines for Implementations under the RMP*' (IWC, 2012h) be updated as given in Annex D, item 2.1.3.

The Committee thanked Brandon, Butterworth, Cooke, de la Mare, Donovan, Kitakado and Punt, as well as the other participants of the many intersessional meetings without whom it would not have been possible to complete the MSYR review. Above all, it acknowledged the contribution and dedication of the field researchers, whose data, particularly on bowhead, blue, right and humpback whales, collected over periods of up to 40 years, formed the backbone of the meta-analysis and the MSYR review.

5.2 Finalise the approach for evaluating proposed amendments to the *CLA*

In 2006, the Committee agreed that two steps needed to be completed in order to finalise the approach for evaluating proposed amendments to the *CLA*: the review of MSY rates, completed this year (see Item 5.1 above), and specification of additional trials for testing the *CLA* and amendments to it. Last year, the Committee re-established a working group under Allison to develop and run such trials for consideration at this year's meeting. However, Allison reported that there had been insufficient time during the intersessional period to conduct the work.

The Committee noted that the Working Group on Ecosystem Modelling had identified a set of possible issues to be addressed using individual-based simulation and other models (see Annex K1, item 3). These issues could form the basis for additional trials to further explore the behaviour of the RMP. The Committee **agrees** to re-establish the working group under Allison (see Annex R) to formulate and run trials related to environmental degradation, taking account of the discussions in Annex K1, and to report the results to the next Annual Meeting.

5.3 Evaluate the Norwegian proposal for amending the *CLA*

In 2004, Norway had indicated that it might submit a proposal for the revision of the *CLA* and the base-case and *Robustness Trials* (IWC, 2006a, pp.79-80). In 2007, the Committee received a paper (Aldrin and Huseby, 2007) documenting the results for all single stock trials for a proposed alternative *CLA*, as required for consideration of a proposed revision of this nature (IWC, 2007a, p.89).

The Committee noted in the past that evaluation of this proposal required: (a) completion of the MSYR review, (b) review of the trials conducted in Aldrin and Huseby (2007); and (c) review of additional trials which explore the performance of the RMP given environmental degradation. This year, the Committee has completed the MSYR review (see Item 5.1), but it was not able to complete the trial specifications related to environmental degradation (see Item 5.2) and it did not have time to review Aldrin and Huseby (2007).

The Committee **agrees** that: (a) Aldrin and Huseby (2007) should be a primary document for SC/65b; and (b) it would not be necessary to have all of the trials related to environmental degradation completed before a decision on amending the *CLA* could be made, given the time required to parameterise trials based on individual-based models. It also **agrees** that the *Implementation Review* for the North Atlantic common minke whales could take place even though a decision had yet to be made regarding the Norwegian proposal to amend the *CLA*.

5.4 Modify the 'Catch Limit' program to allow variance-covariance matrices

Last year, it was noted that the Norwegian 'CatchLimit' code for the current *CLA* allows variance-covariance matrices for the abundance estimates to be specified, and Allison was tasked to work intersessionally with the Norwegian Computing Center to develop a final version of the program. She reported that the Norwegian version of the current *CLA* version was used in the trials for western North Pacific minke whales, although some coding issues remain. The Committee **recommends** that Allison contact the Norwegian Computing Center to resolve any final coding issues.

5.5 Update the 'Requirements and Guidelines for Conducting Surveys'

Last year, the Committee recommended that a review covering model-based abundance estimation in theory and practice, and its relation to the design-based approach, be conducted. The review was to provide draft text for inclusion in the 'Requirements and Guidelines for Conducting Surveys' (IWC, 2012g). Hedley was contracted to conduct the review, but was unable to complete it on time. The Committee looks forward to receiving the review at the 2014 Annual Meeting.

5.6 Update the list of accepted abundance estimates to include western North Pacific common minke whales

The Committee noted that last year it had developed a list of accepted abundance estimates related to RMP stocks (IWC, 2013d, p.105). It **agrees** that the list of accepted abundance estimates for the RMP be updated using the values provided by the Working Group on western North Pacific minke whale (see Annex D1, item 9). The broader question of accepted abundance estimates is addressed under Item 22.

5.7 Other business

A number of issues arose during the 'second' western North Pacific common minke whale *Implementation Review* Workshop (SC/65a/Rep04) that were of general relevance to the RMP process and required the Committee's attention. The issues, and the rationale for the sub-committee's recommendations, are given in Annex D, item 2.7. The recommendations arising are as follows.

(1) Imbalanced sex ratio in incidental catches: the Committee **agrees** to consider this matter at the 2014 Annual Meeting and encourages papers on this topic.
(2) Review of abundance estimates in an RMP context: the Committee **endorses** the recommendation that the specified set of associated information be provided along with abundance estimates in its 'Requirements and Guidelines for *Implementations* and *Implementation Reviews*'.
(3) Changing survey coverage in time-series of abundance estimates: the Committee **agrees** to consider the matter at the 2014 Annual Meeting and encourages papers on the topic. It will at that time re-examine the set of core robustness trials which relate to this issue.
(4) Use of surveys carried out in different months in both the *Implementation* process and in actual implementation of the RMP: the Committee **agrees** to consider the matter at the 2014 Annual Meeting and encourages papers on the topic.

5.8 Work plan

The Committee's views on the work plan developed by the RMP sub-committee are given in Item 24, and the financial implications in Item 26.

6. RMP – *IMPLEMENTATION*-RELATED MATTERS

6.1 North Pacific common minke whales

Since 2010, the Committee has been following the process of an *Implementation Review* for western North Pacific common minke whales according to its 'Requirements and Guidelines for *Implementations* under the RMP' (IWC, 2012b). The scheduled period for an *Implementation* or *Implementation Review* is normally two years but, given the complexities of this particular *Implementation Review*, it has not been possible to keep to this schedule. This year's Annual Meeting was thus the third of the *Implementation Review*, but its objectives were those of the 'Second Annual Meeting' as described in the Requirements and Guidelines for *Implementations*, which are to complete the *Implementation Review* by examining the results of the final *Implementation Simulation Trials* and agreeing recommendations for implementation of the RMP.

6.1.1 Review report of intersessional Workshop

The Committee reviewed the report of the intersessional Workshop held in La Jolla, California in March 2013 and chaired by Donovan (SC/65a/Rep04). The Workshop is referred to as the '2nd Intersessional Workshop', although it is actually the third such Workshop because of the extended schedule of this *Implementation Review*.

The Workshop was primarily a technical Workshop, the objectives of which were to review the results of work agreed at the 2012 Annual Meeting of the Scientific Committee (IWC, 2013c) and to consider the results of the final trials using the agreed approach that forms part of the *Implementation* process (IWC, 2012h). The ultimate objectives were to develop recommendations for consideration by the Committee on: management areas; RMP variants (e.g. catch-cascading, catch-capping); suggestions for future research to narrow the range of plausible hypotheses or eliminate some hypotheses; and 'less conservative' variants(s) with their associated required research programmes and duration.

A detailed summary of the Workshop report is given in Annex D1, item 2. A map defining the sub-areas used for the *Implementation Review* is given as Fig. 1.

The Workshop made considerable progress but it had not been possible to consider final trial results because decisions necessary for finalising the trials were only able to be taken at the Workshop. However, some preliminary results for some trials were available and review of these led to refinement and reduction of the total number of management variants (see Item 6.1.3.1) to be considered at this Annual Meeting.

The Workshop had developed a work plan for the remainder of the intersessional period aimed at completing the final trials and providing results well in advance of this Annual Meeting. Considerable progress was made but because of the complexities of this *Implementation Review* it had not been possible to complete this work prior to the Annual Meeting. The Workshop had also identified a number of generic issues related to conducting trials which were referred to the RMP sub-committee (see Annex D, item 2.7).

The Committee **endorses** the conclusions and recommendations from the Workshop report (SC/65a/Rep04) and expressed its thanks to Donovan and all participants for their hard work and progress.

6.1.2 Progress since intersessional Workshop

6.1.2.1 UPDATE TO TRIAL SPECIFICATIONS

Changes to the trial specifications and the code implementing these specifications since the 2nd Intersessional Workshop are described in Annex D1, item 3.1. The Committee **endorses** these changes to the trial specifications; the final trial specifications are given in Annex D1, Appendix 2.

6.1.2.2 REVIEW OF FINAL CONDITIONING RESULTS

Regarding conditioning the *Implementation Simulation Trials*, the Committee had reviewed the fit diagnostics for the base-case trials and those for many of the sensitivity tests implemented in other trials at the 2012 Annual Meeting (IWC, 2013c). Work on conditioning trials continued during the intersessional period and the conditioning diagnostics for all trials conducted during this period had been reviewed by Punt. The Committee had agreed that the *ad hoc* Working Group established under the Working Group on the *Implementation Review* for Western North Pacific common minke whales to review trial results should check the conditioning of any trials that may be influential in the final decisions regarding the selection of RMP variants. The

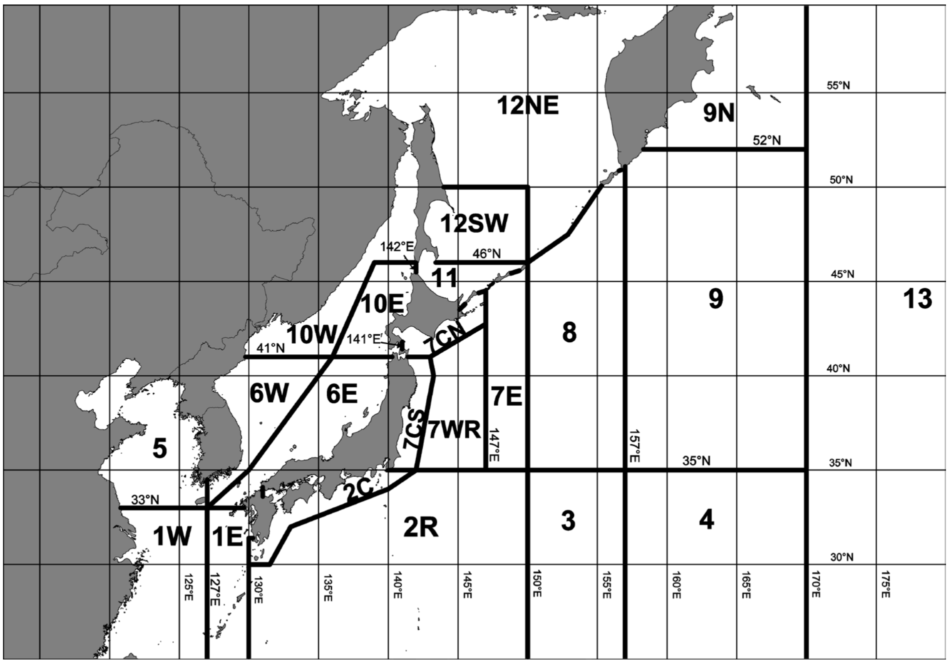

Fig.1. The 22 sub-areas used for the *Implementation Simulation Trials* for North Pacific minke whales.

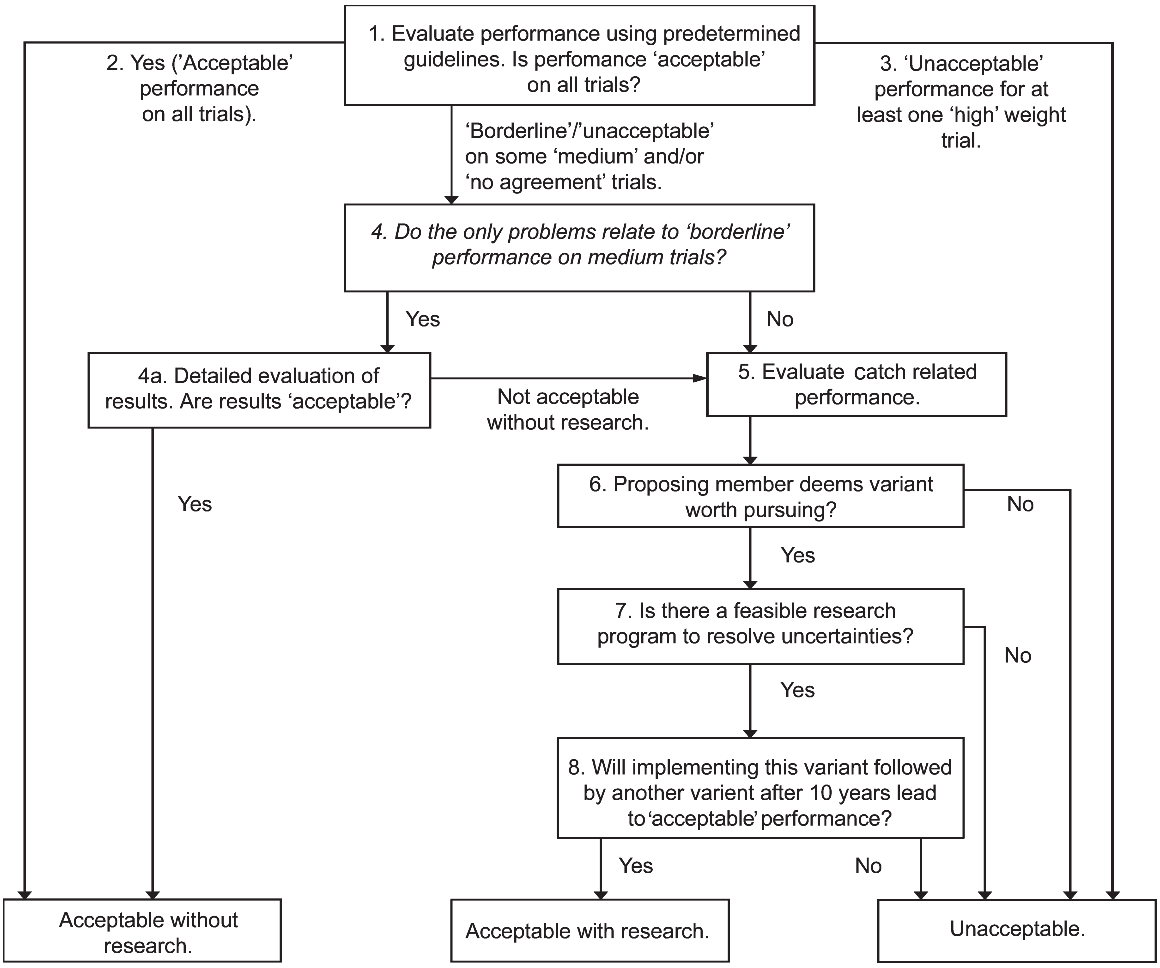

Fig.2. Flowchart summarising the procedure for review of *IST*s (from IWC, 2005a, pp.91-92).

Committee confirms that conditioning had been successfully achieved for all influential trials (Annex D1, item 3.2).

6.1.3 Complete Implementation Review

According to the Requirements and Guidelines for *Implementations,* completing the *Implementation Review* involves reviewing the results of the final *Implementation Simulation Trials* and making recommendations on: Management Areas; RMP variants; and inputs to the *CLA* for use in actual applications of the RMP.

6.1.3.1 REVIEW RESULTS OF FINAL *IMPLEMENTATION SIMULATION TRIALS*

The procedure for reviewing results of the final trials is given in the Committee's Requirements and Guidelines for *Implementations* (IWC, 2012h). A very brief summary is given below.

Fig. 2 shows a flow chart of the decision process to be followed.

The procedure first involves consideration of specified diagnostics to evaluate conservation performance generated from trial results, and determining from them whether the performance of each trial is 'acceptable', 'borderline' or 'unacceptable' under each of the defined RMP variants (see Annex D1, item 4.1). The style in which these results should be presented is detailed in Annex D1, item 4.2. RMP variants are defined by the *Management Areas* to be used (*Small Areas*, etc.) and how any catches are to be taken from them (see Annex D1, item 5). This part of the procedure is a technical exercise that follows directly from the results and requires no judgement.

The second stage is to evaluate each RMP variant by considering the results of all trials together in order to decide whether each variant is 'acceptable without research', 'acceptable with research' or 'unacceptable' (see Annex D1, item 5). This part of the procedure does require judgement because consideration is needed of the overall balance of the trials and the characteristics of any specific trials for which performance is questionable. The process for evaluating each variant can be summarised as follows:

(1) if the performance is close to 'acceptable' for a small number of 'borderline' trials then the Committee may agree that the variant is 'acceptable without research';
(2) if the performance is close to 'unacceptable' or is 'unacceptable' for a number of trials based on a specific hypothesis, then the Committee may agree that this is a candidate for the 'acceptable with research'; and
(3) if the performance is close to 'unacceptable' or is 'unacceptable' for a number of trials under several hypotheses, then the Committee may agree that the variant is 'unacceptable' and thus eliminated from further consideration.

Ten RMP variants to be evaluated had arisen from the 2nd Intersessional Workshop.

(1) *Small Areas* equal sub-areas. For this option, the *Small Areas* for which catch limits are set are 5, 6W, 7CS, 7CN, 7WR, 7E, 8, 9*, and 11.
(2) Sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* and catches are taken from sub-areas 5, 6W, 7CN, 9 and 11.
(3) Sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* and catches are taken from sub-areas 5, 6W, 7CS, 9 and 11.

(4) Sub-areas 5, 6W, 7CS, 7CN, 7WR+7E+8, 9* and 11 are *Small Areas* and catches are taken from sub-areas 5, 6W, 7CS, 7CN, 7WR, 9 and 11.
(5) Sub-areas 5 and 6W are *Small Areas* and catches are taken from sub-areas 5 and 6W. Sub-areas 7+8+9*+11+12 form a combination area and catches are cascaded to the sub-areas within the combination area. The catch limits for sub-areas 12SW and 12NE are not taken.
(6) Sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* except that the catches from the 7+8 *Small Area* are taken from sub-areas 7CS and 7CN using the same method as for catch cascading to allocate the catch across the two sub-areas.
(7) Sub-areas 5+6W+6E+10W+10E and 7+8+9*+11 are *Small Areas*; catches from the 5+6W+6E+10W+10E *Small Area* are taken from subareas 5 and 6W using the same method as for catch cascading to allocate the catch across those five sub-areas, and catches from the 7+8+9+11 *Small Area* are taken in sub-area 7CN.
(8) Sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* and catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 8 and 9 using the same method as for catch cascading to allocate the catch across the two sub-areas.
(9) Sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* and catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8 and 9 using the same method as for catch cascading to allocate the catch across these sub-areas.
(10) Sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* and catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8, 9 and 11 using the same method as for catch cascading to allocate the catch across these sub-areas. Catches from sub-area 11 occur in May and June only.

After reviewing the initial results at the meeting, Japan requested that an 11th variant be evaluated.

(11) Sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* and catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8 and 9 using the same method as for catch cascading to allocate the catch across these sub-areas, except the catches from sub-areas 7CS, 7CN, 7WR and 7E are reduced by 50% after first subtracting the bycatches in these sub-areas.

The Committee's Requirements and Guidelines for *Implementations* allow for additional variants to be proposed for evaluation during the 2nd Intersessional Workshop as part of the *Implementation* process. However, due to the complexities of this *Implementation Review*, the results of only a few trials had been available during the 2nd Intersessional Workshop rather than the complete set as envisioned in the Requirements and Guidelines. Recognising these exceptional circumstances, the Committee **decided** to evaluate this additional variant noting that it was in accord with the RMP in that catches from all *Small Areas* cannot exceed the RMP catch limit (except when the bycatch exceeds the RMP catch limit when the commercial catch is set to zero).

In doing so, the Committee **reiterates** that, under normal circumstances, proposal and evaluation of additional variants should not take place at the 2nd Annual Meeting.

Annex D1, table 2 lists the factors considered in the trials and the plausibility assigned to each. Some of the factors were assigned 'medium' plausibility because the Committee had not been able to reach agreement on whether they should be 'low', 'medium' or 'high' (IWC, 2013c, p.11). A list of all the trials is given in Annex D1, table 1. In all there were 66 trials of which none were given 'high' weight. More details are given in Annex D1, item 5.

Annex D1, tables 3 and 4 summarise the application of the procedure for evaluating conservation performance. Results are shown in Annex D1, table 3 by stock-structure hypothesis and in Annex D1, table 4 by RMP variant. Annex D1, table 5 lists the average catches by sub-area for each RMP variant for the six base-case trials, reported for years 1-10 and for the entire 100-year projection period. The results in this table are illustrative only; the actual catches will depend on the application of the *CLA* to the abundance estimates and catches selected by the Committee (see Items 6.1.4.2 and 6.1.4.3).

The full set of trial results is available from the Secretariat upon request. Results for each variant are given in Annex D1, item 5 and are summarised below.

Variants 1, 2, 3, 4 and 6
These variants did not have 'unacceptable' performance for any trials, but had 'borderline' performance for one trial (B04) as shown in Annex D1, fig. 3. Given that the 'borderline' performance was close to 'acceptable', and that 'borderline' performance occurred only once out of 66 trials, these variants can be considered as candidates which are 'acceptable without research' (step 4a in Fig. 2).

Variant 5
Variant 5 had 'unacceptable' performance for trial B04 (Annex D1, fig. 3). It had 'borderline' performance for trials A04 (Annex D1, fig. 4), B03 (Annex D1, fig. 5), C03 (Annex D1, fig. 6), and C04 (Annex D1, fig. 7). Given that this variant fails for only one trial (B04) and is 'borderline' on four trials in which it is close to 'acceptable' for trial A04, this variant can be considered 'acceptable with research' because it fails only for stock structure hypothesis B (step 4a in Fig. 2).

Variant 7
Variant 7 performed 'unacceptably' on 22 out of 27 trials for stock-structure hypothesis C and 'borderline' on two (C14, C17). It also had 'borderline' performance for two trials based on stock-structure hypotheses A and B (A04, B04). This variant was close to 'acceptable' for these two trials (Annex D1, figs 3 and 4). This variant can thus be considered as a candidate for 'acceptable with research' because it was 'borderline' for only two out of 39 trials for hypotheses A and B, while its performance was 'unacceptable' for hypothesis C; that is, this variant fails for only one stock structure hypothesis (step 4a in Fig. 2).

Variant 8
Variant 8 was acceptable for all 'medium' weight trials. Therefore this variant can be considered to be 'acceptable without research' (steps 1 and 2 in Fig. 2).

Variant 9
Variant 9 performed 'unacceptably' on 20 out of 27 trials for stock-structure hypothesis C, and had 'borderline' performance for four trials (C11, C14, C17 and C30). It had 'borderline' performance on only two out of 39 trials based on stock-structure hypotheses A and B (A04, B04). This variant can thus be considered as a candidate for 'acceptable with research' because it fails only for stock structure hypothesis C (step 4a in Fig. 2).

Variant 10
Variant 10 performed 'unacceptably' on 23 out of 27 trials for stock-structure hypothesis C and had 'borderline' performance for two trials (C17 and C27). It also performed 'unacceptably' for one trial for stock structure hypothesis B (B04) and 'borderline' for 8 trials (B03, B05, B06, B09, B18, B20, B22, B28). 'Borderline' performance was also observed for three trials for stock structure hypothesis A (A03, A04, A28). This variant is therefore 'unacceptable'.

Variant 11
Variant 11 performed 'unacceptably' on three out of 27 trials for stock-structure hypothesis C (C13, C20, C23) and had 'borderline' performance for 16 stock structure hypothesis C trials. The conservation performance of this variant is between that of variants 5 and 9, which were both considered to be candidates for variants with research. Therefore, this variant can be considered as a candidate for 'acceptable with research'.

Variants with research
With respect to variants that are candidates for 'acceptable with research', it is the responsibility of relevant government(s) to inform the Committee whether it wishes additional trials to be run to determine the conservation performance of proposed 'hybrid variants'. A 'hybrid variant' is one for which catches for the first 12 years are set using the candidate 'acceptable with research' variant followed by a 6-year phase down/phase out period and then catches set by an 'acceptable without research' variant. The conservation performance of the 'hybrid variant' must be 'acceptable' under the criteria described above.

If the 'hybrid variant' performs acceptably then, before it can be recommended, the Committee must agree a research programme that it believes has a realistic chance of determining whether the trial(s) for which this variant performed poorly should be accorded low weight. The Committee will review progress with the research programme annually and may recommend early reversion to the 'acceptable' variant if progress is not sufficient.

The Committee noted that any research proposal submitted would be reviewed at next years' meeting.

6.1.4 Recommendations

6.1.4.1 RMP VARIANTS

Under the management options recommended (see below), the *Management Area* designations for each RMP variant are as follows.

(1) Variant 1: sub-areas 5, 6W, 7CS, 7CN, 7WR, 7E, 8, 9* and 11 are *Small Areas*.
(2) Variant 2: sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* (all of the catch from the 7+8 *Small Area* is taken from sub-area 7CN).
(3) Variant 3: sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* (all of the catch from the 7+8 *Small Area* is taken from sub-area 7CS).
(4) Variant 4: sub-areas 5, 6W, 7CS, 7CN, 7WR+7E+8, 9* and 11 are *Small Areas* (all of the catch from the 7WR+7E+8 *Small Area* is taken from sub-area 7WR).
(5) If Variant 5 proves to be acceptable with research: sub-areas 5 and 6W are *Small Areas* and catches are taken from sub-areas 5 and 6W. Sub-areas 7+8+9*+11+12 form a Combination Area (catch limits for sub-areas 12SW and 12NE are not taken).
(6) Variant 6: sub-areas 5, 6W, 7+8, 9* and 11 are *Small Areas* (catches from the 7+8 *Small Area* are taken from sub-areas 7CS and 7CN using the same method as for catch cascading).
(7) If Variant 7 proves to be acceptable with research: sub-areas 5+6W+6E+10W+10E and 7+8+9*+11 are *Small Areas*; (catches from the 5+6W+6E+10W+10E *Small Area* are taken from sub-areas 5 and 6W using the same method as for catch cascading; catches from the 7+8+9+11 *Small Area* are taken in sub-area 7CN).
(8) Variant 8: sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* (catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 8 and 9 using the same method as for catch cascading).
(9) If Variant 9 proves to be acceptable with research: sub-areas 5, 6W and 7+8+9*+11+12 are *Small Areas* (catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8 and 9 using the same method as for catch cascading).
(10) If Variant 11 proves to be acceptable with research: sub-areas 5, 6W, and 7+8+9*+11+12 are *Small Areas* (catches from the 7+8+9*+11+12 *Small Area* are taken from sub-areas 7CS, 7CN, 7WR, 7E, 8 and 9 using the same method as for catch cascading).

The Committee **agrees** that, according to the Committee's Requirements and Guidelines for *Implementations* (IWC, 2012h):

(1) variants 1, 2, 3, 4, 6 and 8 are 'acceptable without research';
(2) variants 5, 7, 9 and 11 are candidates for 'acceptable with research'; and
(3) variant 10 is 'unacceptable'.

Some members stated that with only two exceptions, all of the 'unacceptable' trials were under stock structure hypothesis C. Under the Committee's current Requirements and Guidelines for *Implementations* under the RMP, when there is no agreement on plausibility of the hypotheses, the plausibility is automatically assigned as 'medium'. In the case of stock structure hypothesis C, there was no agreement and therefore the plausibility became 'medium' as for the other stock structure hypotheses. However these members reiterated their view that the plausibility of stock structure hypothesis C is 'low' (IWC, 2011c, p.138). Whilst agreeing that the review of trials had appropriately followed the Committee's current Requirements and Guidelines for *Implementations*, under these circumstances they could not accept the recommendations on management based on the conservation performance of the *Implementation Simulation Trials* using hypothesis C reviewed at this meeting. They pointed out that the problem of assigning plausibility has been an ongoing problem and suggested that it is necessary to review the method of determining plausibility.

6.1.4.2 ESTIMATES OF ABUNDANCE

The Committee did not have sufficient time to finalise the estimates of abundance for use in actual applications of the RMP. Annex D1, table 6 summarises the current status of abundance estimates for use in the trials and in actual applications of the RMP. Work to determine whether the abundance estimates that need further consideration can be accepted for use in actual applications of the RMP is included in the work plan. Final decisions regarding which abundance estimates can be used in actual applications of the RMP will be made at next year's meeting, taking into account any revision to the Requirements and Guidelines for Conducting Surveys (see Item 5.5, Annex D, item 2.5).

6.1.4.3 HISTORICAL AND FUTURE REMOVALS

The Committee has previously agreed that the best estimates of the direct catches and the average predicted bycatch from the six baseline trials would be used in actual applications of the RMP (IWC, 2013c). The calculated average predicted bycatch from the six baseline trials are given in Annex D1, Appendix 2.

6.1.4.4 CONSIDERATION OF DATA/ANALYSES TO REDUCE HYPOTHESES IN FUTURE

The Committee did not have sufficient time to discuss this item fully. It **encourages** those Contracting Governments which are contemplating application of the RMP to review previous discussions on this matter in the Committee.

The Committee highlighted that the *Implementation Simulation Trials* structure provided a way to identify the value of information to resolve uncertainties. In particular, analyses could be undertaken to assess where data on mixing proportions and abundance would be most informative in terms of resolving the plausibility of various hypotheses. The Committee recognised that becoming familiar with how to use the *Implementation Simulation Trials* structure to evaluate the value of information could be complicated, and **encourages** members of the Committee to work with the Secretariat to develop the ability to condition and run trials.

6.1.5 Surveys and estimates of abundance

6.1.5.1 RESULTS FROM RECENT SURVEYS

SC/65a/NPM01 presented the results of satellite tracking of common minke whales in the Sea of Japan in autumn 2012. Little information on migration behaviour was obtained because of the short transmission duration (14 days). More details are given in Annex D1, item 8.1. The Committee welcomes this information and **recommends** that researchers conducting tagging studies on North Pacific minke whales work together with those conducting similar work in other areas, particularly in relation to tag technology and deployment.

SC/65a/NPM04 provided a cruise report on a sighting survey in the East Sea in spring 2012. More details are given in Annex D1, item 8.1.

6.1.5.2 PLANS FOR FUTURE SURVEYS

SC/65a/NPM02 presented the research plan for a sighting survey for common minke whales in the Sea of Okhotsk, including the Russian EEZ, in summer 2014. The primary objective of the survey is to obtain a new estimate of abundance for sub-areas 11 and 12. The secondary objective of the survey will be biopsy sampling and satellite tagging for common minke whales, if permission is obtained from the Government of the Russian Federation. This latter objective is important given the need to obtain information on the mixing rate of J- and O-stocks, and the distribution of J-stock in the Okhotsk Sea. Further details are given in Annex D1, item 8.2.

SC/65a/NPM05 reported that a sighting survey for common minke whale will be conducted in the Yellow Sea in spring 2014. This survey is part of a four-year programme to survey the waters of sub-areas 5 and 6W and increase survey coverage from 13% to 35%. Further details are given in Annex D1, item 8.2.

The Committee welcomes these plans and noted that there have been no surveys in sub-area 12 in recent years. It appointed Miyashita and An to provide oversight of these surveys on behalf of the Committee. The Committee **strongly recommends** that the Government of the Russian Federation give permission for the survey to take place in its EEZ in the Sea of Okhotsk throughout sub-area 12, given the importance of abundance estimates for sub-area 12 to the understanding of the status of common minke whales in the western North Pacific.

6.1.5.3 UPDATED LIST OF ACCEPTED ABUNDANCE ESTIMATES

Annex D1, Appendices 3 and 4 summarise information on primary effort, primary sighting position, survey blocks, sub-areas and area definitions for surveys for western North Pacific minke whales. The Committee thanked Miyashita, Hakamada and An for providing this information, which had been requested by the 2nd Intersessional Workshop.

Annex D1, table 7 lists these estimates of abundance in a format consistent for collation with estimates from other species and areas.

6.1.6 Conclusions

The Committee re-established the Intersessional Steering Group (see Annex D1, item 11 for membership) to co-ordinate intersessional work and prepare for the 2014 Annual Meeting.

The Committee recognised that this *Implementation Review* had been the most complicated to date and thanked all those who had contributed over the last three years to its completion, especially Hammond and Donovan who chaired the Working Group and intersessional Workshops, respectively. In particular, the Committee expressed its appreciation for the large amount of work done by Allison and De Moor without which it would not have been possible to complete the *Implementation Review*. The Committee noted that the need to take three years to complete this complicated *Implementation Review* may have implications for conducting other *Implementations* and *Implementation Reviews*. The Committee **agrees** to review its Requirements and Guidelines for *Implementations* under the RMP in this context at next year's meeting.

6.2 North Atlantic fin whales

6.2.1 Implementation Review

The Committee reviewed the report of the pre-meeting to initiate the *Implementation Review* (see Annex D, Appendix 2) and **endorses** its conclusions, recommendations and work plan. It established an intersessional group (see Annex R) under Elvarsson to develop revised specifications for the trials. It **recommends** that a two-day Workshop is held back-to-back with an AWMP intersessional Workshop in early 2014 to reduce travel costs.

6.3 North Atlantic common minke whales

6.3.1 Review new information

The Committee received five papers which had either been presented to the Special Permit Review Workshop held in Iceland (SC/65a/Rep03), or were revised versions of papers presented then. Details are given in Annex D, item 3.2.1.

The Committee **welcomes** the information in SC/F13/SP17 and SC/F13/SP20rev. It should be useful for the upcoming *Implementation Review,* and, in particular, the work of the joint AWMP/RMP Working Group on stock structure.

The Committee recognised the value of the satellite tracking of minke whales, reported in SC/F13/SP18, for the development of *Implementation Simulation Trials*. It **reiterates** the recommendations of the Special Permit Review that such tagging should continue, as much information as possible should be collected from each tagged individual, and that the results from the various stock definition approaches should be integrated.

The Committee **agrees** that data from satellite tracking could be used in *Implementation Simulation Trials* both qualitatively and quantitatively. There would be benefits in identifying the analysis methods to apply to data from satellite-tagged animals to determine the minimum number of animals needed for meaningful quantitative estimates and the point at which tagging additional animals leads to minimal additional information. If such analysis methods are developed, they should be reviewed by the Working Group on Stock Definition.

The Committee noted that SC/F13/SP06 stated the main objective of the aerial survey component of the research programme is to obtain a seasonal profile of relative abundance in coastal Icelandic waters in the off-season. This is discussed in Annex D, item 3.2.1.

6.3.1.1 NEW SURVEYS

SC/65a/RMP10 presented Norway's plans to conduct a new series of annual partial surveys over the period 2014-19 to collect data for a new estimate of minke whale abundance in the Northeast Atlantic in accordance with the requirements of the RMP. The survey and analytical methods will follow the procedures used in the previous survey cycles.

The Committee noted that the upcoming *Implementation Review* could lead to changes to the definitions of the *Small Areas*. It recognised that there are some advantages in agreement between survey and *Small Area* boundaries, but **agrees** that an approach has been developed which can address changes in *Small Area* boundaries.

6.3.2 Prepare for 2014 Implementation Review

The Committee was informed that the joint AWMP/RMP group is coordinating discussions and analyses on using genetics to examine stock structure for North Atlantic minke whales. It reviewed the report of the group (Annex D, Appendix 3) and **endorses** its recommendations. It **reiterates** its recommendation from last year that the work plan for the group (IWC, 2013d) be completed, and **recommends** the holding of a joint AWMP/RMP intersessional Workshop to consider stock structure hypotheses for common North Atlantic minke whales. It **recommends** a research proposal to conduct simulation analyses to support the deliberations of the intersessional Workshop (Annex D, Appendix 4) and future considerations of stock structure for other populations (see Item 26).

6.3.3 Recommendations

The Committee **recommends** that a Steering Group under Walløe be established to co-ordinate planning for the 2014 *Implementation Review* (see Annex R). It **recommends** that a three day pre-meeting be held prior to the 2014 Annual Meeting to ensure that sufficient progress is made on the *Implementation Review*, noting that this *Implementation Review* could be more complicated than previous ones because the original *Implementation* was not conducted under the current Requirements and Guidelines for *Implementation.*

6.4 North Atlantic sei whales

Last year, the Committee established an intersessional group to review the available data for North Atlantic sei whales in the context of a possible *pre-Implementation assessment* and provide a report to the 2013 Annual Meeting. Unfortunately, insufficient progress was made during the intersessional period to warrant starting the *pre-Implementation assessment* at this year's meeting. The Committee therefore **recommends** that the intersessional group be re-established and progress evaluated at the 2014 Annual Meeting. The decision whether to initiate an *Implementation* after a *pre-Implementation assessment* is made by the Commission. The Committee noted that this procedure might lead to delays now that the Commission will meet biennially; it may consider possible recommendations to the Commission at next year's meeting.

6.5 Western North Pacific Bryde's whales

6.5.1 Prepare for 2016 Implementation Review

The Committee received an update on progress and plans for the 2016 *Implementation Review* (Annex D, item 3.4). A sighting survey will be conducted in western North Pacific minke whales sub-areas 7 and 8 in 2013. IWC-POWER cruises will also take place in 2013 and 2014. Sightings data will be collected and attempts will be made to biopsy Bryde's whales. Bryde's whale genetic samples were collected during JARPN II cruises in 2012 and additional samples will be collected during the 2013 JARPN II cruises.

6.6 Work plan

The Committee's views on the work plan for the sub-committee on the RMP are given in Item 24, and the financial implications in Item 26.

7. NON-DELIBERATE HUMAN-INDUCED MORTALITY OF LARGE WHALES

The report of the Working Group on Non-deliberate Human-induced Mortality of Large Whales is given as Annex J.

7.1 Criteria for determining cause of death

The objective of this Item is to assist the Committee in its general attempts to assess human caused mortality and in particular to agree to specific criteria by which the Ship Strike Data Review Group can assess ship strikes reported to the ship strike database. If standardised criteria became internationally accepted, this will also assist countries as they report ship strikes through their National Progress Reports.

Moore reported via videolink on a workshop held in the USA (1-2 February 2012) that defined criteria for degrees of confidence in the diagnosis of sharp or blunt vessel trauma, and peracute or chronic fishery trauma in cetaceans. The amount of data needed to make an adequate diagnosis depends on the scenario as is discussed in Moore *et al.* (2013b) and summarised in Annex J, item 6. Their criteria are for 'Confirmed', 'Probable' and 'Suspect' outcomes and this approach had been used to examine large whale mortalities in the northwest Atlantic in the context of management strategies designed to mitigate these impacts (Van der Hoop *et al.*, 2012). They found that trends in numbers (and location) of reports of vessel strikes and entanglements did not differ significantly before or after 2003, when a number of management mitigation initiatives were begun along the Atlantic coast of the USA.

A handbook was presented for recognising, evaluating and documenting human interactions in stranded cetaceans and pinnipeds was presented (Moore and Barco, 2013). The Committee **recognises** the value of standardising approaches to enable more consistent data collection which in turn can assist in obtaining information on the likely extent of causes of death and necessary priorities for mitigation. Details are provided in Annex J, item 6.

The above two papers describe complementary actions and criteria and represent important tools for stranding networks globally. While a full forensic necropsy is often very difficult this should nevertheless be the goal to aim for. The two papers provided a progression of data collection options, and the visual options in the handbook should be feasible almost anywhere. Data collected using these protocols are being archived with the ultimate intent of making some images available for consultations and training. The Committee **encourages** this work and broader use of the handbook.

One hundred and eight ship strike reports from Alaskan waters between 1978-2011 are described in Neilson *et al.* (2012). In order to assess the reliability of these reports, which ranged from well documented reports with full necropsies to secondhand reports with sparse documentation, the authors developed 'confidence criteria' for categorising the reports. The Committee **welcomes** this summary and noted that this information will provide valuable input into the IWC's ship strikes database.

The criteria developed in these papers have been used to develop the criteria and definitions in Annex J, Appendix 2. The Committee **recommends** that these be adopted for the IWC ship strike database.

7.2 Reporting to National Progress Reports

This matter is discussed under Item 3.2.

7.3 Entanglement of large whales

7.3.1 Estimation of rates of entanglement, risks of entanglement and mortality

SC/65a/HIM02 describes a recent incidental catch of a baleen whale in a long-line fishery off the Brazilian coast. The incident demonstrates the need for more investigation of such interactions in the southwest Atlantic Ocean. A large long-line fleet operates out of ports along Brazil's southern coast in the path of migratory whales. The fleets are not monitored and they are unlikely to report whales entangled in their gear since, while it is forbidden to entangle a whale and there are regulations requiring that they are reported, these measures are not effective. In September 2012, just south of this area, a meeting was held to develop an action plan to mitigate bycatch and entanglement in similar Argentine fisheries. It is hoped that a report of the action plan developed will be available at next year's meeting. The Committee looks forward to receiving a report of the plan.

7.3.2 Methods to estimate time-series of bycatch

This item was not discussed by the Working Group this year but will be considered next year in light of discussions in e.g. Annexes D1 and E.

7.3.3 Collaboration with FAO and FIRMS

The IWC is currently an observer to the FIRMS partnership (Fisheries Resources Management System). It had been hoped that FIRMS may hold data on fishing effort that could be useful in estimating bycatch but FIRMS appears to have changed its focus somewhat since initial discussions with the IWC. Leaper will follow up on any new developments intersessionally to see if there is progress to discuss next year.

7.3.4 Collaboration with Commission initiatives on entanglement, including consideration of mitigation measures

Much of the work of the Secretariat's technical advisor, Mattila (generously seconded by the USA since 2012) has been devoted to capacity building on the issue of large whale entanglement. The strategy has provided an overview for over 500 scientists and government managers from 20 countries, followed by detailed training and assistance with setting up entanglement response networks. Over the remainder of 2013, training is scheduled for Ecuador (with participants from the Permanent Commission for the South Pacific (CPPS) countries), Panama, and a joint IWC-UNEP-SPAW session for the French and English Caribbean. The Committee **commends** this work, noting that besides assisting countries to establish relatively safe entanglement response capabilities which have already released a number of individual whales, it has stimulated other local and national initiatives on the issue of entanglement, including actions intended to both understand and mitigate them. The Committee **reiterates** that prevention rather than disentanglement is the ultimate solution. It **encourages** members to submit information and papers on prevention studies to next year's meeting.

7.4 Ship strikes

7.4.1 Progress on the global database

Last year, in response to a Committee recommendation (IWC, 2013h), Ritter and Panigada had been contracted jointly as co-ordinators for the ship strikes database. The primary objective was to raise awareness about the ship strike database and to stimulate its use. Outreach activities have resulted in a large number of new data entries compared to previous years. Data from around 100 incidents have been entered in the last year and the data from around a further 200 incidents are expected to be incorporated during the rest of 2013. These data cover some areas not previously covered including the Gulf of St Lawrence (Canada) and Alaskan waters. Contact was also made with researchers and authorities in Sri Lanka. A total of 111 entries of collisions between sailing vessels and cetaceans are expected to be entered by the end of 2013. A new edition of the multi-lingual IWC ship strike leaflet, supported by Belgium, has been distributed to a range of stakeholders. A self-standing banner display has been developed and two copies were produced; one was displayed at the recent European Cetacean Society conference in Portugal.

The Committee **commends** this work, noting that a modest financial investment by the IWC has produced good results. It noted the value of the leaflet to highlight the issue and create an ongoing dialog on whale avoidance in the maritime industry; for example, Neilson *et al.* (2012) had recommended its wide distribution. The Committee **recommends** that this work continues and is funded (see Item 26). The Committee also **agrees** that the co-ordinators should give priority to populations identified for CMPs for proactive data gathering outreach efforts.

The Committee noted that Australia and the USA have ship strike databases and have worked to ensure that these are compatible with the IWC database, and that data fields can be accurately mapped between them to facilitate data exchange. The Committee **reiterates** previous recommendations that member nations should submit data to the IWC's global database as soon as possible.

7.4.2 Estimating rates of ship strikes, risk of ship strikes and mortality

SC/65a/HIM01 provided information from the Canary Islands. A large fleet of commercial ferries operates on a year-round basis in the area and ship strikes are a known problem. Different ferry types exhibit distinct noise spectra. Based on certain assumptions, especially on hearing thresholds, the authors concluded that whales may be capable of hearing approaching vessels at distances that should enable them to react fast enough to avoid a collision. However, numerous factors need to be considered in evaluating the actual collision risk. Jet-driven ferries travelling at high speed, combined with comparably low intensity bow-radiated noise, result in an especially high risk of collision. These results confirm the role of vessel speed and the need to reduce vessel speed so as to minimise the risk of collision.

SC/65a/HIM03 reported that two pygmy blue whales were struck and killed in Sri Lankan waters in early 2012. The southern coast of Sri Lanka is one of the busiest shipping routes in the world and overlaps with an area of high whale sightings. The reported deaths can only be considered minimum values. These deaths and the unknown population size highlight an urgent need for long-term monitoring of the blue whale population in Sri Lankan waters and elsewhere in the northern Indian Ocean.

Vaes and Druon (2013) presented a novel approach to considering the seasonal ship strike risk to fin whales in the western Mediterranean Sea using satellite-derived data (surface temperature and chlorophyll-a content) as a proxy for fin whale habitat in addition to using AIS data for vessel traffic. The Committee agreed that further comparisons using this approach with contemporary whale sighting data are required to assess its value.

Neilson *et al.* (2012) reported data on collisions in Alaska between 1978 and 2011; these have been made available to the IWC database as noted above. There were 108 reports classified as definite, probable or possible ship strikes, mostly from collisions witnessed at sea. It was noted that even in this relatively large data set there were only a few cases in which the circumstances of the collision and outcome could be related to the size, speed and type of the vessel involved. This highlights the need for a central global database, which will increase the likelihood of obtaining a sample size sufficiently robust for meaningful analyses of factors related to risk.

7.4.3 Collaboration with the Commission's ship strikes working group including consideration of mitigation measures

An IWC-endorsed Ship Strike Mitigation Workshop was held in Tenerife in October 2012 (Tejedor *et al.*, 2013). This was primarily aimed at management and mitigation. There was broad recognition and acceptance that currently the best way to avoid collisions with whales is to avoid areas of high density, but if this is not possible then ships should maintain a vigilant watch and slow down as appropriate. Several participants from the industry agreed that they would prefer to know of a whale 'hot spot' well in advance, and be able to plan their routes accordingly, rather than getting a message upon arrival in an area that they need to re-route.

The apparent willingness of key stakeholders at this Workshop to investigate the feasibility and utility of voyage planning to avoid high density areas represents an opportunity for the Committee to play an important role in this effort. The Committee **agrees** that this is a productive way forward on this issue and **recommends** that the topic of defining and identifying critical whale 'hot spots' and engaging the shipping industry in the process should be an agenda item for the Commission's next Ship Strike Workshop. The Committee recognised that the Tenerife Workshop was primarily concerned with management and mitigation, and as such, **recommends** that the Commission's next Ship Strike Workshop reviews the report in full, and considers endorsing it and seeking partnerships with stakeholders to carry out appropriate recommended actions.

Bryde's whales in the Hauraki Gulf, New Zealand were also discussed. The population is believed to be less than 200 individuals and there have been 16 confirmed ship strike mortalities between 1996 and 2013. A proposal for funding an aerial survey to provide an abundance estimate for Bryde's whales throughout their primary range in New Zealand and to use this and data on distribution to inform mitigation measures to reduce ship-strike mortality was received (also see Item 26).

7.5 Marine debris

7.5.1 Report of the intersessional Workshop

A summary of the first IWC Marine Debris Workshop (SC/65a/Rep06), held from 13-17 May 2013 at Woods Hole Oceanographic Institution, was presented. The original objectives are outlined in IWC (2013j, pp.261-62).

Thirty-eight participants representing eight countries attended the Workshop. The first day of the Workshop included a public seminar consisting of keynote presentations which illustrated the ways in which debris and cetaceans interact, including the long lingering deaths that can result from entanglement, and a growing realisation that ingestion of plastics, including microplastics, may be a significant problem. In 2012, 280 million tonnes of plastic were produced globally, less than half of which was consigned to landfill or recycled. If current rates of consumption continue, the planet will hold another 33 billion tonnes of plastic by 2050 (Rochman, 2013). The keynote presentations also highlighted the need for improved international cooperation.

The participants recognised the potential significant impact that marine debris has on both cetacean habitat and cetaceans through both macrodebris (such as fishing gear, plastic bags and sheeting) entanglement and ingestion and through microplastics and their associated chemical exposures through ingestion or inhalation. The Workshop encouraged debris sampling when conducting observational cetacean research at sea (i.e. water sampling and visual observations during cetacean sightings surveys) and recommended that industry partners be involved in marine debris prevention, research and response to ensure success in reducing marine debris impacts on cetaceans.

Finally, the Workshop agreed that ingestion and inhalation of marine debris may sometimes be lethal, that sub-lethal impacts may also occur with long term negative consequences and that intake of debris is a problem, both as an individual welfare concern and potentially for some populations and species. More research was encouraged. The Workshop recommended that the IWC Scientific Committee should evaluate the risks of ingestion and inhalation based upon: (1) the spatial distribution of microplastics and macro debris; and (2) the feeding strategies and location of feeding areas of cetaceans. It also recommended that the Scientific Committee prioritise studies of those cetaceans that are likely at greatest risk of ingesting or inhaling macro- and micro-debris and associated pollutants (e.g. see Fossi *et al.*, 2012). The Workshop thus recommended that the initial focus of research be on three species of baleen whale: the North Atlantic right whale, the fin whale in the Mediterranean Sea and the gray whale in the eastern North Pacific. The Workshop noted that none of its recommendations required the lethal collection of cetaceans.

7.5.2 Committee discussion

A full discussion of the Workshop report can be found in Annex K, item 11.2. For a full list of scientific recommendations see SC/65a/Rep06. Information was also presented on marine debris found in the stomach contents of common minke whales, sei whales, Bryde's whales and sperm whales sampled by JARPN II (SC/65a/O03, SC/65a/O06, SC/65a/O07). No marine debris was observed in the stomachs of Antarctic minke whales (SC/65a/O09). After review of the Workshop report and other papers, the Committee **endorses** the recommendations of the Workshop (see SC65a/Rep06 for full details), including its recommended pathology protocol and **agrees** that:

(1) legacy and contemporary marine debris have the potential to be persistent, bioaccumulative and lethal to cetaceans and represent a global management challenge; and
(2) entanglement in and intake of active and derelict fishing gear and other marine debris have lethal and sub-lethal effects on cetaceans.

Therefore the Committee **strongly agrees** that marine debris and its contribution to entanglement, exposures including ingestion or inhalation, and associated impacts, including toxicity, are welfare and conservation issues for cetaceans on a global scale and a growing concern. The Committee **recommends** that the Commission and the Secretariat take prompt action to help better understand and address this growing problem, including:

(1) providing data on rates of marine debris interactions with cetaceans into the national progress reports and supporting the second marine debris Workshop (which will have mitigation and management as its focus);
(2) strengthening capacity building in the IWC entanglement response curriculum and adding information on marine debris;
(3) building international partnerships with other relevant organisations and stakeholders including an effective transfer of information about on-going research and debris-reduction and removal programmes and the international and national marine debris communities;
(4) developing programmes to remove derelict gear and schemes to reduce the introduction of new debris; and
(5) incorporating consideration of marine debris into IWC conservation management plans where appropriate and to consider making it the focus of a plan in its own right.

The Committee thanked the Workshop Convenor, the Woods Hole Oceanographic Institution for hosting the Workshop and the tremendous work done by the Workshop organisers and participants. The Committee also appreciates the funds provided by the various organisations in support of this Workshop.

The Committee **agrees** to establish an intersessional correspondence group (see Annex R) to review and prioritise the research-related recommendations from the Workshop. It was noted that this review should give consideration to: (1) the evaluation of the efficacy of fishing practices that pose a lower risk of entanglement or loss of gear, given that active and derelict fishing gear are a major cause of injury and mortality in cetaceans; and (2) further investigations into microplastics, their associated chemical pollutants and microbes, and macrodebris ingestion. Further work on microplastics has been taken up by the POLLUTION 2020 work plan (see Annex K, Appendix 2). The intersessional correspondence group will also liaise with the steering group for the second Marine Debris Workshop.

7.6 Work plan

The Committee's views on the work plan developed by the Working Group are given in Item 24, and the financial implications in Item 26.

8. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT PROCEDURE (AWMP)

This item continues to be discussed as a result of Resolution 1994-4 of the Commission (IWC, 1995a). The report of the SWG on the development of an Aboriginal Whaling Management Procedure (AWMP) is given as Annex E. The Committee's deliberations, as reported below, are largely a summary of that Annex, and the interested reader is referred to it for a more detailed discussion. The primary issues at this year's meeting comprised: (1) finalising work on the PCFG (the Pacific Coast Feeding Group) of gray whales; (2) developing *SLAs* and providing management advice for Greenlandic hunts; and (3) reviewing management advice for the humpback whale fishery of St Vincent and The Grenadines. Considerable progress on items (1) and (2) was made as a result of an intersessional Workshop (see SC/65a/Rep02).

8.1 Matters arising out of the *Implementation Review* for eastern North Pacific gray whales

8.1.1 SLAs for the potential Makah hunt

In 2010, the Committee agreed that PCFG (Pacific Coast Feeding Group) whales should be treated as a separate management unit. The Makah Tribe would like to take gray whales in the Makah Usual and Accustomed fishing grounds (U&A) in the future and the objective of the *SLA*s tested during the *Implementation Review* process was to minimise the risk to the PCFG whales and meet the Commission's conservation objectives.

Last year, the Committee had agreed that two *SLA* variants met the conservation objectives of the Commission (IWC, 2013e):

(1) *SLA* variant 1: struck-and-lost whales do not count towards the APL (the 'allowable PCFG limit' – a protection level) i.e. there is no management response to PCFG whales struck but not landed; and
(2) *SLA* variant 2: all struck-and-lost whales count towards the APL irrespective of hunting month i.e. the number of whales counted towards the APL may exceed the actual number of PCFG whales struck.

SLA variant 2 was only acceptable if it was accompanied by a research programme (i.e. a photo-id programme to monitor the relative probability of harvesting PCFG whales, the results of which are presented to the Scientific Committee for evaluation each year).

However, the Committee also noted that the two variants did not exactly mimic the proposed hunt and expressed concern that the actual conservation outcome of the proposed hunt had not been fully tested. The reason for this relates to how strikes in May are treated in *SLA* calculations. No hunting is allowed after May since that is when the proportion of PCFG whales to migrating whales is highest (PCFG whales are defined as those photographed in multiple years from 1 June to 30 November within the PCFG area).

After discussions at the intersessional Workshop (SC/65a/Rep02), results were received for six new variants to cover the full range of possible strikes occurring in May or prior to May, i.e. variants allowing x strikes prior to May where x = 1,…,6 (SC/65a/AWMP06). In summary, the performance of all the new variants was no worse than for Variant 1 and no better than for Variant 2.

In conclusion, the Committee **agrees** that the conservation performance of the proposed Makah whaling management plan has now been fully examined within the *SLA* evaluation framework. It **confirms** that the proposed management plan meets the conservation objectives of the Commission provided that if struck and lost animals are not proposed to be counted toward the APL, then a photo-identification research programme to monitor the relative probability of harvesting PCFG whales in the Makah U&A is undertaken each year and the results presented to the Scientific Committee for evaluation. In other words, only Variant 2 above meets the Commission's conservation objectives without the research requirement.

The Committee noted that the intersessional Workshop (SC/65a/Rep02) had recommended that the photo-id catalogue for the eastern North Pacific gray whales that will be used to assess whether landed whales are from the PCFG be made publicly available as it is a key component of the management approach. Weller reported that NOAA still has funds available to digitise the catalogue of PCFG whales. Scordino noted that work is underway to compile photographs from a few key contributors for a photo catalogue of PCFG whales to be held at NOAA's National Marine Mammal Laboratory; this catalogue, at least initially, will not be publicly available.

SC/65a/AWMP03 presented an update on the availability of PCFG whales in the Makah U&A based on photo-identification surveys. The results: (1) supported the proposed prohibition of hunting in the Strait of Juan de Fuca; and (2) confirmed that the availability of PCFG gray whales in Pacific Ocean waters of the Makah U&A was not appreciably different to the 30% availability used in the 2012 *Implementation Review*. An updated paper next year will also include an examination of possible trends.

8.1.2 Potential for western gray whales to be taken during aboriginal hunts

Given ongoing concern about the status of the gray whales that summer in the Western North Pacific (WNP), in 2011 the Scientific Committee emphasised the need to estimate the probability of a western gray whale being killed during aboriginal gray whale hunts (IWC, 2012a). The Committee noted that the work described in SC/65a/AWMP3 above can assist in this. This year, Moore and Weller (2013) updated the analysis of mortality risk to WNP whales from the proposed Makah hunt by incorporating Committee feedback last year (IWC, 2013c, p.20). Based on their preferred model, depending on assumptions, the probability of striking at least one WNP gray whale during a five-year period ranges from 0.036 to 0.170. The authors concluded that this represents a conservative initial step in assessing the potential risk.

The Committee welcomed this paper, recognising that it represents an initial approach. As detailed under Annex F, item 2.2.2, it also received information on an ongoing telemetry study of PCFG whales and considered the report of a US scientific task force that assessed gray whale stock structure in the light of US domestic legislation.

The Committee **agrees** that all of this information will make a valuable contribution to the recommended rangewide Workshop (Annex F, Appendix 2) described under Item 26.

Finally, in regard to questions on whether it should consider conducting an *Implementation Review* to evaluate the potential impacts of the Makah hunt on whales identified in the western North Pacific, the Committee **agrees** that ideally before an *Implementation Review* is conducted, the recommended rangewide Workshop be held (see Item 26).

8.2 Guidelines for *SLA* development and evaluation

Considerable effort was put into general consideration of the development of *SLA*s at the beginning of the AWMP process (IWC, 2000b; 2001b; 2001c; 2002b). This year, the Committee briefly outlined some guiding principles for *SLA*s to assist developers of candidate *SLA*s for the Greenland hunts. These are summarised below.

(1) The primary objective of any *SLA* is to meet the objectives set by the Commission with respect to need satisfaction and conservation performance, with priority given to the latter.
(2) *SLA*s must incorporate a feedback mechanism.
(3) Once need has been met for the 'high' need envelope while giving acceptable conservation performance, then there is no need to try to improve the performance of an SLA further.
(4) Simple *SLA*s are to be preferred, providing this simplicity does not compromise achieving the Commission's objectives.
(5) With respect to (4), empirical procedures may prove preferable to population model based procedures because: (a) they are more easily understood by stakeholders; and (b) there is little chance for significant updating of population model parameters (e.g. MSYR) over time as the extent of additional data will probably be limited for populations subject to aboriginal whaling only. Nevertheless, the choice of the form for any candidate *SLA* lies entirely in the hands of its developer, with selection amongst candidates to be based on performance in trials.
(6) If in developing *SLA*s, a situation arises where relatively simple *SLA*s fail on one or a few trials where the circumstances which might lead to the failure occur only many years in the future, rather than attempt to develop more complex *SLA*s to overcome this problem, a simpler *SLA* could be proposed despite this failure, and the difficulties dealt with by means of an *Implementation Review* should there be indications in the future that the circumstances concerned are arising. This principle applies only to:
    (a) circumstances in a scenario that are external and independent of the hunting/quota feedback loop, such as very high values of the future need envelope; and
    (b) are judged to be very unlikely to occur in the next few decades.

    Failure of an *SLA* to perform acceptably in some circumstances is not in itself a reason to apply this principle.

The Committee also reviewed and discussed the performance statistics, tables and plots that are required to evaluate conditioning and trial results. This discussion can be found under item 3.2.3 of Annex E. The Committee **endorses** this approach.

8.3 Progress on *SLA* development for the Greenlandic hunts

In Greenland, a multispecies hunt occurs and the expressed need for Greenland is for 670 tonnes of edible products from large whales for West Greenland; this involves catches of common minke, fin, humpback and bowhead whales. The flexibility among species is important to the hunters and satisfying subsistence need to the extent possible is an important component of management. For a number of reasons, primarily related to stock structure issues, development of *SLA*s for some Greenland aboriginal hunts (especially for common minke and fin whales) is more complex than previous *Implementations* for stocks subject to aboriginal subsistence whaling. The Committee has endorsed an interim safe approach to setting catch limits for the Greenland hunts in 2008 (IWC, 2009b), noting that this should be considered valid for two blocks, i.e. the target will be for agreed and validated *SLA*s, at least by species, for the 2018 Annual Meeting.

8.3.1 Common minke whales and fin whales off West Greenland

The Committee's discussions were informed by the work of the intersessional Workshop (SC/65a/Rep02) as well as those in Annex E. There is potential overlap between RMP and AWMP management with respect to common minke whales and fin whales in the North Atlantic. The process of developing *SLAs* and RMP *Implementations* for stocks in regions where both commercial and aboriginal catches occur should include the following steps: (a) development of a common trials structure which adequately captures uncertainties (regarding stock structure, mixing, MSYR, etc.); (b) identification of an *SLA* which performs as adequately as possible if there are no commercial catches; and (c) evaluation of the performance of RMP variants given the *SLA* selected at step (b).

With respect to common minke whales, the Workshop **reiterates its support** for a joint AWMP/RMP stock structure Workshop which will be essential to the *SLA* development process and the simulation framework (see Annex D, Appendix 2).

With respect to fin whales, in addition to working closely with intersessional work being undertaken within an RMP context (see Annex D), the Committee also noted that it may be possible to base the *SLA* for fin whales off West Greenland on operating models which considered West Greenland only. This will be investigated further (including at the intersessional RMP Workshop on fin whales) as it requires careful evaluation as to whether there may be more than one stock mixing off West Greenland.

In order to progress development work, the Committee last year funded a new computer program called RMP/AWMP-lite. It uses an age-aggregated rather than an age-structured model to considerably speed up calculations; this will allow developers to explore more easily the properties of candidate *SLA*s before they are submitted to rigorous full testing. It allows for multiple stocks of whales being exploited by a combination of commercial and aboriginal whaling operations. This was first reviewed at the intersessional Workshop (SC/65a/Rep02) and SC/65a/RMP05 implements the improvements suggested there.

The current approach to evaluating *SLA*s for the Greenlandic hunts treats each species independently even though need is expressed as a total amount of edible products over multiple species. The Committee **reiterates** that work on single-species *SLA*s should be completed before multi-species considerations are examined.

8.3.2 Humpback whales

The Committee's discussions were informed by the work of the intersessional Workshop (SC/65a/Rep02) as well as those in Annex E. Development of an *SLA* for humpback whales had been identified as one of the priorities for the Workshop and considerable progress was made.

8.3.2.1 STOCK STRUCTURE AND MOVEMENTS

The Committee has already agreed that the West Greenland feeding aggregation was the appropriate management unit to consider when formulating management advice. Whales from this aggregation mix with individuals from other similar feeding aggregations on the breeding grounds in the West Indies (IWC, 2008a, p.21).

In order to investigate whether West Greenland humpback whales are subject to mortality in other parts of the range then it is important to examine the available information from telemetry and photo-identification data. Considerable telemetry work has been undertaken off West Greenland (Heide-Jørgensen, 2012) and similarly there has been extensive photo-identification work. This has been used to inform how ship strike and bycatch data will be incorporated into the trials. This work is ongoing and Greenlandic scientists will work with the College of the Atlantic to present a review of the photo-identification data in time for an intersessional Workshop (see Item 26).

8.3.2.2 ABUNDANCE

The Committee has relative abundance data available from aerial surveys (see SC/65a/Rep02 and Annex E). It **agrees** to use the estimates of relative abundance from aerial surveys to condition the trials. The mark-recapture studies cover a shorter period and are heavily correlated so they will only be used in a *Robustness Trial*. However, given that mark-recapture abundance estimates may become common in the future for both humpback and bowhead whales, the Committee **agrees** that efforts should be made to develop ways to better integrate them into the operating models for the *SLA* trials.

With respect to absolute abundance, SC/65a/AWMP01 used information from 31 satellite-linked time-depth recorders to address the question of availability bias for the 2007 aerial survey. Fully corrected abundance estimates of 4,090 (CV=0.50) for mark-recapture distance sampling analysis and 2,704 (CV=0.34) for a strip census abundance estimate were developed. The estimated annual rate of increase is 9.4% per year (SE 0.01), unchanged from Heide-Jørgensen *et al.* (2012).

The Committee noted that the methods behind the new estimates had been discussed fully at previous meetings when considering the 2007 survey. The revised estimate was based on updated and improved information on the diving behaviour of whales from additional satellite tag data. It therefore **accepts** the new strip census abundance estimate as the best estimate. This information is also included in the trial specifications (see Annex E, Appendix 2).

8.3.2.3 REMOVALS

The Committee **agrees** that given past difficulties in modelling the full western North Atlantic (including allocation of past catches) and the decision to treat the feeding aggregation as the appropriate management unit, trials will begin in 1960 under an assumption that the age-structure in that year is steady. The direct catch series for this period is known. However, given possible migration routes (e.g. from telemetry data), it was noted that known direct catches occurred from whaling stations off the east coast of Canada after 1960 that may have included some 'West Greenland' animals. An approach to account for this has been developed. The Committee **agrees** that this will be incorporated into the catch series in the revised trial specifications, but that no future direct catches off Canada will be simulated.

In addition to direct catches, the question of bycatch in both West Greenland and of West Greenland animals elsewhere in their range needs investigation. For West Greenland, noting that the crab fishery which was primarily responsible for bycatch has now peaked, a conservative (from a conservation perspective) method for generating future bycatch has been developed. A similar method for accounting for bycatch outside West Greenland has been developed for bycatch and ship strikes. The Secretariat will work with Canadian scientists and others to investigate the available information on bycatch and ship strikes and develop a final removals table for consideration.

8.3.2.4 BIOLOGICAL PARAMETERS

Prior distributions need to be specified for three biological parameters: (a) non-calf survival rate; (b) age-at-maturity; and (c) maximum pregnancy rate. The values for these parameters used in the actual trials will encompass a narrower range than these priors because the priors will be updated by the data on abundance and trends in abundance during the conditioning process. Considerable discussion of this took place at the intersessional Workshop based on the range of estimates in the literature. The Committee **endorses** the priors shown in Annex E, Appendix 2. Recognising the considerable uncertainty, *Robustness Trials* have been developed to investigate the sensitivity to these priors.

8.3.2.5 NEED

Need envelopes are an important component of developing a trial structure and are the responsibility of the relevant Governments. They are used to allow for advice to be provided in the future on any increased need requests without having to conduct major *Implementation Reviews* or new *SLA* development. The need 'envelope' usually includes maintenance of the current limit, is bounded by a 'high need' case and then includes a middle option. A need envelope for humpback whales was submitted to the intersessional Workshop by Greenland (SC/D12/AWMP4) and these reflected the Greenlandic preference for humpback whales over fin whales and Greenland's desire for flexibility and a 'backup' to account for any unforeseen decline in the common minke whale strike limits. The need envelope is summarised in Annex E.

8.3.2.6 *SLA*S TO BE CONSIDERED

All trials will be conducted for a bounding case and for two 'reference *SLA*s', in addition to any other *SLA*s which might be proposed by developers:

(1) the *Strike Limit* is set to the need;
(2) the *Strike Limit* is based on the interim *SLA* (IWC, 2009b); and
(3) the *Strike Limit* is based on a variant of the interim *SLA* which makes use of all of the estimates of abundance, but downweights them based on how recent they are.

Guiding principles for *SLA*s are discussed under Item 8.2 above.

Developers are provided with the following information: total need for the next block; catches by sex; mortalities due to bycatch in fisheries and ship strikes; and estimates of absolute abundance and their associated CVs.

8.3.2.7 TRIAL STRUCTURE

After considering the report of the intersessional Workshop and the new information available at this meeting, the Committee agrees to the detailed trial specifications given in Annex E, Appendix 2. Some further discussion and parameterisation of one of the trials (that on asymmetric environmental stochasticity) is required and an intersessional steering group has been established to oversee this (Annex R).

The factors considered in the trials are summarised in Table 2 while the trials themselves are given in Annex E, Appendix 2, tables 5 and 6. The Committee **endorses** the trial specifications.

As noted under Item 8.2, the Committee also **endorses** the performance statistics, tables and plots proposed.

Table 2

Factors tested in the trials.

Factors	Levels (reference levels shown underlined)	
	Humpback whales	Bowhead whales
MSYR$_{1+}$	1%, 3%, 5%, 7%	1%, 2.5%, 4%
MSYL$_{1+}$	0.6	0.6, 0.8
Time dependence in *K**	Constant, Halve linearly over 100 years	
Time dependence in natural mortality, *M**	Constant, Double linearly over 100 years	
Episodic events*	None, 3 events occur between years 1-75 (with at least 2 in years 1-50) in which 20% of the animals die, events occur every 5 years in which 5% of the animals die	
Need envelope	A: 10, 15, 20; 20 thereafter B: 10, 15, 20; 20->40 over years 18-100 C: 10, 15, 20; 20->60 over years 18-100 D: 20, 25, 30; 30->50 over years 18-100	A: 2, 3, 5; 5 thereafter B: 2, 3, 5; 5 -> 10 over years 18-100 C: 2, 3, 5; 5 -> 15 over years 18-100
Future Canadian catches	N/A	A: 5 constant over 100 years B: 5-> 10 over 100 years C: 5-> 15 over 100 years D: 2.5 constant over 100 years?
Survey frequency	5 years, 10 years, 15 years	
Historic survey bias	0.8, 1.0, 1.2	0.5, 1.0
First year of projection, τ	1960	1940
Alternative priors	S_{1+} ~ U[0.9, 0.99]; f_{max} ~ U[0.4, 0.6]; a_m ~ U[5, 12]	N/A
Strategic surveys	Extra survey if a survey estimate is half of the previous survey estimate	
Asymmetric environmental stochasticity parameters	To be finalised by an intersessional group	

*Effects of these factors begin in year 2013 (i.e. at start of management). The adult survival rate is adjusted so that in catches were zero, then average population sizes in 250-500 years equals the carrying capacity. Note: for some biological parameters and levels of episodic events, it may not be possible to find an adult survival rate which satisfies this requirement.

8.3.3 Bowhead whales

8.3.3.1 STOCK STRUCTURE

The current working hypothesis in the Scientific Committee is a single Baffin Bay-Davis Strait stock of bowhead whales (see Annex E, fig. 2). However, pending the availability of some genetic analyses, the Scientific Committee had agreed that the possibility that there are in fact two different stocks present in the overall area, with the second located in the Foxe Basin-Hudson Strait region, cannot be ruled out (e.g. see IWC, 2009b).

Given that the objective is to develop an *SLA* for the Greenland hunt of bowhead whales, the Committee **agrees** to proceed first on a conservative basis that assumes that the absolute abundance of bowhead whales on the West Greenland wintering area is informed by abundance estimates from data for that region only (see below). Only if such an *SLA* proved unable to meet need would abundance estimate information and stock structure considerations from the wider area be taken into account.

8.3.3.2 ABUNDANCE

The absolute abundance estimates can be found in Annex E, table 3. It is not possible to combine the Foxe Basin-Hudson Bay 2003 survey with the 2002 Prince Regent Inlet survey to obtain an estimate for the entire Davis Strait-Baffin Bay-Foxe Basin area. The Committee therefore **agrees** to condition the operating model using data for Davis Strait-Baffin Bay stock only.

It is not known whether the 2002 survey in Prince Regent Inlet will be regularly conducted, although a new survey is anticipated, whereas it is known that regular surveys will be conducted off West Greenland. The Committee therefore **agrees** to conduct trials: (a) in which the estimate for Prince Regent Inlet is treated as an estimate of absolute abundance; and (b) in which the estimates from West Greenland are treated as estimates of absolute abundance.

With respect to relative estimates of abundance, the Committee **agrees** that they should be considered in a similar manner to those for humpback whales. Details can be found in Annex E, item 3.3.1.2. These estimates are also included in the trial specifications (see Annex E, Appendix 2).

While the sex ratio of animals in West Greenland is ~80:20 in favour of females (Heide-Jørgensen *et al.*, 2010), it is expected that the sex ratio for the total population is 50:50 (based on historic catches over the whole region and present Canadian catches). The trials will assume that the proportion of males available to the surveys will be the observed average male/female ratio in the biopsy samples.

The Workshop **agrees** that the information provided to the *SLA* will be the results of surveys off West Greenland (relative indices if the operating model is conditioned to the estimate of abundance for Prince Regent Inlet and absolute if the operating model is conditioned to the estimate of abundance for West Greenland).

8.3.3.3 REMOVALS

For reasons similar to those agreed for humpback whales above, the Committee **agrees** that population projections should begin from a recent year (1940). This is earlier than for humpback whales because of the extended age-structure of the population. All post-1940 direct catches of bowhead whales by Canada and Denmark (Greenland) are at present assumed known and thus that there may be no need to consider an alternative catch series. The Secretariat will consult with Reeves on post-1940 Canadian catches.

The Secretariat is consulting with Canada with respect to the agreed allowance for the hunters, to determine whether it applies to landed whales only or includes strikes.

The Workshop agreed that four scenarios regarding future Canadian catches should be considered as detailed in Annex E, item 3.3.1.3 and included in the trial specifications. The sex-ratio for the West Greenland catches will be set to the sex ratio observed in the biopsy samples taken off West Greenland over the 2002-11 period while that for the Canadian catches will be set to the observed sex-ratio which is being confirmed by the Secretariat.

Known bycatch of bowhead whales in this stock's range and further information on bycatch or ship strikes that can be found by the Secretariat in consultation with Canadian scientists will be included in the revised trials specification. The Committee noted that if the number of ship strikes increases as the Northwest Passage opens up, this could trigger an *Implementation Review*.

8.3.3.4 BIOLOGICAL PARAMETERS

In the absence of information for this region, the Workshop agreed to use the priors for f_{max}, S_{1+}, and a_m used for the *Implementation* for the Bering-Chukchi-Beaufort Seas bowhead whales, noting that these incorporate considerable uncertainty for all three parameters.

8.3.3.5 NEED

SC/D12/AWMP4 presented by Greenland had proposed three scenarios, each of which involves an increase to the need from 2 to 5 at the start of the projection period followed by either: (1) no increase of need; (2) a doubling; and (3) a tripling of need in a linear fashion over the total time period. This is shown in Annex E.

8.3.3.6 TRIALS

After considering the report of the intersessional Workshop and the new information available at this meeting, the Committee **agrees** to the detailed trial specifications given in Annex E, Appendix 2. As for the humpback whale case, some further discussion and parameterisation of one of the trials (that on asymmetric environmental stochasticity) is required and an intersessional steering group has been established to oversee this (see Annex R). The factors considered in the trials are summarised in Table 2 while the trials themselves are given in Annex E, Appendix 2, tables 5 and 6. The Committee **endorses** the trial specifications.

As noted under Item 8.2, the Committee also **endorses** the performance statistics, tables and plots proposed.

A number of the preliminary results considered under Item 8.3.4 illustrated that it would be difficult to meet conservation objectives satisfactorily when the need level was high, especially if Canadian catches (which are taken by a non-IWC member country) increase. The SWG discussed whether it would be advisable to reconsider how strike quotas and incidental removals (i.e. by Canadian hunters) are accounted for in the *SLA* computations. However, the Committee **agrees** to continue with the current framework but also **agrees** that this topic should be further considered at the next intersessional Workshop.

8.3.4 Results of initial work on SLA*s*

The Committee welcomed papers SC/65a/AWMP02, SC/65a/AWMP04 and SC/65a/AWMP05 that produced initial exploratory results by two sets of developers based on the draft trial specifications developed at the intersessional Workshop. It was noted that at this stage, each set of developers had developed their own approaches to choose amongst the *SLA* candidates which they had tested. The Committee noted that this was an acceptable approach for developers to take when investigating the performance of their initial *SLA*s before deciding to put 'official' candidates forward, but re-iterated that final choices would need to be based on the full set of performance statistics agreed for the trials.

8.4 Scientific aspects of an Aboriginal Whaling Scheme

In 2002, the Committee **strongly recommended** that the Commission adopt the Aboriginal Subsistence Whaling Scheme (IWC, 2003). This covers a number of practical issues such as survey intervals, carryover, and guidelines for surveys. The Committee has stated in the past that the AWS provisions constitute an important and necessary component of safe management under AWMP *SLA*s and it **reaffirms** this view as it has for the previous 11 years.

8.5 Greenland conversion factors

In 2009, the Commission appointed a small scientific working group (comprising several Committee members) to visit Greenland and compile a report on the conversion factors used by species to translate the Greenlandic need request which is provided in tonnes of edible products, to numbers of animals (Donovan *et al.*, 2010). At that time, the group provided conversion factors based upon the best available data, noting that given the low sample sizes, the values for species other than common minke whales should be considered provisional. The group also recommended that a focused attempt to collect new data on edible products taken from species other than common minke whales be undertaken, to allow a review of the interim factors; and that data on both 'curved' and 'standard' measurements are obtained during the coming season for all species taken. The group's report was **endorsed** by the Committee (IWC, 2011b, p.21).

Since then, the Committee has received progress reports but has commented that more detail and information is required. Last year, the Committee reiterated its recommendations from 2010 and 2011 (IWC, 2013c, p.22):

(1) the provision of a full scientific paper to the next Annual Meeting [i.e. IWC/65] that details *inter alia* at least a full description of the field protocols and sampling strategy (taking into account previous suggestions by the Committee), analytical methods, and a presentation of the results thus far, including information on the sex and length of each of the animals for which weight data are available; and
(2) the collection and provision of data on Recommendation No. 2 of Donovan *et al.* (2010) comparing standard versus curvilinear whale lengths, this should be done for all three species on as many whales as possible.

8.5.1 New information

SC/65a/AWMP07 reported on the collection of weights and length measures from fin, humpback and bowhead whales caught in West Greenland. To improve the data collection process, information meetings involving biologists, hunters, wildlife officers and hunting license coordinators were held in the larger towns in 2012, and an information folder was produced and distributed to the hunters. The data collection process was also combined with an existing research project on hunting samples in order to get a stronger involvement of biologists. When researchers participate in hunts they train the hunters in measuring the lengths (curved and standard) and they make sure that the meat is weighed.

Until now the reporting rate has been lower than expected, with the data obtained in 2012 being from only one fin whale and one humpback whale, and the total number of reports since 2009 being from six bowhead whales, six humpback whales and three fin whales. These data provide preliminary yield estimates for all edible products of 9,014kg (SE: 846) per humpback whale, of 6,967kg (SE: 2.468) per fin whale, and of 8,443kg (SE: 406) per bowhead whale. These numbers are all somewhat lower than the suggested yield in Donovan *et al.* (2010), and this is especially pronounced for fin whales. Nevertheless, the obtained estimates for fin whales fall within the range of previous yield weight estimates for fin whales in West Greenland.

A major reason for the low reporting rate has been the almost complete absence of weighing equipment where the whalers could weigh the different products. To increase the reporting rate, the Greenland Institute of Natural Resources has now purchased and distributed weighing equipment that can be fitted to cranes in major towns for the hunters to use for weighing when landing a catch. It was also realised that the 'bin system' described in previous reports (e.g. IWC/64/ASW10) is more complicated than first anticipated because there is a large variation in the size of the bins used within the same hunt and between hunters. It is therefore now recommended that hunters weigh all edible products with the crane weight when they land the meat. This approach will be investigated further in 2013 and discussed with the hunters. Owing to the logistical difficulties involved with whale hunts in Greenland (which are widespread along the huge coastline and occur at unpredictable times during a long season) and the required change in the reporting system and subsequent need for training, it is likely that it will take several years to collect sufficient data on edible products.

8.5.2 Discussion

In response to questions, a number of clarifications were made. The original intention of weighing ten boxes had been so that an average weight per box could be developed to be multiplied by the total number of boxes to obtain an estimated total weight. However, with the efficient crane weights that are now in place in three cities, and with the finding that hunters may use different sized boxes even for the same whale, it has now been decided to weigh all boxes.

There were only five cases when scientists were able to be present at a humpback catch, and this low number illustrates the logistical difficulties in having scientists present at hunts. Witting did not have the precise details of this work or of the number of wildlife officers who may be able to assist in the work but will consult in Greenland. Efficient reporting requires not only training of hunters, but also the distribution of weighing equipment, so that hunters can report on their own.

In conclusion, the Committee **agrees** that the report was an advance on those previously received (and provided the first information on curvilinear lengths). However, it also **agrees** that it still did not provide sufficient information to fulfil the recommendations of last year. While aware of the logistical difficulties involved in obtaining these data, it **repeats its recommendations** of last year given in the second paragraph of this section. It **encourages** Witting to assist in the writing of such a report to ensure that it better meets the request of the SWG next year.

9. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT ADVICE

9.1 Eastern Canada and West Greenland bowhead whales

9.1.1 New information

No new information was presented.

9.1.2 New catch information
No bowhead whales were taken off West Greenland in 2012. Official catch data have not yet been received from the Canadian Government for 2012. The Secretariat reported that it is in contact with the Canadian authorities who have acknowledged the request but not yet sent the catch data. The Committee also **encourages** the Government of Canada to continue research on Eastern Canadian bowheads.

9.1.3 Management advice
Using the interim safe approach (IWC, 2009b, p.16) as endorsed by the Commission, the Committee **agrees** that the current annual limit of two strikes for Greenland will not harm the stock. It was also aware that catches from the same stock have been taken by a non-member nation, Canada. Should Canadian catches continue at a similar level as in recent years, this would not change the Committee's advice with respect to the strike limits agreed for West Greenland.

9.2 Eastern North Pacific gray whales
9.2.1 New information
SC/65a/BRG02 presented new estimates of abundance for eastern North Pacific gray whales. Shore-based counts of southbound migrating whales off California have formed the basis of abundance estimation since 1967. A new observation approach has been used and evaluated in four recently monitored migrations (2006/07, 2007/08, 2009/10 and 2010/11). The summed estimates of migration abundance ranged from 17,820 (95% Highest Posterior Density Intervals [HPDI]=16,150-19,920) in 2007/08 to 21,210 (95% HPDI=19,420-23,230) in 2009/10, consistent with previous estimates and indicative of a stable population size.

The Committee welcomes and **accepts** the new population estimates.

SC/65a/BRG05 reported on photographic identification research in Laguna San Ignacio, Laguna Ojo de Liebre and Bahia Magdalena, Mexico, during the 2012 and 2013 winters. These results demonstrate a greater amount of movement between different breeding and calving lagoons for female-calf pairs than for single adult whales.

SC/65a/BRG05 summarised the results of a standard boat census of gray whales in Laguna San Ignacio and Laguna Ojo de Liebre during the winters from 2007 to 2013. In Laguna San Ignacio, counts of female-calf pairs increased during January and February to their highest numbers in March and April. During the 2011 to 2013 winters the average number of pairs was 108 and numbers remained high in the lagoon in April; by contrast, this number was only 40 pairs during the 2007 to 2010 winters and there were no pairs in April. In Laguna Ojo de Liebre in 2013 numbers of adults increased from January to February and declined to mid-April. Single animals only use the lagoon for 3-5 days. Females with calves use lagoons for up to 18 days. In one season with the highest counts, there was an estimated total of approximately 2,500 whales that used Laguna San Ignacio.

The Committee thanked Urbán and his colleagues for the interesting results from the studies in the breeding lagoons and **encourages** the continuation of those studies that will contribute greatly to the proposed intersessional rangewide gray whale Workshop (see Items 23 and 26).

SC/65a/BRG21 presented information on the body condition of gray whales in northwestern Washington, USA, from 2004-10 to examine whether this can provide insights into the variability of gray whale fidelity to the region. Of particular interest was a comparison with similar studies for the animals feeding off Sakhalin Island (Bradford *et al.*, 2012) that suggested that body condition in northwestern Washington is generally not as good as at Sakhalin. The reasons for this are not clear.

SC/65a/BRG12 presented information on harvested gray whales in 2012. In June and September 2012, scientists examined 23 gray whales caught near Mechigmensky Bay. Females averaged about 10m in length. Animals between 7.7m and 9.5m were sub-adults. Yearlings had the highest body condition index (blubber thickness/body length) and immature animals had the lowest; some 67% of the examined animals had full or half-full stomachs. There were no 'stinky' gray whales in Mechigmensky Bay. An immature, 7.7m female had traces of milk in an almost empty stomach. The hunters did not see a large whale escorting this small one and believed it was feeding independently. In discussion it was noted that milk might remain in the stomach for several hours or a little more.

SC/65a/BRG13 reported on the stomach contents of 82 gray whales taken in Mechigmensky Bay (63 from Lorino) from 2007-09; amphipods and polychaetes predominated by biomass and frequency of occurrence. Information was also presented on coastal counts.

The Committee thanked the authors for this interesting and important work examining harvested gray whales. It encouraged the work on photo-identification of harvested whales which is now beginning.

9.2.2 Catch information
SC/65a/BRG24 and SC/65a/BRG25 presented catch data for gray and bowhead whales in Russia. The quota is expressed in terms of landed animals not strikes and the 2007-12 block quota was for 620 gray whales (maximum 140 in any one year). A total of 143 gray whales were struck in 2012 of which 139 were landed (50 males and 89 females); eight were inedible ('stinky' whales). Body length and weight data were presented. In general some 10% of the whales are stinky. While stinky whales can sometimes be detected at sea and avoided, sometimes the whale has to be butchered before it is found to be stinky. For the period 2008-12, 638 gray whales were struck, 11 were lost and 627 whales were landed of which 24 were inedible, i.e. 603 edible whales were landed. Ilyashenko stated that stinky whales were not counted against the quota by the Russian authorities, since they do not meet the food needs of the indigenous people.

The Committee noted that the total number of gray whales struck during the 2008-12 period was 638 animals of which 24 of the 627 whales landed were inedible ('stinky') whales. The Commission expressed its limits for the 2008-12 period in terms of whales taken (620). While matters related to struck, landed and 'stinky' whales are matters for the Commission, the Committee noted that from an *SLA* perspective, all struck whales are considered removals.

9.2.3 Management advice
As was the case last year, the Committee **agrees** that the *Gray Whale SLA* remains the appropriate tool to provide management advice for eastern North Pacific gray whales taken off Chukotka; the question of the Makah hunt and whales from the Pacific Coast Feeding Group (PCFG) is considered under Item 8.1. The Commission adopted catch limits for a six-year block in 2012, i.e. 2013-18. The total number of gray whales taken shall not exceed 744 with a maximum in any one year of 140. The Committee **agrees** that these limits will not harm the stock.

9.3 Bering-Chukchi-Beaufort (B-C-B) Seas bowhead whales

9.3.1 New information

Three papers (SC/65/BRG01, SC/65a/BRG09 and SC/65a/BRG11) presented the improvements in field methods, the details of the acoustic and visual field observations and the new estimation method that underlie a new abundance estimate of this bowhead stock for 2011. The 2011 survey was among the most successful. The details are discussed fully in Annex F, item 2.1 and only a short summary is provided here.

SC/65a/BRG11 presented an overview of the spring 2011 bowhead whale abundance survey conducted near Point Barrow, Alaska. The 2011 survey was unique in that it included multiple simultaneous data collection efforts, these included: ice-based visual observations, an independent observer (IO) survey (to estimate detection probabilities), acoustic surveillance and an aerial photo identification survey. A total of 3,379 new whales was seen from the primary perch. This is close to the record (3,383 in 1993); however in that year it was estimated that 93% of the whales passed within view of the perch in contrast to 58% in 2011. Information was also provided on extensive photo-identification effort (aerial) and acoustic work.

SC/65a/BRG09 reported much higher levels of bowhead acoustic activity in comparison to recording efforts in past seasons that included high rates of singing and call sequences. The mean rate of acoustically located events in 2011 (calls/hr) was some 5.7 times higher than in 1993. Viewing conditions were similar to past surveys including substantial periods of watch missed due to poor visibility and closed leads. Telemetry and acoustic data suggest several hundred whales passed without the possibility of being seen.

SC/65a/BRG01 presented a new estimate of the total abundance for this population. The estimate is based on two large datasets: visual sightings and acoustic locations from spring 2011. A Horvitz-Thompson type estimator was used, based on the numbers of whales counted at ice-based visual observation stations. It divided sightings counts by three correction factors: (1) for detectability (and see Givens *et al.*, 2012, discussed by the Committee last year); (2) for whale availability using the acoustic location data (SC/65a/BRG09); and (3) for missed visual watch effort. The mean correction factors are estimated to be 0.501 (detection), 0.619 (availability) and 0.520 (effort). The resulting 2011 abundance estimate is 16,892 (95% CI; 15,704, 18,928). The annual increase rate is estimated to be 3.7% (95% CI; 2.8%, 4.7%). These abundance and trend estimates are consistent with previous findings.

The Committee thanked the authors, recognising the substantial field and analytical work that underlies the new abundance estimate. Discussion of the analytical approach can be found in Annex G, item 2.1. In conclusion, the Committee **accepts** this estimate and **endorses** it for use with the *Bowhead Whale SLA*. It further notes that under the guidelines outlined in the proposed Aboriginal Whaling Management Scheme (see Item 8.4), which has not been agreed by the Commission, a new survey would be required by 2021.

In discussion, it was noted that ice-based surveys depend very much on the availability of suitable ice conditions. The ice conditions may change within and between years and may become more difficult in the light of the climate changes observed in the Arctic. Aerial photographic surveys, which also were conducted during 2011, can form the basis of an independent mark recapture estimate of abundance (Koski *et al.*, 2010) although their precision is less than ice-based surveys.

SC/65a/BRG22 presented a study of DNA sequence variation for X- and Y-chromosome linked genes (USP9X and USP9Y) in bowhead whales using two methods to discover variable sites. The authors noted that with the PCR and sequencing primers reported, the X and Y chromosomes could be used to assess population variation in bowheads and other great whales to provide new perspectives on genetic issues such as stock structure, male reproductive success, gene flow and evolution. In discussion it was noted that bowhead whales have a relatively low level of variation in the Y chromosome due to skewness in male reproductive success. Population studies are underway.

9.3.2 New catch information

SC/65a/BRG19 provided harvest data for the Alaska hunt. In 2012, 69 bowhead whales were struck resulting in 55 animals landed. Total landed in 2012 was higher than the past 10 years (2002-11: mean of landed=38.9; SD=7.1) but similar for efficiency (no. landed/no. struck; mean of efficiency=77%; SD=0.07). Of the landed whales, 29 were females, 24 were males, and sex was not determined for two animals. Based on total length, six of the 29 females were presumed mature (>13.4m in length). All five of the mature females that were examined were pregnant.

SC/65a/BRG25 reported the results of the Russian aboriginal whaling in the Chukota region for the period of 2008-12: four bowhead whales were struck and landed out of a possible quota of 25 animals for that period. No bowhead whales were reported as struck and lost.

9.3.3 Management advice

The Committee **endorses** the abundance estimate of 16,892 (95% CI: 15,704-18,928) for spring 2011. It was noted that the next survey should be completed by 2021 based on the provisional guidelines in the Aboriginal Whaling Scheme (see Item 8.4).

The Committee **agrees** that the *Bowhead Whale SLA* continues to be the most appropriate way for the Committee to provide management advice for this population of bowhead whales. The Commission adopted catch limits for a six-year block in 2012, i.e. 2013-18. The total number of strikes shall not exceed 336 with a maximum of 67 in any one year (with a carryover provision). The Committee **agrees** that these limits will not harm the stock.

9.4 Common minke whale stocks off Greenland

The Committee noted that the Commission had not reached agreement on strike limits for Greenland at the 2012 Annual Meeting (see IWC, 2013a). It based its management advice on the same limits considered last year. In providing this advice it noted that the Commission has endorsed the interim safe approach (based on the lower 5th percentile for the most recent estimate of abundance) for providing advice for the Greenland hunts developed by the Committee in 2008 (IWC, 2009b, p.16); it was agreed that that this should be considered valid for two blocks, i.e. up to the 2018 Annual Meeting. This applies to all of the Greenland hunts below (i.e. Items 9.4-9.6).

9.4.1 West Greenland

NEW INFORMATION

In the 2012 season, 144 minke whales were landed in West Greenland and 4 were struck and lost. Of the landed whales, there were 109 females, 33 males and 2 of unknown sex. Genetic samples were obtained from 112 of these whales. Last year, the Committee re-emphasised the importance of collecting genetic samples from these whales, particularly in the light of the proposed joint AWMP/RMP Workshop (see

Table 3

Most recent estimates of abundance for the Central stock of common minke whales.

Small Area(s)	Year(s)	Abundance and CV
CM	2005	26,739 (CV=0.39)
CIC	2007	10,680 (CV=0.29)
CG	2007	1,048 (CV=0.60)
CIP	2007	1,350 (CV=0.38)

Annex D). The Committee **welcomes** the fact that nearly 80% of the catch had been sampled in 2012 and **encourages** continued sample collection.

This year, the Committee adopted a revised estimate of abundance for the 2007 survey. The revised published estimate (16,100, CV=0.43) was slightly lower than that first agreed in 2009. The Committee noted that this estimate is an underestimate of the total population by an unknown amount.

MANAGEMENT ADVICE

In 2009, the Committee was for the first time able to provide management advice for this stock. This year, using the agreed interim approach and the revised estimate of abundance given above, the Committee **advises** that an annual strike limit of 164 will not harm the stock. It **draws attention** to the fact that this is 14 whales fewer than its advice of last year due to the revised 2007 abundance estimate.

9.4.2 East Greenland

NEW INFORMATION (INCLUDING CATCH DATA AND AGREED ABUNDANCE ESTIMATES)

Four common minke whales were struck (and landed) off East Greenland in 2012. Two were females and the sex of the other two was unknown. The Committee was **pleased** to note that genetic samples were obtained from all of minke whales caught in East Greenland (these could be used *inter alia* to determine the sex of the unknown animals). The Committee **again emphasises** the importance of collecting genetic samples from these whales, particularly in light of the proposed joint AWMP/RMP Workshop (see Annex D).

MANAGEMENT ADVICE

Catches of minke whales off East Greenland are believed to come from the large Central Stock of minke whales. The most recent strike limit of 12 represents a very small proportion of the Central Stock (see Table 3). The Committee **repeats** its advice of last year that a strike limit of 12 will not harm the stock.

9.5 Fin whales off West Greenland (AWMP)

9.5.1 New information

A total of four fin whales (all females) were landed, and one was struck and lost, off West Greenland during 2012. The Committee was **pleased** to note that genetic samples were obtained from three whales. It **re-emphasises** the importance of collecting genetic samples from these whales, particularly in the light of the proposed work to develop a long-term *SLA* for this stock.

9.5.2 Management advice

Based on the agreed 2007 estimate of abundance for fin whales (4,500; 95%CI 1,900-10,100), and using the agreed interim approach, the Committee **repeats** its advice that an annual strike limit of 19 whales will not harm the stock.

9.6 Humpback whales off West Greenland

9.6.1 New information

A total of seven (two males; four females; one unknown sex) humpback whales were landed (three more were struck and lost) in West Greenland during 2012. The Committee was **pleased** to learn that genetic samples were obtained from all of these whales and that Greenland was contributing fluke photographs to the North Atlantic catalogue – four have been submitted from whales taken since 2010. The Committee again **emphasises** the importance of collecting genetic samples and photographs of the flukes from these whales, particularly with respect to the MoNAH and YoNAH initiatives (Clapham, 2003; YoNAH, 2001).

This year, the Committee **accepts** the revised fully corrected abundance estimate for West Greenland from the 2007 survey of 2,704 (CV=0.34) for the strip census abundance estimate (see Item 8.3.2.2 above). The agreed annual rate of increase of 0.0917 (SE 0.0124) remains unchanged.

9.6.2 Management advice

Based on the revised agreed estimate of abundance for humpback whales given above and using the agreed interim approach, the Committee **agrees** that an annual strike limit of 10 whales will not harm the stock.

9.7 Humpback whales off St Vincent and The Grenadines

9.7.1 New information

No new information or catch data were provided in time for consideration by the Scientific Committee although information has been requested by the Secretariat. There is one sample collected from a humpback whale taken on 11 April 2012 in the SWFSC tissue archive. The Committee **welcomes** this information.

Iñíguez reported information obtained from local newspapers on hunts in St Vincent and The Grenadines: a 35ft male (8 March 2013); a 41ft female and a 35ft male (both 18 March 2013); and another whale with no length or sex information (12 April 2013).

Regarding the same stock, he referred to reports that residents of Petite Martinique, Grenada, spent hours attempting to drive a mature whale onto a beach using five inflatable boats, two large trader boats and a speedboat on 22 November 2012. The whale finally escaped but was harpooned four times. He has no further information on the fate of this whale.

9.7.2 Management advice

The Committee repeated its previous strong recommendations that St Vincent and The Grenadines:

(1) provide catch data, including the length of harvested animals, to the Scientific Committee; and
(2) that genetic samples be obtained for any harvested animals as well as fluke photographs, and that this information be submitted to appropriate catalogues and collections.

The Committee has agreed that the animals found off St Vincent and The Grenadines are part of the large West Indies breeding population (abundance estimate 11,570; 95%CI 10,290-13,390). The Commission adopted a total block catch limit of 24 for the period 2013-18 for Bequians of St Vincent and The Grenadines. The Committee **repeats** its advice that this block catch limit will not harm the stock.

The Committee **draws the Commission's attention** to the unofficial reports of attempts to land a humpback whale in Grenada; the Schedule specifies that the quota applies only to Bequians of St Vincent and The Grenadines. It requests that the Secretariat contacts the Government of Grenada to obtain official information on this incident.

10. WHALE STOCKS

10.1 Antarctic minke whales

The Committee is undertaking an in-depth assessment of the Antarctic minke whale. Details of the discussions summarised below can be found in Annex G. The primary abundance data are those collected from the 1978/79 to 2003/04 IWC-IDCR/SOWER cruises (e.g. Matsuoka *et al.*, 2003) that had been divided into three circumpolar series (CPI, CPII and CPIII). Two methods for estimating abundance from CPII and CPIII have been developed in recent years. Last year, the Committee formally agreed abundance estimates (IWC, 2013c, p.27). These were developed by basing the estimates on one method (the OK model, Okamura and Kitakado, 2012) and applying adjustment factors based on analyses from the other method (the SPLINTR model, e.g. Bravington and Hedley, 2012).

While the agreed estimates were suggestive of a decline in abundance between CPII and CPIII, the decline was not statistically significant either at a circumpolar level or at a *Management Area* level, given the inferred amount of annual variability in distribution (see Item 10.1.2). The Committee has been working for some time on explaining variability in abundance of Antarctic minke whales, both by the development of population dynamics models (Item 10.1.3) and by examining possible changes in environmental conditions during the period of the CPII and CPIII surveys (Item 10.1.2). Regarding the latter, the Committee has been investigating possible ways to estimate abundance of Antarctic minke whales within the unsurveyed pack ice region (since the IWC-IDCR/SOWER cruises were only able to survey in open water), and to discover the extent to which changes in sea ice concentration and many other environmental processes may have been affecting the open water abundance estimates.

10.1.1 Consideration of technical aspects of the agreed abundance estimates for CPII and CPIII

No further developments were presented to the Committee this year, although the items identified last year (IWC, 2013c, p.28) remain pertinent. The model refinements required will be assisted by the recent work described in SC/65a/IA15, in which a new IWC simulated data scenario is developed based on empirical data from Antarctic minke whale video dive time experiments conducted on the 2004/05 IWC SOWER cruise.

The Committee welcomed the new datasets, recognising that it was unlikely that improved methods would be available next year, but that further progress was expected by the meeting after. The results of this exercise (improved simulated datasets and estimation methods) should be of value not only to this species but also to many abundance estimation tasks faced by the Committee.

The estimates agreed last year were presented as two sets of numbers with two sets of CVs; Annex G, item 2.2.2, clarifies the reasons why the estimates were presented this way, and what the limitations are when interpreting these numbers.

In summary and also to provide clarity on what can be said at this stage in relation to trends, the Committee noted the following issues.

(1) At the scale of the circumpolar surveys, there is no statistically significant difference between the two population estimates. This of course does not mean that the number of Antarctic minke whales did not change at all. Rather, the uncertainty around the two estimates is sufficiently large that it is not possible to conclude with confidence whether the abundance increased, decreased, or remained about the same.

(2) The same is true at the scale of the six IWC Management Areas; there are no statistically significant trends detected.

(3) Nevertheless, the point estimate of change at a circumpolar level is quite large, and the same is true for some of the Management Areas. While not significant statistically, the differences are suggestive that some real changes in abundance may have occurred, particularly in areas near the large embayments of the Ross and Weddell Seas. The Committee is continuing to investigate issues of habitat utilisation and movement patterns of Antarctic minke whales which may further inform its understanding and ability to interpret these survey results (see Item 10.1.2).

10.1.2 Continue to examine reasons for the difference between abundance estimates from CPII and CPIII

10.1.2.1 AERIAL SURVEYS

The Committee has for some years been working towards explaining a putative decline in Antarctic minke whale abundance between CPII and CPIII. Aside from the statistical catch-at-age modelling work described in Item 10.1.3, a particular focus has been on investigating possible changes in the relative proportions of whales within the pack ice, since such regions were inaccessible to the IDCR/SOWER vessels. Papers describing Australian surveys using fixed-wing aircraft (Kelly *et al.*, 2011; 2012) and German surveys from a vessel-based helicopter (Williams *et al.*, 2011) have been considered by the Committee at previous meetings, and although no new work on these surveys was presented at SC/65a, further analyses are expected to be received next year.

10.1.2.2 NEW MODELLING WORK

Without further information from direct observations, the Committee is restricted to analyses based on extrapolations of sightings in open water areas to within-ice regions for investigating the relative proportions of whales that may have been within the ice regions during the CPII and CPIII period. SC/65a/IA11 presented one such approach for doing so, using models which assumed a relationship between whale abundance and ice concentration. It also examined causal relationships between Antarctic minke and humpback whale distribution; the Committee considered that this approach was more promising for open water areas than within pack ice regions where humpback whales do not enter.

10.1.2.3 NEW INFORMATION

SC/65a/IA12 described a study of Antarctic minke whales in their sea ice habitat during the austral summer of 2012-13, in two regions of the Antarctic: the Ross Sea and the western Antarctic Peninsula. In less than a month of fieldwork (of which only a portion was dedicated to Antarctic minke whale research), the researchers deployed 16 satellite-linked data recorders and two short-term archival data recorders; they also collected biopsy samples and took a large number of photo-identification images of well-marked individuals.

In discussion of SC/65a/IA12, the Committee congratulated the authors on their achievement: this is the first time that reliable tag deployment has been achieved on this species. For investigation of differences in abundance estimates between CPII and CPIII, the Committee noted that the diving data collected from one type of tag deployed is also directly relevant to the interpretation of aerial survey estimates of abundance in different sea-ice conditions. The Committee **recommends** that this work should continue (and see Item 26).

There was considerable discussion (see Annex G, item 2.3) about *inter alia*: the particular conditions, location and group size and behaviour needed for successful tag deployment or biopsy sampling; the utility of photo-identification for abundance estimation; the feeding behaviour inferred from the telemetry result; and the relative merits and demerits of lethal and non-lethal sampling for in-depth assessment of Antarctic minke whales.

10.1.2.4 DID MINKE WHALE ABUNDANCE DIFFER BETWEEN CPII AND CPIII?

The Committee noted the apparent contradiction in retaining this item on its agenda when the difference in point estimates of abundance are not statistically significant at the usual 5% level (Item 10.1.1; see also Annex G, item 2.4). There is some evidence of differences (for example as seen consistently from the integrated statistical catch-at-age (SCAA) modelling – see Item 10.1.3 below), but the wide uncertainty around the estimates cannot exclude the possibility that overall abundance has not changed between CPII and CPIII. The Committee **agrees** to rename this item as: 'What are the factors that drive minke whale distribution and abundance?'

10.1.3 Apply statistical catch-at-age models

Population dynamics modelling provides a way to explore possible changes in abundance and demographic parameters within Areas IIIE-VW, where appropriate data are available. The inputs are catch, length, age, and sex data from the commercial harvests and both JARPA and JARPA II programmes, as well as abundance estimates from IDCR/SOWER. For over a decade, the Committee has been developing population dynamics models of Antarctic minke whales, and following early attempts using an ADAPT-VPA approach (e.g. Butterworth *et al.*, 2002), the Committee concluded that SCAA modelling was the most appropriate framework, since *inter alia,* the latter approach is able to incorporate variability in age-reading (and consequent errors in age-at-length). Following the abundance estimates agreed from IDCR/SOWER last year, this year it has been possible for the first time to study the performance of the models using a fairly complete set of agreed inputs.

SC/65a/IA04 presented an updated statistical method for quantifying age-reading error, i.e. the extent of bias and inter-reader variability among age-readers. The method was applied to data for Antarctic minke whales taken during Japanese commercial (1971/72-1986/87) and scientific (1987/88-2004/05) whaling.

The methodology and conclusions of SC/65a/IA04 were based on a careful experimental study to compare readers (see Annex G, item 2.1). To estimate the bias and variance, the method needs to assume that at least one of the readers produces age estimates which are either unbiased or have a known degree of bias, and that ageing errors between readers but on the same earplug are independent. These assumptions are unavoidable for any analysis of ageing error where no absolute ground-truth is available, and the Committee **agrees** that the approach and results of SC/65a/IA04 provide useable input data for the SCAA analysis in SC/65a/IA01.

SC/65a/IA01 reported on the most recent application of SCAA to data for Antarctic minke whales, thus incorporating the agreed IDCR/SOWER abundance estimates and the age-at-length data for recent years of JARPA II, neither of which had been available when results from these models have been presented previously to the Committee. This work has been directed by the Committee and funded through the Committee's budget. The SCAA approach allows for multiple breeding stocks, which can be allowed to mix across several spatial strata on the summer feeding grounds where catches are taken. It also allows carrying capacity and the annual deviations in juvenile survival to vary over time. Most analyses indicated that Antarctic minke whale abundance in Antarctic Areas III-E to VI-W increased from 1930 until the mid-1970s and declined thereafter, with the extent of the decline greater for minke whales in Antarctic Areas III-E to V-W than for those further eastward.

In discussion of SC/65a/IA01, the Committee noted that the modifications to the SCAA model suggested last year plus the addition of the new data had now produced largely acceptable fits (see also table 1 of Annex G). The SCAA has received extensive scrutiny and improvement over the years of its development (far more than is usual for similar fishery assessment models used in management), and appears to have stood up well. Nonetheless, some issues do remain; detailed technical suggestions to investigate these are given in Annex G, item 8. The Committee considered the interpretation of the current results in SC/65a/IA01 (plus additional runs of the model made during the meeting), bearing in mind also the numerous sensitivity analyses and alternative formulations explored in previous years. Overall, some conclusions appear to be quite robustly supported, while others are more sensitive to details of model formulation or data selection. Resolution of the issues identified will allow more confident interpretation of the results next year.

10.1.4 Work plan

The work plan for the in-depth assessment of Antarctic minke whales is described in Annex G, item 8 and will be furthered by two intersessional Working Groups – one on SCAA issues for further investigation, and one on remaining IDCR/SOWER data management. The Committee's views on the work plan for the sub-committee on In-depth Assessments is given under Item 24.

10.2 Southern Hemisphere humpback whales

The report of the IWC Scientific Committee on the assessment of Southern Hemisphere humpback whales is given in Annex H. The Committee currently recognises seven humpback whale breeding stocks (BS) in the Southern Hemisphere, labelled A to G; (IWC, 1998b), which are connected to feeding grounds in the Antarctic. An additional population that does not migrate to high latitudes is found in the Arabian Sea. Assessments of BSA (western South Atlantic), BSD (eastern Indian Ocean) and BSG (eastern South Pacific) were completed in 2006 (IWC, 2007b), although it was concluded that BSD might need to be re-assessed with BSE and BSF in light of mixing on the feeding grounds. An assessment for BSC (western Indian Ocean) was completed in 2009 (IWC, 2010d) and for BSB in 2011 (IWC, 2012c).

10.2.1 Assessment of Breeding Stocks D, E and F

In 2011, the Committee initiated the re-assessment of BSD, and the assessment of BSE and BSF. As shown in Fig. 3, these stocks correspond, respectively, to humpback whales wintering off Western Australia (BSD), Eastern Australia (sub-stock BSE1) and the western Pacific Islands in Oceania including New Caledonia (sub-stock BSE2), Tonga (sub-stock BSE3) and French Polynesia (sub-stock BSF2). For simplicity, the combination of BSE2, BSE3 and BSF2 will be referred to as Oceania.

10.2.1.1 NEW INFORMATION

SC/65a/SH13 presented the results of an updated analysis recommended last year by the Committee (IWC, 2013g p. 217). It analysed mixing proportions of humpback whale breeding stocks BSD, BSE and BSF in Antarctic Areas IIIE to VI. The analysis was based on 575 samples obtained in the Antarctic during JARPA/JARPA II and IDCR/SOWER and 1,057 samples from low latitudes of the South Pacific and eastern Indian Ocean. Analysis of approximately the first half of the mtDNA control region yielded 137 haplotypes, and mixing proportions and Fst were analysed under two stock structure hypotheses. Under the most general hypothesis of six breeding stocks, BSD predominated in Areas IIIE, IV-W and IV-E. BSE1 predominated in Area V-W, BSE2 dominated in Area V-E and BSE3 dominated in Area VI. BSF sub-stocks did not predominate in any Antarctic area, although BSF1 was partially represented in Area VI.

The Committee thanked the authors for completing the work in time for on-going assessment modelling. Technical aspects of the paper were discussed by the Working Group on Stock Definition (see Annex I) and mixing proportions for alternate Antarctic area boundaries were calculated for the assessment models (see Item 10.2.1.2).

SC/65a/SH08 described the first photo-id and biopsy sampling surveys for humpback whales and small cetaceans around nine islands in eastern French Polynesia's Tuamotu and Gambier Islands (BSF2). The Committee welcomed this information on BSF2 and **recommends** additional sampling in this remote area of the South Pacific from which few data are available.

Rankin *et al.* (2013) estimated calving intervals of humpback whales at Hervey Bay, East Australia based on a long-term photo-id catalogue of 2,973 individuals. Two methods of calculation (multi-event mark-recapture modelling and truncation) led to similar estimates of calving intervals: 2.98 years (95% CI: 2.27-3.51) and 2.78 years (95% CI: 2.23-3.68) respectively.

The technical details of this paper were not presented, but the Committee noted that these calving intervals do not strongly suggest a population undergoing a high rate of population increase (e.g., Noad *et al.*, 2011). The cause of this apparent discrepancy requires further evaluation.

10.2.1.2 REVIEW ASSESSMENT MODELS

The Committee reviewed the progress of assessment modelling of breeding stocks BSD, BSE and BSF. Last year, a three-stock model with feeding and breeding ground interchange was proposed to address two inconsistencies that arose in single-stock assessments: (1) the model-predicted population trajectory for BSD was unable to simultaneously fit the absolute abundance estimate of 28,830 whales in 2011 (Hedley *et al.*, 2011a) and the high growth rate suggested by the relative abundance series; and (2) the model-predicted minimum population size in Oceania violated the N_{min} constraint informed from haplotype data.

Intersessionally, three-stock (BSD+BSE1+Oceania) and two-stock (BSD+BSE1) models were developed that included mixing on the feeding grounds. These did not substantially improve model fit unless customary Antarctic stock boundaries were shifted eastward to allow for more Antarctic catches to be allocated to BSD and fewer to Oceania. SC/65a/SH01 presented the results of single-stock, two-stock and three-stock models that used the original Antarctic boundaries, as well as new proposed boundaries based on this finding.

During the meeting, further model runs were attempted to improve model fits to the BSD data. An examination of the BSD absolute abundance estimate (Hedley *et al.*, 2011a) identified irregularities in the underlying survey data which called into question the validity of the estimate. This could not be resolved during the meeting, but given this, and the strong influence of this estimate on the model results, single-stock BSD models were used to explore the effects of a lower, fixed abundance estimate and a model that was not fitted to absolute abundance but included an uninformative prior on this value. These models for BSD produced relatively good fits to all the relative abundance series (see Fig. 4). The Committee recognised that any abundance measurement method that could provide a lower bound to this prior (i.e. a value other than zero) would be useful in improving future model fits to BSD, and **recommends** that analyses to achieve this be attempted.

Three-stock models were also run using mixing proportions calculated with revised Antarctic area boundaries (Annex H, Appendix 2). One key result was that in order to fit the BSD relative abundance trends, the model removed more westerly Antarctic catches from BSE1, which

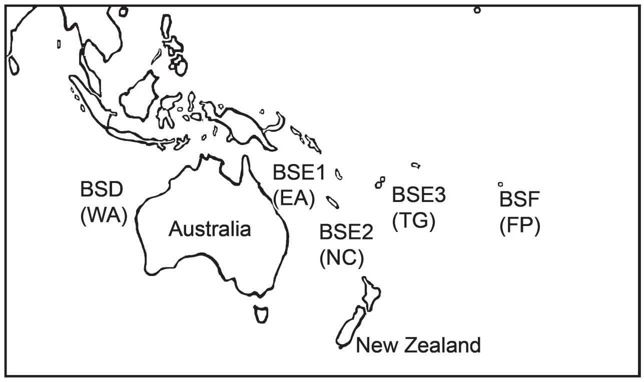

Fig.3. Distribution of Southern Hemisphere humpback whales breeding stocks grounds BSD, BSE1, BSE2, BSE3 and BSF2. Note the following abbreviations: WA=Western Australia, EA=Eastern Australia, NC=New Caledonia, TG=Tonga and FP=French Polynesia.

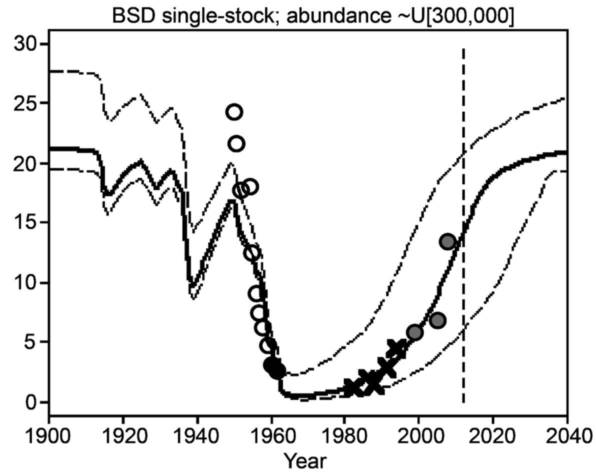

Fig.4. Posterior median population trajectories for BSD, showing the trajectories and the 90% probability envelopes. Results are shown for a single-stock model using the original catch boundaries. Plots show fits to the Chittleborough (1965) CPUE series (open circles), the Bannister and Hedley (2001) and relative abundance series (crosses), the Hedley *et al.* (2011b) relative abundance series (grey circles). The model is fit to both the Hedley *et al.* (2011b) and Bannister and Hedley (2001) relative abundance series only. The BSD abundance prior is set at U[0; 30,000]). The Chittleborough (1965) CPUE series is shown as consistency check. The trajectory to the right of the vertical dashed 2012 line shows projection into the future under the assumption of zero catch.

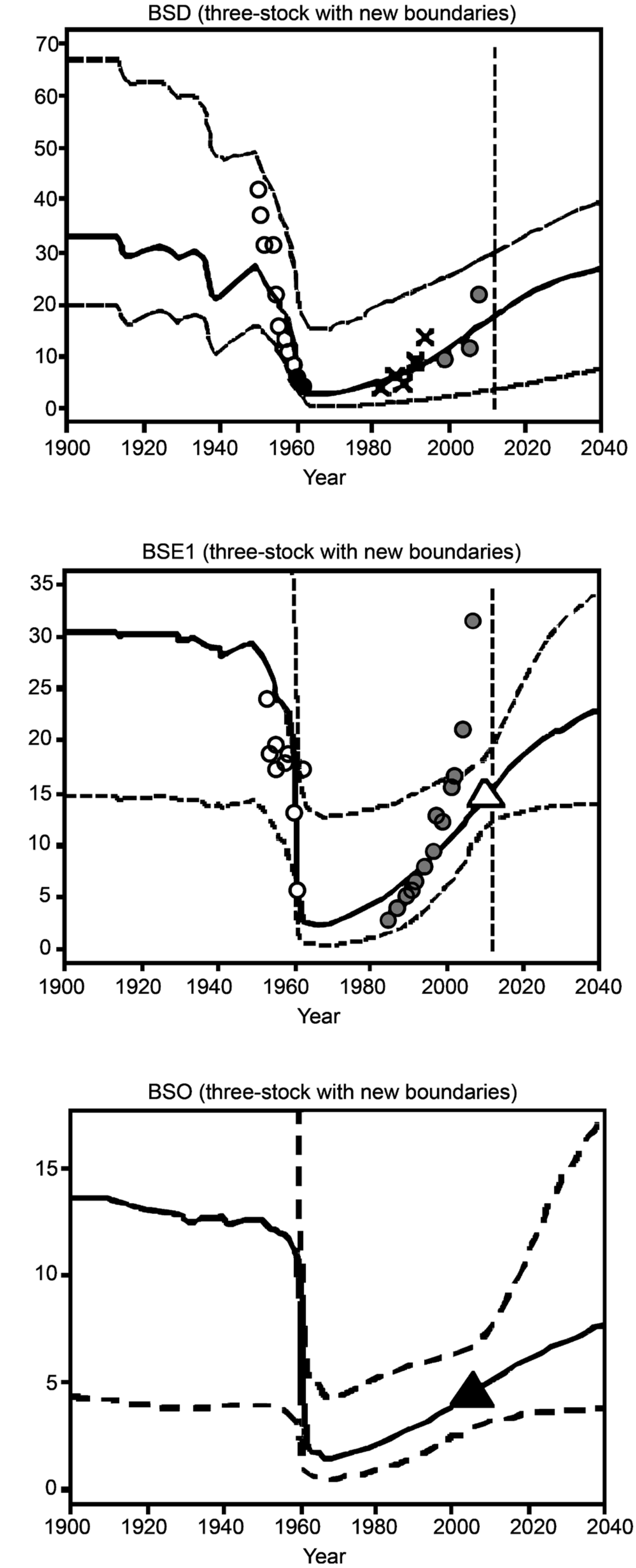

Fig.5. Three-stock model results assuming 'new' Antarctic catch boundaries proposed in SC/65a/SH01. The BSD abundance prior is set at U[0; 30,000]). BSO refers to Oceania (New Caledonia (E2)+Tonga (E3)+French Polynesia (F2)). SC/65a/SH01 details the data fitted for each breeding stock but in essence these are the Bannister and Hedley (2001) and Hedley *et al.* (2011b) relative abundance series for BSD (crosses and grey circles, respectively), the Noad *et al.* (2011) abundance estimate and relative abundance series for BSE1 (open triangles and grey circles, respectively), and the Constantine *et al.* (2011) photo-id mark-recapture data for Oceania. The black triangle for Oceania is the separate abundance estimate from mark-recapture data reported by Constantine *et al.* (2011) and the open circles for BSD and BSE1 are the CPUE data from Chittleborough (1965); these data are not fitted directly, but shown as consistency checks.

in turn led to the removal of Antarctic catches from Oceania to allocate to BSE1. Even so, the whales removed from BSE1 by the model did not deplete the population enough by the late 1960s (when most harvesting ceased) to reflect the rapid recent increases shown later by the east Australian surveys (Noad *et al.*, 2011). Use of an uninformative prior abundance on BSD in these models (with and without new Antarctic boundaries) did not improve the fit of the model to the BSE1 relative abundance data (see Fig. 5). Furthermore, none of the model formulations were consistent with the mixing proportions estimated by genetic data from the feeding grounds. Additional details of these results are provided in Annex H.

Other potential explanations for poor model fit were explored. Cooke (2009) describes situations in which attempts to fit a deterministic density-dependent population model to a recovering whale stock sometimes fail, because there are insufficient historic catches to account for the recent increase. His analyses suggested that lack of model fit should not be regarded as an anomaly to be explained, but a normal situation that is to be expected beyond a certain level of recovery and can be better fitted by accounting for environmental variability. Attempts to repair the lack of fit by allowing an arbitrary increase in carrying capacity could be expected to make the overestimation worse. Possible ways of addressing this in the current assessment models were discussed.

With respect to model fits to Oceania in SC/65a/SH01, the Committee **recommends** replacing the photo-id mark-recapture data with genetic mark-recapture data.

SC/65a/SH07 presented other progress toward modelling the population dynamics for East Australia and Oceania. This paper used logistic Bayesian FITTER models to co-measure population trajectories for pairs of South Pacific breeding grounds which share common high latitude feeding grounds. Two stock models were undertaken for East Australia (BSE1)/New Caledonia (BSE2), Tonga (BSE3)/ French Polynesia (BSF2) and East Australia (BSE1)/ Oceania (BSE2+BSE3+BSF2). In these preliminary results, East Australia carrying capacity varied between models (medians 26-42,000) while population increase rates were uniformly high. Median estimates of carrying capacity for New Caledonia ranged from 5,200-6,100, for Tonga 5,600-8,700 and for French Polynesia 4,000-5,700, with median recovery levels of 13-33%, 31-44% and 24-32% respectively.

The Committee thanked the authors for this work and noted several technical issues that still need to be addressed, including the use of a uniform prior on carrying capacity which leads to a biased estimate of MSYR.

In conclusion, the Committee **strongly agrees** that the assessment of breeding stocks D, E and F should be completed at next year's meeting. The following final **recommendations** were made to complete this work:

(1) a lower bound on the BSD abundance estimate should be obtained;
(2) a single-stock model for BSD will be run for a range of choices of the Antarctic feeding ground catches between 120°E and 150°E;
(3) two stock BSE1-Oceania models (with further breeding stock division within Oceania) will be explored; and
(4) if time permits after sufficient exploration of the models above, more complex options may be examined. These could include a three-stock model covering all of BSD, BSE1 and Oceania, together perhaps with more complex models for the dynamics of BSD, as discussed above.

The work plan for completing this work is provided in Item 10.2.6.

10.2.1.2 FUTURE WORK
SC/65a/SH09 described efforts by the South Pacific Whale Research Consortium to plan future sampling in Oceania with a view toward a future humpback whale assessment. Simulations and power analyses were used to evaluate planned field research in light of three main objectives: (1) to determine population size with a coefficient of variation of less than 20%; (2) to determine if the population is increasing or decreasing; and (3) to detect if population growth is significantly different from that of East Australia. Details are available in Annex H. The Committee welcomed this work, noting the importance of such planning and the value to future assessments of BSE2 and BSE3.

A modified POPAN model (Carroll *et al.*, 2013a) was discussed that explicitly accounts for heterogeneity in capture probability related to breeding cycles. The latter can cause substantial positive bias (+19%) in female abundance estimates and may be a consideration in the mark-recapture modelling of many cetacean species.

10.2.2 Review new information on other breeding stocks
New information was available for humpback whale Breeding Stocks B, C and G.

10.2.2.1 BREEDING STOCK B
SC/65a/SH24 collated humpback whale data from small boat surveys off Namibia (~23°S), 2005-12. Photo-id images were compared with catalogues from Gabon (2000-06) and West South Africa (WSA, 1983-2007). No confirmed matches were found, likely due to catalogue size and sampling period. However, a study of wounds from cookie cutter sharks (*Isistius brasiliensis*) and killer whales was used to infer relationships among these three areas in BSB.

The Committee welcomed this study, noting the potential utility of indirect indicators of stock structure for the Namibia region, where insights from photo-id and genetic data are still limited.

SC/65a/IA13 reported on cetacean sighting survey results in Gabon coastal waters from 4-10 September 2011 and in the Gulf of Guinea (Côte d'Ivoire, Ghana, Togo and Benin) from 23 March to 6 April 2013. The Committee thanked the authors for presenting these survey data. More information is available in Annex H, item 3.2.

10.2.2.2 BREEDING STOCK C
Two papers were received on satellite tagging projects to study the movements of humpback whales in this breeding stock. SC/65a/SH22 reported movements of twelve humpback whales satellite tagged off northeast Madagascar (BSC3). A wide range of movements were observed, including use of areas not previously recognised as preferred habitat. No tagged whales travelled to the west coast of Madagascar, Mozambique or the Mascarene Islands, where breeding aggregations are well documented. Observed movements between Madagascar and central-east Africa were likely not detected previously because of a lack of surveys in northern BSC1.

The Committee welcomed this work and noted its value for helping to clarify stock structure within BSC. Details of further discussion are available in Annex H.

SC/65a/SH02 described the results of satellite tagging eight humpback whales in the Comoros Islands (BSC2) in 2011 and 2012. Whales either remained at their breeding site for several weeks after tagging (n=3), dispersed to the northwest (n=2) or to southwest (n=3) coast of Madagascar. Of those tracked toward the Antarctic, one moved south-eastward towards the French sub-Antarctic islands and the other travelled to Antarctic Area III. These are the first detailed reports of humpback whale movement for this breeding sub-stock.

10.2.2.3 BREEDING STOCK G
SC/65a/SH04 described the results of small-boat surveys in the Gulf of Chiriqui (western Panama) during the austral winter season from 2002 through 2012. Initial catalogue comparisons have established matches to southern Costa Rica, and to feeding areas off Chile and Antarctica. Future plans include genetic analysis, comparing mother-calf habitat use to other breeding areas and long term acoustic monitoring. Discussion of this paper focused on the prevalence of mother/calf pairs in the area, which will be investigated further by the authors. This discussion can be found in Annex H.

10.2.3 Review new information on feeding grounds
Three studies (SC/65a/SH10, SC/65a/SH20 and SC/65a/O09) reported sightings of humpback whales during surveys in the Antarctic. Further details can be found in Annex H, item 3.3.

10.2.4 Antarctic Humpback Whale Catalogue
SC/65a/SH15 presented the interim report of IWC Research Contract 16, the Antarctic Humpback Whale Catalogue (AHWC). During the contract period, the AHWC catalogued 938 images representing 774 individual humpback whales submitted by 36 individuals and research organisations. Catalogue details are provided in Annex H, item 3.4.

The Committee recognises the contribution of the AHWC to humpback whales studies in the Southern Hemisphere and **recommends** its continuation (and see Item 26).

10.2.5 Other new information
SC/65a/SH05 reported on a study of Type 1 satellite tag performance and health impacts in humpback whales. This study has already informed tag modifications that have substantially increased tag duration, and are expected to reduce impacts on individuals. The Committee **thanks** the authors for this work, noting its value to future satellite tagging research.

10.2.6 Work plan
The Committee **confirms** that it will complete its assessment of Breeding Stocks D/E/F at next year's meeting, and thus also the Comprehensive Assessment of Southern Hemisphere Humpback Whales. Further details are given under Items 23 and 24.

10.3 Southern Hemisphere blue whales
10.3.1 Review new information
10.3.1.1 ANTARCTIC BLUE WHALES
Several papers reported results from the SORP Antarctic Blue Whale Project. SC/65a/SH21 provided an overview of activities undertaken on the Antarctic blue whale voyage between January and March 2013. This 47-day voyage focused on an area south of 60°S between 135°E and 170°W. Acousticians processed 26,545 Antarctic blue whale calls in 'real-time' and acoustically 'targeted' 51 groups of vocalising animals for photo-id and biopsy sampling. Further detail on tracking, sampling and other activities are provided below and in Annex H, item 5.1.1.

SC/65a/SH18 summarised the long-range acoustic tracking undertaken during the Antarctic Blue Whale Project. DIFAR sonobuoys were used to detect, localise and track Antarctic blue whales. In total, 85% of acoustic targets resulted in visual encounters and yielded 32 encounters with groups of blue whales. The project demonstrated the ability of acoustic tracking to locate Antarctic blue whales that are widely dispersed over a large area as well as the capacity to acoustically track whales for days at a time.

SC/65a/SH11 reported on the 50 Antarctic blue whales photo-identified as a result of acoustic-tracking during the 2013 voyage. The re-sighting rate of individuals during the voyage was similar to recent IWC SOWER cruises. Time between re-sights ranged from one to 27 days and straight-line distances ranged from 15km to 1,172km. Three individuals were matched to the Antarctic Blue Whale Catalogue and one had moved a minimum of 6,550km and 145° of longitude. Photo-identification data collected during the voyage will contribute towards a new abundance estimate of Antarctic blue whales using mark-recapture methods.

SC/65a/SH03 reported on the movements of satellite tagged Antarctic blue whales on their feeding grounds in 2013. Two tags collected movement data for 14 and 74 days, over 1,433km and 5,300km, respectively. Both whales performed long-scale movements interspersed with patches of searching, often in close association with the ice edge. Additional satellite tag deployments are planned to increase understanding of fine and large scale movements of Antarctic blue whales.

The Committee discussed these papers largely in the context of the ultimate aim of the Antarctic Blue Whale Project to estimate abundance through mark-recapture methods. It also highlighted the success of the SORP Antarctic Blue Whale Project to date and the significant advance it represents in non-lethal research on blue whales in the Southern Ocean. Additional details of this discussion can be found in Annex H, item 5.1.1.

SC/65a/O09 summarised sightings of blue whales during JARPAII of 2012/13. Details can be found in Annex H, item 5.1.1.

10.3.1.2 PYGMY BLUE WHALES

Three papers provided new information on blue whales off New Zealand. SC/65a/SH12 reported on blue whales observed and photo-identified in the coastal waters of New Zealand from 2004-13. Of 18 whales identified, 14 were observed during the SORP Antarctic Blue Whale Voyage in 2013, on transit to the Antarctic. Further details are available in Annex H, item 5.1.2.

SC/65a/SH19 reported additional findings from a combination of acoustics and visual observations at New Zealand, including data obtained during the 2013 SORP Antarctic Blue Whale Voyage noted above. Acoustic tracking confirmed blue whales to be the source of low frequency sounds recorded in this area. Comparison to recordings from 1964 and 1997 suggested that song types have persisted over several decades, are distinct from the Antarctic blue whales, and indicate a year-round presence around New Zealand. Blue whale song in this region has changed slowly, but consistently, over the past 50 years.

Torres (2013) presented evidence that the South Taranaki Bight is a blue whale foraging habitat and called for a greater understanding of their habitat use patterns to manage anthropogenic activities.

The Committee discussed the taxonomic status of blue whales in New Zealand waters. Based on available data on morphology, timing, distribution and acoustics, these whales are most likely to represent a form of pygmy blue whales. This is consistent with a growing body of evidence that populations of pygmy blue whales show considerable variation across the Southern Hemisphere.

The Committee **reiterates** that the relationship among pygmy blue whales in different areas is unclear and merits further investigation.

10.3.1.3 BLUE WHALES OFF CHILE

SC/65a/SH17 provided an update on surveys, photo-identification and biopsy research off the Isla de Chiloe and Isla de Chañaral (northern Chile) in 2013. Research at multiple sites has highlighted the importance of continued monitoring and increased photo-identification efforts to better understand the dynamics of the blue whales in this area. Concerns were also raised about the overlap of blue whales and vessels at the mouth of Chacao Channel. One blue whale stranding was documented north of this area in 2013, but cause of death was not determined.

The taxonomic status of Chilean blue whales was discussed by the Committee. They are intermediate in size between Antarctic and pygmy blue whales (Branch *et al.*, 2007). Furthermore, blue whales off Chile and Australia are as different genetically from each other as each is from Antarctic blue whales. Ongoing genetic analyses using additional samples from the Southern Hemisphere, Eastern Tropical Pacific and North Pacific will be undertaken to try to resolve their taxonomic status (see SC/65a/SH25).

10.3.1.4 PHOTO-IDENTIFICATION CATALOGUES

SC/65a/SH16 reported on the comparison of Antarctic blue whale photographs from JARPA to the Antarctic Blue Whale Catalogue (ABWC). Thirty-one individual Antarctic blue whales were photo-identified during JARPA cruises in the Antarctic during 12 austral summer seasons between 1992/93 and 2004/05. Photos were obtained in IWC Management Areas III, IV, V and VI. No new matches were found. This work brings the ABWC catalogue total to 305 individuals and notably increases available coverage from Area III (n=165) and in Area V (n=93). The Committee **recommends** that the 380 additional JARPA II blue whale photographs be compared to the ABWC.

SC/65a/SH23 describes efforts to consolidate all blue whale catalogues in the Southern Hemisphere. The Southern Hemisphere Blue Whale Catalogue (SHBWC) now contains 884 individual blue whales. Catalogues from South America, the Eastern Tropical Pacific (ETP) and Antarctica are now included and catalogues from the Indonesia/Australia/New Zealand area are in the process of being added. Comparisons between the eastern South Pacific and ETP have been completed and no matches were found. Comparisons between ETP and the Southern Ocean, as well as those from eastern South Pacific and the Southern Ocean are approximately 50% complete, with no matches found. The Committee **recommends** that the SHBWC continue its work and that all relevant data holders submit their photos to the catalogue.

10.3.1.5 NEW GENETIC INFORMATION

Attard *et al.* (2012) reported on hybridisation between pygmy and Antarctic blue whales, and a genetic estimate of the proportion of blue whale sub-species in the Antarctic. Further details and the discussion is provided in Annex H, item 5.1.5.

10.3.2 Work plan

The Committee's views on the work plan are given under Item 24.

10.4 North Pacific sei whale in-depth assessment

10.4.1 Review intersessional progress

Last year, an issue had been identified with the division of Japanese catch records between sei and Bryde's whales in the period 1955-72. This year the Committee heard that this had been a misunderstanding: the division of the catch figures had already been accomplished in the context of the Bryde's whale assessment.

Owing to other Committee priorities, it had not been possible to complete the incorporation of the Soviet and Canadian catch records intersessionally; this remains in the work plan for the forthcoming year (see Item 10.4.3).

10.4.2 Assessment

Although it was not possible to proceed with the assessment, analyses were presented that will inform the assessment when it is undertaken. Relating to stock structure, SC/65a/IA05 described the results of microsatellite DNA analysis conducted on North Pacific sei whale samples obtained from the 2010-12 IWC-POWER surveys (Annex G, item 5.2). The genetic data from 14 microsatellite loci from these samples were compared with previously reported genetic data from JARPN II (from 2002-07) and from commercial whaling samples (from 1972-73) across a range of locations within the North Pacific. The study supports the author's previous view that the open waters of the North Pacific were occupied by the individuals from a single stock of sei whales. This paper was discussed extensively by the Working Group on Stock Definition (Annex I), which made three recommendations for further analyses: (i) estimate the power of the data set to detect subtle population structure that might nevertheless be important for management; (ii) undertake a clustering analysis using STRUCTURE or a similar approach; and (iii) undertake a relatedness analysis when the sample size is sufficient to expert to find a reasonable number of close relatives.

It was reported that the recommended studies will be carried out, but not before 2016 because of other priorities. The Committee did not expect that these analyses would materially change the current understanding of stock structure; it **agrees** that it is not necessary to await the results before proceeding with the in-depth assessment.

Two preliminary analyses using sightings data from IWC-POWER were presented. SC/65a/IA09 provided a standard line transect analysis to estimate abundance of sei whales from the 2012 IWC-POWER survey (see Annex G, item 3 for a map showing the survey area). SC/65a/IA10 modelled the spatial distribution of fin, sei and humpback whales using data from the first three IWC-POWER surveys (2010-12). The Committee welcomed this analysis, and made a number of technical suggestions. Updated and revised analyses from both SC/65a/IA09 and SC/65a/IA10, using all available data, will be undertaken intersessionally; the Committee looks forward to receiving these and considering them in more detail at the in-depth assessment next year.

10.4.3 Work plan

Corrected Soviet catch data are documented by Ivashchenko *et al.* (2013). The Committee **agrees** that these represent the best possible reconstruction of the Soviet catch history in the North Pacific at this time, and that they should be incorporated into the IWC database (if this has not already been done). The Committee requests that Allison complete the remaining catch history additions or revisions (such as the revised Canadian catch data) during the coming intersessional period.

10.5 North Pacific gray whales

10.5.1 New information on stock structure and movements

There was considerable discussion of genetic information (see especially SC/65a/BRG16) on gray whale stock structure for the North Pacific both within the working group on stock definition (see Annex I, item 3.1.3) and the sub-committee on bowhead, right and gray whales (Annex F, item 3.1.2). Considerable attention was paid to developing the range of plausible hypotheses about the gray whales that summer in the Sea of Okhotsk near Sakhalin Island. The outcome of these discussions was the development of a list of seven hypotheses presented in Annex F, Appendix 3.

SC/65a/BRG04 summarises the results of the second year of the collaborative Pacific-wide study developed under the auspices of the IWC. The paper reported on the comparison of the gray whales photo-identified off Sakhalin Island (n=232) and the Kamchatka Peninsula (n=150) with the Mexican gray whale catalogue (n=4,352). A total of nine confirmed matches was found. Two whales were observed in the three places, three in Sakhalin and Mexico and four in Kamchatka and Mexico. These results provide new information important to the evolving understanding of gray whale population structure in the North Pacific.

The Committee thanks all the collaborators for the excellent progress on this project. The comparison of photographs between Sakhalin Island and Kamchatka, Russia with photos from lagoons in Baja California Sur, Mexico provides improved understanding of the connections between feeding and breeding/calving areas and interactions between western and eastern gray whales.

The Committee received papers summarising the work of two ongoing photo-identification and biopsy programmes off Sakhalin Island. Details are given in Annex F, item 3.2.1 and only a short summary is provided here. SC/65a/BRG03 reviewed findings from the ongoing 18-year collaborative Russia-US research programme on western gray whales summering off north eastern Sakhalin Island, Russia. When 2012 data are combined with results from 1994-2011, a catalogue of 214 photo-identified individuals has been compiled.

SC/65a/BRG08 reported on the programme being undertaken by the Russian Institute of Marine Biology (IBM) team that has been working off Sakhalin Island since 2002 and Kamchatka since 2004. The Sakhalin photo catalogue now contains 219 individual gray whales over the period of 2002-12. At present, the Kamchatka Gray Whale Catalogue contains 155 gray whales identified in 2004 and 2006-12 of which 85 were also photographed offshore of Sakhalin. Information on body condition was also presented. While the population remains small and therefore vulnerable, individual animals appeared to be in good body condition in 2012 compared with indicators from previous years. Few skinny whales were observed and those that were, had restored their body condition to normal over the course of the summer feeding season.

SC/65a/BRG18 reported on the results of the shore- and vessel-based surveys conducted in August-September 2012 under the Western Gray Whale Monitoring Program funded by Exxon Neftegas and Sakhalin Energy. The authors concluded that the results of the 2012 distribution surveys and photo-identification studies indicate that the Sakhalin gray whale feeding aggregation is gradually increasing in size and that the distribution of the whales remains similar to previous years.

The Committee welcomed these papers, recognising the importance of long-term monitoring of the animals off Sakhalin. It **strongly recommends** that the studies continue.

In addition to the work in Russia, the Committee received information from Japan and Korea. SC/65a/BGR20 reported on the status of conservation and research on North Pacific gray whales from May 2012 to April 2013 in Japan (including sightings surveys and morphological comparisons), while SC/65a/BRG26 reported on sighting surveys in Korean waters from 2003 to 2011. Neither the Japanese nor the Korean surveys saw any gray whales.

The Committee thanks Japan and Korea for providing this information and continuing work on gray whales. It **encourages** further comparison of skeletal morphology of gray whales across the North Pacific. It also thanked Japan for providing photographs of a juvenile gray whale sighted off Japan in March 2012; comparison with both Sakhalin and eastern catalogues produced no matches.

Given the large amount of new information related to population structure of gray whales in the North Pacific and the potential implications of this for conservation and management advice (see also Annex E, item 2), the Committee **endorses** a proposal for a rangewide review of the population structure and status of all North Pacific gray whales with an initial focus on an international Workshop (Annex F, Appendix 2).

10.5.2 Conservation advice

SC/65a/BRG27 presented an updated population assessment of the Sakhalin gray whale aggregation using photo-id data collected from 1994 to 2011 in the Piltun area by the Russian-US team. Details are provided in Annex F, item 3.2.1. The results showed evidence for between-year variability in calving rates and calf survival rates. The calving rate was found to be correlated with the calf survival rate with a two-year time lag. Under the assumptions made, no immigration in recent years was detected, suggesting that the population has been demographically self-contained, consistent with a high degree of maternally-directed feeding site fidelity. The 1+ (non-calf) population size in 2012 is estimated at 140 (±6) whales, increasing at 3.3 (±0.5) % per annum.

A number of matters for further consideration were raised. Work is underway to incorporate both Sakhalin catalogues into the assessment but certain issues needed to be resolved first. The Committee **agrees** that if possible both datasets should be included in a final assessment. Given the implications for conservation, a more thorough investigation of immigration should occur and the incorporation of body condition information into the model was also encouraged.

Annex F, Appendix 5 provided an update on the progress of the Western Gray Whale Advisory Panel (WGWAP), which is convened by IUCN.

10.5.4 Conservation advice

The Committee **reiterates** its support for the important work of the IUCN. As previously, the Committee **recommends** that oil and gas development activities (including exploratory seismic surveys) in areas used by gray whales be undertaken only after careful planning for mitigation and monitoring, noting the guidance provided by the WGWAP in this regard[16].

10.6 Southern Hemisphere right whales

The Committee completed an assessment of Southern Hemisphere right whales last year and the report is published as IWC (2013f).

10.6.1 Review new information

The Committee received a number of papers providing new information on southern right whales and details can be found in Annex F, item 4. A short summary of this work is provided below.

SC/65a/BRG10 reported on the results of the aerial survey for right whales in South African waters in October 2012 funded by the IWC and part of a long-term monitoring programme. The number of identified cow-calf pairs was the fifth highest since surveys began in 1979, and an exponential fitted to the data over the 34-year period provides a significant rate of increase (0.0625±0.0035 SE per annum).

SC/65a/BRG17 extended the analyses of Brandão *et al.* (2012) which applied the three-mature-stages (receptive, calving and resting) model of Cooke *et al.* (2003) to photo-identification data from the long-term monitoring programme available from 1979 to 2010 for southern right whales in South African waters, by taking two further years of data into account. The 2012 number of parous females was estimated to be 1,321, the total population (including males and calves) 5,062, and the annual population growth rate 6.6%.

Carroll *et al.* (2013b) provided information of a return of southern right whales to former habitat around the main islands of New Zealand including the first evidence of female site fidelity to the mainland New Zealand calving ground. There was some discussion as to whether this represented a re-establishment of primary habitat by a remnant stock that survived in the New Zealand sub-Antarctic.

Carroll *et al.* (2013a) reported on methods to extend the 'superpopulation' capture-recapture model (POPAN) to explicitly account for heterogeneity in capture probability linked to reproductive cycles, such as the 2-5 year birth intervals observed in southern right whales. This model extension, referred to as POPAN-τ, has potential application to a range of species that have temporally variable life stages. The authors demonstrate the utility of this model in simultaneously estimating abundance and annual population growth rate (λ) in the New Zealand southern right whale from 1995-2009, with a total 'superpopulation' estimate from the best model of around 2,100 (95% CL1,836-2,536).

SC/65a/O09 reported that four schools and five individuals of southern right whales were sighted in 2012/13 of JARPA II in the Antarctic. One southern right whale was photographed for photo-identification.

10.6.2 Complete assessment

SC/65a/BRG15 reported on a Workshop on the ongoing southern right whale die-off at Península Valdés. The 2010 IWC Workshop on this topic (IWC, 2011f) reviewed the significant number of right whale calf deaths and *inter alia* drew attention to the increasing incidence of parasitic behaviour of kelp gulls which peck at the outer skin and then feed on the blubber of live whales, and recommended that management measures be taken with respect to kelp gulls displaying this behaviour.

SC/65a/BRG15 also reviewed the most recent information on gull lesions and calf mortality. There is a strong signal of gull attacks as a unique, increasing, and acute element of the lifecycle of young right whale calves. The participants developed hypotheses on the mechanisms by which these attacks and injuries can lead to death and agreed to continue to work on these. The Workshop commended the work of the SRWHMP team.

Solving the kelp gull harassment problem is a priority action within the CMP developed for this region. Information was received on a feasibility study was carried out last year testing the use of different gun types - a 12-gauge shotgun was deemed to be the most successful. The reactions of the southern right whales to gun discharge were also recorded and no changes in their behaviour were observed. For the 2013 southern right whale season the objective is to continue this programme.

[16]*http://www.iucn.org/wgwap/wgwap/seismic_survey_monitoring_and_mitigation_plan/.*

The Committee **expresses concern** over the continued large annual mortality of calves at Península Valdés, and its potential significance to the population. The increase in gull populations is driven by anthropogenic factors such as open landfills and discharge from fisheries. It **recommends** that investigation of the causes of this mortality, including the hypothesis that gull attacks are contributing to calf deaths, should continue as a matter of priority and **recommends** that strategies and actions to reduce the risk of gull attacks on southern right whales at Península Valdés should be further developed and implemented. The Committee **commends** the SRWHMP for their hard work and diligence in trying to resolve this situation and **encourages** continuation and further support of this important work.

The Committee received information on progress with the IWC Conservation Management Plan for the Southern Right Whale Southwest Atlantic Population as a result of a Workshop held in Argentina (SC/65a/BRG07). The overall objective of the CMP is to protect SRW habitat and minimise anthropogenic threats to maximise the likelihood that SRW will recover to healthy levels and recolonise their historical range. The CMP (details in Annex F, item 4.4) developed nine high priority actions, ranging from public awareness and capacity building through research to mitigation. Iñíguez has been appointed co-ordinator of the programme for a two-year period and a Steering Committee has been established including range state representatives, the Chairs of the Conservation Committee, Scientific Committee and the CMP SWG and the IWC Head of Science. A panel of experts will also be established.

The Committee **welcomes** the progress with the CMP and is willing to assist with scientific advice if required.

The Committee also **endorses** the holding of a workshop to develop and implement a strategy to minimise kelp gull harassment on southern right whales as proposed by the CMP. Such a workshop would be held in early 2014 and developed in consultation with the Province of Chubut. A budget request for partial funding is given under Item 26.

SC/65a/BRG14 noted that the southern right whale is listed as 'least concern' in the IUCN Red List of Threatened Species. Although not a threatened species, data from a review of strandings and sightings reveal a real reduction in southern right whales records for the southeast coast of Brazil. The authors stated that this should be considered as a cause of conservation concern**.**

Galletti Vernazzani *et al.* (In press) reported on behaviour and habitat use patterns of eastern South Pacific southern right whale sub-population. This population is likely to contain less than 50 mature individuals, and has been classified as critically endangered by IUCN. In 2012, the IWC endorsed a CMP to promote its long-term recovery. One of the highest priorities of the CMP is to identify the breeding area(s) which is difficult given the length of the coastline and and the low number of individuals. The first resighting between years of a known individual, the southernmost sighting of a cow-calf pair and the first documented record of likely reproductive behaviour in these whales has been reported in a small area off coastal waters off northwestern Isla Grande de Chiloe (Isla de Chiloe), southern Chile. This new information highlights the importance of this area for this population and suggests that it is part of a breeding area. Isla de Chiloe is the northern limit of the Chilean fjord system and was a former whaling ground for southern right whales, therefore it seems that whales are reoccupying their former range. However, a large wind farm project and associated port is being proposed to be built at northwestern Isla de Chiloe and it is likely it will affect this important habitat for this critically endangered population.

The Committee welcomed this information and, in light of this critically endangered status and the importance of this area for the recovery of the population, it **strongly recommends** relocation of the wind farm project away from shore, and **reiterates** the need for the urgent development of an environmental impact assessment that considers possible impacts on cetacean habitats.

10.7 North Atlantic right whales

10.7.1 Review any new information

No new information was presented.

10.7.2 Conservation advice

The Committee **repeats** its concern over North Atlantic right whale stocks and notes that it is a matter of urgency that every effort be made to reduce anthropogenic mortality (e.g. see IWC, 2012a). It requests that updated information on the status of any of these stocks be provided to the next Annual Meeting.

10.8 North Pacific right whales

10.8.1 New information

The Committee welcomed new information of sightings of North Pacific right whales: (1) one animal amongst several bowhead whales in July 2011 in the Western Okhotsk Sea; (2) two separate animals in 2012 as part of the JARPN II programme (both photographed and one biopsy sample); and (3) one animal (photographed) southeast of Kodiak Island during the 2012 IWC-POWER cruise.

10.8.2 Conservation advice

The Committee **reiterates** its previous concern over the status of this endangered species throughout the North Pacific. Noting that significant new data has accumulated from survey work in recent decades, especially in the western North Pacific and Sea of Okhotsk, the Committee **recommends** that the survey data on North Pacific right whales (including search effort, sightings, photo-id and biopsy results) be synthesised and presented by Matsuoka and colleagues to next year's meeting.

10.9 North Atlantic bowhead whales

10.9.1 Review any new information

No new information was presented.

10.10 Okhotsk Sea bowhead whales

10.10.1 New information

The Committee received considerable new information on bowhead whales from Ulbansky Bay in the Okhotsk Sea in 2011 and 2012 (SC/65a/BRG28 and SC/65a/BRG29). Details can be found in Annex F, item 2.2. Local observations indicate bowhead whales appeared in early May and were present in the area during the study from early July to early September. Large groups (up to 43 in 2011 and 51 in 2012) were seen. An individual biopsied in 2001 was recaptured in 2012. Approximate abundance based on the 2012 genetic recaptures (105 whales genotyped in 1995-2011 with 5 recaptures in 31 whales biopsied in 2012) suggest values about twice that of the earlier estimate of about 300 animals. However, false negatives resulting from differences in laboratory analyses for earlier samples could result in fewer recaptures and cause positive bias to any estimates. For mtDNA analyses, complete sequences of the control region were obtained for 64 individuals. Seven haplotypes were found including one not found in the earlier study by MacLean (2002), who also identified seven haplotypes.

In discussion, the Committee commended Shpak and colleagues for their excellent work. It **strongly encourages** further research on this small and little-studied stock, including: (1) continue biopsy collection in the Shantar region during summer; (2) calibration of samples collected in 1994-2001 and 2011-12 via an exchange of samples between US and Russian laboratories; (3) determining if whales in the various Bays of the Shantar region represent an homogeneous group; and (4) examining the relationship between bowhead whales observed in spring in the Shelikhov Bay and those from the Shantar region.

It was further noted that combining data from bowhead genetic studies conducted in the 1990s would allow updated capture-recapture (minimum) population estimates.

Brownell reported on new plans for offshore oil and gas development in the northern Okhotsk Sea. It was noted that oil and gas exploration lease blocks were purchased 50 to 14km offshore of the city of Magadan approximately in water depths of 120 to 180m. It is expected that exploration will start in 2017 and drilling by the mid-2020s. This area is north of Sakhalin Island and likely in the areas used by Okhotsk Sea bowhead whales when they migrate back and forth across the north Okhotsk Sea. In discussion it was noted that bowhead whales use the Shelikov region in spring but that there have been no reported sightings of bowhead whales off Magadan. There have been sightings of gray whales.

10.11 Arabian Sea humpback whales

10.11.1 Review new information

SC/65a/SH06 reported recent information on a discrete and non-migratory population of humpback whales in the Arabian Sea. A small vessel survey was conducted in Oman in 2012, and made three humpback whale sightings (five individuals) in 1,250km of survey effort. Sightings occurred in the Gulf of Masirah, which was previously identified through habitat modelling as a critical area for the population. Passive acoustic data are pending analysis and units will be re-deployed over the next year. Photo-id data were not adequate to revise population estimates as requested last year. Fishing and shipping in the region were reported in the context of potential threats to this population.

Information was also provided on progress toward the regional conservation initiative mentioned in SC/65a/SH06. Members of the intersessional correspondence group on the Arabian Sea population, together with regional NGO partners have begun work to establish a regional research and conservation programme for this population. The programme would help to initiate and foster collaborative research amongst range state partners, increase local capacity and generate awareness of Arabian Sea humpback whale conservation issues. Additional details are available in Annex H, item 4.

The Committee welcomed these important updates on the Arabian Sea humpback whale population. Given the critical status of this population, it **recommends** that this research be allocated a high priority. The regional conservation initiative was strongly supported as a positive opportunity for range states to work together towards improving the status of this population. Such work could also benefit a CMP, should one ultimately be established for this population (see Item 10.11.2).

Plans were described to satellite tag Arabian Sea humpback whales with implantable tags. Tagging would involve no more than 20% of the population, which has most recently estimated at 84 individuals (Minton *et al.*, 2011), and would address priority research questions identified previously by the Committee. The proponents stated that they have carefully reviewed the present state of tag development and will be following international best practice including using a well-designed and tested tag and an expert tagging team. Further project details and precautions are outlined in Annex H, item 4.

The Committee noted the importance of the proposed work, given how little is known about the Arabian Sea humpback whale population. While the proposed sample size is modest, even a small number of tags has the potential to significantly increase what is known about this population. At least seven dead humpbacks have been detected in the last 10 years and this casts doubt on the sustainability of the population, e.g. it exceeds the estimated Potential Biological Removal (PBR) for this population (Wade, 1998). As noted above, Oman has experienced a rapid increase in the development of fisheries, high speed ferries and coastal infrastructure projects, many of which overlap with known humpback habitat. Given the observed mortality and known threats, there is an urgent need for better information on movement and habitat use. This project has the potential to considerably improve knowledge in the short term and is in fact the only way to collect this information given the nature of this population and the available resources.

It was noted in discussion that the results of recent satellite tag assessment studies on the health of animals (SC/65a/SH05) will be available in the next few years and that consideration should be given to waiting for those results. However, the Committee also recognised the urgency of this issue and the potential benefit to the conservation management of this critically endangered population. The Committee **recommends** that this work be undertaken as a high priority. An important caveat is that any untested tag modifications should be evaluated on other populations and not used first on Arabian Sea humpbacks.

10.11.2 Progress toward the development of a Conservation Management Plan

In 2010, the Committee recommended the development of a Conservation Management Plan (CMP) for Arabian Sea humpback whales. A CMP could address concerns for this population as well those for other species of large whale. To date, neither of the two range state members of the IWC (India, Oman) has yet volunteered to lead the development of a CMP, although there is some recognition of urgent conservation concerns and research needs.

10.12 International cruises

10.12.1 IWC-POWER cruises in the North Pacific

The Committee has now agreed objectives for the IWC-POWER programme, and this year reviewed the results of the 2012 cruise (Item 10.12.2), the Planning Meeting report for the 2013 survey (Item 10.12.3) and discussed plans for the 2014 cruise (Item 10.12.4).

The 2014 cruise will mark the end of the short-term phase of the programme, completing coverage of a large area of the North Pacific (see Annex G, fig. 2). This phase had been designed to cover the whole survey area in as short a time as possible to provide baseline information on distribution and abundance for several large whale species/populations. Alongside sightings data, dedicated time for biopsy sampling and photo-identification work has been allocated, providing information on stock structure, movements and potentially further information on abundance.

10.12.2 Review of the 2012 IWC-POWER sighting survey
The 3rd IWC-POWER cruise was successfully conducted from 13 July-10 September 2012, in the eastern North Pacific using the Japanese Research Vessel *Yushin-Maru No.3* (SC/65a/IA08). The cruise was organised under the auspices of the IWC. Researchers from Japan, Korea and the US participated in the survey. The cruise had five main objectives (see Annex G, item 3.1). The survey plans had been endorsed by the Committee (IWC, 2012a, p.32). The Committee **agrees** that it was duly conducted following the guidelines of the Committee.

Further details of the cruise, including summaries of the sightings made, may be found in Annex G, item 3.1. The Committee, thanks the Cruise Leader, researchers, captain and crew for completing the third cruise of the IWC-POWER programme. The Governments of Canada and the USA had granted permission for the vessel to survey in their respective waters, without which this survey would not have been possible. The Governments of the Republic of Korea and the USA provided one scientist each, and the Government of Japan again generously provided the vessel and crew, as it had done for the 2010-11 cruises. The Committee recognised the value of the data contributed by this and the other IWC-POWER cruises, collected in accordance with survey methods agreed by the Committee, covering many regions not surveyed in recent decades, and addressing an important information gap for several large whale species.

In discussion of the 2012 POWER cruise results, the Committee heard that weather conditions in the North Pacific in summer tend to be poor. For future planning of the medium- and long- term phases of the programme, the Committee agreed that the sighting conditions during the 2010-14 cruises should be investigated. This is relevant both to the feasibility of estimating abundance of various whale species from current North Pacific surveys, and also for considering any changes in design required for subsequent cruises after 2014. These considerations were referred to the IWC-POWER Technical Advisory Group (TAG) Workshop scheduled for later in 2013 (see also Annex G, Appendix 2).

10.12.3 Planning for 2013 IWC-POWER cruise
SC/65a/Rep01 presented the report of the detailed Planning Meeting for the 2013 IWC-POWER cruise. The Meeting received preliminary results from the 2012 IWC-POWER cruise and these were used, along with overall objectives of the first phase of the IWC-POWER surveys, to formulate a plan for the 2013 cruise, which will take place between 30-40°N, and from 135-160°W. The vessel (kindly supplied by Japan) will depart on 12 July 2013. The Meeting also agreed to a suggestion to highlight the IWC-POWER surveys on the IWC website with the ultimate aim of inspiring multinational collaboration in the survey programme. Fortunately, there will be no problems arising from requirements for CITES permits during the 2013 survey as the tracklines do not enter any EEZs; however, the problems will return in 2014, when the planned survey design will take the vessel into US waters (see Item 10.12.4 below). The Committee was informed that the Japanese and US authorities are working to solve this issue. SC/65a/Rep01 also covered a number of items related to the short, medium and long-term objectives of IWC-POWER, which were later discussed by the IWC-POWER TAG (Annex G, Appendix 2).

The Committee **thanks** the members of the Planning Meeting for their report and **endorses** their recommendations.

10.12.4 Recommendations for 2014 cruise
SC/65a/O05 outlined the plan for the IWC-POWER cruise in 2014. The proposed research area is the eastern north Pacific, between 170°E and 160°W, from 30°N to 40°N (Annex G, fig. 2). Photo-id and biopsy experiments are also planned. The plan was drawn up following general guidelines agreed in 2012 at the Tokyo Planning Meeting (SC/65a/Rep01). Information collected from this survey will provide essential information for the intersessional Workshop to plan for a medium-long term international survey programme in the North Pacific.

On receiving these plans, the Committee **recommends** that permission be sought to operate in the US EEZ far enough in advance for the 2014 cruise. The Committee was informed that the Japanese and US governments are working to solve the problems before the 2014 survey. It thanked the Government of Japan for its generous offer of providing a vessel for this survey.

The Steering Group for IWC North Pacific Planning appointed last year was re-established, convened by Kato (see Annex R). Final planning will take place at a Planning Workshop to be held in Tokyo (see Item 26).

10.12.5 IWC-SOWER cruises (progress on website, publications and analyses)
Last year, the Committee nominated an Editorial Board, and tasked it with responsibility for the preparation of a commemorative IDCR/SOWER volume. As Convenor, Bannister reported that in accordance with the Committee's wishes, a timetable has been developed, a contents list has been proposed and authors have been approached to prepare brief outlines of their contributions.

The volume is intended to be a book reviewing the cruises: not a series of original scientific papers, but rather a series of review chapters bringing together all the work that has been accomplished so far (see Annex G, item 4.1). The volume will provide an introduction to the IDCR/SOWER programme and its fieldwork, including its original aims and objectives, and cruise narratives. There will be major chapters on whale distribution and movements, particularly of minke and blue whales, on taxonomy and population structure, on acoustics, and on abundance (including the development of DESS). An extremely important chapter will be devoted to conclusions and lessons for the future, with emphasis on achievements and lessons learned.

The Committee thanked Bannister and the Editorial Board, and looked forward to an update next year.

In order to facilitate analyses for some of the planned contents, the Committee considered that the production of standard datasets (similar to those produced for the analysis of Antarctic minke whales) would be useful. The Secretariat will make the data available when requested although additional information must be provided if any additional verification is needed to that which is already incorporated into IWC-DESS.

10.12.6 Other cruises
10.12.6.1 REPORT OF JAPANESE CETACEAN SIGHTING SURVEYS IN THE NORTH PACIFIC IN 2012
SC/65a/O04 reported on three systematic dedicated sighting surveys conducted in 2012 summer by Japan (ICR) as a part of JARPN II to examine the distribution and abundance of large whales in the western North Pacific. Over 8,700 n.miles were searched in total, and of the baleen whales, Bryde's whales were most frequently encountered, with only five individual minke whales observed in the offshore strata.

The Committee welcomed this report and **recognises** the value of the data. As noted under Item 10.12.2, sighting conditions might need to be accounted for when estimating abundance in the North Pacific (particularly for common minke whales), and indeed when designing surveys for that purpose. Although the small number of sightings of common minke whales in the offshore strata might well be largely due to poor weather, it was considered premature to conclude that no abundance estimate could be made without first seeing a weather-stratified analysis.

10.12.6.2 PLANS FOR A JAPANESE CETACEAN SIGHTING SURVEYS IN THE NORTH PACIFIC IN 2013

Plans for a systematic dedicated sighting survey in the North Pacific by Japan (ICR) as part of JARPN II in 2013 are described in SC/65a/IA03; the survey is currently underway. The main objective is to examine the distribution and estimate the abundance of common minke and sei whales for management. Notwithstanding a possible minor trackline design issue, the Committee **endorses** the proposal.

10.12.6.3 REPORT OF CETACEAN SIGHTING SURVEYS IN THE ANTARCTIC IN 2012/13

Plans for a dedicated sighting survey in the Antarctic in the 2012/13 austral summer were presented last year and subsequently endorsed by the Committee (IWC, 2013a, p.41). Two research vessels were to survey Area III E, Area IV, and the western part of Area V, using the same methods as in the IWC-SOWER surveys, and in accordance with the guidelines agreed by the SC (IWC, 2005b). Unfortunately the research could not be conducted due to violent interference from an anti-whaling NGO (SC/65a/IA07).

The Committee noted and expressed its concurrence with the Commission's previous consideration of this issue and its 2011 Resolution on Safety at Sea (2011-12) in which the Commission and its Contracting Governments condemned any actions that were a risk to human life and property in relation to the activities of vessels at sea. In particular, the Committee expressed its regret that the actions prevented the sighting survey from being conducted, just as in 2011/12. Following the cessation of the IDCR/SOWER programme in 2009 (and notwithstanding smaller-scale national projects to collect sightings data in particular regions), surveys such as in SC/65a/IA07 provide the only dedicated cetacean sightings that are synoptic over a wide area, and as such are extremely valuable for the work of the Scientific Committee.

10.12.6.4 PLANS FOR CETACEAN SIGHTING SURVEYS IN THE ANTARCTIC IN 2013/14

A systematic cetacean sighting survey for abundance estimation is planned in the Antarctic in the 2013/14 austral summer, as part of JARPA II (SC/65a/IA06). The planned research area comprises Area IV, Area V and the western part of Area VI, from December 2013 to March 2014. Details, which also incorporate biopsy sampling and photo-id work, are in Annex G, item 4.3.

In discussion, the Committee recognised the difficulty of fully reviewing a proposal without detailed design information, but noted that this seems unavoidable given security considerations (see Item 10.12.6.3). The use of consistent protocols over time makes this series of cruises a valuable resource, not least for analysing ice effects. The Committee recalled that photos of blue, right, and humpback whales from similar surveys in the past have been submitted to the relevant catalogue-holders for those species (and will continue to be submitted in future). The Committee broadly **endorses** the proposal, **recommending** that the proposed trackline design be changed if a survey of the Ross Sea was actually able to proceed.

10.13 Other

10.13.1 Photographic archiving

SC/65a/IA14 presented a progress report of a major archiving and cataloguing exercise being undertaken by the Secretariat for the photographic collections arising out of the IDCR/SOWER and continuing IWC-POWER cruises. The photographs have a wide range of potential uses ranging from photo-identification through education to contributing to assessments of human impacts.

The Committee **expresses** its appreciation for the efforts of Taylor and Donovan in archiving and cataloguing the collections and looks forward to a further update next year.

10.13.2 Sperm whales

SC/65a/SH14 investigated the potential population recovery of sperm bulls off Albany, Western Australia. This segment of the population was reduced by commercial whaling by 74% between 1955 and 1978. In 2009, an aerial survey was undertaken to replicate the behaviour of the 'spotter' planes employed by the Albany whaling fleet from 1968-78. The mean number of sperm bulls seen on transect per day (morning) in 2009 was substantially lower than the mean number seen in any of the years between 1968 and 1978. The authors emphasised the preliminary nature of the results, but considered them indicative of a lack of increase in the number of sperm whales frequenting this area compared to when whaling was taking place.

The Committee discussed possible interpretations of these findings, including the potential for population shifts due to ecological changes. It also noted a relevant discussion on sperm whales off New Zealand in Annex M, item 8.8. However, the possibility of population decline led the Committee to discuss the feasibility of undertaking a future assessment of sperm whales. There was general agreement that such an assessment would concentrate on sperm whales in the Southern Hemisphere, but include equatorial nursery groups and the Arabian Sea. The Committee discussed the availability of data on: (1) population structure within ocean basins; (2) population size within ocean basins (and abundance in smaller areas); (3) catch history; and (4) considerations in the development of a new assessment model.

The Committee **agrees** that data availability and feasibility of future assessment would continue to be evaluated intersessionally and reported to the Committee next year. It **recommends** that a dedicated agenda item be added for this species for next year's meeting. More details can be found in Annex H, item 6.1.

11. STOCK DEFINITION

This agenda item was established in 2000, and has been handled since then by a Working Group. The Terms of Reference for this Working Group were changed in 2012 to reflect the evolving needs of the Committee. During this meeting, the Working Group continued to develop guidelines for preparation and analysis of genetic data within the IWC context (see Item 11.1), provided the Committee with feedback and recommendations concerning stock structure related methods and analyses presented to other sub-committees (see Item 11.2), and developed a draft reference glossary of stock related terms, to aid consistent definition of 'stocks' in a management context for the Committee (see Item 11.4 and Annex I, Appendix 5). The report of the Working Group is given as Annex I.

11.1 Guidelines for DNA data quality and genetic analyses

Two sets of reference guidelines have been developed and endorsed by the Committee (IWC, 2009d) and form 'living documents' that can be updated as necessary[17]. The first set addresses DNA validation and systematic quality control in genetic studies. The second set provides guidelines for some of the more common types of statistical analyses of genetic data used in IWC contexts, and contains examples of management problems that are regularly faced by the Committee. Three new sections were added to the data quality guidelines during SC/65a. Substantial progress on the genetic analysis guidelines was also made during this meeting and this document will now be completed intersessionally (see Item 11.5). Both guidelines will also be published in the peer-reviewed literature.

11.2 Statistical and genetic issues related to stock definition

A number of Committee stock related papers were discussed by the Working Group. These were submitted to the following sub-committees: Revised Management Procedure (Annex D), Bowhead, Right and Gray Whales (Annex F), In-Depth Assessments (Annex G), Other Southern Hemisphere Whale Stocks (Annex H) and Review of Special Permit Proposals (Annex P). Technical comments on these papers are given in Annex I.

Gray whale stock structure was discussed in the context of SC/65a/BRG16 and Annex I, Appendix 2. An initial set of hypotheses were developed from these documents to describe the stock structuring of western and eastern gray whales, with particular reference to the Sakhalin Island feeding ground. These initial hypotheses are shown in Annex I, Appendix 3. They will be further developed intersessionally and assigned levels of plausibility. This will contribute to the proposed rangewide Workshop on gray whale stock structure and status (see Item 26).

A general comment was raised that is relevant to many discussions of stock related papers presented to the Committee. With new 'next-generation' DNA sequencing (NGS) techniques, it is now relatively inexpensive to increase the number of genetic markers analysed, so that more information can be gained from each sample in a population study. More genetic markers are often called for in circumstances where the existing marker set cannot detect population differentiation, either due to lack of discriminatory power or lack of population subdivision. Increasing the number of genetic markers increases the power to detect subtle population structuring and can facilitate future studies of relatedness patterns among sampled animals. Simulation analysis of the power of DNA markers to measure departures from panmixia and to reject demographically significant (i.e. sufficiently high) migration rates between putative differentiated populations can provide a useful means of measuring whether the existing DNA marker dataset is sufficient to answer the management question being posed. In all Committee studies, it is important to consider the level at which structure population needs to be detected in order for it to be of management concern. Increased numbers of loci can increase power to detect subtle population structure and also allow for improved inference of the population history underlying the substructure. However, they can also increase resolution to the point where even individuals can be discriminated and can also amplify spurious signals from genotype errors and small departures from random sampling. With the rapid recent developments in NGS technology and analysis, there are some emerging issues of relevance to the Scientific Committee, in terms of: (1) assessment of NGS data quality, and how best to curate such data; and (2) new methods for measuring stock structuring and measurement of other statistical quantities of interest to the Committee. New and published papers on this topic are therefore solicited for submission next year, where they will be considered in the context of the existing Committee guideline documents on DNA analysis and quality (see Item 11.5).

11.3 Testing of Spatial Structure Models (TOSSM)

The aim of TOSSM is to facilitate comparative performance testing of population structure methods intended for use in conservation planning. From the Committee's perspective, the IWC-developed TOSSM software package allows evaluation of methods for detection of genetic structure, in terms of how well the methods can be used to set spatial boundaries for management. It is available for all to use and simulated datasets exist for three of the five stock-structure archetypes previously proposed by the Committee (IWC, 2009b, p.51). Progress has been made on the work items suggested at last year for the Pacific Coast Feeding Group (PCFG) of gray whales (see Item 8.1) and will be presented at the 2014 Annual Meeting.

The Committee noted that the potential for using simulated datasets generated by TOSSM for work to evaluate dispersal rates and new methods for genetic clustering, as proposed under RMP (Annex D, Appendices 3 and 4), particularly in relation to stock hypothesis under review for the Scientific Committee.

11.4 Terminology and unit-to-conserve

Defining and standardising the terminology used to discuss 'stock issues' is still a long standing objective of the Working Group on Stock Definition, in order to help the Committee report on these issues according to a common reference of terms. Appendix 5 of Annex I has been developed by the Working Group with the aim of encouraging consistent use of stock related terms within Committee reports and in papers submitted to the Committee. The Appendix provides initial draft definitions of Committee terms such as 'biological stock', 'sub-stock', 'population' and 'management stock' which will be further discussed and refined intersessionally by members of the Committee. A list of agreed terms will be finalised next year. A challenging example set of cetacean populations that have been discussed by the Scientific Committee over the last five years will be chosen and their stock 'definitions' agreed intersessionally, also for presentation and discussion at next year.

11.5 Work plan

The Committee's work plan is given under Item 24.

12. ENVIRONMENTAL CONCERNS

The Commission and the Scientific Committee have increasingly taken an interest in the possible environmental threats to cetaceans. In 1993, the Commission adopted resolutions on research on the environment and whale stocks and on the preservation of the marine environment (IWC, 1994a; 1994b). A number of resolutions on this topic have been passed subsequently (e.g. IWC, 1996b; 1997; 1998a; 1999a; 1999b; 2001a). As a result, the Committee formalised its work on environmental threats in 1997 by establishing a Standing Working Group that has met every year since.

[17] *http://iwc.int/scientific-committee-handbook#ten.*

12.1 State of the Cetacean Environment Report (SOCER)

SOCER provides an annual update, requested by the Commission, on: (a) environmental matters that potentially affect cetaceans; and (b) developments in cetacean populations/species that reflect environmental issues. It is tailored for a non-scientific audience. The 2013 SOCER (Annex K, Appendix 4) had the Mediterranean and Black Seas as the regional focus. Publications summarised ranged from impacts of fisheries removals on cetacean prey to strategies aimed at reducing bycatch in the severely reduced population of common dolphin, to contaminants in Mediterranean cetaceans. Disease continued to be an important issue in the Mediterranean. Finally, an overview published by ACCOBAMS identified the main threats to cetaceans in the Mediterranean and Black Seas.

Globally, numerous studies on climate change and ocean acidification are starting to show impacts on marine species. Data on the impacts of underwater noise are increasing with new models becoming available on stress responses in cetaceans linked to underwater noise.

The Committee encourages continued contributions to this effort. Next year, the focus of the SOCER will be on the Atlantic Ocean region.

12.2 Pollution

12.2.1 Update on POLLUTION 2000+ Phase II progress

At the intersessional POLLUTION 2000+ Phase II Workshop, held in 2010 (IWC, 2011a), four objectives for the cetacean pollutant exposure and risk assessment modelling component were agreed: (1) improve the existing concentration-response function for PCB-related reproductive effects in cetaceans (completed in 2011); (2) derive additional concentration-response functions to address other endpoints (e.g. survival, fecundity) in relation to PCB exposure (completed in 2012); (3) integrate improved concentration response components into a population risk model (individual-based model) for two case study species: bottlenose dolphin and humpback whale; and (4) implement a concentration-response component for at least one additional contaminant of concern.

SC/65a/E04 provided a summary of the intersessional work that was completed in POLLUTION 2000+, Phase III. The objective of this work was to develop a framework for assessing the health risks associated with contaminant exposure on cetacean populations. Two previous papers on the first phases of this work are Hall *et al.* (2011) and Hall *et al.* (2012).

Bioaccumulation of contaminants and their population level effects were explored using a stochastic model that integrates measured tissue concentrations with a dose-response relationship to estimate potential impact on population dynamics. Two examples were examined using this framework: bottlenose dolphins and humpback whales. One of the model outputs was an annual accumulation rate for blubber PCB levels (e.g. 1.2 mg/kg lipid for female bottlenose dolphins and 0.2 mg/kg lipid for Gulf of Maine humpback whales). These exposure levels would produce no discernible effects on population growth. Analyses of model parameter sensitivity and uncertainty indicate that the model is reasonably robust and would be acceptable for making population inferences and management decisions.

An approach that would allow concentrations of total blubber PCBs in cetaceans to be estimated from data on concentrations in their prey was also explored, assisting in situations where biopsy samples are not obtainable. In an example again using bottlenose dolphins, data on energy requirements and consumption rates on concentrations of total PCBs in prey were combined in a physiology-based toxicokinetic model.

These modelling approaches provide a risk assessment tool that can be used to determine the population consequences of exposure to contaminants. The model framework also has the potential for investigating the impact of a variety of stressors on cetaceans and is currently being converted into a web-based program with a user-friendly interface that will be accessible from the Commission website.

Since the Pollution 2000+ Phase III risk assessment work plan is near completion, the Committee began planning the next phase. The Committee established a Pollution 2020 steering group, which will next focus on assessing the toxicity of microplastics and polycyclic aromatic hydrocarbons and dispersants in cetaceans (see Annex K, item 11.2 and Appendix 2).

The Committee **commends** the progress on Pollution 2000+ Phase III objectives and **strongly supports** its continued work to further develop the necessary tools to assess cetacean pollutant exposure risk. The Committee **agrees** to the Pollution 2020 framework plan.

12.2.2 Oil spill impacts

After the Deepwater Horizon oil spill in April 2010, oil spill response was followed immediately thereafter by a Natural Resource Damage Assessment (NRDA) to investigate the injuries and impacts to cetaceans in the Gulf of Mexico. The NRDA investigation has included stranding response in the northern Gulf of Mexico; photo-id and biopsy surveys for bay, sound and estuary dolphins; aerial and boat-based surveys, including biopsy and tagging activities, for cetacean abundance and distribution in coastal and offshore habitats; and live capture/release health assessments.

An Unusual Mortality Event (UME) was declared in November 2010 for cetaceans in the northern Gulf of Mexico that started in February 2010 and now includes over 1,000 cetacean strandings. The Deepwater Horizon oil spill has not been ruled out as a possible contributing factor to this UME, which is the longest lasting and largest dolphin mortality event in US recorded history. In addition to the UME investigations, live capture/release health assessments of bottlenose dolphins from Barataria Bay, Louisiana (oiled area) and Sarasota Bay, Florida (reference site) were performed in 2011. Dolphins from Barataria Bay showed significant health issues, including pulmonary lesions and adrenal abnormalities, as compared to animals in Sarasota Bay. Chemical analyses associated with these stranded and live-capture dolphin studies have been completed and are currently being validated. In addition, a number of monitoring and assessment efforts on cetaceans have been conducted in offshore areas, including photo-id, passive acoustic monitoring, and tagging studies on pelagic species (e.g. sperm whales), as well as aerial and boat-based surveys.

The Committee **expresses great concern** about the continued high number of dolphin strandings in 2013. The Committee **agrees** that funding gaps are problematic for long-term monitoring projects, recognising that 3-5 year funding cycles are not geared toward such studies. The Committee welcomes the new information on marine mammal studies in the Gulf of Mexico and **encourages** scientists to provide restoration ideas for cetaceans to NOAA.

Information on oil spill preparedness was also presented. Details were provided on the Arctic Council's efforts to address oil spill preparedness (and response) based on the 1990 International Convention on Oil Pollution Preparedness

Response and Cooperation (OPRC), administered by the International Maritime Organization (IMO), to which all eight Arctic States are Parties[18]. Additionally, the Committee was given details on the US National Research Council's review of the capabilities, limitations, and needs for responding to an oil spill in the Arctic[19], as well as the US Arctic Research Commission's recently published white paper examining the state of oil spill preparedness, response and damage assessment in the Arctic[20].

Several workshops focused on Arctic resource development and policy will be held in the next year. Developing recommendations related to cetacean conservation and management may provide the Convenors of these workshops with information necessary for sound decision-making. The Committee **reiterates** its previous conclusion (IWC, 2011b, p.41) that a review of the capacity for oil spill response in the Arctic was an urgent priority in the aftermath of the Deepwater Horizon oil spill. The Committee **concludes** that it would be useful to know more about the current capacities and mechanisms of oil spill recovery. Given the amount of activity occurring related to oil spill preparedness and the fact that oil spill preparedness and response plans are being developed, the Committee **recommends** an increased exchange of information between the IWC Secretariat and the Arctic Council's Emergency Prevention, Preparedness, and Response Working Group (EPPR-WG).

12.2.3 Other pollution-related issues

In response to the statement in Resolution 2012-1 encouraging the World Health Organization (WHO) to conduct reviews of recent scientific publications regarding contaminants in certain cetacean products and give updated advice for consumers, the Committee **recommends** that the Secretariat reinitiate discussions with the WHO as a preliminary step, to ensure that they are in need of this information and would be willing to receive it, prior to moving forward on this Item.

Hunt *et al.* (2013) focused on methods that can produce information on parameters relevant to stress physiology, reproductive status, nutritional status, immune response, health and disease using non-lethal sampling techniques (see Annex K, item 7.3.2). Field application of these techniques has the potential to improve our understanding of the physiology of large whales, better enabling assessment of the relative impacts of many anthropogenic as well as ecological pressures. SC/65a/BRG23 reported on the progress of a programme to analyse biopsy samples of gray whales feeding off of Sakhalin Island, Russia that will include pregnancy testing, determination of stable isotope ratios and genetic analyses.

The Committee **commends** the recent advances in methods for non-lethal sampling, noting that information on stress physiology, reproductive status, nutritional status, immune response, health and disease are valuable to health assessment efforts. The Committee **endorses** this work and **strongly recommends** further development and improvement of these methodologies. The Committee **commends** the application of such techniques to the gray whales feeding off of Sakhalin Island, Russia.

The Committee received several contaminant-related papers associated with the Icelandic Research Programme, including those reporting concentrations of legacy persistent organic pollutants, trace elements, radioactivity and new contaminants of concern in Icelandic minke whales. A summary of the findings of these studies is listed in Annex K, item 7.3.3. The Committee thanked the Icelandic scientists for summarising these findings.

12.3 Cetacean Emerging and Resurging Disease (CERD)

In 2007, the Committee recognised the need for increased research and standardised reporting in a wide range of disciplines dealing with cetacean health (IWC, 2008d), which led to the creation of the Cetacean Resurging and Emerging Disease (CERD) Working Group.

12.3.1 Update from CERD Working Group

An update to the CERD work plan agreed in 2011 (IWC, 2012e, Appendix 3) included: (i) identification of regional and national experts/points of contact via Steering Committee membership; (ii) creation of a listserve and a website; (iii) creation of a Framework Document; and (iv) identification of and contact with organisations synergistic with the goals of CERD.

12.3.2 CERD website and work plan

Data on infectious and non-infectious diseases, general cetacean disease, nutritional disorders and biotoxins have been compiled and await entry. Additional input on skin diseases, visual health assessment and mortality events or unusual mortality events (UMEs) is needed. Although significant progress had been made the final website had not yet been completed. It was noted that an internship programme with projects aimed at expanding specific sections related to skin diseases, mortality events and visual health assessment would aid in this process.

The Committee **agrees** that supporting the aggregation of website information and input, and the ability to post and manipulate high-resolution images and video, are critical to the success of the CERD website. The Committee also **agrees** that there is value in linking to social websites in order to direct inquiries and information to the CERD website (for appropriate material). The Committee **encourages** continued development.

12.3.3 Strandings and mortality events

SC/65a/SM27 reported on a mass stranding event (MSE) in which 20-30 short-beaked common dolphins stranded on a beach in the Rio de Janeiro State, Brazil, and were returned to the water by tourists. The authors proposed that these pelagic dolphins were probably acoustically trapped or restricted by some noise source that caused them to panic and swim toward the beach and strand. An update also was received on a highly unusual event involving the long-term displacement and mass stranding of approximately 100 melon-headed whales that occurred in May-June 2008 in northwest Madagascar. An Independent Stranding Review Panel was formed to review all the information and a report is expected in a few months. Details of the response can be found in Annex K, item 8.3. The Committee **commends** industry and response organisations for a tremendous and successful effort in responding to and investigating this event.

Park *et al.* (2012) reported on a mass mortality of 249 finless porpoises that occurred on 3 February 2011 at a dyke in the Saemangeum Sea, Korea. This MSE was due to freezing surface water in the enclosed area and the animals died of suffocation. The Committee **expresses concern** about this MSE, especially with respect to the potential impact of dykes and encouraged the continued evaluation of animals in this area. The Committee **commends** the efforts made to investigate the stranding event.

[18]*http://www.Arctic-council.org/index.php/en/reources/news-and-press/press-room/733-press-release-15-may-kiruna-2.*
[19]*http://www.dels.nas.edu/study-in-progress/responding-spills-Arctic/DELS-OSB-09-02.*
[20]*http://www.Arctic.gov/publications/oil_spills.2012.html.*

SC/65a/BRG15 reported on a workshop held in April 2013 dealing with the ongoing southern right whale die-off at Península Valdés, Argentina. A previous IWC Workshop on the southern right whale die-off in 2010 (IWC, 2011f) drew attention to the increasing incidence of parasitic behaviour of kelp gulls, which peck at the outer skin and then feed on the blubber of live whales at Península Valdés. The recent workshop developed an additional hypothesis on the possible contribution of gull attacks to calf mortality at Península Valdés (see Annex F, item 4.4 for additional details).

The Committee **commends** the investigative team in Argentina for their thorough investigation. The Committee **encourages** continued work to evaluate the cause(s) of these mortalities, the implications to the population and the effectiveness of planned gull mitigation measures (and see Item 26).

Information on the International Workshop for Capacity Building on Marine Mammal Stranding (NOAA-IMARPE) was also received. The Government of Peru requested this workshop to help increase capacity for cetacean stranding response after a large die-off of common dolphins occurred in early 2012, in northern Peru. For more details see Annex K, item 8.3. Additional information on strandings and the detection of human-induced mortality was provided to a joint meeting of the SWG on Environmental Concerns and the Working Group on non-deliberate Human Induced Mortality. Furthermore, two papers on categorisation of human-induced trauma and interactions in cetaceans (Moore and Barco, 2013; Moore *et al.*, 2013a) were presented. Summaries of these papers can found in Annex J, item 6.

12.3.4 Other disease-related issues

The Committee received a summary of three disease-related papers reporting on the occurrence and prevalence of parasitic organisms and pathogens in Icelandic minke whales, associated with the Icelandic Research Programme. Discussion points related to these papers are listed in Annex K, item 8.4. The Committee thanked the Icelandic scientists for summarising these findings.

12.4 Anthropogenic sound

12.4.1 New information on the effects of anthropogenic sound on cetaceans

SC/65a/HIM01 discussed underwater bow-radiated ship noise in the Canary Islands (Spain), where a large fleet of commercial ferries operates on a year-round basis, and at the same time a high number of stranded cetacean carcasses in the area have shown injuries typically attributed to ship strikes. Whales may be capable of hearing approaching vessels at reasonable distances, enabling them to react fast enough to avoid collision; however, there are numerous factors to be considered in evaluating the actual collision risk. Overall, ferry traffic appears to contribute significantly to noise pollution in the Canary Islands archipelago.

SC/65a/E03 reported that significant progress has been made on the issue of marine noise pollution beginning in the mid-1990s. Within a few years, agencies such as the US Marine Mammal Commission had acknowledged the significance of marine noise pollution, as did some regional conventions, and later other legislative measures, such as the EU Marine Strategy Framework Directive – which specifically addresses noise – were developed.

New tools are under development to assess the cumulative effects of noise, such as cumulative noise and cetacean distribution mapping. Marine Spatial Planning and Marine Protected Areas are increasingly considering noise and disturbance, and industry is investing in noise reduction and alternative technologies. For at least some noise sources, there seems to be a general consensus that time-area closures represent one of the most effective available means of reducing impacts on marine mammals. Ship-quieting technologies for commercial vessels are also being developed. For further details see Annex K, item 9.1.

The Committee **encourages** time/area closures and the development of new quieting technologies to address noise pollution. The Committee **encourages** further scientific investigations to better understand the effects of sound on cetaceans and their habitats and to better understand the effectiveness of mitigation measures.

12.4.2 Update on new tools and approaches to mitigate effects of anthropogenic sound on cetaceans

The status of current noise management is one of traditional focus on relatively short-term and relatively small-scale human activities, emphasising thresholds of noise exposure from high intensity and short duration sources, with limited abilities to incorporate knowledge of background noise or look at the broader cumulative impacts. However, recently there has been a shift underway to focus on more ecologically-relevant spatial and temporal scales, in order to address chronic, perhaps lower intensity, sources.

Work being undertaken on soundscape mapping was presented last year. An update on progress intersessionally was provided and a joint IWC/IQOE (International Quiet Ocean Experiment) technical Workshop on soundscape modelling was proposed (see Annex K, item 9.2.1; the full proposal can be found as Annex K, Appendix 3). The goals of the Workshop are to exchange, evaluate and analyse soundscape modelling methodologies, examine and assess priority regions and important sound sources, and develop scientific recommendations.

The Committee **commends** the work on soundscape modelling. The creation of 'soundscapes' and noise maps was considered a valuable initiative. The Committee **encourages** the Workshop planners to consider not only the identification of sites of highest noise impacts, but also the direct benefits that could be realised by the reduction of noise impacts. A direct link to conservation outcomes such as reducing noise impacts on cetaceans could be of particular interest to the Commission. For additional discussion of the proposed Workshop, see Annex K, item 9.2.1.

The Committee **strongly supports** this proposal for a Workshop to be held intersessionally (Item 26).

12.5 Climate change

12.5.1 Update on recommendations from previous climate change Workshops

No updates on previous climate change Workshop recommendations were submitted for review and no papers were submitted under this topic.

12.5.2 Other climate change-related issues

The Committee recognised that climate change is an issue of increasing importance and should be kept on the agenda. In order to better identify topics for future climate change studies, the Committee **agrees** to the formation of an intersessional correspondence group (see Annex R). The Committee **agrees** to use the outputs of the intersessional group to develop future priorities under this topic.

12.5.3 Planning for Intersessional Arctic Anthropogenic Impacts Workshop

In 2010, the Commission requested that the Committee develop an agenda for a Workshop on Arctic Anthropogenic Impacts on Cetaceans. The Committee drafted an agenda and formed a Workshop steering group to further develop a plan for the Workshop (IWC, 2012f). A revised agenda that focused on anthropogenic activities related to oil and gas exploration, commercial shipping and tourism was developed by the Workshop steering group and presented last year (IWC, 2013j, p.255).

In discussion, it was noted that this will be a Commission Workshop and is planned for the next intersessional period. The agenda, venue, timing and participant list are still being developed.

The Committee recognises that the topic of anthropogenic impacts to cetaceans in the Arctic is broad and complex and **encourages** further efforts to address these impacts. The Committee noted that the activities recommended above under Item 12.2.2 on oil spill preparedness and responses represent one immediate effort to better coordinate with Arctic IGOs.

12.6 Other habitat-related issues

12.6.1 Interactions between Marine Renewable Energy Devices (MREDs) and cetaceans

SC/65a/E02 reviewed public knowledge of the Marine Renewable Energy Devices (MRED) Workshop report from last year (IWC, 2013b), as well as its larger impacts, to better understand whether the recommendations from such reports are reaching the appropriate audiences and providing them with useful information. Workshop participants were surveyed and whilst the respondents found the Workshop useful personally and the meeting generally well run, the replies provided little evidence yet that the Workshop has had any influence on policy-making or other processes related to marine renewables. There is also little sign of any footprint of the Workshop in any recent scientific or other related literature. Related to this, several participants raised concerns about the inability to find and access the report, as well as how to cite it.

The Committee **agrees** that the visibility and accessibility of its reports needs to be improved and **encourages** the Secretariat and the Committee to consider additional mechanisms to enhance access to, and distribution of, Committee reports.

12.7 Work plan

This is discussed under Item 24.

13. ECOSYSTEM MODELLING

The Ecosystem Modelling Working Group was first convened in 2007 (IWC, 2008c). It is tasked with informing the Committee on relevant aspects of the nature and extent of the ecological relationships between whales and the ecosystems in which they live.

Each year, the Working Group reviews new work on a variety of issues falling under three areas:

(1) reviewing ecosystem modelling efforts undertaken outside the IWC;
(2) exploring how ecosystem models can contribute to developing scenarios for simulation testing of the RMP; and
(3) reviewing other issues relevant to ecosystem modelling within the Committee.

The report of the Working Group on Ecosystem Modelling is given as Annex K1.

13.1 Review ecosystem modelling efforts undertaken outside the IWC

13.1.1 Modelling of the direct relationship between baleen whale populations and the abundance of their prey

Two invited presentations were made on ecosystem models of the effects on predators of fishing on forage fish, summarising the results of two large studies commissioned by the Marine Stewardship Council, MSC (Smith *et al.*, 2011) and the Lenfest Ocean Program (Pikitch *et al.*, 2012), that were completed in recent years. An important message from these studies is that fishing of forage fish down to their MSY level may have major impacts on predators, including birds and marine mammals, in some ecosystems. SC/65a/EM03, which summarised the MSC study, explored the effects of different levels of depletion of forage fish in five different ecosystems (the southern Benguela Current, the northern Humboldt Current, the California Current, the North Sea, and southeastern Australia) using three modelling frameworks (Ecopath with Ecosim [EwE], OSMOSE and Atlantis). The results showed a trade-off between yield from the forage fish species and impacts on the rest of the ecosystem. Although the broad results were relatively robust to the type of model used, predictions about impacts of and on particular species or groups varied considerably between models, suggesting that their use for 'tactical purposes' is not yet warranted.

SC/65a/EM05, which summarised the Lenfest study, conducted a meta-analysis of 72 published studies that used Ecopath models on a variety of marine ecosystems, with the goals of characterising the role of forage fishes and fisheries, and of providing general recommendations for conservative fisheries management. Further analyses using EwE models for 10 ecosystems suggested that minimum biomass levels to avoid predator declines should be about 75% of the unfished biomass – much higher than those predicted by single-species, MSY-based management. A tiered management approach was recommended where more conservative harvest limits are applied when there is high uncertainty about forage fish dynamics or predator dependencies. This study did not evaluate the impacts on marine mammals, and the general approach would need modification to address important aspects of whale populations which do not exhibit the high degree of variability that is characteristic of forage fish populations, or the effects of 'prey switching' that occurs when several forage species are present in an ecosystem.

The Committee **concurs** with the authors of the presented studies that the models used in the studies to date are useful for their broad-scale strategic conclusions, but are not yet suitable guides for short-term tactical management decisions. The Committee **agrees** that, in broad terms, the case has been established that forage fisheries are expected to impact predator populations including cetaceans, and considers that the priority for this Group should now be on more detailed models for specific cases involving whales, with more attention being paid to the dynamics, including stochastic factors. The Committee **agrees** that the framework discussed in Item 13.2 is a promising basis for modelling the effect of changes in prey species on whale populations.

13.1.2 Update from CCAMLR's Ecosystem Monitoring and Management Programme (WG-EMM) on krill and its dependent predators

The Committee held a joint Workshop with CCAMLR in 2008 (IWC and CCAMLR, 2010). Since then, the

Committee has identified significant knowledge gaps in aspects such as spatial variability and trends in prey species, on the relationships between predators and prey, and on the effects of environmental variability on predators. Given CCAMLR's considerable expertise on these aspects, the Committee **agrees** that the Chair of the Committee should write to CCAMLR in time for the meeting of the WG-EMM in Bremerhaven, Germany, in early July 2013, to discuss how to establish future collaborations.

13.2 Explore how ecosystem models can contribute to developing scenarios for simulation testing of the RMP

De la Mare (2013) described a modelling framework originally presented at the fourth MSYR Workshop (SC/65a/Rep05) that uses spatially resolved individual animal behaviour and detailed energy budgets to determine reproductive success and mortality in an environment where food has a patchy spatial distribution. One immediate application relates to the characterisation of yield curves for populations in stochastic environments, including assessing the relative advantages of defining yield curves in terms of number or biomass.

The Committee identified nine issues (listed in Annex K1, item 3) relating to ecosystem effects and the RMP that could be usefully explored either with this individual-base model (IBM) or with simplified emulator models that mimic the behaviour of the IBM. The Committee appointed a correspondence group under de la Mare to develop specific trials for the RMP for one of these issues (characterisation of yield curves for populations in stochastic environments) and **agrees** to make two of the remaining items a high priority for next year:

(1) effects of competition, including effects on whales from fisheries on prey species; and
(2) observable environmental and population characteristics likely to be indicators of ecosystem effects.

The Committee **encourages** analyses on these issues and **agrees** to invite outside expertise as needed.

13.3 Review of other issues relevant to ecosystem modelling within the Committee

13.3.1 Update on Antarctic minke whale body condition analyses

For the last three years, the Committee has discussed apparent declining trends in blubber thickness and body condition in Antarctic minke whales (Konishi *et al.*, 2008) over the 18 years (1987-2006) of the JARPA special permit programmes (e.g. IWC, 2013i). At the heart of the discussion has been the validity of the statistical methods that were used to derive these trends and more specifically whether the models fitted so far adequately captured the main sources of variability in the data, given the nature of the sampling (de la Mare, 2011; 2012). This discussion is relevant to ecosystem modelling because the findings have implications for energetics, reproductive fitness, foraging success and the prey base itself, all of which are important as input in models.

Previously, the Committee has requested further analyses of the data, including:

(1) determining whether the models fitted so far capture all the main features of the data,
(2) determining whether the estimate of trend could be made more precise,
(3) analysing the two sexes separately,
(4) including the interaction of slopes by latitudinal band with year as a random effect, and
(5) investigating independence issues by using mixed-effects models with trackline as a random effect (IWC, 2011e; 2012d).

Two reanalyses of the data were conducted at the 2011 meeting (IWC, 2012d, p.260), one using the jack-knife method with one year as the unit on the published regression model, the other using mixed-effect models to account for some of the variance structure. Both reanalyses resulted in a much higher variance of the estimated trend, but the point estimates were little changed and were still significant.

This year, SC/65a/EM04 presented jack-knife estimates of the variance of the trend by taking individual years or groups of up to three years as the jack-knifing unit. Unexpectedly, the variance of the trend estimate was much less than the variance calculated by Skaug (2012) from the model itself. This led to considerable discussions within the Working Group on the appropriate statistical procedures to use. These are detailed in Annex K1 under item 4.1 and are not repeated here. In addition, a new analysis of total body fat was also presented (Annex K1, Appendix 6) that the authors believed supported the earlier conclusion of a decline in energy storage in Antarctic minke whales during the JARPA period but that others questioned.

The Committee **reiterates** its recommendations from previous years that the outstanding issues raised at recent meetings should be examined (for details see Annex K1, item 4.1). A number of additional suggestions were also made this year. The Committee **encourages** additional analyses to be undertaken on both the blubber thickness and body fat data and noted that papers should ideally be submitted to the forthcoming JARPA II review Workshop (see Item 17.3).

13.3.2 Other, if new information is available

SC/65a/EM02 outlined plans for conducting ecosystem modelling for baleen whale species in Antarctic Area IV, based on data from the JARPA and JARPA II programs. Two types of approaches will be employed; one is a comprehensive, 'whole ecosystem' model (EwE), and the other is a 'model of intermediate complexity' for ecosystem assessments (a multi-species production model). Baleen whales and krill play key roles in both, and the results will be applied to available time series data of baleen whales, seals and krill. Results from these two approaches will be reported at the JARPA II review.

The Committee **welcomes** these plans but suggested that the aims of the modelling exercise be better clarified. The author explained that one aim is to compare the results from a broad-sweep model such as EwE that encompasses most components of the ecosystem with those from a model that includes more detail on the dynamics of the main species of interests. Documentation of the input sources will be provided and options for diagnostic tests of the predictions should be developed. This information should be included in any paper presented to the forthcoming JARPA II review.

SC65a/EM01 presented a preliminary report from a multi-species modelling effort to study the role of minke whales in the marine ecosystem around Iceland, including consumption of sand eel and cod. In its initial phase the focus is on implementing single-species models in the Gadget statistical framework, but the medium to long-term plans are to build multi-species models and to compare different modelling approaches such as Gadget, FishSums, EwE and Atlantis, in order to assess their value to the management of living resources in Icelandic waters as part of the MareFrame project.

The Committee **welcomes** these efforts and **encourages** further refinements to include the effects of environmental variability on prey species and to incorporate prey switching in the next version. It was also noted that these exercises typically require a substantial amount of exploration to determine what is driving the observed trends in the predicted abundance of the target species.

SC/F13/SP02rev, SC/F13/SP03rev and SC/F13/SP04rev were initially presented at the Icelandic Special Permit Expert Panel Review Workshop in February 2013 and then revised in the light of comments made by the expert panel (see SC/65a/Rep03). These papers presented new information on the feeding ecology of common minke whales based on analyses of stomach contents, fatty acid profiles in blubber and blood tissues, and stable isotopes measured in blood, muscle, and skin tissues. The studies showed pronounced spatial and temporal variations. The fatty acid and stable isotope analyses further revealed tissue specificity, indicating that the results need to be interpreted with their limitations in mind. Together, these papers indicated that the differences between the stomach contents, fatty acid and stable isotope analyses can best be explained by the different time periods reflected by these methods, such that the stomach content analysis represents the most recent feeding and is therefore the best measure for local diet composition within the time-frame of their model, while the other two methods reflect feeding before arrival on the Icelandic feeding grounds in spring.

Tamura and Murase welcomed the information on diet data from these studies stating that they are useful in ecosystem models. Detecting changes in prey requires long time-series of data and fatty acid analyses complement data from stomach analyses.

SC/65a/O02 presented estimates of seasonal energy deposition in minke whales from Icelandic waters, based on measured increase in weight and energy of different tissues. Minke whales increase their weight by 27% over the feeding season, but due to increases in energy density of tissues, the total increase in energy content of the body is around 90%. Most of the energy is stored in adipose tissue (blubber and visceral fat), but posterior dorsal muscle and bone tissue are also important sites for energy storage.

13.4 Development of a list of priority populations as candidates for Conservation Management Plans

The Committee **agrees** that the Ecosystem Modelling Working Group can best assist in this process in the context of provide specific advice once CMPs have been identified (see Item 21).

13.5 Work plan

The Committee's views on the work plan for Ecosystem Modelling can be found under Item 24.

14. SMALL CETACEANS

14.1 Review current status of selected populations of small cetaceans in east Asian waters (China [including Taiwan], Korea, Japan and Russia [white whales only])

This year, the priority topic was to review the current status of selected populations of small cetaceans in east Asian waters (see Annex L, fig. 1). The selection of species was based primarily on concerns about conservation status and the expectation that new information would be available.

14.1.1 Narrow-ridged finless porpoise (Neophocaena asiaeorientalis)

14.1.1.1 TAXONOMY AND NOMENCLATURE

SC/65a/O01 proposed that the general acceptance of two identified species in the genus *Neophocaena* – the narrow-ridged finless porpoise (*N. asiaeorientalis*) and the Indo-Pacific finless porpoise (*N. phocaenoides*) – should be recognised by the IWC. The change in taxonomy was based on clear morphological differences, genetic data and partial sympatry of the two forms in the Taiwan Strait (Jefferson and Wang, 2011). The Committee **endorses** the updating of the IWC list of recognised species (see Item 20).

SC/65a/SM24 presented a genetic analysis of finless porpoises in Japanese waters. The Committee **agrees** that these results confirmed previous ecological, morphological and molecular studies showing that there are at least five separate local populations of finless porpoises in Japanese waters that should be treated as different management units.

14.1.1.2 BYCATCH: REPUBLIC OF KOREA

Korea reported a total bycatch of more than 1,000 finless porpoises in 2011, including 249 that died under ice after being trapped inside a newly constructed 33km dike within the Saemangeum reclamation project (Yellow Sea). In 2012, Korea reported bycatches of 2,050 finless porpoises in the Yellow Sea and 128 in the Sea of Japan/East Sea (see details in Annex L, table 1).

Deliberate killing of cetaceans has been illegal in Korean waters since 1986 and a requirement has been in place since 1996 to monitor whale meat coming from incidental catches. This was amended in 2011 to intensify monitoring of the circulation of whale meat in markets. Currently, every incidental catch must be reported to the Korean Coast Guard and a tissue sample from each animal must be submitted to the Cetacean Research Institute for its DNA registry established to detect and trace illegal catches. The Korean government has intensified its monitoring effort since 2011 and consequently the reported number of finless porpoises bycaught in the Yellow Sea has increased dramatically. Korea will prepare a mitigation programme to reduce the finless porpoise bycatch, including consideration of gear modifications, changes to fishing practices and 'pingers'.

Zhang *et al.* (2005) provided uncorrected (and thus minimum) estimates of finless porpoises of 21,532 animals in offshore waters and 5,464 animals in near-shore waters along the west coast of the Korean Peninsula (South Korean waters) to Jeju Island. At that time (IWC, 2006b), the Committee had welcomed the studies and looked forward to their future refinement. The Committee noted that the current bycatch of 2,000 porpoises would be about 7.4% of an estimate of total uncorrected abundance of 27,000 porpoises in 2004.

The Committee **appreciates** the valuable information on finless porpoise bycatch provided by the Korean scientists. It **encourages** researchers and managers to continue their efforts to improve reporting and investigate ways to assess and manage the bycatch, particularly given the uncertainty regarding sustainability. The Committee **recommends** that an analysis be conducted to estimate past bycatches of finless porpoises using data on historical and recent fishing effort together with recently documented bycatch levels. It further **recommends** that available abundance data on finless porpoises in Korean waters be summarised for consideration at next year's meeting together with bycatch data to allow a better evaluation by area. The Committee **commends** the Korean authorities for their efforts to reduce this bycatch and **requests** that a report summarising progress on bycatch mitigation measures be submitted next year.

14.1.1.3 BYCATCH: JAPAN

Reported bycatch in Japan is low; a provisional figure of only 15 finless porpoises were reported as bycaught for January-December 2011[21]. Provisional data on strandings in Japan over the same time period indicated a total of 181 finless porpoises of which 178 were necropsied; it is not known to what extent the strandings were a result of bycatch.

14.1.1.4 IUCN RED LIST STATUS[22]

In 2012, IUCN listed *N. asiaeorientalis* as Vulnerable (see Annex L, item 3.1.4, for full details). Reeves reported that a new assessment of the Yangtze subspecies *N. asiaeorientalis asiaeorientalis* will soon be published listing the subspecies as Critically Endangered.

14.1.2 Populations of Tursiops aduncus *in Korean and Japanese waters*

Wang and colleagues (Wang *et al.*, 1999, 2000a, 2000b) distinguished the Indo-Pacific bottlenose from the common bottlenose dolphin using genetic, osteological and external morphological data. Around Japan, Kurihara and Oda (2006; 2007) concluded that the Indo-Pacific bottlenose dolphin occurs in at least three locations: (1) Amami Islands; (2) Amakusa-Shimoshima Island; and (3) Mikura Island. Kim *et al.* (2010) confirmed the presence of this species around Jeju Island, Korea.

14.1.2.1 JAPAN

SC/65a/SM26 summarised the abundance of, and threats to, nine populations of Indo-Pacific bottlenose dolphins in the Japanese Archipelago (details are given in Annex L, item 3.2.1). The Committee **notes with concern** an apparently serious bycatch problem around Amakusa-Shimoshima Island (Shirakihara and Shirakihara, 2012). It **recommends** that this problem is monitored closely and that efforts are made to reduce bycatches.

SC/65a/SM29 reported on a stranding of a 2.7m male Indo-Pacific bottlenose dolphin in Kagoshima for which gross and histological examinations suggested the animal had a Lobomycosis-like disease. Analyses are underway to confirm this diagnosis.

The Committee **agrees** that it is important to understand the origins and routes of spreading of this disease and **recommends** further investigation and continued close monitoring of the population around Amakusa-Shimoshima Island in western Kyushu.

While recognising the responsibility of the range state for the conservation and management of small cetacean species, Japan reconfirmed its position on the involvement of IWC in the management of small cetaceans and reserved its position on all management recommendations regarding small cetaceans.

14.1.2.2 KOREA

Korean scientists provided information on the year-round resident population of Indo-Pacific bottlenose dolphins in the coastal waters of Jeju Island. The total population was estimated[23] as 124 (95% CI=104-143) in 2008 and 114 (95% CI=109-133) in 2009 using photo-identification mark-recapture methods. The animals are most regularly observed along the northern coast of the island. Bycatch has been investigated since 2009 and the annual bycatch rate was estimated at 7%, with most of the animals being trapped in pound nets (a type of set net or trap). More than 80% of the dolphins have been alive when found in pound nets; if released alive, a gradual increase in the local dolphin population might be expected.

An effort is underway to release three dolphins back into the wild in summer 2013 after being instrumented with satellite tags in the area of Jeju Island (where they were caught before being sold illegally to Korean oceanaria). They are among at least 11 bottlenose dolphins brought into captivity from the Jeju population in the last four years.

The Committee thanked H-W Kim and colleagues for providing information on the small local population of bottlenose dolphins around Jeju. It **encourages** their work to continue and **requests** updates on this including the satellite-tagged released animals and efforts to release dolphins in fishing gear.

14.1.3 Short-finned pilot whales (Globicephala macrorhynchus) *in Japan*

SC/65a/SM12 reviewed available information on the status of the southern and northern form short-finned pilot whales in Japan. Available abundance estimates of both forms are more than twenty years old. Catches have declined but the cause or causes are uncertain. Changes in catch composition of the northern form in the 1980s, with a declining proportion of old and large individuals (probably mostly males) observed in the catch, was inferred to indicate a decline in the population. No recent information has been published on the catch composition of either form. In the absence of an analysis of relevant data on effort, catch locations, etc., the most parsimonious assumption would be that the decline in catches has been due to a decline in the availability of pilot whales in the whaling areas.

In the absence of new information, the Committee **recalls** its previous concerns regarding these stocks (IWC, 1987; 1992). A **recommendation** relating to catches of small cetaceans by Japan (including this species) is given under Item 14.4.1.

Morishita stated that the declines in catches of small cetaceans in Japan are largely attributable to economic factors such as low prices of the products, high fuel prices and the effects of the 2011 earthquake and tsunami.

14.1.4 Dall's porpoise (Phocoenoides dalli)

SC/65a/SM11 reviewed available information on the status of Dall's porpoise populations taken in hand harpoon hunts in Japan. Details are given in Annex L, item 3.4. The most recent available abundance estimates of the hunted *dalli*-type population date from 2003 (Miyashita *et al.*, 2007)[24]. The Committee previously recommended that a complete survey of the ranges of the populations be undertaken as soon as feasible (IWC, 2009e).

Catches of both forms have declined, particularly those of the *dalli* form, with only 16% of the quota taken in 2010. Available data are insufficient to determine the cause of catch declines and no up-to-date information on catch composition has been published for either form of the species. In 2012-13 the catch limits were set at 7,147 *dalli*-type and 6,908 *truei*-type porpoises; around 4% of the 2003 abundance estimates.

The Committee notes that abundance estimates are now ten years old and catch limits are still probably unsustainable (Wade *et al.*, 2008). The Committee **reiterates** its previous concerns (IWC, 2002a, pp.57-8; 2008a, p.51). A **recommendation** relating to catches of small cetaceans by Japan including this species is given under Item 14.4.1.

[21]*http://www.jfa.maff.go.jp/j/whale/w_document/pdf/130531_progress_report.pdf.*
[22]*http://www.iucnredlist.org/.*
[23]The Committee did not review this estimate.
[24]The estimates were not assessed by the Committee.

14.1.5 White whales of the Okhotsk Sea

SC/65a/SM23 summarised available information on population structure, abundance and historical catches of white whales in the Okhotsk Sea. Based on aerial surveys in 2009-10, the entire population was estimated to be a minimum of 6,113 (CV=0.068), and when corrected for availability bias was estimated at 12,226 (see Annex L, Appendix 2 for more details). Two-thirds of satellite-tagged animals (2007-10, *n*=22) that summered in the Sakhalin-Amur region stayed in or visited the eastern part of the Shantar region in the autumn. In the winter, the whales travelled northward and offshore, where they used different wintering grounds. None of the 22 animals went to the area which a single tagged animal from western Kamchatka visited in winter.

SC/65a/SM23 also reported genetic data that suggested the existence of at least two Okhotsk populations: northeastern Okhotsk Sea and western Okhotsk Sea. Animals from the western population have been subject to live-capture for the last 30 years under an annual quota system. The average annual catch from 2000-12 was 23 (range 0 to 44). In 2012, the quota for the North-Okhotsk subzone was increased by a factor of five (to 212) and then in 2013 to 263; 44 were live-captured in 2012. There is a quota of 45 for the West-Kamchatka subzone in 2013.

After reviewing the information from both SC/65a/SM23 and a recent assessment by Reeves *et al.* (2011) the Committee **concludes** that the Russian domestic quota of 263 for the North-Okhotsk subzone was at least 6 to 8 times higher than that likely to be sustainable for the Sakhalin-Amur portion of the total regional population. In practical terms, the live captures are likely to be conducted at a single site which means they will target only the Sakhalin-Amur summer aggregation which raises concerns about local depletion.

Given this, the Committee **recommends** that the live-capture quota for the North-Okhotsk subzone be reduced to a level that is consistent with available scientific data and that at least four summer aggregations in the North-Okhotsk subzone should be managed separately such that the total allowable quota is broken down into separate quotas for Sakhalin-Amur, Ulbansky Bay, Tugursky Bay and Udskaya Bay (a fifth aggregation, in Nikolaya Bay, should have a zero quota as the number of animals using that bay is very small; SC/65a/SM23).

The Committee further **recommends** that no removals are authorised for the West-Kamchatka subzones, until sufficiently rigorous analyses of sustainability are provided that are at least as rigorous to those currently available for the North-Okhotsk subzone.

14.2 Report on the Voluntary Fund for Small Cetacean Conservation Research

14.2.1 Update on the 2011 awarded projects

Of the nine projects awarded in 2011, four were completed in 2012 and two projects will be completed in 2013. A further three will end at the beginning of 2014. See details in Annex L, item 4.1.

At this meeting, information was received from five projects (Annex L, item 4.1). The Committee was informed that the Secretariat is preparing a dedicated section for the IWC website on projects funded by the Small Cetacean Conservation Research Fund that will summarise projects' main achievements and ongoing activities.

14.2.2 Update on the 2013 selection process

Thanks to recent voluntary funding from Italy, the Netherlands, UK, USA, WWF-International and World Society for Protection of Animals, the Small Cetacean Conservation Research Fund (SCCRF) was replenished sufficiently to allow funding of a few new projects, fully or partially depending on their budget requests. A new call for proposals was announced by the Secretariat in April 2013. A total of 19 proposals were received by the deadline. In accordance with the agreed procedure, the Review Group (Bjørge, Donovan, Fortuna, Gales, Reeves, Rojas-Bracho) recommended five projects from this year's call for proposals (Table 4). The Committee **endorses** these five projects.

Table 4

Summary of projects recommended to be funded by the Voluntary Fund for Small Cetacean Research, and their principle investigators (PI).

PI	Project title
Chen	Defining the units of conservation and historic population dynamics for two small cetacean species affected by directed and incidental catches in the North Pacific. (F)
Kelkar	Strengthening the meaning of a freshwater protected area for the Ganges river dolphin: looking within and beyond the Vikramshila Gangetic Dolphin Sanctuary, Bihar, India. (P)
Mustika	A pilot study to identify the extent of small cetacean bycatch in Indonesia using fisher interview and stranding data as proxies. (P)
Rajamani	Capacity building in conducting cetacean abundance surveys in southeast Asia through a training workshop and actual surveys. (P)
Wakid	Investigating the abundance of Ganges river dolphin (*Platanista gangetica gangetica*) and factors affecting their distribution in Indian Sundarban. (F)

Key: F=full funding; P=partial funding.

Given the large number of requests and the limited funding available, for future calls for proposals the Review Group had recommend that priority is given to projects with clear potential for effective conservation outcomes in areas of particular need (e.g. critical conservation problem known or suspected, but not likely to be addressed without support). The Committee **agrees** with this recommendation.

14.3 Progress on previous recommendations

14.3.1 Vaquita

The plight of the critically endangered vaquita has been discussed by this Committee and the International Committee for the Recovery of the Vaquita (CIRVA) for many years. In recent years, the focus of the recommendations has been that the only way to prevent the extinction of this species is to eliminate gillnets from its entire range.

SC/65a/SM13 provided information on the continuation of the Acoustic Monitoring Scheme for Vaquita. Preliminary analyses show with 60% credibility that the acoustic encounter rate has decreased between the sampling periods, indicating continued decline of the population.

The new Mexican Administration established the 'Advisory Commission to the Presidency of Mexico for the Recovery of Vaquita' which includes the Minister of Environment, the National Commissioner of Fisheries, two members of Congress, NGO representatives, four scientific advisors, fishing representatives and the Navy. At its first meeting in February 2013, one key agreement was to eliminate gillnets and other entangling nets throughout the vaquita's range and to establish a compensation programme for fishermen. At its second meeting in March 2013, it was agreed that Federal and State Government officials and representatives of civil society would visit the fishing communities to inform the fishermen of the alternatives that the federal government has prepared to address the social problems arising from vaquita conservation measures in the region. It was also agreed that the head of the National Institute of Ecology and Climate Change would explore the feasibility of carrying out a new vaquita population survey cruise in Autumn 2013.

On 6 June 2013, the Mexican government approved the new Mexican Official Standard NOM-002-PESC that requires fishermen to switch from shrimp gillnets to alternative fishing gear (specifically purpose-built light trawls) over a three-year period (30%, 30% and 40% annual reduction over the three-year period).

The Committee **commends** the Government of Mexico for establishing the Advisory Commission to the Presidency of Mexico for the Recovery of Vaquita and for the final approval of the Mexican Official Standard NOM-002-PESC.

CIRVA members produced an analysis, required by the Government of Mexico, which uses a Bayesian model to estimate current (i.e. 2013) abundance of the vaquita population. The posterior distribution for 2013 abundance indicates a best estimate of 189 individuals. This result confirms the urgent need to remove all entangling nets from the vaquita's range to allow the population to recover.

In light of the significance of this updated estimate, the Committee **agrees** to include the full analysis as an appendix to its report (see Annex L, Appendix 3). The Committee **notes with great concern** the model's prediction that if the status quo is maintained, the species population will continue to decline towards extinction.

It is a recurring problem that the rarer a species is, the harder it becomes to collect sufficient sightings to generate robust abundance estimates and detect population declines. As a result, the Committee **strongly endorses** the decision to embed empirical estimates of vaquita abundance and trends (such as in this case the acoustic monitoring data) into rigorous statistical models, using all available relevant data and information to predict population trajectories. The Committee **expresses** confidence that the best estimate of vaquita abundance in 2013 is **189 individuals** (see Annex L, Appendix 3).

In addition, the Committee **reiterates its previous recommendations** that further actions to eliminate bycatch should **not** be delayed in favour of efforts to collect more population survey data.

14.3.2 Hector's dolphin

SC/65a/SM07 reported on efforts to improve estimates of abundance for local populations of Hector's dolphins using capture-recapture (CR) methods based on genotyping and photo-identification. The authors presented three consistent abundance population estimates: (1) a genotype CR (Lincoln-Petersen estimator with Chapman Correction); (2) a photo-identification CR; and (3) a single-sample, linkage disequilibrium method, giving the effective number of breeding individuals in the parental generation. Details are given in Annex L, item 5.2.

14.3.2.1 MAUI'S DOLPHIN

Maui's dolphin is the North Island (New Zealand) coastal endemic sub-species of Hector's dolphin. The Committee was informed that the management measures it recommended last year were incorrectly attributed to a proposal by the New Zealand Government. The Committee **acknowledges and regrets** this mistake.

SC/65a/SM06 presented an update on the status of Maui's dolphins. The population has declined significantly with the latest genetic mark-recapture analysis in 2010/11 estimating a population size of 55 individuals one year and older (Hamner *et al.*, 2012). The author suggested that unless their full range out to the 100m depth contour (including harbours) is protected against gillnetting and trawling (95.5% of human-caused mortality; Currey *et al.*, 2012), Maui's dolphins will decline to 10 adult females in six years and become functionally extinct (<3 breeding females) in less than 20 years, even under maximum population growth (0.018 according to Slooten and Lad, 1991). Additional threats to Maui's dolphins (besides bycatch) include seismic survey work in or near their habitat and a plan to begin development of the world's largest marine iron sand mining operation.

SC/65a/SM22 reviewed the response of the New Zealand Government to the 2012 recommendations of the Committee for urgent action. Although some measures were taken to limit bycatch, the author considered that they were insufficient because they did not cover the entire range. The paper stated that the protected area should be expanded, all gillnetting and trawling should be banned within it (including harbours), and restrictions should be placed on oil and gas development and on other potentially harmful activities where the dolphins are found, including a buffer zone.

Currey *et al.* (2012) described the risk assessment undertaken in June 2012 to inform the Maui's Dolphin Threat Management Plan. The risk assessment identified 23 activities or processes that pose a threat to the sub-species, with bycatch in commercial set net, commercial trawl, and recreational/customary set net fisheries assessed as likely to have the greatest impacts. The risk posed by the cumulative impact of all threats was assessed as significant, resulting in a high likelihood of, and a potentially rapid rate of, population decline. The spatial overlap between dolphin distribution and commercial fishing effort helped to identify specific areas where risk posed by commercial fishing activities remained, given management measures already in place. There was a reported capture of a dolphin in the south end of the Maui's range in January 2012 but no specimen was available to determine whether it was a Maui's dolphin or a specimen of the other Hector's dolphin subspecies. In response, interim measures were put in place in July 2012 that either restrict fisheries activities or require 100% observer coverage in the set net fishery in much of the area where the risk assessment indicated a continuing risk to Maui's dolphins from commercial fisheries.

Maas stated that the 100m depth contour is used to define the offshore limit of the range for Maui's dolphins; this ranges from 4 to 39 n.miles. However, Currey noted that the risk assessment expert panel estimated the offshore distribution as out to 7 n.miles based on modelling, public sightings, strandings and historical information on the dolphins' alongshore range. The fishery restrictions are based on distance from shore and vary between 2 to 7 n.miles.

New Zealand has a limited observer programme for Maui's dolphins in the trawl fisheries and the limited data suggests some risk of bycatch in trawl gear. The great uncertainty surrounding aspects of Maui's dolphin ecology and distribution makes evaluation of the efficacy of management very difficult. Emergency measures could be triggered by further bycatch.

The Committee **agrees** that management measures must be precautionary. If any fisheries with the potential for bycatch were to remain active within the range of Maui's dolphins, 100% observer coverage would maximise the chance of identifying any bycatch and providing information that might trigger immediate further area closures.

In conclusion, the Committee **reiterates its extreme concern** about the survival of Maui's dolphin given the evidence of population decline, contraction of range and low current abundance. The Committee **agrees** that the human-caused death of even one dolphin in such a small population would increase the extinction risk for this subspecies.

The Committee therefore **recommends** that rather than seeking further scientific evidence, the highest priority should be given to immediate management actions that will lead to the elimination of bycatch of Maui's dolphins. This includes full closures of any fisheries within the range of Maui's dolphins that are known to pose a risk of bycatch of small cetaceans.

The Committee **commends** the New Zealand Government on its initial and interim measures to protect Maui's dolphins. However, the Committee **emphasises** that the critically endangered status of this sub-species and the inherent and irresolvable uncertainty surrounding information on small populations require the immediate implementation of precautionary measures. Ensuring full protection of Maui's dolphins in all areas throughout their habitat, together with an ample buffer zone, will minimise the risk of bycatch and maximise the chances of population increase.

14.3.3 Irrawaddy dolphins

SC/65a/SM05 presented work on Irrawaddy dolphins in Laos where on the Laos-Cambodia border only six individuals remain in the trans-boundary pool, compared to at least 17 present in 1993. Despite efforts at protection on both sides of the border, the continuing use of gillnets, explosives and electric fishing gear as well as the proposed Don Sahong dam will very likely cause the extirpation of this small group of dolphins.

The Committee **agrees** that the situation in Laos was of serious concern and that without urgent conservation measures in the trans-boundary pool and the surrounding area as recommended in SC/65a/SM05, the remaining dolphins will not persist for much longer.

Porter reported that individuals from six populations of Irrawaddy dolphins in Malaysia, India and Bangladesh had developed cutaneous nodules. Disease prevalence ranged from 2.2% to 13.9% with the two most affected populations inhabiting the most polluted of the six areas. In India, prevalence was significantly higher in 2009-11 than in 2004-06. The emergence of this disease in several populations is of concern given the possible link to degraded environmental conditions and the vulnerability of this species to other threat factors.

The Committee thanked Porter for this information and **encourages** further investigation in collaboration with health experts and biologists working in these (and other) regions.

14.3.4 Atlantic humpback dolphin

SC/65a/SM16rev provided an update on an IWC Small Cetacean Research and Conservation Fund (SCRCF) project on the Atlantic humpback dolphin in Congo and Gabon. Details can be found in Annex L, item 5.4.

The Committee **welcomes** the important contribution to research and conservation made by this project and looks forward to receiving further information in future meetings.

14.3.5 Indo-Pacific humpback dolphin

Updates from three projects funded under the IWC SCRCF were presented at this meeting (see Annex L, item 5.5 for details). Smith *et al.* (2013) provided an update on their project to determine the population identity for animals in the northern Bay of Bengal, Bangladesh and to contribute to the resolution of taxonomy within the genus *Sousa*; Wang (2013) reported on progress on photo-identification monitoring of the Eastern Taiwan Strait Population, and information was presented on the project on the ecology, status, fisheries interactions and conservation of coastal Indo-Pacific humpback and bottlenose dolphins on the west coast of Madagascar.

The Committee **welcomes** the important contribution to research and conservation made by these projects and looks forward to receiving further information in future meetings.

14.3.6 Harbour porpoise

SC/65a/SM21 reported on a ship board double-platform line-transect survey to assess harbour porpoise abundance in the 'GAP area' between the North Sea and the Baltic Proper. Details can be found in Annex L, item 5.6. The abundance of harbour porpoises within the survey area was estimated at 40,475 animals (95% CI: 25,614-65,041, CV=0.235). Large areas of the northern part of the study region were not surveyed due to poor weather. The GAP plan identifies key areas for porpoises and focuses conservation measures on special areas of conservation for porpoises.

The Committee **welcomes** this work and **accepts** the abundance estimate.

SC/65a/SM25 reported on a National Programme in Mauritania ('Biodiversité, Gaz, Pétrole', BGP) that includes monitoring beaches for stranded cetaceans four times per year. Between November 2012 and May 2013, high numbers of stranded harbour porpoises and other species were found. The Northwest African population of harbour porpoises is probably reproductively isolated from the Iberian and other European populations (Van Waerebeek and Perrin, 2007). No abundance estimates are available but the population is believed to be small. Of ten individuals for which the cause of death could be established (from a total of 27 examined) all appeared to be bycaught.

Based on sightings recorded from 2003-11, SC/65a/SM20 provided an uncorrected abundance estimate of 683 animals (95% CI: 345-951) of harbour porpoises in northern Spanish waters that are considered part of the separate Iberian Peninsula Management Unit (ICES, 2013). The Committee **endorses** the authors' view of the need for unbiased estimates of both abundance and bycatch for this area in order to provide reliable advice for conservation and management actions. It **strongly encourages** Portuguese and Spanish authorities to promote collaborative research projects towards this end.

14.3.7 Solomon Islands update on both live-capture and drive fisheries

Oremus *et al.* (2013) contained the final report to the Government of the Solomon Islands on small boat surveys, photo-identification and genetic sampling to assess the population status of Indo-pacific bottlenose dolphins which are subject to live capture for international trade. Since 2003, more than 100 Indo-Pacific bottlenose dolphins have been shipped from the Solomon Islands to facilities around the world. The Committee **notes** that the new survey results presented by Oremus *et al.* (2013) reinforce previously expressed concerns regarding the sustainability of live-capture removals from this small island-associated population of Indo-pacific bottlenose dolphins. This project was partially funded by the IWC SCCRF. Details are given in Annex L, item 5.7.

The Committee:

(1) **emphasises** the importance of verifying the true number of live-captures and associated dead dolphins - the new survey results **reinforce** previously expressed concerns regarding the sustainability of live-capture removals from this small island-associated population;
(2) **endorses** the recommendation of Oremus *et al.* (2013) calling for the development of a DNA register, i.e. genetic samples of all dolphins captured should be collected systematically and archived to allow verification of their origin and legitimacy; and
(3) **reiterates its previous encouragements** for comparison of existing photo-id catalogues (e.g. that of RH Defran and this study) in order to produce a synthesis of sighting information.

SC/65a/SM08 described efforts to document the numbers and species of dolphins killed recently in the traditional drive hunts on the island of Malaita in early 2013. The Committee thanked the authors for this report, and:

(1) **commends** the Government of the Solomon Islands and the Ministry of Fisheries and Marine Resources for the substantial funding provided to conduct the surveys and for facilitating the work on the traditional drive hunts;
(2) **agrees** that there is an urgent need for estimates of the abundance of small cetaceans around Malaita and, if possible, the Solomon Islands as a whole; and
(3) **expresses concern** regarding the potential depletion of local populations given the scale of the recent (and historical) catches.

In this context, the extensive programme of aerial surveys for cetaceans and other megafauna in the South Pacific being undertaken by the French Government can provide valuable and reliable baseline estimates of abundance for previously unsurveyed or little surveyed areas. It was noted that this programme is planning to survey the New Caledonia area in 2014. The Committee **recognises** the great potential conservation value that would result if it was possible to extend the surveyed area to include the Solomon Islands. The Committee therefore **recommends** that the Secretariat forward a letter on behalf of the Committee expressing its appreciation for the current survey programme, explaining the benefits of extending the 2014 survey to the Solomon Islands and respectfully requesting this to be considered if at all possible.

The Committee also **encourages** the Australian Museum, Sydney to grant the authors of SC/65a/SM08 access to pantropical spotted dolphin teeth and teeth from other specimens from the Solomon Islands hunt that could be used to compare past and modern genetic diversity.

Finally, the Committee **endorses the recommendations** of SC/65a/SM08 encouraging the Solomon Islands Ministry of Fisheries and Ministry of Environment to:

(1) collect information on all future hunts and, if possible, provide some verification of species and numbers through independent observers or photographs;
(2) collect genetic samples (e.g. skin, meat, teeth) from each hunt, to confirm species identification and monitor changes in diversity and population identity over time; and
(3) support further surveys of waters around Malaita (and other islands, if possible) to estimate the abundance of small cetaceans.

14.3.8 Boto and tucuxi

Recalling last year's recommendations regarding the illegal capture and use of botos and tucuxis for fishing within Brazilian territory, the Brazilian Government has been taking steps to counteract this activity through enforcement actions. Details of these actions can be found in Annex L, item 5.8.

The Committee **commends** Brazil for its National Action Plan for the Conservation of Aquatic Mammals and Small Cetaceans, and **welcomes** the report on implementation relative to these two species.

The Committee also **reiterates its previous recommendation** that an international scientific Workshop be organised involving scientists and managers from the range states, with the goal of addressing research and conservation priorities, standardising methodologies and planning long-term strategies.

SC/65a/SM17 reported on the distribution of botos in the Amazon delta; they are regular and widespread in Marajó Bay and the surrounding coastline of Marajó Island. To investigate genetic variation in Amazon river dolphins and make inferences about possible subspecies of boto, analyses of the control region and cytochrome b were conducted. One specimen from the east coast of Pará state appeared to represent an isolated geographic form, genetically distinct from other known subspecies.

Iriarte and Marmontel (2013) reported that interactions of botos and tucuxis with fishing activities are common in the western Brazilian Amazon, but the prevalence of incidental and intentional catches is not known.

Williams and others conducted analyses to infer trends in boto and tucuxi numbers in the Colombian Amazon. They estimated an 87% chance that the boto is declining and an 80% chance that the tucuxi is stable or increasing.

The Committee **expresses its appreciation** for this information on the boto and tucuxi.

14.4 Takes of small cetaceans

14.4.1 New information on takes

Funahashi provided the Committee with a translation of the records of directed catches and associated quotas for small cetaceans from 1997-2011 obtained from the Japanese National Research Institute of Far Seas Fisheries website (Annex L, Appendix 4, table 4).

The Committee also received from the Secretariat the summary of catches of small cetaceans in 2012 extracted from this year's National Progress Reports (Annex L, Appendix 4). The Committee agreed to further explore, intersessionally, more specific terms of reference for evaluating direct take data, including the idea of developing case studies or other analyses from this information.

The Committee thanked Funahashi and the Secretariat for their work in compiling this information for the Scientific Committee each year and reiterated the importance of having complete and accurate catch information, encouraging all countries to submit appropriately qualified and annotated catch data.

SC/65a/SM12 presented information on small cetaceans targeted by direct hunts in Japan. In 2012 there was an increase in the hunting season for Baird's beaked whales in some areas. With respect to drive hunts of other species in Taiji, the number of live captures has increased in the last decade whilst the number of animals killed has gradually declined. The increase in live captures has been accompanied by an increase in exports.

Catch limits for all species were established in 1993 and remained largely constant until 2007. Since then catch limits for most species have been reduced, with the exception of Baird's beaked whales, Pacific white-sided dolphins and northern form short-finned pilot whales which have remained constant. The catch limit for false killer whales has increased. A recent assessment submitted to the 2011 Society for Marine Mammalogy Conference indicated that for all species assessed, catch limits were above sustainable levels (Funahashi and Baker, 2011), with those of striped and spotted dolphins and false killer whales particularly high, exceeding calculated PBR values by a factor of more than five.

For all species reviewed, with the exception of Baird's beaked whales, Risso's dolphins and the Pacific white-sided dolphins (which was only recently added to the quota scheme), catches have declined and have not filled the reduced quotas. See Annex L, item 6.1 for more details.

Published assessments of the abundance of targeted populations are now ten years old or older and exceed the maximum period for which a population estimate should be considered reliable (Moore and Leaper, 2011). Given the indications of population decline in some species (IWC, 1992; 1993; 1998c; Kasuya, 1985; 1999), the long history of intensive exploitation, the lack of information on changes in catch composition and that catch limits and catches remain above sustainable levels, SC/65a/SM12 concluded that there is an urgent need to suspend catches of species taken in direct hunts in Japan and conduct up to date assessments of the exploited populations.

Regarding the species that are subject to direct exploitation in Japan (i.e. common bottlenose dolphins, striped dolphins which apparently experienced a collapse of the coastal population, spotted dolphins, Risso's dolphins, false killer whales and Pacific white-sided dolphins), the Committee expresses **concern** that catch limits exceed sustainable levels and that abundance estimates of all species are now more than ten years old, particularly given the indications of population decline in a number of the species (IWC, 1992; 1993; 1998c; Kasuya, 1985; 1999). The Committee therefore **re-iterates** its previous concerns (IWC, 1992; 1993; 1998c) and **recommends** that:

(1) up-to-date assessments of these exploited populations be undertaken, including studies of population structure and life-history;
(2) up-to-date data on struck and lost rates, bycatch rates, directed hunting effort, stock identity and reproductive status and age composition of catches be collected and made available; and
(3) catch limits take into account struck and lost and bycatch rates and be based on up-to-date population assessments, and be sustainable with allowance for population recovery.

Some members expressed a different view concerning the problems mentioned above, for example regarding the existence of coastal populations of common bottlenose dolphins and striped dolphins (see Annex L).

14.4.2 Follow up on the Workshop on 'poorly documented hunts of small cetaceans for food, bait or cash'

Ritter presented a proposal on the growing and emerging problem of poorly documented hunts of small cetaceans for food, bait or cash (sometimes referred to as the 'marine bushmeat' problem). A provisional agenda was provided for an open symposium and a two-day Workshop (Annex L, Appendix 5). The scope was limited to Africa, Madagascar, Sri Lanka and southeast Asia.

It was agreed that the Workshop steering group shall focus its initial work on:

(1) appointing new members to be included in the steering group (September 2013): new members shall be experts working in the areas the Workshop focuses on that are not related to cetacean assessment;
(2) producing a final draft budget (September 2013), including costs for the venue and for (French) interpretation;
(3) determining additional expertise to be invited to the Workshop (October 2013);
(4) identifying a definitive venue (December 2013); and
(5) liaising with international organisations dealing with bushmeat and emerging infectious diseases (e.g. Eco Health Alliance [US] and others).

The steering group shall at the same time start finding funds from NGOs and other organisations. The progress on the work on the above points shall be referred to the co-Convenors of the sub-committee on small cetaceans and the Head of Science for consideration.

14.4.3 Significant direct and incidental catches of small cetaceans: an update

Donovan drew attention to the Committee's 'Report on Significant Direct and Incidental Catches of Small Cetaceans' that was prepared for the United Nations Conference on Environment and Development (UNCED) in 1992 (Bjørge *et al.*, 1994). Whilst recognising that this was a major undertaking, he suggested that there was a need for a single, up-to-date, authoritative reference on this topic and that the sub-committee on small cetaceans was an appropriate group for producing such a document.

After a short discussion on the merit and the difficulties of this idea, the Committee **agrees** to consider it in more detail next year.

14.5 Update on the proposed joint Workshop on monodontids

In 2012, the Committee established a Steering Group (Bjørge [Convenor], Acquarone, Donovan, Ferguson, Reeves and Suydam) to plan for a global review of monodontids (IWC, 2013k, p.296). The terms of reference were: (1) continue planning for a joint Workshop on monodontids with the NAMMCO SC, the Canada-Greenland Joint Commission on Narwhal and Beluga (JCNB), the Alaska Beluga Whale Committee, and others; (2) prepare a proposal for global review with a Workshop to be held in the autumn of 2013; and (3) facilitate exchange of data between the involved groups.

After consultation with NAMMCO, the deadline of autumn 2013 was considered unrealistic. However, the NAMMCO Secretariat, with the IWC Scientific Committee as co-sponsor, has indicated it can convene a global review workshop back-to-back with the joint meeting of the NAMMCO SC Working Group on Belugas and Narwhals and the JCNB, to be held in Copenhagen in the second half of 2014 (or first half of 2015). Experts from all range states (Greenland, Canada, USA, Russia and Norway) should be invited and a list of possible participants in the workshop has been developed. NAMMCO has indicated that it is prepared to cover part of the costs for invited participants and funding for this workshop will be sought from the IWC. Suydam noted that with the workshop and funding coming together, other interested organisations would help support participant travel. In response to a question on participation of observers, Bjørge noted that he was not familiar with NAMMCO procedures but that observer participation should be possible.

The Committee **welcomes** this report and thanked the NAMMCO Secretariat for its willingness to host the meeting and help fund invited participants. Bjørge and Fortuna will work with the Secretariat to ensure that the request for IWC funding of this workshop is considered in a timely manner. The Steering Group will continue to advance the plans for the workshop intersessionally and report back at next year's meeting.

14.6 Other information on small cetaceans
The sub-committee reviewed information in several additional papers that were not relevant to its priority topics. Details are given in Annex L, item 8.

14.7 Work plan
The Committee's work plan is given under Item 24.

15. WHALEWATCHING

The report of the sub-committee on whalewatching is given as Annex M. Scientific aspects of whalewatching have been discussed formally within the Committee since a Commission Resolution in 1994 (IWC, 1995b). The Commission also has a Standing Working Group on Whalewatching that reports to the Conservation Committee.

15.1 Assess the impact of whalewatching on cetaceans
SC/65a/WW01 summarised four papers addressing the impacts of whalewatching on cetaceans: Peters *et al.* (2013) documented the effects of swim-with-dolphin tourism on the behaviour of the 'burrunan dolphin' (*Tursiops australis*[25]) in South Australia; Lundquist *et al.* (2012) sought to estimate the potential impact of dolphin watching and swimming on dusky dolphins in Kaikoura, New Zealand; Dans *et al.* (2012) investigated changes in behavioural budget of dusky dolphins in Golfo Nuevo, Patagonia, Argentina; and Ayres *et al.* (2013) collected data on hormone levels from the faeces of southern resident killer whales to assess factors in population decline. Summaries are to be found in Annex M, item 5.

The Committee noted that hormone analysis, using faecal and blow sampling, is a potentially valuable methodology for examining impacts of whalewatching. Clearly the efficacy of these methods will be species-specific. A third methodology to measure stress responses is telemetry using tags that can monitor heart rates The impact of research vessels (for all these sampling methods) can be significant and a good experimental design is needed to control for this.

The Committee **agrees** that a joint session on stress responses related to vessel presence and shipping noise be held next year by the sub-committee on whalewatching and the SWG on environmental concerns, provided sufficient information is available. The Committee **requests** the Convenors of those two sub-groups to invite experts to submit papers next year on the use of faecal and blow sampling to measure stress hormones in relation to whalewatching, as well as in relation to other stressors where the methodology could be applied to whalewatching.

New provided an update on the mathematical models for the behavioural, social and spatial interactions of bottlenose dolphins first described in New *et al.* (2012). The model has been adapted to incorporate ecological and geographical features and also has the potential to assess the relative impact of different vessel types, as well as their cumulative effects. The model is an individual-based model, so it can also be modified to assess individual characteristics. The Committee **welcomes** this work and **encourages** future development and its use in case studies.

15.2 Review whalewatching in the Republic of Korea
Whalewatching from one vessel began in 2009 in Ulsan. Species encountered include long-beaked common dolphins, common minke whales, Pacific white-sided dolphins, false killer whales, common bottlenose dolphins and occasional finless porpoises. Tourism numbers are increasing and are expected to reach 20,000 in 2013.

There is a resident population of *T. aduncus* in the waters of Jeju Island; however, the Ministry of Oceans and Fisheries has advised against developing boat-based dolphin watching due to this population's small size, which led to a protected species designation in 2012. The local government has decided to pursue land-based dolphin watching only. The Committee **commends** the Jeju Government and the Ministry of Oceans and Fisheries for their precautionary approach and **recommends** that research be continued on the bottlenose dolphin population of Jeju.

Guidelines are being developed for Korean whalewatching and the Committee **refers** the developers to the Commission's guiding principles and the Compilation of Worldwide Whalewatching Regulations[26]. Ulsan, given the early stages of its whalewatching development, may be a suitable location for a study under the Modelling and Assessment of Whalewatching Impacts (MAWI) project (see Item 15.3.1 and Annex M, item 7.1).

15.3 Progress on Commission's Five-Year Strategic Plan including guidelines and regulations
15.3.1 Large-scale Whalewatching Experiment (LaWE) steering group
There was no intersessional communication or formal update on LaWE submitted to this year. Consequently the Committee **agrees** to re-evaluate the project.

The primary objectives of LaWE were to assess the population-level impacts of whalewatching and determine the effectiveness of suggested mitigation measures in avoiding any potential negative effects of the activity. These objectives remain relevant to the work of the sub-committee; it is important that research addressing these objectives continues. The Committee **agrees** to establish a new intersessional working group, with New as Convenor, tasked with developing a revised work plan to move forward with this project, now named the Modelling and Assessment of Whalewatching Impacts (MAWI), which will seek to build on what was learned in LaWE (see Annex M). The group, using the Five-Year Strategic Plan research objectives and actions as guidance, will seek to define the specific research questions and hypotheses that will most benefit understanding of the impact of whalewatching, identify those whalewatching locations that would be suitable and amenable for targeted studies addressing these questions, and summarise the current modelling tools available to analyse the data that will be collected. Once these issues have been addressed, it will be possible to identify a timeline, benchmarks, budgets and any additional resource or support needs.

[25]The Committee has not included *Tursiops australis* in its list of recognised species.

[26]*http://iwc.int/whalewatching*.

15.3.2 LaWE budget development group
This item was not discussed, as there was no intersessional communication with this Working Group.

15.3.3 Swim-with-whale operations
A questionnaire seeking more detail on these operations was successfully beta-tested in the Dominican Republic in early 2012 and was distributed to operators in Tonga and New Caledonia in May 2013. A summary of results from these surveys will be presented at next year (see Annex M).

15.3.4 In-water interactions
A scientific study was conducted in October 2012 off La Gomera (Canary Islands), where in-water interactions with different small cetacean species were examined. During experimental in-water encounters, specific behaviours exhibited by the animals were observed, recorded and videotaped. Results from this study will be presented at next year (see Annex M).

15.3.5 Guiding principles development
SC/65a/WW03 was a draft of the guiding principles produced per Action 1.1 of the Commission's Five-Year Strategic Plan for Whalewatching. The principles include general management considerations and guidelines for cetacean watching. These guiding principles are fundamental to the development of the Handbook as part of the Commission's Five-Year Strategic Plan for Whalewatching.

The Committee **agrees** to develop a 'background document' to annotate the guiding principles, with an explanation of their origin and evolution, as well as definitions of terms and other explanatory background (which might include illustrations of descriptive content). A draft of this document will be presented next year (see Annex M).

The Committee **endorses** the guiding principles, which can be found in Annex M, Appendix 2, and **recommends** that they are posted on the Commission website.

15.4 Other issues

15.4.1 Review scientific aspects of the Commission's Five-Year Strategic Plan for Whalewatching
The Committee reviewed elements of the Five-Year Strategic Plan for Whalewatching and the Commission's Whalewatching Handbook relevant to its work. Objective 1, Research, details three action items tasked to the Committee:

1.1 Develop (and/or review), pending further comprehensive scientific research and assessment (refer to action 1.3), guiding principles to be followed in whalewatching operations including swim with and provisioning programs to minimise potential adverse impacts;
1.2 Identify data deficient and critically endangered populations likely to be subject to whalewatching. Develop precautionary guidance and advice on additional mitigation measures that may be required for whalewatching operations on such populations; and
1.3 Consider an integrated research program (a form of long term experiment) to better understand the potential impacts of whalewatching on the demographic parameters of cetacean populations. Seek to:
   - demonstrate a causal relationship between whalewatching exposure and the survival and vital rates of exposed cetacean individuals;
   - understand the mechanisms involved in causal effects, if they exist, in order to define a framework for improved management; and
   - establish standard methodologies for the conduct of assessments.

Action item 1.1 is addressed in SC/65a/WW03 and Parsons agreed to collate data for action item 1.2 and report to the Committee next year. The Committee noted that the MAWI intersessional working group will address action item 1.3 (see Annex M, item 7.1).

15.4.2 Report of 2013 IWC Whalewatch Operator's Workshop
A Whalewatch Operator's Workshop, funded by the Governments of Australia and the USA, was held in Brisbane, Australia on 24-25 May 2013. The main objective of the workshop, attended by over 60 representatives of industry, science and government, was to get input from operators and industry representatives for the Whalewatching Handbook to be posted on the Commission's website, with continued oversight by the Commission's Standing Working Group on Whalewatching and an on-going and iterative monitoring, evaluation and review of the Five-Year Strategic Plan for Whalewatching. In addition, the workshop sought to help the Commission understand what role it can play in identifying and promoting 'best practices' and responsible whalewatching, what the industry might like to see or have in an online Whalewatching Handbook, actions in the plan that might require further engagement with industry and how to continue to integrate work at the Commission with industry expertise.

The Committee **agrees** to establish an intersessional working group, with Rojas-Bracho as Convenor, to determine how the Committee can best assist and contribute to the Whalewatching Handbook (see Annex R).

15.4.3 Consider information from platforms of opportunity of potential value to the Scientific Committee
A 'citizen science' handout drafted by the Tonga Whalewatching Operators Association was examined (see details in Annex M, item 8.3).

The Committee noted that this type of handout could allow 'citizen scientists' to provide data directly to research groups and **suggests** that the simple data form developed in (the Data Reporting Scheme) is revived and made available as a resource through the Commission's website.

In late 2009, researchers began collecting data from whalewatching vessels as platforms of opportunity in Ballena Marine National Park in Costa Rica. Tour operators were trained in the use of data forms and GPS. The first year of data collection by operators has been completed and these data will be compared with data collected by researchers, to determine if there are significant differences in data quality. A paper will be prepared for next year's meeting.

Denkinger *et al.* (2013) studied cetacean presence and diversity in the Galápagos Marine Reserve (GMR) during El Niño, La Niña, and neutral conditions, using wildlife viewing vessels as platforms of opportunity. These data showed that most species seem to move out of the GMR during El Niño years.

SC/65a/SH25 reported on a meeting of the Southern Ocean Research Partnership (SORP) held on Jeju Island, Republic of Korea, on 31 May-2 June 2013. The meeting's primary objective was to present the scientific results stemming from the five on-going SORP research projects. Recommendation 4 of the meeting report asked partners in SORP to employ all platforms of opportunity and, where applicable, 'citizen science', to collect data for inclusion in SORP research projects, thereby reducing the logistical constraints of circumpolar coverage and overall expenditure. Recommendation 5 was to store and archive data collected from international, collaborative research efforts such as SORP in open-access, central repositories that have the capacity to handle both primary scientific data and information derived from 'citizen science', e.g. image catalogues.

SORP is coordinating with the International Association of Antarctic Tour Operators to solicit data from platforms of opportunity. Cruise ships were identified as excellent potential platforms, as experienced biologists are often on board as naturalist guides, making them a potential source of good-quality data. 'Citizen science' efforts should be coordinated, because photographs in particular often come from tourists and key matches can come from this source.

15.4.4 Review whalewatching guidelines and regulations
SC/65a/WW01 reviewed two studies that addressed compliance with whalewatching guidelines and regulations: Kessler and Harcourt (2013) studied the levels of compliance with regulations by commercial and recreational whalewatching boats off Sydney, Australia; and Chinon *et al.* (2013) looked at the effectiveness of a proposed regulation for white whale watching in the Saguenay-Saint Lawrence Marine Park, Quebec, Canada, using an agent-based modelling approach. Summaries are presented in Annex M, item 8.4.

The Committee noted that this modelling approach is a technique that could be applied to other locations to assess the effectiveness of whalewatching regulations.

The 2013 Compilation of Worldwide Whalewatching Regulations[27] is almost complete and should be online by August 2013.

15.4.5 Review of collision risks to cetaceans from whalewatching vessels
SC/65a/WW04 investigated the probability of vessel collisions with humpback whales in the waters of Maui County, Hawaii, USA. Surprise encounters and near-misses, defined as a group of whales sighted (at abeam and forward angles) within 300m and 80m of a vessel respectively, were used as proxies for probability of whale-vessel strikes. The rate of surprise encounters increased with vessel speed, from 1.5 encounters/hr at 5 knots to 4.2 encounters/hr at 20 knots. No near-misses occurred at 5 knots. Calves were present in 28.3% of surprise encounters and 58.3% of near-misses, which coincides with previous reports that calves may be more susceptible to vessel collisions. Continued research will contribute to developing a predictive model of vessel strikes for management purposes.

The Committee noted that risk of vessel collision should be factored into models developed under MAWI. The model to be developed in Hawaii will be compared to data from the Hawaiian reporting network for ship strikes, which also reports 'encounters' (the equivalent of near misses), to see if the model matches the network's reports.

Ritter presented relevant aspects of Neilson *et al.* (2012), which analysed all reported whale-vessel collisions in Alaska between 1978 and 2011. Many types and sizes of vessels collided with whales; however, small recreational vessels as well as commercial vessels were most commonly involved in collisions. When vessel speed was known, 49% of the collisions occurred at vessel speeds ≥12knots.

[27]*http://iwc.int/whalewatching.*

15.4.6 Swim-with-whale operations
SC/65a/WW01 summarised four papers addressing swim-with-whale operations: Curnock *et al.* (2013) explored effort and spatial distribution of tourists swimming with dwarf minke whales across time on the Great Barrier Reef, Australia; Kessler and Harcourt (2013) studied human-whale value transition in Tonga across time and the current impact of humpback whale tourism; Kessler *et al.* (2013) documented humpback whale responses to experimental swim-with-whale encounters in Tonga; and Lundquist *et al.* (2013) documented responses by southern right whales in Argentina to simulated swim-with-whale encounters. Summaries are presented in Annex M, item 8.6.

The Committee noted that Hervey Bay, Australia, is an important resting area for humpback mother-calf pairs. Currently swimming with whales is not occurring but tour operators there are interested in conducting such encounters, The Committee **recommends** that the IWC's guiding principles (see Annex M, Appendix 2) be applied to any management decisions in Hervey Bay.

SC/65a/SM26 refers to swim-with-cetacean excursions in Japan and recommends monitoring the situation. The Committee **agrees** to add this to its agenda in 2014 and invites submissions on this situation at next year's meeting.

15.4.7 Emerging whalewatching industry in Oman
The Committee received an update on the emerging whalewatching industry in Oman and an initiative to guide and regulate the industry, as previously recommended (IWC, 2013c, p.64).

The objectives of the new initiative to educate the industry are to protect whales and habitat from impact whilst raising the industry's 'best practice' standards. Progress has been made with securing support of ministries, developing an inventory of operators, assessing operator performance and drafting a set of whalewatching guidelines. Operator workshops are planned for the last quarter of 2013.

The Committee **welcomes** the progress demonstrated by this initiative, and invites the continued submission of updates on this emerging situation. It encouraged local stakeholders, including non-governmental organisations, to continue their commitment to taking this initiative forward. In addition, the Committee **recommends** that the whalewatching guidelines in Oman consider the growing body of research on swim-with-whale encounters and the guiding principles (see Annex M, Appendix 2), which discourage this activity.

15.4.8 Assessing 'whalewatching carrying capacity'
Childerhouse reported on the situation in Kaikoura, New Zealand and whalewatching targeting sperm whales. A moratorium on new commercial whalewatching permits for sperm whales at Kaikoura expired on 1 August 2012. Thus, the New Zealand Government commissioned a two-year research programme into the impact of commercial whalewatching on sperm whales at Kaikoura (Markowitz *et al.*, 2011). The research identified a decline in the abundance of sperm whales over the period since whalewatching started, although the cause of the decline is unknown. After public consultation, another 10-year moratorium was recommended and has been implemented. A 10-year period will allow for meaningful monitoring of the effects of whalewatching activity on sperm whales.

In discussion, other plausible hypotheses for the decline were suggested (see Annex M, item 8.8).

The Scientific Committee **welcomes** this research and **commends** New Zealand for active assessment and management of whalewatching in this region.

15.4.9 IWC Conservation Management Plans
This is discussed under Annex M, item 8.9 and Item 21.

15.5 Work plan
This is discussed under Item 24.

15.6 Other matters
SC/65a/WW05 reported on results from a survey of whalewatching passengers designed to identify causes of a decline in the number of whalewatchers in Hervey Bay, Australia. Details are found in Annex M, item 10.

SC/65a/SM15 summarised a genetic analysis of bottlenose dolphins in Bocas Del Toro, Panama, which showed that this small population (~150 dolphins) has a unique haplotype not seen elsewhere in the Caribbean, confirming its genetic isolation. Last year (IWC, 2013c, p.61), the Committee strongly recommended that the Panamanian authorities enforce national whalewatching regulations and recommended continued research to monitor this dolphin population and the impacts of dolphin watching. However, the Committee received information that enforcement has not happened, and that there has recently been a confirmed report of a dolphin watching vessel striking a dolphin. In light of this observed mortality, the Committee **strongly reiterates** its previous recommendations.

16. DNA TESTING

The report of the Working Group on DNA is given as Annex N. This particular agenda item has been considered since 2000 in response to a Commission Resolution (IWC, 2000a).

16.1 Review genetic methods for species, stock and individual identification
SC/65a/SD01 was prepared in response to a recommendation from the Icelandic Scientific Permit Review Workshop (SC/65a/Rep05) to provide details of the protocol used for the genetic analyses presented to the Workshop, to ensure that genetic sampling and analysis followed the IWC guidelines for genetic research. SC/65a/SD01 provided a comprehensive and clear description of the Icelandic DNA registry protocol, on which the genetic analyses presented to the Review Workshop were based. The Committee **welcomes** this document and **agrees** that it responded appropriately to the recommendation from the Icelandic Scientific Permit Review Workshop.

The Committee **encourages** the preparation of technical documents on methods for species, stock and identification for discussion at the next year meeting under this agenda item.

16.2 Review results of the 'amendments' of sequences deposited in GenBank
During the first round of sequence assessment in *GenBank* (IWC, 2009f, p.347) some inconsistencies were found but these appear to be due to a lag in the taxonomy recognised by *GenBank* or uncertainty in taxonomic distinctions currently under investigation (IWC, 2013l, pp.330). After the assessment, some of the inconsistencies were corrected but further corrections have been hampered by the fact that only the original submitter can alter taxonomy fields in *GenBank*. Last year, the Committee agreed that Cipriano should make a request to *GenBank* to add an additional field for comments (IWC, 2013c, p.64).

Cipriano contacted *GenBank* during the intersessional period and received a response that *GenBank* is willing to work with the IWC on this. They requested that a list of accession numbers associated with problematic taxonomic designations be provided. This would help *GenBank* to understand the scope of the problem while considering a mechanism to allow taxonomy corrections and notations by request.

The Committee **agrees** that the list of accession numbers involving inconsistencies (Annex N, Appendix 2) should be sent to *GenBank* by Cipriano with a letter explaining the background and the main reasons for the inconsistencies, which include:

(1) species for which the taxonomy is still being worked out (e.g. the 'Brydes whale' species complex);
(2) species that have been recently split into new (or redescribed) species (e.g. the right whales and minke whales); and
(3) subspecies for which the taxonomy is still being investigated (e.g. the recognised sub-species of blue whales and minke whales).

Cipriano will also communicate about the need for an annotation indicating uncertainty in subspecies identity for a specimen.

16.3 Collection and archiving of tissue samples from catches and bycatch
The Committee previously endorsed a new standard format for the updates of national DNA registers to assist with the review of such updates (IWC, 2013c, p.53), and the new format worked well last year. This year the updates of the DNA registers by Japan, Norway and Iceland were based on this new format. Details are given in Appendices 3-5 of Annex N for each country, respectively, covering the period up to and including 2012. The Committee **thanks** the countries involved for providing this information.

16.4 Reference databases and standards for diagnostic DNA registries
Annex N, Appendices 3-5 summarise the status of mtDNA and microsatellite analyses of the stored samples for Japan, Norway and Iceland, respectively. In almost all cases, the great majority of samples have been analysed for at least one of either mtDNA or microsatellites and in most cases both. Work on unanalysed samples is continuing although in Japan's case 100% coverage was not possible because many samples were lost in the 2011 tsunami. Details on the exact number of samples collected and analysed are provided in Annex N.

The Committee **appreciates** the efforts of Japan, Norway and Iceland in compiling and providing this detailed information of their registries. The Committee **reiterates** its view that the information provided in the new format greatly facilitated the annual review.

16.5 Work plan
The work plan is discussed under Item 24.

Members of the Committee are encouraged to submit papers in response to requirements placed on the Committee by the IWC Resolution 1999-8 (IWC, 2000a). Relevant information in documents submitted to other groups and sub-committees of the Committee will be reviewed next year. Results of the 'amendments' work on sequences deposited in *GenBank* will be reported next year.

17. SCIENTIFIC PERMITS

This Agenda Item was discussed by the Working Group on Special Permits and its report is given as Annex P. In order to assist the reader, this section provides a summary of Annex P and it also includes a summary of the expert Workshop (SC/65a/Rep03) on the Icelandic special permit held in accordance with the Committee's guidelines (IWC, 2013m).

17.1 Review report of Workshop for Icelandic special permit whaling

In 2003, Iceland presented and the Committee reviewed a special permit research programme to the Committee for review that had included proposed takes of 200 fin whales, 100 sei whales and 200 common minke whales spread over a two-year period that was intended as feasibility study (IWC, 2004). In the event, the programme was reduced to considering only common minke whales and the catch period was extended such that the 200 common minke whales were taken from 2003-07. Due to practical difficulties in Iceland, review of the final results from the programme was delayed. Following the Committee's revised guidelines and timetable for such a review (IWC, 2013m), the expert panel meeting took place in February 2013. All due dates for availability of data, documents, reports and revised documents were met.

17.1.1 Panel Chair's summary of the panel report

The Panel was chaired by Kitakado and its composition was decided upon by a steering group comprising the past four Scientific Committee chairs and the Head of Science. Difficulties in the availability of proposed candidates meant that participation by scientists who had no connection with the Committee proved very difficult. In the event, the Panel comprised the present Committee Chair and the Head of Science (in accord with the guidelines), two ex-Committee Chairs, one current member of the Committee, one scientist who has not participated in the Committee for several years and two scientists who have never participated. Expertise in all areas of the research programme was available. In addition to the proponents, four observers were present. Thirty papers were submitted by proponents (SC/F13/SP01-30) and three additional papers were submitted by other scientists (SC/F13/O01-03).

The Panel report (SC/65a/Rep03) is divided into sections based on the stated objectives of the programme: abundance; stock structure; biological parameters, feeding ecology; energetics; pollution; parasites and pathology. Each of these contained the proponents' summary of their results followed by an analysis of the results by the Panel including conclusions and specific recommendations. The final section presents the Panel's general overview and conclusions followed by a summary of all of the recommendations divided into short, medium and long-term.

The report is a long and detailed review. What follows here is a short Panel Chair's summary of only the broad conclusions (SC/65a/Rep03); it does not provide a substitute for reading the full report. In reaching its conclusions and recommendations, the Panel noted that no further special permit programme was envisaged by Iceland at present. With respect to consideration of the effect of the catches on stocks, it noted that the level of catches was considerably below the level for the CIC *Small Area* that would have been allowed under the RMP (IWC, 2011b, p.64). The Panel emphasised that its task was to provide an objective scientific review of the results of the Icelandic programme; its task was not to provide either a general condemnation or approval of research under special permit. Consideration of that would require examination of some issues way beyond the purview of a scientific panel.

The Panel made a number of general points in addition to its review of individual topics. The first related to the objectives of the programme. The general nature of the objectives of the original proposal and its characterisation as a feasibility/pilot study made it difficult for the Panel to fully review how well the programme could be said to have met its own objectives. It agreed that it is important that any special permit programme provides careful objectives and sub-objectives for which performance can more easily be assessed, as is now the case in the guidelines for proposed permits in IWC (2013m), developed since the Iceland permit was presented in 2003.

The Panel also commented that better information on sampling design and an evaluation of sample size and representativeness at the local and population level was required. While the method used was probably sufficient for a feasibility study, it would not be the case for a full programme.

A common thread throughout the report related to the need for integrated analyses of the individual components of the programme; it regarded such work as essential and this was the subject of several recommendations. Given the objective of multi-species modelling to improve management, this should also include consideration of the results in the context of a modelling framework. The Panel noted that the programme had tried to maximise the information obtained from the whales taken. It stressed the importance of archiving material collected as well as storing analytical results and data in a relational database linked to the tissue archive.

With respect to abundance, the Panel agreed that the Icelandic survey data have improved knowledge about the abundance and distribution of the common minke whale in Icelandic waters both for use in the RMP and for input to potential multispecies modelling. Despite the logistical difficulties, the spring and autumn surveys provided valuable new information, especially in the context of any future multi-species modelling.

With respect to stock structure, the Panel agreed that the data will assist in the Committee's work on this topic. With respect to feasibility component, it was of course already well-known that it is possible to collect samples to better understand stock structure from carcases (as well as from biopsy samples as the proponents' note). It welcomed the efforts to compare genetic data across the North Atlantic but recommended further effort to integrate information regarding stock structure from the variety of genetic and non-genetic sources.

With respect to biological parameters, the Panel recognised the extensive amount of field and laboratory work that had been undertaken and presented. It noted that evaluating the feasibility of collecting information on biological parameters of sufficient precision and accuracy to inform multi-species modelling requires examining the sensitivity of model results to the parameters concerned. As the modelling was not as advanced as had been originally planned, this evaluation cannot yet be conducted. One of the most important feasibility questions relates to the issue of ageing common minke whales and the Panel commended the work to examine a new approach for common minke whales, recognising that further work needs to be undertaken.

With respect to feeding ecology, a primary component of the programme, the Panel acknowledged the large amount of effort undertaken and the generally thorough analyses using a variety of techniques. The temporal changes observed as a result of the extension of the sampling period could be related to climate change or a regime shift in the waters around Iceland and this is an important issue for further research.

The general nature of the objectives made evaluation of the success of the feasibility study more complex but the Panel agreed that knowledge of the general feeding ecology of common minke whales around Iceland has been advanced. It also acknowledged the efforts to collect data in such a way as to allow a more systematic than usual examination of the results that can be obtained from lethal and non-lethal methods (see SC/65a/Rep03, table 4). Finally, the Panel strongly recommended that integrated analyses including comparison of the information from each approach be developed and submitted to the Scientific Committee.

With respect to energetics, again the Panel recognised the considerable field, laboratory and analytical effort. These provided valuable insights into aspects of the energetics of common minke whales around Iceland but further effort is required to integrate the various analyses to provide quantitative input to energetics models and multispecies modelling and allow an evaluation of the sensitivity of the results to the inevitable uncertainty.

With respect to modelling, the Panel recognised the practical difficulties explained by the proponents but concluded that this important part of the programme is as yet poorly developed. In particular, a simple preliminary model should have been developed to inform discussions of which are key parameters with respect to obtaining robust results, evaluating how sensitive results are to different levels of uncertainty and determining appropriate sample sizes. This was a major weakness in the programme. However, the Panel welcomed the modelling work presented to the Workshop as a small but valuable initial step toward the programme's overall objective.

With respect to pollutant studies, the Panel acknowledged the considerable field, laboratory and analytical work that had resulted in a number of published papers. It also appreciated the effort made to compare results across the North Atlantic and to examine relationships between concentration levels in different tissues including 'pseudo' biopsy samples. However, it agreed that the objective of assessing health status had not been fully addressed and cautioned against broad assumptions that low levels necessarily indicate no effect. The sample size of the feasibility study was insufficient to properly address any toxic-related cause-effect relationships.

With respect to parasites and pathology, the objective had been to investigate the feasibility of monitoring and evaluating the morbidity of potential pathogens. The Panel recognised the difficulty of conducting full post-mortems of animals and undertaking thorough examination for parasites and pathogens at sea. While the study of the epibiotic macro fauna has resulted in a good baseline for future analyses, overall, the Panel concluded that the approaches adopted in the feasibility study would be insufficient to achieve the objective outlined.

The Panel briefly noted that the Commission had passed several resolutions relevant to research on the ecosystem, contaminants and environmental change. It agreed that many aspects of the programme were relevant to these topics and that the information had been made available to the Scientific Committee.

With respect to the utility of lethal and non-lethal techniques the Panel referred to extensive discussions at the JARPN II review (IWC, 2010a) and the SORP conference (Baker *et al.*, 2012). The Panel welcomed the efforts of the programme to provide data to allow a more thorough and quantitative comparison of some lethal and non-lethal techniques than has previously been possible (see recommendation in IWC, 2010a). The Panel developed a simple qualitative table to summarise the situation for North Atlantic common minke whales but stressed that is not intended to represent a complete or comprehensive evaluation of lethal or non-lethal techniques, either in general or for this specific programme and drew attention to a number of caveats.

Finally the report provided a summary of its recommendations. Seventeen addressed specific issues that might be termed 'short-term' while twelve addressed 'medium to long-term' issues.

In conclusion, the Panel's Chair thanked the Panel, the proponent scientists and the observers for their constructive and patient approach to the Workshop and the Marine Research Institute for providing excellent facilities.

17.1.2 Proponents response to the Panel report

SC/65a/SP01 provides an overview of the response of scientists from the Icelandic research programme (IRP) to the report of the Panel (SC/65a/Rep03). The IRP scientists consider that in general the evaluation of the IRP by the Panel was constructive, objective and balanced.

SC/65a/SP01 also responded to the Panel's request to provide further documentation of the sampling design. The authors emphasised that the objective was to cover the Icelandic continental shelf area and not to be representative of the Central stock of common minke whales. Sampling was distributed in relation to relative abundance in nine small areas used as part of the Bormicon framework for multispecies modelling of boreal systems. In addition, sampling was stratified seasonally into five units. The purpose of such a fine-scale stratification in this feasibility study was to ensure good distribution of the sampling around Iceland and to allow for post-stratification as appropriate for the different sub-projects.

While agreeing with most of the suggestions and recommendations of the Panel, as can be seen in Table 5, the IRP scientists have not been able to fully respond to all of these within the short period determined by the review process protocol (40 days). However, the IRP plan to conclude most of these before the 2014 Annual Meeting with a particular emphasis on those considered relevant for the upcoming RMP *Implementation Review* of North Atlantic common minke whales and the joint AWMP/RMP Workshop on the stock structure of North Atlantic common minke whales (see Annex D). For example, collaboration has already been established to investigate the isotope ratios in baleen plates.

SC/65a/SP01 also noted additional collaborations and studies that were initiated during the project on subjects outside the original objectives (brain anatomy, radioactivity, climate change aspects, genetic relatedness methodology, and analysis of additional pollutants).

In conclusion, the IRP scientists noted that the Panel had acknowledged the quality and scientific relevance of the presented results to common minke whale research, while identifying areas where further work was required. IRP scientists had responded positively to the comments and recommendations of the Panel as shown in Table 1. They also noted that the guidelines for review of scientific permit programs call for special considerations of the utility of non-lethal and lethal research techniques. This comprised a special objective of the IRP and the Panel had welcomed the efforts of the IRP to provide data to allow a more thorough and quantitative comparison of some lethal and non-lethal techniques than has previously been possible. This is relevant for other populations and species. The Panel had

Table 5

IRP scientists' summary of status of progress (based on table 2 in SC/65a/SP01) in responding to the Panel's recommendations (SC/65a/Rep03), including the list of papers submitted to the Committee in response to SC/65a/Rep03 and the sub-groups at which they were presented.

Recommendations (sub-group); Item no. in SC/65a/Rep03	Status of work
Abundance (RMP)	
12.1.1.1	To be addressed in the near future. Further recommendations may be needed as to the approach to take (before the North Atlantic common minke whale *Implementation Review*).
Stock structure (RMP, SD)	
Short term recommendations	
12.1.2.1	A fully integrated stock structure paper was submitted (SC/65a/SD02).
12.1.2.2	A paper describing the genetic protocols employed during the IRP was submitted (SC/65a/SD01).
12.1.2.3	This has been dealt with in the fully integrated stock structure paper (SC/65a/SD02).
12.1.2.4	This has been partly dealt with in the fully integrated stock structure paper (SC/65a/SD02).
12.1.2.5	To be addressed in the near future.
Biological parameters (EM)	
Short term recommendations	
12.1.3.1	Addressed in SC/F13/SP15rev.
12.1.3.2	Addressed; changes in reproductive status considered in SC/F13/SP10rev and SC/F13/SP05rev.
12.1.3.3	To be addressed in the near future.
Feeding ecology (EM)	
Short term recommendations	
12.1.4.1	To be addressed in the near future.
12.1.4.2	A revised paper on the diet composition was submitted (SC/F13/SP02rev).
12.1.4.3	An update of status and response to specific recommendations is given in SC/65a/EM01 and Daníelsdóttir and Ohf (2013).
Energetics (EM)	
Short term recommendations	
12.1.5.1	A fully integrated paper was submitted (SC/65a/O02).
12.1.5.2	The revised paper was submitted (SC/F13/SP10rev).
12.1.5.3	The revised paper was submitted (SC/F13/SP05rev).
Pollution (E, EM)	
Short term recommendations	
12.1.6.1	Addressed in SC/F13/SP22rev and SP23rev.
12.1.6.2	Addressed in SC/F13/SP23rev.

also noted that the level of catches was considerably below the level that would have been allowed under the RMP. Finally the IRP scientists noted the relevance of the research programme to the work of the Scientific Committee and the RMP in particular.

17.1.3 Committee's discussion

The Committee **thanks** the Panel for its thorough review of the Icelandic programme. It also **acknowledges** the work of the IRP scientists in producing revised papers after the Workshop so that they were available 40 days prior to the Annual Meeting.

In discussion, some members noted that while the Panel had agreed that 'many aspects of the Icelandic programme were directly relevant' to a number of Commission Resolutions on the environment and climate change, they believed that it was more appropriate to say that they were 'potentially' relevant to Commission Resolutions. They also believed that the Icelandic Programme fell short of meeting the Resolution on Whaling under Special Permit (IWC, 1996a).

Some members, having taken account of the expert review, expressed some broader critical views of the Icelandic programme and these are provided in Annex P1. This was not discussed and neither was the response from the proponents given in Annex P2. Noting the previous discussions on special permit whaling, the Committee did not discuss an overall evaluation of the Icelandic program.

Without questioning the quality of the members of the Panel, the future need for increased participation from experts outside of the Scientific Committee was noted. The Steering Group explained that this was the intention but despite a long list of potential candidates developed, the availability and/or interest of outside scientists in participating in the review had proved extremely challenging.

A large number of scientific papers originated from the Icelandic programme. Several of these papers were presented to the relevant sub-committees and working groups (RMP, SD, EM and E) as shown in Table 1 of the report. However, some members of the Committee suggested that further consideration be given to how to manage the time allocated to review such papers in the future, as they felt that not enough time was available for review in some sub-groups.

17.2 Review of results from ongoing permits

As in previous years, the Committee received short cruise reports on activities undertaken but spent relatively little time on discussion of the details. For long-term programmes, the Committee has agreed that regular periodic detailed reviews (following its guidelines, IWC, 2013m) were more appropriate.

17.2.1 JARPN II

SC/65a/O03 presented the results of the 2012 JARPN II (Second Phase of the Japanese Whale Research Program under Special Permit in the Western North Pacific) offshore component. A detailed summary is given in Annex P. There were three main research components: whale sampling survey, dedicated sighting survey and whale sighting and prey survey. A total of five research vessels were used: two sighting/sampling vessels (whale sampling survey component), one research base vessel (whale sampling survey component), three dedicated sighting vessels (dedicated sighting survey component) and one whale sighting and prey survey vessel (whale sighting and prey survey component). Catches occurred between 16 May and 3 August 2012 (74 common minke, 100 sei, 34 Bryde's and three sperm whales). Sightings surveys covered over 2,300 n.miles and eight species of large whales were seen including five blue and two North Pacific right whales. Preliminary results of biological and feeding ecology analyses are presented in this document. Data obtained during the 2012 JARPN II survey will be used in the elucidation of the role of whales in the marine ecosystem through the study of whale feeding ecology in the western North Pacific.

SC/65a/O06 presented the results of the 2012 JARPN II coastal component off Kushiro, northeastern Japan (middle part of sub-area 7CN). A more detailed summary is given in Annex P. Research occurred from 9 September to 28 October 2012, using four small sampling vessels. Catches (48 common minke whales) occurred within 50 n.miles of Kushiro port, and animals were landed at the JARPN II research station for biological examination. The frequency of whales feeding on Japanese anchovy was much lower in 2012 than in previous Kushiro surveys.

In discussion, it was clarified that search areas and vessel course were determined from weather conditions, whale distribution and information on fishing ground of coastal fisheries.

SC/65a/O07 presented results of the 2012 JARPN II coastal component off Sanriku (northeastern Japan, corresponding to a part of sub-area 7). A more detailed summary is given in Annex P. Research occurred from 12 April to 26 May 2012. Catches (60 common minke whales) occurred within 50 n.miles of Ayukawa port and all animals collected were landed at the JARPN II research station for biological examination. Information on sighting distribution, biological characteristics and prey species of whales collected during the 2012 survey was similar to that recorded before the 2011 earthquake and tsunami.

In response to a question, Sakamoto explained that samples from 32 individuals of four species from 2012 JARPN II were screened for radioactivity for the purpose of food safety. Ten of them were below the detection limit and the other 22 were well below the National Food Safety Limit set by the ministry of Health, Labor and Welfare. This information is available on the website of the Fisheries Agency of Japan[28].

17.2.2 JARPA II

SC/65a/O09 presented results of the eighth cruise of the JARPA II (Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic) survey in the 2012/13 austral summer season. A more detailed summary is given in Annex P. Research was conducted from 26 January to 14 March 2013 in Areas III East, IV, V West and part of Area V East. Four research vessels were used: three sighting/sampling vessels (SSVs) and one research base vessel. The SSVs surveyed a total of 2,103.3 n.miles in a period of 48 days. Unfortunately, the research activities were interrupted several times by members of Sea Shepherd, which directed violent sabotage activities against Japanese research vessels. A total of 103 Antarctic minke whales were caught and examined on board the research base vessel. Photo-identification, biopsy sampling and oceanographic work was also conducted. The main results of were as follows: (1) humpback whales were widely distributed in the research area with a higher density index than that of the Antarctic minke whales in all areas except in Prydz Bay; (2) the ice-free extent of the research area was substantially larger than in past seasons; (3) mature female Antarctic minke whales were observed only in Prydz Bay; and (4) all Antarctic minke whales sampled in Area IV east were immature animals.

[28]*http://www.jfa.maff.go.jp/e/inspection/.*

17.3 Planning for periodic review of results from JARPA II

JARPA II is due for a periodic review during the next intersessional period. According to the revised guidelines (IWC, 2013m), the proponents should submit a document explaining the data to be made available to the Workshop one Annual Meeting prior to the review Workshop. This information is provided in SC/65a/O08.

SC/65a/O08 summarised the data available for the next JARPA II Review Workshop to be held early in 2014. The summary was made for the six first surveys of JARPA II (2005/06-2010/11). The summary of the data followed the revised guidelines (IWC, 2013m):

(a) outline of the data that will be available;
(b) references to data collection and validation protocol;
(c) references to documents and publications of previous analyses; and
(d) contact details.

Data in SC/65a/O8 were summarised into the following sections:

(a) data for abundance estimate for several baleen and toothed whale species;
(b) ecological data;
(c) biological, feeding ecology, pollutant and stock structure data of Antarctic minke whale;
(d) biological, feeding ecology, pollutant and stock structure data of fin whale; and
(e) stock structure data of other species. Details of these data are given in Annex P5.

The next step of the review process is that the proponents make data available in electronic form one month after the end of the Annual Meeting. Then the proponents will send a document to the Secretariat describing the analytical methods to be discussed at the Workshop. This will happen nine months prior to the next Annual Meeting; i.e. the beginning of September. Based on the description of analytical methods, the Steering Group (Chair[29], Vice Chair, Head of Science and the last four Scientific Committee Chairs) will begin the process of identifying experts to participate in the Workshop. The need to try to find experts from outside the Committee was stressed. The full timetable for the process is summarised in Table 6 and details can be found in IWC (2013m).

The Committee **reaffirms** its guidelines (IWC, 2013m) that when members submit substantive analyses for a review panel, the Panel Chair, in exercising their discretion, may allow presentation of such analyses in the same manner allowed for proponents.

17.4 General comments regarding Special Permit whaling

Some members of the Committee stressed that the lack of review and comment outside the periodic reviews under the Committee's revised guidelines should not be interpreted as an indication that any of the serious scientific concerns

[29]Given his involvement in the programme, the Scientific Committee Chair, Kitakado, will not take part in the Steering Group. Palka (as immediate past Chair) will act on his behalf.

Table 6

Timetable for the periodic review of JARPA II assuming that the Annual Scientific Committee Meeting is on 1 June.

Item	Schedule	Date
Information on likely analytical methods to be used in the documents to the Workshop.	9 months before Annual Meeting	1 Sep.
Distribute documents to Vice Chair, Head of Science and Standing Steering Group (SSG).	1 week later	8 Sep.
SSG suggest names for the Specialist Workshop. Announcement of review to IWC and call for observers.	2 weeks later	22 Sep.
Chair, Vice Chair and Head of Science develop draft list of specialists and reserves.	2 weeks later	6 Oct.
Final comments from SSG.	1 week later	13 Oct.
Invitation and documents to Specialists.	1 week later	20 Oct.
Receipt and circulation of results/review documents from Special Permit research (including to IWC Scientific Committee members).	>6 months prior to Annual Meeting	1 Dec.
Observer reviews/papers due at the Secretariat.		30 Dec.
Observer's reviews sent to Specialists and Proponents.		6 Jan.
Hold Workshop.	>100 days prior to Annual Meeting	23 Feb.
Final Workshop report made available to Proponents.	>80 days prior to Annual Meeting	13 Mar.
Distribution of result documents, Workshop report and comments from Proponents to the Scientific Committee.	>40 days prior to Annual Meeting	22 Apr.
Discussion and submission of documents to the Commission.	Annual Meeting	1 Jun.

expressed about Special Permit whaling programmes have been addressed. This statement is included as Annex P3. Other members opposed this view and their statement is included as Annex P4.

17.5 Review of new or continuing proposals

17.5.1 JARPA II

Japan reported that there was no plan to change the JARPA II programme.

17.5.2 JARPN II

Japan reported that there was no plan to change the JARPN II programme.

18. WHALE SANCTUARIES

There were no new proposals for IWC Sanctuaries this year. The Committee **agrees** to keep this item on the Agenda. General matters relevant to marine protected areas were dealt with by relevant sub-groups (and see Item 4.7).

19. SOUTHERN OCEAN RESEARCH PARTNERSHIP (SORP)

SC/65a/SH25 reported on a Southern Ocean Research Partnership (SORP) meeting (31 May-2 June 2013, Jeju, South Korea). The aims of the conference were to: (1) present the scientific results from the five ongoing SORP research projects; (2) update the existing project plans and discuss new research proposals (refer to Annex 1 of SC/65a/SH25rev for details of these plans); and (3) make recommendations for the continuation and development of the SORP.

The SORP meeting made key recommendations in relation to the SORP initiative:

(1) to ensure all SORP Partners are seeking funding from all suitable sources to ensure the five existing SORP research projects are resourced adequately;
(2) to improve communication with the Commission on SORP-related outcomes to ensure that they are aware of the scientific products and to encourage financial support;
(3) to improve the dissemination of information on SORP projects and initiatives;
(4) for SORP Partners to encourage all platforms of opportunity and, where applicable, citizen science, to collect data for inclusion in SORP research projects, thereby reducing the logistic constraints of circumpolar coverage and overall expenditure;
(5) that all data and samples collected from international, collaborative research efforts such as SORP are stored and archived in recognised central repositories; and
(6) that the holders of large, long-term datasets that contain valuable information relevant to SORP, particularly acoustic data, should be strongly encouraged to analyse and publish these data as soon as possible.

The Committee **congratulates** the many scientists engaged in SORP for the significant progress and new information presented to the Scientific Committee. It **endorses** the recommendations above and notes that the scientific results were being integrated into the broader work of the Committee.

The Committee **agrees** that the preliminary objective of the Antarctic blue whale project had now been met; the identification of the most appropriate survey design method. The project has also developed a passive acoustic tracking technique that has ramifications for all future whale surveys in Antarctica. The Committee **agrees** that the data from this SORP project are key to the assessment of the Antarctic blue whale population.

The Committee also **recognises** that the acoustic trends project is extremely ambitious; it will take many years to complete but may be the only way to assess the recovery of fin whales. In time it may become the most efficient way to describe the abundance and distribution of many Antarctic whale species.

The first objectives of the Oceania humpback whale project have been completed through the collaborative analysis of biopsy and photo-identification data and those results are being used in the current assessment of Breeding Stock E humpback whales. The results of SC/65a/SH13 are also informative to this project.

The Committee **agrees** that the collection of data through platforms of opportunity may be a highly effective way to collect data in the remote Southern Ocean.

20. IWC LIST OF RECOGNISED SPECIES

The recent literature in cetacean taxonomy (SC/65a/O01) was reviewed and discussed (see Annex L) and it was agreed to add two newly recognised species to the List. *Inia geoffrensis* has been split into the Amazon river dolphin, *I. geoffrensis* and the newly recognised Bolivian bufeo, *I. boliviensis* (Ruiz-García and Shostell, 2010). *Neophocaena phocaenoides* has been split into the Indo-Pacific finless porpoise, *N. phocaenoides* and the newly recognised narrow-ridged finless porpoise, *N. asiaeorientalis* (Jefferson and Wang, 2011). New analyses based on the cytochrome b gene (SC/65a/SM03) have confirmed the split of the finless porpoises. The Burrunan dolphin *Tursiops australis* was recently described (Charlton-Robb *et al.*, 2011) but its validity is uncertain[30] and the Committee **agrees** to not add it to the List at present, pending further studies. It was noted that the extent of sympatry of the two finless porpoise species (Taiwan Strait) is thought to be small, and further sampling (molecular and morphological) to investigate possible divisions within the two recognised species is encouraged.

The Committee also recalled the open questions remaining about the taxonomy of the Bryde's whale species complex and the holotype of the common minke whale. With respect to the former, the genetic identity of the holotype specimen of *Balaenoptera edeni* remains to be identified; the Committee **reiterates** its previous recommendation that this be done.

21. CONSERVATION MANAGEMENT PLANS

Conservation Management Plans (CMPs) and their role in the IWC was first discussed by the Committee in 2008 (IWC, 2009b, p.70). A key feature of CMPs is that they provide a framework for international collaboration to address threats to populations that occur within the waters of more than one country and in offshore waters i.e. they are complementary or supplementary to individual national initiatives.

The IWC has identified some key components of CMPs (see IWC/63/CC5). These are as follows.

(1) The focus should be on practical and achievable actions (including protection for critical habitats) that have the greatest chance of resulting in improved conservation status; actions fall broadly under a number of headings (co-ordination, research, monitoring, public awareness, mitigation) all of which must be driven by the need for positive conservation outcomes.
(2) CMPs are living documents that are to be reviewed periodically against measureable milestones based on monitoring, assessment, and compliance with agreed measures.
(3) CMPs are designed to complement existing measures (e.g. national recovery plans or other national or regionally agreed measures) not to replace them; in particular they can fill identified gaps given the geographical and seasonal range of the populations involved. IWC involvement can *inter alia* bring in additional range state support, the involvement of other IGOs and scientific/technical expertise.

The approach for identifying populations for which CMPs can be developed will depend on the level of information that is available on abundance, status and threats. In addition, CMPs will only be effective where there are identified threats that are practicable to address. If management measures to address threats are already being taken by the range states involved, or if there is only one range state, then there may be little additional benefit in coordinated action through a CMP. In addition, the IWC will need to give consideration as to how CMPs might interact with other efforts such as that of the Convention on Biological Diversity for defining 'Ecologically or Biologically Significant Areas (EBSAs)' or regional agreements such as ACCOBAMS.

[30]Society for Marine Mammalogy, Committee on Taxonomy. List of marine mammal species and subspecies. *http://www.marinemammalscience.org* [16 April 2013].

The Committee noted that there were different approaches to identify whether a population that meets at least one of the following criteria (1)-(4) might be considered as a candidate:

(1) population status (i.e. knowledge of where the population is now in relation to its unexploited abundance, with an estimate of future trend) has been assessed and is of concern, and actual or likely human activities that can threaten the population have been identified;
(2) population status has not been assessed but the impacts of human activities are believed by the Committee to be substantial and thus of concern;
(3) present abundance is known and actual or likely human activities that can threaten the population have been identified; and
(4) present abundance and trend are not well known but abundance is believed by the Committee to be small such that any adverse impacts as a result of human activity may be critical.

The approach taken, for example whether the primary motivation is driven by concerns over status or the level of threat, will depend on what data are available. The Committee discussed CMPs during the work of different sub-committees, some of which considered the issue from the perspective of threats while others from the perspective of population status. The Committee **agrees** that the focus for initial discussions this year is on large whales; it is a much larger and more complex task for small cetaceans. The Committee **seeks guidance** from the Commission on whether or not it wishes the Committee to develop a priority list of populations of small cetaceans for which CMPs might be of value. The Committee **recognises** that consultation with range states is an essential first step in developing a CMP.

The Committee **agrees** that those populations with draft CMPs already in place (western gray whales – collaboratively with IUCN; southwest Atlantic population of southern right whales; and southeast Pacific population of southern right whales) remain a high priority for CMPs.

The Committee also identified the populations that could be considered for a CMP if supported by the range states. This list illustrates different examples, including agreement that populations were high priorities for a CMP, populations where their status would merit a CMP but it is difficult to identify practicable conservation measures, and populations where there were different views on whether the conservation status required a CMP.

21.1 Populations considered based on assessments by the Scientific Committee

Arabian Sea humpback whales

This population was first suggested as a possible priority candidate by the Committee in 2010. It is believed to have numbered as few as 82 individuals in 2004 (95% CI 60-111) based on dorsal fin and fluke photo identification work around Oman. No trend information is available and there are few data available from other range states (India, Pakistan, Sri Lanka, with occasional sightings for Iran and Iraq) to be sure to whether this reflects total abundance of the humpback whales in the Arabian Sea or just around Oman. Known and likely threats include entanglement in fishing gear and ship strikes but the full extent of these is unknown.

The Committee **agrees** that the Arabian Sea population remains a high priority for a CMP if support was provided by the range states.

Common minke whales in the coastal waters of China, Japan (especially the west coast) and Republic of Korea
Of the common minke whale populations in the North Pacific considered by the Committee, only common minke whales in the coastal areas of Japan, China and the Republic of Korea might satisfy the guidelines for populations which could be subject to a CMP. China, Republic of Korea, North Korea, Japan, Russian Federation are the range states. Information on the animals in these waters comes primarily from the discussions of stock structure and the modelling work undertaken as part of the RMP *Implementation Review* (Annex D1, item 10). The stock structure issue led to no agreement within the Committee: there are three hypotheses (A, B, C of increasing numbers of stocks or sub-stocks). Stock structure hypothesis C leads to most concern for the 'J-like stocks' and the 'Y-stock'; the high levels of incidental take, in particular, cause substantial projected future decline (see Annex D1). In addition to the stock structure discussions, a major information gap is the poor survey coverage, particularly the sub-areas 5 and 6W.

Despite the uncertainties, some members believed that the results from assessments underlying the *Implementation Simulation Trials* undertaken during the *Implementation Review* were sufficient to warrant consideration of the value of a CMP, given the projected impact of incidental bycatch. Other members believed that it was premature to put this proposal forward given the uncertainty regarding stock structure and the poor survey coverage in some areas.

North Atlantic right whales
The Committee reiterated its concerns over the status of North Atlantic right whales, a small population subject to high levels of human impacts from entanglement and ship strikes. However, the two range states (USA and Canada) are already taking management action and the Committee did not identify any specific ways in which a CMP would assist their conservation efforts.

North Pacific right whales
The Committee noted concern over the small size of this population, particularly in the eastern part of the species' range, and the need for more research to understand distribution, assess threats and identify actions that could be taken to reduce these. It was also noted that the range states for right whales in the North Pacific were the same as for gray whales and so there may be options for integrating North Pacific right whales with the current western gray whale CMP.

21.2 Populations considered based on knowledge of threats

Blue whales in the northern Indian Ocean
The Committee noted that there are no population estimates for blue whales in the northern Indian Ocean but there have been a number of reported ship strikes of blue whales off Sri Lanka. This highlights the urgent need for long-term monitoring of the blue whales in Sri Lankan waters and elsewhere in the northern Indian Ocean. Further assessment is needed on whether this population may benefit from a CMP.

Fin whales in the Mediterranean
This population is Red-Listed as *Vulnerable* by IUCN and is known to be subject to a high level of ship strikes. The IWC and ACCOBAMS have a joint work plan to address ship strikes in the Mediterranean. Further evaluation is required as to whether an IWC CMP would assist in the current work by IWC, ACCOBAMS and range states.

Sperm whales in the Mediterranean
This population is considered as *Endangered* by IUCN and is at risk from driftnet entanglement and ship strikes. As for fin whales in the Mediterranean, further evaluation is required to determine whether an IWC CMP would assist in the current work by IWC, ACCOBAMS and range states.

Other populations that were tentatively considered in some sub-group reports as potentially benefitting from a CMP in the future include: Antarctic blue whales; a small southeast Pacific (Isla de Chiloe) group of blue whales; and a small southeast Pacific group of 'pygmy' fin whales. However, the current information on status and/or threats in these cases was not adequate to support a recommendation at this time. In particular, in the case of these blue whale and fin whale populations, no major threats amenable to practical management action have been identified. The Committee **agrees** that other populations will be re-evaluated for priority listing as additional information becomes available.

Entanglement and ship strikes are the highest cause of non-deliberate anthropogenic mortalities for large whale populations. In addition to assessments including abundance and status, the Committee has discussed ways of estimating the numbers of entanglement and ship strike mortalities and evaluating mitigation measures. The Committee also noted that any population which is known to spend significant time in areas of high entanglement risk or high density shipping may be considered, even with a low number of reports. This is especially true if there is no local stranding network or ship strike reporting infrastructure. The Committee **agrees** that it is not currently in a position to propose any populations for CMPs based only on risk analysis where reporting is very limited.

Once a CMP is developed, the mitigation aspects of measures considered within it will need to be evaluated to assess what risk reduction is expected or being achieved. The Committee therefore **encourages** studies that fill any data gaps regarding ways that entanglement or ships strikes may be reduced, for input into CMPs. This may be in areas where CMPs have already been developed (western gray whales; southwest Atlantic population of southern right whales; and southeast Pacific right whales); are currently under consideration as candidates (Arabian Sea humpback whales) or are high on the list of priority candidates. Recognising that CMPs continue to evolve, the Committee **agrees** that it would welcome requests for further scientific input into existing CMPs.

For ship strikes, the IWC has consultative status to the International Maritime Organization (IMO) and so can assist with IMO involvement. The IMO is responsible for all measures outside of national waters that affect shipping and so an effective dialogue with IMO is critical for all measures related to ship strikes. In addition it was noted that as part of the CMP for the southwest Atlantic population of southern right whales, the range states have agreed to collect information on ship strikes with this species and report them to the IWC.

For entanglements, the IWC has established a large whale entanglement expert advisory group, with members from Australia, Canada, New Zealand, South Africa and the USA, to advise countries on the issue, and has initiated a programme to build capacity in prioritised areas, when requested (IWC, 2013a). In addition, the Committee **recommends** that the Secretariat bring the IWC's most current scientific and mitigation information to the relevant bodies within the FAO.

22. COMPILATION OF AGREED ABUNDANCE ESTIMATES

The Committee has recognised the need for consistency in evaluating abundance estimates across sub-groups, recognising that to some extent 'acceptance' depends on the use to which the estimate is being put. It is also valuable for the Commission to have an updated overview of how many whales there are by broad ocean area. This year the Committee began a process to develop such lists and summaries by placing this as an item on the agendas of the relevant sub-groups. It established an *ad hoc* working group whose report is given as Annex Q.

The Committee **agrees** with the *ad hoc* group that the most appropriate way to make progress on further development of summary tables for both its use and that of the Commission is to establish an intersessional Working Group that will consider doubtful and potentially missing estimates, compile and summarise existing estimates and report to next year's Annual Meeting (Annex R).

The membership of this Working Group should comprise members representative of the Committee's relevant sub-groups and those familiar with methods for estimating abundance. It will also produce a draft strategy for discussion at the next Annual Meeting for a process to ensure:

(a) regular updating of the tables; and
(b) a strategy to ensure consistency of the review of abundance estimates across sub-committees and Working Groups.

The objective is for this group to complete its work and circulate draft tables by the beginning of January 2014.

23. RESEARCH AND WORKSHOP PROPOSALS AND RESULTS

23.1 Review results from previously funded research proposals

Table 7 shows the progress of funded proposals from last year (IWC, 2013c).

23.2 Review Workshop proposals for 2013/14

Table 8 summarises the Workshop proposals agreed at this year's meeting. Detailed information on funding is given under Item 26.

Table 7

Progress on Research Proposals and Workshops funded last year.

	Title	Status
(1)	Development of an operating model for West Greenland humpback and bowhead whales	Completed (SC/65a/Rep02)
(2)	Workshop on development of *SLA*s for Greenlandic hunts	Completed (SC/65a/Rep02)
(3)	AWMP developers funds	Used to fund work in SC/65a/AWMP02
(4)	Ship strike database coordinator	Completed (SC/65a/HIM04)
(5)	Right whale survey off South Africa	Completed (SC/65a/BRG10)
(6)	Genomic diversity and phylogenetic relationships among right whales	Not funded
(7)	Photographic matching of gray whales	Completed (SC/65a/BRG04)
(8)	Contribution to the preparation of the State of the Cetacean Environment Report (SOCER)	Completed (SC/65a/E01)
(9)	Pre-meeting Workshop on assessing the impacts of marine debris	Completed (SC/65a/Rep06)
(10)	Develop simulation of Southern Hemisphere minke line transect data	Completed (S/65a/IA15)
(11)	IWC-POWER cruise	Completed (SC/65a/Rep01 and SC/65a/IA8)
(12)	Statistical catch-at-age assessment method for Antarctic minke whales	Completed (SC/65a/IA01)
(13)	'Second' *Implementation Review* Workshop for western North Pacific common minke whales	Completed (SC/65a/Rep04)
(14)	Essential computing for RMP/NPM and AWMP	Completed (Annexes D, D1, AWMP)
(15)	MSYR review Workshop	Completed (SC/65a/Rep05)
(16)	Review and guidelines for model-based and design-based line transect abundance estimates	Postponed until this year
(17)	Modelling of Southern Hemisphere humpback whale populations	Completed (SC/65a/SH01 and SC/65a/SH07)
(18)	Antarctic humpback whale catalogue	Completed (SC/65a/SH15)
(19)	Photo matching of Antarctic blue whales	Completed (SC/65a/SH16)
(20)	Southern Hemisphere blue whale catalogue 2012/13	Completed (SC/65a/SH23)
(21)	Expert workshop for review of Iceland's Special Permit programme	Completed (SC/65a/Rep03)
(22)	Whalewatching guidelines and operator training in Oman	Completed

Table 8

Summary of proposed Workshops and pre-meetings.

Subject	Annex	Dates	Venue
IWC-POWER Technical Advisory Group meeting	Annex G	September 29-30	Tokyo, Japan
IWC-POWER planning meeting for the 2014 cruise	Annex G	October 2-3	Tokyo, Japan
Oman whalewatching Workshop	Annex M	October	Oman
IWC/IQOE soundscape Workshop	Annex K	'Winter'	The Netherlands
Workshop on developing *SLA*s for the Greenland hunts	Annex E	Early January (*)	Copenhagen, Denmark
Workshop on the North Atlantic fin whale *Implementation Review*	Annex D	Early January	Copenhagen, Denmark
International gray whale Workshop on stock structure and status	Annex F	March/April	TBD
Workshop on the problem of kelp gulls and southern right whales	Annex F	April	Puerto Madryn, Argentina
AWMP/RMP North Atlantic minke whale stock structure	Annex D, E	April	CPH (or Bergen)
JARPA II review	Annex P	Late February	Japan
North Atlantic common minke whale *Implementation Review*	Annex D	Pre-meeting (3days)	TBD
Southern Hemisphere humpback whale assessment	Annex H	Pre-meeting (2days)	TBD

24. COMMITTEE PRIORITIES AND INITIAL AGENDA FOR THE 2014 MEETING

The Committee **notes** that the Commission's decision to move to biennial meetings means that it will need to develop a two-year proposed work plan at next year's meeting. The Committee **agrees** the following priorities below based on consideration in the plenary of the recommended work plans of the sub-committees and working groups. In addition, all relevant sub-groups will continue to consider updated abundance estimates and CMPs. Given its workload, the Committee **stresses** that papers considering anything other than priority topics will not be addressed at next year's meeting. The new online system for submitting papers will be updated during the year such that Convenors will be notified directly when papers are submitted for their sub-group; they may then contact authors directly if they believe that the papers are unlikely to be discussed.

Revised Management Procedure (RMP)

The following issues are high priority topics.

General issues

(1) Finalise the approach for evaluating proposed amendments to the *CLA*;
(2) evaluate the Norwegian proposal for amending the RMP;
(3) update the requirements and guidelines for conducting surveys to reflect considerations related to model-based methods for abundance estimation;
(4) specify how to deal with imbalanced sex ratios in incidental catches under the RMP;
(5) develop guidelines for handling situations in which survey coverage in time-series of abundance estimates changes over time; and
(6) consider the use of surveys carried out in different months in the *Implementation* process and in actual implementation of the RMP.

Implementation-*related issues*

(1) Finalise work on western North Pacific common minke whales:
    (a) review results from 'hybrid' variants with respect to variants with research;
    (b) review any research proposals with respect to variants with research; and
    (c) agree estimates of abundance for use in actual applications of the RMP;
(2) complete the *Implementation Review* for the North Atlantic fin whales;
(3) begin preparations for a focused basin-wide stock structure study for North Atlantic fin whales to be completed in time to inform the next *Implementation Review*;
(4) start an *Implementation Review* for the North Atlantic minke whales beginning with a three day pre-meeting (Convenor: Walløe) including review report of the joint AWMP/RMP Workshop on the stock structure of common minke whales;
(5) review the information available for North Atlantic sei whales in the context of a *pre-Implementation assessment*; and
(6) review new information on western North Pacific Bryde's whales.

Aboriginal Whaling Management Procedure (AWMP)

The following issues are high priority topics.

(1) Participate in the North Atlantic fin whale RMP process and review the implications of this for *SLA* development for the Greenland hunt;
(2) hold joint AWMP/RMP Workshop on the stock structure of common minke whales in the North Atlantic;
(3) submit need envelopes for West Greenland fin and common minke whales;
(4) finalise the trials for the West Greenland humpback and bowhead whales (including coding) to allow developers to work intersessionally. Ensure that standard software is available to produce agreed performance statistics, as well as tabular and graphical output;
(5) present overview of photo-identification work with respect to movements to inform stock structure and human induced mortality outside West Greenland;
(6) finalise removals series including consideration of human-induced mortality outside the West Greenland area;
(7) continue initial exploration of potential *SLA*s for the Greenland humpback and bowhead whale hunts; and
(8) produce a full report on the Greenlandic conversion factor programme.

Bowhead, right and gray whales (BRG)

The following issues are high priority topics.

(1) Review report from Workshop on the rangewide review of the population structure and status of North Pacific gray whales;
(2) perform the annual review of catch information and new scientific information for the B-C-B stock of bowhead whales;
(3) perform the annual review of catch information and new scientific information for eastern gray whales;
(4) review any new information on all stocks of right whales, especially results of assessments for southern right whales and the kelp gull Workshop; and
(5) review any other new information on western North Pacific gray whales and other stocks of bowhead whales.

In-depth assessment (IA)

The following issues are high priority topics.

(1) Further investigation and application of the SCAA models;
(2) further work examining the factors which drive Antarctic minke whale distribution and abundance;
(3) complete preparations for an in-depth assessment on North Pacific sei whales, specifically:
    (a) update the IWC catch data to include new data from Canadian and Soviet catches; and
    (b) analyse available survey and genetic data from the North Pacific, including from the IWC-POWER surveys;
(4) investigate the distribution and density of baleen and toothed whales in the Antarctic relative to spatial and environmental covariates;
(5) plan and undertake the 5th IWC-POWER survey in the North Pacific; and
(6) plan the next phase of the POWER cruises in the light of the Technical Advisory Group report.

Non-deliberate human-induced mortality (HIM)

The following issues are high priority topics.

(1) Review progress in including information in National Progress Reports;
(2) entanglement;

(3) ship strikes;
(4) review of information on other sources of non-deliberate human induced mortality; and
(5) develop five year plan for suggestions for priority work by the Committee to estimate and address non-deliberate human-induced mortality; review work of intersessional group.

Stock definition (SD)
The following issues are high priority topics.
(1) Genetic analysis guidelines;
(2) stock definition terminology;
(3) statistical and genetic issues concerning stock definition;
(4) testing of spatial structure models (develop new terms of reference); and
(5) providing advice to sub-groups as appropriate.

DNA
The following issues are high priority topics.
(1) Review genetic methods for species, stocks and individual identifications;
(2) review of results of the 'amendments' work on sequences deposited in *GenBank*;
(3) examine the technical information relevant to the TORs of the Group;
(4) collection and archiving of tissue samples from catches and bycatch; and
(5) reference databases and standard for diagnostic DNA registries.

Environmental concerns (E)
The following issues are high priority topics.
(1) SOCER;
(2) pollution (including POLLUTION 2020);
(3) Cetacean Emerging and Resurging Diseases (CERD) and mortality events;
(4) effects of anthropogenic sound on cetaceans and approaches to mitigate these effects (including the results of the intersessional joint Workshop);
(5) climate change;
(6) other habitat related issues including the report of the Conservation Committee's Workshop on marine debris; and
(7) Conservation Management Plans.

Ecosystem modelling (EM)
The following issues are high priority topics.
(1) Review ecosystem modelling efforts undertaken outside the IWC (competition and environmental variability);
(2) explore how ecosystem models contribute to developing scenarios for simulation testing of the RMP (linking individual based models to the RMP); and
(3) review other issues relevant to ecosystem modelling within the Committee.

Southern Hemisphere whales other than Antarctic minke whales and right whales (SH)
The following issues are high priority topics.
(1) Complete assessment of Breeding Stocks D/E/F humpback whales - this will complete the Comprehensive Assessment of Southern Hemisphere humpback whales;
(2) review new information on Southern Hemisphere blue whales in preparation for assessment;
(3) consider the feasibility of undertaking a future assessment of sperm whales; and
(4) Arabian Sea humpback whales.

Small cetaceans (SM)
The following issues are high priority topics.
(1) Voluntary funds for small cetacean conservation research;
(2) review of small cetaceans in the eastern Mediterranean and Red Seas; and
(3) progress on previous recommendations.

Whalewatching (WW)
The following issues are high priority topics.
(1) Assess the impacts of whalewatching on the physiology, behaviour, and fitness of cetaceans (individuals and populations) and their habitats;
(2) review reports from Intersessional Working Groups;
(3) review progress on Five-Year Strategic Plan for Whalewatching;
(4) review whalewatching in the region of the next meeting;
(5) consider information from platforms of opportunity of potential value to the Scientific Committee;
(6) review whalewatching guidelines and regulations; and
(7) consider emerging whalewatching industries of concern.

Scientific Permits (SP)
The following issues are high-priority topics.
(1) Review results of specialist JARPA II meeting;
(2) review of activities under existing permits; and
(3) review of new or continuing proposals.

25. DATA PROCESSING AND COMPUTING NEEDS FOR 2013/14

Allison reported on the computing needs and requirements identified for the forthcoming year. These are summarised in Table 9.

26. FUNDING REQUIREMENTS FOR 2013/14

This year, the sub-groups of the Committee's recommended projects for funding greatly exceeded (>£180,000) the allocated funding by the Commission within the two-year budget (Table 10). Reducing the budget to within the Commission's allocation was therefore a much greater task than is usually the case. For example, last year the full budget request was less than £24,000 over the available budget. The Scientific Committee's handbook states that one of the tasks for a Convenor is:

> 'f. 'To develop with other members of the Convenors' Group a prioritised list for funding that should to be made available to the full Committee at least by 6pm on the penultimate day of the Scientific Committee Annual Meeting.'

Given the difficult situation this year, the Convenors circulated to the Committee the full budget request and the full background information on the 13 June i.e. two days before the close of the meeting, before it had managed to meet to discuss a 'prioritised list' for circulation.

After a suggested budget had been developed on the afternoon of 14 June but before a document including the suggestions and rationale could be circulated to the full Committee, it was agreed to hold a Heads of Delegation meeting in the late afternoon of 14 June; this was followed by another on the morning of 15 June. During the second meeting, it was agreed that the option for a reduced budget

Table 9
Computing tasks for the coming year.

Group	Item
RMP	
(1)	Complete final compilation of tables and plots from the *Implementation Review* of North Pacific minke whales.
(2)	Run hybrid trials (variants with research) of North Pacific minke whales as required.
(3)	Redo conditioning and rerun existing trials of North Atlantic fin whales.
(4)	Other work related to the *Implementation Review* of North Atlantic fin whales (e.g. revision of the control program; conditioning and running of final trials to be specified by the intersessional Workshop (Annex D, Appendix 2).
(5)	Run a full set of trials for western North Pacific Bryde's whales and North Atlantic minke whales using the Norwegian version of the *CLA* and place the results on the IWC website.
(6)	Work with the Norwegian Computing Centre to standardise the Norwegian catch limit program code (Annex D, item 2.4).
(7)	Work to specify and run additional trials for testing amendments to the *CLA* (Annex D, item 2.2).
AWMP	
(1)	Finalise the catch and other removals series for use in trials including ship strikes and other human induced mortality outside West Greenland and data from Canada (see Annex E, item 3.2 and 3.3).
(2)	Work on the control program for the West Greenland humpback and bowhead whales (see Annex E, item 3.2 and 3.3).
IN-DEPTH ASSESSMENT	
(1)	Prepare catch series for North Pacific sei whales including inclusion of revised Canadian catch data and new analysis of Soviet North Pacific catch records to extent possible in time available, noting any discrepancies (see Annex G, item 5.1).
(2)	Validation of the POWER cruise data and work towards standard IDCR/SOWER dataset (see Annex G, item 5.3).
(3)	Complete validation of the 1995-97 blue whale cruise data and incorporate into the DESS database (carried over).
(4)	Eliminate discrepancies between the IWC individual catch data for Antarctic minke whales and the Japanese special permit data held by scientists.
BRG	
(1)	Update the catch series for North Pacific gray whales (Annex F).

developed by the Convenors should be submitted to the full Committee, noting that it had been seen by the Heads of Delegations but that there had been insufficient time for them to fully review it. In doing so, it was recognised that the Convenors had given full consideration to the reduced budget; the revised budget discussion document was annotated with comments made by individual Heads of Delegations.

The Committee **agrees** that it is important to consider possible new systems for future budget allocations; it will add this topic to its agenda next year. In this regard it also noted the need to develop a two-year budget request next year. The Heads of Delegations **requested** that the Secretary review the governance rules, procedures and practices of the Scientific Committees of the other intergovernmental organisations and report back to the Scientific Committee in 2014 in order to assist discussions of the working methods of the Committee. They also requested a more substantial role in Committee governance. Recognising that these are funds provided by the Commission, the Committee **agrees** that *inter alia* Heads of Delegations should play a substantial role in discussions of how the budget should be allocated in future. Convenors should continue to play an important role since they are familiar with the research needs and priorities of each sub-group. The advice of the Commission will also be sought on both the process and its priorities.

As noted above, trying to balance the budget this year was an extremely difficult task. The approach taken by the Convenors for the discussion document is summarised below.

Check the feasibility of voluntary reductions
Each budget line was examined to see if any proposal could be lowered (based on the knowledge of single projects, discussions with proposers where possible or discussions within the sub-committee itself) e.g. by reducing the number of participants to workshops/meetings, finding external funders (for research, workshops or participants), removing part of the research programme, etc.

Checking the feasibility of projects' postponement, in the light of the sub-group priorities
In some cases the amount was either lowered or cut, according to the feasibility to defer some work by one year.

Final cuts based on the strength of recommendations in sub-group reports and an assessment by all Convenors of overall Committee priorities
This was by far the most difficult part of the process, given a remaining overrun of more £100,000.

Table 10 summarises the complete list of recommendations for funding made by the Committee as well as the reduced budget developed in light of the known available funding. The Committee **recommends** all of these proposals to the Commission. In **recommending** its reduced budget, the Committee **stresses** that projects for which it has had to suggest reduced or no funding are still important and valuable.

(1) AWMP-1 INTERSESSIONAL WORKSHOP ON DEVELOPING *SLA*S FOR THE GREENLAND HUNTS
The Committee has identified completion of the development of long-term *SLA*s for these hunts as high priority work. In order to meet the proposed timeframe, an intersessional Workshop is required. The focus of the proposed Workshop is to: (1) to review the results of the developers of *SLA*s for humpback whales and bowhead whales; (2) finalise the modelling framework/trial structure for these hunts; (3) develop a workplan to try to enable completion of work on *SLA*s for these two hunts at the 2014 Annual Meeting; and (4) consider possible input (e.g. using AWMP/RMP-lite) for the joint AWMP/RMP Workshop on North Atlantic common minke whale stock structure. The Workshop will be held in early 2014 in Copenhagen, Denmark. It is intended to hold this back-to-back with the RMP Workshop on fin whales to save travel costs given some common participants.

(2) AWMP-2 AWMP DEVELOPERS' FUND
The developers fund has been invaluable in the work of *SLA* development and related essential tasks of the SWG. It has been agreed as a standing fund by the Commission.

Table 10

Budget requests (see text). Note that the Committee's agreement on the Small Cetacean Conservation Research Fund is given under Item 14.2. Asterisks indicate alternative funding has been found.

Number	Summary of item	Plenary Agenda Item, Annex item	Full cost (£)	Reduced budget (£)
AWMP-1	AWMP Intersessional Workshop on developing *SLA*s for the Greenlandic hunts	Item 8.3. Annex E, item 9.2	8,000	8,000
AWMP-2	AWMP developers fund	Item 8.3. Annex E, item 9.2	7,000	7,000
BRG/AWMP/SD-1	Gray whale rangewide Workshop	Items 8.1.2, 9.2.1, 10.5.3, 11. Annexes E, F and I	15,000	10,000
BRG-1	Southern right whale kelp gull Workshop	Item 10.6.2. Annex F, item 4.4	6,000	6,000
BRG-2	Southern Ocean right whale survey	Item 10.6. Annex F, item 4.1	23,000	*
E-1	State of the Cetacean Environment Report (SOCER)	Item 12.1. Annex K, item 6	5,000	4,000
E-2	POLLUTION 2020	Item 12.2.1. Annex K, item 7.1	27,000	20,000
E-3	Complete implementation of the CERD website	Item 12.3.2. Annex K, item 8.2	5,000	4,000
E-4	Joint IWC/IQOE Workshop predicting soundfields-global soundscape modelling	Item 12.4.2. Annex K, item 9.2	26,900	19,700
E-5	2nd phase Workshop on marine debris	Item 7.5.1. Annex K, item 11.2	5,000	*
HIM-1	Ship strike data coordinator	Item 7.4. Annex J, item 8.1	10,000	8,000
HIM-2	Bryde's whale abundance, distribution and risk of ship strike in the Hauraki Gulf	Item 7.4.3. Annex J, item 8.3	27,1	0,000
IA-1	Satellite tagging of Antarctic minke whales to provide information on breeding grounds, habitat utilisation and availability bias	Item 10.1.2. Annex G, item 8	69,500	0,000
IA-2	Statistical catch-at-age issues for further investigation	Item 10.1.3. Annex G, item 2.1	12,500	12,500
IA-3	2014 IWC-POWER North Pacific survey	Item 10.12.1 Annex G, item 3.3	62,600	58,600
RMP-1	Intersessional Workshop on North Atlantic fin whales	Items 6.2.1, 8.3.1. Annex D, item 5	4,000	4,000
RMP-2	Pre-meeting on North Atlantic minke *Implementation Review*	Item 6.3.2. Annex D, item 3.2	2,000	2,000
RMP/AWMP/SD	Simulations to evaluate power and precision of genetic clustering at critical [demographic] dispersal rates	Items 6.3.2, 8.3.1. Annex D, Appendix 3, adjunct 2	15,000	15,000
RMP/AWMP-1	Joint AWMP-RMP Workshop on stock structure hypotheses for North Atlantic minke whales	Items 6.3.2, 8.3.1. Annex D, item 3.2	10,000	10,000
RMP/AWMP-2	Computing support for RMP and AWMP	Item 22. Annexes D and E	8,000	4,000
SH-1	Minimum abundance estimates of Breeding Stock D humpback whales from Western Australian aerial surveys	Item 10.2.1.2. Annex H, item 3.1	4,000	4,000
SH-2	Modelling work to complete assessments of Breeding Stocks D, E and F	Item 10.2.1.1. Annex H, item 3.1	3,000	3,000
SH-3	Antarctic Humpback Whale Catalogue	Item 10.2.4. Annex H, item 3.4	15,000	10,000
SH-4	Comparison of photographs from JARPA II to the Antarctic Blue Whale Catalogue	Item 10.3.1.4. Annex H, item 5.1.4	7,500	5,000
SH-5	Southern Hemisphere Blue Whale Catalogue 2012/13	Item 10.3.1.4. Annex H, item 5.1.4	15,000	5,000
SH-6	Pre-meeting Workshop to complete the assessment of humpback whale Breeding Stocks D/E/F	Item 10.2.1. Annex H, item 3.1	7,000	7,000
SP-1	Expert Workshop to review JARPA II	Item 17.3. Annex P, item 7.3	30,000	25,000
IPs	IPs	All	64,000	64,000
Total			**498,000**	**315,800**

The primary development tasks facing the SWG are for the Greenlandic fisheries. These tasks are of high priority to the Committee and the Commission. The fund is essential to allow developers to work and thus allow progress to be made.

(3) BRG/AWMP/SD RANGEWIDE GRAY WHALE WORKSHOP ON STOCK STRUCTURE AND STATUS

Recent information has led to the need for a reappraisal of the population structure and movements of North Pacific gray whales. Sufficient new information exists to justify an international Workshop dedicated to developing new models to evaluate the question of North Pacific gray whale stock structure, and to better assess the potential impact of human activities on the status and develop appropriate strategies and mitigation measures. It will also suggested revisions to the background information sections of CMP. The issue has been an important part of discussions in AWMP, BRG, SD and is also relevant to CMPs and it is hoped the results will inform discussions at the 2014 Commission Meeting. The funding is for eight Invited Participants.

(4) BRG-1 SOUTHERN RIGHT WHALE KELP GULL WORKSHOP

The mass mortality of southern right whale calves has been an important issue for the Committee. This year, the Committee expressed concern and recommended that investigation of the causes of this mortality, and actions to reduce the risk of gull attacks on southern right whales at Península Valdés should be further developed and implemented. This is also a high priority action for the CMP.

(5) BRG-2 SOUTHERN RIGHT WHALE SURVEY

After consultation with the proposer this was reduced to zero as outside funding is expected.

(6) E-1 SOCER REPORT

SOCER is a long-standing effort to provide information to Commissioners and Committee members on environmental matters that affect cetaceans in response to several Commission resolutions. Funds are for salaries, library services, and printing.

(7) E-2 POLLUTION 2020

POLLUTION 2000+ has been a flagship programme of the Committee and the Commission has supported it and continued work on pollution in several Resolutions. POLLUTION 2020 is in effect Phase III of POLLUTON 2000+ and has two main priority areas of research; the toxicity of microplastics and the impact of polyaromatic hydrocarbons on cetaceans.

(8) E-3 COMPLETE IMPLEMENTATION OF CERD WEBSITE

The CERD website is being developed in two phases. The first phase focuses on large cetacean species and relies on a 'consultation and sharing' approach. The second phase is intended to include all cetacean species and incorporate a potential 'reporting' role. This website will have 'public' and 'registered user' levels. The public level will provide basic information on diseases in cetaceans, as well as access to selected discussion forum content. Registered users will have full access to the site, including in-depth information on cetacean disease, as well as to discussion forums and posting ability. Links will be provided for quick access to discussion boards that can be shared with groups focused on other topics such as pollution, ship strikes and marine debris.

(9) E-4 JOINT IWC/IQOE ACOUSTIC WORKSHOP

This is a co-sponsored Workshop dealing with global soundscape modeling to inform management of cetaceans and anthropogenic noise. Noise has been an important topic for the Committee since a 2004 Workshop. An increasing number of scientific efforts (International Quiet Ocean Experiment (IQOE), US's National Oceanic and Atmospheric Administration CetSound effort) directed at this topic reflect this broader scope. In September 2011, the IQOE held an open science planning meeting where research into soundscape characterisation and modelling were identified as one of the four key themes to be contained in the IQOE's draft Science Plan. This proposal for a joint IWC/IQOE Workshop will work to expand these tools and their application to a more global scale where they can be used to inform management of potential impacts on cetaceans.

(10) E-5 FUNDING FOR INVITED PARTICIPANTS FOR THE 2ND PHASE WORKSHOP ON MARINE DEBRIS

The Committee is working on this issue with the Conservation Committee. The first Workshop has taken place and the second is due. This is a high priority issue. The money (£5,000) was for two SC participants at the 2nd Workshop. The funds are available from an alternative source.

(11) HIM-1 SHIP STRIKE DATA COORDINATOR

The ongoing development of the IWC ship strike database requires data gathering, communication with potential data providers and data management. Co-ordinators were appointed last year and HIM agreed this should continue and a list of tasks was developed. It relates directly to the Commission's Conservation Committee Working Group on the topic.

(12) HIM-2 BRYDE'S WHALE ABUNDANCE, DISTRIBUTION AND RISK OF SHIP-STRIKE IN THE HAURAKI GULF

This money was requested to partially fund an aerial survey to estimate abundance of a small stock of Bryde's whales around New Zealand where the number of ship strikes has been giving cause for possible conservation concern.

(13) IA-1 DETERMINATION OF BREEDING GROUNDS, HABITAT UTILISATION AND AVAILABILITY BIAS IN ANTARCTIC MINKE WHALES

Habitat utilisation, location of breeding grounds and diving behaviour of Antarctic minke whales represent major data gaps in the Committee's knowledge in relation to four major issues. Research reported in SC/65a/IA12 has demonstrated that the deployment of these types of tags is practical and efficient and can provide a great deal of valuable data. Tags are intended to be deployed in the Ross Sea in December 2013/January 2014. One researcher has a pending research proposal with the US NSF that would provide ship time for tag deployment later in 2014-15 in the Ross Sea. The cost is for 15 Splash MK10A Satellite-linked time-depth recording LIMPET tags (location and dive data) 10 Spot 5 Satellite-linked LIMPET Tags (location only data).

(14) IA-2 DISTRIBUTION OF BALEEN AND TOOTHED WHALES RELATIVE TO SPATIAL AND ENVIRONMENTAL COVARIATES

This was reduced to zero as alternative funding was found.

(15) IA-3 STATISTICAL CATCH-AT-AGE (SCAA) ISSUES FOR FURTHER INVESTIGATION

This approach is one that has been guided and funded by the Committee for several years. The SCAA can be used to evaluate various hypotheses regarding the dynamics of Antarctic minke whales, such as whether growth and carrying capacity have changed. The Committee has identified where further work might solidify some of the conclusions, and a number of detailed technical suggestions were made by the Committee. This proposal addresses the main remaining suggestions made. The Committee also suggested that work be made available for the JARPA II review. The funds will allow the recommended analytical work to be completed.

(16) IA-4 2014 IWC-POWER NORTH PACIFIC SURVEY

The Committee has strongly advocated the development of an international medium- to long-term research programme involving sighting surveys to provide information for assessment, conservation and management of cetaceans in the North Pacific, including areas that have not been surveyed for decades. The Committee developed objectives for the overall plan and this will fund the final leg of the initial phase. The money is for: (1) IWC researchers and equipment as the vessel is provided free by Japan; (2) to allow the Committee's Technical Advisory Group to meet to review the multi-year results thus far and develop the plans for the next phase of POWER based on the results obtained from Phase I; and (3) to enable analyses to completed price to the 2014 Annual Meeting.

(17) RMP-1 INTERSESSIONAL RMP WORKSHOP ON NORTH ATLANTIC FIN WHALES

The objective of this short Workshop is to review the results of conditioning and trials for North Atlantic fin whales, modify these if necessary and determine an intersessional workplan to ensure that the *Implementation Review* can be completed at the 2014 Annual Meeting. It is also relevant to developing *SLA*s for the Greenland hunt. It will be held back-to-back with the AWMP Workshop to save costs. Costs are for five IPs. This work should allow the *Implementation Review* to be completed in 2014 and greatly assist the work on the AWMP.

(18) RMP-2 PRE-MEETING NORTH ATLANTIC MINKE *IMPLEMENTATION REVIEW*

The Committee has agreed to undertake a full *Implementation Review* of common minke whales in the North Atlantic. This is a large exercise that will build upon discussions at the joint AWMP/RMP Workshop on stock structure. A pre-meeting will maintain progress such that it should be able to be completed within two years.

(19) RMP/AWMP/SD SIMULATIONS TO EVALUATE POWER AND PRECISION OF GENETIC CLUSTERING AT CRITICAL [DEMOGRAPHIC] DISPERSAL RATES

On many occasions the Committee has found that identifying stocks from genetic analyses often yielded ambiguous results because the values of key parameters at which management recommendations change are not defined. Realising that such 'tipping points' are likely to be case specific it has been agreed to use the North Atlantic minke whale as a case study. This study will: (1) conduct demographic simulations under reasonable range of stock hypotheses and management scenarios to determine the dispersal rates such that management performance is acceptable from a conservation point; and (2) the second step is to conduct genetic simulations to assess the ability of genetic clustering methods to robustly determine the number of breeding populations and assign individuals to a breeding population. It will enable similar work to be undertaken for other large whale species of conservation and management concern.

(20) AWMP/RMP-1INTERSESSIONAL JOINT AWMP-RMP MEETING ON STOCK STRUCTURE HYPOTHESES FOR NORTH ATLANTIC MINKE WHALES

This Workshop addresses common issues for AWMP/RMP and will use the work of proposal 19 above. It was discussed and agreed last year. The costs are for eight invited participants.

(21) AWMP/RMP-2 ESSENTIAL COMPUTING FOR RMP AND AWMP

This is to provide assistance to the Secretariat with the large computing tasks it is facing in the coming year.

(22) SH-1 OBTAINING MINIMUM ABUNDANCE ESTIMATES OF BREEDING STOCK D HUMPBACK WHALES FROM WESTERN AUSTRALIAN AERIAL SURVEYS

This work was identified as of great importance if the Assessment of Breeding Stock D is to be completed. The cost is for new analyses of data from western Australian aerial surveys, 1999, 2005 and 2008. The observers' search pattern during these aerial surveys had not followed conventional protocols for conducting aerial surveys. The effect of such search patterns on the estimates is unknown, but sufficient concerns about their effect reduces confidence in the use of the resulting abundance estimates as absolute (rather than relative) estimates within the modelling exercise being undertaken (see next project).

(23) SH-2 MODELLING OF SOUTHERN HEMISPHERE HUMPBACK WHALE POPULATIONS

The project will focus on a combined assessment of humpback breeding stocks D, E1 and Oceania using a three-stock model which allows for mixing on the feeding grounds. Methods used will be based upon the Bayesian methodology as developed and presented for BSC and BSB Comprehensive Assessments recently completed. Exploration of alternative models which may be able to explain the observed data will be explored. These will include models that address anomalies identified regarding the population model fit to data for breeding stock D, and approaches suggested there to account for them, such as use of an environmental variation model and changes in carrying capacity over time.

(24) SH-3 ANTACTIC HUMPBACK WHALE CATALOGUE

The Antarctic Humpback Whale Catalogue collates photo-identification information from Southern Hemisphere humpback whales. Increasing awareness of the project among research organisations, tour operators and other potential contributors has widened the scope of the collection; research efforts in areas that had not previously been sampled have extended the geographic coverage. This catalogue has grown by 25% in the last two years, adding 1,127 new individuals, and increasing the time required to analyse photographs. In addition to these requested IWC funds, additional funds from other sources will be sought.

(25) SH-4 COMPARISON OF ANTARCTIC BLUE WHALE IDENTIFICATION PHOTOGRAPHS FROM JARPA II TO THE ANTARCTIC BW CATALOGUE

This work follows on from previous recommendations and work by the Committee on the assessment of Southern Hemisphere blue whales. It is also be of relevance to the SORP blue whale project. The sighting histories of individual Antarctic blue whales from photo-id provide data for a mark-recapture estimate of abundance as well as information on the movement of individual blue whales within the Antarctic region. The addition of more samples to the collection of Antarctic blue whale identification photographs would be extremely useful for these analyses. A total 380 blue whale identification photographs were collected during JARPA II cruises but need to be compared to the Antarctic Blue Whale Catalogue (305 individuals) and the associated sighting data added to the sighting history database.

(26) SH-5 SOUTHERN HEMISPHERE BLUE WHALE CATALOGUE 2012/13

The Southern Hemisphere Blue Whale Catalogue (SHBWC) is an international collaborative effort to facilitate cross-regional comparison of blue whale photo-identifications catalogues. In 2006, the Committee of the agreed to initiate an in-depth assessment of Southern Hemisphere blue whales and in 2008, it endorsed a proposal to establish the SHBWC. Currently the SHBWC holds photo-identification catalogues of researchers from major areas off Antarctica, Australia, Eastern South Pacific and the Eastern Tropical Pacific. A total of 884 blue whales are catalogued. Results of comparisons among different regions in Southern Hemisphere will improve the understanding of population boundaries, migratory routes and model abundance estimates. In addition, assessment of blue whales and estimates abundance of populations will require improving software capabilities to access encounter histories of individuals.

(27) PRE-MEETING WORKSHOP TO COMPLETE THE ASSESSMENT OF HUMPBACK WHALE BREEDING STOCKS D/E/F

This pre-meeting is required to facilitate the timely completion of the assessment of humpback whales breeding stocks D, E and F (Item 3.1.2). These are the last stocks remaining in the in-depth assessment of Southern Hemisphere humpback whales. The Committee has agreed that this assessment should be completed in SC/65b, as a matter of high priority. The meeting will evaluate the results of intersessional modelling efforts. Costs are for eight Invited Participants.

(28) EXPERT WORKSHOP TO REVIEW JARPA II

The Committee has agreed a procedure for periodic and final reviews of results from Special Permit research (IWC, 2013m). This procedure outlines an intersessional review meeting by an expert panel. The report from the intersessional expert meeting will be reviewed and discussed at the 2014 Scientific Committee Annual Meeting, SC/65b. The experts to the review Workshop will be identified by September 2013 and the expert Workshop will be convened during four days in February/March 2014. The requested funds are for travel for the invited experts. The Committee noted that after discussion at the Commission Meeting last year, a budget for the review of the Icelandic permit was approved.

27. WORKING METHODS OF THE COMMITTEE

27.1 Annual Meetings

Last year (IWC, 2013c, pp.78-9), after considerable discussion of the balance between cost savings and the efficiency of the Committee, it was agreed that primary documents would be distributed only electronically at Scientific Committee meetings thereby making significant cost savings in terms of freight (paper and pigeon holes) and copying (paper, Xeroxing and staff).

This year, the Committee continued to review its procedures both in terms of efficiency and cost savings. As part of this, careful consideration was given as to whether it might be possible to reduce the number of days of the Committee's meetings (e.g. removing the initial reading day from the start of the meeting, removing the rest day, reducing the length of Plenary, reducing the number of sub-committees, reducing sub-committee agendas or having some sub-committees meet only biennially). With its present workload and agenda, the Committee **agrees** that changing the number of days in an already full schedule was not practical at this time. However, it **agrees** to keep this item on its Agenda. In particular, it **agrees** to a trial period of introducing an earlier deadline for paper submission.

At present, authors are requested to submit at least preliminary titles, authors and ideally an abstract about six weeks before the meeting using an online system. Whilst authors are strongly encouraged to submit papers as early as possible, the final deadline is that primary papers must be submitted by the end of the first day of the Annual Meeting. This procedure recognises that participants voluntarily submit papers and most have other responsibilities than the IWC; some papers are also the result of recommendations made by the Committee or intersessional Workshops and are essential to the Committee's progress in a timely fashion. After considerable discussion, the Committee **agrees** to establish a deadline for primary papers as a trial for the 2014 Annual Meeting of seven days before the start of the meeting. In doing so it **agrees** that this has the potential to improve the Committee's efficiency in a number of ways; however, at least as a measure on its own, it will not result in cost savings but will provide information to inform discussions of cost savings next year.

The Committee will review the trial next year in the light of information to be provided on a number of factors to be finalised by the Convenors intersessionally including: improvements to efficiency of Convenors in terms of developing annotated agendas; number of papers available by the deadline; timing of overall submission in the weeks leading up to the meeting; download data; questionnaire to the Committee.

The Committee also agreed to improvements with the National Progress Reports database as discussed under Item 3.2 and Annex O.

27.2 Increasing the support of the Scientific Committee on conservation related issues

The Committee welcomed information that a number of scientists (Galletti Vernazzani, Iñíguez, Luna, Marzari, Peres and Rodríguez-Fonseca) will present next year a review of the Committee's reports, IWC Resolutions and information on population status since 1986. The review will highlight *inter alia* when the Committee has commented/recommended on as scientific matters (when a comment/conclusion is aimed to continue gathering scientific information), whaling management matters (when a comment/conclusion is aimed towards whaling management) and conservation matters (when a comment/conclusion is aimed to call the attention on threats and/or status, or improve the conservation of a species/subspecies/population). The objective of this work is to stimulate discussion within the Committee as to how best to improve communications on conservation matters to the Conservation Committee and Commission, in order to better contribute to the long term survival of cetacean species, sub-species and populations.

The Committee **agrees** that this item will be placed on its Agenda next year.

28. ELECTION OF OFFICERS

This is the first year for both the Chair and the Vice-Chair and so no elections were necessary.

29. PUBLICATIONS

The Committee was pleased to hear that the *Journal of Cetacean Research and Management* was now to become open access and freely available. It **agrees** that the *Supplement* should continue to be available in hard copy for participants given its central role at the meeting. The Committee **re-emphasises** the importance of the *Journal* to its work and **thanks** the Secretariat and the Editorial Board for its work.

30. OTHER BUSINESS

There was no other business.

31. ADOPTION OF REPORT

The completed parts of the report were adopted at 17:10hrs on 15 June 2013. As is customary, those parts that were only discussed on the final afternoon were agreed by the Chair, rapporteur and Convenors. The Chair thanked all of the participants for their co-operative attitude on this his first meeting, the rapporteurs, Secretariat and especially the host government and the hotel for their provision of excellent facilities. The meeting thanked the Chair for his expert and fair handling of the meeting.

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EXECUTIVE SUMMARY

Recent observations of gray whales (*Eschrichtius robustus*) identified in the western North Pacific (WNP) migrating to areas off the coast of North America (Alaska to Mexico) raise concern about the possibility of the small western population being subjected to the gray whale hunt proposed by the Makah Indian Tribe in northern Washington, USA. To address this concern, we estimated the probability of striking (i.e. killing or seriously injuring) a WNP whale during the Makah hunt using six models from 4 model sets that varied based on the assumptions and types of data used for estimation. Model set 1 used WNP and ENP abundance estimates. Model set 2 used these abundance estimates, as well as sightings data from the proposed hunt area. Model sets 3 and 4 used only the sightings data. Within model sets 1 and 2, two models (A and B) differed based upon whether migrating ENP and WNP whales were assumed to be equally available to the hunt per capita (A) or whether this assumption is relaxed (B). We consider Model 2B the most plausible of all models because model set 2 makes use of all available information and 2B contains fewer assumptions than 2A. Based on model 2B, the probability of striking ≥1 WNP whale in a single season ranges from 0.007 to 0.036, depending on if the median or upper 95^{th} percentile estimate is used and on which maximum is used for the total number of whales struck. The probability of striking ≥1 WNP whale out of 5 seasons ranges from 0.036 to 0.170 across the same scenarios. The expected number to be struck in a single year ranges from 0.01 to 0.04 and from 0.04 to 0.19 across 5 years. For context, these strike estimates were compared to different possible values of Potential Biological Removal (PBR). We also summarized analogous estimates for the number of WNP whales that would be "taken" non-lethally, in terms of the number of attempted but unsuccessful strikes as well as the number of animals approached and pursued during the hunt.

INTRODUCTION

Gray whales (*Eschrichtius robustus*) are recognized as comprising two populations in the North Pacific Ocean. Significant mitochondrial and nuclear genetic differences have been found between whales in the western North Pacific (WNP) and those in the eastern North Pacific (ENP) (Lang *et al*., 2011). The ENP population ranges from wintering areas in Baja California, Mexico, to feeding areas in the Bering, Beaufort, and Chukchi Seas (Fig. 1). An exception to this generality is the relatively small number (100s) of whales that summer and feed along the Pacific coast between Kodiak Island, Alaska, and northern California (Calambokidis *et al*. 2012). These whales are collectively called the Pacific Coast Feeding Group (PCFG). U.S. domestic policy defines the PCFG as gray whales observed between 1 June and 30 November from Northern California through Northern British Columbia. The International Whaling Commission (IWC) has refined this definition to be: PCFG whales are those observed between 1 June and 30 November from 41°N to 52°N in two or more years (IWC, 2012). The WNP population feeds in the Okhotsk Sea off Sakhalin Island, Russia (Weller *et al*., 1999; Weller *et al*. 2012), and in nearshore waters of the southwestern Bering Sea off the southeastern Kamchatka Peninsula (Tyurneva *et al*., 2010).

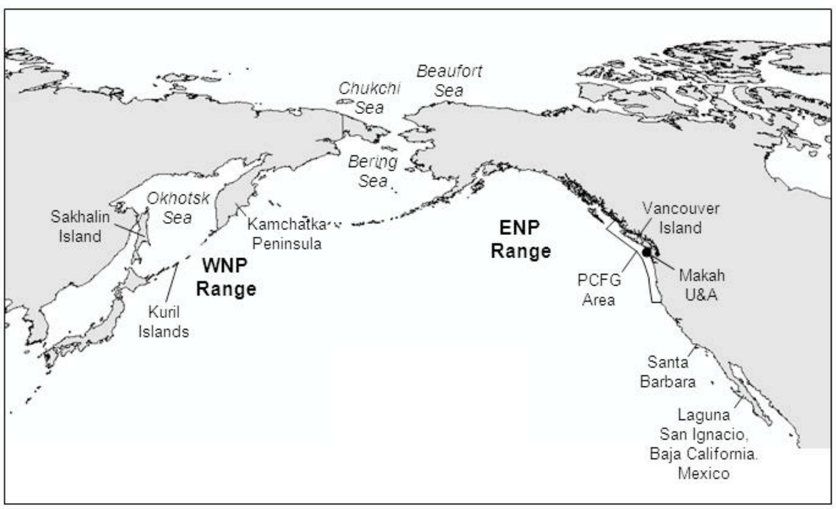

Figure 1. Areas in the western and eastern North Pacific mentioned in the report.

The historical distribution of gray whales in the Okhotsk Sea greatly exceeded what is found today (Reeves *et al*., 2008). Whales associated with the Sakhalin feeding area can be absent for all or part of a given feeding season (Bradford *et al*., 2008), indicating they use other areas during the summer and fall feeding period. Some of the whales identified feeding in the coastal waters off Sakhalin, including reproductive females and calves, have also been documented off the southern and eastern coast of Kamchatka (Tyurneva *et al*., 2010). Whales observed off Sakhalin have also been sighted off the northern Kuril Islands in the eastern Okhotsk Sea and Bering Island in the western Bering Sea (Weller *et al*., 2003).

Recently, mixing of whales identified in the WNP and ENP has been observed (Weller *et al*., 2012). Lang (2010) reported that two adult individuals from the WNP, sampled off Sakhalin in 1998 and 2004, matched the microsatellite genotypes, mtDNA haplotypes, and sexes (one male, one female) of two whales sampled off Santa Barbara, California in March 1995. Mate and colleagues (Mate *et al*., 2011) satellite-tracked three whales from the WNP to the ENP (Mate *et al*., 2011; IWC, 2012). Finally, photographic matches between the WNP and ENP, including resightings between Sakhalin and Vancouver Island and Laguna San Ignacio, have further confirmed use of areas in the ENP by whales identified in the WNP (Weller *et al*., 2012, Urbán *et al*., 2012). Despite this level of mixing, significant mtDNA and nuclear genetic differences between whales in the WNP and ENP have been found (Lang *et al*., 2011).

Observations of gray whales identified in the WNP migrating to areas off the coast of North America (Alaska to Mexico) raise concern about placing the WNP population at potential risk of being harmed or killed incidental to the ENP gray whale hunt proposed by the Makah Indian Tribe off northern Washington, USA (IWC, 2012). Given the ongoing concern about conservation of the WNP population, in 2011 the Scientific Committee of the International Whaling Commission (IWC) emphasized the need to estimate the probability of a western gray whale being killed during aboriginal gray whale hunts (IWC, 2012). Additionally, NOAA is required to prepare an Environmental Impact Statement (EIS) pertaining to the Makah's request for a waiver under the U.S. Marine Mammal Protection Act (MMPA) in order to hunt gray whales (NOAA, 2008). The EIS will include an estimate of the likelihood of Makah hunters approaching, pursuing, and attempting to strike a WNP whale in addition to the likelihood of actual strikes (assumed to result in death or serious injury).

The objective of this analysis was therefore to estimate the probability that one or more whales identified in the WNP might be lethally or non-lethally "taken[1]" during the hunt proposed by the Makah Indian Tribe. This report updates the analysis of mortality risk provided by Moore and Weller (2012), by incorporating feedback from the IWC Scientific Committee on that report and by including an analysis of the likelihood of non-lethal as well as lethal take.

METHODS

The probability of striking or taking a WNP whale during the proposed Makah hunt was estimated using four different sets of models (6 models total). Models were based on the following information: (1) the most recent estimates of WNP and ENP population abundance; (2) sightings data from spring 1999-2010 off the coast of northern Washington (NWA) in the Makah Usual and Accustomed (MUA) fishing grounds, where the proposed hunt would take place; and (3) minimum estimates of the proportion of the WNP population that migrate to ENP areas along the North American coast.

Data

Abundance estimates

The most recent WNP abundance estimate (for 2012) is 155, with 95% CI = 142 – 165 (IUCN, 2012). The most recent ENP estimate (for 2007) is 19,126, with CV = 0.071 (Laake *et al*., 2009). In the models, these estimates were expressed as log-normally distributed random variables with parameters $\mu_{WNP} = 5.043$, $\sigma_{WNP} = 0.0387$, and $\mu_{ENP} = 9.856$, $\sigma_{ENP} = 0.0709$.

[1] Under the U.S. Marine Mammal Protection Act, "take" is defined as "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect."

Sightings in the Makah Usual and Accustomed (MUA) Fishing Grounds
During spring surveys (1 March to 31 May) in 1999-2009, there were 118 "whale-days" in the MUA off the NWA coast (Calambokidis *et al*., 2012), where all sightings of an individual on a particular day collectively count as 1 "whale-day" (e.g., multiple sightings of the same individual on the same day count as just 1 whale-day, but the same individual seen the next day would count as a second whale-day). There were 9 gray whale sightings in March. All other sightings were in April or May. None of the 118 whale-days observed included WNP whales[2]; 35 (29.7%) were considered "Pacific Coast Feeding Group" (PCFG) whales; and the rest (83, or 70.3%) were assumed to be migrating ENP whales. The photo-identification catalog for whales identified in the WNP off Sakhalin Island is characterized by extremely high (> 95%) resighting rates since 2002 (Burdin *et al*., 2012). Therefore, we assumed in this analysis that the absence of WNP sightings is not likely due to false negative identification (although it is possible that WNP whales were missed during days when MUA surveys were or were not conducted).

Proportion of WNP whales migrating with ENP whales
The proportion of the WNP population that migrates along the North American coast is unknown but based on recent photo-identification, telemetry, and genetic matches of WNP whales to ENP areas, we estimate the value to be at least 0.15, based on there being 23 known matches out of an estimated population size of 155 (Mate *et al*., 2011; IWC, 2012; Urbán *et al*., 2012; Weller *et al*. 2012).

Models

Model set 1
Model set 1 makes use of the ENP and WNP abundance estimates but ignores information obtained from sightings in the MUA off the NWA coast. The potential justification for ignoring the sightings data is that these may not be representative of the whale compositions that would be encountered by hunters, perhaps because of a timing mismatch (if hunt does not occur in April/May) or if whales approached by field researchers in motorized boats behave fundamentally differently than those approached by hunters in non-motorized boats.

<u>Model 1A</u> - All whales migrating through the MUA area -- WNP and ENP -- are assumed to be equally available to the hunt, so that the probability of taking a WNP whale is:

$$P_{WNP} = mN_{WNP}/N_{ENP}$$
$$m \sim \text{uniform}(0.15, 1)$$
$$N_{WNP} \sim \text{log-normal}(\mu_{WNP}, \sigma_{WNP})$$
$$N_{ENP} \sim \text{log-normal}(\mu_{ENP}, \sigma_{ENP}),$$

where m is the proportion of WNP whales that migrate with ENP whales along the North American coast and abundance parameters are as above (see Data section). The lower limit for m, 0.15, is based on genetic and photo-identification matching data (see Data section). The upper limit of 1 for m is precautionary, as the true value is unknown but could be high. We used Monte Carlo simulation based on drawing 100,000 random samples from the above distributions to estimate the distribution for P_{WNP}.

<u>Model 1B</u> – Rather than assuming P_{WNP} to be directly proportional to the ratio of abundances (N_{WNP}/N_{ENP}), we express our uncertainty in P_{WNP} as a uniform distribution with the upper limit

[2] Although not in the MUA, Weller *et al*. 2012 report observing three WNP whales on 2 May 2004 and three more on 25 April 2008 near Barkley Sound off the west coast of southern Vancouver Island, British Columbia, Canada.

for P_{WNP} based on the maximum (99th percentile) estimate for the number of WNP whales available to the hunt divided by a minimum (1st percentile) estimate for the ENP population, i.e.,

$P_{WNP} \sim \text{uniform}(0, P_{max})$
$P_{max} = m \cdot N_{99,WNP}/N_{01,ENP}$.

The interpretation of this model is that, within some plausible upper bound (defined as P_{max}), we have no information about the per capita probability of taking a WNP whale, given unknown differences in migration patterns between WNP and ENP animals. Just as for Model 1A, we use a Monte Carlo approach (100,000 samples) to estimate a distribution for P_{WNP}. For each sample, P_{WNP} is drawn from the uniform distribution specified by P_{max}. P_{max} varies with each sample based on the draw for m, while the ratio $N_{99,WNP}/N_{01,ENP}$ is fixed. Analysis for Model set 1 was conducted in R.

Model set 2
Model sets 2, 3, and 4 differ from Model set 1 in that they use the information from the sightings data in the MUA. In these models, it is assumed that the sightings data from the MUA are representative of the composition of whales (three groups: ENP, WNP, PCFG) that would be available to the hunt. In other words, whales that are most likely to be photographed (i.e., approachable in a small boat) are also the most likely to be approached by hunters.

Model set 2 makes use of the MUA sightings data, as well as WNP and ENP abundance estimates. WNP whales are assumed to be moving with the ENP migrants, so that the marginal probability of a WNP whale being taken is the probability of being a migrant, P_{mig} (i.e., probability of not being a whale from the PCFG), multiplied by the conditional probability of being a WNP whale given that it is a migrant ($P_{WNP|mig}$), i.e., $P_{WNP} = P_{mig}P_{WNP|mig}$. P_{mig} is estimated using Bayesian MCMC methods assuming that $n_{mig} \sim$ Binomial (N, P_{mig}), where n_{mig} is the number of non-PCFG migrants (83) out of N (118) sightings in the MUA sightings data set. Models 2A and 2B differ in how the conditional probability $P_{WNP|mig}$ is estimated.

Model 2A - The distribution for $P_{WNP|mig}$ is given by the estimator for P_{WNP} in Model 1A. Thus, it is assumed the per capita probabilities of an ENP or WNP whale being taken are the same.

Model 2B - The distribution for $P_{WNP|mig}$ is given by the estimator for P_{WNP} in 1B. Thus, this model asserts that we have no information (apart from specifying a reasonable upper bound) about the per capita likelihood of a WNP whale being killed relative to that of an ENP whale.

Model 3
This uses the MUA sightings data but does not make use of information about WNP population size or the proportion of WNP whales that migrate with ENP whales. Thus, P_{WNP} estimates are solely based on the proportion of animals in the MUA sightings data set that are from the WNP. The posterior distribution for P_{WNP} is estimated using MCMC methods assuming that $n_{WNP} \sim$ Binomial (N, P_{WNP}), where $n_{WNP} = 0$, and N = 118. The justification for this model (i.e., for ignoring information about WNP abundance) would be that the relative per capita probability of taking WNP vs. ENP animals is totally unknown apart from the information contained in the sightings data set. For example, WNP whales could be much more (or less) available to the hunt than ENP whales due to differences in migration timing or behavior, such that our knowledge about the WNP population being very small is irrelevant to the estimates.

Model 4
Model 4 is a variant of Model 3, explained below.

Bayesian estimation
Analyses for Models 2, 3, and 4 were conducted in WinBUGS. Posterior distributions for parameters were summarized from two MCMC chains, each 50,000 samples in length (100,000 samples total) following a burn-in of 20,000 samples. These simple models converged quickly and clearly (chains well mixed) in all cases (Fig. 2). A uniform [0, 1] prior was used for P_{mig} in model set 2 and for P_{WNP} in model 3 and 4; these are the only parameters for which the prior is updated by data (the MUA sightings data) to obtain a new posterior. The posterior distributions for $P_{WNP|mig}$ in Models 2A and 2B were not informed by the sightings data and thus are essentially determined by informative priors given by the above estimators for these parameters.

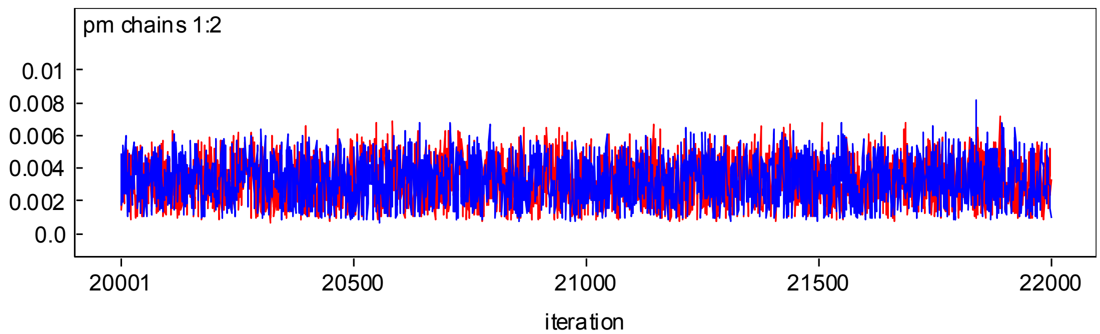

Figure. 2. Example from Model 2A of two MCMC chains (red and blue) mixing for the parameter P_{WNP}.

Estimated parameters
Based on estimates of P_{WNP} for each model, we calculated the probability of striking at least one WNP whale (i.e., P(x>0)) out of X total strikes (strikes are treated as lethal takes), the probability of non-lethally taking at least one WNP whale out of Y strike attempts (P(y>0)), or the probability of non-lethally taking at least one WNP whale out of Z approaches (P(z>0)). We also estimated the expected number of WNP takes out of X, Y or Z total takes. These are calculated as follows:

$$P(x > 0) = 1 - (1 - P_{WNP})^X$$
$$P(y > 0) = 1 - (1 - P_{WNP})^Y$$
$$P(z > 0) = 1 - (1 - P_{WNP})^Z$$
$$E(x) = P_{WNP}X$$
$$E(y) = P_{WNP}Y$$
$$E(z) = P_{WNP}Z$$

For model sets 1, 2, and 3, let X = X* = 5, 7, 20, and 35 gray whale strikes. These were based on the description of the Makah Tribe's proposed gray whale hunt (IWC, 2012 Annex D), which states the following: 5 is the maximum allowable number of landed whales per year; 7 is the maximum number of struck whales allowed per year; 20 is the maximum number allowed to be landed over a 5-year period; and 35 is the maximum number that could be struck over a 5-year period.

For model sets 1, 2, and 4, let X = X** = 3 or 4 strikes in one year and 15 or 20 strikes in 5 years of *non-PCFG whales*. The justification for considering this scenario is that, given other management measures within the Makah plan – most importantly the provision to cease the annual hunt if a certain number of PCFG whales are struck – it may be unlikely that the maximum strike limits in the proposal will be achieved. Implementation trials conducted by the Aboriginal Whaling Management Procedure (AWMP) subgroup of the IWC scientific committee suggest that, when management measures are considered, the expected number of strikes per year *to non-PCFG whales* would typically be between 3 and 4 (J. Scordino, pers. comm.).

For Model set 1, estimates for when X = X** are calculated the same as for when X = X*. For Model set 2, since it is given that X** are for *non-PCFG* whales (i.e., migrant whales), then it follows that $P_{mig} = 1$, so the model 2 estimators for P_{WNP} reduce from $P_{mig}P_{WNP|mig}$ to just $P_{WNP|mig}$, which are the same estimators as for Model set 1. When X = X**, we use Model 4 as a variant of Model 3 (which is for X = X*). In Model 3, $n_{WNP} \sim$ Binomial (N_{tot}, P_{WNP}), where $n_{WNP} = 0$, and $N_{tot} = 118$ total whale-day sightings, 35 of which were PCFG whales and 83 of which were migrating ENP whales. In Model 4, $n_{WNP} \sim$ Binomial (N_{mig}, $P_{WNP|mig}$), where $N_{mig} = 83$ whale-day sightings of non-PCFG migrant whales (i.e., we are only evaluating conditional probability of being a WNP whale given being migrant whale.

Values of Y for each model were calculated as 4X, and values for Z were calculated as 20X. In other words, for every struck whale, there are an estimated 4 strike attempts and 20 whales approached in attempt to strike. These numbers are based on the Makah tribe's experience in the 1999 and 2000 hunts, for which they stated that for every struck whale, there would be approximately 4 attempted strikes and 10 individuals pursued, which are assumed to affect 20 whales, given an average pod size of two whales (NOAA, 2008).

Comparison to Potential Biological Removal (PBR)

To contextualize the Table 1 estimates of lethal takes, we provide 5-year estimates of PBR[3]) for comparison. PBR is conventionally calculated as $0.5R_{max}N_{min}F_R$, where R_{max} is the maximum productivity rate estimate for the population (we used 0.062 based on the 2012 Draft Stock Assessment Report; NMFS, 2012), N_{min} is the 20th percentile abundance estimate (we used 150 based on WNP abundance parameters), and F_R is a recovery factor. We provide PBR estimates for F_R = 0.1, 0.5, and 1.0. F_R = 0.1 is typically used for stocks of endangered species, noting that the WNP gray whale stock is listed as Endangered under the U.S. Endangered Species Act and Critically Endangered on the IUCN Red List. F_R = 0.5 is a recommended default for most stocks (NMFS 2005), whereas F_R = 1.0 may be appropriate for stocks with known and favorable population status. The PBR estimate is also supposed to take into the account (be discounted by) the proportion of the stock using US waters and the proportion of time it is there (NMFS, 2005). The proportion of the WNP migrating in the ENP range is unknown but characterized in our models by a uniform (0.15, 1) distribution. The proportion of time spent in US waters is difficult to estimate for migratory animals but is probably on the order of 3 months or 0.25 years. Thus, for each value of F_R, we calculated a distribution for the 5-year PBR estimate, by multiplying the standard equation by 0.25 and by a uniform (0.15, 1) distribution.

[3] Under the U.S. Marine Mammal Protection Act, PBR level is defined as "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population."

a b

RESULTS

Take estimates

Estimated parameters from all model sets are in Tables 1 – 3. Table 1 presents estimates for the probability of striking a WNP whale during a single strike event (P_{WNP}), and of striking at least one WNP whale (P(x>0)) and the expected number of WNP whales (E(x)) that would be struck given X = X* (number of gray whales struck) or X** (number of *non-PCFG* whales struck). Table 2 presents the analogous estimates for the number of attempted strikes (Y = Y* or Y**), and Table 3 presents the analogous estimates for the number of whales approached (Z = Z* or Z**). We present median estimates and, for precautionary purposes, 95th percentile estimates from the Monte Carlo or Bayesian posterior distributions.

For X = X*, Y = Y*, and Z = Z* (i.e., out of the total number of events affecting gray whales, irrespective of the putative stock affected), parameter estimates were higher for Model set 1 than Model set 2. Within these models sets, median parameter estimates were higher for version A than B, although upper (95th percentile) estimates were similar. Estimates for Model 3 were higher than for the other models, particularly when looking at upper bound (95th percentile) estimates, because of the highly skewed and unconstrained posterior for P_{WNP} (Fig. 3).

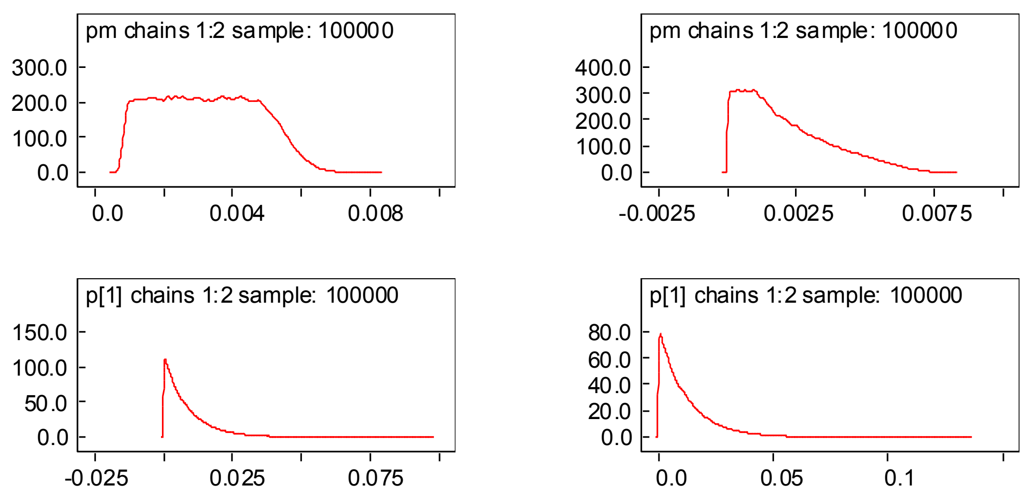

Figure 3. Comparison of Bayesian posterior distributions for P_{WNP} for Models 2A (a), 2B (b), 3 (c), and 4 (d).

For X = X**, Y = Y**, Z = Z** (i.e., out of the total number of events affecting *non-PCFG* whales), model set 1 and model set 2 results are the same (because the estimators are the same), but median estimates were higher for version A than B in these model sets (although 95th percentile estimates were similar). Estimates for Model 4 were higher than for the other models.

In Tables 1 – 3, we highlight (bold) estimates from Model 2B because Model set 2 makes the greatest use of available information (i.e., uses all datasets), and model 2B is based on fewer assumptions than 2A, and thus we favor Model 2B estimates as the most plausible (see Discussion). Estimates from this model for the proposed 5-year hunt period are as follows. The median (and 95th percentile) probability of striking a WNP whale within the 5-year permit period ranged from 0.036 (0.107) to 0.058 (0.170) as X increased from 15 *non-PCFG* whales to 35 whales of any putative stock, and the expected number of whales that would be struck ranged from 0.04 (0.11) to 0.06 (0.19). The probability of an attempted strike on a WNP whale ranged from 0.136 (0.365) to 0.212 (0.524), and the expected number of attempts on WNP whales ranged from 0.15 (0.45) to 0.24 (0.74). Finally, the probability that a WNP whale would be pursued or approached by a hunter ranged from 0.519 (0.897) to 0.697 (0.976), and the expected number of WNP whales that would be approached ranged from 0.73 (2.26) to 1.19 (3.70).

In summary, we estimate based on Model 2B a fairly high probability that at least one WNP would be taken in the broadest sense of being pursued or approached by Makah hunters (i.e., $P(z>0) = 0.52 – 0.98$, depending on Z and whether the median or upper estimate is used). The probability of an attempted strike on least one WNP whale in 5 years was relatively moderate (i.e., $P(y>0) = 0.14 – 0.52$). The probability of actually striking at least one WNP whale during the 5-year period was relatively low but non-trivial (i.e., $P(z>0) = 0.04 – 0.17$).

Table 1. Summary statistics for six models from four model sets. P_{WNP} is probability of taking (striking) a WNP whale during a given take event. $P(x>0)_X$ are probabilities of striking at least 1 WNP whale out of X events. $E(x)_X$ is the expected number of struck WNP whales out of X total events. X=X** indicates that events are known to affect *non-PCFG* whales (otherwise X = X*, the number of events to gray whales in general). Cell entries are median and upper (95th percentile) probabilities.

	Model 1A	Model 1B	Model 2A	**Model 2B**	Model 3	Model 4
P_{WNP}	0.005 (0.008)	0.002 (0.008)	for X = X* 0.003 (0.006) for X = X** 0.005 (0.007)	**for X = X* 0.002 (0.005) for X = X** 0.002 (0.008)**	0.006 (0.025)	0.008 (0.035)
1 year						
$P(x>0)_{3**}$	0.014 (0.024)	0.007 (0.023)	0.014 (0.023)	**0.007 (0.022)**	NA	0.024 (0.102)
$P(x>0)_{4**}$	0.018 (0.031)	0.010 (0.030)	0.018 (0.031)	**0.010 (0.030)**	NA	0.033 (0.134)
$P(x>0)_5$	0.023 (0.039)	0.012 (0.037)	0.016 (0.028)	**0.008 (0.026)**	0.029 (0.119)	NA
$P(x>0)_7$	0.032 (0.054)	0.017 (0.052)	0.022 (0.039)	**0.012 (0.036)**	0.040 (0.162)	NA
$E(x)_{3**}$	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)	**0.01 (0.02)**	NA	0.03 (0.11)
$E(x)_{4**}$	0.02 (0.03)	0.01 (0.03)	0.02 (0.03)	**0.01 (0.03)**	NA	0.03 (0.14)
$E(x)_5$	0.02 (0.04)	0.01 (0.04)	0.02 (0.03)	**0.01 (0.03)**	0.03 (0.13)	NA
$E(x)_7$	0.03 (0.06)	0.02 (0.05)	0.02 (0.04)	**0.01 (0.04)**	0.04 (0.18)	NA
5 year						
$P(x>0)_{15**}$	0.067 (0.113)	0.036 (0.108)	0.067 (0.112)	**0.036 (0.107)**	NA	0.117 (0.416)
$P(x>0)_{20**}$	0.089 (0.147)	0.048 (0.141)	0.089 (0.146)	**0.048 (0.141)**	NA	0.152 (0.512)
$P(x>0)_{20}$	0.089 (0.147)	0.048 (0.141)	0.063 (0.106)	**0.034 (0.101)**	0.110 (0.397)	NA
$P(x>0)_{35}$	0.151 (0.244)	0.082 (0.233)	0.107 (0.178)	**0.058 (0.170)**	0.185 (0.587)	NA
$E(x)_{15**}$	0.07 (0.12)	0.04 (0.11)	0.07 (0.12)	**0.04 (0.11)**	NA	0.12 (0.53)
$E(x)_{20**}$	0.09 (0.16)	0.05 (0.15)	0.09 (0.16)	**0.05 (0.15)**	NA	0.17 (0.70)
$E(x)_{20}$	0.09 (0.16)	0.05 (0.15)	0.06 (0.11)	**0.03 (0.11)**	0.12 (0.50)	NA
$E(x)_{35}$	0.16 (0.28)	0.09 (0.26)	0.11 (0.20)	**0.06 (0.19)**	0.20 (0.87)	NA

Table 2. Summary statistics for six models from four model sets. P_{WNP} is probability of taking (attempted strike) a WNP whale during a given take event. $P(y>0)_Y$ are probabilities of attempting to strike at least 1 WNP whale out of Y events. $E(y)_Y$ is the expected number of attempted-struck WNP whales out of Y total events. Y=Y** indicates that events are known to affect *non-PCFG* whales (otherwise Y = Y*, the number of events to gray whales in general). Cell entries are median and upper (95th percentile) probabilities.

	Model 1A	Model 1B	Model 2A	**Model 2B**	Model 3	Model 4
P_{WNP}	0.005 (0.008)	0.002 (0.008)	for Y = Y 0.003 (0.006) for Y = Y* 0.005 (0.007)	**for Y = Y** **0.002 (0.005)** **for Y = Y*** **0.002 (0.008)**	0.006 (0.025)	0.008 (0.035)
1 year						
$P(y>0)_{12**}$	0.054 (0.091)	0.029 (0.087)	0.054 (0.090)	**0.029 (0.087)**	NA	0.094 (0.349)
$P(y>0)_{16**}$	0.072 (0.120)	0.039 (0.114)	0.072 (0.119)	**0.038 (0.114)**	NA	0.124 (0.436)
$P(y>0)_{20}$	0.089 (0.147)	0.048 (0.141)	0.063 (0.106)	**0.034 (0.101)**	0.110 (0.397)	NA
$P(y>0)_{28}$	0.122 (0.200)	0.066 (0.192)	0.086 (0.145)	**0.047 (0.138)**	0.151 (0.507)	NA
$E(y)_{12**}$	0.06 (0.10)	0.03 (0.09)	0.06 (0.09)	**0.03 (0.09)**	NA	0.10 (0.42)
$E(y)_{16**}$	0.07 (0.13)	0.04 (0.12)	0.07 (0.13)	**0.04 (0.12)**	NA	0.13 (0.56)
$E(y)_{20}$	0.09 (0.16)	0.05 (0.15)	0.06 (0.11)	**0.03 (0.11)**	0.12 (0.50)	NA
$E(y)_{28}$	0.13 (0.22)	0.07 (0.21)	0.09 (0.16)	**0.05 (0.15)**	0.16 (0.70)	NA
5 year						
$P(y>0)_{60**}$	0.244 (0.380)	0.137 (0.366)	0.243 (0.377)	**0.136 (0.365)**	NA	0.391 (0.883)
$P(y>0)_{80**}$	0.311 (0.472)	0.178 (0.455)	0.310 (0.468)	**0.178 (0.454)**	NA	0.484 (0.943)
$P(y>0)_{80}$	0.311 (0.472)	0.178 (0.455)	0.228 (0.360)	**0.127 (0.346)**	0.373 (0.877)	NA
$P(y>0)_{140}$	0.479 (0.673)	0.291 (0.655)	0.364 (0.543)	**0.212 (0.524)**	0.558 (0.971)	NA
$E(y)_{60**}$	0.28 (0.48)	0.15 (0.45)	0.28 (0.47)	**0.15 (0.45)**	NA	0.49 (2.11)
$E(y)_{80**}$	0.37 (0.64)	0.20 (0.61)	0.37 (0.63)	**0.20 (0.60)**	NA	0.66 (2.82)
$E(y)_{80}$	0.37 (0.64)	0.20 (0.61)	0.26 (0.45)	**0.14 (0.42)**	0.47 (2.00)	NA
$E(y)_{140}$	0.65 (1.11)	0.34 (1.06)	0.45 (0.78)	**0.24 (0.74)**	0.82 (3.49)	NA

Table 3. Summary statistics for six models from four model sets. P_{WNP} is probability of taking (approaching) a WNP whale during a given take event. $P(z>0)_Z$ are probabilities of approaching at least 1 WNP whale out of Z events. $E(z)_Z$ is the expected number of approached WNP whales out of Z total events. Z=Z** indicates that events are known to affect *non-PCFG* whales (otherwise Z = Z*, the number of events to gray whales in general). Cell entries are median and upper (95th percentile) probabilities.

	Model 1A	Model 1B	Model 2A	**Model 2B**	Model 3	Model 4
P_{WNP}	0.005 (0.008)	0.002 (0.008)	for Z = Z 0.003 (0.006) for Z = Z* 0.005 (0.007)	**for Z = Z** **0.002 (0.005)** **for Z = Z*** **0.002 (0.008)**	0.006 (0.025)	0.008 (0.035)
1 year						
$P(z>0)_{60**}$	0.244 (0.380)	0.137 (0.366)	0.243 (0.377)	**0.136 (0.365)**	NA	0.391 (0.883)
$P(z>0)_{80**}$	0.311 (0.472)	0.178 (0.455)	0.310 (0.468)	**0.178 (0.455)**	NA	0.484 (0.943)
$P(z>0)_{100}$	0.373 (0.550)	0.218 (0.532)	0.276 (0.428)	**0.157 (0.412)**	0.442 (0.920)	NA
$P(z>0)_{140}$	0.479 (0.673)	0.291 (0.655)	0.364 (0.543)	**0.212 (0.524)**	0.558 (0.971)	NA
$E(z)_{60**}$	0.28 (0.48)	0.15 (0.45)	0.28 (0.47)	**0.15 (0.45)**	NA	0.49 (2.11)
$E(z)_{80**}$	0.37 (0.64)	0.20 (0.61)	0.37 (0.63)	**0.20 (0.60)**	NA	0.66 (2.82)
$E(z)_{100}$	0.47 (0.79)	0.25 (0.76)	0.32 (0.56)	**0.17 (0.53)**	0.58 (2.50)	NA
$E(z)_{140}$	0.65 (1.11)	0.34 (1.06)	0.45 (0.78)	**0.24 (0.74)**	0.81 (3.49)	NA
5 year						
$P(z>0)_{300**}$	0.753 (0.909)	0.521 (0.898)	0.752 (0.906)	**0.519 (0.897)**	NA	0.916 (1.000)
$P(z>0)_{400**}$	0.845 (0.959)	0.625 (0.952)	0.844 (0.958)	**0.624 (0.952)**	NA	0.963 (1.000)
$P(z>0)_{400}$	0.845 (0.959)	0.625 (0.952)	0.725 (0.893)	**0.494 (0.880)**	0.903 (1.000)	NA
$P(z>0)_{700}$	0.962 (0.996)	0.821 (0.995)	0.896 (0.980)	**0.697 (0.976)**	0.983 (1.000)	NA
$E(z)_{300**}$	1.40 (2.48)	0.74 (2.27)	1.39 (2.36)	**0.73 (2.26)**	NA	2.47 (10.56)
$E(z)_{400**}$	1.86 (3.18)	0.98 (3.03)	1.85 (3.15)	**0.98 (3.02)**	NA	3.29 (14.07)
$E(z)_{400}$	1.86 (3.18)	0.98 (3.03)	1.29 (2.23)	**0.68 (2.12)**	2.33 (9.98)	NA
$E(z)_{700}$	3.26 (5.56)	1.72 (5.30)	2.26 (3.90)	**1.19 (3.70)**	4.07 (17.46)	NA

Comparison to PBR

Table 4 provides 5-year estimates of PBR based on F_R = 0.1, 0.5, and 1.0. Uncertainty in the estimates (e.g., 95% CI) reflects uncertainty in the proportion of the WNP stock that migrates with the ENP stock. For F_R = 0.1, striking one WNP whale in the 5-year period would exceed PBR. For F_R = 0.5, one WNP strike could exceed PBR, depending on how many WNP individuals migrate with the ENP stock. Fewer WNP whales in U.S. waters would mean higher chance that one strike would exceed PBR, but it would also translate into lower probability of there being a WNP strike in the first place (i.e., lower than reflected in the Table 1 estimates). For F_R = 1, striking one WNP whale in the 5-year period would not exceed PBR.

Table 4. Estimates of PBR (5-year total) for the WNP gray whale stock under three different values of F_R. Uncertainty in the estimates reflects uncertainty in the proportion of the WNP that uses U.S. waters; the lower estimate corresponds to a little more than 0.15 of the WNP stock migrating in ENP areas, whereas the upper estimate corresponds to nearly all WNP animals migrating in ENP areas.

	F_R = 0.1	F_R = 0.5	F_R = 1.0
2.5%	0.10	0.50	0.99
median	0.33	1.67	3.35
97.5%	0.57	2.85	5.69

DISCUSSION

In general, we consider Model set 2 the most plausible of the model sets used, because it makes use of information from sightings in the MUA from the NWA coast area as well as relative abundance of the WNP vs. ENP. In contrast, Model set 1 ignores the MUA sightings information, and Models 3 and 4 ignore our knowledge of the WNP being small relative to the ENP. We also feel that, within Model sets 1 and 2, the B-versions of each model are more appropriate than A-versions, because the B models make fewer assumptions. The B models assume no prior knowledge about $P_{WNP|mig}$, except to specify a reasonable upper bound, whereas the A models assume that WNP and ENP migrants are equally available to the hunt on a per capita basis. Therefore, Models 2A and 2B, but especially 2B, may be considered the most useful estimates.

Models 3 and 4 are probably the least justifiable, since by ignoring information about the WNP population size they allow for upper parameter estimates that are likely implausible. For example, if we assume that WNP and ENP animals are equally available to the hunt and there are 16,000-22,000 ENP animals, then the upper estimate for Model 4 of P_{WNP} = 0.035 corresponds to a WNP population estimate of nearly 560-770 animals, which far exceeds existing estimates. Alternatively, WNP animals would need to be far more available to hunters on per capita basis than ENP animals for behavioral reasons, and there is no reason presently to expect this is the case.

Estimates from our analysis are considered precautionary since they assume that the Makah will achieve their proposed maximum strike limits. That being said, the results herein offer a conservative initial step in assessing the potential risk of WNP gray whales incurring mortality incidental to the proposed hunt on the ENP population by the Makah Indian Tribe.

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NOAA Technical Memorandum NMFS

SEPTEMBER 2018

UPDATED ESTIMATES OF THE PROBABILITY OF STRIKING A WESTERN NORTH PACIFIC GRAY WHALE DURING THE PROPOSED MAKAH HUNT

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U.S. DEPARTMENT OF COMMERCE
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EXECUTIVE SUMMARY

Observations of gray whales (*Eschrichtius robustus*) from the western North Pacific (WNP) migrating to areas off the coast of North America (Alaska to Mexico) raised concerns that this small population could be encountered during a hunt of eastern North Pacific (ENP) gray whales proposed by the Makah Indian Tribe in northern Washington, USA. In 2013, an analysis was conducted to estimate the probability of striking (i.e. killing or seriously injuring) a WNP whale under the Makah Tribe's hunt proposal (Moore and Weller 2013). NOAA Fisheries is considering a draft proposal that would govern ENP gray whale hunts by the Makah for up to 10 years. Under the draft proposal, hunting seasons would alternate between winter-spring hunts in even-numbered years and summer hunts during odd-numbered years. It is presumed that only in even-numbered years (thus, for 5 of the 10 years) would WNP whales potentially be encountered during the hunt. In each of these years, the draft proposal would allow for up to 3 gray whales to be struck. Based on this alternative hunting scheme and the availability of updated gray whale data, this report re-estimates the probability of striking a WNP whale reported earlier (Moore and Weller 2013). One of the models from the 2013 analysis (Model 2A) was used to generate new estimates. We estimate that for an individual strike on a gray whale, the expected probability of it being a WNP whale is 0.004 (95% CRI: 0.002 – 0.007). For a single year's hunt (3 strikes), the expected probability of striking ≥1 WNP whale would be 0.012 (0.006 – 0.019). Across the 10-year hunt period (15 strikes), the probability of striking ≥1 WNP whale would be 0.058 (0.030 – 0.093).

INTRODUCTION

Two gray whale (*Eschrichtius robustus*) populations are recognized in the North Pacific Ocean. Significant mitochondrial and nuclear genetic differences have been found between whales in the western North Pacific (WNP) and those in the eastern North Pacific (ENP) (LeDuc *et al*., 2002, Lang *et al*. 2010, Lang *et al*., 2011). The ENP population ranges from wintering areas in Baja California, Mexico, to feeding areas in the Bering, Beaufort, and Chukchi Seas (Fig. 1). An exception to this generality is the relatively small number (100s) of whales that summer and feed along the Pacific coast between Kodiak Island, Alaska, and northern California (Weller *et al*., 2013). These whales are collectively called the Pacific Coast Feeding Group (PCFG). The International Whaling Commission (IWC) has defined PCFG whales as individuals observed between 1 June and 30 November from 41°N to 52°N in two or more years (IWC, 2012), and NOAA Fisheries has adopted this definition in recent assessments (Weller *et al.*, 2013). The usual and accustomed (U&A) fishing grounds of the Makah Indian Tribe are off the coast of northern Washington, USA, and overlap with a portion of the PCFG summering area (Fig. 1).

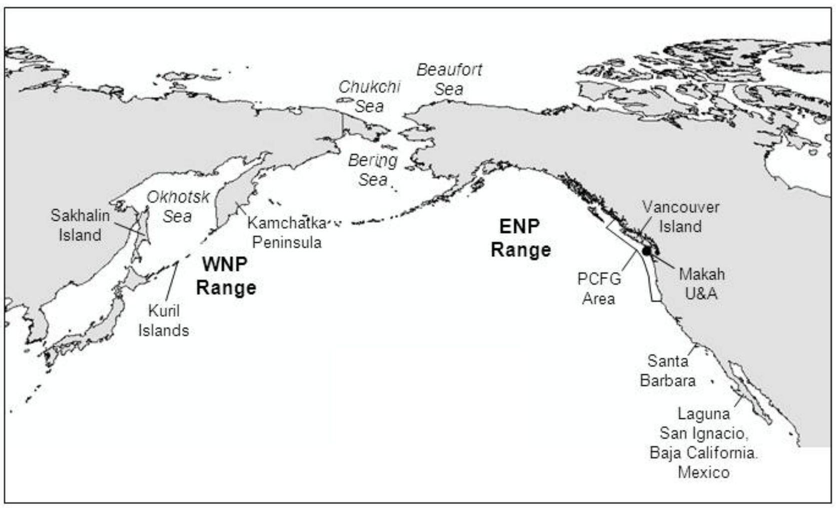

Figure 1. Areas in the western and eastern North Pacific mentioned in the report.

The WNP population feeds in the Okhotsk Sea off Sakhalin Island, Russia (Weller *et al*., 1999; Weller *et al*. 2012), and in nearshore waters of the southwestern Bering Sea off the southeastern Kamchatka Peninsula (Tyurneva *et al*., 2010). The historical distribution of gray whales in the Okhotsk Sea greatly exceeded what is found today (Reeves *et al*., 2008). Whales associated with the Sakhalin feeding area can be absent for all or part of a given feeding season (Bradford *et al*., 2008), indicating they use other areas during the summer and fall feeding period. Some of the whales identified feeding in the coastal waters off Sakhalin, including reproductive females and calves, have been documented off the southern and eastern coast of Kamchatka (Tyurneva *et al*., 2010). A small number of whales observed off Sakhalin have also been sighted off the northern Kuril Islands in the eastern Okhotsk Sea and Bering Island in the western Bering Sea (Weller *et al*., 2003).

Mixing of whales identified in the WNP and ENP has been observed (Weller *et al*., 2012). Lang (2010) reported that two adult individuals from the WNP, sampled off Sakhalin in 1998 and 2004, matched the microsatellite genotypes, mtDNA haplotypes, and sexes (one male, one female) of two whales sampled off Santa Barbara, California in March 1995. Between 2010 and 2012 three whales outfitted with satellite transmitters were tracked moving from Sakhalin in the WNP to the ENP (Mate *et al*., 2015). Finally, photographic matches between the WNP and ENP, including matches between Sakhalin, Vancouver Island and Laguna San Ignacio (Fig. 1), have further confirmed use of areas in the ENP by whales identified in the WNP (Weller *et al*., 2012, Urbán *et al*., 2012). Despite this level of mixing, significant mtDNA and nuclear genetic differences between whales in the WNP and ENP have been found (LeDuc *et al*. 2002, Lang *et al*., 2011).

In 1995, following the 1994 delisting of ENP gray whales under the U.S. Endangered Species Act, the Makah Indian Tribe notified NOAA Fisheries of its interest in re-establishing limited ceremonial and subsistence whale hunting. The decision-making history on this issue is complex and not described here except to note that in 2005, the Makah Tribe submitted a detailed proposal for hunting ENP gray whales in the coastal portion of its U&A off northern Washington, USA, as part of a request for a waiver of the U.S. Marine Mammal Protection Act's (MMPA) take moratorium (16 USC 1371(a)(3)(A)). Subsequently, observations of WNP gray whales migrating through areas off the coast of North America (Alaska to Mexico) emphasized the need to evaluate the probability of a WNP gray whale being encountered in aboriginal hunts for ENP gray whales (IWC, 2012). Following recommendations of the Scientific Committee of the International Whaling Commission (IWC), analyses were conducted to estimate such probability in the context of the Makah Tribe's hunt proposal (Moore and Weller, 2013). These analyses informed a draft Environmental Impact Statement (DEIS), completed in 2015 (NMFS, 2015), pertaining to the Makah Tribe's MMPA waiver request.

NOAA Fisheries is presently considering a MMPA waiver and associated draft proposal that would govern a modified version of the Tribe's hunt proposal. The objective of the analysis reported here was to provide updated estimates of the probability that one or more WNP whales might be subjected to strikes[1], unsuccessful strike attempts (i.e., harpoon throws that do not penetrate), and vessel approaches during hunts and hunt training exercises considered in the draft proposal. This report is based on the methods used by Moore and Weller (2013) and incorporates updated information about the population sizes of ENP and WNP gray whales and their occurrence within the proposed hunt area.

METHODS

Hunt proposal

NOAA Fisheries' draft proposal would govern a Makah Tribe hunt of ENP gray whales in the coastal portion of the U&A (i.e., the "hunt area") over a 10-year hunt period. In odd-numbered years, the hunt would take place from 1 July through 31 October, a period when no sightings of WNP whales have been recorded in the ENP, and when gray whales generally (apart from PCFG

[1] As described in NOAA Fisheries' DEIS (NMFS, 2015), the term "strike" is interpreted to be consistent with the IWC Schedule definition as meaning "to penetrate with a weapon used for whaling."

animals) are in northern feeding areas. Thus, hunted animals in these odd-numbered years would presumably belong to the PCFG and it is assumed that WNP whales would not be at risk from proposed hunt operations. In even-numbered years, the hunt would take place from 1 December through 31 May. This period coincides with both the southward (December to mid-February) and northward (mid-February to late May) migration of ENP whales and overlaps with the time when WNP gray whales have been sighted in the ENP. Thus, in even-numbered years there is a potential risk to WNP whales from proposed hunt operations. In each of the even-numbered years, a maximum of 3 gray whales per year could be struck (including "struck and lost" animals). Over the 10-year period of the proposed hunt, a maximum of 15 whales could be struck (in even-numbered years) that would have some probability of being WNP whales. We therefore evaluate the probability of striking at least one WNP whale per even-numbered year (out of 3 strikes) and for the 10-year period (out of 15 strikes). We also evaluate associated rates of WNP whales being subjected to aforementioned "unsuccessful strike attempts" (i.e., harpoon throws that do not penetrate) and "approaches" (i.e., whales approached by vessels during hunts and hunt training exercises).

Data

Abundance estimates - The most recent ENP abundance estimate (for 2015/2016) is 26,960 (CV = 0.05) (Durban *et al.*, 2017). The most recent WNP abundance estimate (for 2015) is 200 (CV = 0.03) for the 1+ population (i.e., excluding calves) (Cooke 2018). We then multiplied the WNP estimate by 1.099 to account for calves. This multiplier is based on the ratio of the population size with and without calves in 2012 (IUCN, 2012).

Mixing proportions based on sightings in the Makah Hunt Area - During spring surveys (March to May) in 1996-2012 there were 181 observed whale-days in the Makah hunt area (Calambokidis *et al*., 2014). To clarify the term "whale-day" – all sightings of an individual on a particular day collectively count as 1 whale-day (e.g., multiple sightings of the same individual on the same day count as just 1 whale-day, but the same individual seen the next day would count as a second whale-day). None of the 181 whale-days observed included WNP whales[2]; 73 (40.3%) were considered PCFG whales; and the rest (108, or 59.7%) were assumed to be migrating ENP whales.

However, rather than use 40.3% as the expected PCFG proportion in the hunt area during an even-year hunt, we use 28% for this mixing proportion (i.e. 72% of animals encountered during an even-year hunt are likely to be non-PCFG animals). This value is based on analyses summarized in a 2018 IWC workshop (IWC, 2018).

Proportion of WNP whales migrating with ENP whales - The proportion of the WNP population that migrates along the North American coast is unknown but estimated to be at least 0.37 based on analysis by Cooke (2015) and reported to a 2015 IWC workshop on gray whale population structure (IWC, 2016).

[2] Although not in the Makah hunt area, Weller *et al*. (2012) report observing three WNP whales on 2 May 2004 and three more on 25 April 2008 near Barkley Sound off the west coast of southern Vancouver Island, British Columbia, Canada.

Model

Moore and Weller (2013) considered four models in their analysis but they based final inferences on what they termed Model 2B. Here, we use Model 2A instead. Models 2A and 2B are similar. The difference is that for Model 2A, the conditional probability of a non-PCFG whale being a WNP (rather than ENP) whale is simply based on the ratio of WNP:ENP population size. This is an intuitive estimator, though it does rely on the assumption that WNP and ENP animals migrating together are using the same migration corridors and behaving similarly. For Model 2B, this assumption is relaxed and we allow for broader uncertainty by stating that the conditional probability varies uniformly from zero (if the WNP whales do not migrate through the Makah area at all) to some maximum value that is based on (but not equivalent to) the ratio of WNP:ENP population size. However, it is difficult to define that maximum value, and allowing a lower probability of zero is not precautionary and arguably should not be considered without supporting evidence.

Model 2 (A and B) makes use of the mixing proportion/sightings data for the Makah hunt area, as well as WNP and ENP abundance estimates. WNP whales are assumed to be moving with the ENP migrants, so that the marginal probability of a WNP whale being struck is the probability that the struck whale is a migrant, P_{mig} (i.e., probability of not being a PCFG whale), multiplied by the conditional probability of being a WNP whale given that it is a migrant ($P_{WNP|mig}$). Thus, $P_{WNP} = P_{mig}P_{WNP|mig}$.

P_{mig} is defined as $1 – P_{PCFG}$, where P_{PCFG} is given by an informative prior: P_{PCFG} ~ Beta (5.3648, 13.7952) which has a mean of 0.28 and SD of 0.1 (IWC 2018).

We assume that the per-capita likelihood of a migrating (non-PCFG) whale in the hunt area being a WNP whale (i.e., $P_{WNP|mig}$) is simply given by the proportion of the migrating population made up of WNP whales. This proportion depends on what fraction of the WNP population migrates along the U.S. West Coast, which we call *m*, and the relative size of the WNP to the ENP population. Thus, $P_{WNP|mig} = mN_{WNP}/(mN_{WNP} + N_{ENP})$. Let *m* ~ Uniform (0.37, 1), based on Cooke *et al.* (2015). N_{WNP} and N_{ENP} are treated as lognormally distributed variables with means and CVs as given above.

Estimation

Earlier analyses (Moore and Weller, 2013) used Bayesian estimation. In the current exercise, analysis was conducted using OpenBUGS software, but estimation is not strictly Bayesian because there are no new data updating the informative prior inputs. Rather, the present analysis is essentially a Monte Carlo procedure, with distributions for the parameters of interest (e.g., probability of striking a WNP whale) being derived from random draws from informed prior distributions for the input parameters. Derived parameter distributions are summarized from two MCMC chains, each 25,000 samples in length (50,000 samples total).

Derived parameters

The key parameter of interest is the per-strike probability of striking a WNP whale. Derived from this parameter are the probabilities of striking at least one WNP out of 3 gray whale strikes (i.e., the annual probability of striking a WNP whale, for the even-numbered years) or out of 15 gray whale strikes (i.e., probability for the whole 10-year period). These are calculated as $P(x > 0) = 1 - (1 - P_{WNP})^X$, where X is 3 or 15. Additionally, we can derive the expected number of WNP strikes as $E(x) = P_{WNP}X$. Using data collected during previous hunts (NMFS, 2015), the following two assumptions were used to calculate analogous estimates for vessel approaches and unsuccessful strike attempts: (1) there will be 353 vessel approaches per year (3530 across all 10 years)[3], and (2) there will be 6 unsuccessful strike attempts for every strike in an even-year hunt[4].

RESULTS

Parameter estimates

Estimated parameters from all model sets are in Table 1. Figure 2 shows the distribution for P_{WNP}. It is straightforward to integrate across the uncertainty in P_{WNP} to obtain a single probability estimate. We did this for the probability of striking ≥ 1 WNP whale over the entire 10-year hunt period (i.e., out of 15 strikes). This probability was 0.058.

Table 1. Distribution summaries for key model parameters. "Prob(WNP)" is the probability of at least 1 WNP animal being struck or subjected to unsuccessful strike attempts or vessel approaches given the specified number of events.

Parameter	Posterior mean	2.5% CRI	Posterior median	97.5% CRI
Prob(WNP) for a single interaction, i.e., P_{WNP}	0.004	0.002	0.004	0.007
Prob(WNP|3 strikes in 1 yr)	0.012	0.006	0.012	0.019
Prob(WNP|15 strikes in 10 yrs)	0.058	0.030	0.057	0.093
Prob(WNP|18 unsuccessful strike attempts in 1 yr)	0.070	0.036	0.069	0.110
Prob(WNP|90 unsuccessful strike attempts in 10 yrs)	0.299	0.167	0.298	0.442
Prob(WNP|353 approaches in 1 yr)	0.735	0.511	0.751	0.899
Prob(WNP|3530 approaches in 10 yrs)	~ 1.0	0.999	~ 1.0	~ 1.0
Expected WNP|3 strikes in 1 yr	0.012	0.006	0.012	0.019
Expected WNP|15 strikes in 10 yrs	0.060	0.030	0.059	0.097
Expected WNP|18 unsuccessful strike attempts in 1 yr	0.072	0.036	0.071	0.116
Expected WNP|90 unsuccessful strike attempts in 10 yrs	0.361	0.182	0.353	0.582
Expected WNP|353 approaches in 1 yr	1.416	0.714	1.386	2.283
Expected WNP|3530 approaches in 10 yrs	14.160	7.141	13.860	22.830

[3] This number is conservative because it assumes that all approaches (hunting and training) in both even and odd years occur during the winter/spring period when WNP whales may be present. Realistically we would expect a substantial number of approaches to occur outside this period, i.e., during the summer when ocean conditions are more favorable and, in odd years, when hunting approaches are restricted to July - October.

[4] We expect zero in odd years because the draft proposal limits training strikes (which count as unsuccessful strike attempts) to the summer-fall hunting season, when WNP whales are not expected to be present.

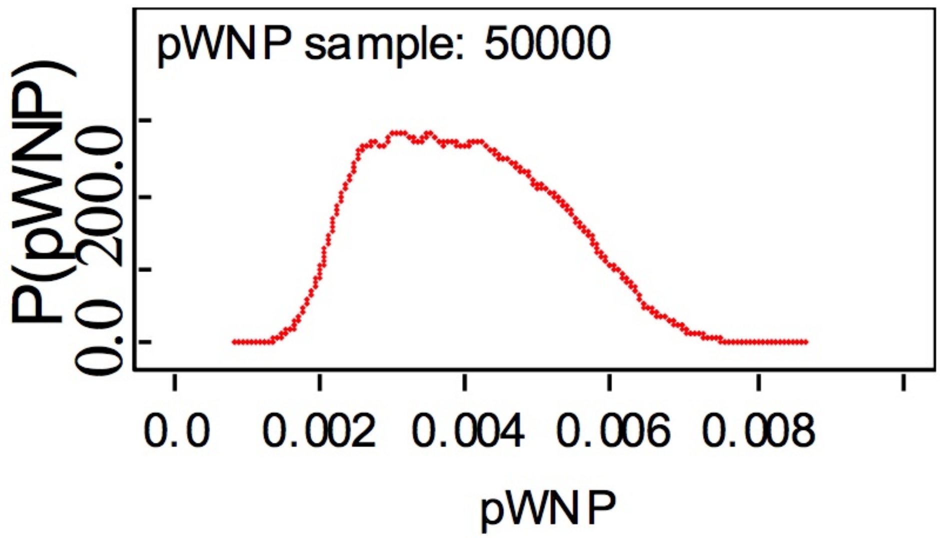

Figure 2. Posterior distribution for probability that any given strike is a WNP whale.

DISCUSSION

Estimates from our analysis may be precautionary since they assume that the Makah hunt will achieve proposed maximum strike limits, and because the assumption of Model 2A is that WNP whales are homogenously mixed with ENP whales. The likelihood of striking a WNP whale is overestimated if fewer total animals are struck or if in reality the WNP animals use a different migration corridor and are less likely to travel through the Makah hunt area. Given uncertainties associated with the model and scenario assumptions, these results serve as a rough approximation of the potential for WNP gray whales to be subjected to strikes, unsuccessful strike attempts and vessel approaches during a Makah hunt operating under a draft proposal currently being considered by NOAA Fisheries.

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WESTERN GRAY WHALE ADVISORY PANEL	**WGWAP-11**
11th Meeting	**12-14 February 2012**
	Geneva, Switzerland

REPORT OF THE WESTERN GRAY WHALE ADVISORY PANEL AT ITS ELEVENTH MEETING

CONVENED BY THE INTERNATIONAL UNION FOR CONSERVATION OF NATURE

CONTENTS

ACRONYMS

EIA	Environmental Impact Assessment
EMTF	Environmental Monitoring Task Force
ENL	Exxon Neftegas Limited
ENP	Eastern North Pacific
HAB	Harmful algal bloom
IBM	Institute of Marine Biology
IFAW	International Fund for Animal Welfare
IPEE RAS	Institute of Problems in Ecology and Evolution of the Russian Academy of Sciences
ISRP	Independent Scientific Review Panel
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
IWG	Interdepartmental Working Group
MCI	Maximum Cumulative Impact
MNR	Ministry of Natural Resources of Russian Federation
MVA	Multivariate analysis
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NTF	Noise Task Force
OSR	Oil Spill Response
OSRP	Oil Spill Response Plan
PA	Piltun Area
PBDE	Polybrominated Diphenyl Ether
PCB	Polychlorinated Biphenyl
PCI	Potential Cumulative Impact
PCoD	Population Consequences of Disturbance
POI	Pacific Oceanological Institute
PSA	Production Sharing Agreement
RMS	Root-Mean-Square
SEIC	Sakhalin Energy Investment Company
SEL	Sound Exposure Level
SSTF	Seismic Survey Task Force
UNDP	United Nations Development Programme
WGW	Western Gray Whale
WGWAP	Western Gray Whale Advisory Panel

1 OPENING

1.1 Introductory remarks

The eleventh meeting of the Western Gray Whale Advisory Panel (WGWAP-11) was held at the Hotel Royal, Geneva, Switzerland, from 12-14 February 2012 under the chairmanship of R.R. Reeves. The meeting was preceded by the second meeting of the Noise Task Force at the same venue on 8-9 February.

Reeves began the meeting by recalling that the independent scientific panel process, involving engagement between IUCN and Sakhalin Energy, had started more than seven years ago. Much has been learned about western gray whales since then, but it is clear that much more remains to be learned. The first meeting of the present Panel was in November 2006. It had been agreed by Sakhalin Energy and IUCN that the initial commitment would be for five years, with the possibility of continuation depending on how things went. Reeves expressed his opinion that all individuals and groups involved to date, including the Lenders, the NGOs, IUCN support staff, Company officials, the Company's contracted scientists and engineers, Associate Scientists enlisted to help the Panel with technical issues, as well as the Panel members themselves, have learned from one another and developed a degree of mutual respect and trust.

This meeting inaugurated the second five-year phase of an exceptional, if not unique, arrangement between conservation and industry. Some challenges can be foreseen in the coming years, and others likely await, unforeseen. It is nevertheless encouraging to look back and recall challenges that have been dealt with, more or less successfully, in the first five years. This gives reason to hope that the WGWAP process will prove resilient in the face of future challenges. What is most important is that all participants in the process keep the conservation and recovery of western gray whales and their ecosystem in the centre of the frame.

All Panel members were present (Annex 1). In addition, Brandon Southall attended the meeting as an Associate Scientist at the request of the Panel.

Representatives of the following organisations also attended the meeting (see Annex 1).

AEA Group	Sakhalin Energy Investment Company Ltd
Credit Suisse	Sakhalin Ministry for Nature Resources
International Fund for Animal Welfare	Standard Chartered Bank
International Union for Conservation of Nature	WWF Russia
Mizuho Corporate Bank, Ltd	WWF UK
Pacific Environment	

Reeves reminded participants of procedures regarding interventions by Observers at WGWAP meetings. Priority is given to Panel members and Company representatives but at the end of each agenda item, Observers are given the opportunity to ask questions and make comments. This is generally limited to about five minutes but can vary at the discretion of the Chair. Also, at any time the Chair may recognise an Observer and request that he or she provides information on a particular topic to the Panel. From the Panel's perspective, the contributions by Observers to WGWAP meetings have been extremely valuable, and it is hoped that this pattern will continue.

Patricio Bernal, Tatiana Saksina, Béatrice Riché and Olivier Hasinger of IUCN facilitated meeting preparations and logistics. Sarah Humphrey served as meeting reporter. Interpreters Alexander Danilov and Grigory Shkalikov provided excellent simultaneous translation, as always. The efforts of all of those individuals in support of the Panel's work are greatly appreciated.

1.2 Adoption of agenda

The draft agenda was adopted essentially without any major changes (Annex 2).

1.3 Documents

The list of documents is given in Annex 3. Those designated as public are available at http://www.iucn.org/wgwap/wgwap/meetings/wgwap_11/

The draft reports of the first meeting of the Environmental Monitoring Task Force and the second meeting of the Noise Task Force were available for reference. Both will be posted on the WGWAP public website once they have been reviewed by task force members and finalised by the chairs.

1.4 Reporting procedures and timelines

The normal procedure is for the Panel to develop its draft report as quickly as is feasible, with a general goal of making it available for fact checking by Sakhalin Energy within about two weeks after the meeting. The Company is expected to complete its fact check within two weeks so that the final report can be made available for public release approximately a month after the meeting. This delivery schedule has often proven to be overly optimistic but it remains a reasonable goal.

1.5 Update on outstanding business from previous meetings including status of recommendations

Reeves reported on progress towards ensuring that the cumulative list of Panel recommendations is up to date and publicly available (http://www.iucn.org/wgwap/wgwap/recommendations/). He noted that some ground had been lost on this aspect of the WGWAP's work as a result of the staffing transition at IUCN but also that there was reason to hope Saksina's availability to help would make it possible to catch up (see Item 1.7).

The Noise Task Force (NTF) agreed that it would strive, in future recommendations, to include clarity on: precise objectives, data requirements, analytical techniques, a realistic timeline, and a means for tracking progress. In principle, clarity on these points would be useful for other Panel recommendations insofar as it is feasible and appropriate to the topic.

The Noise and Environmental Monitoring Task Forces had both noted that many recommendations include an expectation that a policy or procedure will be adopted as regular practice. Once the Company has responded favourably to such a recommendation, it is considered Closed – implemented. However, in view of turnover in the company and changes in company practice over time, there is a need to ensure that implementation continues to be tracked. The Panel **recommends** that IUCN work on this matter with the Panel chair and report back no later than at WGWAP-12.

1.6 Website update

Hasinger provided an update and called attention to the fact that documents for this meeting are available on the WGWAP-11 page of the Panel website (http://www.iucn.org/wgwap/wgwap/meetings/wgwap_11/).

1.7 IUCN update on personnel, contract, TOR etc.

Bernal updated the meeting on changes in support personnel within the IUCN Global Marine and Polar Programme. Finn Larsen left IUCN in May 2011 and Bernal provided interim support to WGWAP until February 2012 when Saksina came onboard as a fulltime replacement for Larsen. Also, Hasinger has been helping since December 2011 in anticipation of Riché's upcoming maternity leave and he is now serving as a temporary replacement for her.

The contract between IUCN and Sakhalin Energy has been renewed and the WGWAP Terms of Reference have been updated and revised. With regard to the latter, questions were raised by Panel members and Observers, and Reeves encouraged them to provide written submissions for IUCN's consideration, noting that the Terms of Reference are subject to change at any time with concurrence of the parties.

During the course of this meeting, a question arose concerning the extent to which participants, including Sakhalin Energy, Panel members, Observers, IUCN officials and others, should be constrained with regard to publicising discussions, conclusions etc. via social media and other outlets. The WGWAP Terms of Reference, and indeed the very basis for this engagement between industry and civil society, hinge on the principle of transparency. After a lengthy discussion it was agreed that the terms of disclosure of 'findings' and other information presented at meetings need to be spelled out more explicitly than is presently the case in the WGWAP Terms of Reference, and IUCN was assigned the task of working with the Panel chairman to develop a proposed 'code of conduct' for Observers. Donovan offered to provide, as background for use in this endeavour, the existing IWC documentation used to develop its guidelines for the participation of Observers in Commission meetings. This comprises a review of practices in a number of international organisations. The availability of an agreed WGWAP code of conduct should provide clarity and guidance to all parties and preclude future problems in this regard.

2 TWO-YEAR EVALUATION

Turner gave a presentation on his most recent evaluation of the WGWAP process commissioned by IUCN (available at http://www.iucn.org/wgwap/wgwap/evaluations/). The structure and process of this evaluation (completed in November 2011) were similar to those of the previous evaluation in 2008 (completed early in 2009). The emphasis of Turner's Terms of Reference was on evaluating the effectiveness of individual participants and of the process as a whole. Fortuitously, the timing of the evaluation meant that IUCN was able to make use of Turner's results during the late stages of revision of the WGWAP Terms of Reference (see Item 1.7, above).

Turner found some improvement in the functioning and effectiveness of the WGWAP process since the previous evaluation, but he also identified a number of areas where more improvement is desirable (see Annex 4 for the full Summary and Recommendations from the Turner report). For example, he concluded that IUCN should 'lift its game' not only by achieving greater integration of WGWAP (and the related rangewide initiative) with various other IUCN programmes, commissions, country offices etc., but also by establishing closer links with partners and stakeholders in the wider world, both formally and informally. In his view, there is considerable potential for documenting and disseminating 'lessons learned' from the WGWAP experience to wider audiences, but it will require more focussed and sustained effort by both IUCN and the other process participants to produce tangible products and make sure they reach the appropriate constituencies (e.g. business and industry groups, regulatory agencies). Regarding recommendations, Turner noted the difficulty of tracking and managing the large number of recommendations that have been made since the report of the Independent Scientific Review Panel was published in 2005. Considerable progress has been made on this task, but it will be a challenge to recover the ground lost over the past eight or nine months since Larsen's departure. Also, Turner urged the Panel to strive to make its recommendations more operationally precise and avoid ambiguities and generalities.

During discussion, attention was drawn to several specific outreach activities that had taken place since the last WGWAP meeting. These included attendance by Tsidulko and Reeves at the Sakhalin Oil and Gas Conference in Yuzhno in September 2011, where Reeves gave a formal presentation on WGWAP and chaired a roundtable discussion. The attendance of an Observer from the Sakhalin Oblast Government at WGWAP-11 was a direct outcome of Tsidulko's efforts at the Yuzhno conference (see Item 13, below). Also, in December 2011 Reeves, Tsidulko and Yablokov attended a meeting of the Interdepartmental Working Group in Moscow, Reeves and Tsidulko as observers and Yablokov as a member of the working group (again, see Item 13).

Reeves pointed out that several WGWAP members were active in the work of the IWC Scientific Committee and that Cooke's population assessments of western gray whales were regularly presented and discussed at that committee's annual meetings. Summary update reports on WGWAP activities are presented each year and these are published in the Commission's scientific journal (Reeves et al. 2009, 2010, 2011, in press). Reeves also stressed the potential of a multi-authored 'lessons learned' paper, currently being prepared mainly by Nowacek and Southall for peer-reviewed journal publication, to become one of the 'tangible products' of the WGWAP process (see above) which hopefully will have an impact on industry practice in general. Finally, Panel members suggested that the upcoming United Nations Conference on Sustainable Development (the 'Rio=20 Summit' in Rio de Janeiro in June 2012) may present an opportunity for IUCN to showcase the WGWAP model, and it was noted that plans were already underway for a Sakhalin Energy/IUCN collaborative event on western gray whales at the IUCN World Conservation Congress in South Korea in September 2012.

IUCN is obliged, according to its internal procedures, to prepare and post a detailed 'evaluation response' on the public WGWAP website that includes, for each of Turner's recommendations, a list of specific actions to be taken, the individual(s) responsible for the actions, how implementation will be measured and a timeframe (again, see http://www.iucn.org/wgwap/wgwap/evaluations/ for the response document from the 2008-09 evaluation). The response document for the 2011 evaluation was not yet complete at the time of WGWAP-11 but was expected to be posted on the website in the near future.

3 REPORTS ON FIELD ACTIVITIES IN 2011

3.1 Photo-identification

Tyurneva presented preliminary findings from the 2011 field effort. Photo-ID data were collected from the Piltun, Offshore and Chaivo areas on the Sakhalin Shelf and Olga Bay in Kamchatka. Photos from opportunistic sightings were also obtained in Vestnik Bay, SE Kamchatka. Field methods were the same as in previous years. Photos taken by the tagging team were also included in the data analysis. Tyurneva emphasised that all results are subject to further quality assessment and control.

A total of 16 days of photo-ID effort were achieved by the IBM team off Sakhalin during the period from 23 August to 21 September. Based on a preliminary analysis of the data, a total of 111 individuals were identified, including seven mother-calf pairs, six 'highly probable' calves and two 'likely' calves (i.e. small individuals sighted without their mothers or presumed mothers present). The proportion of animals deemed to be in poor body condition (body condition class 2-4) was 20.7% (23 animals, including seven nursing females). The corresponding proportion in 2010 was 11.5%.

Analysis of photos collected during 2011 tagging operations off Sakhalin is still underway. Provisionally, a further ten distinct individuals were identified during the tagging work.

Photo-ID work in Olga Bay was conducted from 21 July to 8 August. There were six days of effort during this period. A total of 30 different whales were photo-identified, 18 of which were included only in the Kamchatka catalogue as they had not been photo-identified previously at Sakhalin, and 12 of which were included in both catalogues (Kamchatka and Sakhalin). Nine whales were photo-identified in Olga Bay for the first time and two of these were already in the Sakhalin catalogue. Two cow-calf pairs were identified; neither of the mothers was known from the Sakhalin catalogue. The number of 'skinny' whales is traditionally high in Olga Bay: in 2011, 70% were judged to be in poor body condition.

Photos of six whales in Vestnik Bay were supplied by V. Burkanov and V. Vertyankin. One was a whale new to both catalogues (Sakhalin and Kamchatka). Five other whales had been photo-identified at Sakhalin in previous years.

The total number of whales included in the IBM Sakhalin catalogue seen in 2011 at Sakhalin and Kamchatka was 134. [Note: The Panel was informed after the meeting that the final figure was 137.] Furthermore, it was noted that in the past three years of observations (2009-2011) a total of 182 individuals included in the IBM Sakhalin catalogue were sighted, including calves.

Currently the IBM Sakhalin catalogue (KOGW) includes 205 identified whales; the Kamchatka catalogue contains 150 whales. Of those, 84 whales are included in both catalogues, i.e. they were photo-identified at both Sakhalin and Kamchatka.

The Panel welcomed this report and looked forward to receiving final results for 2011 and previous years at its next meeting.

3.2 Distribution

Vladimirov provided an overview of effort and preliminary results from the joint Sakhalin Energy/ENL 2011 vessel- and shore-based distribution surveys. Overall, the 2011 effort mirrored that of previous years in both scope and timing. Vessel surveys were conducted from the research vessel *Igor Maximov* and followed the transect lines employed in 2010. Survey lines in the offshore area were placed further to the east. Visibility and sea state conditions were generally poor during the study period. Only one vessel survey, on 23 September, covered the entire transect area and 34 whales were counted. A partial survey, with a count of 8 whales, was conducted on 20 August.

The 2011 shore-based distribution effort was similar to that of previous years. Surveys were conducted between 1 August and 28 September. Although poor weather conditions prevailed during some portions of the study period, there were six complete surveys (i.e. when all 13 shore stations were covered in a single day) and 14 partial surveys in August and nine complete and 16 partial surveys in September. In August shore-based data showed the highest numbers of whales off stations 3-4 and 5-6 in the north and stations 9-10 and 11-12 near the mouth of Piltun Lagoon and further to the south. In September the highest numbers of whales were observed off stations 9-10 near the mouth of the lagoon.

In discussion, some Panel members noted that the distribution and density of whales was likely influenced by a combination of factors, including not only benthic biomass and prey availability but possibly also industrial activities. The Panel welcomed the clear graphics provided in this presentation and encouraged the use of similar representations of data in the future.

3.3 Acoustics

Racca summarised the 2011 acoustics programme, conducted by POI on behalf of Sakhalin Energy and ENL. The purpose of this programme is to monitor background and anthropogenic underwater sound in and near the two gray whale feeding areas off Sakhalin and in so doing, measure and track changes in the acoustic environment in relation to oil and gas activities.

The results presented were preliminary. The recording buoys appeared to have performed well, remaining in the water for as long as 52 days without maintenance. This increased longevity is welcome because it should mean less need for vessel traffic to service the buoys in coming years. The downside of this improved life is that it requires the use of more alkaline batteries, but hopefully these can be recycled. Data from the buoys appeared to be of good quality, although the Panel was unable to make a full assessment because only a portion of the data was presented.

Racca noted several things in his presentation. Firstly, signals from a seismic survey were recorded on the ‘control’ and ‘Odoptu-N-20’ buoys, indicating that the survey occurred in the vicinity of the northern part of the Piltun feeding area. Racca presented some of the received signals and indicated that the data could be mined to estimate source levels; the AIS data from the *Pacific Explorer* recorded on the *Igor Maximov* would be useful for making these calculations.

Secondly, Racca drew attention to vessel noise on several of the recorders, including what was inferred to be noise from trawling operations. He further noted that the recorder at the ‘Arkutun-Dagi’ buoy had been lost, possibly because of fishing activity in the area. The Panel expressed concern about the possibility that trawling was occurring near or even in the gray whale feeding areas as this could affect the whales in two ways, by causing direct noise disturbance and/or by damaging the benthos and thus affecting the whales’ food supply. However, without knowing more about the nature and scale of such fishing activity, it will not be possible to assess its potential impacts.

In its report of WGWAP-8 (Item 3) the Panel had expressed concern about the potential effects of fishing activities on western gray whales in the Sakhalin region. At that time, the Panel had expressed its intention to 'approach contacts on Sakhalin for more information' in this regard. However, no significant progress has been made since then. It is hoped that with support from IUCN, more progress can be made before the next meeting. Therefore, the Panel **recommends** that IUCN approach the Sakhalin Oblast government, the Sakhalin Fisheries Agency, and any other potential source with an explicit request for information on fishing activities (e.g. number and type of vessels, seasons of operations) in and near the gray whale feeding areas off Sakhalin. Such a request is justified by the Panel's need to be able to assess fisheries-associated risks (including noise) to the whales. A report on progress should be provided by IUCN at WGWAP-12.

In its WGWAP-10 report (Item 6.5.2) the Panel noted that it had had insufficient time to consider carefully the joint programme's noise report from the 2010 season and that it would return to the subject at this meeting. To begin with, the Panel took note that Sakhalin Energy, with the help of POI and Jasco, had presented data in the format requested and that the format, *inter alia* how the spectrograms are presented and the frequency bands displayed, greatly improves the reader's ability to comprehend and interpret the data.

Thanks in part to this improved data format, the Panel's attention was drawn to several very loud periods in August and September 2010. Further consideration of the 2010 acoustics data led the Panel to conclude that there had been periods when noise levels, especially continuous noise, rose well above the criteria set by the Panel in its WGWAP-2/15 report. In fact, in several cases the noise received inside the Piltun feeding area (i.e. at buoys placed along the 10 m isobath) far exceeded the Panel's criteria for behavioural disturbance of gray whales.

Therefore, the Panel makes the following **recommendation** (following the format mentioned under Item 1.5 for new Noise recommendations):

RECOMMENDATION ON THE PROVISION OF ACOUSTIC DATA FOR SPECIFIED PERIODS IN 2010

Objective

To investigate identified periods of loud noise within the feeding grounds in more detail with regard to both the activities underway and the acoustics data recorded. This investigation will attempt to (a) identify the cause(s) of the noise and (b) determine the extent (i.e., sound exposure) of the potential threat or disturbance, so that mitigation can be improved in the future, recognising that the sources of the loud noise are likely not SEIC activities.

Reporting/data requirements

According to the impulse noise format described in recommendation WGWAP-7/002, the Panel wishes to analyse the data from the following acoustic buoys on the dates indicated: Buoys A10, Odoptu N10, Odoptu-S-20 and Odoptu N20 for the periods 25-30 August, and 11-20 September; and Buoy OFA, 1-7 September 2010.

Responsible persons

Sakhalin Energy. IUCN, the Panel

Timeline

The data should be submitted to IUCN by 31 May 2012 and circulated to the Panel. The Panel will provide a report at least three weeks before WGWAP-12.

3.4 Benthic

Fadeev began his report by taking note of the unfortunate death during the 2011 field season of Nikolai Ivanov, a key member of the benthic monitoring field team with skills as a diver and videographer. A moment of silence was observed in commemoration of Ivanov's life and contributions.

Fadeev presented a summary of major data categories collected in summer and autumn 2011 by his field team. Many of the samples were still being analysed, and the data presented were therefore partial and preliminary. Sample categories collected include contaminants (heavy metals and hydrocarbons) in sediment samples, and benthic species used by gray whales in recognised feeding areas. Sample collection methods and locations followed the standard station design used in previous years (a ‘monitoring grid’ of points within feeding areas positioned at random). The data presented suggest little change in benthic biomass densities in whale feeding areas between 2010 and 2011. Benthic work in Olga Bay, eastern Kamchatka, was limited in 2011 due to inclement weather and unfavourable sea conditions. A complete report, including consideration and presentation of all 2011 data, is anticipated at the WGWAP-12 meeting.

Fadeev noted that he was participating in an ongoing collaboration with Professor Kriksunov of Moscow State University to carry out multivariate statistical analyses of spatial patterns in existing benthic data (see Item 11.3). The analytical framework had not yet been fully resolved and remained in development. Based on preliminary evaluations of the influences of 17 independent parameters on amphipod distribution, and recognising that phytoplankton appear to be the most significant primary producers for benthic communities in the feeding areas, a current working hypothesis is that the date of annual ice melt in the late spring or early summer is important to phytoplankton biomass and may be significant to inter-annual variation of amphipod biomass in the benthos. Satellite imagery is available for chlorophyll concentrations in surface waters, possibly allowing the generation of index values linked to phytoplankton concentrations.

The Panel has for many years noted the great difficulty yet importance of integrating the various datasets in order to evaluate the effects of various activities on the population. This is discussed further under Item 11.3.

As a follow-up to discussions at the Environmental Monitoring Task Force meeting in December (Item 6.1), Fadeev described an effort to sample and identify phytoplankton in the gray whale feeding areas, with the goal of determining presence and abundance of species capable of producing harmful algal blooms (HABs). One hundred phytoplankton species were identified, of which nine are known to be capable of producing HABs. There is no evidence to suggest the concentrations of these species are high in the gray whale feeding areas off Sakhalin. Brownell suggested that reference to data from other areas where marine mammal exposure to HABs has been investigated would be a useful next step. He also noted that coastal areas in China had some of the highest incidence of severe HABs known, and data from that region should be examined in the context of this discussion.

The Panel **recommends** that Brownell and Weller take the lead in consulting with outside experts (e.g. Frances Gulland in California) on the marine mammals/HABs issue and how it may pertain to western gray whales, and that they report back at WGWAP-12.

3.5 Field programme of Russia-US team in 2011

On behalf of Alexander Burdin and his colleagues at the Kamchatka Branch of the Pacific Institute of Geography, Far East Division of the Russian Academy of Sciences, Weller provided a summary of the 2011 photo-identification results from the long-term (1994-2011) Russia-U.S. research program on western gray whales. A total of 14 small-boat surveys, including 33 hours of directly observing 83 whale groups, were completed in 2011. This effort resulted in the identification of 82 individuals, including 12 calves and one previously unidentified non-calf. When combined with photo-identification images collected during the 2011 satellite tagging operation (used by permission of the IWC), the total number of whales identified and calves observed in 2011 increased to 122 and 15, respectively. The Russia-U.S. 1994-2011 photo-identification catalogue, containing a total of 205 identified individuals, has been finalised and is available upon request from Burdin or Weller. The Panel thanked Burdin and colleagues for providing their summary and extended appreciation to IFAW for supporting the Russia-U.S. research and ensuring its continuation over the past decade.

3.6 2012 Joint Programme

At the Panel’s request, Evans provided a spoken summary of the planned Sakhalin Energy 2012 research and monitoring programme. The shore-based behaviour team and archival acoustic monitoring buoys will be in place by mid-June to collect case specific data related to the planned seismic and acoustic site surveys (see Items 5 and 9, below). Once that effort has been completed, there will be a 2-3 week hiatus in the research and monitoring work. On or about the first of August, the joint SEIC/ENL programme, including shore- and vessel-based distribution, benthic, acoustic and photo-identification components, will begin and continue until approximately the end of September, similar to the programme executed in 2011.

4 SATELLITE TAGGING

4.1 Summary of field effort in 2011

Tsidulko and Mate presented the main results of last year’s satellite tagging effort conducted under the Research Program of the Okhotsk-Korean Gray Whale (*Eschrichtius robustus*) Population Habitat Using Satellite Telemetry by the A.N. Severtsov Institute of Problems in Ecology and Evolution of the Russian Academy of Sciences (IPEE RAS) in collaboration with Oregon State University Marine Mammal Institute as well as the U.S. National Marine Fisheries Service, Kronotsky State Nature Biosphere Reserve and the Kamchatka Branch of the Pacific Institute of Geography. The Program was funded jointly by Sakhalin Energy and ENL, with contracting and administration through the IWC and IUCN.

The field protocol for selecting whales as candidates for tagging had been updated by the IWC Scientific Committee at its annual meeting in June 2011 based in part on the tagging results from 2010 (see IWC in press). The protocol was further modified during fieldwork in September 2011 based on observations by the field team of the general health status of parturient females known to have weaned their calves earlier in the season. According to the final agreed protocol (with approval of the Scientific Steering Group obtained via e-mail), in 2011 tags could be deployed on mature whales of both sexes as long as they were judged by experts on the field team to be in good health and not accompanied by a calf. The field season spanned from 16 August to 24 September, with tagging effort conducted from 22 August to 22 September. Poor weather limited effort but 17 tagging missions on 16 days were achieved.

Six tags were deployed (five females; one male) on animals that had been photo-identified previously off Sakhalin in multiple years. Four tags stopped transmitting (4-67 days) while the whales were still in Sakhalin waters. One tag was still transmitting at the time of this meeting.

Ancillary to the tagging effort, the tagging team photo-identified 103 individual whales including 11 calves. Six skin samples and four blubber samples were also obtained from biopsies during the tagging effort. The importance of careful use of the biopsy samples was noted. Donovan noted that at least those samples that fell under the control of the IWC would be governed by IWC protocols that include review of any proposals for use by the Scientific Committee (which includes a number of Panel members).

The gray whale known as ‘Flex’ that had been tracked as a result of the 2010 satellite tagging effort (Rozhnov et al. 2011; Mate et al. 2011), was resighted multiple times in 2011 and was evaluated to be in satisfactory health and condition.

Two of the whales tagged in 2011 (both females) departed the Sakhalin coast approximately a month earlier than Flex had in 2010. While Flex and both 2011 whales crossed from the western to eastern North Pacific, they followed somewhat different tracks. One of the 2011 transmitters stopped working while the whale was in the southern part of the Gulf of Alaska. The other 2011 whale moved south along the west coast of North America almost to the tip of the Baja California peninsula (Mexico). This individual was resighted on two occasions (one day apart) off Oregon and California. At that time the tag appeared to be fully deployed and she was travelling in a group of 8-10 whales, although only one of those was with her on both occasions.

The directed long-range movement by all three tagged whales suggests purposeful migration. *Inter alia* the results will require reconsideration of gray whale migration speeds. Whilst Mate noted that all three whales whose tags continued transmitting migrated eastwards, he emphasised that the sample size was small and the possibility of other migratory routes and destinations of gray whales that feed off Sakhalin in the summer and autumn could not be ruled out.

4.2 Future satellite tagging

Tsidulko reported that five telemetry tags remain in Russia and Mate commented that they may be used to continue the effort. The Panel noted, however, that the batteries of these tags (now several years old) must be checked to verify their ability to perform at an acceptable factory specification prior to future deployment. At its previous meetings (see WGWAP-9 report, item 10; WGWAP-10 report, item 14), the Panel has expressed support for continuation of the tagging programme with oversight by the IWC Scientific Committee. The central objective remains: to learn where the whales from Sakhalin (and Kamchatka) go in winter and the routes they use to get there and back. This information is needed to guide efforts to protect the animals throughout their range, including Russia, Japan, Korea, China, Canada, the United States and Mexico. The Panel also **reiterates** the important role of the joint IWC-IUCN steering group in scientific aspects of the programme.

Evans stated that the main sponsors of the work to date, Sakhalin Energy and Exxon, believed that the funding burden should now be shared more broadly and he also stated that neither company had additional tagging effort in its 2012 scope of work. Yablokov reported that funds for tagging were being sought within Russia and Tsidulko noted that despite the current lack of funding, the permitting process was already underway and would not pose a serious obstacle to any 2012 follow-up effort should funds be made available.

The Panel **urges** all potential sponsors, including Sakhalin Energy and ENL, to consider providing support for the tagging programme. [Note: Following the meeting, the Panel was informed by Evans that SEIC and ENL were working with the IWC, Oregon State University and the Institute of Ecology and Evolution of the Russian Academy of Sciences to find a way to field a satellite tagging programme off Kamchatka in 2012. Evans stressed that an ‘internationally led’ effort was needed and that additional funding beyond that provided by SEIC and ENL would be required. He reported that IUCN and WWF had promised to investigate ways of supporting this effort and that discussions with the United Nations Development Fund were also ongoing.]

5 NOISE TASK FORCE

5.1 Background

Donovan, who chairs the Noise Task Force (NTF), reported on the two meetings that had been held since WGWAP-10. The NTF had been formed at WGWAP-10 to supersede the Seismic Task Force (SSTF)[1]. Its remit was to:

(1) Continue work on pulse noise issues, especially
- Analyses of the results from the 2010 Astokh 4D seismic survey
- Provide advice and recommendations on the planned summer 2012 2D (geotechnical) surveys

(2) Address broader noise-related issues, including
- Specific noise-generating events or activities
- Continuous noise
- Chronic overall increase in noise on the Sakhalin Shelf

[1] (see http://www.iucn.org/wgwap/wgwap/task_forces/seismic_survey_task_force)

- Review status of past 'noise' recommendations.

5.2 Report of November 2011 meeting (NTF-1)

The first meeting of the NTF was held in Vancouver, Canada, from 13-14 November 2011. The final report is available at http://www.iucn.org/wgwap/wgwap/task_forces/noise_task_force/. What follows here is Donovan's summary of that meeting, the primary focus of which was to consider progress with and the status of past recommendations related to noise issues. The task force's views on these can be found under Items 5.3 and 5.4. New recommendations are dealt with below.

5.2.1 General discussion of recommendations

At the start of its work, the NTF considered the issue of recommendations in general. It agreed that past recommendations had sometimes suffered from imprecise specifications that had led to misunderstandings between the Panel and the Company and this had often resulted in delayed or incomplete fulfilment of those recommendations. It noted that this issue was broader than noise-related recommendations. It agreed that at least for major NTF recommendations, it would try to formulate them under the following headings, recognising that not all headings would always be applicable:

(1) precise objectives;
(2) data requirements;
(3) analytical techniques;
(4) realistic timelines;
(5) a means to track progress.

With respect to items (4) and (5) in the above list, the NTF agreed that it was important to establish mutually agreed and realistic timelines for implementation of recommendations, including completion of analyses and presentation of results. An efficient mechanism is needed to review progress between meetings. Experience has shown that regular teleconferences can be valuable. This should be an organisational priority for the IUCN WGWAP officer.

The NTF suggested that the Panel should consider using the above approach when formulating its recommendations (cf. earlier discussions under Item 1.5).

The NTF also noted that some previous recommendations of the Panel (and its predecessors) refer to actions by Sakhalin Energy that are expected to be incorporated into routine business and require regular attention and updating. The NTF recommended that the Panel develops a mechanism to ensure that if such recommendations are classified as 'Closed' in the online list, they are identified so all parties (especially IUCN) are 'reminded' of the need to ensure continuing compliance/implementation (again cf. Item 1.5).

5.2.2 New or consolidated recommendations agreed at NTF-1

The NTF agreed to one major new recommendation at NTF-1. This related to the reporting of new and ongoing activities for consideration by WGWAP. The formulation goes beyond simply noise issues and the NTF hoped that this would assist the WGWAP in formulating a general recommendation. The Panel's view on this can be found under Item 5.5.1.

The NTF also began to develop a new recommendation dealing with (a) Timing and format for acoustic data presentation, especially in the light of new projected activities and if necessary a re-examination of relevant data from previous years and (b) the need for regular sampling/analysis of ambient noise. The discussions at NTF-1 were continued at NTF-2 (see Item 5.5) where a new recommendation was agreed.

Finally, the NTF agreed that Nowacek would develop a consolidated recommendation arising out of discussions over the unusual noise recorded near the PA-A platform in 2009. This is discussed under Item 5.5.

5.2.3 New information on South Piltun (including the 2D surveys planned for 2012)

The task force received new information from Sakhalin Energy on deliberations within the Company. Further information was received at NTF-2 (see Items 5.3.3 and 9).

5.2.4 D-Tags

The use of D-Tags to collect detailed information on received sound levels and behaviour of gray whales during noise-generating activities and in ‘quiet’ periods has been discussed at previous meetings (e.g. SSTF-7 and WGWAP-10). The D-Tag (Johnson and Tyack 2003) is a multi-sensor acoustic recording tag that simultaneously measures an animal’s movements with accelerometers and magnetometers, the depth of water via a pressure sensor, the temperature of the water, and the sounds made by the animal as well as the sounds to which it is exposed. NTF-1 received an update on the use of D-Tags. It was anticipated that further consideration would be possible once a detailed proposal was available (see recommendation WGWAP 9/028).

5.2.5 Possible ways to obtain, validate, analyse and interpret data from previous seismic surveys by other companies (including Gazprom and Rosneft)

NTF-1 agreed that the issue of obtaining and reviewing data on seismic surveys from other companies would require a more focussed and consistent effort by IUCN than has occurred thus far. It hoped that the appointment of the new full-time officer, along with the contacts with Rosneft made by Tsidulko and Reeves, would improve the situation.

5.2.6 Cumulative noise

NTF-1 received an initial briefing on the integrated analysis being funded by the joint programme of Sakhalin Energy and Exxon Neftegas (also see Item 11.3, below); stage 1 related to integrating information on the multiyear distribution and benthic datasets. Amongst issues raised was the definition of baseline (no activity) years and the appropriate acoustic metrics.

It also received a summary of two recent studies. Rolland et al. (2011) reported that a 6 dB decrease in underwater ship noise below 150 Hz in the lower Bay of Fundy (coinciding with decreased traffic as a result of the terrorist attack on the Twin Towers in New York on 11 September 2001) correlated with a significant decrease in stress hormones measured in faecal samples from North Atlantic right whales. Blackwell et al. (2011) used a modelling approach to examine received sound levels and acoustic behaviour of bowhead whales off northern Alaska over a four-year period. The received ‘dose’ of airgun sound at which detected bowhead calling rates began to decline was ~ 120 dB re 1 µPa^{2}s cumulative SEL over 15 min, corresponding to received SPL at the whale of at least 100 dB re 1 µPa. The unit designation here – 1 µPa^{2}s – provides the appropriate reference pressure (1 µPa) as well as the terms(s) indicating sound energy summed over time.

The NTF noted the importance of integrating information from studies of other baleen whales in developing conservative (i.e. precautionary or risk-averse) advice on potential disturbance from sound whilst recognising the potential limitations of interspecific comparisons. It also noted the practical difficulties in obtaining faecal samples from gray whales in the Sakhalin area.

Issues related to cumulative noise are also considered under Items 11.3 and 11.4.

5.2.7 Review progress on analyses of the 2010 4D data

The task force received and discussed a progress report that provided input to inform the main discussion of this issue at NTF-2. The relevant deliberations are incorporated into the consolidated view given under Item 5.3.

5.2.8 Future of the joint programme

There was a substantial discussion concerning the future of the joint SEIC/ENL gray whale research and monitoring programme, particularly with regard to the question of whether the acoustics element would be maintained. The NTF was concerned to hear of difficulties in getting approval for the 2011 joint programme as a result of pressure from MNR. *Inter alia* this related to questions of 'recoverability' of research costs. The NTF was informed that it is ultimately the prerogative of the Russia Party under the PSA terms (Production Sharing Agreement) who agree with the Company (effectively 'a contractor' under the PSA terms) on the scope of the work and what costs are and area not 'recoverable'.

This issue is also discussed under Items 3.6 and 11.1.

5.2.9 Panel discussions of NTF-1

The Panel welcomed and endorsed the report of NTF-1 and its recommendations. As noted previously, recommendations relating to POI data obtained under the Joint Programme require joint permission from Sakhalin Energy and Exxon Neftegas. It was agreed that Nowacek would develop a consolidated recommendation arising out of discussions over the unusual noise recorded near the PA-A platform in 2009 for the WGWAP-12 meeting.

5.3 Report (provisional) of February 2012 meeting (NTF-2)

The second meeting of the NTF (NTF-2) was held in Geneva, Switzerland, from 9-10 February 2012. The draft report, largely complete apart from editorial changes (discussion, conclusions and recommendations sections had been agreed by the NTF on 11 February), was available to this meeting. The final report of NTF-2 will be posted on the IUCN website (http://www.iucn.org/wgwap/; http://www.iucn.org/wgwap/wgwap/task_forces/noise_task_force/). What follows here is Donovan's summary of that meeting, the primary focus of which was to:

(1) review progress on 4D analyses and possible implications of any results for planned 2D surveys (see item 3 of this list);
(2) consider the noise section of the 'Issues Document' prepared by Sakhalin Energy (WGWAP-11/5);
(3) review updated plans for 2D (geotechnical) surveys (currently planned for summer 2012).

5.3.1 4-D analyses

The task force was pleased to receive detailed progress reports on the three primary study elements from Sakhalin Energy, recognising the considerable work that had gone into them:

(1) 'Case studies' - each of these consists of a whale track constructed from theodolite sightings by the behaviour teams, resolved in 1-minute steps and associated point-wise with estimated sound exposure levels from the seismic source where applicable;
(2) 'Behaviour' MVAs (these represent a similar but refined approach to previous multivariate analyses by Gailey;
(3) 'Distribution MVAs' (these MVAs focus on the distributional data, and involve newly developed statistical methodologies).

The detailed technical comments, suggestions and recommendations on these progress reports can be found in the NTF-2 report and are not summarised here. The general conclusions under each heading are summarised below.

Case studies

These studies provided valuable detailed observations from the 4D survey that can inform the quantitative analyses of MVAs. The inevitable limitations (e.g. with respect to sample size) are largely a result of success of the mitigation measures (i.e. to complete the survey as soon as possible when fewest whales are present). When data are collected in a non-controlled situation such as this, the results should be interpreted cautiously and it should be recognised that the approach is only likely to detect relatively large-scale effects. Careful consideration is needed to determine the appropriate metrics for exposure (here and in the other studies).

Behaviour MVAs

The NTF welcomed the progress made thus far and endorsed the proposed way forward. It encouraged the use of data from other years to obtain more appropriate 'natural' models and noted that it was important that the analysts were provided with the best bathymetric data (both here and in the 'distribution' MVAs).

Distribution MVAs

The NTF welcomed the progress made thus far. It focussed its suggestions on the three most promising approaches: (a) analysis of scan counts, (b) analysis of distance from shore and (c) analysis of densities.

General conclusions

The NTF recognised both the complexity of the analyses that are required and their importance in adding to understanding of the effects of seismic surveys on whales and in developing improved mitigation measures. It also recognised the future value of trying to incorporate recent developments in the use of state-space models to examine behavioural (and other) responses to human activities. As has been stated several times before, considerable effort and resources were expended by the Company and the Panel to design a comprehensive monitoring and mitigation programme for the 2010 4D survey. Similarly considerable effort and resources were expended in successfully implementing the programme in the field – an effort perhaps unparalleled in the world. It would be false economy not to complete full analyses of the resultant data. While progress may not have been as fast as the NTF would have liked, this is not a criticism of the analysts but a reflection of the complexity of validating and preparing the data, determining appropriate metrics for key parameters and developing new integrative analytical methods. The discussions during the meeting show that considerable progress has been made and the NTF recommended that the work continues and looks forward to receiving the results. A timetable was to be provided by Broker before 21 February.

The NTF also recommended that the analysts seek input from members by email and conference calls in the event that unforeseen issues arise with any of the analyses.

5.3.2 Noise component of the 'Issues' document.

The NTF considered the relevant sections of WGWAP-11/5 that had been produced in response to recommendations WGWAP-9/019 and especially WGWAP-9/020. Its comments can be found later under Item 10 in this report.

5.3.3 Update of general South Piltun project

The NTF discussions on this general issue are reflected in the discussion under Item 9 of the present Panel report.

5.3.4 2012 2D seismic surveys

The task force was informed that the postponement of operations originally planned for summer 2011 to summer 2012 had been due to a delay in obtaining Russian Federation approvals for the critical geophysical part of the work.

Sakhalin Energy confirmed that the previously identified potential location for the South Piltun platform remained valid. However, Company officials were investigating alternative locations farther offshore for the following reasons:

(a) less well complexity (risk) and better target access;
(b) such locations would be farther away from the gray whale feeding area and closer to existing pipelines.

The possibility of shallow gas at the alternative locations requires that 2D seismic survey data also be obtained for them. To this end, consideration is being given to modifying the proposed survey area. As currently envisioned, any newly designed area will be farther from the gray whale feeding area and may be smaller than the originally proposed area.

In addition, as reported at NTF-1, geoacoustic surveys will be conducted to cover relief well locations near the PA-A, PA-B and Lun-A platforms.

Before addressing the specifics of the planned 2012 surveys, the task force developed a general statement on mitigation and monitoring programmes, recognising that the Panel's recommendations on such matters may be consulted and cited by other companies operating in the region. This statement and subsequent recommendations regarding the planned 2012 surveys are under Item 5.4.

The task force recognised that it had never fully discussed the potential impacts of the sub-bottom profiler(s) to be used during the planned 2012 surveys (and beyond). Actual dimensions of the devices had been provided to Racca's company (JASCO) for acoustic 'footprint' modelling. A small group consisting of Racca, Southall, Nowacek, Broker and Vedenev was established to consider this issue. It had been hoped that this group would be able to report progress at the WGWAP-11 meeting or if not by the end of February 2011. This is discussed further under Item 5.3.7.

5.3.5 Further progress on the consideration of cumulative impacts

NTF-2 received a summary of relevant initiatives underway outside the work of this Panel. In particular, information was provided on a project being carried out by the University of California, Santa Barbara. This is a two-year multi-disciplinary project aimed at developing standardised and practical methods for assessing cumulative effects of anthropogenic underwater sound on marine mammals. Although the aim is general, case studies are being used as part of the project, including a study focussing on bowhead whales in the Beaufort Sea in 2008. *Inter alia*, simulation studies (use of 'animats') are used to examine received levels of computer-generated whales. Output from the project may be valuable in terms of input for the St Andrews University ('Population Consequences of Disturbance' (PCoD) initiative. NTF-2 also received information on parallel efforts of US NOAA and Office of Naval Research on large-scale sound mapping. Further discussion of cumulative impacts can be found under Item 11.4 of this report.

5.3.6 Chair's concluding remarks

Donovan concluded his presentation by thanking the participants for their co-operation. Despite the complex nature and important implications of the discussions within the task force, all members had contributed fully to rigorous debate in a professional and scientific manner.

5.3.7 Panel's discussion of NTF-2

The Panel thanked Donovan and the other task force members for their hard work and clear reports. The Panel **endorsed** the draft report of NTF-2 and its recommendations as presented by Donovan at the meeting; the major recommendations are dealt with below under Item 5.5.

Nowacek summarised progress with respect to sub-bottom profilers – see Item 5.3.4 (above). There was some confusion about the sub-bottom profiler(s) to be used. The Company uses such devices every year to inspect pipelines for damage or maintenance needs and it had not considered them to be a problematic sound source. Without the specifications of the device or devices to be used for the 2012 surveys, however, the Panel cannot make informed recommendations about this matter, particularly because there is a range of source levels for the units the Company was reportedly considering. The Panel **recommends** that information on the sub-bottom profiler(s) to be used for the 2012 surveys be provided as soon as possible to IUCN and that an appropriate mechanism be determined for the Panel to provide timely advice.

There was some discussion over the status of MVA (or similar) analyses and their relevance to future work such as examining any plans for a South Piltun development or consideration of seismic surveys beyond 2012. To date, there have been five such cases: the Exxon seismic survey in 2001, PA-B related work in 2005, Sakhalin Energy pipeline construction in 2006, Exxon pile-driving in

2008 and 2009 and Sakhalin Energy's 2010 4D seismic survey. It was noted that data collection and analyses for these events were not all of equal quality for a number of reasons including inclement weather, poor equipment or equipment failure. It was suggested that this was particularly true of acoustic data. Also, some of the analyses involved information and data from different sources, i.e. Exxon only, Sakhalin Energy only, or the SEIC/ENL Joint Programme. This may affect the ability of the Panel or task force to conduct additional analyses. Broker noted that Sakhalin Energy would like ultimately to publish its studies (which at present are in the form of 'gray literature' reports) in the formal peer-reviewed literature.

The Panel noted the importance of using past experience to inform planning of future activities as well as the need to consider cumulative and aggregate sources of noise. This may come not only from examination of already completed analyses (such as Gailey's earlier MVAs) but also from re-examination of existing data using newly developed analytical methods such as those being developed for application to the 4D seismic survey data. Consideration of future aggregate sound levels by the Panel will require information on likely activities of other industrial activities in addition to those of Sakhalin Energy (see Item 11.2).

Sohl (WWF UK) reported that WWF opposed the additional platform and considered it premature to continue with the 2D and acoustic site surveys this year in the absence of information on the new platform and development. The risk associated with the survey cannot be reduced to zero. Aggregate and cumulative effects are of concern. She noted her understanding that ENL would be constructing its Arkutun Dagi platform about 25 km from shore in 2012 and this would generate additional associated ship noise.

5.4 Update on the status of previous noise recommendations

The Panel **noted** that IUCN will update the status of noise recommendations from previous meetings in accordance with the guidance given in the NTF-1 report.

5.5 New major recommendations arising out of Panel discussion of the NTF-1 and NTF-2 reports

5.5.1 Recommendation WGWAP-11/006

CONTINUOUS RECOMMENDATION ON THE REPORTING OF NEW SAKHALIN ENERGY ACTIVITIES AND CHANGES IN ACTIVITIES WITH POTENTIAL IMPLICATIONS FOR WESTERN GRAY WHALES

Objective

The Panel has a responsibility to review, evaluate and advise on Sakhalin Energy activities that may have impacts (including in a cumulative manner) on western gray whales (e.g. with respect to noise, damage to benthos, oil spill risk). This requires that the Panel is made aware of planned 'new' activities as well as any changes to ongoing activities well in advance of these becoming operational.

Reporting/data requirements

It would be valuable and efficient to have a single 'activities' document that can be updated regularly (at a minimum, immediately prior to WGWAP meetings).

Items to be summarised include:

- numbers, types, locations and general operating patterns of marine vessels working for SEIC (e.g. supply vessels, oil spill response vessels, standby vessels, accommodation vessels, diving vessels, *ad hoc* activities)
- changes to 'regular' operations (e.g. drilling, well conductor driving, maintenance and project activities)

- potential or actual specific/unusual activities (e.g. seismic surveys, pipeline stabilisation, construction works) – with notification as early as possible;
- timelines of such activities throughout the season or seasons (to allow consideration of aggregate activities).

Where changes occur, there should be a concise explanation of why they are necessary, a summary of options considered, an evaluation and risk assessment of any possible impacts and a presentation of measures proposed by the company to ensure that disturbance or other effects on gray whales are minimised. As appropriate, this should include an explanation as to why certain potentially applicable mitigating measures were not adopted.

Responsible persons

Sakhalin Energy

Timeline

Sakhalin Energy should report at least annually in document form, consistent with its normal business planning cycle. Information must reach the Panel sufficiently in advance to ensure that any ensuing recommendations can be used by the company to modify its plans if necessary. Large-scale activities such as those involved in the South Piltun development, seismic surveys etc. are best dealt with (as has been the case) as separate exercises with considerably more lead time and detailed information must be provided well in advance. It is recognised that the task force approach may need to be used for such cases.

Also see Item 11.1 (below).

5.5.2 Recommendation WGWAP-11/007

CONTINUOUS RECOMMENDATION ON THE DESIRED ANALYSIS AND REPORTING OF ACOUSTIC DATA FOR SUMMARY REPORTS.

Objective

To provide a more constructive and productive means of initial analysis and examination of acoustic data, consistent and adequate summaries of data on temporal patterns of noise must be submitted to the Panel for consideration. In addition, the original time series of data must be available for more detailed analysis of specific events of interest. This new process should facilitate the most efficient and productive review of acoustic data by the Panel and NTF.

Reporting/data requirements

All original time-series data should continue to be collected and stored by the Acoustic Monitoring Group at the Pacific Oceanological Institute (POI). This is not a new request but reflects the critical importance of full archival preservation of the original data.

WGWAP recommendation 7/002 specifies the need for the reporting of data on specific acoustic events on relatively fine temporal (1-s for impulse noise; 1-min for continuous noise) and spectral (1-Hz band) scales. While data must be made available upon request on these fine scales for specific events, this is not a regular requirement for all sensors and all sampling periods. However, to expedite the release of 'event' data in a timely and efficient manner Sakhalin Energy has agreed to include in its contract with POI a requirement that all raw acoustic data be pre-processed and archived as time-indexed frequency-resolved records (e.g. through the computation of simple, non-averaged spectrograms). This operation will minimise the time needed by POI to fulfil subsequent requests for data.

For each season, beginning with 2012, the following tabular and graphical summary representations of the acoustic data should be included in, or enclosed in digital format with, the reports. Specifically, each annual report would include for every recording station and all available data periods:

* Tabular summaries in digital format of 30-min Leq levels in 1/3-octave bands between 10Hz and 10kHz (ANSI standard centre frequencies)

* Graphs showing sequential 1-min Leq values for the 20Hz-2 kHz and 20 Hz-15 kHz passbands (presented chronologically with ~3 days data/graph)

* Distinct spectrograms showing a) 1-min averages in the range 20Hz-2kHz on a linear frequency scale and b) 1-min averages in the range 20Hz-15kHz on a logarithmic frequency scale. For completeness and ease of reference, the 2-20 Hz frequency range could be shown on a common time axis alongside the 20Hz-15kHz logarithmic spectrograms, but should be segregated and rendered separately with an independent colour scale so as not to restrict the dynamic range of the >20 Hz data.

Responsible persons

SEIC, IUCN

Timeline

The company should submit a report annually through IUCN in document and/or digital form that contains the data as described above. Sakhalin Energy and IUCN will develop an efficient method to transfer and circulate this material to the Panel and/or Task Force members as appropriate.

5.5.3 Recommendation WGWAP-11/008

RECOMMENDATION ON ANALYSES OF RESULTS FROM THE 4-D SEISMIC AIRGUN ARRAY SURVEY

Objective

Perhaps unparalleled effort and resources were expended to design and successfully implement a comprehensive monitoring and mitigation programme for the 2010 4D seismic survey. Considerable effort and resources have also been invested in validating, coding and developing initial analyses of the data. It is important that the data collected are fully analysed as soon as possible to increase understanding of the effects of seismic surveys on whales and thus contribute to the evaluation of existing mitigation measures and the development of improved measures for future surveys.

Data requirements/analyses

These are specified in the reports of the Noise Task Force (NTF-1 and NTF-2) and the comments, suggestions and recommendations in those reports have been endorsed by the Panel. They are not repeated here.

Responsible persons

Sakhalin Energy (for ensuring the analyses are carried out in accordance with NTF-1 and NTF-2 reports, informing NTF members on progress, consulting with them on methods where appropriate and submitting written reports), NTF members (for providing verbal and written comment as appropriate through email, teleconferences and meetings) and IUCN (for logistical support with document circulation, teleconferences and meetings).

Timeline

The Panel was advised by Sakhalin Energy after the meeting that it expected work on the behaviour and distribution MVAs to be completed by 31 August 2012.

5.5.4 Recommendation WGWAP-11/009

STATEMENT AND RECOMMENDATIONS ON SEISMIC AIRGUN SURVEYS IN SAKHALIN WATERS WHERE GRAY WHALES ARE CONCENTRATED

Recognising that the mitigation and monitoring programmes developed by the Panel and Sakhalin Energy may be considered by others as precedents, the Panel **emphasises** the following:

(1) the mitigation and monitoring strategies developed for the 2010 and (proposed) 2012 seismic airgun surveys were based on:

(a) careful analysis of the specific airgun array being used (**2620** in^3 in 2010 and **160** in^3 in 2012) and associated modelled footprints in the feeding area;

(b) the position and extent of the surveyed area with respect to the gray whale feeding areas[2];

(c) the seismic survey strategy, especially the timing of the survey;

(2) thus while the development processes and analytical methods used to determine mitigation measures for seismic surveys involving airgun arrays of different sizes are generally applicable, several aspects are case-specific and must be seen in the context of the total mitigation strategy;

(3) the primary mitigation measure for any seismic airgun survey in Sakhalin waters where gray whales are concentrated must be to complete the survey before the majority of whales have arrived in the area (nominally by 7 July based on conditions observed at Sakhalin in about 2005-2010); without this, the other measures alone established for the 2010 and 2012 surveys would not have been considered sufficient by the Panel.

The sizes of the recommended exclusion zones[3] around vessels operating seismic airguns for gray whales are primarily dependent on the power of the sound source and not the location or spatial extent of the survey. The Panel **recommends** that exclusion zones must be at least the modelled $180dB_{RMS}$ re:1µPa distance from the specific array to be used plus an appropriate additional safety margin that may change with circumstances. Generalising from the analyses undertaken for the 2010 and 2012 surveys, the Panel **recommends** that for seismic surveys in areas off Sakhalin where gray whales are concentrated:

(1) for sound sources of 200 in^3 or less, the exclusion zone must be at least 500m;

(2) for sound sources of over 200 in^3 it must be based on modelling (for $180dB_{RMS}$ re:1µPa) and verified in the field (or directly measured) and in any case must not be less than 1000 m.

The Panel **recommends** that this general statement is clearly displayed on the IUCN website along with the detailed mitigation and monitoring strategies developed thus far.

5.6 Future work of NTF

The Panel agreed that there was a need for the NTF to continue its work. In particular, its next meeting should focus on the analyses of the 4D seismic survey data as well as reviewing progress on other recommendations. The timing of that meeting must wait until SEIC provides the timeline for this work. The value of regular teleconferences to review progress and finalise the date of the next meeting and its agenda was recognised. The Panel **requests** that IUCN ensures that NTF teleconferences are organised on a regular basis.

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[2] The Panel developed a working definition of the 'feeding area' based on an analysis of distribution data collected over a number of years (see WGWAP-6 report, Item 5.5). The area varies by season. The analysis should be updated from time to time as more data become available.

[3] Area around the seismic vessel within which activities must cease immediately if a marine mammal is observed.

There was some discussion as to how to handle new information on the forthcoming 2D survey. The Panel recognised the formal commitment from Sakhalin Energy that (a) the full agreed suite of monitoring and mitigation measures would be implemented and (b) if there are any changes to the survey area the Panel would be informed immediately and such changes would not increase the size of the survey area or move it nearer to a gray whale feeding area. The Company **confirmed** that the details of any significant changes would be submitted immediately to IUCN for circulation to the Panel. In consultation with the Panel and especially those serving on the NTF, the Chair of the Panel would then determine what response is required.

While recognising that in this case, it appears that any changes would be in the direction of reducing potential noise disturbance, the Panel **stresses** the need to determine future mechanisms for response to single emerging inter-sessional issues that do not necessarily involve holding a full meeting.

For more on the topic of future meetings, see Item 14.

6 ENVIRONMENTAL MONITORING TASK FORCE (INCLUDING OIL SPILLS)

6.1 Report of December 2011 EMTF meeting

VanBlaricom, co-chair with Dicks, presented a brief overview of the first WGWAP Environmental Monitoring Task Force meeting (EMTF-1) and discussed updates on environmental monitoring recommendations and the future work of the task force (Items 3.4, 6.3 and 6.4). Dicks followed with an overview of the oil spill portion of the EMTF's work and then summarised changes to oil spill recommendations (Item 6.2).

EMTF-1 was held 7-9 December 2011 in Geneva. A draft report was provided for review at WGWAP-11 and the final report will be made available on the WGWAP website in due course.

6.2 Update on oil recommendations

Consideration was given at the EMTF meeting to the status of previous recommendations related to oil spill and gas associated risks. Reeves, Dicks and VanBlaricom completed an update with Saksina at WGWAP-11. During this process, it was noted that recommendations WGWAP 3/025 and 3/027 had been wrongly allocated on the IUCN website to oil spill and gas associated risks when they contained only minor reference to oil analysis. The main subject of these recommendations is whale carcasses and necropsy so they should be relocated to Table 7 (The Rest) on the Recommendations page of the WGWAP website. Saksina agreed to ensure this is done.

Victoria Broje, an oil spill specialist from Shell in Houston who was involved with the Macondo (Deepwater Horizon) platform blow-out in the Gulf of Mexico, joined EMTF-1 via teleconference and provided some interesting insights into how international perceptions regarding the use and effectiveness of dispersant chemicals and in-situ burning have changed. The Panel noted that there had been relatively few changes in the operational aspects of the Sakhalin II offshore platforms or at the Prigorodnoye terminal in Aniva Bay since Dicks's last visit in 2009. It sees little need for changes to oil spill response planning. The Panel believes SEIC's oil spill response arrangements have already been tailored as far as practicable to minimise impacts on gray whales and their prey. In view of this, the Panel welcomed the reconfirmation by Evans of the Company's commitments under the terms of the HSESAP Management System, as published on SEIC's website and as subject to regulation by the Lenders and the Lenders' representatives. Should any significant changes to existing arrangements be contemplated by the Company in the future, the Panel would expect to be advised and given the opportunity to comment.

It was noted at EMTF-1 that there is potential for change to occur in oil properties through the life of an oilfield. The Panel took note of the value of obtaining and evaluating data from Sakhalin Energy on changes in the physical properties of extracted crude oil in the project area over the life of the project. This is something that will need to be checked periodically to ensure that the

Company's oil spill response plans and capabilities are consistent with the oil properties as (and if) they change through time.

An oil spill exercise was conducted at the mouth of Piltun lagoon in September 2011, in compliance with recommendation WGWAP-7/019. The status of recommendation WGWAP 7/019 therefore should be changed to 'Closed - superseded' by the two-part recommendation given later in this paragraph. Sakhalin Energy provided an Ecoshelf report on the September 2011 drill for consideration at the EMTF meeting. Ecoshelf's reports are factual and frank and contain practical recommendations for improvements where problems are encountered. The drill revealed problems with vehicle access to the site (due to the poor quality of roads), with deployment of protective booms in the lagoon mouth (due to strong tidal currents) and with support for personnel in the field. It was proposed at EMTF-1 that a repeat drill should be conducted in 2012 to resolve these difficulties.

The Panel **recommends** that (i) lessons learned from the 2011 Piltun drill are taken into account during the Piltun drill that is scheduled by SEIC for 2012, with attendance by Dicks and other Panel members/IUCN representatives; (ii) Dicks and other Panel members, if needed, take part in planning of the drill to ensure that amongst other objectives it addresses the Panel's concerns; and (iii) the site visit is combined with a review of Sakhalin Energy's OSR equipment and other response resources. Sakhalin Energy confirmed its agreement and support in principle and indicated its willingness to facilitate the site visit.

Regarding recommendation WGWAP 7/020, the Panel had only been supplied with the relevant documentation on oil spill exercises during this meeting. Sakhalin Energy conducted more than 200 spill response exercises in 2011. Many were routine desktop exercises to check communications procedures, but a number of drills deployed large offshore skimming systems at sea around the PA-A and PA-B platforms and in Aniva Bay, and shoreline equipment was deployed at Piltun Lagoon (see above) and in winter conditions on onshore pipeline routes and river crossings. The OSR reports contain suggestions for improvement, especially to organisation and management of personnel. The reports reviewed by Dicks concerned Sakhalin Energy exercises with limited involvement of Sakhalin Oblast or Russian Federation authorities. Therefore the Panel was pleased to learn that the Company was scheduled to conduct a Tier 3 exercise in May 2012 jointly with Russian authorities and hopefully with the involvement of Japanese government interests. Evans pointed out that the Federal Oil Spill Response Plan in Russia provides different levels of engagement with Russian Federation authorities depending on the size of the spill. The Panel intends to pursue further the subject of Tier 3 exercises (scope, participating authorities and interests, etc.) with Sakhalin Energy during 2012.

On a related matter, the Panel believes there is a strong likelihood that oil from a major spill at or near one of the Sakhalin II platforms or pipelines would penetrate into Piltun Lagoon. An important component of the lagoon ecosystem is emergent vegetation (marsh grasses and other species) which is highly vulnerable to oil damage and ill-advised attempts at clean-up. Restoration methods for marsh vegetation (such as re-seeding or transplantation of vegetation plugs) can assist with recovery, but these only work for certain communities. The supporting documentation for the OSRPs does not provide adequate information on the wetland vegetation such that targeted restoration measures could be identified and put in place. The Panel suggests that further studies aimed at providing baseline data on emergent wetland vegetation within Piltun Lagoon be conducted during 2012 with the aim of producing marsh restoration proposals for the OSRPs.

The Panel reiterates the need for a mechanism by which IUCN follows up and tracks recommendations through time, making sure commitments are met (e.g. see Items 1.5 and 5.1, above). The spill exercise reports are a good example of an annual requirement, as was agreed when recommendation WGWAP 7/020 was assigned a status of 'Closed – implemented'. The addition of a tracking column to the cumulative list of recommendations on the WGWAP website would be one way for IUCN to monitor compliance into the future.

Regarding recommendation WGWAP 8/012, on provision, Sakhalin Energy reported early in the meeting that technical issues had arisen with the factual content of the report and this had prevented the Company from providing it for Panel review. However, it was later learned that the report is publicly available on the Sakhalin Energy website, so recommendation WGWAP 8/012 can be considered ‘Closed – implemented’. Dicks will review the document and report back at WGWAP-12.

Recommendation WGWAP 10/017 concerns the provision of revised copies of Ice Response and Environmental Monitoring handbooks. With respect to the former, Evans reported that the Russian version had been updated in August 2011, but the English translation was unacceptable and is currently being re-done. Once the new translation is available, it will go to the Lenders’ environmental consultants and will then be provided to the Panel for review through IUCN. Evans also agreed to check the status of the Environmental Monitoring handbook and report back to the Panel.

During the discussion at WGWAP-11 Knizhnikov referred to a Scanex report he had provided to the Panel which summarised the use of satellite imagery to track vessel traffic around Sakhalin in 2011, and also included consideration of the potential for detecting oil on the sea surface. Dicks had seen the Scanex report and agreed to follow up on whether time sequence data on vessel activity might be available and also on the oil detection issue.

6.3 Update on Environmental Monitoring recommendations

Recommendations for Panel consideration that emerged from EMTF-1 related to Environmental Monitoring were forwarded either to this agenda item (see below) or to Items 3.4 and 6.2 (above).
Recommendations WGWAP 1/021 (1) and 10/013 should be classified as ‘Closed – superseded’ by the following two-part recommendation: The Panel **recommends** that Panel members Tsidulko and VanBlaricom collaborate with Fadeev and colleagues at the Russian Academy of Sciences in Vladivostok to produce a review of literature relevant to the following question: “Why do western gray whales focus their foraging effort on the recognised feeding areas on the northeastern Sakhalin shelf?” It further **recommends** that VanBlaricom and Tsidulko, in collaboration with Fadeev, develop a formal proposal to IUCN for support of the literature review, with objectives and funding needs identified.

The Panel **recommends** that when biopsy samples are collected from western gray whales for various research purposes, blubber portions be used, in part, to assess anthropogenic contaminant levels (particularly persistent organic contaminants such as PCBs and PBDEs), as long as the volume of a given sample is sufficient to allow such analyses, with due consideration of other priorities for use of the biopsy material.

6.4 Future work of EMTF

There was general agreement that another EMTF meeting would not be scheduled at this time, although future meetings may be deemed appropriate in response to emerging issues. The principal tasks over the next few months will be completion of the literature review as described above, and the site visit by Dicks to observe a shoreline oil spill response exercise at Piltun Lagoon and conduct inspections of OSR resources, scheduled for summer 2012.

7 PHOTO-ID

7.1 Update on status of catalogue comparisons

The annual update of cross-comparison of the Sakhalin gray whale catalogues of the two field teams (Russia-US and IBM) was carried out for 2010. Each team matched the other team’s catalogue with its own.

As of 2010 there were 187 whales in the IBM Sakhalin catalogue and 188 whales in the Russia-US catalogue. Of these, 171 whales were common to both catalogues, making a total of 204 distinct whales. There was complete agreement between the teams as to the results of the cross-comparison.

The 2010 Russia-US catalogue includes whales identified during tagging-related surveys in 2010. This inclusion resulted in two additional whales in the catalogue, both of which were matched with whales in the IBM catalogue.

No systematic attempt has yet been made to compare the Russia-US catalogue with the Kamchatka catalogue, but during the comparison exercise by the IBM team, one whale was noted that was common to the Russia-US and Kamchatka catalogues but not found in the IBM Sakhalin catalogue.

The total of distinct whales seen by one or other of the teams off Sakhalin in 2010 is 121, including eight calves. A further 20 whales in the catalogues (i.e. whales seen off Sakhalin in previous years) were seen off Kamchatka in 2010, making a total of 141 Sakhalin-catalogued whales (including eight calves) seen alive somewhere in 2010.

The Panel thanked both teams for their participation in the cross-comparison exercise, and notes its standing recommendation (WGWAP-6/015) that the cross-matching between the Russia-US and IBM Sakhalin catalogues be updated annually. This recommendation should be included among those that are considered ongoing (see Item 1.5). Due to an oversight, the IBM team has already received the 2011 catalogue additions from the Russia-US team. Therefore, the comparison of the 2011 catalogues will not be double-blind as normally recommended.

The Panel also **notes** its recommendation (WGWAP 10/04) that the Russia-US catalogue and the Kamchatka catalogue be compared directly, and **requests** that Saksina (IUCN) initiate this by contacting the relevant parties. The Panel further notes that this is a relatively small task, since it requires only matching those whales in the Russia-US and Kamchatka catalogues that are not also found in the IBM Sakhalin catalogue.

7.2 Status of comparisons of Sakhalin catalogue to collections from other regions (e.g. Canada, western US, Mexico)

Weller provided a summary of recent efforts to compare the Russia-U.S. team's Sakhalin photo-identification catalogue with a similar catalogue of gray whales in the eastern North Pacific. The objective of this comparison was to investigate possible population mixing in addition to that revealed by the movements of 'Flex' during the 2010 tagging study conducted by A.N. Severtsov Institute of Ecology and Evolution of the Russian Academy of Sciences and Oregon State University Marine Mammal Institute (see Item 4, above).

The western North Pacific (WNP) to eastern North Pacific (ENP) catalogue comparison involved 181 and 1,064 individuals, respectively, and resulted in six matches (three males, two females and one whale of undetermined sex). Three of the six whales were first identified as calves (with their mothers) off Sakhalin. All ENP sightings of Sakhalin whales occurred off southern Vancouver Island, British Columbia, and were made during only two days of effort. Three whales were identified on 2 May 2004 and three more on 25 April 2008. The three 2004 whales were observed together in a single group, while the three whales in 2008 were in two separate groups in close proximity. All six whales had been sighted off Sakhalin prior to their ENP sightings and five were observed off Sakhalin subsequent to being sighted in the ENP. Four whales were sighted in both the ENP and WNP in the same year, three in 2004 and one in 2008. As the ENP catalogue represents only a small fraction of the total number of individuals in the ENP population (~19,000), it is likely that more WNP/ENP exchange has occurred than was detected from this comparison.

Although these matches provide new records of cross-basin movements, Weller reminded participants that winter/spring observations of gray whales off Japan, including a 2006/2007 photographic match between Honshu (Japan) and Sakhalin, suggest that not all gray whales identified off Sakhalin follow the same migration pattern as the few tagged whales that have been tracked thus far. Therefore, Weller hypothesised that the number of Sakhalin whales that migrate along the Asian coast could be fewer than previously estimated and therefore of greater conservation concern.

Weller called attention to a recently initiated 'Pacific wide study on stock structure and movement patterns of North Pacific gray whales, which is being carried out under the auspices of the IWC

(IWC in press). The purpose is to facilitate comparisons of photo-identification and genetic samples collected in areas traditionally allocated to the 'eastern' (e.g. Mexico, USA, Canada, Alaska, Chukotka, north-eastern Kamchatka) and 'western' (Sakhalin, south-eastern and western Kamchatka/Sea of Okhotsk, Japan, Korea, China) populations. Priority has been given to previous recommendations of the IWC Scientific Committee, including: (1) genetic comparisons between Japan/Russia (i.e. Sakhalin, Kamchatka, Chukotka) due to their near proximity in the WNP and recent photographic links between Japan and Sakhalin (Weller et al. 2008) and Sakhalin and Kamchatka (Tyurneva et al. 2010) and (2) genetic comparisons between Kamchatka (which may represent a mixed feeding area for ENP and WNP) and all regions in the ENP and WNP.

7.3 Future photo-ID efforts

Sakhalin Energy confirmed that collection of photo-ID data on the Sakhalin Shelf was included in the programme of work for 2012 approved by MNR. Continuation of photo-ID data collection in Kamchatka was not included, however. It was explained that Russian authorities had decided that costs of data collection outside the Sakhalin II licence area could not be counted as recoverable under the PSA. It is unclear to the Panel whether this implies that the Company is not permitted to support such work. Evans clarified that in 2011 the companies (SEIC and ENL) had been advised by MNR that the Kamchatka scope was not approved and therefore this scope was removed.

The Panel heard that the Russia-US team was optimistic that its data collection would continue in the 2012 field season, but that this could not yet be confirmed at the time of the meeting.

Noting the value of this work for population assessment and other purposes, the Panel considers it highly desirable that the photo-ID research and monitoring work on the Sakhalin Shelf continue.

The Panel considers the continued collection of data in Kamchatka to be important because it contributes to understanding of the 'Sakhalin population' and Evans confirmed that the companies also consider this important. Among other things, it is valuable to have records of Sakhalin individuals in Kamchatka, especially in years when they are not photo-identified or otherwise recorded in Sakhalin. Therefore, the Panel **recommends** that Sakhalin Energy makes every effort to support the work in Kamchatka as it is integral to monitoring population status. If the Company cannot implement this recommendation, the Panel alternatively **recommends** that Sakhalin Energy ensures there is no obstacle to continuation of the work with funding from another source. In particular, the Company and other parties should make every effort to extend the rights of access to and use of the data collected in Kamchatka thus far to whatever agency or persons continue the photo-ID work there. This would enable the Kamchatka catalogue and sightings history database to continue being updated. In the event that rights reside jointly with co-sponsors (i.e. ENL), Sakhalin Energy should work with co-sponsors to furnish the required permissions.

8 POPULATION ASSESSMENT

8.1 Updated assessment (validity of assumptions etc.)

The last assessment, presented to WGWAP-8 in 2010, had used photo-ID data collected off Sakhalin by both the Russia-US and IBM teams through to 2008 (document WGWAP 8/9).

In view of the recent satellite-tagging results, the interpretation of the assessment requires more attention. The model had been based on the assumption that the Sakhalin whales form a demographically self-contained population. Given the documented migration of Sakhalin whales to the eastern North Pacific (see Items 4.1 and 7.2), it now seems unlikely that they are fully isolated. It is still possible that the Sakhalin group is demographically self-contained (i.e. that the whales coming to Sakhalin were all born to mothers that came to Sakhalin) but this requires further investigation. There is clearly a high degree of site fidelity, in that whales seen in Sakhalin return to Sakhalin at a high rate, and female Sakhalin whales have a propensity for bringing their calves to Sakhalin, but these factors require quantification.

The Panel **recommends** further work on the interpretation of the population assessment in the light of recently available tagging, photo-ID and genetics results. The Panel further **recommends** that, when a definitive version of the IBM dataset through 2011 is available, an updated joint assessment be conducted.

Preparation of a joint assessment had been planned for this meeting, using sighting history data from both teams for the seasons through 2010. However, the most recent available tabulations of the IBM data (document WGWAP 10/14) showed retrospective changes to the sighting history data also for years prior to 2008, relative to the version of the dataset used for the assessment in document WGWAP 8/9; it was unclear which versions were definitive. The Panel recalls its previous recommendation (WGWAP-6/020) that datasets be assigned version numbers, and that a record be maintained of all retrospective changes to data.

The Panel **recommends** that both teams be requested to supply definitive versions of their sighting history datasets, including data through the 2011 season, for input to a joint assessment to be presented at WGWAP-12. Changes relative to previously submitted versions should be documented. Sighting history entries from Kamchatka should also be included in the assessment if possible, at least for those whales which have also been seen off Sakhalin.

In the meantime, a preliminary updated population assessment was presented by Cooke using only Russia-US data through the 2011 season. The model was the same as that used in the 2010 assessment (document WGWAP 8/9), which had been subject to independent review in 2011 (document WGWAP 10/9). The median estimate for the non-calf population size in 2012 is 141 whales (95% 126-152) (155 whales (95% CI 142-165), if calves are included). Median estimates and associated 90% confidence limits for the key population parameters are: calf survival rate 0.72 (0.67-0.81), non-calf survival rate 0.976 (0.960-0.984) and annual rate of increase 4.0% (3.1-5.8%). While the population continues to increase, the estimates of population size in the new assesment are slightly lower than those in the 2010 assessment (document WGWAP 8/9), when comparing estimated numbers for the same year (e.g. median estimate for non-calf population size in 2008 in the new assessment is 123 (118-128) whales compared with 127 (123-130) in the 2010 assessment), but the changes are within the confidence intervals.

8.2 Stock identity

In addition to the questions of direct relevance to population assessment, the Panel considers that the full range of questions relating to population structure and stock identity of gray whales needs to be re-examined in light of the new data from satellite tracking (Item 3, above) and photographic and genetic matching (Item 7.2, above). This will require extensive input from various scientific disciplines, including the field of population genetics which is not well represented on the Panel. Rather than attempting to resolve the evident complexity of the topic itself, the Panel considers that it is best addressed in other scientific fora, particularly the IWC Scientific Committee. The matter is on the committee's agenda for its June 2012 annual meeting. Therefore, the Panel does not make a recommendation of its own at this stage.

9 UPDATE ON SOUTH PILTUN PLANNING AND DECISION-MAKING

Davey gave a presentation on behalf of Sakhalin Energy to explain the current state of planning for a third platform near the Piltun feeding area. He stressed that the Company is obliged to consider this third platform (PA-C or South Piltun) under the terms of the Production Sharing Agreement, which require that hydrocarbon resources in the licence area are exploited to the maximum extent that is feasible and commercially viable. It is standard industry practice to develop the most accessible and economically attractive portions of an oil and gas structure first and only later investigate options for extracting products from the more marginal portions. Thus the difficulty being experienced by the Company in deciding if and how to proceed with a third platform is not unexpected. Davey stated that some rethinking is underway and the timeline for the phased decision process, as previously presented to the Panel, has been adjusted somewhat in recent months pending further studies. The current understanding is that a final investment decision will not be made before

2014, which means the earliest conceivable date for the start of production would be around 2019/2020.

As part of his presentation, Davey summarised potential rig types, substructure options, oil and gas processing options, possible pipeline configurations and tradeoffs. He presented some preliminary modelling results intended to explore worst-case construction noise scenarios, noting that a great deal more of this kind of work would be needed to meet environmental impact assessment requirements if and when a decision was made to proceed with a new platform. Finally, Davey mentioned that the scope of the planned 2-D seismic and acoustic site surveys to assess shallow gas and seabed hazards at and around potential sites for a new platform (see Item 5) had been modified to allow the identification of sites for relief wells (for existing well-stock) in the event of a blow-out. This stems from a review of Sakhalin Energy's entire operation in the light of the Macondo (Deepwater Horizon) oil spill in the Gulf of Mexico and prudent risk management being pursued by responsible operators worldwide.

In the reports of its last two meetings, the Panel made clear that its willingness to cooperate with Sakhalin Energy in developing a robust monitoring and mitigation programme for the 2-D seismic and acoustic surveys for site selection must not be interpreted as an 'endorsement' of the overall South Piltun project. Moreover, the Panel explicitly recommended against commencement of any new construction until more progress was made towards understanding the effects on the whales of PA-B construction noise and on cumulative effects more generally. In its formal response to recommendation WGWAP 10/020, Sakhalin Energy acknowledged the Panel's concerns and pointed to the Company's 'early engagement' with the Panel on the subject of the South Piltun development. It also gave assurance that the project EIA would address cumulative effects. At this meeting, Company officials clarified that the EIA for the 2-D seismic and acoustic site selection surveys were entirely separate from the South Piltun project EIA.

Another point made in the Panel's WGWAP-10 report (item 12.2) was the apparent contradiction between the Company's consideration of a major new construction project and the substantial scaling back of its investment in gray whale research and monitoring (e.g. shortened field season, elimination of the behaviour monitoring programme; see Item 3.6, above). At WGWAP-9 (item 2.1.7) and again at WGWAP-10, the Panel stated, "it seems particularly ill-advised for Sakhalin Energy to be scaling down its overall monitoring effort at the same time that it has announced plans to scale up its industrial footprint via the South Piltun development". Nothing was presented at WGWAP-11 that would lead the Panel to change this assessment. Although the 'summary report' of the joint programme 2002-2010 (document WGWAP-11/7-8), the 'issues document' discussed under Item 10 (below) and the 'integrated analysis' discussed under Item 11.3 (below) may together be seen as constituting an effort to respond to the Panel's often-expressed concern about the lack of programme coherence and synthesis, the need remains for a stronger effort to characterise and assess the potential cumulative and aggregate effects of industrial development on the Sakhalin Shelf (see Item 11.4, below).

The Panel finds it difficult to reconcile the possibility of a major new construction project directly offshore of the mouth of Piltun Lagoon with the possibility of scaled-back gray whale field studies and broader monitoring efforts only for specific activities such as seismic surveys. The importance of annual monitoring has been stressed repeatedly in past Panel reports (see for example reports of WGWAP-2, item 8 and recommendation WGWAP 2/011; WGWAP-3, item 12.2; WGWAP-5, item 14.1). The Panel **reiterates** its views from the report of WGWAP-5 (item 14.1):

> 'From the Panel's perspective, the primary aims of research and monitoring are to provide a scientific basis for long-term monitoring of the status of western gray whales, particularly in the light of the anthropogenic activities on the feeding grounds, to ensure that appropriate mitigation measures are in place for whatever activities are occurring, and to evaluate the effectiveness of those measures.'

> 'The monitoring effort must be adequate to detect changes in whale abundance and distribution over time, should they occur, and, where possible, to link such changes to environmental and anthropogenic factors.'

> ‘Whilst the companies indicate that they will develop additional programme components for specific circumstances, the short-term expansion of monitoring during a particular activity may not be sufficient to allow adequate evaluation of effects or ensure the success of mitigation measures.’

The Panel **stresses** that an annual monitoring programme (and subsequent prompt integrated analyses over years) with the full complement of elements – distribution/density, behaviour, benthic, photo-identification and acoustics – is essential for the proposed development to be properly evaluated. It **recommends** that Sakhalin Energy maintains such a programme for at least as long as it continues to consider a new South Piltun development.

In order to judge whether and to what extent changes to a field programme notified for a single year (which in fact may or may not be permanent or long-term) are likely to compromise the value of a long-term monitoring programme, it is essential to have some information on future plans (i.e. whether the changes are intended to remain in place). Therefore the Panel **recommends** that Sakhalin Energy provides it with its provisional longer-term (say 5-year) plans with respect to monitoring; the Panel is willing to participate in any discussions over improvements or modifications to any elements.

During discussion, Yablokov raised the issue of decommissioning. He pointed out that the cost of dismantling a complex structure in an environmentally responsible way could rival or exceed the cost of building and installing it in the first place. This important matter needs to be addressed and it is unclear whether adequate account of it has been taken for the existing Sakhalin II platforms much less the contemplated third PA platform. The Panel therefore **requests** clarification from Sakhalin Energy regarding the decommissioning plans for the PA-A and PA-B platforms as well as how decommissioning options have been taken into account in South Piltun planning.

10 UPDATE ON ‘ISSUES’ DOCUMENT (WGWAP-11/5) (INCLUDING MULTI-YEAR SUMMARY REPORT BY SEIC/ENL) – A RESPONSE TO RECOMMENDATION WGWAP-9/020

The Panel welcomed this effort by Sakhalin Energy to respond to recommendation WGWAP 9/020, which called for “a comprehensive overview of the issues and risks that need to be addressed for a new development such as South Piltun, including *inter alia* oil spills, continuous noise, vessel collisions, disturbance of benthos and cumulative impacts.” The recommendation specified that this overview “should include a risk matrix that makes clear how Sakhalin Energy would prioritise the various elements, as well as how the company assesses each issue in terms of potential short-, medium- and long-term effects on the western gray whale population.”

In presenting document WGWAP-11/5, Evans explained that it was clear from the recommendation that the report should represent the Company’s view and incorporate all ‘learning’ reflected in the many documents considered, beginning with those reviewed by the Independent Scientific Review Panel (ISRP) in 2004-05 and continuing through the recent work shared and discussed within the WGWAP context.

10.1 Noise

Donovan noted that while the NTF had welcomed the noise component of WGWAP-11/5, it had recognised that it was not practical for the task force to undertake a detailed review at a level which would enable it to fully endorse all of the report’s contents. However, the task force noted that the document covered all of the appropriate topics and provided useful background for discussions of noise issues related to future operations and developments, including broad strategies to be followed in terms of evaluating risks and developing effective mitigation measures.

The Company’s view is that its noise mitigation efforts have considerably reduced the impacts from what these might have been without such measures. Evans stressed the value of capturing the benefits of some of the noise mitigation approaches and encouraging their wider adoption by industry (cf. Item 2). For its part, the Panel acknowledged Sakhalin Energy’s exceptional investment in monitoring and mitigation over the years and its willingness to engage constructively in the panel process. Many of the Panel's recommendations have been implemented either fully or to a significant degree, and on a number of occasions the Company has postponed an activity or significantly modified its work schedule in response to concerns regarding the potential impacts on western gray whales.

The Panel noted during the discussion of WGWAP-11/5 that the extremely full agenda of this meeting meant that although document WGWAP-11/7 and 8, 'Summary of the Joint Okhotsk-Korean Gray Whale Monitoring Programme Findings, Sakhalin, Russian Federation, 2002–2010', was available ahead of time, it had not been able to review this document as thoroughly as it would have liked. The Panel recognised the importance of studies carried out on the north-eastern Sakhalin Shelf by scientists from leading Russian research institutes and that the ENL-Sakhalin Energy Joint Monitoring Programme had produced a great deal of valuable information on western gray whales of potential use in assessing population status and mitigating the potential impacts of the Sakhalin I and Sakhalin II projects. A few comments on the noise portion of WGWAP-11/7 and 8 are offered hereunder.

The Panel noted a tendency in the document to overstate conclusions. For example, the key acoustic conclusion is, "Distribution and abundance of whales did not appear to correspond with specific industry activities and seemed to be more linked to availability of prey" (see p. 1, *Executive Summary*). Whilst recognising that Sakhalin Energy, through its joint programme with ENL, has collected and presented data on western gray whales annually for approximately a decade, the Panel considers this conclusion premature. Only recently has the Company established an effort to analyse the 2002–2010 datasets in an integrated manner to determine the quantitative relationships between different programme components (acoustic, benthic, behaviour, photo-identification) and the effects of industrial activities on whale distribution and abundance (e.g. seismic surveys, pipeline construction and offshore platform construction). This complex and difficult work is still in progress and its results are not yet available (see Item 11.3, below).

In addition, the acoustic monitoring data in Table 3.2 ('*Sound levels generated by specific ENL or Sakhalin Energy project (or other industry) activities*'; p.15), taken mainly from document WGWAP 10/19[4], are in the form of maximum levels in dB (re 1 μPa^2) at 90% percentile level of one-third octave power spectral density (where all levels are less than 115 dB). This does not demonstrate absence of acoustic impact on the gray whales. To compare such noise levels with the 120 dB criterion for gray whale disturbance (for continuous noise), they need to be presented in one-third octave power spectral density and integrated along the full frequency band (e.g. 2 Hz – 2 kHz) to show received SPL levels measured at acoustic monitoring locations. RMS noise levels generated by industrial activity (not presented in Table 3.2) could exceed the 120 dB disturbance threshold. Although the presentation of acoustic data in the form of maximum levels in dB at 90% percentile level of one-third octave power spectral density may be correct in principle, it is inappropriate in the present context because doing so makes it impossible to determine whether industrial noise associated with activities of the Sakhalin I and Sakhalin II projects did or did not exceed the threshold.

Finally, document WGWAP-11/7 and 8 states (*'Initial Conclusions';* p. 30), "Highest sound levels were those due to near-shore research vessels as opposed to the construction activity". This conclusion is based on results of the 2005 MVA where acoustic data from a very small sample were incorporated improperly into the statistical analysis.

In conclusion, while recognising the importance of the work of the joint programme and indeed recommending its continuation elsewhere in this report, the Panel is not in a position to endorse all of the conclusions of document WGWAP-11/7 and 8.

[4] WGWAP-10/19 - Rutenko et al. 2011. Analysis of Acoustic Measurements Conducted in the Piltun and Offshore Gray Whale Feeding Areas on the Northeast Sakhalin Shelf During the 2003-2009 Field Seasons. Report submitted by ENL and Sakhalin Energy to the Ministry of Natural Resources.

10.2 Benthos

WGWAP-11/5 concluded that risks from platform construction to the gray whales' benthic prey populations were low despite concerns expressed in the ISRP report. The existing platforms are well offshore of the Piltun feeding area and not near the Offshore feeding area; this would also be true of a South Piltun platform. There are no discharges of toxic materials into the sea, the existing pipeline was routed specifically to avoid the nearshore feeding area (as would be any new pipeline needed for a new platform) and the suspension of sediment from dredging has been and would be minimised. Moreover, the benthic sampling work by Fadeev's team has revealed no detrimental effects such as hydrocarbon contamination of sediments.

VanBlaricom agreed with the Company's conclusion on this issue, noting that published data on platform effects on benthos in other regions typically indicate localised measurable impacts (spatial scales of tens to hundreds of metres, far short of the scale of impact required to influence any of the gray whale feeding areas in the present context). Therefore the physical impacts of a properly functioning offshore platform, based on currently proposed siting information, should not be a serious concern with respect to gray whale prey.

10.3 Ship strikes

Measures implemented to minimise the risk of ship strikes on gray whales were judged by the Company to have been highly effective (document WGWAP-11/5). No such strikes have been documented and there is evidence of vessel captains taking action to avoid collisions when advised to do so by Sakhalin Energy's onboard Marine Mammal Observers.

10.4 Oil spills

Document WGWAP-11/5 also judged the risk from oil spills to be low given the measures in place both to prevent spills and to respond in the unlikely event that one occurs. Oil Spill Response (OSR) exercises (drills) are carried out year-round and equipment stockpiles are ample and well maintained. Losses of oil into the sea have been negligible thus far.

Sakhalin Energy's advisors on OSR methodology see a role for dispersant chemicals and immediate in-situ burning of any large-scale release of hydrocarbons. This view is not aligned to the Company's current OSRPs that have been approved by Russian authorities. Further work is required across the industry and SEIC is well advised to follow progress.

Dicks agreed in broad terms that the oil spill risk was low and that OSR plans and resources were in place to deal with spills. He made the point that both Sakhalin Energy and the Panel had put considerable effort into refining the OSRPs and that this had resulted in a beneficial approach to spill response for the protection of gray whales and their food sources. A good balance has been achieved among oil recovery, dispersant application, shoreline clean-up and in-situ burning. This balance considers the properties and likely behaviour of Vityaz crude and the environmental conditions specific to Sakhalin Energy's operations at Sakhalin. Dicks noted that after the Macondo blow-out in the Gulf of Mexico, there had been changes in international perceptions, which have promoted the apparent effectiveness of dispersant use and in-situ burning. Whilst potential benefits in techniques should be taken on board to improve the OSRPs, it is important that these changed perceptions not become a driver that upsets the balance already achieved in the Company's approach. The Panel anticipates further discussion of this matter at future meetings and expects Dicks to raise the issue at appropriate intervals and ensure it is not neglected.

10.5 Cumulative effects

Finally, WGWAP-11/5 acknowledged the difficulty of assessing cumulative effects but concluded that those effects must not be large since both adult and calf numbers appear to be increasing and individual whales are observed to return to the Sakhalin feeding areas year after year. As mentioned in the preceding agenda item, however, the Panel believes that a stronger effort is needed to characterise and assess the potential cumulative and aggregate effects of industrial development on the Sakhalin Shelf (also see Item 11.4, below). The document rightly points out that many factors affecting the whale population are outside the control of Sakhalin Energy and this underlines the importance of approaching western gray whale conservation from a rangewide perspective.

10.6 Overview

The risk matrix included in WGWAP-11/5 ranked the risks from all Sakhalin Energy activities, properly mitigated, as low and short-term. Even in the case of abnormal or emergency situations, the risks, with mitigation, were judged to be only medium and short-term.

Overall, the Panel welcomed the effort by Sakhalin Energy but noted that WGWAP-11/5 would have benefitted from some form of external peer review and from inclusion of references to support many of the conclusions. Also, more circumspection around some of the conclusions would have been appropriate in view of the significant gaps in knowledge that remain concerning the more subtle effects of anthropogenic activities on whales and other wildlife. It is important, for example, to bear in mind the long life spans and long generation times of whales, which mean that the population trends used to justify some of the no-effect conclusions in the report are short-term trends by whale standards and could prove misleading once truly long-term trends become evident. This again highlights the need for continued long-term monitoring (see Item 9).

In addition, the issue of other activities in the Sakhalin region that are beyond the influence of Sakhalin Energy was raised. Ultimately, if the cumulative risk to the whales is high, even if the component attributed to the Company is zero, the overall risk to the whales remains high. This, again, emphasises the need to understand other operators' activities (see Item 11.1, below). Evans agreed that it is important to reach out to other operators and to publicise mitigation protocols related to activities such as seismic surveys which have been developed collaboratively by the Panel and the Company and which have potentially broad application (see Item 5.5.5).

In discussion, Vorontsova (IFAW) recalled a detailed technical presentation in 2004 on plans for the PA-B platform at a meeting in Moscow, chaired by Shell. In response to the NGO demand that the platform be sited farther offshore and thus farther away from the Piltun feeding area, the response was that this was not feasible. Also, Sakhalin Energy clearly stated that the chosen location would preclude the need for a third platform as it would allow access to all parts of the hydrocarbon field. The issue thus raised had been discussed at WGWAP-10 as well (see item 12.2 in the report) and the Panel had requested clarification from the Company (recommendation 10/019). The Company's formal response is quoted here in full from the WGWAP website (http://cmsdata.iucn.org/downloads/wgwap_10_recommendations_table_with_seic_response.pdf):

> The EIA for Phase 2 TEO-C chapter 5.2.1 says the following: "Over the 1990s major advances in extended reach and non-vertical drilling has allowed for a single platform to extend its lateral reach up to 6 km. This has greatly reduced the number of platforms needed to three for full field development, which resulted in a smaller "footprint" i.e. the overall offshore impact. PA-V platform option was determined to be currently uneconomic, but has been kept as a future option."
>
> Reservoir performance determines the ultimate drainage configuration required and is therefore monitored during the lifetime of production. Dependent upon this, the Operator must determine how best to fulfill the requirements to maximise recovery of hydrocarbons, which is an implicit requirement of the PSA. Based on the observed reservoir performance, the drainage configuration and current technologies, it is now apparent that to fulfill PSA requirements an additional platform is required.

With regard to the current state of extended reach drilling, Davey indicated that it was still possible to drill only six, and maybe up to eight, kilometres in exceptional circumstances. He estimated that to achieve full exploitation of the South Piltun sector it would be necessary to drill to 13 km from the PA-A (Molikpaq) platform, which was shown by a 2008 study to be infeasible. The Company will revisit this study to determine whether such a conclusion remains valid. In response to a question of how ENL has been able to reach 11 km at Chaivo, Davey explained that the drilling there is from a large onshore facility, which makes a big difference. However, as noted, even 11 km would still fall short of the South Piltun requirement of 13 km.

11 ACTIVITIES BY SEIC AND OTHER COMPANIES ON SAKHALIN SHELF IN 2011, 2012 AND BEYOND

11.1 SEIC Key Activities

In its last meeting report (item 13) the Panel clarified recommendation WGWAP 9/018 concerning its longstanding request for advance notice of Sakhalin Energy activities that could affect western gray whales. At this meeting, the Company provided document WGWAP-11/6 as a response.

The Panel expressed its appreciation for the detail provided in WGWAP-11/6 and encouraged the Company to continue the practice of providing such information in the future. It is important that all industrial activities and not solely those that involve noise input to the marine environment be considered in selecting what to report. Evans confirmed that although noise tended to be the focus of concern, the full range of activities had been reported in WGWAP-11/6 and this would continue in future presentations. The Panel's recommendation above under Item 5.5.1 is intended to cover this topic.

There was also some discussion of planned activities beyond 2012, such as the PA-B 4D seismic survey tentatively scheduled for 2014. In particular, the Panel reiterated its concern over the issue of the continuation of the joint programme and again emphasised the importance of sustaining full monitoring effort even during years between major noise events, to provide baseline information for comparison with high-activity years (see Item 9).

The Panel noted the importance of obtaining data on 'noise signatures' for certain types of activities, particularly in the context of determining priorities for minimising disturbance and for any serious efforts to assess cumulative effects. For example, an accommodation vessel (Heimdal DP) has been stationed at the platforms annually from June to November since 2010 and this is expected to continue into the future.

11.2 Non-SEIC Activities 2011-2013 and Beyond

Hasinger presented document WGWAP-11/13 which summarised the information that he was able to obtain on other companies' activities. The Panel welcomed this effort and congratulated Hasinger for doing such an excellent job of carrying out a difficult task.

Four oil and gas projects are approaching or in production mode on the eastern Sakhalin Shelf – Sakhalin I, II, III and V. Sakhalin I (ENL) and II (SEIC) are of greatest concern due to their proximity to the nearshore (Piltun) gray whale feeding area. However, adjacent projects are also important as gray whales are known to feed at least sporadically, for example, at the northern end of the island (Severnaya Bay) and south to nearshore waters off Chaivo Lagoon. Also, whales move often between the Piltun and Offshore feeding areas, the latter being partially within the Arkutun-Dagi Licence Area (Sakhalin I) and partially within the Veninsky Licence Area (Sakhalin III, Rosneft). It should also be noted that exploration is proceeding in other parts of the Okhotsk Sea shelf, notably Magadan and western Kamchatka (both areas used to some extent by gray whales historically).

During discussion it was pointed out that ENL planned to begin installation of the Berkut offshore platform, a large concrete gravity-based structure, in the Arkutun-Dagi field off Chaivo, immediately after ice melt in 2012. This work was expected to take about two weeks and would likely involve substantial continuous noise. No information was available on ENL's gray whale monitoring and mitigation plans.

The Panel noted that, once again, gray whales returning to the north-eastern Sakhalin Shelf in 2012 were likely to be exposed to seismic survey noise even though no large-scale surveys are planned by either Sakhalin Energy or ENL. This would mean, apart from anything else, that the results of the mitigation and monitoring programme for the Sakhalin Energy 2-D seismic and acoustic site surveys in 2012 (see Item 5.3.4) need to take account of the possibility that aspects of the whales' behaviour and distribution will have been influenced by such other factors.

Knizhnikov (WWF Russia) added a note of appreciation for Hasinger’s effort and suggested that IUCN establish a regular reporting format for receiving and compiling this kind of information from the NGO community (and others). The Panel would welcome this.

11.3 Integrated Analysis

Vladimirov made a verbal presentation on a recently initiated effort to develop a multivariate analytical framework for application to data from the joint Sakhalin Energy/ENL gray whale research and monitoring programme. This work is being led by Professor Kriksunov and a team of statisticians at Moscow State University and the Institute of Evolution. A scoping seminar took place in Moscow in late September 2011 and preliminary results are currently under review by the companies and their contractors. There is no intention of making results available for Panel review for some time.

Initial effort has centred on attempting to integrate data from two programme elements, whale distribution/density and benthic sampling, and for two years, 2004 and 2008, when the industrial noise ‘footprint’ on the Piltun feeding area from Sakhalin I and II activities was judged to have been relatively light. The intention is to progress step by step, beginning with methodology. Once the challenges of integrating whale counting and benthic sampling data have been overcome, the next steps will be to incorporate acoustics and photo-ID data and to develop meaningful ways of comparing the ‘control’ data (from 2004 and 2008) with the ‘disturbance’ data (from years with construction activities near the feeding area).

The Panel was unable to offer any commentary or advice in the absence of a document to review and because so little detail was provided in the verbal presentation. However, it welcomed these efforts and **encourages** Sakhalin Energy and its collaborating scientists to continue efforts to apply multivariate statistical analyses and other appropriate quantitative approaches to investigate the relations of benthic prey, geospatial information on gray whale distribution and abundance through time, and various environmental variables, with the goal of achieving a better understanding of factors that influence gray whale numbers and distribution on the north-eastern Sakhalin shelf.

The Panel further noted that this is a long-standing problem and a number of individual scientists and teams of scientists elsewhere in the world have been working to develop analytical techniques which are likely to be applicable or at least useful to this project. The Panel **encourages** the Company and its collaborators to seek such input at an early stage. It **emphasises** that the preferred (and most efficient, cost-effective) approach would be to consult widely from the outset and ensure that the methodology is appropriate and credible before investing in extensive analyses.

During a somewhat related but different discussion, Yablokov proposed that the results, or reviews of the results, of western gray whale studies carried out by various research groups since 1995 be published in the format of a classic scientific monograph (possibly under the title: ‘Western North Pacific Gray Whales: Ecology, Distribution and Population Dynamics’). Yablokov stated that he would volunteer his time to be the organiser and scientific editor of such a monograph, which could present (in concise form) and thus preserve for science and management a substantial amount of valuable data and information contained in scientific papers and internal reports, including those submitted to MNR and WGWAP. The Panel expressed support for this idea and hoped that both industry-sponsored researchers and others could be encouraged to participate in the project. The Panel invited Yablokov to submit a progress report on this activity by the next meeting.

11.4 Addressing cumulative effects

A number of approaches for addressing the issue of cumulative effects on marine mammal populations are currently under development. Some of these focus solely or primarily on acoustic disturbance but similar principles apply to most types of impacts.

A panel of the National Research Council (NRC) in the United States outlined a conceptual structure for determining the population effects of acoustic disturbance on marine mammals (NRC 2005). The Population Consequences of Acoustic Disturbance Working Group, now called PCoD (see above under Item 5.3.5), a multidisciplinary collaboration involving several institutions, has tried to build on the NRC framework (Anon. 2010). The Working Group has further developed the conceptual model of the NRC report and applied it to some sample species: northern and southern elephant seals, coastal bottlenose dolphins, North Atlantic right whales and Blainville's beaked whales.

The NRC report recommended that the concept of Potential Biological Removal (PBR), now legally recognised in the US and in some other jurisdictions, which sets limits to anthropogenic mortality on marine mammal populations, should be extended to cover sub-lethal impacts (NRC 2005). This notion was developed further by a 2009 meeting in Monterey, California (Asilomar), called Workshop on Assessing the Cumulative Impacts of Underwater Noise with other Anthropogenic Stressors on Marine Mammals (Wright 2010). This workshop introduced the concept of Potential Cumulative Impact (PCI) (sometimes referred to as Maximum Cumulative Impact, MCI) which extends the PBR to cover sub-lethal impacts. The impact of each sub-lethal influence is expressed first in terms of energy loss, then converted to changes in demographic parameters, and finally converted to mortality equivalents. The total of actual mortality plus equivalent mortality should not exceed PBR. The main feature of the PBR approach is retained, that standard values ('defaults') are used for the parameters where species- or population-specific values are not available.

The case of western gray whales can, in principle, both benefit from and contribute to those efforts to quantify cumulative impacts from acoustic disturbance and other factors. The data collected during the construction work and seismic surveys may yield information relevant to dose-response relationships for acoustic disturbance, as being investigated by the Noise Task Force. The resulting insights could be used for assessing impacts on gray whales and also contribute to the pool of data used for developing generic values. Conversely, the cumulative effects models generated in other contexts may prove useful for quantifying the potential population effects of the cumulative exposure of western gray whales to various factors including noise.

A major challenge for the assessment of cumulative impacts on Sakhalin gray whales is one of gaining access to data on all major sources of disturbance, not just the data related to the activities of Sakhalin Energy. A first step might be to list all major activities likely to have caused acoustic or other disturbance to gray whales in the Sakhalin feeding areas over the last ten years, including basic information on the nature, extent and duration of each activity. Document WGWAP 11/13 (see Item 11.2) summarises the known ongoing oil and gas projects but more information is needed on associated activities, including seismic surveys, construction and vessel traffic. The general issue of obtaining information on other companies' activities is discussed below under Item 13. Regarding assessment of cumulative impacts, ideally, a comprehensive database on all industrial and other activities on the north-eastern Sakhalin Shelf should be developed and maintained. The Panel is probably not the appropriate body to do this, and the involvement of the relevant Federal and Oblast authorities would be essential.

The Panel **recommends** that IUCN, in close coordination and with the help of Panel members, Sakhalin Energy and other stakeholders in the WGWAP process (Lenders, NGOs) as well as relevant Russian government agencies, begin to develop such a comprehensive database and report back on progress at WGWAP-12.

12 UPDATE ON MONITORING FOR AND REPORTING GRAY WHALE CARCASSES, NECROPSY CAPACITY AND PROTOCOLS, HEALTH ASSESSMENT ETC.

In September 2009, one gray whale was found dead on the east coast of Sakhalin Island (see WGWAP-7 report) and another carcass (likely also that of a gray whale) was found in Kronotsky State Reserve (eastern Kamchatka) in the spring of 2010 (see WGWAP-9 report). The Panel was concerned after the 2009 stranding in particular that no cause of death had been determined and that the carcass had only been examined superficially. The Panel believes it is in the interests of all stakeholders to ensure that any future stranded gray whale be examined in detail. However, this requires that a trained necropsy team be on call and available to respond to the next stranding. Two relevant recommendations were made in the report of WGWAP-7, one concerning the basic procedures to be taken by first responders to gray whale strandings (WGWAP-7/015) and the other asking Sakhalin Energy to prepare a proposed way forward on the necropsy issue (WGWAP-7/016). Little progress has been made since that time (December 2009), and in fact the Panel was disappointed to learn at WGWAP-9 (confirmed at WGWAP-10; see both meeting reports) that Sakhalin Energy had decided to discontinue its dedicated aerial surveys of Sakhalin beaches to check for whale carcasses. In its WGWAP-9 report, the Panel requested that Sakhalin Energy provide a clear, updated statement of its plans with regard to carcass surveys (recommendation WGWAP 9/008). In its formal response rejecting the Panel's advice, the Company cited its decision to reduce 'all but essential flights … due to increased safety risks with rotary wing aircraft' and indicated it would no longer conduct dedicated carcass detection flights as 'designated sorties'. This lack of dedicated surveillance, together with the elimination of the behaviour component of the joint Sakhalin Energy/ENL field programme which had provided at least opportunistic ancillary beach surveillance, reduces the chances of detecting stranded gray whales at Sakhalin while they are in a fresh state. The Company emphasised at this meeting that aerial fly-overs had been conducted only monthly during the open-water season and therefore the chances of detecting a fresh carcass from the dedicated surveys was small. It also pointed out that the distribution monitoring team uses most of the same stations formerly used by the behaviour/photo-ID team and that unlike the behaviour/photo-ID team, the distribution team moves between stations during the day, giving it greater temporal and spatial coverage and a better chance of detecting carcasses.

As acknowledged in the WGWAP-7 report, Rosprirodnadzor Sakhalin Administration has lead responsibility for investigating stranded whales and Rosselkhoznadzor Sakhalin Administration has ultimate responsibility for authorizing whale necropsies. The Panel is aware that Sakhalin Energy previously received permission from authorities to collect tissue samples from stranded whales in response to Panel recommendations WGWAP-3/001 and 4/004 (see WGWAP-5 report, item 7.3). On the basis of current understanding, the Panel **recommends** that the Company seek explicit advance permission from the appropriate authorities to allow Company employees or contractors to carry out, promptly and without delay, a full examination (necropsy and sampling) of any dead whale found in north-eastern Sakhalin Island. Any delay from discovery to examination lowers the chances of determining cause of death and of identifying the individual through photo-identification or a genetic sample and increases the risk that the carcass will be lost entirely.

At WGWAP-9 the Panel learned of an effort by two Moscow-based researchers, Olga Sokolova and Tatyana Denisenko, to develop a proposal for addressing the western gray whale necropsy issue (see WGWAP-9 report, item 11). At WGWAP-11 the Panel received a new proposal from Sokolova and Denisenko although it only arrived on the morning of the last day of the meeting and therefore participants had no opportunity to consider it carefully. The Panel nonetheless discussed the proposal briefly and made three comments: (1) the question of who is authorized to examine and sample a dead whale on Sakhalin remains unresolved (see above), (2) the role, training and responsibilities of any field team need to be specified more clearly and (3) an international review team needs to be established that can examine all data collected by the field team and confirm or revise any determination of the cause of death.

The current proposal from Sokolova and Denisenko, as written, is overly broad and still does not address the Panel's key concern: that a competent, adequately equipped rapid-response team is established to examine and sample any gray whale carcasses found on Sakhalin in a timely manner.

13 WGWAP RELATIONS WITH RUSSIAN AUTHORITIES (INCLUDING IWG) AND OTHER COMPANIES

The Panel acknowledged and expressed appreciation for Nevenchina's attendance as an Observer on behalf of the Sakhalin Oblast Ministry of Natural Resources. The issue of relations with Russian authorities and with oil companies other than SEIC has been a recurrent theme at WGWAP meetings. Although representatives of the Federal Ministry of Natural Resources had attended several past meetings as Observers, this was the first time a representative of the Oblast Government had attended.

In her brief remarks to the meeting, Nevenchina suggested that the biodiversity group, which was established in 2007 and reports to the Ecological Council on Sakhalin Island, might function as a focal contact point for the Panel, given that both her agency and Sakhalin Energy are active members. She also noted that she had a good understanding of the terms of the UNDP Global Environment Facility proposal process as it applies to the Russian Far East and therefore that she would be in a good position to provide support for a gray whale satellite tagging proposal.

The Panel has repeatedly cited the importance of broader application of robust monitoring and mitigation efforts (including maximum permissible noise levels) by other oil and gas companies operating on the Sakhalin Shelf. Very little, if any, information is made available in advance by companies other than Sakhalin Energy on their plans for potentially harmful and disturbing activities, nor has it been easy to gain access to the results of other companies' monitoring and mitigation efforts. ENL reports some of its results to the IWC Scientific Committee but it has chosen not to share information directly with the Panel.

After some discussion, the Panel concluded that it would be best to address the problem of access to information on other companies' activities in a stepwise manner and that a first step would be for Yablokov, as a member of the Interdepartmental Working Group, to raise the issue at that group's next meeting in Moscow on 17 February 2012. Therefore Reeves, on instructions from the Panel, sent a formal letter to Yablokov requesting that he do so. Nevenchina, Sakhalin Energy and WWF-Russia (Knizhnikov is a member of the IWG) gave assurances that they would lend support to this initiative whilst recognising that the Federal ministry (MNR) is the responsible regulatory body. The Panel stands ready to provide scientific and technical advice. There was general agreement at the present meeting that a concerted effort should also be made by the Panel, IUCN, Sakhalin Energy and other stakeholders involved in the WGWAP process (including Sakhalin Oblast and NGOs represented as Observers) to communicate with other companies and seek to improve access to information on their activities.

14 WGWAP WORK PLAN FOR 2012 AND BEYOND

It was agreed that under the circumstances, a full Panel meeting in the spring of 2012 (April or May) would not be necessary but that WGWAP-12 should be planned for the autumn of 2012 and the pattern of two Panel meetings per year (basically one in the spring and one in the autumn) should be re-established in 2013. Concern was expressed by Panel members that the abbreviated 3-day meeting duration, in contrast to the 4-day meetings typical of the first four years of WGWAP, should not come to be regarded as the norm. For example, it was pointed out that at WGWAP-12 the Panel would need to review final reports of the 2011 field season, preliminary results from the 2012 season including the planned monitoring during the 2-D seismic survey, final results of analyses of the monitoring data from the 2010 Astokh 4-D seismic survey, progress on the integrated analyses, developments with regard to South Piltun planning and a number of other items, some foreseen and some not. It was considered unlikely that three days would be sufficient to cover the full array of topics, but any decision about meeting duration should remain open until later in the year.

The option of having virtual (video-/teleconference) meetings for certain small well-defined topics should be considered (e.g. model and variable selection for multivariate analyses; final discussions in advance of the 2012 2-D seismic survey if no major issues arise). The Panel does not believe that virtual meetings are appropriate for full Panel meetings or major task force meetings, even if this were found to be consistent with the Terms of Reference, which seems doubtful given the need for participation not only by Company representatives and the Panel but also by Observers.

The Panel was also informed of Sakhalin Energy's strong preference for all future meetings to be held in Russia, noting that the Company would consider Japan and South Korea as acceptable.

The Panel recognises the need to be financially prudent (in fact many members give their time for free) but also notes its responsibility to provide thorough, timely review in a transparent manner. It is essential that this is not compromised. It notes that the Panel process is under the auspices of

IUCN. It expects that IUCN will ensure that the Panel is adequately consulted on dates, length and venues for meetings before decisions are taken.

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16 SUMMARY OF RECOMMENDATIONS FROM THE 11TH MEETING OF WGWAP

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
ITEM 1: OPENING					
WGWAP-11/001	Item 1.5	The Noise and Environmental Monitoring Task Forces had both noted that many recommendations include an expectation that a policy or procedure will be adopted as regular practice. Once the Company has responded favourably to such a recommendation, it is considered Closed – implemented. However, in view of turnover in the company and changes in company practice over time, there is a need to ensure that implementation continues to be tracked. The Panel **recommends** that IUCN work on this matter with the Panel chair and report back no later than at WGWAP-12.	IUCN, Panel chair	WGWAP-12	
Item 3: REPORTS ON FIELD ACTIVITIES IN 2011					
WGWAP-11/002	Item 3.3	[...] the Panel **recommends** that IUCN approach the Sakhalin Oblast government, the Sakhalin Fisheries Agency, and any other potential source with an explicit request for information on fishing activities (e.g. number and type of vessels, seasons of operations) in and near the gray whale feeding areas off Sakhalin. Such a request is justified by the Panel's need to be able to assess fisheries-associated	IUCN	WGWAP-12	

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		risks (including noise) to the whales.			
WGWAP-11/003	Item 3.3	Objective To investigate identified periods of loud noise within the feeding grounds in more detail with regard to both the activities underway and the acoustics data recorded. This investigation will attempt to (a) identify the cause(s) of the noise and (b) determine the extent (i.e., sound exposure) of the potential threat or disturbance, so that mitigation can be improved in the future, recognising that the sources of the loud noise are likely not SEIC activities. Reporting/data requirements According to the impulse noise format described in recommendation WGWAP-7/002, the Panel wishes to analyse the data from the following acoustic buoys on the dates indicated: Buoys A10, Odoptu N10, Odoptu-S-20 and Odoptu N20 for the periods 25-30 August, and 11-20 September; and Buoy OFA, 1-7 September 2010.	Sakhalin Energy, IUCN, Panel	Data submitted to IUCN by 31 May 2012 and circulated to the Panel, Panel provides a report at least three weeks before WGWAP-12	
WGWAP-11/004	Item 3.4	The Panel **recommends** that Brownell and Weller take the lead in consulting with outside experts (e.g. Frances Gulland in California) on the marine mammals/HABs issue and how it may pertain to western gray whales, and that they report back at WGWAP-12.	Brownell, Weller	WGWAP-12	
Item 5: NOISE TASK FORCE					

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
WGWAP-11/005	Item 5.3.7	The Panel **recommends** that information on the sub-bottom profiler(s) to be used for the 2012 surveys be provided as soon as possible to IUCN and that an appropriate mechanism be determined for the Panel to provide timely advice.	Sakhalin Energy	As soon as possible	
WGWAP-11/006	Item 5.5.1	Objective The Panel has a responsibility to review, evaluate and advise on Sakhalin Energy activities that may have impacts (including in a cumulative manner) on western gray whales (e.g. with respect to noise, damage to benthos, oil spill risk). This requires that the Panel is made aware of planned 'new' activities as well as any changes to ongoing activities well in advance of these becoming operational. Reporting/data requirements It would be valuable and efficient to have a single 'activities' document that can be updated regularly (at a minimum, immediately prior to WGWAP meetings). Items to be summarised include: numbers, types, locations and general operating patterns of marine vessels working for SEIC (e.g. supply vessels, oil spill response vessels, standby vessels, accommodation vessels, diving vessels, *ad hoc* activities) changes to 'regular' operations (e.g. drilling, well conductor driving, maintenance and project	Sakhalin Energy	Open-ended (annual reporting)	

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		activities) potential or actual specific/unusual activities (e.g. seismic surveys, pipeline stabilisation, construction works) – with notification as early as possible; timelines of such activities throughout the season or seasons (to allow consideration of aggregate activities). Where changes occur, there should be a concise explanation of why they are necessary, a summary of options considered, an evaluation and risk assessment of any possible impacts and a presentation of measures proposed by the company to ensure that disturbance or other effects on gray whales are minimised. As appropriate, this should include an explanation as to why certain potentially applicable mitigating measures were not adopted. Timeline Sakhalin Energy should report at least annually in document form, consistent with its normal business planning cycle. Information must reach the Panel sufficiently in advance to ensure that any ensuing recommendations can be used by the company to modify its plans if necessary. Large-scale activities such as those involved in the South Piltun development, seismic surveys etc. are best dealt with (as has been the case) as separate exercises with considerably more lead time and detailed information must be provided well in advance. It is recognised			

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		that the task force approach may need to be used for such cases.			
WGWAP-11/007	Item 5.5.2	Objective To provide a more constructive and productive means of initial analysis and examination of acoustic data, consistent and adequate summaries of data on temporal patterns of noise must be submitted to the Panel for consideration. In addition, the original time series of data must be available for more detailed analysis of specific events of interest. This new process should facilitate the most efficient and productive review of acoustic data by the Panel and NTF. Reporting/data requirements All original time-series data should continue to be collected and stored by the Acoustic Monitoring Group at the Pacific Oceanological Institute (POI). This is not a new request but reflects the critical importance of full archival preservation of the original data. WGWAP recommendation 7/002 specifies the need for the reporting of data on specific acoustic events on relatively fine temporal (1-s for impulse noise; 1-min for continuous noise) and spectral (1-Hz band) scales. While data must be made available upon request on these fine scales for specific events, this is not a regular requirement for all sensors and all sampling periods. However, to expedite the release	Sakhalin Energy, IUCN	Open-ended (annual reporting)	

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		of ‘event’ data in a timely and efficient manner Sakhalin Energy has agreed to include in its contract with POI a requirement that all raw acoustic data be pre-processed and archived as time-indexed frequency-resolved records (e.g. through the computation of simple, non-averaged spectrograms). This operation will minimise the time needed by POI to fulfil subsequent requests for data. For each season, beginning with 2012, the following tabular and graphical summary representations of the acoustic data should be included in, or enclosed in digital format with, the reports. Specifically, each annual report would include for every recording station and all available data periods: * Tabular summaries in digital format of 30-min Leq levels in 1/3-octave bands between 10Hz and 10kHz (ANSI standard centre frequencies) * Graphs showing sequential 1-min Leq values for the 20Hz-2 kHz and 20 Hz-15 kHz passbands (presented chronologically with ~3 days data/graph) * Distinct spectrograms showing a) 1-min averages in the range 20Hz-2kHz on a linear frequency scale and b) 1-min averages in the range 20Hz-15kHz on a logarithmic frequency scale. For completeness and ease of reference, the 2-20 Hz frequency range could be shown on a common time axis alongside the 20Hz-15kHz logarithmic spectrograms, but should be segregated and rendered separately with an independent colour scale so as not to restrict the			

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		dynamic range of the >20 Hz data. Timeline The company should submit a report annually through IUCN in document and/or digital form that contains the data as described above. Sakhalin Energy and IUCN will develop an efficient method to transfer and circulate this material to the Panel and/or Task Force members as appropriate.			
WGWAP-11/008	Item 5.5.3	Objective Perhaps unparalleled effort and resources were expended to design and successfully implement a comprehensive monitoring and mitigation programme for the 2010 4D seismic survey. Considerable effort and resources have also been invested in validating, coding and developing initial analyses of the data. It is important that the data collected are fully analysed as soon as possible to increase understanding of the effects of seismic surveys on whales and thus contribute to the evaluation of existing mitigation measures and the development of improved measures for future surveys. Data requirements/analyses These are specified in the reports of the Noise Task Force (NTF-1 and NTF-2) and the comments, suggestions and recommendations therein endorsed by the Panel.	Sakhalin Energy, Noise Task Force members, IUCN	By the end of August 2012	

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		Responsible persons Sakhalin Energy (for ensuring the analyses are carried out in accordance with NTF-1 and NTF-2 reports, informing NTF members on progress, consulting with them on methods where appropriate and submitting written reports), NTF members (for providing verbal and written comment as appropriate through email, teleconferences and meetings) and IUCN (for logistical support with document circulation, teleconferences and meetings).			
WGWAP-11/009	Item 5.5.4	Recognising that the mitigation and monitoring programmes developed by the Panel and Sakhalin Energy may be considered by others as precedents, the Panel emphasises the following: (1) the mitigation and monitoring strategies developed for the 2010 and (proposed) 2012 seismic airgun surveys were based on: (a) careful analysis of the specific airgun array being used (2620 in^3 in 2010 and 160 in^3 in 2012) and associated modelled footprints in the feeding area; (b) the position and extent of the surveyed area with respect to the gray whale feeding areas; (c) the seismic survey strategy, especially the timing of the survey; (2) thus while the development processes and analytical methods used to determine mitigation measures for seismic surveys involving airgun arrays	Sakhalin Energy, IUCN	As soon as feasible *and* open-ended (ongoing)	

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		of different sizes are generally applicable, several aspects are case-specific and must be seen in the context of the total mitigation strategy; (3) the primary mitigation measure for any seismic airgun survey in Sakhalin waters where gray whales are concentrated must be to complete the survey before the majority of whales have arrived in the area (nominally by 7 July based on conditions observed at Sakhalin in about 2005-2010); without this, the other measures alone established for the 2010 and 2012 surveys would not have been considered sufficient by the Panel. The sizes of the recommended exclusion zones around vessels operating seismic airguns for gray whales are primarily dependent on the power of the sound source and not the location or spatial extent of the survey. The Panel **recommends** that exclusion zones must be at least the modelled 180dB$_{RMS}$ re:1µPa distance from the specific array to be used plus an appropriate additional safety margin that may change with circumstances. Generalising from the analyses undertaken for the 2010 and 2012 surveys, the Panel **recommends** that for seismic surveys in areas off Sakhalin where gray whales are concentrated: (1) for sound sources of 200 in^3 or less, the exclusion zone must be at least 500m; (2) for sound sources of over 200 in^3 it must be based on modelling (for 180dB$_{RMS}$ re:1µPa) and verified in			

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		the field (or directly measured) and in any case must not be less than 1000 m. The Panel **recommends** that this general statement is clearly displayed on the IUCN website along with the detailed mitigation and monitoring strategies developed thus far.			
WGWAP-11/010	Item 5.6	The Panel **requests** that IUCN ensures that NTF teleconferences are organised on a regular basis.	IUCN, NTF members	Open-ended	
ITEM 6: ENVIRONMENTAL MONITORING TASK FORCE (INCLUDING OIL SPILLS)					
WGWAP-11/011	Item 6.2	The Panel **recommends** that (i) lessons learned from the 2011 Piltun drill are taken into account during the Piltun drill that is scheduled by SEIC for 2012, with attendance by Dicks and other Panel members/IUCN representatives; (ii) Dicks and other Panel members, if needed, take part in planning of the drill to ensure that amongst other objectives it addresses the Panel's concerns; and (iii) the site visit is combined with a review of Sakhalin Energy's OSR equipment and other response resources. Sakhalin Energy confirmed its agreement and support in principle and indicated its willingness to facilitate the site visit.	Sakhalin Energy, Dicks and other Panel members, if needed	Open-ended	
WGWAP-11/012	Item 6.3	Recommendations WGWAP 1/021 (1) and 10/013 should classified as 'Closed – superseded' by the following two-part recommendation: The Panel **recommends** that Panel members Tsidulko and VanBlaricom collaborate with Fadeev and colleagues at the Russian Academy of Sciences in Vladivostok	Tsidulko, VanBlaricom	As soon as feasible	

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		to produce a review of literature relevant to the following question: "Why do western gray whales focus their foraging effort on the recognised feeding areas on the northeastern Sakhalin shelf?" It further **recommends** that VanBlaricom and Tsidulko, in collaboration with Fadeev, develop a formal proposal to IUCN for support of the literature review, with objectives and funding needs identified.			
WGWAP-11/013	Item 6.3	The Panel **recommends** that when biopsy samples are collected from western gray whales for various research purposes, blubber portions be used, in part, to assess anthropogenic contaminant levels (particularly persistent organic contaminants such as PCBs and PBDEs), as long as the volume of a given sample is sufficient to allow such analyses, with due consideration of other priorities for use of the biopsy material.	Sakhalin Energy	As soon as feasible	
Item 7: PHOTO-ID					
WGWAP-11/014	Item 7.1	The Panel also **notes** its recommendation (WGWAP 10/04) that the Russia-US catalogue and the Kamchatka catalogue be compared directly, and **requests** that Saksina (IUCN) initiate this by contacting the relevant parties. The Panel further notes that this is a relatively small task, since it requires only matching those whales in the Russia-US and Kamchatka catalogues that are not also found in the IBM Sakhalin catalogue.	IUCN, Russia-US and IBM field teams	As soon as feasible	

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
WGWAP-11/015	Item 7.3	[...] the Panel **recommends** that Sakhalin Energy makes every effort to support the work in Kamchatka as it is integral to monitoring population status. If the Company cannot implement this recommendation, the Panel alternatively **recommends** that Sakhalin Energy ensures there is no obstacle to continuation of the work with funding from another source. In particular, the Company should make every effort to extend the rights of access to and use of the data collected in Kamchatka thus far to whatever agency or persons continue the photo-ID work there. This would enable the Kamchatka catalogue and sightings history database to continue being updated. In the event that rights reside jointly with co-sponsors (i.e. ENL), Sakhalin Energy should work with co-sponsors to furnish the required permissions.	Sakhalin Energy	As soon as feasible	
Item 8: POPULATION ASSESSMENT					
WGWAP-11/016	Item 8.1	The Panel **recommends** further work on the interpretation of the population assessment in the light of recently available tagging, photo-ID and genetics results. The Panel further **recommends** that, when a definitive version of the IBM dataset through 2011 is available, an updated joint assessment be conducted.	Cooke, Sakhalin Energy, Russia-US and IBM field teams	As soon as feasible	
WGWAP-11/017	Item 8.1	The Panel **recommends** that both teams be requested to supply definitive versions of their sighting history datasets, including data through the 2011 season, for input to a joint assessment to be presented at	Cooke, Sakhalin Energy, Russia-US	WGWAP-12	

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
		WGWAP-12. Changes relative to previously submitted versions should be documented. Sighting history entries from Kamchatka should also be included in the assessment if possible, at least for those whales which have also been seen off Sakhalin.	and IBM field teams		
ITEM 9: UPDATE ON SOUTH PILTUN PLANNING AND DECISION-MAKING					
WGWAP-11/018	Item 9	The Panel **stresses** that an annual monitoring programme (and subsequent prompt integrated analyses over years) with the full complement of elements – distribution/density, behaviour, benthic, photo-identification and acoustics – is essential for the proposed development to be properly evaluated. It **recommends** that Sakhalin Energy maintains such a programme for at least as long as it continues to consider a new South Piltun development.	Sakhalin Energy	Open-ended	
WGWAP-11/019	Item 9	[...] the Panel **recommends** that Sakhalin Energy provides it with its provisional longer-term (say 5-year) plans with respect to monitoring; the Panel is willing to participate in any discussions over improvements or modifications to any elements.	Sakhalin Energy	As soon as feasible	
WGWAP-11/020	Item 9	The Panel **requests** clarification from Sakhalin Energy regarding the decommissioning plans for the PA-A and PA-B platforms as well as how decommissioning options have been taken into account in South Piltun planning.	Sakhalin Energy	WGWAP-12	
ITEM 11: ACTIVITIES BY SEIC AND OTHER COMPANIES ON SAKHALIN SHELF IN 2011, 2012 AND BEYOND					

Recommendation Number	Cross-Reference	WGWAP Recommendations & Requests	Responsible Party/Parties	Target Completion Date	Sakhalin Energy Response
WGWAP-11/021	Item 11.4	Regarding assessment of cumulative impacts, ideally, a comprehensive database on all industrial and other activities on the north-eastern Sakhalin Shelf should be developed and maintained. The Panel is probably not the appropriate body to do this, and the involvement of the relevant Federal and Oblast authorities would be essential. The Panel **recommends** that IUCN, in close coordination and with the help of Panel members, Sakhalin Energy and other stakeholders in the WGWAP process (Lenders, NGOs) as well as relevant Russian government agencies, begin to develop such a comprehensive database and report back on progress at WGWAP-12.	IUCN, Panel, Sakhalin Energy	WGWAP-12	
ITEM 12: UPDATE ON MONITORING FOR AND REPORTING GRAY WHALE CARCASSES, NECROPSY CAPACITY AND PROTOCOLS, HEALTH ASSESSMENT ETC.					
WGWAP-11/022	Item 12	On the basis of current understanding, the Panel **recommends** that the Company seek explicit advance permission from the appropriate authorities to allow Company employees or contractors to carry out, promptly and without delay, a full examination (necropsy and sampling) of any dead whale found in north-eastern Sakhalin Island.	Sakhalin Energy	As soon as feasible	

Annex 1. List of participants

PANEL MEMBERS PRESENT

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Associate Scientists

Brandon SOUTHALL

IUCN

Patricio BERNAL
Olivier HASINGER
Sarah HUMPHREY (Rapporteur)
Tatiana SAKSINA
Stephen TURNER (Independent evaluator)

Governmental Observers

Elena Nevenchina, Sakhalin Ministry for Nature Resources

Observer NGOs (including alternates)

Naoko FUNAHASHI, IFAW
Maria VORONTSOVA, IFAW Alexey KNIZHNIKOV, WWF Russia
Heather SOHL , WWF UK
Doug NORLEN, Pacific Environment (from midday day 1)
Audrey WOOD, Pacific Environment

Observer Lenders

Bruno Bischoff, Credit Suisse (Day 1&2)
Jonathan Hancox, AEA Group
Bruce Mate, AEA Group
Corinne Raux-Foggon (Day 3)
Sayaka Wakabayashi, Mizuho Corporate Bank, Ltd

Interpreters

Alexander Danilov
Grigory Shkalikov

Annex 2. Final meeting agenda

WESTERN GRAY WHALE ADVISORY PANEL		**12-14 February 2012**
11th meeting		**Geneva, Switzerland**
WGWAP-11 AGENDA AND TIME SCHEDULE		

12 February 2012		**Documents**
09:00 – 09:45	**1. Opening of 11th WGWAP meeting**	
	1.1 Introductions and logistics 1.2 Adoption of agenda 1.3 Documents 1.4 Report drafting procedures and timeline 1.5 Update on outstanding business from previous meetings incl. status of recommendations [***Reeves***] 1.6 Website update [***Hasinger***] 1.7 IUCN update on personnel, contract, TOR etc. [***Bernal***]	WGWAP-11/1 WGWAP-11/2 WGWAP-11/3 WGWAP-11/9 WGWAP-11/14 WGWAP-11/16
09:45 – 10:30	**2. 2-year evaluation [*IUCN, Turner*]**	WGWAP-11/12
10:30 – 10:45	***Coffee break***	
10:45 – 12:30	**3. Reports on field activities in 2011** 3.1 Photo-identification [***Turnyeva***] 3.2 Distribution [***Vladimirov***] 3.3 Acoustics [***Racca***] 3.4 Benthic [***Fadeev***] 3.5 Field programme of Russia-US team [***Weller***]	WGWAP-11/10 WGWAP-11/11
12:30 – 13:30	***Lunch break***	
13:30 – 15:00	**4. Satellite tagging**	
	4.1 Summary of field effort in 2011 [***Mate, Tsidulko***] 4.2 Summary of results so far [***Mate, Tsidulko***] 4.3 Future satellite tagging [***All Participants***]	
15:00	***Adjourn and coffee***	

13 February 2012		**Documents**
09:00 – 10:30	**5. Noise Task Force**	
	5.1 Report of November 2011 NTF-1 meeting [***Donovan and others***] 5.2 Report (provisional) of February 2012 NTF-2 meeting [***Donovan and others***] (including updates on Astokh 4-D Seismic Survey Data Analyses and Noise Component of South Piltun 'Issues' Document, both by SEIC) 5.3 Update on Noise recommendations other than seismic survey related [***Nowacek***] 5.4 Update on Noise recommendations related to seismic surveys including 2010 Astokh 4-D and planned South Piltun 2-D [***Nowacek***] 5.5 Future work of NTF [***Donovan, SEIC***]	WGWAP-11/5 WGWAP-11/15 WGWAP-11/17
10:30 – 10:45	***Coffee break***	
10:45 – 12:30	**6. Environmental Monitoring Task Force (including Oil Spills)**	
	6.1 Report of December 2011 EMTF meeting [***VanBlaricom, Dicks***] 6.2 Update on Oil recommendations [***Dicks***] 6.3 Update on Environmental Monitoring recommendations [***VanBlaricom***] 6.4 Future work of EMTF [***VanBlaricom, Dicks***]	WGWAP-11/18
12:30 – 13:30	***Lunch break***	
13:30 – 14:00	**7. Photo-ID**	
	7.1 Update on status of catalogue comparisons [***Cooke***] 7.2 Future photo-ID efforts 7.3 Status of comparisons of Sakhalin (and Kamchatka?) photo catalogues to photo collections from other regions (including Canada, western US, Mexico, Chukotka?, China) [***Weller, SEIC***]	WGWAP-11/inf.1
14:00 – 15:00	**8. Population assessment** [***Cooke***]	
	8.1 Updated assessment (validity of assumptions etc.) 8.2 Plans for publication 8.3 Stock identity	
15:00	***Adjourn and coffee***	

14 February 2012		**Documents**
09:00 – 10:30	**9. Update on South Piltun Planning and Decision-making [*Davey*]**	
10:30 – 10:45	***Coffee break***	
10:45 – 11:30	**10. Update on Non-Noise Components of 'Issues' Document (including multi-year Summary Report by SEIC/ENL) [*SEIC*]**	WGWAP-11/5 WGWAP-11/7 WGWAP-11/8
11:30 – 12:30	**11. Activities by SEIC and Other Companies on Sakhalin Shelf in 2011, 2012 and Beyond**	
	11.1 SEIC key activities [***Evans***] 11.2 Non-SEIC activities 2011-2013 and beyond [***Hasinger***] 11.3 Integrated Analysis [***Vladimirov***] 11.4 How WGWAP can and should address Cumulative Effects issue [***Cooke***]	WGWAP-11/6 WGWAP-11/13
12:30 – 13:30	***Lunch break***	
13:30 – 14:00	**12. Update on monitoring for and reporting gray whale carcasses, necropsy capacity and protocols, health assessment etc. (including Olga Sokolova proposal) [Reeves, Others]**	WGWAP-11/19
14:00 – 14:30	**13. WGWAP Relations with Russian Authorities (including IWG) and Other Companies [*Reeves*]**	
14:30 – 15:00	**14. WGWAP Work Plan for 2012 [*Reeves, Others*]**	
15:00	***Adjourn and coffee***	

Annex 3. List of documents

DOCUMENT NUMBER	SUBMITTED BY	TITLE	STATUS
PRIMARY DOCUMENTS			
WGWAP-11/1	IUCN	Provisional agenda (including time schedule) (English)	Public
WGWAP-11/2	IUCN	Provisional agenda (including time schedule) (Russian)	Public
WGWAP-11/3	IUCN	List of documents distributed in connection with the 11th meeting of the WGWAP	Public
WGWAP-11/4		No document	
WGWAP-11/5	SEIC	Response to WGWAP 9_020 Risk Mitigation Final	Public
WGWAP-11/6	SEIC	SEIC Key activities assoc with noise	Confidential
WGWAP-11/7	SEIC	MNR Summary report of the joint monitoring program 2002-2010 (English)	Public
WGWAP-11/8	SEIC	MNR Summary report of the joint monitoring program 2002-2010 (Russian)	Public
WGWAP-11/9	SEIC	Marine Mammal Observer Programme 2011 Close-Out Report	Public
WGWAP-11/10	SEIC	Sonograms 2010 program according to WGWAP format	Confidential
WGWAP-11/11	SEIC	Sonograms 4D program according to WGWAP format	Confidential
WGWAP-11/12	S.D. Turner	Evaluation of the Western Grey Whale Advisory Panel	Public
WGWAP-11/13	IUCN	Activities of other companies from 2011 to 2012 and beyond	Public
WGWAP-11/14	SEIC IUCN	WGWAP Terms of Reference 2012-2016	Public
WGWAP-11/15	Greg Donovan	Report of November 2011 NTF-1 meeting	Public
WGWAP-11/16	IUCN	List of documents distributed in connection with the 11th meeting of the WGWAP(Russian)	Public

WGWAP-11/17	Greg Donovan	Report of February 2012 NTF-2 meeting	Public
WGWAP-11/18	Glenn VanBlaricom Brian Dicks	Report of December 2011 EMTF-1 meeting	Public
WGWAP-11/19	Olga Sokolova	Summary on Gray Whale 2011 meeting in Tampa	Public

DOCUMENT NUMBER	PREPARED BY	TITLE	STATUS
FOR INFORMATION DOCUMENTS			
WGWAP-11/Inf.1	Greg Donovan	IWC extracts for WGWAP-11	Public

Annex 4. Summary and recommendations of the 2011 Evaluation of the Western Grey Whale Advisory Panel by S.D. Turner[5]

Background

The IUCN Western Grey Whale Advisory Panel (WGWAP) has now been operating for five years. Its terms of reference (TOR) require it to undergo an evaluation every two years. This is the second such evaluation, covering the period from the first quarter of 2009 to the third quarter of 2011.

During the review period, the panel has continued to work intensively, holding five more meetings (as well as several task force meetings). Two important developments have been the announcement by Sakhalin Energy that it is investigating development of a third platform on the Sakhalin Shelf in the South Piltun area; and the findings of satellite tracking, which have shown a western grey whale travelling across the Pacific to the west coast of North America.

This review therefore comes at a time of change for the panel. A second phase of operations will soon be launched, under a new contract between IUCN and Sakhalin Energy. The timing of this evaluation and IUCN's preparation of new TOR for the next panel contract were not synchronised. As it seemed that the new TOR might be finalised earlier, preliminary comments from the evaluation were submitted to IUCN as an input to the TOR.

The evaluation is based on review of the documentation; interviews with 31 informants; and a questionnaire survey.

Relevance

The WGWAP process is relevant to the conservation and recovery of the western grey whale population. But it is constrained by the fact that it still works with only one of the energy companies active on the Sakhalin Shelf; and its work is largely confined to one – critically important - part of the animal's range.

Recommendation 2.1[6]. To enhance the relevance and effectiveness of the WGWAP process, IUCN, supported by Sakhalin Energy, must continue efforts to engage other energy companies on the Sakhalin Shelf in the process, both formally and informally.

Recommendation 2.2. To enhance the relevance of the WGWAP process, IUCN, in consultation with the IWC and NGOs, must intensify efforts to secure funding for the rangewide initiative for the western grey whale – which will remain important despite emerging evidence of trans-Pacific migration by the animals.

From a scientific perspective, the WGWAP's advice to Sakhalin Energy is strongly relevant. The challenge for the panel is to optimise the operational relevance of its advice so that industry managers and technicians can understand and act on it. The challenge for the company is to make the best use of such advice in ways that optimise both operational advantage and conservation impact – while understanding that relevant advice may take time to construct.

Thematically, the cutting edge work of the panel in a particular field of marine conservation is highly relevant to IUCN. The practical value of this relevance depends on how effectively IUCN exploits it. Strategically, the panel is relevant in IUCN's overall approach towards, and experience with, the private sector. IUCN has not been capitalising adequately on either of these aspects of the panel's relevance.

Recommendation 2.3. To enhance the relevance of the WGWAP process for IUCN, IUCN's Global Marine and Polar Programme (GMPP) should ensure adequate interaction, engagement and cross-fertilisation with and between the WGWAP's work and that of its other projects and activities, as

[5] The full text of the 2011 Evaluation of the Western Grey Whale Advisory Panel Report can be found at: http://cmsdata.iucn.org/downloads/wgwap_evaluation_report_nov_11.pdf
[6] Recommendation numbers are keyed to chapter numbers in the report.

well as the Business and Biodiversity Programme and other relevant activities of the Secretariat and Commissions.

Recommendation 2.4. IUCN should affirm its commitment to, and clarify its procedures for, acting both as neutral convenor of the WGWAP and also as active conservation advocate on matters addressed by the panel.

Thematically, the issues with which the panel and Sakhalin Energy are grappling in the WGWAP process are highly relevant to the other companies working on the Sakhalin Shelf and to the oil and gas industry more broadly. The WGWAP process is also strategically relevant to the industry as it considers how to interact with environmental and conservation interests. It is not surprising that no other company has volunteered to join Sakhalin Energy in its collaboration with and funding of the panel. This does not diminish the strategic relevance of the WGWAP process for the sector.

Effectiveness

Overall, the WGWAP is complying with the principles laid down for it. However, several constraints make it difficult for it to perform all its tasks as intended.

The timely and adequate provision of the relevant information by Sakhalin Energy to the WGWAP is fundamental to the panel process and central to the health of panel relationships. Following the crisis of poor company performance in this regard in 2008, there has been a significant improvement. Against the backdrop of this generally improved performance, there has been less satisfaction with Sakhalin Energy's transmission of information about the South Piltun development.

Recommendation 3.1. Sakhalin Energy should ensure that it delivers a full and timely flow of information regarding the South Piltun development to the panel.

Good progress has been made in the content and management of WGWAP recommendations since 2008. IUCN and the WGWAP are managing them more effectively. WGWAP recommendations have become clearer, more practical and more usable (due partly to the way many of them emerge from task force discussions), while their number has become somewhat more manageable. More progress is needed in all these areas, although the panel cannot and should not guarantee that it will find fewer matters on which to make recommendations.

Recommendation 3.2. The panel should continue its efforts to improve the specificity, clarity and practicability of its recommendations.

Sakhalin Energy has acted effectively to implement some panel recommendations. The result is improved practice (sometimes at the cutting edge of best practice) with regard to potential disturbances like seismic surveys and boat traffic, probably leading to reduced disturbance for western grey whales. However, other recommendations have not led to a clear and effective result of this kind. The company may be reluctant to act as decisively as it should on some recommendations. It may find others difficult to act on in a practical and focused manner. Or various internal constraints – of which there have been several recently – may delay or diminish implementation.

IUCN needs to lift its game with regard to the WGWAP. It gives its undoubted credibility and respected name as a neutral convenor to the panel process, but not enough beyond that. This is ammunition for those who argue that it is too ready to make mutually beneficial arrangements with the private sector to lend environmental respectability to the latter's operations. Instead, it should stimulate much more active and open communication and engagement with and between all stakeholders in the panel process, the GMPP, the Business and Biodiversity Programme (BBP) and other IUCN programmes about the conservation issues and opportunities arising from the panel's work for conservationists and the private sector. It should also work more strongly in strategic areas above and beyond the panel's reach. Not only does the panel co-ordinator in the Global Marine and Polar Programme (GMPP) need to combine conservation experience and the ability to engage constructively with the worlds of industry and state policy; IUCN management must also be proactive in engaging with the work the panel does and the opportunities it presents for the Union as a whole. Several informants expressed confusion about how the co-ordinator post is to be filled following the departure of the previous incumbent in May.

Recommendation 3.3. IUCN should ensure that arrangements for substantively filling the WGWAP co-ordinator position are clearly communicated and fully understood by all stakeholders.

The broader priority for IUCN is to achieve more productive understanding and collaboration with the Russian government. Russian language proficiency on the part of the next WGWAP co-ordinator would be a strong advantage in this regard. Working with NGOs, IUCN and the panel should also seek stronger links with the local oblast government on Sakhalin, which has relevant regulatory functions and scientific concerns.

Recommendation 3.4. IUCN, its GMPP and the WGWAP should strengthen their engagement with the Russian authorities and the Interdepartmental Working Group with regard to the WGWAP process.

Recommendation 3.5. IUCN and Sakhalin Energy should support closer interaction between the panel and local authorities and NGOs on Sakhalin.

At the same time, IUCN should communicate more effectively to all concerned about its administrative arrangements for the panel, and give a more convincing justification for the ways it uses the overheads that it charges on the project budget contributed by Sakhalin Energy. This has been a point of contention within the GMPP and in IUCN's relations with the company.

Panel meetings have included some useful self-assessment discussions, but the concept of a regular formal agenda item on this is not working out effectively.

Recommendation 3.6. Before each meeting, the panel chair and the IUCN co-ordinator should prepare a short document assessing the performance of the WGWAP, referring to the previous meeting and the intervening period, and table this in the self-assessment slot on the agenda for discussion.

Changes at Sakhalin Energy have meant a sharper focus on risk-based justification for panel recommendations and consequent company action, and an evident impatience with any hint of science for the sake of science in the panel's deliberations. There have been frictions. A new and possibly more inclusive trust and process need to be built, with arguably more flexible thinking about how to involve other companies, NGOs and local and national government – even if these parties do not all take part in the formal panel process as currently constituted. There is commitment on all sides to build this broader trust and process, although it will take some facilitation to find mutually acceptable expression by and among all parties.

Recommendation 3.7. IUCN and Sakhalin Energy should work together to build a new and more inclusive trust and process in the WGWAP, with more flexible thinking about how to involve other companies, NGOs and local and national government – even if these parties do not all take part in the formal panel process as currently constituted.

Efficiency

Five years into the WGWAP process, roles and responsibilities are mostly clear and stable, although somewhat unsettled by this year's transition in the co-ordinator post at IUCN and changes in Sakhalin Energy. The management of meetings, reporting and work flow is generally satisfactory. The machinery of the WGWAP can now function fairly smoothly.

From some perspectives, the WGWAP process costs more than it might. From others, it costs less than any conceivable option. Both IUCN and Sakhalin Energy must work in good faith to maximise the conservation and business benefits through continuing attention to the cost-effectiveness of the process.

Relationship management in the panel process has generally been adequate. There is more good faith on the various sides of the WGWAP process than some participants realise. Despite the changing personalities and shifts in emphasis, there is a good prospect that relationship management can develop from adequate to satisfactory.

WGWAP members are commended for the enormous effort they devote to the panel process. It is now time to review panel membership.

Recommendation 4.1. IUCN and the WGWAP chair should carry out a review of all panel members and determine whether to retain or replace them. Without increasing the size of the panel, they should aim to increase Russian representation and to ensure that at least one new member has strong practical experience of addressing environmental and technical concerns from within the oil and gas sector.

The idea of cutting each meeting to two days has rightly been resisted, as has that of having only one full meeting per year. There are criticisms of the task force approach as inadequately transparent and possibly generating conflicts of interest. The ultimate test must be whether the results of this modus operandi, as reflected in the company's actions and the mitigation and conservation results, adequately work towards the panel's goal of conservation and recovery of the western grey whale population. So far, the balance of the evidence is positive.

Recommendation 4.2. The panel should maintain its use of task forces, provided that panel members retain their independent stance in task force discussions, and that this independence is safeguarded by the private and plenary meetings of the panel as a whole.

Recommendation 4.3. The panel should ensure that its environmental monitoring task force functions effectively and catches up with its work.

Overall, the transparency of the WGWAP process is judged good, within the realistic limits imposed by the nature of that process. IUCN has produced a commendably thorough communications strategy for the WGWAP process. The fact that the responsible officer is also in charge of all routine WGWAP administration has slowed implementation of the strategy somewhat. There has been some improvement in the availability of communications and documents on the process in Russian. IUCN continues to be criticised in some quarters for communications that paint too favourable a picture of Sakhalin Energy motives and performance. Given that influencing the private sector is an important part of its overall strategy, it must achieve a difficult balancing act. To publish communications implying a crusade to police and correct the private sector would be counter-productive. Not surprisingly, it fails to please all of the people all of the time. In communications on the WGWAP, continuing vigilance is needed from panel members and communications staff to strike the appropriate balance and tone.

Open information sessions, and an online question and answer process, have not been effective.

Recommendation 4.4. Instead of attempting focused information or question and answer sessions on the western grey whale and the WGWAP, IUCN should give prominence to its and the panel's readiness to answer questions via the website, and actively seek the collaboration of Russian and other NGOs in spreading the word about this. It should also include a 'frequently asked questions' link to the fact sheet on the website.

IUCN provides generally strong and efficient administrative and logistical support to the WGWAP process. Reports on all panel and most task force meetings are thorough and efficient.

The influence and impact of the WGWAP

The WGWAP process has had a modest but positive impact on the conservation of the western grey whale population, and a marginal but positive impact on its recovery. The potential for it to achieve positive impact on the animals' conservation and recovery would be much greater if its efforts were nested within a rangewide initiative for this purpose.

The panel process has had a positive impact on Sakhalin Energy's practice on the Sakhalin Shelf. It is harder to be positive about the sustainability of these positive impacts on Sakhalin Energy. Beyond the duration of current obligations to lenders, much will depend on whether the environmental attitudes and practice of Gazprom – seen in the context of the Russian oil and gas industry overall – have evolved beyond their present sub optimal state. It will depend, too, on the evolution of Russian regulatory practice and how effectively it can maintain the conservation standards that the panel is encouraging Sakhalin Energy to adopt.

So far, the WGWAP process has had relatively little influence on broader state and industry practice in the range of the western grey whale.

There are two ways in which the WGWAP process can affect the marine conservation practices of the oil industry in general. The first is for the panel model of interaction between independent experts and a company to be replicated. The second is for the industry to adopt approaches or practices that the panel has recommended. There is some evidence of the first type of impact, notably through the panel that IUCN set up to advise on oil and gas activities off the Mauritanian coast (2007 – 2009) and the Yemen LNG Independent Review Panel (operating since 2009). There is only limited, diffuse evidence of the second kind of impact.

The WGWAP process has had a substantial and positive influence on IUCN's approach to building partnerships with the private sector, which in turn has some significance for the overall IUCN Programme.

Updated analysis of abundance and population structure of seasonal gray whales in the Pacific Northwest, 1996-2012

John Calambokidis, Jeffrey Laake, and Alie Pérez

Abstract

The existence of a small number of Eastern North Pacific gray whales that spend the spring, summer and fall feeding in coastal waters of the Pacific Northwest has been known for some time and localized short-term studies have examined aspects of the natural history of these animals. We report the results of a 17-year (1996-2012) collaborative study examining the abundance and the population structure of these animals conducted over a number of regions from Northern California to British Columbia using photographic identification. Some 16611 identifications representing 1303 unique gray whales were obtained during 1996-2012 from Southern California to Kodiak, Alaska. Gray whales seen from 1 June - 30 Nov (after the northward and before southward migrations) were more likely to be seen repeatedly and in multiple regions and years;therefore only whales seen during those data were included in the abundance estimates. Gray whales using the Pacific Northwest in summer and fall include two groups: 1) whales that return frequently and account for the majority of the sightings and 2) transients seen in only one year, generally for shorter periods and in more limited areas. A time series of abundance estimates of the non-transient whales for 1996-2012 was constructed. The most recent estimate for 2012 was 209 whales (se=15.4). The estimated abundance increased in the late 1990s and early 2000s during the period when the eastern North Pacific gray whale population was experiencing a high mortality event and this created an apparent influx of whales into the area. The earlier estimates for 1996-1997 are biased low because the survey coverage area was much smaller but those data were included to improve estimates later in the time series. The abundance estimates since the early 2000s has been relatively stable. The proportion of calves documented was generally low in the early portion of the time series and may have been biased downward by under-reporting and weaning of calves prior to entry in the study area or prior to much of the collaborative seasonal effort. In recent years, early season effort has increased and so has the number of calf observations. Observations of calves returning to the Pacific Northwest in subsequent years documents one possible mechanism for recruitment.

1 Introduction

Beginning in 1996, a collaborative effort among a number of research groups was initiated to conduct a range-wide photographic identification study of gray whales in the Pacific

Northwest (Calambokidis et al. 2000, 2002b). An initial publication of findings from 1998 demonstrated there was considerable movement of individual whales among sub-areas from northern California to southeastern Alaska (which we broadly refer to as the Pacific Northwest) and also provided initial estimates of the abundance of whales within that geographical area (Calambokidis et al. 2002a). The ability to look at movements and employ more sophisticated capture-recapture models, however, was restricted by the lack of multiple years of data with broad geographic coverage. A subsequent report by Calambokidis et al. (2004) characterized the group of whales feeding in these survey areas during the summer-fall period as a "Pacific Coast Feeding Aggregation" (PCFA). They proposed that a smaller area within the PCFA survey areas – from Oregon to Southern Vancouver Island (OR-SVI) – was the most appropriate area for abundance estimation for managing a Makah gray whale hunt (Calambokidis et al. 2004). Subsequently the IWC has adopted the term PCFG for Pacific Coast Feeding group so we will use PCFG in place of PCFA.

This report updates information through 2012 from a collaborative effort to collect photographic identifications of gray whales from California to Alaska has continued since 1996 and these data now cover 17 years (1996-2012) and span fifteen survey regions along the coast from Southern California to Kodiak, Alaska (Figure 1). We provide estimates of abundance for the summer-fall seasons (1 June to 30 November) during 1996–2012 for survey regions between Northern California and Northern British Columbia (NCA-NBC), the region chosen by the IWC to represent the PCFG. For the National Marine Fisheries Service development of an Environmental Impact Statement, we also provide estimates for the smaller regions between Oregon and Southern Vancouver Island (OR-SVI) and Makah Usual and Accustomed area (MUA) which includes the outer coastal area of the Olympic Peninsula (NWA) and the Strait of Juan de Fuca (SJF), even though this area is quite small relative to the observed movements of whales within the PCFG.

2 Methods

Gray whales were photographed during small boat surveys conducted from California to Alaska by collaborating researchers (Table 1) between 1996 and 2012. Gray whale identifications were divided into the following regions (Figure 1): 1) SCA: Southern California, 2) CCA: Central California, 3) NCA: Northern California, 4) SOR: Southern Oregon, 5) OR: central Oregon, 6) GH+: Gray's Harbor and the surrounding coastal waters, 7) NWA: Northern Washington coast, 8) SJF: Strait of Juan de Fuca, 9) NPS: Northern Puget Sound, 10) PS: which includes southern Puget Sound, Hood Canal (HC), Boundary Bay (BB) and San Juan Islands (SJ), 11) SVI: Southern Vancouver Island, 12) WVI: West Vancouver Island, 13) NBC: Northern Vancouver Island and coastal areas of British Columbia, 14) SEAK: Southeast Alaska, and 15) KAK: Kodiak, Alaska. With some exceptions, research groups work primarily in one or two regions. Details of identifications obtained by the different research groups are are summarized in Tables 1-2.

2.1 Photographic Identification Procedures

Procedures during surveys by different research groups varied somewhat but were similar to one another in identification procedures. When a gray whale was sighted, the time, position, number of animals, and behaviors were recorded. Whales were generally approached to within 40-100 m and followed through several dive sequences until suitable identification photographs and associated field notes could be obtained.

For photographic identification of gray whales, both left and right sides of the dorsal region around the dorsal hump were photographed when possible. Most identification photographs were obtained with were obtained with 35mm cameras prior to 2004 and primarily with digital SLR after 2004 with both camera types paired most often with a large 300mm lens. Researchers also photographed the ventral surface of the flukes for further identification when possible. The latter method was not as reliable since gray whales did not always raise their flukes out of the water. Markings used to distinguish whales included pigmentation of the skin, mottling, and scarring, which varied among individuals. These markings have provided a reliable means of identifying gray whales (Darling 1984). We also identified gray whales using the relative spacing between the knuckles along the ridge of the back behind the dorsal hump. The size and spacing of these bumps varies among whales and has not changed throughout the years these whales have been tracked, except with injury. Figure 2 shows typical photographs and features used in making gray whale identifications.

Comparisons of whale photographs were made in a series of steps. All photographs of gray whales were examined and the best photograph of the right and left sides of each whale (for each sighting) were selected and printed (7 x 2.5 inch). To determine the number of whales seen during the year, the prints were then compared to one another to identify whales seen multiple days. Finally a comparison was made to the CRC catalog of whales seen in past years. Whale photographs that were deemed of suitable quality but did not match our existing catalog (compared by two independent persons) were considered "unique" identifications and assigned a new identification number and added to the catalog.

2.2 Data Analysis

The abundance of gray whales was estimated with open population models for three nested spatial scales consisting of contiguous survey regions (Figure 1; Table 3) 1) NCA-NBC: the coastal survey regions from Northern California (NCA) through Northern Vancouver Island/British Columbia (NBC) which matches the IWC definition of the PCFG, 2) OR-SVI: survey regions from southern Oregon through Southern Vancouver Island (SVI) identified in the Makah waiver request, and 3) MUA - survey regions NWA and SJF. Inland waters in WA (other than SJF) and in BC are excluded from the abundance estimates because these are used primarily by transient whales in the northward spring migration.

Gray whales photographed and identified anytime during the period between 1 June and 30 November (hereafter referred to as the "sampling period") within the defined region were considered to be "captured" or "recaptured". For each unique gray whale photographed, a capture history was constructed using 17 years of data from 1996-2012. For example, the capture history 00010010010000000 could represent a gray whale photographed in 1999, 2002 and 2005 in the PCFG. The same gray whale may have had a capture history 00010010000000000 for a smaller spatial scale such as OR-SVI or may not have been seen at all (00000000000000000) and would not be used at the smaller spatial scale.

Multiple "detections" of a single whale within the sampling period were not treated differently than a single detection. A "1" in the capture history meant that it was detected on at least one day during the sampling period. However, multiple detections in the same year were used to construct an observed minimum tenure (MT) for each whale. MT was defined as the number of days between the earliest and latest date the whale was photographed with a minimum of one day for any whale seen.

We fitted open population models to the 17 yearly time series of capture history data for each spatial scale to estimate abundance and survival. Open models allow gains due to births/immigration and losses due to deaths/emigration. Using the RMark interface (Laake and Rexstad 2008) to program MARK (White and Burnham 1999), we fitted a range of models to the data using the POPAN model structure. The POPAN model structure (Schwarz and Arnason 1996) provides a robust parametrization of the Jolly-Seber (JS) model structure in terms of a super population size (N), probability of entry parameters (immigration), capture probability (p), and survival/permanent emigration (φ).

It is essential to consider the population structure and its dynamics to build adequate models. In particular, we know from previous analysis of a subset of these data (Calambokidis et al. 2004) that some whales were seen in only one year between 1 June and 30 November and were never seen again. Transient behavior is a well-known problem in capture-recapture models and it is often addressed using a robust design which involves coordinated multiple capture occasions within each year and typically assumes closure within the sampling period (June-November). Region-wide coordinated surveys may be possible but would be difficult with variation in weather conditions. Also, the closure assumption within the year would be suspect due to variable timing of whales arrivals and departures into the PCFG, so it would require nested open models. We know from prior analysis that whales newly seen in year (y) were less likely to return (i.e., seen at some year >y) than previously seen whales but also newly seen whales that stayed longer during their first year (i.e., longer MT) in the PCFG were more likely to return. Likewise, previously seen whales were more likely to be seen in the following year (y+1), if they had a longer MT in year y. Calambokidis et al. (2004) postulated that these observations were consistent with whale behavior that was determined by foraging success.

Transient behavior in which an animal is seen only once can be modeled by including a different "first year" survival (Pradel et al. 1997) for the newly seen animals. Survival in the time interval after being first seen is dominated by permanent emigration rather than true mortality. Survival in subsequent time intervals represents true survival under the assumption that animals do not permanently emigrate except in their first year. Pradel et al. (1997) were working with release-recapture data (Cormack-Jolly-Seber) where modeling this transient effect on survival is straightforward. For a Jolly-Seber type analysis where the first capture event is also modeled, the inclusion of a transient effect is less easily accommodated.

We divided the whales into cohorts based on the year in which they were first seen ("newly seen"). In the model, their first year survival could differ from subsequent annual survival as in Pradel et al. (1997). "Newly seen" is not a particularly useful concept for the first year of the study (1996), because all whales were being seen for the first time. The survey effort and coverage in 1996 and 1997 were not nearly as expansive as 1998 and later. We considered models that had three different first year survivals (1996&97, 1998, and >1998) and we also considered a model that allowed for a different first year survival for each year (cohort) to allow for different transient proportion in each year. The first year survival was also allowed to vary as a function of MT with a model in which the relationship was constant across years and varied for (1996&97, 1998, and >1998). We also considered models that allowed a different first-year survival for whales identified as calves under the presumption that their true survival might be lower but that their probability of returning to the PCFG might be higher. Discussion at the 2012 intersessional AWMP meeting led to consideration of an additional covariate which split whales into 2 groups for estimation of post-first-year survival. Whales seen initially as calves and any whale newly seen in 1998 or was in the CRC catalog because it had been seen prior to 1998 were put in one group and the remaining whales newly seen in 1999 or later were put in another group. The expectation was that the first group would have higher post-first-year survival because many of the newly seen whales that entered after the stranding event in 1999/2000 might eventually emigrate. When this covariate was included it made such a large improvement that any model without it would have no support. Therefore, it was included in all 10 models for survival (Table 4).

In Calambokidis et al. (2010) we estimated a cohort-specific super-population size for each cohort using the median MT covariate value for unseen whales but during the April 2011 AWMP meeting it became apparent that this may lead to bias in estimating abundance. Therefore, we used the method outlined in the 2011 AWMP report which is similar to the method used by Calambokidis et al. (2004) in that we assume that all whales in the PCFG for the first year are seen so the super-population size for each cohort is the number seen and thus there are no unknown covariate values. We fixed capture probability (p) and probability of entry (pent) to 1 for each cohort in their entry year. We are not interested in the number of transient whales so we used an estimator of abundance for non-transient whales (2011 AWMP report) which is a modification of the Jolly-Seber estimator which for any year can be expressed as:

$$\hat{N} = n/\hat{p} = (u+m)/\hat{p}$$

where $n = u + m$, n is the number seen in a year being composed of new animals (u=unmarked) and previously seen animals (m=marked), and $\hat{p}$ is the capture probability estimate. For the PCFG we are assuming that any new whale is sighted ($p = 1$) and we are only interested in estimating the abundance of whales that will remain part of the PCFG which is the portion of the new whales that do not permanently emigrate from the PCFG. We can modify the estimator for year j as follows:

$$\hat{N}_j = u_j \hat{\phi}_j + m_j/\hat{p}_j$$

where ϕ_j is the first year survival rate of "new" whales. When ϕ and p contain whale specific covariates like minimum tenure (MT) the estimator becomes:

$$\hat{N}_j = \sum_{i=1}^{u_j} \hat{\phi}_{ij} + \sum_{i=1}^{m_j} 1/\hat{p}_{ij}.$$

To obtain an abundance estimate for 2012, we assumed that the parameter for first year survival intercept in that year was the same as in 2011. A variance-covariance matrix for the abundance estimates was constructed using the variance estimator in Borchers et al. (1998) for a Horvitz-Thompson type estimator with an adaptation for the first component of the abundance estimator for prediction of number of new whales that do not permanently emigrate. For the estimated capture probabilities (p) not fixed to 1, we fitted 3 models that varied by time (year) and/or varied by MT in the previous year (Table 4).

We used Test 2 and Test 3 results from the Cormack-Jolly-Seber structure (Lebreton et al. 1992) as a general goodness of fit for the global model and as a measure of possible over-dispersion creating the lack of fit. We fitted each combination of models for S (survival) and p (capture probability) and used AICc (Burnham and Anderson 2002) to select the most parsimonious model of the 30 fitted models. Model averaging was used for all models to compute estimates and unconditional standard errors and confidence intervals.

3 Results

The database contains 20187 records for whales photographed between 1996 to 2012 from California to Kodiak, Alaska; however 3576 are replicate identifications of whales on the same day. We define a sighting as one or more photographs of a whale on a day. The number of sightings varied annually from 131 and 1648 with a total of 16611 sightings of 1303 unique gray whales (Table 1). The average number of sightings/whale was 12.7 (range: 1- 280). Identifications were made throughout the year but with most effort from June to September. Number of sightings were most numerous in NCA, SVI, WVI, and NBC and (Table 2). The number of uniquely identified whales was greatest in NCA, NWA, SVI and WVI (Table 2).

3.1 Seasonal Sighting Patterns

Whales have been photographed in every month of the year (Table 5) but with very few during December-February when most of the whales are in or migrating to Mexico and survey effort is reduced. Previous analysis of these data have always used 1 June - 30 November as the sampling period to describe the whales in the PCFG because whales seen prior to 1 June and after 30 November are more likely to be whales that are migrating through the region. The southbound migration starts in December and the separation between May and June is clearly supported by the data. For example, of the 1303 unique whales sighted from California to Kodiak, Alaska, 494 whales were only seen between 1 Dec - 31 May and 88.5% of those were only sighted once (one day). Of the 809 whales sighted between 1 June -30 November at some time, 37.1% were only sighted once (one day). If sightings in Alaska are excluded, then only 30.7% of the 698 were seen only once (one day).

The break between May and June is apparent in various measures such as proportion of whales sighted more than once, sighted in more than one region, and sighted in more than one year (Figure 3). However, the break is more apparent if we separate out SJF, NPS and SVI from the other survey regions (Figure 4). The difference across months is not as strong for inland waters of Washington and British Columbia (NPS, SJF) because these are whales that have diverted from the migration and are either more likely to remain after 1 June or demonstrate high year-to-year fidelity during spring such as with NPS. Also, even though Southern Vancouver Island (SVI) is in the main migration corridor and not an inland water, the pattern across months is also weaker because the sampling has been focused on the spring herring spawn in Barkley Sound (effectively an inland waterway) and has purposefully undersampled passing migrant whales (Brian Gisborne, pers. comm.). The break between May and June is much more apparent for NWA and the other areas in the migration corridor which is consistent with the northbound migration of gray whales proceeding past Washington through May. Resighting rates of whales seen after 1 June remained high through November.

The proposed Makah gray whale hunt in the MUA area (NWA and SJF) may occur in NWA after 30 November and prior to 1 June. A hunt conducted in spring (March-May) potentially could take whales from the PCFG although those chances are less in NWA than in SJF. There have been 181 whale sightings (a unique whale-day) in NWA prior to 1 June of which 40.33% (73) were of whales that were seen in the PCFG after 1 June at sometime. If we restrict the comparison to whales seen in at least 2 years in the PCFG, then the percentage is only reduced to 36.46% (66). If we restrict the area, only 37.02% (67) were of whales that were seen in OR-SVI after 1 June at some time, and 33.15% (60) were of whales that were seen in MUA after 1 June at some time (Figure 5). In comparison, 54 whale sightings were in SJF prior to 1 June of which 70% (39) were of whales that were seen in the PCFG after 1 June at sometime, emphasizing the importance of restricting a hunt to coastal waters of the MUA (i.e., the NWA) to limit the take of whales from the PCFG.

Capture (sighting) histories of whales seen at least once in the PCFG from 1 June - 30 November are provided in Appendix Table 1 which show sightings of whales in 1 Mar -31 May only, 1 June - 30 Nov only and in both time periods within a year.

3.2 Regional Sighting Patterns

There is considerable variation in the annual regional distribution of numbers of whales photographed during the sampling period (Table 6) which is in part due to variation in effort. Although not a true measure of effort, the number of days whales were seen (Table 7) does reflect the amount of effort as well as abundance of whales. In particular, in comparison to other regions, the large number of sightings in SVI partly reflects large numbers of sampling days by Brian Gisborne who has routinely sampled SVI from summer through fall on almost a daily basis. On the other hand, the decline in sightings in SVI during 2007 was not due to reduced effort but to the distribution of whales with many of the whales having moved to waters off Oregon and Washington (Calambokidis et al. 2009b). Similarly, there were 40 survey days in SJF in 2010 but only 4 whales were seen on 4 different days (Table 6, Table 7) so this drop relative to other years was not due to lack of effort.

Whales were sighted across various survey regions and the interchange of whales (Table 8) between survey regions during 1 June - 30 November depends on proximity of the regions (Calambokidis et al. 2004). During 1 June-30 November for 1996 to 2012, 656 unique whales were seen in the PCFG range and 66.8% (438 of the 656 whales seen in the PCFG range) were seen within the smaller OR-SVI region and approximately 34.6% (227 of the 656 whales seen in the PCFG range) were seen within the smaller MUA area; however, there is variation in interchange between areas in the PCFG and the MUA. Of the whales sighted in regions from NCA to NBC, from 35.5% to 58.8% of the whales were seen at some point within MUA (Figure 6). If we exclude transients (whales seen in only one year), the interchange rates with MUA are much higher but the pattern is similar (Figure 7) with a range of 41.3% to 78.9%. Appendix Table 2 provides capture histories using data from 1 June - 30 Nov of whales seen in the MUA at least once. For each year, the table shows whether the whale was sighted in PCFG but not in the MUA during that year, only seen in MUA that year, and seen in both MUA and another PCFG area in that year.

Whales seen in the PCFG exhibited a wide range of movement across and within years. The 118 whales seen in 9 or more years provide a useful example. None of those whales was seen exclusively in a single region, and 68.6% were seen in at least 4 of the 9 survey regions from 1996 to 2012. However, whales did regularly visit the same regions across years with 91.5% were seen in at least one of the regions during six or more of the years they were seen and 67.8% were seen in a region two-thirds or more of the years they were seen. SVI was the region with the maximum number of years seen for 56 of the 118 whales, which in part reflects the larger amount of survey effort in SVI (Calambokidis et al. 2004a, Calambokidis et al. 2013). Thus, some whales regularly visit particular regions more often than others, but they are seen across the other regions as well.

Some of the whales not seen in the PCFG in a year were seen in Kodiak and Southeast Alaska (Table 9). Of the 25 whales identified in Southeast Alaska and the 122 whales identified in Kodiak, Alaska, 14 (56%) and 20 (16.4%), respectively have been seen farther south in the PCFG. For example, whale 130 was only seen in Southeast Alaska in 1999, but had been seen in every other year in the PCFG. Likewise, whale 232 was only seen in Kodiak in 2002, but was seen along Vancouver Island in 2000, 2001, and 2003 but then wasn't seen again until 2011 and may have been somewhere in Alaska waters. Whale 152 was photo-identified in Kodiak in 2002, 2005 and 2010, but was seen in the PCFG as early as 1995 in the Cape Caution, British Columbia, area, and in 1992 in the Clayoquot Sound, British Columbia, survey area but has not been seen in the PCFG after 1 June since 1999, when it was seen along the west coast of Vancouver Island for most of the summer/fall. Another example is Whale 68, which was seen in northern Washington during 1996 and 1997 and then was seen in Southeast Alaska in 1998 and 1999 but not subsequently. While these are only a few examples of whale movements, they illustrate the extensive inter-year movement of whales, which partially explains the gaps in the observations for some whales and the disappearance of others from the PCFG. Whales not seen in a particular year represent a combination of whales that may have spent little time in the PCFG (perhaps primarily staying in some of these neighboring feeding areas) and whales that may have used been missed in the PCFG (coverage of the PCFG is not complete and is concentrated in particular areas and along the coastal zone).

If we look at latitudes of sightings of individual whales across the 17 years using whales that have been sighted on at least 6 different days (Figure 8), we see that sightings of some whales are highly clustered; whereas, sightings of other whales are highly dispersed across several regions. We defined each whales primary range by the 75% inner quantile which is the middle of the range that includes 75% of the locations. The length of the 75% inner quantile in nautical miles exceeded 60 nautical miles (or 1 degree of latitude) for 47.6% of the whales (Figure 9) and it was more than 180 nautical miles for more than 26.5% of the whales. Thus, it makes little sense to compute an estimate of abundance for any region that spans less than a degree of latitude.

3.3 Annual Sighting Patterns

The average number of whales identified in any one year was 146, 95, and 33 for the PCFG, OR-SVI, and MUA, respectively (Table 10). However, those numbers do not represent the total numbers of whales that use each of these areas because not all whales using a region in a year are seen, not all whales return to the same region each year, and not all of the whales return to the PCFG region each year. The annual average number of newly seen whales (excluding 1996-1998 when the photo-id effort expanded to cover all survey regions) was 35.4, 23.8, and 12.1 for PCFG, OR-SVI, and MUA, respectively. The annual average number of newly seen whales that were "recruited" (seen in a subsequent year), excluding 1996-1998 and 2012, was 14.3, 11.8, and 6.1 for PCFG, OR-SVI, MUA respectively. Thus, there were a substantial number of new whales seen each year and 42.1, 50.5, and 53 percent of those were seen again in a subsequent year in the 3 regions respectively. The number of newly seen whales and the number newly seen and recruited (i.e., seen in at least one more year after the initial year it was seen) (Table 11) are displayed as discovery curves in Figures 10 and 11.

Of the whales that were seen during June-November 1996-2012 in the PCFG (NCA to NBC) about half were only seen in one year and the whales that were seen in more years were sighted more often each year and therefore represented a large proportion of the sightings (Figure 12). Of the 603 identified whales first seen before 2012 between 1 June and 30 November in the PCFG range (NCA-NBC), 49% were seen in only one year and only represent about 5% of the sightings (Figure 12). Many of the newly seen whales did not return in subsequent years. Some whales were seen in every year with 7.3% that were seen in every year after their initial identification, including 5 whales first seen in 1996 that were seen in all of 17 subsequent years. The remaining 44% were seen more than once but not in every year.

Likewise, examination of MT in the first sighting year demonstrates that whales who stay longer in their first year were more likely to be seen in a following year (Figure 13). Whales "first" seen in the first few years of the study (1996-1998) includes some whales that were truly new to the PCFG in those years but many were only "new" because it was the first year of the study or as the surveyed regions expanded over time. This is evident (Figure 13) in the much higher proportions for 1996-1998 than for the other years. These relationships will be important in the capture-recapture models for abundance estimation because whales that do not return after their first year (a large percentage in this analysis) would appeared to have not survived because they have permanently emigrated (with a small fraction that died).

3.4 Mothers and calves

In 2011 and 2012, early season effort both prior to 1 June and in the first half of June, identified 18 mothers with calves that had not been seen in any other year and therefore were not known PCFG whales. The vast majority (16, 89%), were seen on only a single day and the only other two were seen on 2 or 3 days. Four of these 18 (including the two seen more than one day) were seen in early June and would qualify as PCFG whales based on the 1 June definition but were likely just late migrating mothers from the overall gray whale population. In 2012 with more intensive effort early in the season and greater attention to mothers with calves, 11 known PCFG mothers with calves were identified, higher than any previous year. This represented 44% of the previously identified PCFG mothers that were seen that year, also representing the highest proportion documented and close to a reasonable reproductive rate for this species.

Through 2012, 45 different PCFG gray whales were seen as definite or probable mothers with 60 calves (Table 12). Despite the many years of study, only 11 whales were seen with calves in multiple years (2 to 4) with only three whales that were sighted with calves in three or more years. One individual (ID#81) was observed with a calf in 2001, 2003, and 2009 and another ID #232 was seen with a calf in 2001, 2003, and 2011. The whale (ID#67) with the most calves included one seen in 1995, 2002, 2004 and 2011. Overall, 3 of the 61 observed calves (Table 12) occurred prior to 1998, leaving 58, about 3.9 per year during our primary study period 1998-2012 . These represent a minimum estimate of the births occurring because: 1) collaborators did not always note the presence or absence of calves, 2) as described below, calves weaned from their mothers, making them unidentifiable as calves, as early as June and July. Both these factors would tend to result in underestimates of the presence of calves. With greater attention to mother and calves in 2012, the number of calves identified of PCFG moms was 12.

The number of mothers seen with calves varied dramatically by year from 0 to 12. In addition to the record numbers of calves seen in 2012 (partly due to a change in effort and focus) there was also a four-year period (2001-2004) which accounted for 27 of the 60 sightings of known mothers with calves indicating there is some real inter-year variation in numbers of calves. During this 4-year period an average of 6.75 calves were seen while an average of 2.7 calves per year was seen in the other 11 years between 1998-2012 . Among the known or suspected mothers seen in 1998 or before, of the years they were seen during 1998-2012, the average proportion they were seen with a calf was 14.8% although it was 21.1% and 27.3% during the peak years of 2001 and 2002, which would be closer to what would be expected if females were getting pregnant almost every other year. In the most recent years of data, the percentages for those females were also higher at 22.2% in 2010, 21.4% in 2011 and 42.9% in 2012. While these years with higher number of calves were likely higher birth years, it is also possible that longer weaning times those years may have contributed to a higher proportion of new calves still with their mothers being documented. Also, recently there has been an increased effort in identification of calves and more sighting effort in the spring.

In 31 cases, a calf was seen associated with its mother early in the season and then the mother or the calf was resighted later in the season separately, suggesting weaning or calf death had occurred. In at least 14 cases separation had occurred prior to a July sighting.

In two cases either the mother or calf was seen separated in June, however, in neither case was the calf resighted in the future year (although the mother was) suggesting these calves may not have survived. If you use the last time mom and calf were sighted together as the separation date, most of the separation dates were in July (32), but 11 were before July and 14 were in August through October. These findings are consistent with weaning most commonly occurring in July.

Of the 45 definite or probable mothers, 32 had been seen four or more years in the study area (13 had been seen only 1, 2, or 3 years). Even those animals with long sighting histories were seen with calves in only a small proportion of the years. However, often the initial sighting of these animals was in late August or later, past the period when weaning may have occurred (Table 12).

While a high proportion of calves were seen in 2012, we also looked at some of the whales first seen in 2012 (after 1 June) that had not been seen as calves associated with mothers to see if they were potentially weaned calves. There were 10 cases where animals first seen in 2012 were resighted five or more times (indicating they were regularly using the area). In four of these case there were comments made in the field that this animal appeared to be a calf or was small and in two additional cases (6 total), the animal appeared to be a younger animal based on photos showing it near another animal. Of first sighting of these 6 animals were in May (1), June (3), and July (2) so spanning the period where weaning occurs. We cannot tell if these might have been calves of PCFG or non-PCFG animals.

Sightings of mothers with calves or known PCFG mothers were in somewhat atypical locations and may suggest some differences in occurrence based on reproductive condition. Four of the mothers identified with calves in 2012 had been seen off Kodiak, AK in 2005 and three of these had not been sighted since they were sighted as mothers in 2012 and the fourth only seen one year in that gap. One mother (ID#281) was regularly sighted in the PCFG area every year from 1999 to 2007. In only one of those years was she with a calf (2002) and in 2008 she was seen on 19 April off Santa Barbara, S California apparently in the migration with a small calf but neither of them were seen that year in any of our effort farther north from Northern California to SE Alaska. Another case not included in our summary because the calf was never seen in the our study area and also there was uncertainty of who was the mother, was an apparent calf (ID 962) sighted off San Miguel Island on 27 July 2006 but which was accompanied by two adults (ID 359 and 718) both of whom were seen in most years from 2002 to 2008 in the Pacific Northwest (N California to SE Alaska), but not in 2006. Both the mothers and calves from these two sightings were not seen in the Pacific Northwest in their birth year (despite the mothers being seen most other years) and were only opportunistically sighted outside the region, suggesting there may be additional calves born to animals that use the Pacific Northwest that perhaps do not come into sampled areas (either within or outside the Pacific Northwest) in their birth year. This would negatively bias estimates of the number of calves born to these animals.

We examined the sighting histories of the identified calves to determine if they tended to be seen in future years. Animals that were not seen in future years could reflect either mortality in the first year of life or animals that did not continue to feed in the Pacific Northwest in future years. Of the 40 calves identified prior to 2011, 60% were resighted in a subsequent year. Using only the 29 calves seen through 2004 (to allow a longer follow up period to resight animals, 19 (65.5%) have been resighted in a later year. In comparison, for non-calves the proportion resighted for those newly seen up through 2004 was lower at 54.9% (230 of 419). Thus, calves appear to be more likely to return to the PCFG than non-calves. The remainder not seen in a following year could be the result of: 1) the calf dying, 2) the calf not returning to the area or not yet resighted during its return, 3) the calf not being recognized by photo-ID since calves can undergo changes in markings rapidly especially if not seen for several years. Given all these factors the resighting rate of calves does suggest a high proportion of surviving calves appear to become part of the feeding aggregation that uses the Pacific Northwest.

3.5 Migratory movements of PCFG whales

A combination of satellite tag and photo-ID data have provided insights into the migratory movements of PCFG whales. Three location-only LIMPET (see Andrews et al. 2008 and Schorr et al. 2009 for details) on gray whales near La Push, WA on 31 May 2012. These tags were deployed as part of a larger study jointly supported by the US Navy and NOAA (though a grant to WDFW)(see Schorr et al. 2013 for details). Tags transmitted for 3–7 days (Table 14, Figure 14) with maximum rate of movement between consecutive points set at 10 kilometers/hour (km/hr) for gray whales. These gray whales were of particular interest because the timing of deployments were still within the migration period but there was a concentration of whales in this area north of La Push that appeared to be feeding. While the duration of the transmissions was fairly short (possibly due to contact with the bottom during feeding), they did confirm these whales were not migrating and almost exclusively stayed in a very localized area consistent with feeding. One whale did shift slightly north to the area off Cape Alava, another known gray whale feeding area, before transmissions ended. All the tagged whales remained very close to shore throughout the transmission period, and in a median water depth of 29 meters (m) (Table 14) which is consistent with the generally shallow feeding depth for gray whales.

Two of the whales that were tagged were known by photo-ID: 1) CRC-813, a known PCFG whale with more than 57 confirmed sightings going back to 2004, and seen every year since in the Pacific Northwest primarily off the northern Washington coast, the Strait of Juan de Fuca and southern Vancouver Island; and 2) CRC-1176 a known individual seen previously in 2009 in spring off south and west Vancouver Island, in January 2011 off northern California and June 2012 off Northern Washington.

Two previous studies have collected data on satellite tagged PCFG whales (Ford et al. 2013, Mate et al. 2010) and both of these combined with photo-ID sighting histories have provided some interesting insights into movements of PCFG whales. Ford et al. (2013) reported on the results of 5 gray whales tagged with LIMPET tags (similar to what we used) in March 2009, 2010, and 2011 during the northward migration off SW Vancouver Island. Durations of these transmissions ranged from 8-16 days and unlike our case these animals consistently continued north migrating up the coast as far as SE Alaska before transmissions ended. Somewhat surprisingly, photo-ID revealed that three of these five were known PCFG whales (CRC 307, 178, and 135 for tags 1, 2, and 3 respectively):

- ID 307 (Tag 1) was only previously known from sightings in June and July 1998 off Vancouver Island. Transmissions from this tag lasted 13 days during which the whale traveled 1,354 km and ended up north of SE Alaska (58.14 N).

- ID 178 (Tag 2) was not identified later in 2010 (the year it was tagged) but had been seen close to 100 times in the PCFG area both in previous years going back to at least 1995 as well as in 2011, the year following when it was tagged. While this tag transmitted the longest of any of the five deployed (16 days), this whale covered the shortest distance (893 km) and ended up only just barely into SE Alaska by the end of transmissions

- ID 135 (tag 3) which was tracked moving north for 8 days after tagging documented as far north as Sitka. Photo-ID documented this animal feeding from June to mid-September later the same year (2010) off S Vancouver Island and this animal was also seen in that same area in 2011 and 2012.

- ID 1380 (tag 4) and ID 1381 (tag 5) have only been identified by photo-ID on the tagging date (20 and 22 March 2011).

Mate et al. (2010) reported on the deployment and movements of 18 PCFG gray whales tagged off N California and S Oregon from September to December 2009. All 18 of these were previously identified PCFG whales and most have resighted in subsequent years although there is one known to have died and three others that have not been seen for 2 or more years (Table 15). There were some interesting relationships between the satellite tag data and photo-ID results:

- Tag 5200827 (ID 659) which was documented to migrate from south to the breeding grounds but spent 9 days of San Miguel Island, S California on route south and stopped there briefly on return, had also been documented feeding off San Miguel Island on 27 July 2006, a year it was not seen at all in the normal PCFG regions suggesting it may have spent the entire summer south of our normal coverage area.

- Tag 5205938 (ID 32) was documented by Mate et al. (2010) to migrate north in spring 2010 to Icy Bay, Alaska after having been tagged off N California in December 2009 and migrating down to Baja. While this whale had been photo-identified almost 50 times in the years prior to having been tagged, most of these are from two years (1999 and 2002) and it was not seen in most other years. Almost all sightings of this animals were from north of Vancouver Island, the northern end of the area regularly sampled by photo-ID. These together suggest this is an animal that has maintained a somewhat regular use of feeding areas north of the normally sampled PCFG area.

In several additional recent cases PCFG whales have been documented during their migration north while on transit in S California. Cascadia receives identification photographs from whale watch operators in the southern California Bight during each spring during the northbound migration. Starting in 2013, identification photographs of gray whales were quickly reviewed by one of matchers familiar with PCFG whales and if the whale was recognized as a potential PCFG whale it was compared to our catalog. While this process is underway initial efforts yielded several surprising matches. On 16 Feb 2013, three PCFG whales were identified in a group of what appeared to be 4 gray whales that were seen off

Santa Barbara by naturalists aboard the whale watch boat Condor Express. There were three sightings of this same apparent group at 10:50, 14:15, and 15:20. In two of those sightings four animals were reported in the sightings and 4 animals were identified with three of them being known PCFG whales (ID 303, 561, and 878) with a 4th unknown whale (in one sighting only two whales were reported and they were 878 and the same unknown whale). These animals were consistently moving west at a consistent speed of about 3 knots. These were the only sightings that day during the two different whale watch trips. It is highly improbable in the overall migration for three PCFG whales to be migrating together in a group of four whales and suggests either some social association or close synchrony in timing of PCFG whales in the migration. Two other PCFG whales (254 and 227) were also identified during the migration north on 21 and 24 February but were not associated with each other. This effort to identify PCFG whales on the migration will continue and should better identify some of the timing and associations of these animals.

3.6 Open Population Capture-Recapture Models

If the yearly cohorts were pooled, Test2+Test3 statistics indicated a significant lack of fit for the PCFG and subsets (Table 16) primarily resulting from Test 3. This was expected due to the different "survival" rates of previously seen whales (true survival) and newly seen whales of which many never returned (i.e., permanently emigrated) (Table 17) . By separating the cohorts, survival for each cohort was time-varying and thus each cohort has a separate first year survival. The goodness of fit test (Test 2) demonstrated a lack of fit for NCA-NBC and OR-SVI (Table 16). For those regions, we estimated an over-dispersion values of $\widehat{c}$=2.25 and $\widehat{c}$=1.4 respectively to adjust AICc and estimated standard errors.

For MUA and NCA-NBC, the best fitted model (Table 18) was model 2 for p with capture probability varying across years and higher when MT was greater in the previous year. For OR-SVI, the simpler model 3 with no year variation in capture probabilty was the best model and in turn it selected a more complex survival model. For φ the best model was model 3 or 4 for MUA, model 6 for OR-SVI and model 4 for NCA-NBC. Both models 4 and 6 included a separate first year survival which depends on MT. There was not much support for the calf covariate for higher first-year "survival" probably because the sample size of calves was small relative to non-calves and because much of the effect would have been absorbed by MT. In models 3 and 4, there are 3 intercepts for first year survival (1996&97, 1998, >1998) and in model 6 the intercept differs for each year. These results were consistent with Calambokidis et al. (2004) who demonstrated strong support for the effect of MT on first year survival (Figure 15) and capture probability (Figure 17) in the following year. These results differ some from Calambokidis et al. (2010) who used an annual median-centered MT. Use of MT with median centering was necessary to construct open model abundance estimates in the manner described in Calambokidis et al. (2010). However, that was not necessary for JS1 and the use of MT without median-centering resulted in lower AICc values.

There was large year to year variation in capture probability. The values for NCA-NBC ranged from 0.42 to 0.98 depending on the year and value of MT (Figure 17). The lowest values were from 2007 which reflects the temporary emigration of whales from MUA and SVI to waters offshore of Oregon in that year. In contrast, for MUA capture probabilities were much lower ranging from 0.09 to 0.86 depending on the year and value of MT (Figure 18). The lower overall capture probability and weaker relationship between capture probability and MT reflect the transitory behavior of whales in such a small area. The lower estimates of of capture probability in 1999-2004 for MUA was due to decreased effort by NMML which spread their survey effort across MUA to WVI during 1999-2002, lost a vessel in 2002 and had no funding in 2004 (Figure 18).

First year survival estimates were dominated by permanent emigration. For NCA-NBC, the estimates varied from 0.32 to 0.82 for non-calf whales with MT=1 in their first year and from 0.75 to 0.93 for MT>80 in their first year (Figure 15). Calf survival is by definition a first year survival rate and potentially includes permanent emigration from the PCFG. Depending on the value of MT, calf survival estimates ranged from about 0.35 to 0.90 (Figure 16). The average calf survival estimate was 0.54 (se = 0.047). There was little support for a different first year calf survival (ϕ models 7-10 in Table 18) possibly because true calf survival with a potentially lower permanent emigration rate happened to be close to first-year survival of non-calves with a higher permanent emigration rate. Unfortunately there is no way to separate these with the existing data.

Survival subsequent to the first year was assumed to be constant but was less for non-calf whales that were newly seen in 1999 or later. Post-first-year suvival for calves and whales present in 1998 or earlier presumably represents true survival assuming there was little permanent emigration after the first year. Those estimates were 0.969 (se=0.0075) and 0.963 (se=0.0079) for OR-SVI and NCA-NBC respectively. The post-first-year survival estimates for whales that entered in 1999 or later and not identified as a calf were 0.906 (se=0.0159) and 0.905 (se=0.0177) for OR-SVI and NCA-NBC respectively.

3.7 Abundance and Recruitment

For NCA-NBC, OR-SVI and MUA annual estimates of abundance were constructed with model averaged values for JS1 (Table 19-20). Estimates for NCA-NBC in Figure 19 are only shown for 1998-2012 with the open models $p = 1$ for 1996 so it will certainly be an underestimate and the survey coverage in 1996 and 1997 was not as extensive as the later years.

The value of N_{min} for 2012 is 197 for NCA-NBC (Table 19). To gain a sense for how these values might be relevant to estimating a possible level of removal (e.g., due to harvest) we computed the MMPA's Potential Biological Removal (PBR) (typically reserved for stock-level assessments). Using the PBR formula, with an Rmax of 6.2% and a recovery factor of 0.5 (Caretta et al. 2013), the PBR for NCA-NBC (PCFG) would be 3.1.

New whales that are not identified as calves have appeared annually and many of these new (non-calf) whales have subsequently returned and been re-sighted (Table 17). In NCA-NBC from 1999-2011, an average of 31.1 (range: 8.0, 69.0) new whales not identified as a calf were seen each year. Of these new non-calf whales, on average 12.5 (range: 1.0, 28.0) whales returned and were seen in subsequent years. It is unknown what proportion of the non-calves used the PCFG as a calf but were not seen in that year. Currently recruitment appears to be offset by losses (either mortality or permanent emigration) as the abundance estimates have been fairly stable since 2002.

4 Discussion

The population structure of gray whales using the Pacific Northwest in summer and fall is complicated and involves two elements. One group of whales return frequently and account for the majority of the sightings in the Pacific Northwest during summer and fall. This group is certainly not homogeneous and even within this group, there is some degree of preference for certain subareas. Despite widespread movement and interchange among areas, some of these gray whales are more likely to be seen returning to the same areas they were seen before. The second group of whales are transients that are seen in only one year, tend to be seen for shorter periods that year, and in more limited areas.

The existence of these two groups in the study area and their dynamics complicate estimating abundance. While the JS1 estimator may not be optimal, it provides a practical way of handling transients in this open population. Excluding 1996-1997, the JS1 sequence of abundance estimates provides the most reliable assessment of trend for the non-transient abundance and the best estimate of current abundance in 2012.

Despite extensive interchange among subregions in our study area, whales do not move randomly among areas. Abundance estimates were lower when using more limited geographic ranges but these more limited areas do not reflect closed populations. While the use of geographically stratified models can be useful in cases where populations have geographic strata they use (see for example Hilborn 1990), this would be difficult in our case because of the frequent sightings of animals in multiple regions within the same season and these models typically only allow an animal to be sighted in one strata per period. This could be dealt with by assigning animals to only a single region per season but this would be forcing the data into a somewhat inaccurate construct.

Several studies have considered the question of gray whale population structure. There is widespread agreement that at least two populations of gray whales in the North Pacific exist, a western North Pacific population (also called the Korean population) and an eastern North Pacific (ENP) population (sometimes called the California population) (Swartz et al. 2006; Angliss and Outlaw 2008; Rugh et al. 1999). The population structure of the gray whales feeding in the Pacific Northwest has remained in question and only a few studies have examined this. Steeves et al. (2001) did not find mtDNA differences in a preliminary comparison of gray whales from the summer off Vancouver Island and those from the larger ENP population. Ramakrishnan et al. (2001) did not find evidence that the Pacific Northwest whales represented a maternal genetic isolate, although even very low levels of recruitment from the larger overall population would prevent genetic drift. More recently, Frasier et al. (2011) generated mtDNA sequences from a larger sample of gray whales from Vancouver Island than tested by Steeves et al. (2001). They found significant differences in the haplotype frequencies between that sample and mtDNA sequence data reported for ENP gray whales, most of which were animals that stranded along the migratory route. The Frasier et al. (2011) samples were from a relatively small area; however, Lang et al. (2011) evaluated biopsy samples from California to southern Vancouver Island in the PCFG and ENP samples from whales sampled north of the Aleutians and also found significant mtDNA halpotype frequency differences. These two studies provide the strongest evidence to date that the Pacific Northwest whales might be sufficiently isolated to allow maternally inherited mtDNA to differ from the overall ENP population.

Population structure in other large whales has been the subject of recent inquiry and has revealed diverse results for different species. Clapham et al. (2008) examined 11 subpopulations of whales subjected to whaling that were extirpated possibly due to the loss of the cultural memory of that habitat and concluded subpopulations often exist on a smaller spatial scale than had been recognized. Studies of other baleen whales, particularly humpback whales, have shown evidence of maternally directed site fidelity to specific feeding grounds based on photographic identification studies (Calambokidis et al. 1996, 2001, 2008). This high degree of fidelity to specific feeding areas is often discernible genetically. In the North Pacific strong mtDNA differences were found among feeding areas even when there was evidence of low level of interchange from photo-ID (Baker et al. 2008). Similar findings were documented for humpback whales in the North Atlantic which feed in different areas but interbreed primarily on a single breeding ground (Palsboll et al. 1995) like ENP gray whales. In the North Pacific the differences for humpback whales were often dramatic. For example, humpback whales that feed off California have almost no overlap in mtDNA haplotypes with humpback whales feeding in Southeast Alaska (Baker et al. 1990, 1998, 2008). One difference between humpback and gray whales is the coastal migration route of gray whales which means gray whales going to arctic waters to feed would migrate right through the feeding areas to the south. Other species of large whales have not shown as strong site fidelity to specific feeding grounds. Blue whales have undergone an apparent shift in their feeding distribution in the North Pacific apparently due to shifting oceanographic conditions (Calambokidis et al. 2009a). Fin whales in the North Pacific have long migrations and while there do not appear to be multiple distinct feeding areas as was the case for humpback whales, there were some distinct and isolated apparently non-migratory populations (Mizroch et al. 2009; Berube et al. 2004).

Even though the population structure of gray whales off the Pacific Northwest remains unresolved, there is a consistent group of animals that use this area and we provide several estimates of their abundance. Different abundance methods and geographic scopes yield varied results but all suggest the annual abundance of animals using the Pacific Northwest for feeding through the summer is at most a couple hundred animals depending on the estimating method and how broadly the region is defined geographically.

The rapid increase in the abundance estimates at the start of this study is in part due to the smaller area of coverage during 1996 and 1997. We included those years to improve the estimate in 1998-1999 and the estimate for 1998 did increase by 7% from previous analysis. The increase from 1998-2000 occurred during a period the overall eastern North Pacific gray whale population was experiencing a high mortality event that included unusually high numbers of gray whales showing up in areas they were not common. The high rate of increase in the late 1990s and early 2000s should be verified with additional data such as compiling photographic identifications for this area from multiple sources to attempt to verify if the abundance of animals prior to the start of our study was as low as suggested by these trends. Even though the rate of increase may be too high, we believe the abundance did increase and now appears to be relatively stable since 2002.

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Table 1: Contributions of numbers of sightings (one or more photographs of a whale per day) by reseach group for 1996-2012 and resulting number of uniquely identified whales. Totals for whales are unique whales across all research groups.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Whales
Brian Gisborne	0	4	342	304	633	504	363	786	288	393	407	100	483	297	556	541	521	399
Canada Fisheries/Oceans	0	0	0	0	0	0	0	0	0	0	0	0	0	1	14	9	0	23
Carrie Newell	0	0	0	0	0	0	0	0	0	0	12	71	0	18	2	0	135	68
CERF	13	260	101	124	203	346	271	125	761	11	33	11	38	4	7	40	26	134
CRC	54	36	126	179	91	60	89	85	136	31	61	92	68	58	50	56	82	449
Dawn Goley-HSU	0	0	21	74	56	60	63	0	0	0	0	0	42	19	50	229	228	288
Jan Straley-UASE	0	0	0	0	0	0	0	7	0	0	1	1	0	0	0	0	0	7
Jeff Jacobsen-HSU	0	0	0	0	0	0	0	0	0	0	0	1	0	5	127	323	121	216
Jim Darling	18	0	48	0	0	34	13	0	0	0	0	0	0	0	0	23	0	80
MAKAH	0	0	0	0	0	0	0	0	30	44	131	62	250	102	45	67	145	193
MAKAH-NMML	0	0	0	0	0	0	0	0	0	0	0	0	0	71	24	45	117	111
NMML	34	109	125	160	115	115	71	63	0	100	45	37	62	25	6	11	19	350
North Slope Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Opportunistic	12	3	8	14	1	1	0	0	0	1	27	46	66	65	44	157	12	163
OSU	0	0	0	0	0	0	0	0	0	0	0	0	0	213	68	0	81	112
UAF	0	0	0	0	0	0	0	0	0	0	0	0	24	0	21	0	4	44
UVIC	0	0	308	125	128	0	113	0	0	0	0	1	0	16	0	32	21	154
Volker Deecke	0	0	39	40	26	3	0	0	0	0	12	0	0	0	0	0	0	74
Wendy Szaniszlo	0	0	0	0	0	0	0	0	0	87	49	59	117	4	23	96	136	123
Photo Totals	131	412	1118	1020	1253	1123	983	1066	1215	667	778	481	1150	898	1037	1629	1648	
Whale Totals	70	77	158	248	176	196	252	178	194	205	184	159	225	244	234	282	329	1303

Table 2: Regional distribution of numbers of sightings (one or more photographs of a whale per day) and resulting number of uniquely identified whales by reseach group for 1996-2012. Totals for whales are unique whales across all research groups. NPS is northern Puget Sound and PS includes southern Puget Sound, San Juan Islands, Hood Canal and Boundary Bay.

	CA	NCA	SOR	OR	GH+	NWA	SJF	PS	NPS	SVI	WVI	NBC	SEAK	KAK
Brian Gisborne	0	0	0	0	0	0	0	1	0	6372	147	2	0	0
Canada Fisheries/Oceans	0	0	0	0	0	0	0	0	0	19	5	0	0	0
Carrie Newell	0	0	0	238	0	0	0	0	0	0	0	0	0	0
CERF	0	0	0	0	0	0	0	0	0	0	48	2326	0	0
CRC	23	97	117	100	240	110	39	68	412	38	0	96	14	0
Dawn Goley-HSU	0	801	5	36	0	0	0	0	0	0	0	0	0	0
Jan Straley-UASE	0	0	0	0	0	0	0	0	0	0	0	0	9	0
Jeff Jacobsen-HSU	8	532	31	6	0	0	0	0	0	0	0	0	0	0
Jim Darling	0	0	0	0	0	0	0	0	0	9	127	0	0	0
MAKAH	0	0	0	19	0	374	483	0	0	0	0	0	0	0
MAKAH-NMML	0	0	0	0	0	202	54	0	0	0	1	0	0	0
NMML	0	10	50	0	0	277	278	0	18	181	146	10	0	127
North Slope Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Opportunistic	38	2	4	39	0	0	22	34	89	205	3	12	7	0
OSU	0	292	3	67	0	0	0	0	0	0	0	0	0	0
UAF	0	0	0	0	0	0	0	0	0	0	0	0	0	49
UVIC	0	0	0	0	0	0	0	0	0	1	743	0	0	0
Volker Deecke	0	0	0	0	0	0	0	1	0	73	0	42	4	0
Wendy Szaniszlo	0	0	0	0	0	0	0	0	0	395	176	0	0	0
Photo Totals	69	1734	210	505	240	963	876	104	519	7293	1396	2488	34	176
Whale Totals	55	406	92	134	132	295	156	43	49	412	231	125	25	124

Table 3: Survey regions and region subsets used for abundance estimation. Numbers refer to locations on the map in Figure 1.

Survey Region	Region Description	NCA-NBC	OR-SVI	MUA
(1) SCA = Southern California				
(2) CCA = Central California				
(3) NCA = Northern California	Eureka to Oregon border; mostly from Patricks Pt. and Pt. St George	x		
(4) SOR = Southern Oregon		x	x	
(5) OR = Oregon Coast	Primarily central coast near Depoe Bay and Newport, OR	x	x	
(6) GH+ = Gray's Harbor	Waters inside Grays Harbor and coastal waters along the S Washington coast	x	x	
(7) NWA = Northern Washington	Northern outer coast waters with most effort from Cape Alava (Sea Lion Rock) to Cape Flattery	x	x	x
(8) SJF = Strait of Juan de Fuca	US waters east of Cape Flattery extending to Admiralty Inlet (entrance to Puget Sound) with most effort ending at Sekiu Point	x	x	x
(9) NPS = Northern Puget Sound	Inside waters and embayments from Edmonds to the Canadian border			
(10) PS = Puget Sound	Central and southern Puget Sound (S of Edmonds), including Hood Canal, Boundary Bay, and the San Juan Islands			
(11) SVI = Southern Vancouver Island	Canadian waters of the Strait of Juan de Fuca along Vancouver Island from Victoria to Barkley Sound, along West Coast Trail	x	x	
(12) WVI = West Vancouver Island		x		
(13) NBC = Northern British Columbia	British Columbia waters north of Vancouver Island, with principal effort around Cape Caution	x		
(14) SEAK = Southeast Alaska	Waters of southeastern Alaska with the only effort in the vicinity of Sitka			
(15) KAK = Kodiak, Alaska				

Table 4: Model specifications for survival (φ) and capture probability (p) parameters in POPAN models for gray whale photo-identification data. For survival models, β_0 is the baseline intercept for non-transient survival. Fy is 1 if it is year the whale was first seen and 0 otherwise. A subscript for Fy means that it applies only for that cohort except that Fy_{99}applies to cohorts 1999 and beyond and Fy_c represents each of the cohorts from 1996 to 2012. C is 1 if identified as a calf in its first year and 0 otherwise. R is 1 for calves or any whale seen in 1998 or was already in the catalog prior to 1998 and 0 otherwise. β_r is an adjustment to post-first-year survival. MT is minimum tenure value of a whale and β_M is the estimated slope parameter for φ or p. $\beta_{M,96-97}$ applies to 1996-97, $\beta_{M,98}$ to 1998 and $\beta_{M,99}$ applies to 1999-2011. $\beta_{Fy,96-97}$, $\beta_{Fy,98}$ and $\beta_{Fy,99}$ are the first-year survival intercept adjustments for 1996-97, 1998 and cohorts 1999-2011 respectively and $\beta_{Fy,c}$ represents 16 cohort-specific first year survival parameters for 1996-2011. β_{CF} is an adjustment for calf first year survival and β_{CM} is an adjustment for calves to the slope of MT for survival. For the capture probability models, β_t has 15 levels for t=1998,...2012 and β_0 represents the 1997 value. For 1996 p=1.

Model	Parameter Logit Formula	Number of parameters
φ		
1	$\beta_0 + \beta_{Fy} Fy + \beta_r R(1 - Fy)$	3
2	$\beta_0 + \beta_{Fy} Fy + \beta_M MT\, Fy + \beta_r R(1 - Fy)$	4
3	$\beta_0 + \beta_{Fy,96-97} Fy_{96-97} + \beta_{Fy,98} Fy_{98} + \beta_{Fy,99} Fy_{99} + \beta R(1 - Fy)$	5
4	$\beta_0 + \beta_{Fy,96-97} Fy_{96-97} + \beta_{Fy,98} Fy_{98} + \beta_{Fy,99} Fy_{99} + \beta_M MT\, Fy + \beta_r R(1 - Fy)$	6
5	$\beta_0 + (\beta_{Fy,96-97} + \beta_{M,96-97} MT) Fy_{96-97} + (\beta_{Fy,98} + \beta_{M,98} MT) Fy_{98} + (\beta_{Fy,99} + \beta_{M,99} MT) Fy_{99} + \beta_r R(1 - Fy)$	8
6	$\beta_0 + \beta_{Fy,c} Fy_c + \beta_M MT\, Fy + \beta_r R(1 - Fy)$	18
7	$\beta_0 + \beta_{Fy,c} Fy_c + \beta_M MT\, Fy + \beta_{CF} C\, F_y + \beta_r R(1 - Fy)$	19
8	$\beta_0 + \beta_{Fy,c} Fy_c + \beta_M MT\, Fy + \beta_{CF} C\, F_y + \beta_{CM} C\, MT + \beta_r R(1 - Fy)$	20
9	$\beta_0 + (\beta_{Fy,96-97} + \beta_{M,96-97} MT) Fy_{96-97} + (\beta_{Fy,98} + \beta_{M,98} MT) Fy_{98} + (\beta_{Fy,99} + \beta_{M,99} MT) Fy_{99} + \beta_{CF} C\, F_y + \beta_r R(1 - Fy)$	9
10	$\beta_0 + (\beta_{Fy,96-97} + \beta_{M,96-97} MT) Fy_{96-97} + (\beta_{Fy,98} + \beta_{M,98} MT) Fy_{98} + (\beta_{Fy,99} + \beta_{M,99} MT) Fy_{99} + \beta_{CF} C\, F_y + \beta_{CM} C\, MT + \beta_r R(1 - Fy)$	10
p		
1	$\beta_0 + \beta_t$	15
2	$\beta_0 + \beta_t + \beta_M MT$	16
3	$\beta_0 + \beta_M MT$	2

Table 5: Regional distribution of numbers of whales seen by month for 1996-2012.

	1	2	3	4	5	6	7	8	9	10	11	12
CA	0	2	5	8	5	2	6	7	13	1	0	9
NCA	118	18	1	43	42	103	131	57	42	90	93	84
SOR	0	3	0	2	3	1	24	28	55	32	0	0
OR	0	0	0	0	13	16	46	62	65	54	2	0
GH+	5	2	17	56	29	17	3	0	27	1	0	0
NWA	4	5	10	50	103	54	68	85	81	60	7	1
SJF	0	0	3	11	23	32	39	45	67	83	61	11
PS-HC-BB-SJ	0	1	6	21	8	10	5	2	1	1	3	1
NPS	1	2	17	28	30	11	1	0	0	0	0	0
SVI	5	6	72	87	101	195	224	172	140	56	14	6
WVI	0	1	9	5	2	50	148	146	97	19	0	0
NBC	1	0	0	0	2	26	84	108	83	0	0	1
SEAK	0	0	0	0	0	17	4	1	3	0	5	0
KAK	0	0	0	0	2	19	23	52	44	0	0	0

Table 6: Regional distribution of numbers of whales seen during June-November for 1996-2012.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CA	0	0	0	1	0	5	0	0	4	0	3	0	0	3	7	1	7
NCA	0	0	15	38	27	32	37	15	3	0	0	1	47	64	62	82	95
SOR	0	0	0	0	0	2	46	24	13	1	0	23	15	2	15	10	11
OR	0	0	17	31	8	15	0	0	16	4	9	38	6	38	18	7	42
GH+	1	0	0	1	1	1	0	0	1	0	0	38	0	2	0	0	0
NWA	13	15	22	7	9	31	7	19	0	19	44	12	35	30	22	36	62
SJF	9	22	18	4	5	2	1	9	21	17	21	14	54	37	4	11	11
PS-HC-BB-SJ	0	0	3	8	4	0	0	0	0	1	0	0	0	4	0	0	1
NPS	0	0	0	0	10	0	0	0	0	0	0	0	0	1	2	0	0
SVI	13	17	60	45	52	101	66	90	86	91	69	37	78	75	62	62	73
WVI	8	0	57	66	53	29	85	9	0	52	40	13	23	23	9	53	28
NBC	13	33	23	26	23	40	43	51	90	12	21	5	21	3	4	2	15
SEAK	0	0	5	6	0	1	0	6	0	1	2	3	0	5	0	0	0
KAK	0	0	0	0	0	0	42	4	0	48	0	0	23	0	17	0	2

Table 7: Number of days in which whales were seen for each region and year from 1996-2012 from 1 June - 30 November.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CA	0	0	0	1	0	2	0	0	2	0	1	0	0	2	4	1	2
NCA	0	0	7	8	20	13	20	2	2	0	0	2	9	19	21	31	28
SOR	0	0	0	0	0	1	4	1	1	1	0	3	1	1	7	6	3
OR	0	0	6	9	5	7	0	0	1	1	7	38	1	21	4	11	67
GH+	1	0	0	1	1	1	0	0	1	0	0	3	0	1	0	0	0
NWA	9	12	22	10	7	11	3	9	0	12	13	6	8	7	14	23	20
SJF	9	42	16	9	9	4	2	15	5	13	18	26	36	30	4	12	17
PS-HC-BB-SJ	0	0	3	11	4	0	0	0	0	2	0	0	0	4	0	0	1
NPS	0	0	0	0	1	0	0	0	0	0	0	0	0	2	3	0	0
SVI	9	10	91	87	82	55	68	66	48	73	59	39	82	71	80	106	75
WVI	10	0	54	46	28	7	10	3	0	6	14	27	31	5	1	22	7
NBC	7	53	39	50	53	43	34	29	53	11	16	9	13	2	8	1	3
SEAK	0	0	2	3	0	1	0	3	0	1	2	2	0	2	0	0	0
KAK	0	0	0	0	0	0	4	2	0	7	0	0	5	0	2	0	1

Table 8: Interchange of whales across regions for all years (1996-2012) for June-November. The diagonal is the number of unique whales seen in that region over the 17 year time span. Many of those whales were only seen once. Here PS includes NPS and CA represents SCA and CCA.

	CA	NCA	SOR	OR	GH+	NWA	SJF	PS	SVI	WVI	NBC	SEAK	KAK
CA	27												
NCA	8	259											
SOR	4	55	84										
OR	4	77	58	131									
GH+	1	18	9	20	43								
NWA	5	64	45	72	26	168							
SJF	3	31	18	35	16	79	138						
PS	0	0	0	0	0	1	1	31					
SVI	9	74	43	76	30	122	93	1	287				
WVI	3	57	35	64	26	94	73	1	160	220			
NBC	2	17	10	30	14	34	31	2	77	76	121		
SEAK	0	2	1	3	2	4	7	0	9	10	12	25	
KAK	1	7	1	4	0	1	0	1	11	8	8	1	122

Table 9: Sighting histories of whales seen in the PCFG during 1 June - 30 November in at least one year and also in Southeast Alaska (SEAK) or Kodiak (KAK) in one year. 1: whale sighted in PCFG but not SEAK or KAK that year, 2: only seen in SEAK or KAK that year, and 3: seen in both PCFG and in SEAK and KAK in that year.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
68	1	1	2	2													
126		1	1			1			1	2			1				1
130		1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1
140		1	1	3	1	1	1	1	1		1		1	1	1	1	1
141		1	1	1		1	1	1	1	1	1	3	1	1			1
152		1		1			2			2					2		
229		1	1	1	1	1	1	1	1	1	2						
323		1	1				1	1	1	2	1		2				
328		1	1	1	1	1	1	1	1	1	1		1	3		1	1
899		1							1	2							
227			1	2	1	1	1	1	1	1	1	1		1		1	1
232			1		1	1	2	1								1	
261			2				1		1							1	
316			1					2		2							
628				2	1	1	1	1	1				1				
538					1	1	1		1	2							
555					1		1	1			1		2	1	1	1	1
566					1		2		1	2					1		
601					1	1		1	1	1	1						2
612					1	1	1	3	1	1	2						1
581						1		1	1	2	1	1					2
604						1		1		2					2	1	
639						1	2					1		1			
684							1	2				1					
687							1				1	1	1	3	1		
691							1	3	1	2			1				
760							1	1	1	3							1
800								3	1	1							
815									1				2				
836									1	3							
900									1					2			1
834										2				1			
893										2							1
918										2							1

Table 10: Number of unique whales seen by year for MUA, OR-SVI, and PCFG (NCA-NBC) during 1996-2012.

Region	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average
MUA	19	27	37	11	14	32	8	22	21	33	58	20	75	57	26	41	67	33
OR-SVI	30	36	86	71	67	128	103	110	114	109	98	114	123	118	92	91	127	95
PCFG	45	69	132	152	137	173	204	157	178	138	128	120	174	154	144	164	208	146

Table 11: Discovery of new unique whales over years 1996-2012 for PCFG,OR-SVI and MUA. Recruited only means that the whale was seen in at least one more year after the initial year it was seen. The number 'recruited' will be less than the abundance estimate because some whales die and others may permanently emigrate and do not return.

Region	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
PCFG	45	90	161	230	281	343	396	416	447	468	476	496	546	569	584	603	656
ORSVI	30	50	105	128	152	208	247	273	302	321	332	354	376	393	401	410	438
MUA	19	34	57	58	69	88	89	100	112	123	146	148	177	190	194	205	227
PCFG-recruited	40	76	123	136	164	190	220	235	249	260	261	268	286	292	304	309	
ORSVI-recruited	26	39	76	85	100	122	150	170	184	195	198	205	216	220	227	230	
MUA-recruited	17	28	34	34	42	49	50	56	65	70	87	89	105	107	109	113	

Table 12: History of mothers seen with calves during study. Each year a whale was seen, the first conrmed sighting date is shown for that year. Years where a calf was documented are shown with an asterisk. Total years seen includes 16 sightings of whales during 1984, 1988, 1990-1993 that are not shown but no calves were seen in those few cases. For one of the calves a mother was not identified.

ID	Calves	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Years seen
43	2	07-09*	07-22	07-15	08-09	07-11	07-16	06-19	07-18*	07-12	06-24	07-04									15
65	1		05-03																	06-23*	3
67	4		07-19*	07-02	07-06		08-10			08-07*		06-04*	08-03	05-04					06-23*	07-07	11
80	2	08-25	06-23	08-08		06-08	06-27	07-03	05-07	05-22*	04-27	06-25	06-18*								12
81	3		08-19		09-23	06-14	06-21	07-29	06-20*	06-24	07-28*	07-23	07-03	07-04	06-16		07-16*		02-10		15
91	1			07-02	07-28	06-23		07-22	08-15	07-05*	06-17		06-23		07-11	06-18			08-21		12
92	2			07-27	08-09	05-04	06-30	07-29	07-09	08-04	07-27	07-11	06-27*	06-18	06-08	05-22	04-04	06-05*	03-23	03-31	18
93	1			07-17	09-23	06-14	06-22	08-12	06-21	07-16	08-02	06-30*		07-04		06-18	06-08		06-17	07-18	16
94	1	08-04				06-27	07-06	07-24	07-07	07-15	07-23	08-05	07-13	03-18	07-08*	07-08	06-02	03-31	06-22	07-21	17
101	1	06-22	09-06	09-05		06-11	07-08	07-29	06-08	07-09	08-09	06-15*	08-01	06-07	06-08	06-28	04-24	06-15	05-18	06-20	21
105	1	07-09*				06-17	06-09	07-20	06-22	07-03	08-02	07-23	07-24	07-28	06-22						11
120	1								06-13*	06-11		06-02						07-06			4
126	1	07-25			07-27	07-08			07-12			08-31	08-31			08-27				06-25*	8
143	1			03-21	09-13	06-27	04-20	05-01	07-06	07-29*	08-17		09-05	03-12	03-24	06-22	08-14	03-10	09-10	03-31	16
144	2		08-25			07-11	08-13	09-06	07-06	07-05*	03-30	06-19	05-26	07-04	03-30	05-25	04-04	03-26	05-01*	03-31	16
175	1		07-22	06-13	06-27	05-26	06-09	05-29	06-15	07-03	05-12*	06-30	07-21	07-04	07-15						13
193	1	06-22		10-06	04-12	07-02				07-05	07-27	06-02	07-20	06-28		06-07	06-08		02-24	06-28*	13
196	1			05-09				08-17		07-17	06-17		05-27	06-28	07-07	05-24	03-12	01-27	06-22	06-02*	12
216	1				06-27	08-23	07-30	06-29	06-15	07-15	07-26*	06-04	06-09								9
232	3					07-06		07-30	07-05*	08-15	06-09*								05-20*	04-06	7
237	1			06-28	06-30	07-23	07-25	07-04	07-05	07-01	04-29*	07-19									9
281	2						07-20	07-15	06-21	08-17*	09-05	07-19	08-13	07-07	09-14	04-19*	08-14				12
291	1					10-01	07-12	08-24	06-08*	08-04	06-25	07-24	07-21	07-05		10-20	09-02	08-06	01-05	06-24	14
312	2					06-12*			07-07									06-22*			3
321	1			06-26	07-09	06-25*															3
324	1		08-15		08-12	07-07	06-29	03-21		07-18	07-15	07-17	06-15			08-16		09-15	08-19	05-07*	13
330	1				07-28	07-23				07-17		09-15					04-30			06-22*	6
364	1						10-12	08-09		08-17			07-11		08-19		06-17	01-27	01-10	01-08*	9
372	1						06-26	05-09		08-04	07-15	06-25*	07-07	07-03	09-01		07-10	08-05	06-16	07-09	12
566	1							07-06		08-17		08-14	09-02					06-22*	02-10		6
581	2								06-05*		07-07	08-02	05-03*	07-04	06-30					06-19	7
596	1								06-26*	07-03											2
612	1							06-23	08-01*	07-01	06-05	07-01	07-18	11-05						06-27	8
668	1									09-06		09-22			08-19			05-09*		07-05	5
683	1									07-25*		10-27	06-18								3
684	1									07-04*	08-11				06-13						3
717	2									07-03*										07-02*	2
760	1									08-05	07-03	07-10	06-14							05-07*	5
815	1											06-19*				07-14					2
893	1												09-04							06-05*	2
918	1												09-02							06-28*	2
973	1														09-14*			08-06			2
993	1													05-01	08-03*			08-06	06-02		4
1111	1																	09-12	06-10*	06-27	3
1426	1																			06-28*	1
Calves	60	2	1	0	0	2	0	0	8	9	5	5	3	0	3	1	1	4	4	12	

Table 13: Sighting histories of calves identified in the study area. First separate date represents sighting of either the calf or mother alone. An asterisk by the calf ID implies it is suspected to be a calf; others are all known to be calves.

CalfID	MomID	FirstDate	LastDate	CalfAloneDate	1994	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Years seen
104	105	9-Jul-94	9-Jul-94		1																		1
107	43	9-Jul-94	4-Aug-94		2	1	2	7		34	10	1	15	11	9	10	3	13	5	22	26	24	17
169*	67	19-Jul-95	23-Jul-95			4					3	5	10	5	3	6	2	5	4	1	2	9	13
246*		11-Aug-98	17-Aug-98					3															1
307	312	28-Jun-98	9-Jul-98					2															1
310	321	25-Jun-98	4-Jul-98	6-Jul-98				3	1														2
583	581	5-Jun-01	2-Jul-01	4-Oct-01							5	1	6		5	2	9	12	24	2	7	1	11
584	81	20-Jun-01	18-Jul-01	22-Jul-01							3	1		27	3	4	2						6
595	596	26-Jun-01	29-Jun-01								3												1
611	43	18-Jul-01	31-Jul-01	28-Oct-01							4						1		3	2	2	4	6
620	232	5-Jul-01	31-Jul-01								2												1
626	291	8-Jun-01	8-Jun-01	15-Jun-01							2												1
657	281	17-Aug-02	6-Sep-02									2	1				2	2	7	2	1	13	8
682	80	22-May-02	29-Jul-02	18-Aug-02								4	23	2	7	8	2	15	9	16	26	15	11
685	684	4-Jul-02	4-Aug-02									5											1
686	717	3-Jul-02	3-Jul-02									3											1
687	683	25-Jul-02	29-Jul-02									2				7	1	3	6	4			6
688	91	5-Jul-02	15-Jul-02	6-Sep-02								6	5	4	8	11	2	6		13	10	3	10
698*	67	7-Aug-02	6-Sep-02	14-Oct-02								4	8	1	11	8	1	11	3	1	65	12	11
714	144	5-Jul-02	4-Aug-02									1				6	1	16	7	1	18	27	8
720	143	29-Jul-02	3-Sep-02	30-Sep-02								1	10	7	6	5	6	19	6	14	6	15	11
786	232	9-Jun-03	3-Jul-03	15-Jul-03									11	6	1	16	5	12	3	24	53	17	10
797	81	28-Jul-03	28-Jul-03	30-Jul-03									1	2	7	18	12	11	3				7
798*	175	12-May-03	12-May-03	16-Jun-03																			0
860*	216	26-Jul-03	28-Jul-03	26-Aug-03									3	4	4	7	2	1	1	5	32	10	10
811	815	19-Jun-04	17-Jul-04											5									1
814	372	25-Jun-04	30-Jun-04											2									1
818	101	17-Jul-04	17-Jul-04	20-Aug-04										2	2	4							3
819	67	4-Jun-04	27-Aug-04	22-Sep-04										8	4	20	20	14	10	4	6	3	9
824	93	30-Jun-04	11-Jul-04	14-Aug-04										4	8			11	9	20	16	14	7
862*	581	3-May-05	3-May-05	21-Jul-05											3								1
863	92	27-Jun-05	24-Jul-05	4-Aug-05											10								1
882	80	18-Jun-05	19-Jun-05	4-Jul-05											3	10	13	13	16	2	11	17	8
976*	973	14-Sep-07	14-Sep-07														1						1
990	94	8-Jul-07	5-Aug-07														4	7	9				3
994	993	5-Aug-07	14-Aug-07														1						1
1066	281	19-Apr-08	19-Apr-08															2					1
1173	81	16-Jul-09	18-Jul-09																2				1
1212	668	9-May-10	9-May-10																				0
1234	566	22-Jun-10	1-Jul-10																	2		7	2
1237	312	22-Jun-10	1-Jul-10	6-Aug-10																4	3	2	3
1254	92	5-Jun-10	7-Jul-10	18-Jul-10																20	10	25	3
1303	144	26-May-11	4-Jul-11	28-Jun-11																	7	4	2
1305	1111	10-Jun-11	10-Jun-11	7-Dec-11																	1		1
1350	67	23-Jun-11	1-Sep-11	20-Sep-11																	14	7	2
1357	232	20-May-11	15-Jul-11	22-Jul-11																	8		1
1421	893	25-Jun-12	7-Jul-12																			4	1
1424	65	23-Jun-12	8-Jul-12																			8	1
1425	364	6-Jun-12	8-Aug-12																			8	1
1455	126	27-Jun-12	8-Aug-12																			5	1
1511	330	22-Jun-12	3-Jul-12	5-Nov-12																		2	1
1512	196	2-Jun-12	18-Jul-12	31-Jul-12																		13	1
1517	193	28-Jun-12	2-Jul-12	21-Jul-12																		2	1
1521	717	2-Jul-12	25-Jul-12	13-Sep-12																		15	1
1529	324	7-May-12	7-May-12																				0
1545	760	7-May-12	7-May-12	12-Jul-12																			0
1559	918	28-Jun-12	28-Jun-12	12-Sep-12																		9	1
1427	1426	28-Jun-12	7-Jul-12																			3	1

Table 14: Deployment and movement summary for LIMPET satellite tags on three gray whales near La Push on 31 May 2012. Cumulative minimum horizontal displacement is likely an under representation of the true distance covered by an individual, as it is calculated as a straight line between Argos locations and does not account for any vertical displacement (diving).

ER Tag ID	Trans. durat (Days)	No. locations which passed filter	Cumulative min. horizontal displacmt (km)	Median distance to deployment (km) (max)	Median depth (m) (Range)	Median distance to shore (km) (Range)
001	2.9	31	57	2 (5)	28 (9-32)	1.1 (0.2-3)
002	4.4	62	162	3 (10)	29 (1-34)	1.3 (0-6.3)
003	6.8	93	203	3 (22)	3 (22)	1.7 (0.1-7.3)

Table 15: Identification histories of PCFG gray whales that were tagged by OSU in fall 2009. Numbers underneath years indicate the number of times the whale was sighted that year. Red highlight indicates two whales not sighted in a subsequent year post-tagging, another whale that has not been seen since Jan 2010 and a 4th whale known to have die (in 2011).

ID	TAG Number	Tagged	1985	1991	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Comments
32	PTT 5205938	2009	1			1			2	16			18	3	6			2		**4**				
89	PTT 5223029	2009			2				20	21	30	13	4	23	10	19	16	8	16	**19**	20	24	30	
164	PTT 5210836	2009		1		7					3	1	1			1	1		1	**9**	14	9	2	
196	PTT 5210838	2009,12					1				2		1	9		6	14	6	8	**21**	24	14*	**12**	*w/ calf
205	PTT 5210842	2009					2	9		6	1	3	3	5					7	**19**	5	6		
206	PTT 5205923	2009					4		3	2	1	3	4	3				2		**9**	1	3		
215	PTT 5205670	2009					2		1				5	4	1			3		**15**	2			Last Jan 2010
291	PTT 5223032	2009							2	2	1	3	6	10	4	1	5		1	**10**	3	16	3	
302	PTT 5205801	2009							4	8	1		4	14	10	1	15	6	15	**8**	16	14	13	
411	PTT 5223038	2009								1	4	8	4					2	3	**11**	7	11		Dead 2011
525	PTT 5200847	2009									1	2	1		1	2	1	4	23	**16**	4		1	
537	PTT 5200831	2009									2			1				1	1	**14**	12	5	1	
615	PTT 5223033	2009										1	1						2	**3**	5	4	1	
643	PTT 5204174	2009										1	2	1		2			3	**13**	1	9	1	
659	PTT 5200827	2009											2		5		1		1	**19**	7	5	7	
797	PTT 5223035	2009												1	2	7	18	12	13	**7**				
854	PTT 5201385	2009														1			3	**11**	8	9	1	
981	PTT 5223041	2009																1		**10**	7	8	4	

Table 16: RELEASE goodness of fit results for each region using pooled and separate cohorts. When cohorts are separated as groups, Test 3 is always 0 because there are no sub-cohorts.

Region	Cohort	Test	χ^2	df	P
MUA	Pooled				
		Test 2	47.9483	24	0.0026
		Test 3	40.8	28	0.056
		Total	88.7483	52	0.0011
	Separate				
		Test 2	9.8441	55	1
OR-SVI	Pooled				
		Test 2	163.0315	38	0
		Test 3	282.9597	29	0
		Total	445.9912	67	0
	Separate				
		Test 2	139.681	100	0.0054
NCA-NBC	Pooled				
		Test 2	296.8194	38	0
		Test 3	544.2195	29	0
		Total	841.0389	67	0
	Separate				
		Test 2	215.955	96	0

Table 17: Number of whales seen each year, number that were new that year in that region, and number that were new and were seen in a subsequent year for whales seen between June-November 1996-2012 in each region. The year a whale was seen as new can vary across regions and if it differs will be later in the smaller region.

Region		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
MUA	Seen	19	27	37	11	14	32	8	22	21	33	58	20	75	57	26	41	67
	Non-calf: New	19	15	23	1	11	18	1	10	10	11	23	2	29	13	4	10	20
	Non-calf: New/Resighted	17	11	6	0	8	7	1	5	7	5	17	2	16	2	2	4	0
	Calf: New	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	1	2
	Calf: New/Resighted	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
OR-SVI	Seen	30	36	86	71	67	128	103	110	114	109	98	114	123	118	92	91	127
	Non-calf: New	30	20	54	23	24	50	32	23	24	16	11	20	21	16	7	6	21
	Non-calf: New/Resighted	26	13	37	9	15	19	23	17	11	10	3	6	11	4	6	2	0
	Calf: New	0	0	1	0	0	6	7	3	5	3	0	2	1	1	1	3	7
	Calf: New/Resighted	0	0	0	0	0	3	5	3	3	1	0	1	0	0	1	1	0
NCA-NBC	Seen	45	69	132	152	137	173	204	157	178	138	128	120	174	154	144	164	208
	Non-calf: New	45	45	68	69	51	56	44	17	26	18	8	17	49	22	12	15	43
	Non-calf: New/Resighted	40	36	46	13	28	23	23	12	11	10	1	6	18	6	9	3	0
	Calf: New	0	0	3	0	0	6	9	3	5	3	0	3	1	1	3	4	10
	Calf: New/Resighted	0	0	1	0	0	3	7	3	3	1	0	1	0	0	3	2	0

Table 18: Delta AICc and QAICc (for OR-NBC and NCA-NBC models) for 30 models fitted to each set of data.

		φ Model									
Region	p model	1	2	3	4	5	6	7	8	9	10
MUA	1	13.6	13.1	2.3	1.9	5.1	9.8	12.1	13.1	6.8	7.2
	2	11.2	11.6	0.0	0.5	3.9	8.7	11.0	12.1	5.9	5.8
	3	99.5	99.4	85.0	85.5	87.9	91.2	93.1	94.0	89.7	91.4
OR-SVI	1	165.3	145.5	160.1	138.8	142.0	140.1	142.2	144.0	144.0	145.8
	2	20.7	6.4	16.8	0.6	3.8	1.2	3.2	5.2	5.8	7.7
	3	20.9	6.4	16.4	0.0	3.2	0.2	2.2	4.1	5.2	7.0
NCA-NBC	1	153.8	129.2	130.9	104.3	107.8	110.1	112.2	114.0	109.3	111.2
	2	44.2	23.7	23.3	0.0	3.4	6.2	8.3	10.2	4.9	6.8
	3	50.0	29.7	29.6	6.4	9.7	12.1	14.1	15.9	11.2	13.0

Table 19: JS1 abundance estimates ($\widehat{N}$), standard errors and minimum population estimate $N_{min} = \widehat{N}e^{-0.842\sqrt{log(1+(se(\widehat{N})/\widehat{N})^2}}$ using data from 1996-2012 in OR-SVI and NCA-NBC regions.

Region	Year	$\widehat{N}$	$se(\widehat{N})$	N_{min}
OR-SVI	1996	25	2.8	23
	1997	42	6.3	37
	1998	86	10.6	78
	1999	83	9.8	75
	2000	89	12.3	79
	2001	139	16.7	125
	2002	135	15.7	122
	2003	164	14.4	152
	2004	159	17.0	145
	2005	169	15.4	157
	2006	154	15.4	142
	2007	165	14.5	153
	2008	181	20.6	164
	2009	161	13.3	150
	2010	148	17.5	134
	2011	143	14.8	131
	2012	165	16.6	152
NCA-NBC	1996	38	2.8	36
	1997	80	10.7	72
	1998	126	10.8	117
	1999	147	15.0	135
	2000	149	15.1	137
	2001	181	14.0	170
	2002	198	13.2	188
	2003	210	18.1	195
	2004	218	17.0	204
	2005	219	26.3	198
	2006	200	21.4	183
	2007	194	25.8	173
	2008	207	18.4	193
	2009	206	20.3	189
	2010	194	18.4	180
	2011	197	15.8	184
	2012	209	15.4	197

Table 20: JS1 abundance estimates ($\widehat{N}$), standard errors and minimum population estimate $N_{min} = \widehat{N}e^{-0.842\sqrt{log(1+(se(\widehat{N})/\widehat{N})^2}}$ using data from 1996-2012 in MUA region.

Year	$\widehat{N}$	$se(\widehat{N})$	N_{min}
1996	18	1.5	16
1997	32	4.6	28
1998	38	9.5	31
1999	37	14.1	27
2000	37	23.4	23
2001	52	12.9	42
2002	45	22.4	31
2003	52	16.6	40
2004	55	20.1	40
2005	60	12.4	50
2006	67	7.7	61
2007	67	18.9	53
2008	79	6.4	74
2009	82	10.7	74
2010	76	19.4	62
2011	74	13.6	63
2012	81	9.9	73

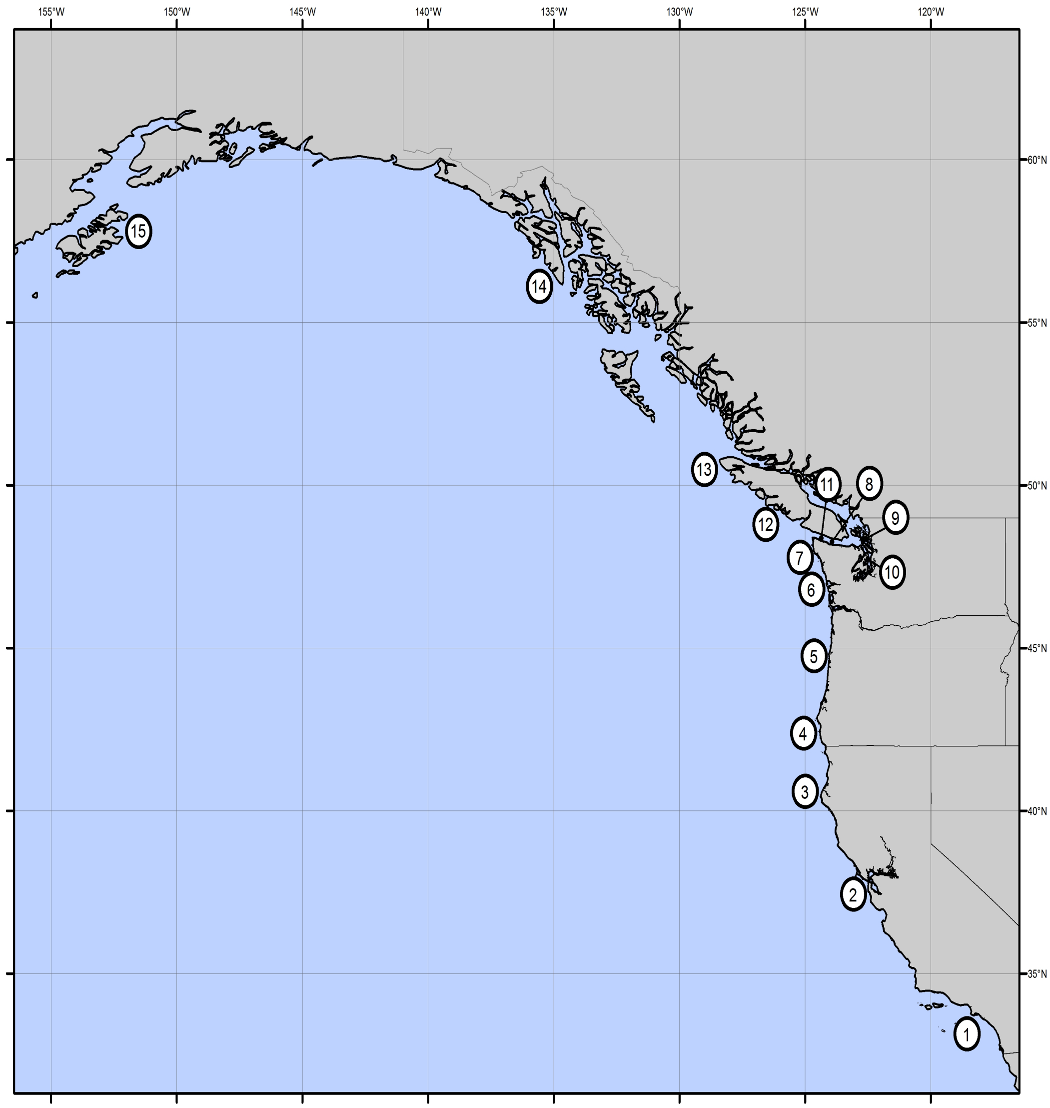

Figure 1: Locations for photo-identifications of gray whales. Numbers refer to values in Table 3.

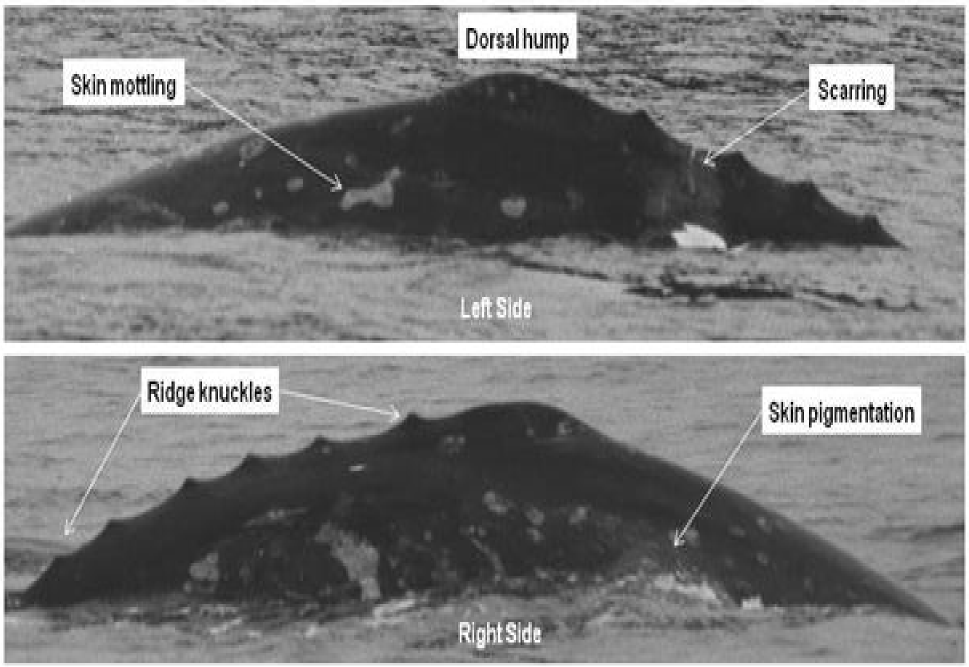

Figure 2: Characteristics used for gray whale photo-identification.

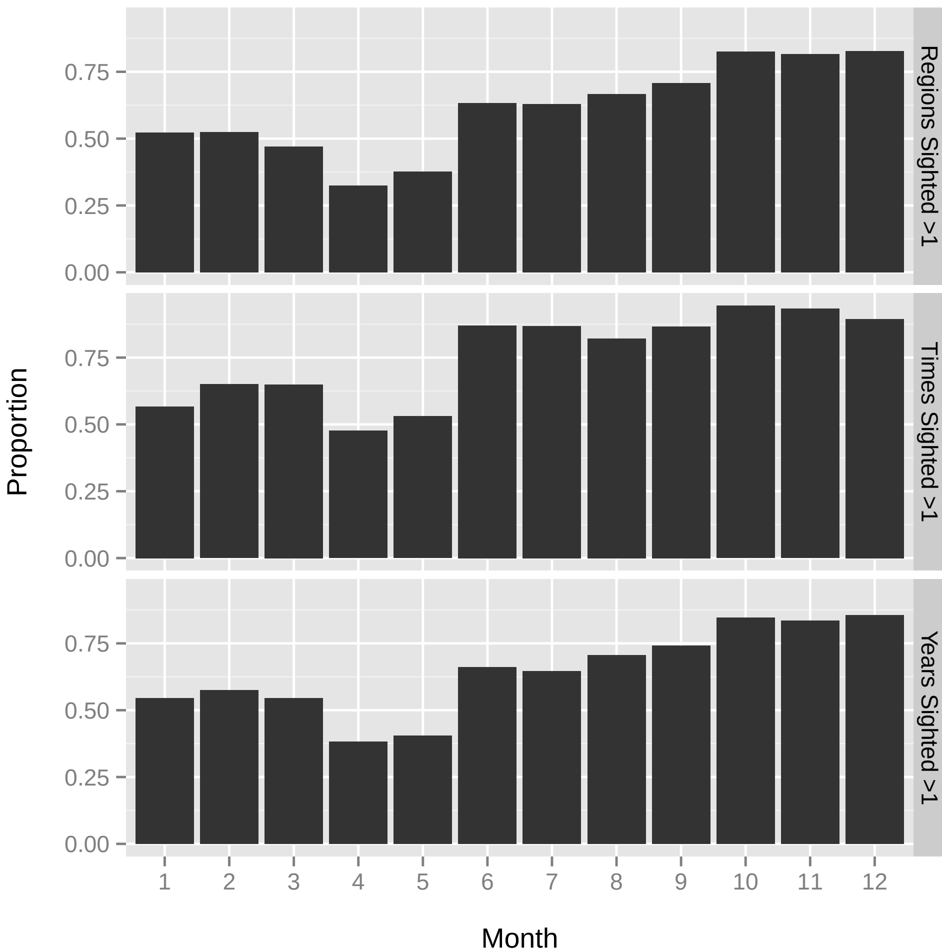

Figure 3: Monthly measures of proportion of whales that were seen in more than one region, seen on more than one day and seen in more than one year. The values include sightings from 1996-2012 in all regions from California to Alaska. Lower values imply whales were simply migrating through the area in a short time frame and were thus less likely to be seen at other times and in other regions. Values are not shown for months with fewer than 20 sightings. Whales seen more often are over-represented because they are used in each month they were seen. For example a whale seen in June, July and August will be in each summary. Thus, these values may be larger than values computed without splitting by month (e.g., overall proportion of whales seen in more than one year).

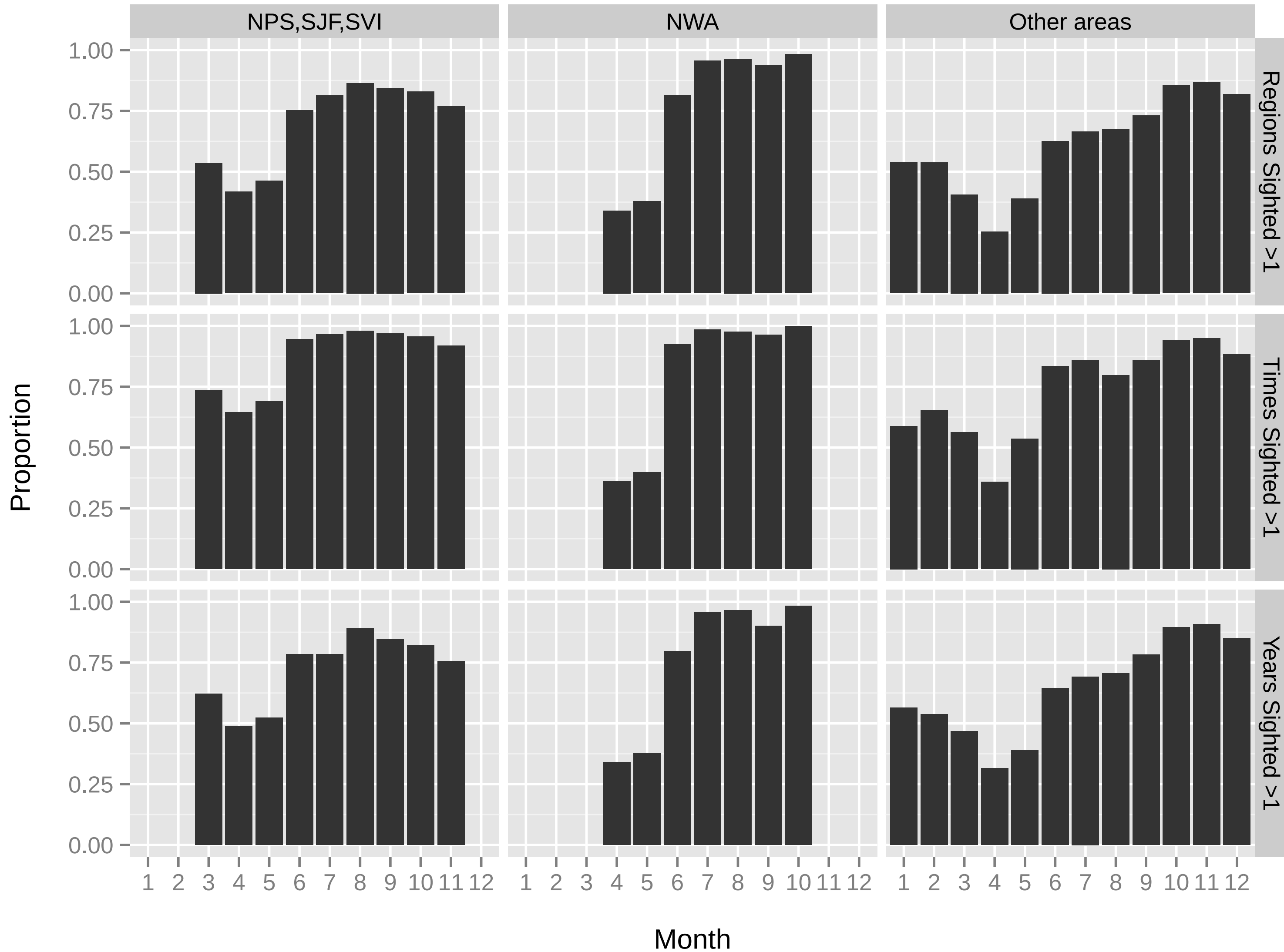

Figure 4: Region and monthly measures of proportion of whales that were seen in more than one region, seen on more than one day and seen in more than one year. The values include sightings from 1996-2012 in all regions from California to Alaska. Lower values imply whales were simply migrating through the area in a short time frame and were thus less likely to be seen at other times and in other regions. Values are not shown for months with fewer than 20 sightings. Whales seen more often are over-represented because they are used in each month they were seen. For example a whale seen in June, July and August will be in each summary. Thus, these values may be larger than values computed without splitting by month (e.g., overall proportion of whales seen in more than one year).

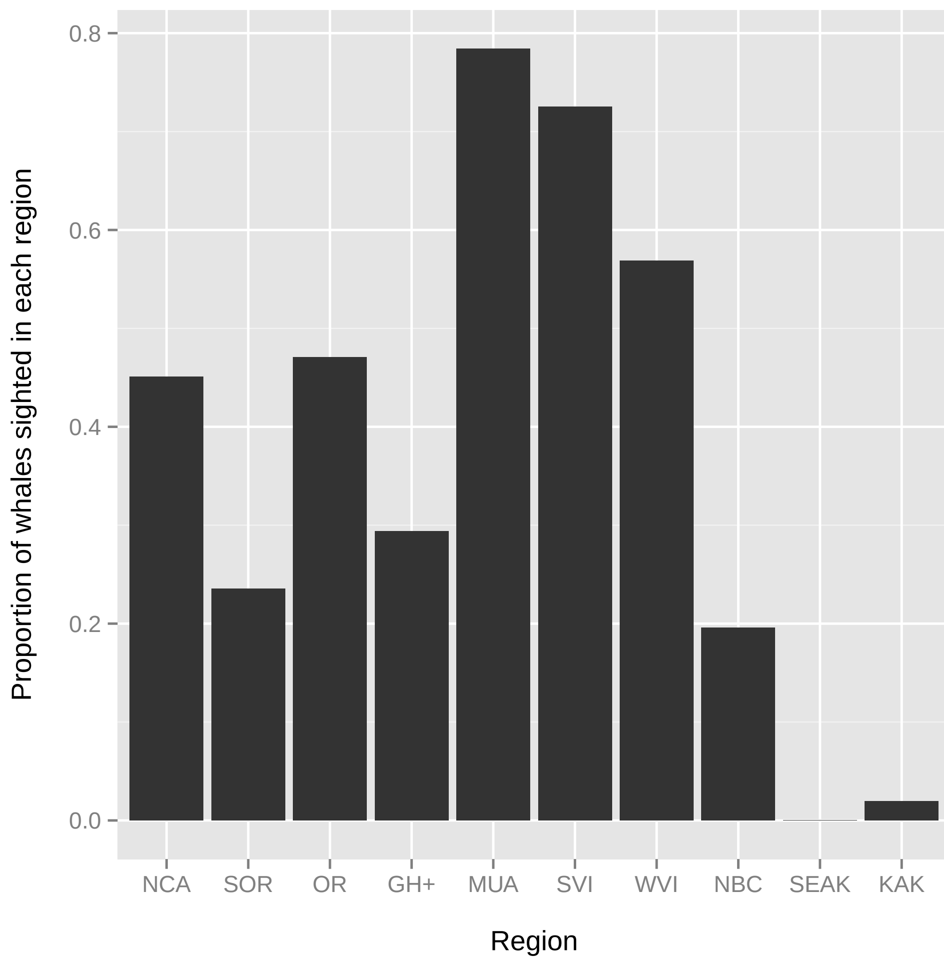

Figure 5: Proportion of the 51 unique whales seen in NWA during the spring and in the PCFG after 1 June that were seen in each PCFG sub-region after 1 June at least once from 1996-2012.

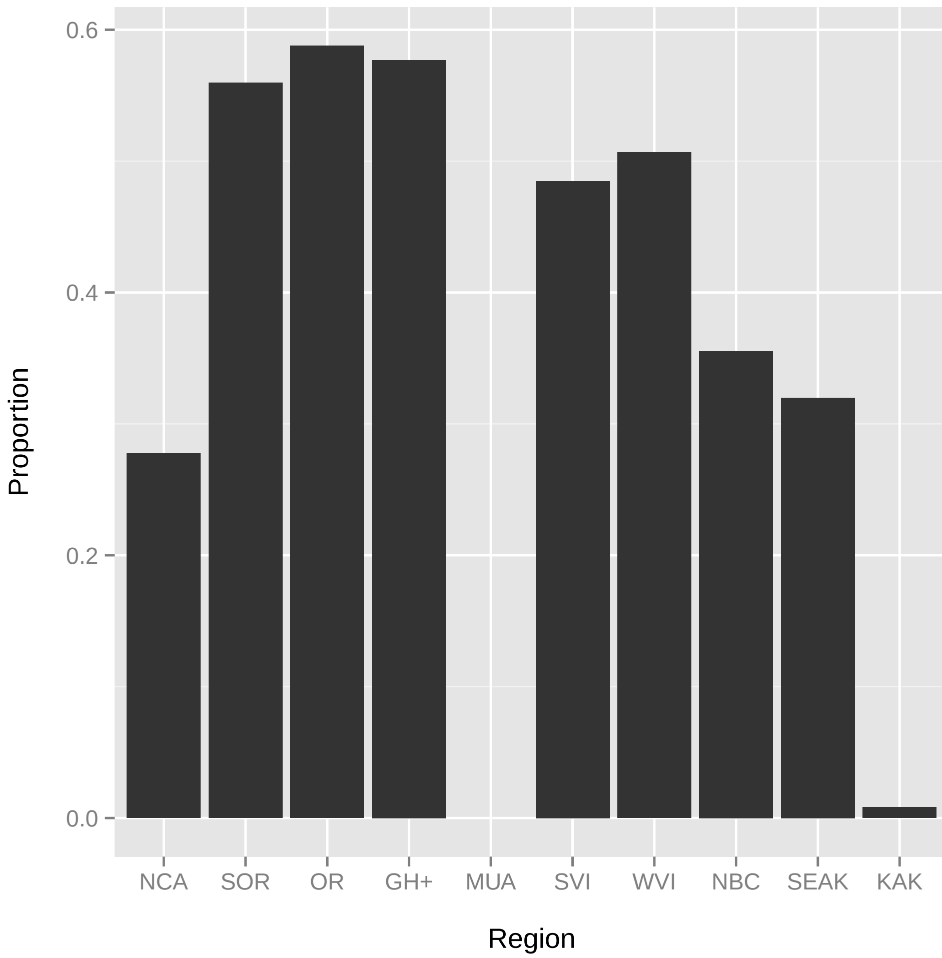

Figure 6: Proportion of whales in sub-regions from NCA to KAK that have been seen in the MUA using sightings after 1 June from 1996-2012.

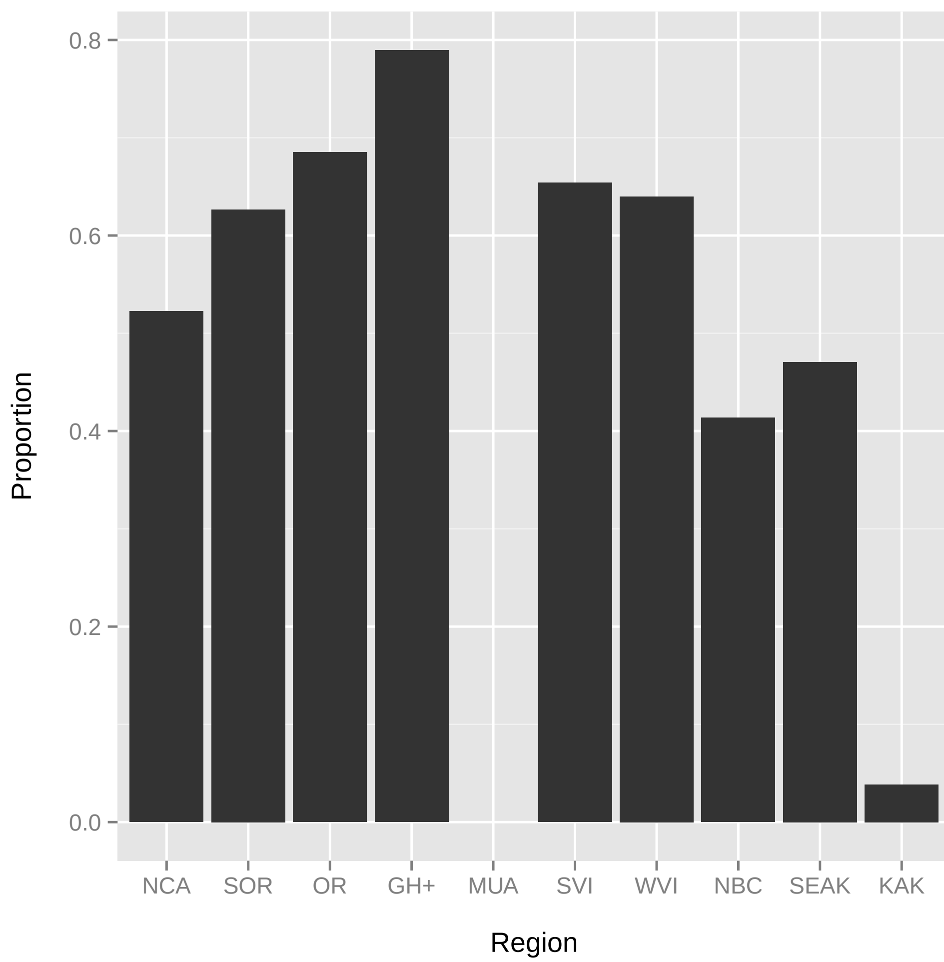

Figure 7: Proportion of whales seen in at least 2 years in sub-regions from NCA to KAK that have been seen in the MUA using sightings after 1 June from 1996-2012.

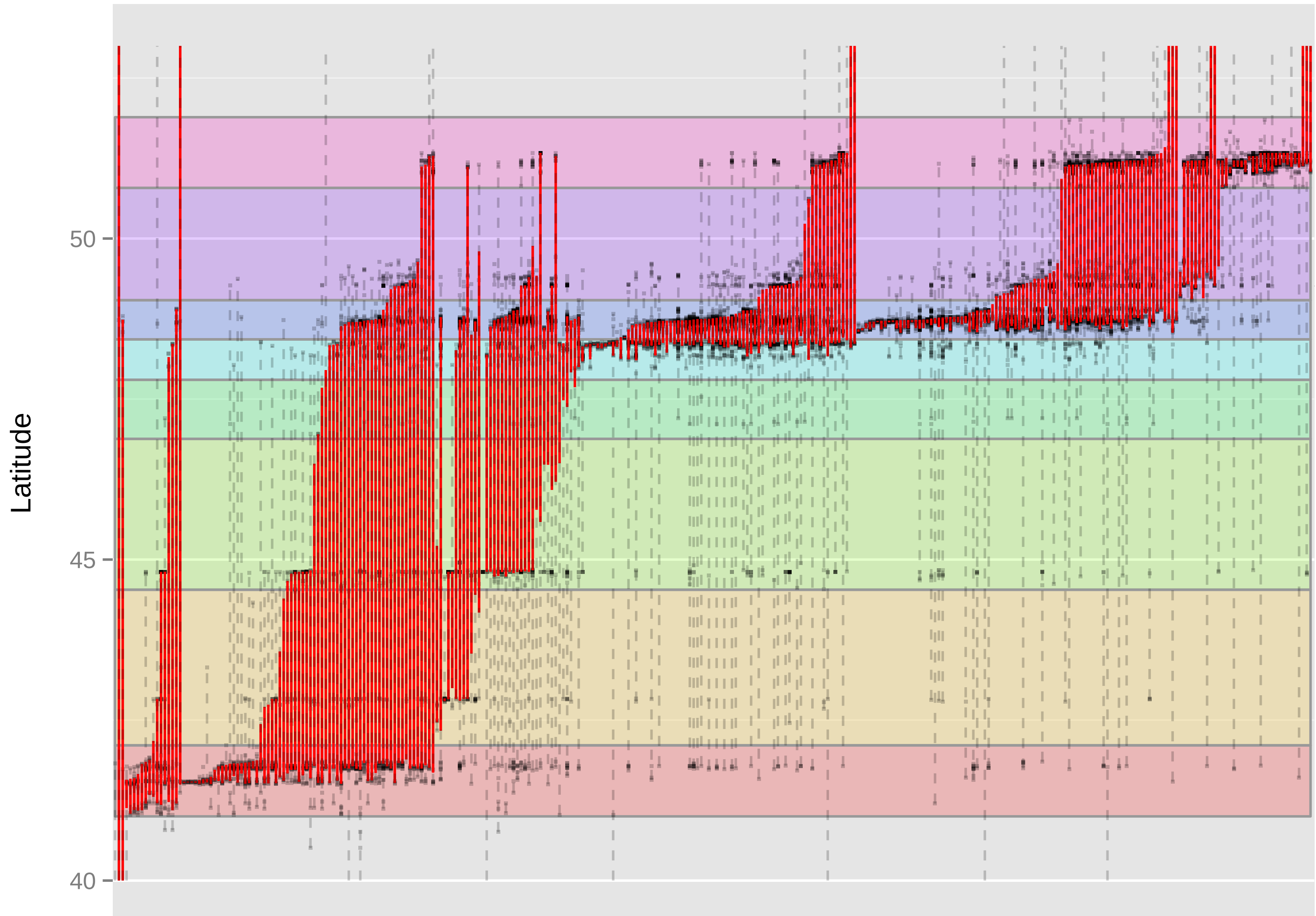

Figure 8: Distribution of latitudes of sightings (points) for whales with 6 or more sightings after 1 June from 1996-2012, the 75% inner quantile (solid thick line), and full range (light dashed line). Each position on the x axis represents an individual whale. Whales have been arranged on the plot by sorting first on the lower bound of the inner quantile (to a half-degree) and then the upper bound of the quantile. This has the effect of sorting from south to north and clusters whales with smaller quantile ranges followed by whales with larger ranges.

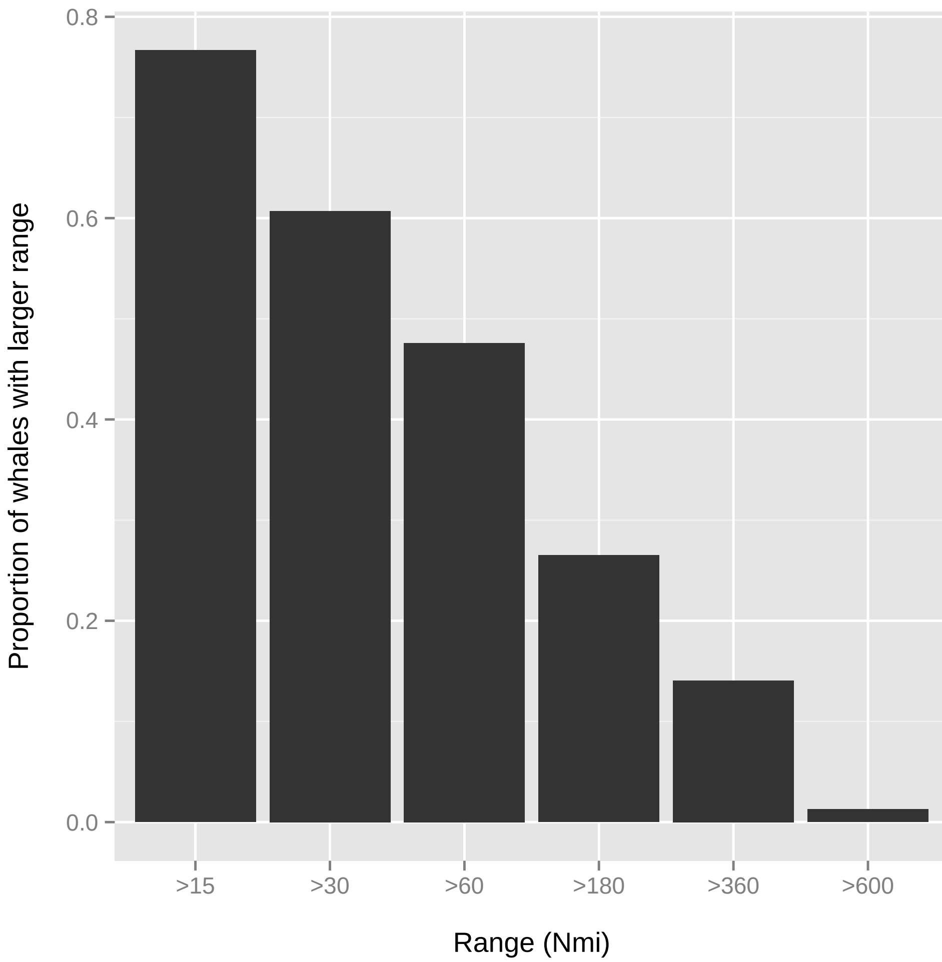

Figure 9: Distribution of ranges of 75% inner quantiles of latitudes expressed in nautical miles for whales sighted on 6 or more days during 1996-2012.

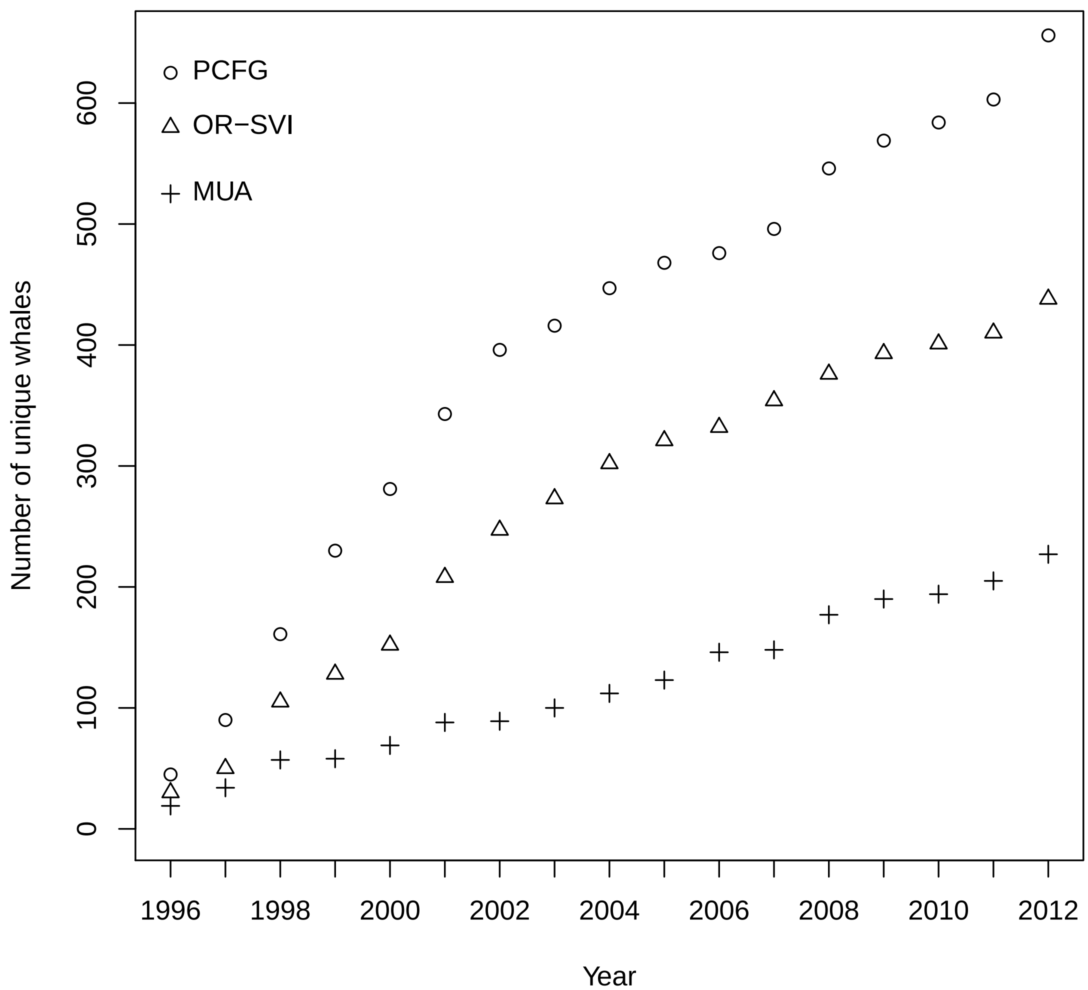

Figure 10: Discovery curves for unique whales seen in PCFG, OR-SVI and MUA for 1996-2012.

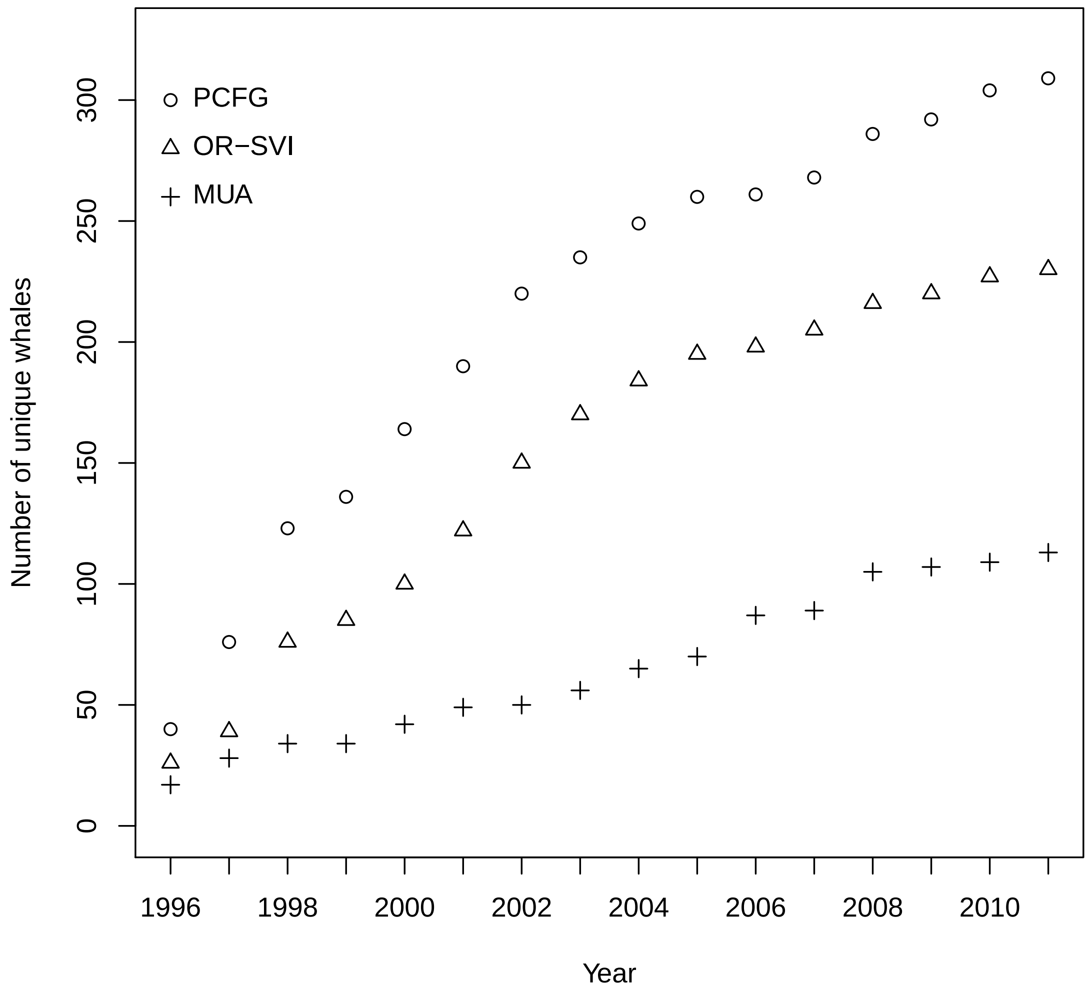

Figure 11: Discovery curves for unique recruited whales seen in PCFG, OR-SVI and MUA for 1996-2012.

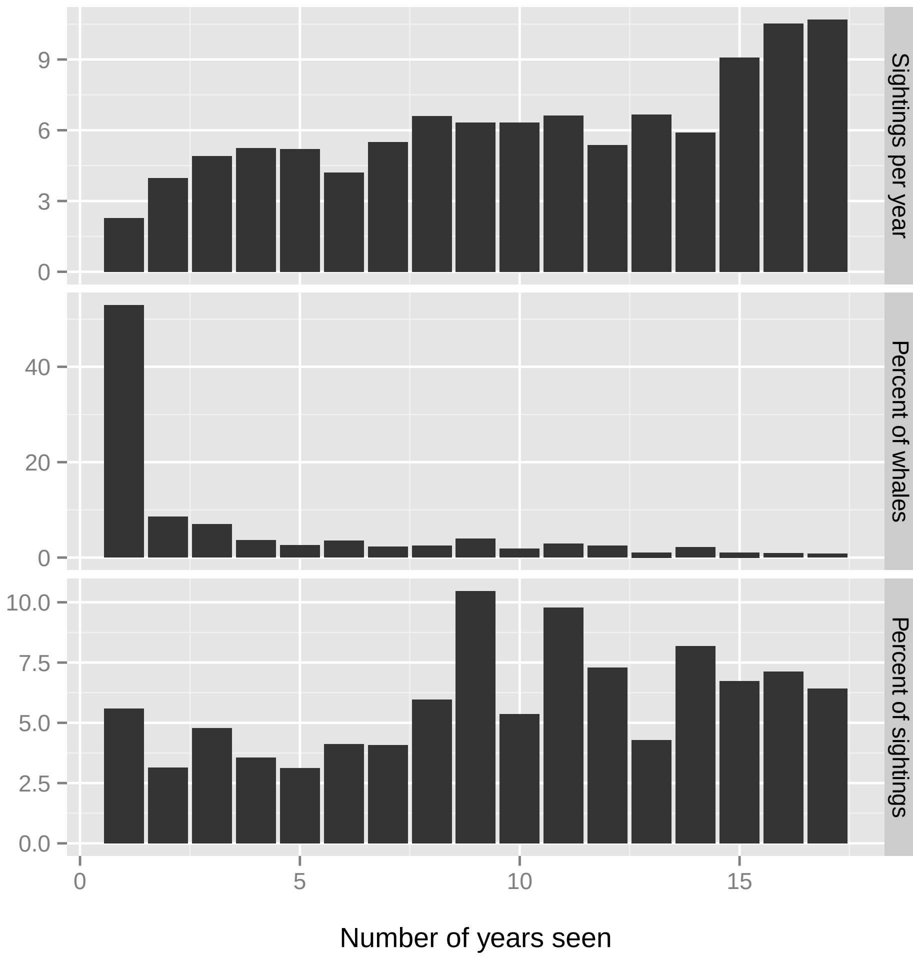

Figure 12: Average number of sightings per year and distribution of whales and numbers of sightings based on numbers of years a whale was seen in NCA-NBC between June-November during 1996-2012.

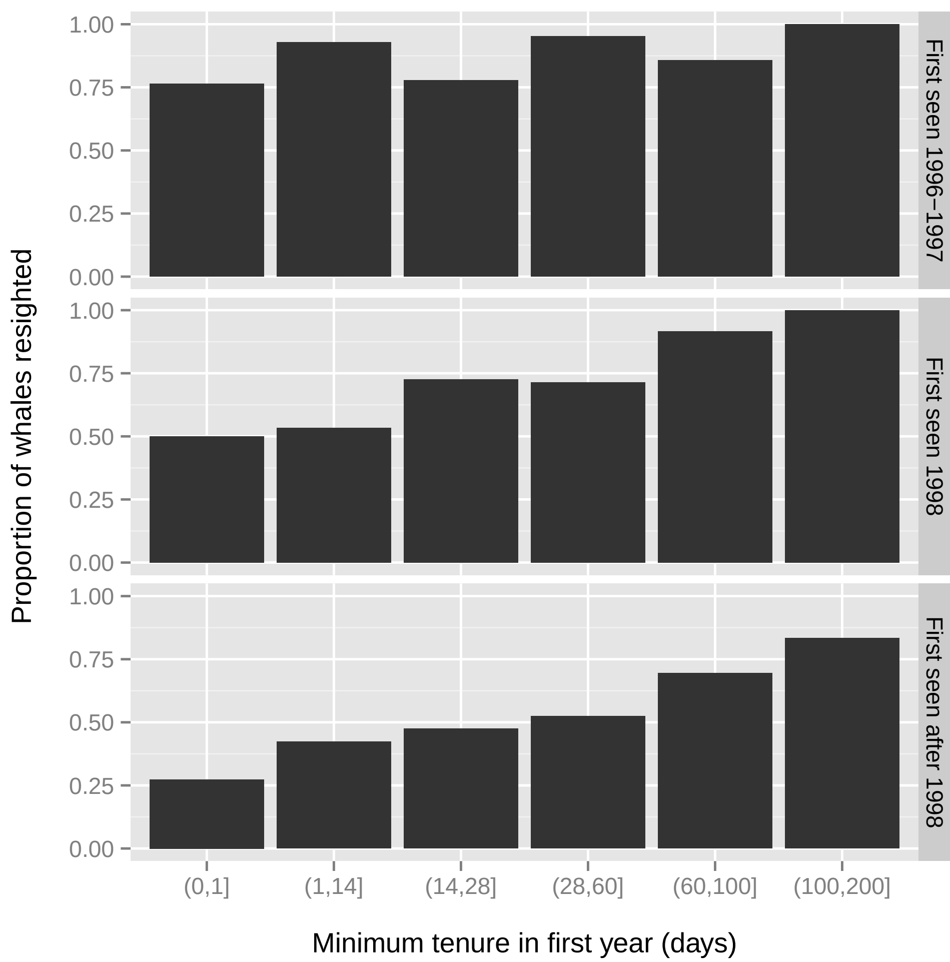

Figure 13: Influence of minimum tenure (MT) in the first year the whale was photographed on the probability it will be re-sighted in one or more following years for whales seen in NCA-NBC for June-November 1996-2012. The bar graphs are divided based on first year in 1996-1997, 1998 and after 1998. Re-sightings for 2012 are used but initial sightings for 2012 are excluded because there are no data beyond to evaluate re-sighting probability.

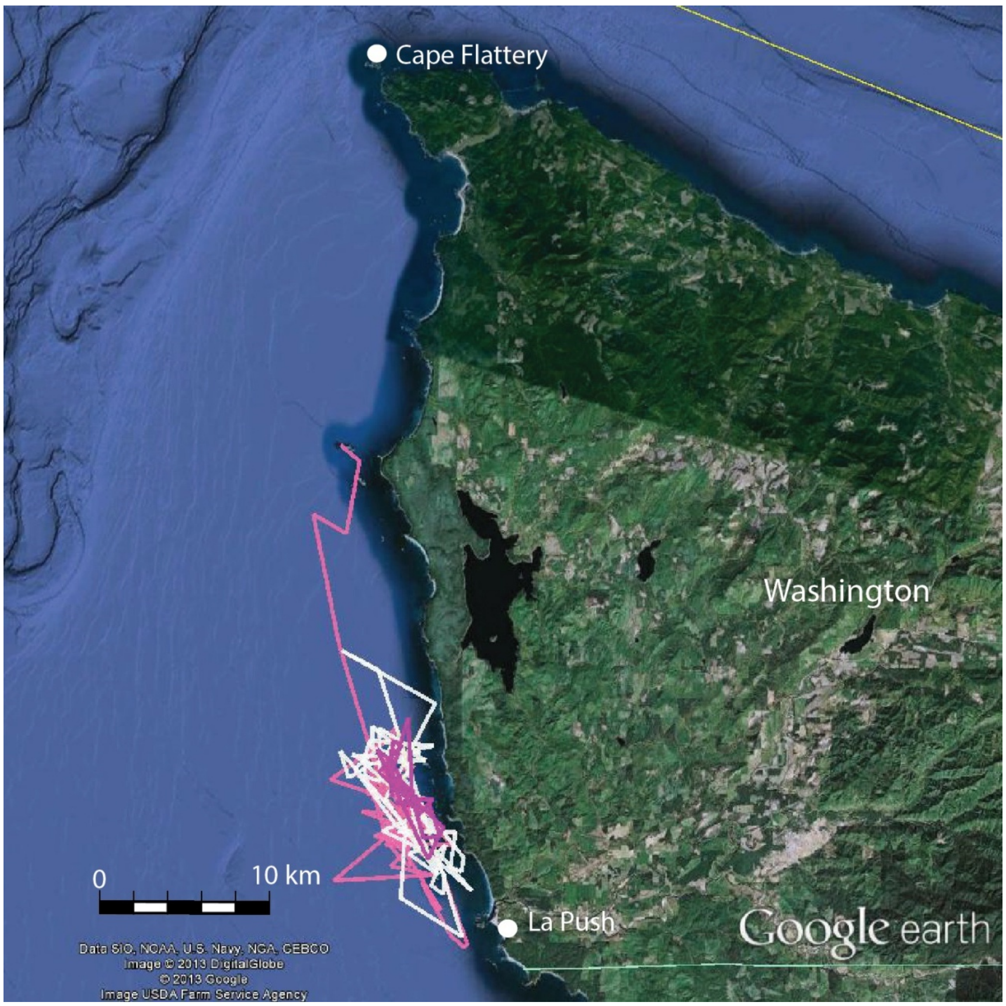

Figure 14: Map showing movements of three gray whales tagged 31 May 2012 near the northern tip of Washington.

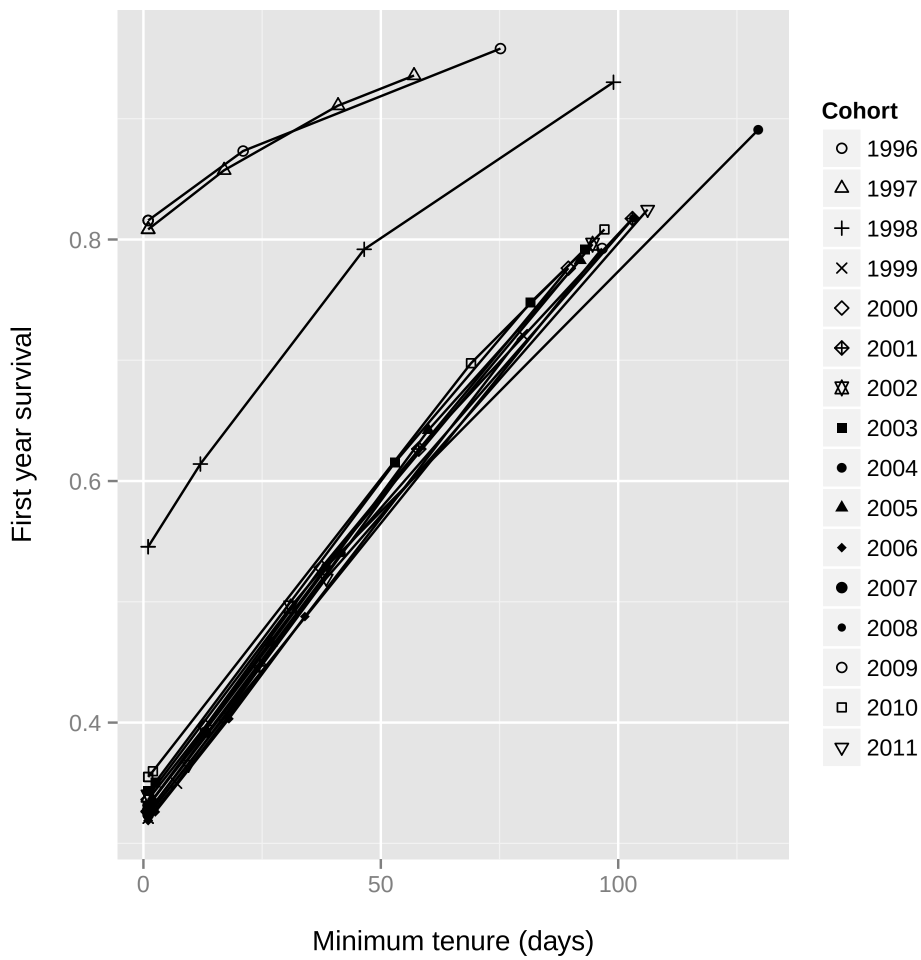

Figure 15: For NCA-NBC analysis of 1996-2012 data, model-averaged estimates of first year survival of non-calves for each cohort at 5%, 25%, 50%, 75%, and 95% quantiles of minimum tenure values for that cohort.

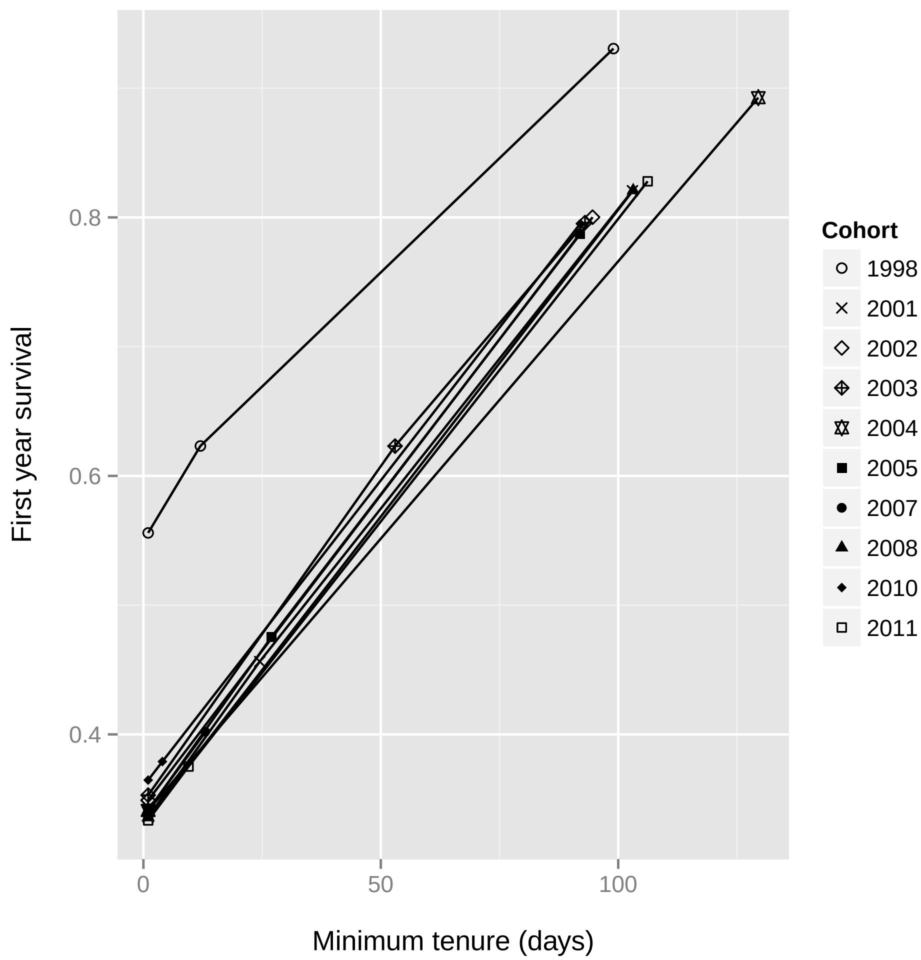

Figure 16: For NCA-NBC analysis of 1996-2012 data, model-averaged estimates of first year survival of calves for each cohort at 5%, 25%, 50%, 75%, and 95% quantiles of minimum tenure values for that cohort.

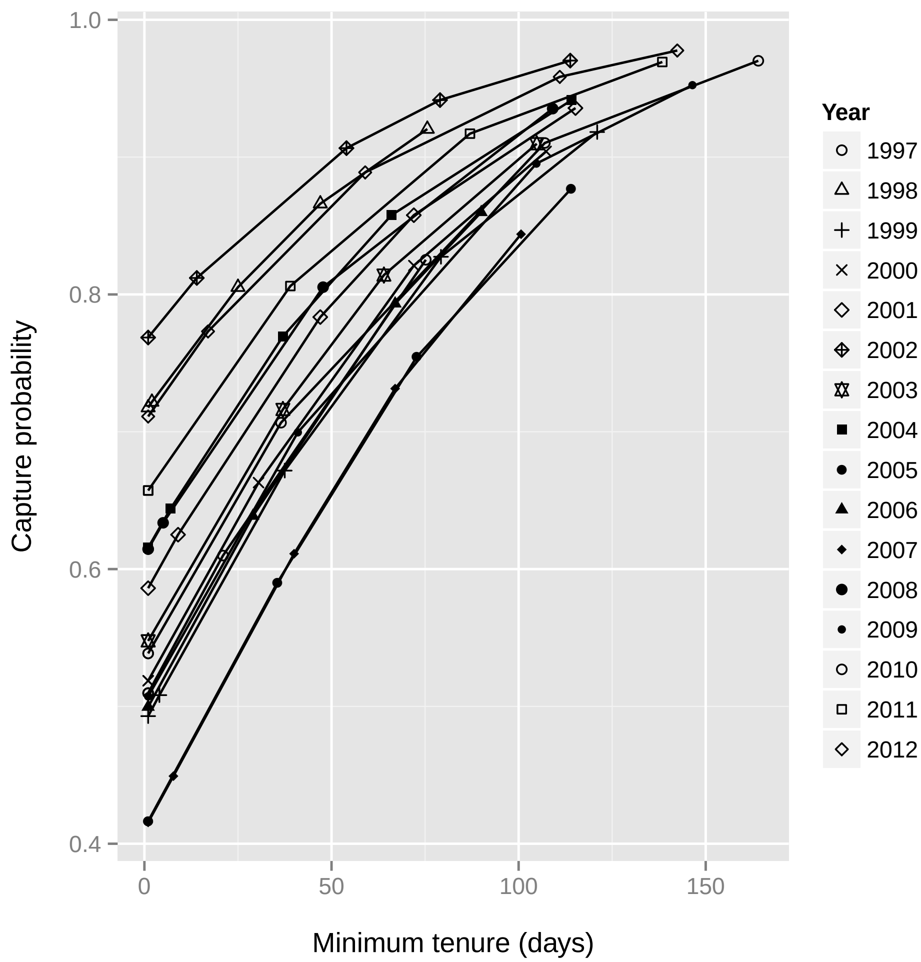

Figure 17: For NCA-NBC analysis of 1996-2012 data, model-averaged estimates of capture probability for each year at 5%, 25%, 50%, 75%, and 95% quantiles of minimum tenure values for whales in the previous year.

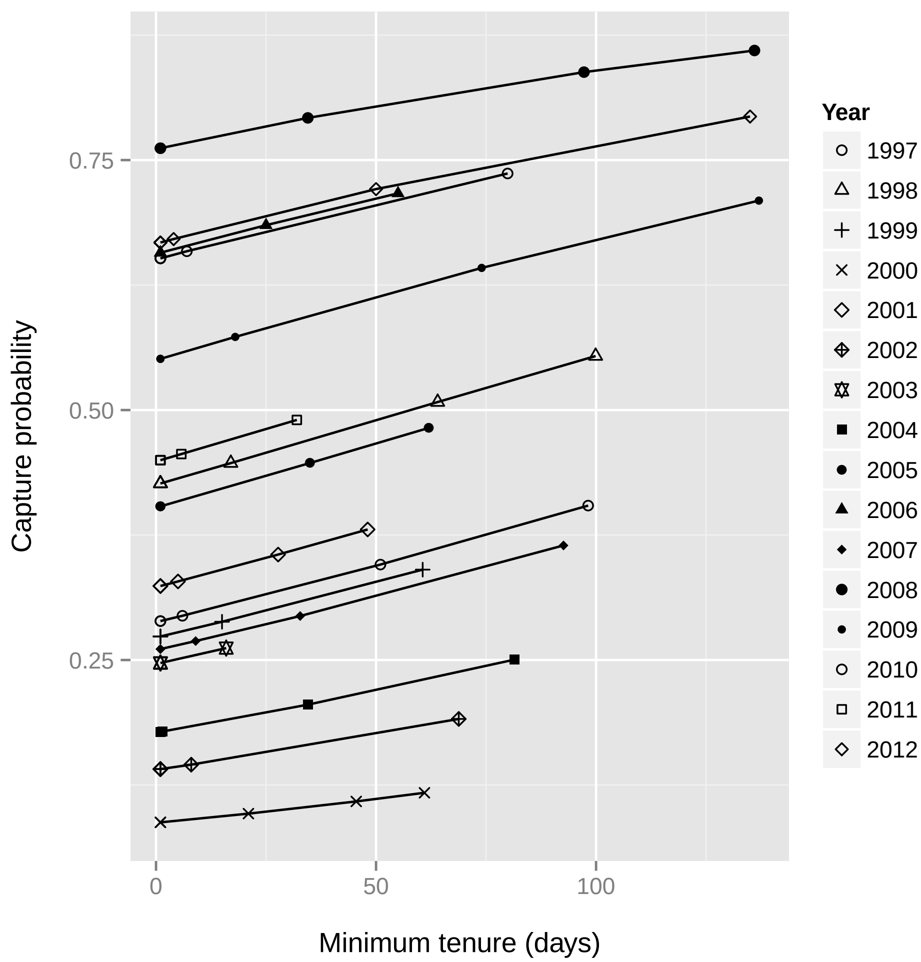

Figure 18: For MUA analysis of 1996-2012 data, model-averaged estimates of capture probability for each year at 5%, 25%, 50%, 75%, and 95% quantiles of minimum tenure values for whales in the previous year.

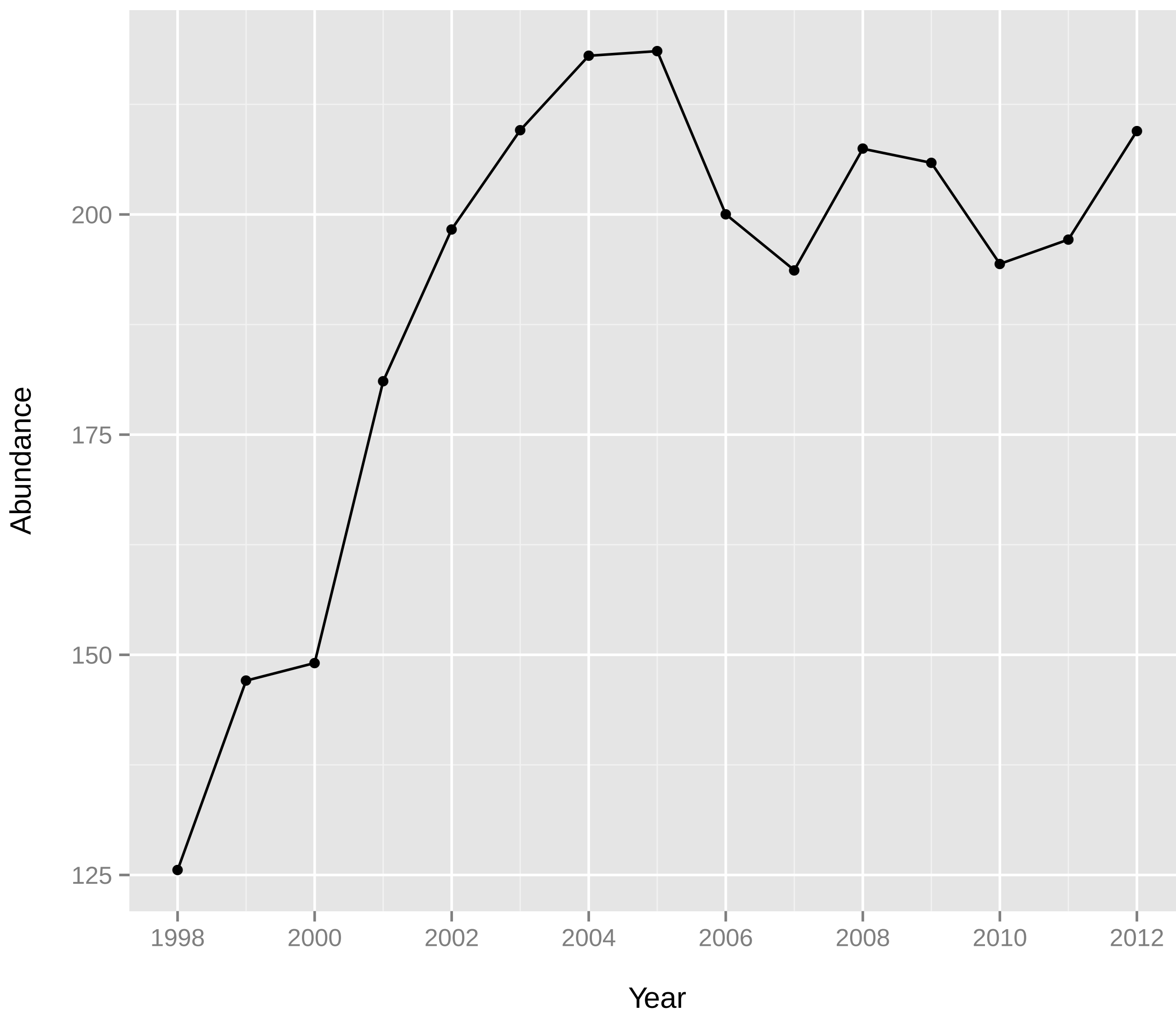

Figure 19: Annual abundance estimates for 1998-2012 in NCA-NBC using the open (Jolly-Seber; POPAN parametrization) population model approach JS1.

Appendix

Table 1 provides capture histories of whales seen in the PCFG at least once from 1 June - 30 November and displays by year, when they were seen only in spring (March-May), only from 1 June - 30 Nov and when they were seen in both time periods. Table 2 provides capture histories using data from 1 June - 30 Nov of whales seen in the MUA at least once. It shows when whales were seen only outside of the MUA but in the PCFG, only in the MUA and both inside the MUA and in the PCFG outside of the MUA

Table 1: Sighting histories of whales seen in the PCFG in at least one year. In year columns, a 1 means the whale was only sighted in the spring (March-May), 2 means it was only seen in June-Nov, and 3 means it was seen in both March-May and June-Nov. The region value is the nunber of years the whale was seen in that region.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
								2	2	2	2			2	2	2		2	2	2		2	2	2	2		2	2	17					1		3	12	8	4
								2	2	2	2	3			2														9				1				9		2
3																													1						1				1
2																													1						1				1
2					2	2						2	2	2	2	2	2	2		2	2	2							13					2	1	10	5	1	5
2						2			2	2	2	2		2	2	2	2	2	2	2	2	2	2	2	2				18	1			1		6	15	7	4	6
2						2		2	2	2	2	2	2	2	2	2	2	2	2	2									15		1	1		5	1	11	3	1	7
2									2					2	2														4			1		2		3	2		4
2									2			2	2	2	2	2	2	2	2	2		2		2	2		2	2	16	3		4		4		11	5	3	6
2				2				2		2	2	2		2	2	2	2	2	2	2	2	2	2	2	3	2	3	2	21				1	5	2	16	9	1	6
	2										2			2	2			2	2	2			1						8							2		6	2
		3																											1						1				1
		3																											1					1	1				2
		2																											1						1				1
		2													2		3	2		2		1	2	2	2	2	2	2	12	5	3	3	3	1	1				6
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				2				2				2		2	2	2	2	2	2	2	2	2		2		2	3	2	16					1	2	8	8	3	5
					2			3	3		2	1		1		3	2	2		2									10		1	1	6	2			1	1	6
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					2																								1					1					1
					1			3							1														3				3						1
					1														2										2				1			1			2
						2																							1							1			1
						2																							1							1			1
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						2																							1							1			1
						2																							1							1			1
						2	2	2				2		2	2	2	2	2	2	2	2	2		2	2	3	3	2	18					1	3	14	5	6	5
						2			2	2		2																	4					2			2		2
						2			1		2		2	2	2		2	2	2	2	2	2	3	2	2	1		3	17			1	1	4		7	9	6	6
						2				2	2	2		2	2	2	2			2	2	3							11			1		2		4	9	2	5
							2				2					1	2	2			1	1		2	2	2	2	3	12	8			4						2
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							2							2	2														3	3									1
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							2							2		2	2	2					2		3	2	2		9	7			1	1			1		4
							2							2			2	2	2	2	2	2	2	2	2	2	2	2	14	8	6	2		1		4	1		6
								3																					1				1						1
								1			3																	2	3	1			2						2
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								2	1	2		2	2																5					2	3				2
								2							2			2	2							2	2	2	7							2	1	5	3
									3	1	2					2	2	2		2				2	2		2	2	11	2		1	3			4	1		5
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									2	2	2	2		2	2	2	2	2	2	2	2								12					3	1	3	1	9	5
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									2																				1					1					1
									2	3		2	2	2	2	2	2	2	2	2				2					12		2	1		5	1	1	6	5	7
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									2			3		2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	17	5	1	2	1	5		12	5		7

Cont.

Table 1: Sighting histories of whales seen in the PCFG in at least one year. In year columns, a 1 means the whale was only sighted in the spring (March-May), 2 means it was only seen in June-Nov, and 3 means it was seen in both March-May and June-Nov. The region value is the nunber of years the whale was seen in that region.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
									2					2	3	3	3	2	2	2	2	2	2	3	2	2	2	2	16	5	4	6		7		13	4		6
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									2			2	2	2		2	2	2	2		2		2	2			2		12		2	1		2	1	6	2	8	7
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										2																			1					1					1
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										2	2	1																	3				1	1	1				3
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										2			2			2			2	2		2							6							1		6	2
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											3	1																	2				2						1
											3	1																	2				2						1
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											3																		1				1						1
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											2																		1						1				1
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											2	2	2	3	2	3	2	2	3	2	2	2	2						13	1		1		5	5	9	7		6
											2		2	2	3														4					3	2	2	1		4
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											2		2	2	2						2								5			1				1	1	5	4
											2		2	2	2		2	2	2	2	2	2		2	2	2		2	14							9	5	7	3
											2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	17					3	4	13	8	7	5
											2		2	2	2	2	2	2		2	2	2	2	2				2	13			1		1	2	3	6	7	6
											2		2	2				2	2	2		2							7								1	7	2
											2		2	2	2	3		2	2	2	2			2		2	2	1	13						1	1	1	12	4
											2		2	2	2														4									4	1
											2		2	2		2	2		2	2	2	2		2				2	11								2	10	2
											2		2	2	2	2	2	2	2	2	2	3	1	2	2	1	2	2	17						1	5	4	11	4
											2							2	2	2				2					5									5	1
											2		2					2	2	2		2						2	7									7	1
											2		2		2			2	2	2						1	2		8	1				1				6	3
											2									2									2									2	1
											2																		1							1			1
											2																		1							1			1
												2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	17	4			1			15	3	2	5
												1	2	2	3	3	2	2	2		2	3	3	2	2	1	2	3	16							15	9	2	3

Cont.

Table 1: Sighting histories of whales seen in the PCFG in at least one year. In year columns, a 1 means the whale was only sighted in the spring (March-May), 2 means it was only seen in June-Nov, and 3 means it was seen in both March-May and June-Nov. The region value is the nunber of years the whale was seen in that region.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
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												2	2	2	2	3	3	2	2	2				2		2			11					3	3	10	2		4
												2		1															2				2						1
												1			1			2	2	2	2	2							7				1	1	1	5	1	1	6
												2	2	3	3	3	3	3	3	2	2	2	2	2	3	3	3	3	17		1	3	1	7	3	15	2		7
												1				2		2	2		3	2	2	3	3	2	2	2	12	4	1	3	1	5		9	1		7
												1		2															2	1			1						2
												1	1	2	2	2	2	2	2		2	2	2	2	2	2	3	2	16	6	2	7	2	6		6	2		7
												3	2		2	2	2	2	2					2	2	2			10	1			1	7	4	3	2		6
												1		2	2	2	2	2	2				2		2	2	2	2	12	8	4	4	1						4
												1												2					2				1		1				2
												2	2	2															3					2	1	2			3
												2																	1					1					1
												1		2				2	2	2			2		2				7	2	3	3	1	1	1				6
												1		2		2	2	2	2	2	2	3	2		2	1	3	2	14							14	3	4	3
												2	2	2	2	2	2	2	3	2									9			1				2	2	9	4
												2		2	2	2	2	2			2		3		2	2	2	3	12	2	1	2		2		8	8		6
												2	2	2	2	2	2	2	2	2							2	2	11							1	1	11	3
												2	2	2	2	2	2	2		2		2							9							1	3	8	3
												2	2	2															3							1	1	3	3
												2					2	2	2	2				2					6									6	1
												2						2	2	2		3							5							1		5	2
												2																	1									1	1
												2																	1									1	1
												2																2	2								1	1	2
													2	2	2	2	2	2	2	2		2		2	2	3	2	2	14	2		1			1	10	6	1	6
													2	2	2	2	2	2	2	2	2								9					2	2	4	1	7	5
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													2																1						1				1
													2																1						1				1
													2	2															2							1		1	2
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													2							2									2									2	1
													2																1									1	1
													2																1									1	1
													2																1							1			1
													2																1							1			1
													2																1							1			1
														2	2	2	2	2	2	2	2	2							9							1	7	4	3
														2	2														2							1	2		2
														2		2	2	2	2	2		3	2	3	3	3			11				1			9	5		3
														2	3	2	2	2			2	2				2			8	1	1			2		8	1		5
														2															1						1				1
														3	3			3	2	2	2	2	2	2	2	2	2	3	13	1	7	2		2		7			5
														2		2	2		2								3		5	1						4	3		3
														1										2					2							2			1
														2															1						1				1
														2	2	3	2	2		2	2	3	2	2	3				11					2	7	8	2	1	5
														2															1							1			1
														2															1							1	1		2
														2															1						1				1
														2															1						1				1
														2															1					1					1
														2															1						1				1
														2															1						1				1

Cont.

Table 1: Sighting histories of whales seen in the PCFG in at least one year. In year columns, a 1 means the whale was only sighted in the spring (March-May), 2 means it was only seen in June-Nov, and 3 means it was seen in both March-May and June-Nov. The region value is the nunber of years the whale was seen in that region.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
														2															1						1				1
														2															1						1				1
														2															1						1				1
														2															1					1					1
														2		2									2		3	3	5	4				2			1		3
														2			2	2	2		2				2	3	3	2	9	7	1	1							3
														2															1	1									1
														2				2	2			2	2		2	2	2	2	9	5	1		1	1	1	2	2		7
														2															1	1									1
														2	2	2	2	2	2	2	2	2		2	2	2	2	2	14	10	2	4		1	1	3	1		7
														2															1	1									1
														2			2	2	2	2			2				2	3	8	3	3	4		1					4
														2															1	1									1
														2	2	2	2	2	2	2		2	2	2			3	2	12	3		2		7		5	1	1	6
														2	2		2	2	2		2	2		2	2		2	2	11	5	1	6		1					4
														2															1			1							1
														2	3	3			2			2	2	2	2				8	2		2		1		5	2		5
														2	2	2	2	2	2		2								7	2	1	3		1		3	2		6
														2	3	2		2	2	2	2	2	2	3	3	3	2	2	14	1		8	1	6	1	8	3	3	8
														2	2		2	2	2	2		2	2		2	2	2	2	12	1	1	6		1		4	3		6
														2															1					1					1
														2	2	2	2	2	2	2		2		2					9							2	6	4	3
														2											1				2								2		1
														2	2			3	2	2	2	2	2	2	2		3	2	12	2		1				4	5	4	5
														2	2													2	1							1		2
														2	2	2	2	2	2	2		2	2	2	3	3	2	3	14	5		4	1	3		1	8		6
														2			2									2			3	1						2	1		3
														2															1								1		1
														2	2	2	2	2	2	2	2	2	3	2	3		3	3	14		1	3		3	2	9	10		6
														2		2	2	2	2	2		2		2	2	2	2	2	12	4		2		4		3	4		5
														2	2	3	2	2	2	2	2								8							4	4	5	3
														2		2		2		2	2	2		2	2	2			9							4	3	7	3
														2				2	2	2		2		3	2	2		2	9					2	2	2		5	4
														2															1									1	1
														2															1						1				1
															2													1								1		1
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															2													1	1									1
															2													1	1									1
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															2	2		2			2		2		2	2	2	2	9	4	2	7		1					4
															2	2	2	2	2					2	2	3	2	3	10	10	2								2
															2		2	2								2	2	3	6	2	1	3				1	3		5
															3	1	3	2		2						2	2	2	8	2	1	1	4			1			5
															2	3		2	2	2	2	2	2		2	2	2	2	12			1	1	5		10	2	1	6
															2													1			1							1
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															2													1	1									1
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															2													1	1									1
															2				1									2							1	1		2
															2													1								1		1
															2													1								1		1
															2		2	2	2	2			2					6	1	2	1		1		2	1		6
															2													1								1		1
															2													1	1									1

Cont.

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															2														1			1							1
															2	2	2	2					2	2	2	3	3		9	8		3							2
															2														1	1									1
															2														1			1							1
															2														1								1		1
															2														1								1		1
															2														1	1									1
															2														1	1		1							2
															2														1	1									1
															2														1								1		1
															2														1								1		1
															2														1	1									1
															2														1	1									1
															2														1	1									1
															2														1	1									1
															2														1	1									1
															2														1	1									1
															2	2													2								2		1
															2														1			1							1
															1	2		2						2	2	3	2	2	8	6	1			1	1				4
															2														1	1									1
															2														1	1									1
															2														1	1									1
															2														1	1									1
															2														1	1									1
															2														1								1		1
															2														1	1									1
															2														1								1		1
															2														1								1		1
															2														1								1		1
															2														1	1		1							2
															2														1								1		1
															2	2	2												3							2	2		2
															2	2	2	2	2	2	2	2	1						9							4	1	8	3
															2														1							1			1
															3														1							1			1
															2														1									1	1
															2														1							1			1
															2														1								1		1
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																2	3	2	2	2		2		2	2	2	2	2	11				1	8	5	10	2	1	6
																2													1								1		1
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																2													1			1			1				2
																2	2	2	2	2		2	2	2	2	2	2	2	12	4	2	1	1	6		8	2		7
																2													1							1	1		2
																2													1								1		1
																3	3	2											3					1	1	2	1		4
																2													1						1				1
																2													1								1		1
																2													1							1			1
																2	2	2		2	2	2	2	2	2	2		2	11	1		1	1	1	1	7	6	1	8
																2													1							1			1
																2													1								1		1
																2	2	2	2	2	2	2		2	2	2	2	2	12	4	1	3		7		7	1		6

Cont.

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																2			2				2	2	2	3	2	2	8	5	4	1		1					4
																2	2	2		2									4			1						3	2
																2		2											2					1			1		2
																2		2							2	3	2	2	6	4	3	2		1		1			5
																2		2		2	2								4	2						2			2
																2													1	1									1
																2		2	2			2			2	2	2	2	8	7	3	1				1			4
																2													1	1									1
																2													1	1									1
																2													1	1									1
																2													1	1									1
																2													1	1									1
																2	2	2	2	2	2	2	2	2	3	3	3	2	13	5		3	1	4		10	3		6
																2		2		2									3	2	1								2
																3													1	1									1
																2													1	1									1
																2		2					2		2	2	2	2	7	5	1	3							3
																2				2						2			3	2						1			2
																2	3	2	2										4							3	3		2
																2	2	2	2	2	2	2		2	2	2	2	2	12							3	7	7	3
																2	2		2	2	2	3					1		7							5	1	3	3
																2	2	2	2	2	2							2	7					1	1	2	2	6	5
																2	2	2	2	2				2					6									6	1
																2	2		2	2									4									4	1
																2		2	2	2	2	1	3	2		1		2	10							8	2	7	3
																2													1									1	1
																2													1							1			1
																2													1							1			1
																	2	2		2						2			4	1		1		1		3			4
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																	2												1							1			1
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																	2	2	2		3	2	3	2	3	3	3	3	11	1		1			2	8	8		5
																	2	2		2	2	2	2						6							3	2	4	3
																	3	3											2							2			1
																	2	3											2						1	1	1		3
																	3												1							1			1
																	2												1							1			1
																	3												1							1			1
																	2												1					1		1			2
																	2												1							1			1
																	2												1					1		1			2
																	2	2											2					1		1	1		3
																	2												1							1			1
																	2												1							1			1
																	2												1							1			1
																	2												1					1					1
																	2												1					1					1
																	2		2								2		3	1				1		1			3
																	2	2	2	2		1							5					4	2	2	1		4

Cont.

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1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
																	2												1							1	1		2
																	2	2											2	1				2					2
																	2												1					1					1
																	2												1						1				1
																	2						2		2	2	2	2	6	5	1	2				1	1		5
																	2	3	3										3							3	1		2
																	2												1							1			1
																	2	2						2	2	2	2	2	7	6						1			2
																	2												1	1						1			2
																	2												1							1			1
																	2												1	1									1
																	2												1							1	1		2
																	2												1	1									1
																	2												1	1									1
																	2												1	1									1
																	2	2											2			1					1		2
																	2												1			1							1
																	2		2	2									3	1	2	1							3
																	2						2		2				3	2		1							2
																	2												1	1									1
																	2	2	2										3	2				1		1			3
																	2	2											2	1	1								2
																	2	2	2		2			2	2	2	2	2	9	7		1		1		1	2		5
																	2												1	1									1
																	2												1									1	1
																	2	2	2	2				2				2	6							3		5	2
																	2	2	2	2	2		2	2	2	2	2	2	11				1	1		7	4	3	5
																		2		2							2		3	1							1	1	3
																		2											1	1									1
																		2											1		1								1
																		2	2										2		1					1			2
																		2	2										2		2								1
																		2	2		1	1	3	2	2	2	2	3	10	4	6	2	3						4
																		2											1		1								1
																		2		2				2	2	2	3	2	7	3	6	1		1		2	1		6
																		2											1		1								1
																		2											1		1								1
																		2											1	1									1
																		2		2			2			1		2	5	1	1	2		1					4
																		2	2	2			2	2	2	2	2	2	9		9	1							2
																		2			2								2	1	2								2
																		2											1									1	1
																		2											1							1	1		2
																		3	2	2	2	3	3	2	3	3	3	2	11	1			1	5	4	10	4		6
																		2		2	2								3						2	2	2		3
																		2					2						2							2	1		2
																		2											1							1	1		2
																		2											1							1	1		2
																		2				2	2	2	2	2			6				1		1	4	2		4
																		2	2	2	3	2	2	2		2	2	2	10	1	1	1		2	2	9	2	1	8
																		2											1							1			1
																		2	2	2				2					4							3	1		2
																		2											1							1			1
																		2	2	2	3	3		2	2	2	2	3	10	3		2		6	8	10			5
																		3			1						3		3						1	3			2
																		2	2	2	3	3	2	2	2	3	2	2	11	3	1	4	1	4		8			6
																		2	2	2	2								4	1						2	1		3
																		2											1	1									1
																		2		2		3	2		1				5	1		2	1	3		2			5
																		2											1	1									1

Cont.

Table 1: Sighting histories of whales seen in the PCFG in at least one year. In year columns, a 1 means the whale was only sighted in the spring (March-May), 2 means it was only seen in June-Nov, and 3 means it was seen in both March-May and June-Nov. The region value is the nunber of years the whale was seen in that region.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
																		2		2			2		2		2		5	4	1								2
																		2											1	1									1
																		2											1	1									1
																		2											1	1									1
																		2											1	1									1
																		2											1	1									1
																		2	2										2	1						1			2
																		2											1	1									1
																		2											1	1									1
																		2	2		2	2	2	2	3	2	2	2	10	2			1	1		3	6		5
																		2											1								1		1
																		2				2	2	2	2	3	2	3	8	2		2	1	4	1	2	5		7
																		2			1								2						1		1		2
																		2										2	2							1	1		2
																		2	2		2	2	1	2	3	3	3	3	10						1	9	7		3
																		2	2	2	2	2	2	2	3	2	2	3	11			1	1	5	3	9	4		6
																		2	2	2	2							3	5					1				5	2
																		2	2				2		2	3	2	3	7	4	2	2	1	1					5
																			2	2	2	2	2	2					6		1	2				2	2	1	5
																			3	2	3	2						2	5							5			1
																			2										1		1								1
																			2	2		2							3					1	2	1			3
																			3	2	3								3					1	3	2			3
																			2	2	3	2	3	2	2	3	3	2	10			2		2	1	10	1		5
																			3	2	2	2	3	2	1	2	3	2	10	2	1	1		3	4	5	1		7
																			2		2								2					2		1			2
																			3		2	3	1	2	3	3	3	3	9					5	1	9	3		4
																			2	2	2				2	2	2	3	7	4				2	2	5	1		5
																			2	2									2							2			1
																			2										1							1			1
																			2										1							1			1
																			2	2									2							2			1
																			2	2	2	2	2	3	2				7			1		1	1	6	2		5
																			2	2	2								3			1			1	1		1	4
																			2										1									1	1
																			2	2			2						3			2						2	2
																			2	2	2	3	2	2	2	2	3	2	10			3		4	1	7	1		5
																				2			1						2						1	1			2
																				2									1							1			1
																				2									1							1			1
																				2									1							1			1
																				2	2	2	2	2	2	2	2	3	9	1		3		5	3	8	1		6
																				2									1							1			1
																				2									1							1			1
																				2									1							1			1
																				2	2	3	1						4					1		4			2
																				2	3	2	2	2	2	2	3	2	9	1	1			3	6	6	2		6
																				2		1							2							2			1
																				2									1							1			1
																				2	2	2	2	2	2	2	2	3	9			1		8	1	3	1		5
																				2	2			2	3	2	3	3	7					2	5	7			3
																				2	2	2	2	2	3	2	2	2	9					3	5	7	2		4
																				2					2				2	2									1
																				2									1		1								1
																				2									1			1							1
																				2		2							2							1		1	2
																				2	2								2								1	1	2
																				2	2								2							1		1	2
																				2	2	2	3	3	2	3	3	3	9					4	6	7	3		4
																				2		2		2					3						2		1		2

Cont.

Table 1: Sighting histories of whales seen in the PCFG in at least one year. In year columns, a 1 means the whale was only sighted in the spring (March-May), 2 means it was only seen in June-Nov, and 3 means it was seen in both March-May and June-Nov. The region value is the nunber of years the whale was seen in that region.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
																				2	2								2								1	1	2
																				2									1						1				1
																				2									1						1				1
																				2								2	2									2	1
																				2									1									1	1
																				2									1									1	1
																				2									1									1	1
																					2								1								1		1
																					2			2	2	2	2	3	6	4				2	1	3			4
																					2								1								1		1
																					2								1								1		1
																					2								1					1					1
																					2		2	2	2	2	2	2	7					1	4	1	3		4
																					2			2	2	3	3	2	6	5	3	2		1					4
																					2								1							1			1
																					2	2	3						3							1	3		2
																					2								1						1	1			2
																					2								1							1			1
																					3								1						1	1			2
																					2								1							1			1
																					2								1						1		1		2
																					2	2	1	2		2	2	1	7					4	1	3	3		4
																					2	2		3					3		1			3		1			3
																					2	2	3	3	2	1			6						2	4	1		3
																					2	2	2	2	2	2	2		7					4	5	4	4		4
																					2	2							2						1	2			2
																					2	2	2	3	2	3	3	3	8					3	4	8	2		4
																					2	2							2							2			1
																						3	3	2	2		3		5					1	3	4	2		4
																						2							1						1				1
																						2							1							1			1
																						1					2	3	3					3					1
																						2							1							1		1	2
																						2							1								1		1
																						2							1							1			1
																						2							1							1			1
																						2							1			1							1
																						1	2			2	2		4	1		1		1			1	1	5
																							2			2			2	1	1								2
																							2						1				1						1
																							2						1		1								1
																							2						1				1						1
																							2						1				1						1
																							2						1				1						1
																							2						1				1						1
																							2						1				1						1
																							2	2				2	3				1	1		1			3
																							2		2				2				1	1					2
																							2						1							1			1
																							2	2	2				3					1	2	2	1		4
																							2	2	2				3		2				1	1			3
																							2	2		2			3	1	2	1							3
																							2						1								1		1
																							2						1								1		1
																							2						1								1		1
																							2						1			1							1
																							1	2					2							1	1		2
																							2						1							1			1
																								2	2	3	2	3	5	5				1					2
																								2					1							1			1

Cont.

Table 1: Sighting histories of whales seen in the PCFG in at least one year. In year columns, a 1 means the whale was only sighted in the spring (March-May), 2 means it was only seen in June-Nov, and 3 means it was seen in both March-May and June-Nov. The region value is the nunber of years the whale was seen in that region.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
																								2					1								1		1
																								2			2	2	3					2	2	2	1		4
																								2					1									1	1
																								2			2		2					2	1				2
																								2	2	1	3	3	5	3				1	4	2			4
																								2	2				2	1					2				2
																								2				2	2					1	1				2
																								2	3	2	2	3	5						4	4			2
																								2					1						1				1
																								2	2	2			3						3				1
																								2					1						1				1
																								2	2	2			3	2				1	1				3
																								2					1						1				1
																								2		2	2		3	3					1				2
																								2					1						1				1
																								2					1						1				1
																								2					1		1								1
																								2	2	2	2		4					1	2	3			3
																								2		2	2	2	4		3	1							2
																								2		2	2		3	3									1
																								2					1	1									1
																								2					1	1									1
																								2		2	2	2	4	4									1
																								2					1	1									1
																								2					1	1									1
																								2					1	1									1
																								2					1	1					1				2
																								2					1	1									1
																								2	2	2	3	2	5	3				3		1			3
																								2					1	1									1
																								2					1	1									1
																								2					1	1									1
																								2					1	1									1
																								2					1	1									1
																								2		2	2	2	4	4									1
																								2					1	1									1
																								2					1	1									1
																								2					1	1									1
																								2					1	1									1
																								2				2	2	2									1
																								2					1	1									1
																								2					1	1									1
																								2					1	1									1
																								2		1			2	2									1
																								2	3	2			3	1					2	1			3
																									2				1							1			1
																									3	2	2	2	4						1	3	1		3
																									2	3		3	3	3									1
																									2	2	3	2	4	4									1
																									2				1							1			1
																									2	2	2		3	2						1			2
																									2				1	1									1
																									2		1		2	1		1							2
																									2				1			1				1			2
																									2				1							1	1		2
																									2	2	3	2	4	3	1	1							3
																									2				1						1				1
																									3				1							1			1
																									2				1							1	1		2
																									2				1	1									1

Cont.

Table 1: Sighting histories of whales seen in the PCFG in at least one year. In year columns, a 1 means the whale was only sighted in the spring (March-May), 2 means it was only seen in June-Nov, and 3 means it was seen in both March-May and June-Nov. The region value is the nunber of years the whale was seen in that region.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
																									2				1				1						1
																									1			3	2					1		1	1		3
																									2				1					1					1
																									2				1						1				1
																									2				1						1				1
																									2	2	2	3	4			2		1	1	2			4
																									2				1	1									1
																									2				1	1									1
																									2				1	1									1
																										2	2	2	3	1	1	1							3
																										2	2		2					1		1	1		3
																										2	2	2	3	3									1
																										2		2	2								2		1
																										2			1									1	1
																										2		2	2					2					1
																										2		2	2	2									1
																										2			1	1									1
																										2	2	2	3	2	1	1							3
																										2	2	2	3	3									1
																										3	3	3	3							3			1
																										2	2	3	3							3			1
																										2		3	2		2	1		1					3
																										2			1	1									1
																										2	2	2	3		3	1		1					3
																											2		1								1		1
																											3	2	2							2			1
																											2		1	1									1
																											2		1	1									1
																											2		1	1									1
																											2		1	1									1
																											2	3	2	2		1		1					3
																											2		1	1									1
																											1	3	2					1		1			2
																											2	2	2					2	1	1			3
																											2		1	1									1
																											2	1	2	1				1					2
																											2		1	1									1
																											2		1	1									1
																											2	2	2	2				1	1				3
																											2		1	1									1
																											2		1					1					1
																											3		1	1						1			2
																											2		1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												3	1			1		1					2
																												2	1	1						1			2
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
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																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1

Cont.

Table 1: Sighting histories of whales seen in the PCFG in at least one year. In year columns, a 1 means the whale was only sighted in the spring (March-May), 2 means it was only seen in June-Nov, and 3 means it was seen in both March-May and June-Nov. The region value is the nunber of years the whale was seen in that region.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	#years	NCA	SOR	OR	GH+	NWA	SJF	SVI	WVI	NBC	#areas
																												2	1	1		1							2
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1									1
																												2	1	1		1							2
																												2	1	1									1
																												2	1					1					1
																												2	1			1		1					2
																												2	1	1									1
																												2	1		1								1
																												2	1			1							1
																												2	1							1			1
																												2	1			1							1
																												2	1							1			1
																												2	1									1	1
																												2	1						1	1			2
																												3	1							1			1
																												2	1							1			1
																												2	1					1					1
																												2	1	1					1				2
																												2	1					1					1
																												2	1					1					1
																												3	1					1					1
																												2	1					1					1
																												2	1					1					1
																												2	1	1				1					2

Table 2: Sighting histories of whales seen in the MUA during 1 June - 30 November in at least one year. 1: whale sighted in PCFG but not in the MUA during that year, 2: only seen in MUA that year, and 3: seen in both MUA and another PCFG area.

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	3	3	1	1	1	1		1	1	1						
1		3	1	1	1	1	1	1	1	1	1	1		1	1	1
1		3	1	1	1	1	1	1	1	1		2		3	1	1
3		3	1	1	1	1	1	1	1	2		1	2	1	1	1
1		3	3	1	1	1	1	1	1	1	1	3	3			
1	3	3	1	1	1	1	3	1								
2	2		3			1		3	2	2					2	3
2	2															
1		3	3	1	1	1	1	1	1							
3		3	3	1	1	1	1	1	3							
3	2	3	1	3	3	1	1	1				1				
2		1	1	1	1	1	1	1	1	3	1	3	1	1	1	3
2																
1	1	3		1	1	1	1		1		1	1			1	
1	3	3	1	1	1	1	3	3	3	3	3	3	3	1	1	3
1	1	3	1	1	1	3	1	1		1		1	1		1	3
1		3	1	1	1	1	1	1	1	3	1	3	1	1	1	3
1		1	1	1	1	1	1		1	1		3	1	1	1	1
3		1	1	1	1			1	1	3						
2	2	3	1	1	3	1	1	1	1	1		3	1	1		
2	3	2														
2	2	3	1	1	1	1	1	1	3	3	3					
2	2	1	1	1	1		1	1	3	1	3	2	2		3	
3	2	1	3	1	1	1	1	1	3	3	1	3	3	1	3	3
3	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1
2	3	3	1	1	1	1	1	1				1		1		
2	3	3	1	1	1	1	1	1	1	3	1	3	3	1	3	1
2	2		2	2	2	1	3					3	3	1		
1	2	3														
2																
2	2	1	1		1	1		1								
1		1	1	1	1	1			1		1		1	1	3	3
	2	3	3	1	3	1	1	1	1	3	1		1			
	1	1	1	1	1	1	1	1	1	3	3	3	3	1	3	3
	3	3		1	3	2	3	1	1	1	1	3	1	3	1	3
	2	1	1	1	3	1	1		1		1		1	1	1	1
	1	1		1	3	1	1	1	1	1	1	3	3	1	1	1
	1	3	1	1	1	1	1	1		1		1	1	1	1	1
	3	1	3		1	1	1	1	3	1	3	1	1			1
	2	1	3													
	2															
	2	1	1	1	1	1	2	1	3							
	2															
	2															
	2	1	1	1	1	1	1	3	1	3	1	3	3	1	1	3
	2															
	1	1	1	1	1	1	1	1	3	3	3	3	3	1	1	3
	1	1	1	1	1	1		1	1	3	1	3				1
	1	1	1	1	1	1	1	1	1	1		3	1		1	1
	1			1	1	1	1	1		2	1	3	3	1	1	
		1			3	1	3	1	3							
		3	1													
		1	1	1	1	1	1	1	3	1	1	3	3	3	3	3
		1	1	1	1	1	1	1	1	1	1	3	3	1	1	1
		1	1	1	1	1	1	1	1	3	3					
		1	1	1	1	1	1	1	1	1	1	3	1	1	1	1
		1	1	3	1	1	1		3	1	1	1	3	3	3	3
		1				1	2	1			1		1			
		1	1	1	3	1			1	3				1		
		2														
		1	1			1	1	1	1	3	1	1	1	1	1	3
		2														
		3	3	3	3	1		1	1	3	2	3	1			
		2														
		2														
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		2														
		2														
		2														
		1				1	1			1	1		1	1	3	1
		1	1	1	1	1	3	1	1	2		1	1	1	1	1
		1			1	1	1	1	1	2	1	1	1	1	1	1
		1	1	2	2	3	3	1		3	3	2			1	1
		1	1		1	1	2		1	1		1	1		1	1
		1	1	1	1	1	1		3							
		1	1	1		1	1	1	1	3	1	3	1	3	3	3
		1	1		1	1	1	1		2	1		1	1	1	1
		2														
		1	1	1	1	1	1	1		1	1	1	1	1	3	3
		1	1	1	1	1	1	1	1	1	1	3	3		1	3
		1		3	3	1	1	1		3		3	1	1	1	1
		1				1	1	1		1		3	2	2		1
		2														

Cont.

Table 2: Sighting histories of whales seen in the MUA during 1 June - 30 November in at least one year. 1: whale sighted in PCFG but not in the MUA during that year, 2: only seen in MUA that year, and 3: seen in both MUA and another PCFG area.

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
			1		1	1		1			1	1	3	1	1	1
			2													
			1	1		1			1		1		3	1	1	1
			1	3		1	1	1	1	3	1		3	3	1	3
			1		1	1	3	1			1					
				1	3	1		1								
				1		1	1		1	3	3	1	3	3	1	3
				3	3	3	3	1		3		3	3	3	3	3
				1		1						1	1	1	3	1
				1	3											
				3												
				2	2	3	1	1		1	1	3	1	3	1	3
				3	3	1										
				2												
				1	1	1		1	1	1	1	3	1	3		1
				3	2	1	1	1	2	3		3	1	1	3	3
				1			1				1	1	1	1	3	1
				2		1										
				1		1							1	3	1	1
				1	1	1	1	1	1	3	1	1	1	1	3	3
				1	1	1	1	1	1							3
					3	1		1						1		
					2	1	1	1	3	2	1	3	1	1	1	3
					3	1	3									
					3											
					1	1	1		1	1	1	3	3	1	1	1
					3											
					3											
					3	1										
					2											
					2											
					2		1								1	
					3	3	2	2								
					2	3										
					2											
					2											
					1	1	3									
					1	1	1		1			1	1	1	1	3
					1	1	1	1	1		1	1	2	1	1	1
						1	3	1	1	1						
						1		1				1	1	1	1	3
						1		1			1					2
						1	1	2	1	3	1	3	3	1	3	1
						1		2	3							
						1				2	1	1	1	1		
						1	1	1	1	3	1	3		1	3	1
						3	3	3	3	2		3	3	3	3	3
						1	1	1	1	3	1	3	1	1	3	1
						1		1		3	3					
						1	1		1	1	1	1	3	1	1	1
						1				3	1	3	3	1	3	3
						1	1		1	1		3	1	1	1	1
						1	3	3	1	3	1	3	3	3	3	3
							2	1		2						
							3	3	2							
							1	1	1	3	1	3	1	1	1	3
							1	3	2	2	1	3		1	3	1
							3		2							
							1		1	3		3	3	3	1	3
							1	1	1				1	3	3	3
							1	1	1	1	1	3	1			
							1	1	3							
							2	3	1	2	1	1	1	3	1	3
								2								
								3	3	3	1	3	3	1	3	3
								1	1	3						
								3	2	3	2	3	3	1	1	1
								3	2	2	3	2	2	3	3	3
								3	3			3	3	3	3	3
								1	1	3	2	3	3	3	3	3
								2	3	3	3	3	1	3	1	3
								2		2		1				
								2								
								2								
									1			1	3	1	3	3
									2							
									1		2	2	2	1	3	1
									2			1	1	1	1	1
									3							
									3							
									2	3		2		2	1	
									3	2		1				
									1	1	2	1	2			
									3	3	2	3	3	1	3	
									1	3						
									1	3	3	3	3	1	1	3
										3	2	3	3		1	

Cont.

Table 2: Sighting histories of whales seen in the MUA during 1 June - 30 November in at least one year. 1: whale sighted in PCFG but not in the MUA during that year, 2: only seen in MUA that year, and 3: seen in both MUA and another PCFG area.

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
										2						
											1	1				2
											1		2			
											1	2	3			
											1	1	3			
											1			1	2	
												2				
												1	1	1	3	1
												3			3	3
												2			2	
												3	3		2	1
												3	2			
												2				2
												2	3	1	3	3
												2				
												2	2	2		
												2				
												2	3	1		
												2				
												3		1	1	
												2				
												2				
												2	3	1	1	
												3				
												1	2	2	1	3
												2	3	1		
													3	1	1	1
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														2	1	
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																3

Implications of observed whale movements on the relationship between the Sakhalin gray whale feeding aggregation and putative breeding stocks of the gray whale

Justin Cooke

ABSTRACT

Comparisons of photo-id catalogues collected in Mexico and off Sakhalin, supplemented by results of whales tagged in Sakhalin, are used to estimate confidence bounds on the proportion of adult Sakhalin whales that do not migrate to breeding grounds in Mexico. Examination of the matching results reveals that "adult" whales (≥ 7 years of age) of either sex from Sakhalin are more likely to be identified in Mexican waters than "young" animals, which may reflect a sampling bias towards adult animals from data collected in the nursing lagoons and/or a lesser tendency for younger whales to migrate. The union of confidence intervals for the two assumptions is that a proportion between 0 and 63% do not migrate to the eastern North Pacific. Further analysis of the Mexican photo-id data, and incorporation of photo and genetic matches from other areas, may enable this bound to be narrowed. Based on the results so far, the possibility of a western Pacific or Asian breeding ground used by some Sakhalin whales is neither confirmed nor excluded by these data, but that if one exists, it is used by at most 63% of the whales in the Sakhalin aggregation, with at least 95% confidence.

Introduction

Since the satellite tracking of the individual gray whale "Flex" from Sakhalin to the waters off the coast of Oregon in 2011 (Mate *et al* 2011) , the question to what extent the Sakhalin feeding aggregation consists of whales from the eastern North Pacific breeding stock(s) has become a focus of scientific attention. Over 30 individuals from the Sakhalin aggregation have been recorded in the eastern North Pacific by means of tagging, genetic matching, or photo-identification (IWC, 2015).

Each whale in the Sakhalin feeding aggregation is assumed to do one of three things each winter:

(1) Migrate to a breeding ground in the eastern North Pacific

(2) Migrate to a putative breeding ground in the western North Pacific

(3) Not migrate to a breeding ground, but possibly undertake more limited feeding migrations.

When an individual does not migrate to a breeding ground, it may not stay in the summer feeding ground if the habitat becomes ice-covered or otherwise unsuitable. The whale is likely to seek feeding opportunities in winter, but these may provide less favourable feeding conditions than the summer feeding ground. Winter feeding may or may not cover the energy requirements the whale. If it does not, the whale will lose some body mass over the winter, but perhaps not lose as much weight as those individuals that migrate to a breeding ground.

Based on experience with other baleen whales, e.g. right (ref) and humpback (ref), the proportion of whales which migrate to a breeding ground may be related to: sex; age (e.g.mature/immature); or, in the case of mature females, reproductive status (e.g. pregnant/non-pregnant). The analysis of migration should be stratified by these factors.

Material and methods

Table 1 lists whales identified off Sakhalin that have also been detected in the eastern North Pacific. A total of 31 Sakhalin whales have been detected in the eastern North Pacific, of which 19 have been photo-matched with the Mexican catalogues. For this analysis, the matches with the Mexican San Ignacio catalogue (17 matches), and the tagging results (3/3 tagged whales migrated east) were used. For the remainder of the matches, the effective sample sizes of the parent data sets in which they were found were not available.

Sakhalin photo-id catalogues

For the Sakhalin catalogue, the total sample is the combined photo-id catalogue of the Russia-US (Burdin et al. 2013) and IBM (Tyurneva et al. 2013) photo-id teams. This includes a total of 223 distinct whales as of 2011 (WGWAP, 2014), plus some new whales in subsequent years (mainly calves) which have not yet been cross-matched. The whales were subdivided according to the following criteria:

(a) known to be alive and belong to the Sakhalin population during most or all of the period 2006-12 (earliest sighting off Sakhalin not later than 2007 *and* latest sighting off Sakhalin not earlier than 2011).

(b) sex: male, female, or unknown

(c) “age” in two classes:

(i) “adult” (known to be born 1999 or earlier);

(ii) “(probably) young” (possibly born 2000 or later).

The year of birth is either known exactly (whale first seen as calf), or it is known to be at least 1 year prior to the first sighting (whale first seen as non-calf). In principle, the “(probably) young” class could include some older whales that were not sampled in their younger years.

The reason for the 1999 cutoff is that in Table 1 all but 2 of the matches are seen to be aged 7 or over in the years where they were seen in Mexico. Whales born in 1999 or earlier were aged 7 or greater in 2006-12.

Mexican photo-id catalogues

Urbán *et al* (2012) report a total of 3,121 annual identifications for the San Ignacio catalogue for the period 2006-11, similar to the figure of 3,099 from a reanalysis reported in Anon (2015). For 2012, Urbán et al (2013) report 670 identifications from San Ignacio and 272 from Magdalena Bay. The 3,405 distinct individuals in the 2006-11 “Mexican catalgoue” reported by Urbán *et al* (2013) presumably include individuals from the Magdalena Bay catalogue. Anon (2015) report 3,768 annual identifications (3,286 individuals) from San Ignacio for 2006-12.

Urbán et al (2012) found 13 Sakhalin matches in the San Ignacio catalogue for 2006-11. Urbán et al (2013) found four (4) Sakhalin matches with the 2012 Mexican catalogues for San Ignacio and Baja Magdalena, of which two (2) were new matches and were seen in Mexico only in 2012. It is unclear whether Urbán et al (2013) searched the 2006-11 Magdalena Bay data for Sakhalin matches: none were found.

A subsequent casual scan of the catalogues (Sychenko *pers. comm*.) yielded a further two (2) Sakhalin matches in the San Ignacio catalogue of which one was a calf of 2011 seen in San Ignacio in 2012 only, and a further two (2) Sakhalin matches in the Magdalena Bay catalogue, of which 1 had been seen in Magdalena Bay only in 1995.

The fact that further inspection of the catalogues revealed additional matches suggests that the matching process is not yet complete, and that further examination may reveal further, previously overlooked, matches. Thus the reported numbers of matches should be treated as minima.

For this analysis the San Ignacio data from the period 2006-12 were used. These include a total of 3,768 annual identifications consisting of 3,286 distinct individuals. Of these, 21 annual identifications (17 individuals) were confirmed Sakhalin matches.

The average resighting rate in San Ignacio for the following 3 years after a sighting in the period 2006-2011 was 16.1% (449/3099) which implies an annual resighting rate of approximately 5.4% (SE ~ 1.0%).

Population size

Regular surveys have been conducting of whales migrating southward past Granite Canyon on the California coast. The latest abundance estimate is 19,126 whales (CV 0.071) from the 2006/7 survey with an estimated growth rate of 3.2% (SE 0.5%) p.a. (Laake *et al*. 2012). The extrapolated average abundance for 2006-12 would be approximately 21,000 (CV 0.073).

The estimate implies an annual average sampling rate in the San Ignacio lagoon of 3.0% (SE 0.2%) of the entire migrating population, or 6.0% (SE 0.4%) of the available population if it is considered that only half the migrating population is available for sampling in breeding areas.

Population structure

The population assessment of the Sakhalin aggregation by Cooke (2014) implies that 45-51% of the aged 1+ population is aged 7+ (the minimum age for all but 2 Sakhalin matches in San Ignacio – Table 1). Given similar estimated annual average growth rates of 3.2% p.a. in Sakhalin (Cooke, 2014), and the eastern north Pacific (Laake et al. 2012), it seems reasonable to assume that the population structures were similar.

Statistical model

Let N_S represent the number of whales in a subset of the Sakhalin catalogue that meet a certain set of criteria. A proportion p of these migrate to the eastern North Pacific at least sometimes, while a proportion $1 - p$ never migrate east. Those which can migrate east have a probability q in any given year of migrating east and being sampled there.

Let N_M denote the number of Sakhalin whales meeting the criteria that are sampled in Mexico over an m-year period. The expected number of Sakhalin whales meeting the criteria that are sampled in Mexico over an m-year period is given by:

$$E(N_M) = N_S \, p\left(1-(1-q)^m\right)$$

assuming independent migration and sampling from year to year. Alternatively, if $M_{M,C}$ is the total number of times that Sakhalin whales are sampled in Mexico over an m-year period (without removing duplicates), then:

$$E(M_M) = mN_S \, p\, q$$

The two expressions are similar but the latter does not require the assumption of independence or the constancy of q. Provided that the span of data years is longer than the calving cycle, any calving-cycle dependence of the migration probability for adult females will be averaged out. In our case m = 7 (2006-12 inclusive).

For given values of q, the likelihood function for p is calculated based on N_S using the binomial likelihood or M_S with the Poisson likelihood. The likelihood is then multiplied by p^3 to reflect the fact that 3 out of 3 tagged whales migrated east.

Results

Table 2 shows the numbers of Sakhalin whales by criterion that were matched or not matched in the San Ignacio catalogue 2006-12.

The matching rate (2/119) of those not meeting criterion (a) is significantly ($p < 0.01$) lower than the matching rate (15/125) of those meeting criterion (a). Only those meeting criteria (a) were included in the rest of the analysis.

The matching rate of "adult" whales (13/70) is significantly ($p < 0.05$) higher than that of "young" whales (2/54) .

Among "adults", the matching rates of males (7/37) and females (5/27) are about the same. There is no significant ($p > 0.05$) sex difference regardless of whether young whales are included or not, and regardless of whether unknown sex whales are included or not, or to which sex they are assigned if included.

Based on these findings, the criterion for estimating the migration proportion was "adult" whales known to be alive at least through 2011. For whales satisfying these criteria, best estimates and 95% confidence limits for p are shown in Table 3 for different values of q.

If all the whales migrating past Granite Canyon are representative of whales that are available for sampling in the Mexican breeding grounds, i.e. consist almost exclusively of adult whales, then $q \sim 0.03$. In this case then the expected number of Sakhalin-Mexico matches is approximately equal to the observed, and the best estimate for p is 1.0 with confidence limits (0.69 to 1.0).

Based on population modelling (see above) it is estimated that approximately half the aged 1+ whales in the population are aged 7+. If adult and other whales migrate at equal rates, so that the whales migrating past Granite Canyon are representative of the total population, then the annual sampling rate in San Ignacio represents approximately 6% of the adult population. This would be consistent with the average annual resighting rate of 5.4% in San Ignacio. If only half the whales migrating past Granite Canyon are "adult" whales then the confidence limits for p are 0.38 to 0.91.

Given the aim of the exercise is to place bounds on p, the union of these two intervals (0.37 to 1.0) is the narrowest bound that can be placed. This implies that the existence of a western Pacific or Asian breeding ground used by Sakhalin whales is neither confirmed nor rejected by these results, but that if it exists, a maximum of 63% of Sakhalin whales currently use it.

Further analysis of the Mexican photo-id data is warranted for two reasons. First, more careful examination of the catalogues may reveal further Sakhalin matches. Second, an analysis of the recapture rates may enable bounds to be placed on the annual sampling rate q, so that assumptions about the population component represented by the Granite Canyon census do not need to be made. Also, the non-Mexican photo-id and genetic matching data should be examined to determine the effective sample sizes of the data sets in which the matches were found, such that these data sets could be include din the likelihood.

Following the three sets of analyses, it may be possible to narrow down the bounds for p.

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Table 1. Matches of Sakhalin whales in the eastern North Pacific (IWC, 2015)

RUS ID#	IBM ID#	Sex	First seen Sakhalin	Last seen Sakhalin	Year as calf	Latest birth year	ENP area	Method	First seen ENP	# years ENP	Min age ENP
141	127	F	2005	2011	2005	2005	GOA	TAG (OSU)	2013		8
68	43	M	1994	2013		1993	CA	PHOTO (OSU)			
166	152	M	2007	2010	2007	2007	CA	GENETIC			
3	114	F	1997	2013		1996	MEX	PHOTO	2011	1	14
20	80	M	1997	2013	1997	1997	MEX	PHOTO	2006	1	9
27	2	M	1995	2011		1994	MEX	PHOTO	2002	1	7
28	59	M	1997	2013		1996	MEX	PHOTO	2006	1	9
29	28	F	1997	2012		1996	MEX	PHOTO	2010	1	13
33	116	M	1997	2013		1996	MEX	PHOTO (SFS)	2007	1	10
38	64	F	1995	2013		1994	MEX	PHOTO (SFS)	1995	1	
42	90	F	1997	2013		1996	MEX	PHOTO	2009	1	12
47	9	M	1995	2013		1994	MEX	PHOTO	2012	1	17
52	26	M	1998	2013		1997	MEX	PHOTO	2007	2	9
63	47	F	1997	2013		1996	MEX	PHOTO	2008	1	11
69	113	M	1998	2013		1997	MEX	PHOTO	2006	1	8
85	51	F	1999	2013		1998	MEX	PHOTO	2008	3	9

91	137	M	2000	2013	2000	2000	MEX	PHOTO	2011	1	11
94	57		2000	2011		1999	MEX	PHOTO	2006	1	6
103	119	F	2001	2013		2000	MEX	PHOTO	2007	2	6
107	108	F	2002	2013	2002	2002	MEX	PHOTO	?		
200	191		2011	2011	2011	2011	MEX	PHOTO	2012	1	1
999	166		2004	2009		2003	MEX	PHOTO	2009	1	5
2	17	M	1994	2010		1993	PNW	PHOTO			
35	94	M	1995	2013		1994	PNW	PHOTO			
78	41		1999	2013		1998	PNW	PHOTO			
119	75	F	2003	2013	2003	2003	PNW	PHOTO			
135	95	F	2004	2013	2004	2004	PNW	PHOTO			
32	68	M	1997	2012	1997	1997	PNW	PHOTO/TAG (OSU)	2011		14
129	73	F	2003	2011	2003	2003	MEX	TAG (OSU)	2013		10
16	11	M	1995	2011		1994	SCB	GENETIC			
76	62	F	1999	2013		1998	SCB	GENETIC			

Table 2. Summary of Matches of Sakhalin whales with the San Ignacio, Mexico catalogue 2006-12, by category (see text).

			Match	Non-match	Subtotals
Known alive 2007-11	"Young"	Female	2	15	17
		Male	0	25	25
		Unknown	0	12	12
		Subtotal	2	52	54
	"Adult"	Female	5	22	27
		Male	7	30	37
		Unknown	1	6	7
		Subtotal	13	58	71
All other Sakhalin whales			2	117	119

Table 3. 95% confidence bounds for p for different q values

	p		
q	Lower cl	Best	Upper cl
0.03	0.69	1.00	1.00
0.06	0.37	0.61	0.91

Report of the Second Workshop on the Rangewide Review of the Population Structure and Status of North Pacific Gray Whales

Report of the Second Workshop on the Rangewide Review of the Population Structure and Status of North Pacific Gray Whales[1]

EXECUTIVE SUMMARY

This Workshop was a technical follow-up to the 2014 Workshop that had fully reviewed the available information including stock structure, abundance and biology, with a view to developing an initial modelling framework for gray whales throughout the North Pacific. The Workshop reviewed the progress made intersessionally on recommendations made at the 2014 annual meeting of the Scientific Committee (SC/65b). These included additional work on the comparison of photographic and genetic catalogues, development of Single Nucleotide Polymorphisms (SNP) assays for use with gray whales to improve genetic analyses, additional work including a new research cruise to improve the sample sizes (genetic and photo-identification) for the northern feeding areas, additional telemetry work, improved abundance estimates for PCFG (Pacific Coast Feeding Group) whales, improved early catch history data for the western North Pacific and better estimates of ship strikes and bycatches throughout the North Pacific. Focus within the Workshop was on how the additional information could feed into the modelling framework, now and in the future. A key analysis identified at the initial workshop was to examine the existing data to see what bounds could be put on the proportion of animals breeding in the western North Pacific as opposed to those regularly feeding in the western North Pacific. Following an analysis by Cooke (SC/A15/GW2), the Workshop concluded that if such a breeding ground exists, then the proportion of the Sakhalin animals that use it is probably lower, and possible considerably lower than 63%. The Workshop made a number of recommendations for work to be undertaken that would narrow the confidence range for this.

The Workshop's primary focus was to review the excellent intersessional work undertaken by Punt (SC/A15/GW1) to produce initial specifications and runs for the age- and sex- structure population dynamics model. The Workshop reviewed progress and in particular examined the parameterisation of the hypotheses allocated as priorities for examination at the 2014 Scientific Committee meeting and updating the modelling framework. This involved further schematic visualisation and clarification of the hypotheses and work to develop the catch mixing matrices and finalisation of the datasets by hypotheses. The Workshop also refined the manner in which uncertainty will be reflected in the trial structure and developed a workplan to allow initial results to be considered at the 2015 Scientific Committee meeting. The importance of developing a plan to update the IUCN/IWC Conservation Management Plan at the 2015 Scientific Committee meeting (SC/66a) was also noted.

1. INTRODUCTORY ITEMS

1.1 Convenor's opening remarks
The Workshop was held at the Southwest Fisheries Science Center (SWFSC), La Jolla, California, from 1-3 April 2015. The list of participants is given as Annex A.[1]

Donovan welcomed the participants to La Jolla and thanked Weller and the Southwest Fisheries Science Center for the excellent facilities. He noted that this was primarily a technical Workshop to review the modelling work recommended by the Scientific Committee at the 2014 Annual Meeting in the light of the work undertaken during the first Workshop (IWC, 2015c).

1.2 Election of Chair
Donovan was elected Chair.

1.3 Appointment of rapporteurs
Reeves, Brandon, Cooke, Lang and Punt were appointed rapporteurs with assistance from the Chair and others as appropriate.

1.4 Adoption of Agenda
The adopted agenda is given as Annex B.

1.5 Documents and data available
The list of documents is given as Annex C.

2. SHORT REPORT ON PROGRESS ON 'NON-MODELLING' RECOMMENDATIONS

The Workshop assessed progress on implementation of the recommendations from the previous (April 2014) gray whale Workshop (IWC, 2015c).

2.1 Preliminary comparison of identified gray whales in Mexico, off central California and in the PCFG with a focus on mothers and calves
The objectives of this recommendation related to improved assessment of internal recruitment into the PCFG (Pacific Coast Feeding Group) (IWC, 2013a), improved estimates of calf survival and better determination of the number of known reproductive PCFG females that have been biopsied.

Weller reported that his group had completed preparation of a catalogue of mother-calf pairs photographed from shore off central California (Piedras Blancas) during 2012-14 and this was to be posted on the SWFSC website within the next few weeks. Jorge Urbán and John Calambokidis are expected to then compare their catalogues to the SWFSC catalogue with the principal goal of evaluating recruitment into the PCFG. The Workshop **recommends** that Weller notifies Urbán and Calambokidis when the catalogue is available and works with them to determine a realistic timeframe for completing the comparisons.

Once the results are obtained, further work will be required to develop an approach for using the results to derive mixing rates. It was noted that the three years (2012-14) to be considered may be insufficient to obtain reliable 'long-term' averages.

2.2 Comparison of photographs (and genetic material) of gray whales from areas of the Okhotsk Sea and elsewhere in Asia with the Sakhalin and Kamchatka catalogues
No formal progress had been made on implementing this recommendation which will, once completed, enable better understanding of stock structure and movements on the western side of the Pacific. However, the Russia-US team had previously reported photographic matches between Sakhalin and Paramushir Island (northern Kuril Islands) and the Shantar archipelago in the western Okhotsk Sea and at

[1]Presented to the Scientific Committee meeting as SC/66a/Rep08.

Bering Island in the Bering Sea (IWC, 2015b). Tyurneva (IBM, Vladivostok) has also reported on some photographs from areas of the Okhotsk Sea other than Sakhalin and eastern Kamchatka (Tyurneva *et al.*, 2012). Donovan will contact Tyurneva in this regard.

With respect to genetic material, Pastene reported (pers. comm.) that: (a) tissue samples from five animals (plus a calf) of the six analysed in Kanda *et al.* (2010), which were thought to have been lost in the tsunami, do still exist, since sub-samples have been discovered in his Tokyo laboratory; and (b) the only Russian samples held in Japan are the seven analysed in Kanda *et al.* (2010) (these were lost in the tsunami). Donovan will contact Ilyashenko regarding the 'about 150 samples' from Russia referred to in IWC (2015c). Brownell agreed to consult with Yamada on potential material that either has gone to or is planned to go into museum displays (or at least collections) in Japan.

The Workshop **recommends** that Weller and Brownell modify the table from Kato *et al.* (2014), adding new records and supplementing information on included records, as appropriate. This should include confirmed non-matches or probable non-matches, as well as matches.

2.3 Development of Single Nucleotide Polymorphisms (SNP) assays for use with gray whales

This recommendation would *inter alia* allow integration of genetic data between laboratories and over time and facilitate work with low quality samples such as bone and baleen. The Workshop was informed of two next generation sequencing projects that are planned to begin this year.

Bickham reported that, in collaboration with Andrew DeWoody of Purdue University, a project to sequence the genome of four gray whales (a male and a female each from the Northern feeding ground and the Sakhalin feeding ground) will begin in 2015. Once genome sequencing is complete, sites that are variable (SNPs) within and among individuals will be identified, and SNP assays will be designed to genotype additional samples (n=35) collected from gray whales off Sakhalin Island at ~100 of these SNP loci. This work will be completed in 2015, and the results will be presented to the IWC Scientific Committee in 2016.

In addition, Lang reported that SWFSC plans to conduct SNP genotyping of ~200 samples of gray whales from the Northern feeding ground, the PCFG and Sakhalin. These genotypes will be generated using a 'genotype-by-sequencing' approach based on a double digest restriction-site associated DNA sequencing protocol. Expected results include the identification of hundreds of SNP loci in gray whales; the data is anticipated to be available in spring 2016. In both studies, the resulting sequence data (e.g. genome and primer sequences in the Bickham study, nuclear sequences encompassing SNPs in the SWFSC study) will be published to allow gray whale researchers in other labs to design SNP genotyping assays for use with traditional and/or next generation sequencing approaches. In addition, Bickham and Lang plan to work together to review the pooled data and select a subset of SNP loci that can be recommended for inclusion in future genetic studies of gray whales, in order to facilitate combining data across labs and over time.

The Workshop **welcomed** this excellent progress and thanked Bickham and Lang for their efforts to ensure this recommendation is being implemented.

2.4 Increased sample size and coverage from the eastern North Pacific

This recommendation will improve comparisons amongst feeding areas and improve stock structure hypotheses for future modelling exercises.

The Workshop considered what additional material has become available (photographs and genetic samples) since the last workshop (IWC, 2015c, table 1).

Potential sources include the North Slope Borough, Alaska (Lang will check on additional data since April 2014), the Chukotka hunt (Brownell will check on what was reported at the last Scientific Committee meeting in May-June 2014), and Urbán's programme in Baja California (Lang will check with Urbán).

2.4.1 2015 Research cruise

Perryman reported that the SWFSC may get access to two months of ship time for a cruise starting in Ketchikan, Alaska, and working south through portions of the Gulf of Alaska, possibly to begin in August 2015. Collection of gray whale photographs, biopsies and possibly deployment of satellite tags, particularly in the area between Kodiak Island and northern California (i.e. the broadest extent of the putative PCFG range), would be a primary objective of the cruise.

The Workshop **welcomed** this news and **recommends** that a cruise of this nature be conducted, and highlighted the value of such work in filling important data gaps, particularly with respect to better understanding the dynamics of the PCFG.

The Workshop also **recommends** that gray whales on northern feeding grounds (e.g. Alaska and Chukotka) are photographed and existing and new photographs are shared with catalogue holders for evaluating the mixing of PCFG and WFG whales on northern feeding grounds.

2.5 Continued telemetry studies

This recommendation was a reiteration of the need for additional telemetry work (IWC, 2012a; 2015b), especially in feeding areas such as Kamchatka, Sakhalin and Chukotka. Such studies provide information on habitat use, migration routes, vulnerability to anthropogenic removals, etc.

The Workshop noted that no further telemetry work with gray whales had taken place since April 2014. Mate reported that the analysis and writing up of previous telemetry studies, including those summarised in IWC (2015c) is progressing well and will be published soon in *Biology Letters*. The proposed telemetry work off Sakhalin in summer 2015 (IWC, 2015c) will not take place due in part to the extensive seismic survey work taking place and the focus on monitoring and mitigation work. It is hoped that more telemetry work will take place off Sakhalin in 2016 but as yet there are no confirmed plans.

The Workshop **reiterated** its previous recommendations for continued telemetry studies (and see the discussion under Item 3.1 and the recommendations under Item 5).

2.6 Improved abundance and trend estimates for the PCFG by identifying and using additional photographic sources

It is important to know the degree to which there was large-scale recruitment into the PCFG during the period prior to around 1998 (which would have to have been from an external source) to evaluate the status of the PCFG. Laake reported that some progress has been made and the Workshop **reiterates** its previous recommendation (IWC, 2015c).

2.7 Improved estimates of western North Pacific catches 1890-1910

The Workshop recognised that the present modelling exercise begins in 1930, i.e. that improved 1890-1910 catches were not a high priority in the short term but are of longer-term value.

Although little progress had been made to date on this recommendation, Brownell reported that he believed that some operational data must be available in Norwegian sources because vessels and captains during this time period were from Norway. Any study on this topic will require participation by researchers with appropriate language abilities, i.e. mainly Japanese, but also Russian and Norwegian sources will need to be checked. Brownell **agreed** to pursue this with colleagues in Japan and Norway and report back at the 2015 Annual Meeting of the Scientific Committee (SC/66a) in May 2015.

2.8 Improved estimates for future ship strikes and bycatches throughout the North Pacific

Scordino reported that considerable progress had been made on this recommendation including presentation of Scordino *et al.* (2014) at the 2014 Annual Meeting (IWC, 2015b). This is discussed further under Item 4.3 and details are provided in Annex D.

3. PROGRESS REPORT ON MODELLING-RELATED ISSUES

3.1 Putting bounds on the proportion of Sakhalin whales that migrate to the eastern North Pacific

As part of the long-term study on whales off Sakhalin Island, Russia, photo-catalogue comparisons of gray whales in the western (WNP) and eastern North Pacific (ENP) have been undertaken to assess population mixing. These comparisons included:

(1) a systematic comparison of a WNP 'Sakhalin Catalogue' (i.e. comprising animals photographed off Sakhalin Island) to an ENP 'Pacific Northwest Catalogue' that consisted of images from the northwest coast of North America (Weller *et al.*, 2012); and
(2) a systematic comparison of a WNP 'Sakhalin Catalogue' and 'Kamchatka Catalogue' (i.e. animals photographed off Kamchatka) to an ENP 'Lagoon Catalogue' that consisted of images from central Baja California, Mexico.

The Sakhalin to Pacific Northwest comparison consisted of 181 and 1,064 whales, respectively, and resulted in 6 matches (Weller *et al.*, 2012). The Sakhalin to Mexico comparison consisted of 232 and 7,493 whales, respectively, and resulted in 17 matches (Urbán R. *et al.*, 2013; Urbán R. *et al.*, 2012). The Kamchatka to Mexico comparison consisted of 150 whales and 7,493 whales, respectively, and resulted in 6 matches (Urbán R. *et al.*, 2013; Urbán R. *et al.*, 2012).

SC/A15/GW2 looked at whether the available matching data could be used to place bounds on the proportion of Sakhalin whales that migrate to the eastern North Pacific, as recommended by the first Workshop (IWC, 2015b). The photo-identification matches between the Sakhalin catalogues and the 2006-12 part of the San Ignacio catalogues were used, in addition to the three successfully tagged animals in Sakhalin.

The photographic matches showed that around 90% of the Sakhalin-Mexico matches (17 out of 19) consisted of whales that were: (a) 'adults' (age at least 7 by 2006); and (b) known to be alive at least until 2011.

The expected number of matches that would be found for a given value for the proportion of Sakhalin whales that migrate to Mexico depends on the annual sampling rate in Mexico. The author noted that if all the ~20,000 whales migrating past California are 'adults', then the observed number of matches is approximately equal to the number that would be expected if all Sakhalin adults migrate to Mexico. However, if the whales passing California include a substantial number of juveniles that do not enter the sampled areas in Mexico (i.e. in this case San Ignacio lagoon), then the sampling rate of adults is higher, and the number of matches is less than would be expected if all Sakhalin whales migrated to California and Mexico.

The author of SC/A15/GW2 had noted that if neither hypothesis can be ruled out at this stage, the union of the confidence limits, 0.37 to 1.0, was the current feasible range for the proportion of Sakhalin animals that migrate to the eastern North Pacific. In summary, this would imply that the data neither confirm nor reject the existence of a western breeding ground. However, if such a breeding ground exists, then an approximate upper bound for the proportion of the Sakhalin animals that use it would be around 63%.

The Workshop considered the available evidence with respect to the animals that are included in the California census data. Rice and Wolman (1971) have shown that the migration of gray whales in the eastern North Pacific is segregated by age, sex and reproductive condition. Catch data and multiple other lines of evidence show that all age and sex class segments of the population migrate past central California on their way to wintering areas off Baja. The first pulse of migrants is led by: (a) near-term pregnant females; followed by (b) oestrous females and mature males; and then (c) immature animals of both sexes.

While in the wintering grounds, whales are segregated by age and sex group (Norris *et al.*, 1983; Swartz *et al.*, 2006). Lagoon entrance aggregations are composed of males, non-parturient females and juveniles. By contrast, females with calves concentrate within the interiors of lagoons. This segregation of whales without calves from females with calves is an extension of the age and sex segregation seen during the spring and fall migrations (Rice and Wolman, 1971). Mate (pers. comm.; IWC, 2015, p.494) had noted that 8 of 17 animals satellite tagged that were found in Mexican waters did not have any high quality locations within the lagoons.

Primarily based on information from Rice and Wolman (1971), the northward migration begins about mid-February and is also segregated according to age, sex and reproductive condition. The first phase of this northern migration includes: (a) newly pregnant females; followed later by (b) adult males and anoestrous females; and then (c) immature whales of both sexes. The second phase consists mostly of mothers with calves. These pairs are observed on the migration route between March and May and generally arrive to the summer feeding grounds between May and June.

In the light of this information, the Workshop **agreed** that it seemed unlikely that the California census data excluded large numbers of juveniles (or indeed any classes) of gray whales. However, it also noted that the available evidence could not rule out that large numbers of animals (including juveniles) do not enter the lagoons. Thus while it concurred with the author of SC/A15/GW2 that the available data neither confirm nor reject the existence of a western breeding ground, it **agreed** that if such a breeding ground exists, then the proportion of the Sakhalin animals that use it probably lower, and possible considerably lower than 63%.

With a view to narrowing the confidence range for the proportion of Sakhalin whales that migrate east, the Workshop **recommends** the following priority analyses:

(1) that the Mexican catalogues be re-examined with a view to finding further Sakhalin matches that may have been overlooked to ensure that the underlying data best reflect the correct number of matches *and* non-matches;

(2) that the Mexican photo-identification data, and particularly that for Laguna San Ignacio, be analysed using mark-recapture models with a view to estimating the size of the sampled population (this will allow improved estimates of the sampling rate) a critical parameter that affects the expected number of matches under any given migration hypothesis;
(3) that other sources of data, including the Pacific Northwest catalogue and the genetic data set held by the SWFSC, be included in updated analyses of those presented in SC/A15/GW2. Although these data sets are smaller, they will inform the estimates of the proportion of juvenile whales that participate in the migration.

Recognising that telemetry studies off Sakhalin can provide considerably more information than simply related to the proportion of animals that migrate east, the Workshop **agreed** that at least in this context, tagging of non-calf animals (<7 years) is important; the youngest of the three successfully tagged whales to date has been 10 years old. While the successful tagging of a small number of additional adults (say three) in Sakhalin would narrow the confidence interval on the proportion only modestly if all the tagged whales migrate east, the results would be revealing if one or more animals migrates to the western Pacific destination.

There was some discussion of the significance of gray whales found in Japanese waters, including a recent (March 2015) sighting that was successfully matched with the Sakhalin catalogue. It would be helpful to ascertain the relative age of these individuals (juvenile or adult). Finding mature animals off Japan at the time of the northward and southward migrations would be more suggestive of there being a western breeding ground.

3.2 Continued development of the population model for the Sakhalin feeding area

Two updates of the model had been presented to the 14th WGWAP meeting held in Sakhalin in October 2014 using: (a) the Russia-US Sakhalin photo-identification data 1994-2013; and (b) the Russia-US 1994-2013 data together with the IBM Sakhalin data 2003-11 and the Kamchatka data 2006-11 (Cooke *et al.*, 2014; IUCN, 2014).

For the analysis using all three data sets, the model had been extended to allow for different stage-specific availabilities in the three data sets. This extension largely resolved the problems encountered in previous attempts to reconcile the three data sets. Juvenile animals (apart from calves) were found to be under-represented in the Sakhalin catalogues and over-represented in the Kamchatka catalogues, relative to other population components.

Both analyses yielded strong evidence of annual variability in calving rate. The analysis using the Sakhalin data alone yielded some indication of annual variation in the calf survival rate, but this effect disappeared when the Kamchatka data were included, because some of the 'missing' young animals were found in Kamchatka. The best estimate of the Sakhalin population in 2013 was 38 mature females (SE 2) growing at an average rate of 2.5% (SE 0.5%) over the previous 10 years. The best estimate of the age 1+ population in 2013 was 176 (SE 2).

3.3 Development of an age- and sex-structured model

In response to recommendations at the 2014 Annual Meeting of the Scientific Committee (IWC, 2015a), SC/A15/GW1 provided *inter alia* specifications for a sex- and age-structured population dynamics model which can represent the stock hypotheses developed during the April 2014 rangewide review of population structure and status of North Pacific gray whales (IWC, 2015b). The model allows for more than one population, each of which can have 'sub-stocks', multiple feeding and wintering grounds, and different migratory corridors. Animals can move between sub-stocks in a pulse or diffusively. The values for the parameters of the model can be estimated by fitting it to data on trends in relative and absolute abundance, as well as mixing proportions (e.g. based on sightings data). While the model itself is generic, the specifications include choices made by the Scientific Committee when an operating model was developed to evaluate alternative *Strike Limit Algorithms* for the PCFG for the eastern north Pacific gray whales (IWC, 2013a). An example application of the model was provided in the paper based upon one of the priority stock structures, i.e. hypothesis 3e (IWC, 2015b) and see Item 4.2 below.

The model in SC/A15/GW1 differs from that presented to the 2014 Scientific Committee (Punt, 2014) because it: (a) is age- and sex-structured; (b) splits the 'North' sub-area into two sub-areas ('southeast Alaska' and 'North'[2]); and (c) considers 'feeding' (Jun.-Nov.) and 'movement' (Dec.-May) seasons for the BCNC and CA sub-areas to account for differences in the relative vulnerability of sub-stocks to bycatch among seasons. SC/A15/GW1 uses the abundance data for the SI sub-area, as well as the estimates of abundance for the BCNC sub-area and the counts off California, and data on mixing rates from Scordino *et al.* (2014). The updated model also includes more sub-areas and seasons, but the extent to which the model can be extended is limited by available data (i.e. sub-areas lacking sufficient data are not included in the model).

The Workshop thanked Punt for developing the age- and sex-structured model and thanked members of the Steering Group for their comments on the model during the intersessional period.

4. UPDATE MODELLING FRAMEWORK

4.1 Review of the nomenclature for stocks, sub-stocks and sub-areas

The model in SC/A15/GW1 is complex and uses terminology (e.g. 'stocks' and 'sub-stocks') developed initially for evaluating variants of the RMP (Revised Management Procedure; IWC, 2012b). Given that this may lead to misunderstanding, the Workshop **agreed** to revise and clarify some of the terminology used in the specifications of the model.

(1) *Breeding stock*. The conceptual model of gray whales in the North Pacific considers two populations or 'breeding stocks': the 'Western' (that breeds in Asian waters) and the 'Eastern' (that breeds in Mexican waters). The analyses assume that all animals are part of one of the two breeding stocks and there is no interchange between breeding populations. The 'Western' breeding stock is extinct in some scenarios.
(2) *Feeding aggregation*. Each breeding stock can consist of one or more feeding aggregations. A feeding aggregation is part of a single breeding stock and may be associated with several sub-areas with respect to feeding and migration. Feeding aggregations move among sub-areas during the year and may be subject to catches, bycatches and other anthropogenic impacts as they migrate (as well as when they are on the

[2]See Item 4 for revised names of the sub-areas.

summering and wintering grounds). Animals from more than one feeding aggregation may be found in each sub-area. Animals may disperse permanently between feeding aggregations (but not breeding stocks). Density-dependence is assumed to operate by feeding aggregation and as a function of abundance relative to carrying capacity in the feeding sub-areas in which the feeding aggregation is found (SC/A15/GW1).

The Workshop recognised that having the same names for feeding aggregations and sub-areas as has been previously done (e.g. during the first Workshop) may lead to misunderstandings. The Workshop therefore **agreed** to the following revised terminology (and see figures in Annex E).

(1) *Breeding stocks*. There are up to two extant breeding stocks (Western and Eastern).
(2) *Feeding aggregations*. The eastern breeding stock consists of up to three feeding aggregations depending on hypotheses: Western Feeding Group (WFG)[3], Pacific Coast Feeding Group (PCFG) and 'North'. There is dispersal between the PCFG and North feeding aggregations, but the WFG is demographically independent of the other two feeding aggregations (i.e. there is no *permanent* movement of animals from the North or PCFG to the WFG).
(3) *Sub-areas*. The model includes 11 geographic sub-areas to explain the movements of gray whales in the North Pacific:
    (a) Vietnam-South China Sea [VSC];
    (b) Korea and western side of the Sea of Japan [KWJ],
    (c) eastern side of the Sea of Japan and the Pacific coast of Japan [EJPJ],
    (d) off Sakhalin Island [SI],
    (e) areas of the Okhotsk Sea not otherwise specified [OS],
    (f) East Kamchatka and the Kuril Islands [EKK],
    (g) the Northern Bering and Chukchi Sea [BSCS],
    (h) Southeast Alaska [SEA],
    (i) British Columbia to Northern California [BCNC],
    (j) California [CA]; and
    (k) Mexico [M].

The model also includes two 'latent' sub-areas used to link model predictions to observed indices of abundance. These are denoted Calif-3 and BC-BCA-3.

'Catch mixing matrices' are a core component of the model of SC/A15/GW1. Several approaches have been used by the Scientific Committee to account for movement of animals across space and the consequences to them of catches and bycatches, e.g. IWC (2014) for North Pacific common minke whales. The approach taken in SC/A15/GW1 does not explicitly model movement but rather considers the relative vulnerability of each feeding aggregation to anthropogenic removals by sub-area. Thus, the entries in the catch mixing matrices reflect relative vulnerability.

To illustrate this, consider the catch in which two feeding aggregations of sizes 100 and 900 are found in a sub-area. If the values in the catch mixing matrix for this sub-area for these feeding aggregations were 1 and 1 respectively, the probability of a catch being from the first feeding aggregation would be 0.1=(=100*1/[100*1+900*1]). In contrast, if the values in the catch mixing matrix for this sub-area were 1 and 0.1 respectively, the probability of a catch being from the first feeding aggregation would be 0.52=(=100*1/[100*1+900*0.1]).

[3]The WFG is a feeding aggregation which is indexed by the mark-recapture estimate for the Sakhalin sub-area.

It is important to note that one element of the catch mixing matrix for each sub-area must be 1 as the elements of the catch mixing matrix are relative scalars; multiplying all of the entries of the catch mixing matrix by any constant would not change the relative vulnerability of each feeding aggregation.

4.2 Summary of priority stock structure hypotheses from first Workshop

The three priority stock structure hypotheses selected by the Scientific Committee at the 2014 annual meeting (IWC, 2015b) can be summarised as:

(1) Hypothesis 3a. Although two breeding stocks (Western and Eastern) may once have existed, the Western stock is assumed[4] to have been extirpated. Whales show matrilineal fidelity to feeding grounds, and the Eastern stock includes three feeding sub-stocks: PCFG, Northern Bering Sea (NBS)/Southern Chukchi (SCH)-Northern Chukchi-Gulf of Alaska ('Northern') and WFG.
(2) Hypothesis 3e. Identical to hypothesis 3a except that the Eastern breeding stock is extant and feeds off both coasts of Japan and Korea and in the northern Okhotsk Sea west of the Kamchatka Peninsula. All of the whales feeding off Sakhalin overwinter in the eastern North Pacific
(3) Hypothesis 5a. Identical to hypothesis 3a except that the whales feeding off Sakhalin include both whales that are part of the Western stock and remain in the western North Pacific year-round, and whales that are part of the Eastern stock and migrate to the eastern North Pacific.

The analyses in SC/A15/GW1 were based on hypothesis 3e. The specifications for this stock structure hypothesis in SC/A15/GW1 had been modified in the light of input from the members of the Steering Group (IWC, 2015b). In particular:

(1) the large 'North' feeding group has been split into a BSCS sub-area and an SEA sub-area. The SEA sub-area was further subdivided into feeding and movement seasons (June-November and December-May respectively). The rationale for this change was the presence, based on telemetry and photo-identification data, of PCFG animals in SEA. There is bycatch in this sub-area which needs to be correctly allocated to feeding aggregation;
(2) the CA sub-area was divided into feeding and movement seasons given different relative proportions of PCFG feeding aggregation and other whales in this sub-area seasonally;
(3) North and Sakhalin animals were allowed to move to the BCNC area. This is consistent with telemetry and photo-identification data for the migration season which suggests that non-PCFG animals are in this sub-area;
(4) a California-survey sub-area was added to the model to allow it to be fitted to the California estimates of abundance. The mixing parameters for this area reflect the proportion of each feeding aggregation that passes the counting platforms and hence do not reflect the relative fraction of time animals from each feeding aggregation spend in this sub-area; and
(5) the link between the North sub-area and the EJPJ sub-area was ignored in the absence of data to demonstrate a linkage.

[4]By the present Workshop; symbols used to represent the movements of the Western breeding stock have been removed in the relevant figures in Annex E.

Table 1

Mixing rates by feeding aggregation by sub-area and season for the Eastern breeding stock.

Feeding aggregation	Season	Sub-area	Areas used for estimates	Total observations	Total sightings	Mixing proportion
WFG	Migratory	BC-NCA	All PCFG except SVI, SJF,	6	1,626	0.00369
PCFG	Migratory	BC-NCA	and NCA	150	469	0.319829
North	Migratory	BC-NCA		319	469	0.680171
PCFG	Migratory	CA	CCA-SCA	3	33	0.090909
WFG	Migratory	CA	CCA-SCA	0	33	0.002[a]
North	Migratory	CA	CCA-SCA	30	33	0.909091
PCFG	Feeding	CA	CCA-SCA	13	43	0.302326
North	Feeding	CA	CCA-SCA	30	43	0.697674
PCFG	Feeding	BC-NCA	NBC-NCA	13,623	14,446	0.943029
North	Feeding	BC-NCA	NBC-NCA	823	14,446	0.056971
PCFG	Feeding	SE Alaska	SE Alaska	19	34	0.558824
North	Feeding	SE Alaska	SE Alaska	15	34	0.441176
PCFG	Feeding	Kodiak	Kodiak	32	176	0.181818
North	Feeding	Kodiak	Kodiak	144	176	0.818182

[a]Value from Moore and Weller (2013).

Table 2

The catch mixing matrices for cases 3a, 3b, and 5a. The γs denote the estimable parameters of the catch mixing matrix and the χs denote values are varied in the tests of sensitivity. Note that the 'CA-3' sub-area is included so that the surveys cover all of the PCFG, Sakhalin and north feeding aggregations while the BCNC-3 sub-area is included so that the surveys for the BNCN sub-area pertain only to the PCFG feeding aggregation.

	Sub-area/season														
	VSC	KWJ	EJPJ	OS	SI	EKK	BSCS	SEA	BCNC (Jun.-Nov.)	BCNC (Dec.-May)	BCNC-3	CA (Jun.-Nov.)	CA (Dec.-May)	CA-3	M
[a] Case 3a (no western stock)															
Eastern															
WFG			1	1	1	1				γ_3			γ_6	1	1
North			γ_8				1	1	1	1		1	1	1	1
PCFG							χ_1	γ_1	γ_2	γ_4	1	γ_5	γ_7	1	1
[b] Case 3e (with western stock)															
Western	1	1	1	1											
Eastern															
WFG			χ_2[a]		1	1				γ_3			γ_6	1	1
North							1	1	1	1		1	1	1	1
PCFG							χ_1	γ_1	γ_3	γ_4	1	γ_5	γ_6	1	1
[b] Case 5a (with western stock)															
Western	1	1	1	1	γ_9										
Eastern															
WFG			χ_2[a]		1	1				γ_3			γ_5	1	1
North							1	1	1	1		1	1	1	1
PCFG							χ_1	γ_1	γ_2	γ_4	1	γ_5	γ_7	1	1

[a]Meant to capture the 'occasional' migration to east Sea of Japan/Pacific coast of Japan.

In discussion, it was noted that the KWJ migratory sub-area should be considered separately from the EJPJ migratory areas. The last sighting of a gray whale in Korean waters was in 1966 (Park, 1995), despite recent survey effort in Korean waters during the winter seasons (Kim *et al.*, 2013). Given this lack of recent sightings, it is likely that this migratory corridor is no longer used (Weller and Brownell, 2012). Thus it was **agreed** that the KWJ sub-area should be modelled as separate from the other two migratory routes where post-1966 records exist (Kato *et al.*, 2014).

In previous representations of all three hypotheses, occasional movements of whales from the North feeding sub-area were assumed to occur to the migratory routes off both coasts of Japan. Any whales moving between these two sub-areas would likely travel through the waters off eastern Kamchatka; thus this link was redrawn to more accurately represent any such movements [sub-area EKK].

Photo-identification analyses have identified one individual that was photographed off Barrow (Alaska) that had been previously sighted in multiple seasons within the PCFG range (the BCNC sub-area; Calambokidis *et al.*, 2012). Although the limited photo-identification effort off Barrow and more generally within the North feeding sub-area makes interpreting the significance of this finding difficult, the Workshop **agreed** that the scenario of occasional movements between BCNC and the North sub-area should be included in the stock hypotheses (see Item 4.4).

4.3 Finalise datasets by stock structure hypothesis

4.3.1 Catches

The model incorporates direct catches (commercial and aboriginal) as well as bycatches and ship strikes (see IWC, 2011) and the 2014 Workshop (IWC, 2015b). SC/A15/GW1 had modelled bycatch for the eastern sub-areas based on the estimates provided by Scordino *et al.* (2014) and had also included the few reported bycatches for Japan (1 in 1955, 1 in 1970, 1 in 1996, 4 from 2005-07), Korea (0) and China (1 in 2011) in the 'catch' series for these areas. The Workshop reviewed the catch series and revised them to reallocate the bycatches off Japan, Korea and China from the catch time-series to the bycatch time-series (a full updated table will be developed at the 2015 Annual Meeting). The Workshop also corrected some errors in the catches used in SC/A15/GW1.

The Workshop **recognised** the considerable uncertainty associated with estimation of bycatches (and ship strikes), as is always the case (IWC, 2013b). Annex D lists the available information on bycatches: (a) numbers of bycaught animals observed and reported as dead due to entanglement or entrapment by sub-area; and (b) estimates of total reported bycatch mortality assuming all injured animals will die. Annex D also lists available data on ship strikes of gray whales. Not all dead bycaught (or ship struck) animals will be recorded. There are no direct estimates of reporting ('carcass recovery') rates for gray whales. Punt and Wade (2010) estimated that only 3.9-13% of gray whales that die in a given year end up stranding and being reported, while a review of published estimates of recovery rates by Carretta *et al.* (2016) indicated that between <1% and 33% of animals that die from bycatch and other causes end up stranding and being reported. Upon reviewing the available information, the Workshop considered that the best proxy for the reporting rate for bycaught and ship-struck gray whales off the west coast of the USA was 0.22 (95%CI 0.17 to 0.30) which had been estimated for coastal bottlenose dolphins in California.

For modelling purposes, the Workshop **agreed** to conduct analyses in which the bycatches and ship strikes (combined) were set to the observed mortality (minimum count or estimate) and in which this was multiplied by 5 to account for underreporting (the 'best' estimate); additional sensitivity tests may be conducted at a later date. The Workshop noted that the higher estimates of bycatch/ship strike may be inconsistent with observed numbers and trends in abundance of feeding aggregations or populations and this may provide information on the plausibility of scenarios investigated. It also **agreed** that development of series of higher estimates of removals by factors other than direct catch might be warranted, but that would be deferred until the additional model results were available.

4.3.2 Mixing rates

The primary data source used to estimate the estimable parameters of the catch mixing matrices (denoted as γ values) are estimates of the relative proportion of animals from each feeding aggregation in each sub-area. These estimates pertain to the relative 'vulnerability' to removals rather than simple presence i.e. *inter alia* they take time present in an area into account. Scordino *et al.* (2014) estimated the relative vulnerability of PCFG compared to other feeding aggregation animals in several sub-areas in the eastern Pacific and these estimates were included in the analyses of SC/A15/GW1.

The Workshop updated the estimates from Scordino *et al.* (2014) to provide estimates for more feeding aggregations, sub-areas and seasons. This involved extracting the number of PCFG, WFG, and North feeding aggregation whales from the Cascadia Research Collective's database of sightings of catalogued whales. A sighting for this analysis was defined as one sighting of a unique whale per day, i.e. a single whale that was observed multiple times in a single day was only counted as one sighting. Mixing rates were computed as the number of sightings of whales of each feeding aggregation divided by the total sightings of whales for each combination of season and sub-area of interest (Table 1). In general, all sightings were used. The exception was for determining the mixing rates of North and PCFG whales during the migratory season in the BCNC sub-area. For this analysis, the inland waters of Southern Vancouver Island and the Strait of Juan de Fuca were removed from the analysis because PCFG whales are disproportionately observed there. Similarly, Northern California waters were removed since telemetry data have shown that PCFG whales are also known to aggregate in northern California for feeding during the migratory season. Given the exceptional behaviour in such waters, the Workshop **agreed** to base the mixing rates on the rest of the BCNC sub-area. There were no reported sightings of WFG whales in California during the migratory season. The Workshop **agreed** to use the annual probability for a WNP whale being observed in the PCFG range by Moore and Weller (2013) for this mixing rate.

The mixing proportions need to be weighted when they are included in the objective function, minimised when fitting the model. There are no direct measurements of precision for the mixing rates in Table 1. However, one measure of precision would be the variance of the among-year estimates of mixing proportions. The Workshop **recommended** that these variances be determined by Punt and included in the model specifications.

The mixing rates in Table 1 are subject to various sources of considerable uncertainty (e.g. see the above discussion for the mixing rate estimates for the BCNC sub-area). The Workshop therefore **agreed** to conduct sensitivity analyses in which the mixing rates for PCFG and WFG whales are twice those reported in Table 2 for the BCNC and CA sub-areas (migratory season).

4.3.3 Abundance estimates

Tables 3 and 4 provide the abundance estimates for the California census and the PCFG. The abundance estimates of the PCFG could be updated before the 2015 meeting of the Scientific Committee (see Items 2.6 and 5). Table 5 provides the estimates of 1+ abundance for the Sakhalin sub-area. The Workshop **recommended** that Cooke provide a covariance matrix for these estimates.

4.4 Development of trials to reflect uncertainty and anthropogenic removals

The Workshop reviewed the analyses in the SC/A15/GW1 and made the following recommendations regarding the model.

(1) Bycatches should be removed from younger ages (<5 years) following the data for California (Heyning and Lewis, 1990). It was **agreed** that Punt could consult the Steering Group if this specification led to an inability to mimic other data.
(2) The catch mixing matrices were updated to more adequately reflect the recommendations from the 2014 rangewide Workshop (Table 2).

The Workshop **agreed** to the following sensitivity tests:

(1) different values for parameters (Punt will propose values and work with the Steering Group to finalise these intersessionally); and
(2) a case in which the PCFG feeding aggregation is not treated as a separate 'population' (Punt will develop a set of specifications and provide these to the Steering Group intersessionally).

The Workshop **agreed** that preliminary projections should be undertaken prior to the 2015 Annual Meeting. These projections should be based on: (a) setting the catches for the 'North' sub-area to the average catch in this sub-area over the last year; (b) setting the catching in the BCNC sub-area to number of strikes expected under the *SLA* selected for the PCFG by the Scientific Committee (IWC, 2013a); and

Table 3

Estimates of absolute abundance (with associated standard errors) for the eastern North Pacific stock of gray whales based on shore counts. Source: 1967/78-2006/07: Laake *et al.* (2012); 2006/07-2010/11: Durban *et al.* (2011).

Year	Estimate	CV	Year	Estimate	CV
1967/68	13,426	0.094	1985/86	22,921	0.081
1968/69	14,548	0.080	1987/88	26,916	0.058
1969/70	14,553	0.083	1992/93	15,762	0.067
1970/71	12,771	0.081	1993/94	20,103	0.055
1971/72	11,079	0.092	1995/96	20,944	0.061
1972/73	17,365	0.079	1997/98	21,135	0.068
1973/74	17,375	0.082	2000/01	16,369	0.061
1974/75	15,290	0.084	2001/02	16,033	0.069
1975/76	17,564	0.086	2006/07	19,126	0.071
1976/77	18,377	0.080	2006/07	20,750	0.060
1977/78	19,538	0.088	2007/08	17,820	0.054
1978/79	15,384	0.080	2009/10	21,210	0.046
1979/80	19,763	0.083	2010/11	20,990	0.044
1984/85	23,499	0.089			

Table 4

Estimates of absolute abundance (with associated CVs) for 41°-52°N (the PCFG sub-area) (source: J. Laake, pers. comm.).

Year	Estimate	CV	Year	Estimate	CV
1998	126	0.086	2006	200	0.106
1999	147	0.102	2007	193	0.133
2000	149	0.101	2008	207	0.088
2001	181	0.077	2009	206	0.098
2002	198	0.064	2010	194	0.094
2003	210	0.086	2011	197	0.080
2004	218	0.078	2012	209	0.073
2005	218	0.120			

Table 5

Indices of 1+ abundance for the Sakhalin sub-area (J.G. Cooke, pers. comm.).

Year	Estimate	CV	Year	Estimate	CV
1995	64	0.041	2004	114	0.006
1996	66.9	0.035	2005	119.2	0.006
1997	72.9	0.024	2006	125.2	0.007
1998	76.4	0.017	2007	126.8	0.008
1999	84.4	0.011	2008	128.4	0.01
2000	85.8	0.009	2009	128.9	0.011
2001	91.4	0.006	2010	133.9	0.012
2002	96.8	0.005	2011	137.8	0.013
2003	104.3	0.005	2012	149.4	0.019

(c) setting bycatches by sub-area based on the assumption of constant effort. The set of the projections will be refined during the 2015 meeting of the Scientific Committee.

4.5 Consideration on conditioning

The age- and sex-structured population dynamics model is conditioned to estimates of abundance for the Sakhalin sub-area, the PCFG feed aggregation and the abundance estimates for California. The model is also conditioned to the mixing rates estimates.

5. WORK PLAN

The Workshop made a number of recommendations related to the comparison of photographic and genetic material (see Items 2.1 and 2.2). It **requests** that progress be reported to the 2015 Scientific Committee meeting. The importance of including information on confirmed non-matches or probable non-matches, as well as matches when presenting results was stressed.

The Workshop also **requested** that Weller and Brownell modify the table from Kato *et al.* (2014), adding new records and supplementing information on included records, as appropriate and present this to the 2015 Scientific Committee meeting.

The last Workshop had noted the importance of knowing the degree to which there was large-scale recruitment into the PCFG during the period prior to around 1998 (which would have to have been from an external source) to evaluate the status of the PCFG. Laake reported that some progress has been made and the Workshop **reiterated** its previous recommendation (IWC, 2015a) and looked forward to a progress report at the 2015 Scientific Committee meeting.

With a view to narrowing the confidence range for the proportion of Sakhalin whales that migrate east, the Workshop **recommended** a number of priority analyses under Item 3.1. It recognised that these would take time but looked forward to any reports of progress at the 2015 Scientific Committee meeting.

The Committee **welcomed** the progress already made by Punt and the additional specifications and scenarios developed at the present Workshop. A number of the recommendations under Item 4 should lead to additional results becoming available at the 2015 Scientific Committee meeting. It **commended** Punt for his efforts thus far and requested that he work with the existing intersessional steering group to progress the modelling work as far as practicable in the time available.

The Workshop recognised that an important driver for the present work was the need to update the present IWC/IUCN Conservation Management Plan for western gray whales. It **recommends** that focussed discussions on how best to achieve this take place at the 2015 Scientific Committee meeting.

6. ADOPTION OF REPORT

The report was adopted at 16:45 on 3 April 2015 subject to final editorial work by the rapporteurs and the development of the figures related to the various stock structure hypotheses given in Annex E. The Chair of the Workshop thanked the participants for the constructive dialogue, the rapporteurs for their hard work and Punt for his usual exceptional modelling efforts. He also thanked the Southwest Fisheries Science Center for their excellent hospitality and facilities. The Workshop thanked the Chair for his usual efficient and fair handling of the meeting.

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Annex A

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Annex B

Agenda

1. Introductory items
    1.1 Convenor's opening remarks
    1.2 Election of Chair
    1.3 Appointment of rapporteurs
    1.4 Adoption of Agenda
    1.5 Documents and data available
2. Short report on progress on 'non-modelling' recommendations
    2.1 Preliminary comparison of identified gray whales in Mexico, off central California and in the PCFG with a focus on mothers and calves
    2.2 Comparison of photographs (and genetic material) of gray whales from areas of the Okhotsk Sea and elsewhere in Asia with the Sakhalin and Kamchatka catalogues
    2.3 Development of Single Nucleotide Polymorphisms (SNP) assays for use with gray whales
    2.4 Increased sample size and coverage from the eastern North Pacific
    2.5 Continued telemetry studies
    2.6 Improved abundance and trend estimates for the PCFG by identifying and using additional photographic sources
    2.7 Improved estimates of western North Pacific catches 1890-1910
    2.8 Improved estimates for future ship strikes and bycatches throughout the North Pacific
3. Progress report on modelling-related issues
    3.1 Putting bounds on the proportion of Sakhalin whales that migrate to the eastern North Pacific
    3.3 Development of an age- and sex-structured model
4. Update modelling framework
    4.1 Review of the nomenclature for stocks, sub-stocks and sub-areas
    4.2 Summary of priority stock structure hypotheses from first Workshop
    4.3 Finalise datasets by stock structure hypothesis
        4.3.1 Catches
        4.3.2 Mixing rates
    4.4 Development of trials to reflect uncertainty and anthropogenic removals
    4.5 Consideration on conditioning
5. Work plan
6. Adoption of report

Annex C

List of Documents

SC/A15/GW

01. Punt, A.E. An age-structured model of exploring the conceptual models developed for gray whales in the North Pacific.
02. Cooke, J.G. Implications of observed whale movements on the relationship between the Sakhalin gray whale feeding aggregation and putative breeding stocks of the gray whale.

Annex D

Non-whaling Anthropogenic Mortality of Gray Whales

J. Scordino, R.R. Reeves and R.L Brownell, Jr.

Scordino and Mate (2012) summarised bycatch and ship strike mortality from stranding databases, human-whale interaction databases and ship strike databases maintained by NOAA's Northwest Region and Southwest Region (databases did not include events in Alaska). Their summary also included bycatches and ship strikes reported by Baird *et al.* (2002) for 1990-95 in British Columbia and all reported ship strikes and bycatch events from 1978-2010 in the USA. The authors chose to calculate annual human-caused mortality rates based on data from 1990-2010 for the USA and 1990-95 for Canada waters because fishing effort in the two jurisdictions was more similar in those years than earlier in the time-series and because stranding networks in the USA were well established by 1990, giving more confidence that animals stranded in the USA with signs of human-caused mortality would have been reported.

Stranding reports and in particular at-sea reports of ship strikes and entanglements were often hard to interpret from the information available. The authors removed reports of free-swimming whales that they judged to be duplicative based on proximity in timing and location and on ancillary information such as type of entangling gear. All bycatch reports were graded into six categories based on the probability that a whale died due to entanglement injuries. The six categories were: (1) cause of death diagnosed as entanglement; (2) entanglement may have been cause of death; (3) disentanglement efforts initiated and only partly successful, with final status of the individual unknown; (4) disentanglement efforts initiated and fully successful or whale managed to free itself; (5) free-swimming with entangling gear, final status unknown; and (6) status of the individual unknown but last seen alive. All reports except those in category 4 (whale successfully disentangled) were included in analyses of annual bycatch rates. A similar approach was taken with ship strike data. The six categories used were: (1) cause of death diagnosed as ship strike; (2) cause of death suspected to have been ship strike; (3) whale free-swimming but injured and likely to die; (4) whale free-swimming, injured from ship strike, and may die; (5) whale struck by a boat but free-swimming and unlikely to die; and (6) whale last seen alive and its status unknown. All categories of ship strikes were used for computing ship strike rates for 1990-2010 although whales classified as category 5 were thought unlikely to die. The results of the analysis were summarised in table 2 of Scordino and Mate (2012) with estimated annual human-caused mortality (bycatch and ship strike combined) of 1.845 PCFG whales (analysis assumed California whales in summer were PCFG whales) and 4.555 ENP/WFG whales.

In 2014, Scordino *et al.* (2014) presented a new estimate of annual bycatch and ship strike rates for the time period of 2008-2012 using a classification procedure developed by NOAA to account for the uncertainty in outcome of injuries to large whales due to entanglements and ship strikes (NOAA, 2012). This procedure makes it possible to prorate mortality values for injuries based on the known fate of individual whales observed with similar injuries in the past (table from NOAA, 2012). Gray whale deaths and injuries were documented through fisheries observer programmes, self-reporting by fishermen and sailing captains, reporting by the public and examinations of dead whales on the beach in the USA and Canada. Every report was documented in a Canadian or US government database. Based on descriptions in the databases, each event was determined to have been either a death, a serious injury, or a non-serious injury, based on NOAA (2012). All US events were assessed for serious vs non-serious injury by a NOAA working group (Carretta *et al.*, 2014) and that group's results were used as the basis for scoring the events reported by Scordino *et al.* (2014). Results of the analysis are presented in Table 1.

Data from Scordino and Mate (2012), Scordino *et al.* (2014), Baird *et al.* (2002) and Heyning and Lewis (1990) are presented in Table 4 (ship strikes) and Table 5 (bycatch). Total ship strikes and bycatch by year, season and area presented in Tables 2 (feeding season) and 3 (migratory season). Methodology from NOAA (2012) could not be applied to data from sources other than Scordino *et al.* (2014). To make interpretation of injuries consistent by year injuries were not prorated.

Table 1

Deaths and prorated serious injuries of gray whales due to ship strike and bycatch in US and Canadian waters, 2008-12, from Scordino *et al.* (2014).

Region	Deaths plus prorated injuries		Average (2008-12)	
	Feeding	Migrating	Feeding	Migrating
Far North	0	0.75	0	0.15
Kodiak	0	0	0	0
SE Alaska	2.75	0.75	0.55	0.15
Puget Sound	0	1	0	0.20
NBC-NCA	4.02	7.75	0.80	1.55
California	6	16.05	1.20	3.21
Total	12.8	26.3	2.55	5.26

Table 2

Observed deaths of gray whales in the feeding season (Jun.-Nov.) due to ship strike and bycatch in US and Canada from 1978-2012. All injured whales, whether or not noted to be disentangled, are assumed dead for the 'dead and injured' column.

Year bin	California		NBC-NCA		Southeast Alaska	
	Dead	Dead and injured	Dead	Dead and injured	Dead	Dead and injured
1978-82	0	0	1	1	0	0
1983-87	2	3	0	0	0	0
1988-92	1	3	3	3	0	0
1993-97	0	0	1	3	0	0
1998-2002	1	4	4	4	0	0
2003-07	0	1	3	5	0	0
2008-12	2	6	1	5	0	3

Table 3

Observed deaths of gray whales in the migratory season (Dec.-May) due to ship strike and bycatch in US and Canada from 1978-2012. All injured whales, whether or not noted to be disentangled, are assumed dead for the 'dead and injured' column.

	California		NBC-NCA		Southeast Alaska		Far North/Puget Sound	
Year bin	Dead	Dead and injured	Dead	Dead and injured	Dead	Dead and injured	Dead	Dead and injured
1978-82	2	2	0	2	0	0	0	0
1983-87	16	42	6	7	0	0	0	0
1988-92	9	29	0	1	0	0	0	0
1993-97	5	15	4	5	0	0	0	0
1998-2002	1	7	0	0	0	0	0	0
2003-07	0	6	5	12	0	0	0	0
2008-12	7	22	4	8	0	1	1	2

Table 4

Ship strike deaths, injuries, and combined total mortality by region, year, and season for gray whales in the eastern North Pacific. Injuries were prorated as mortalities following methods of NOAA (2012) for Scordino *et al.* (2014).

Year	Region	Season	Deaths	Injuries	Total	Source
1985	NBC-NCA	Migratory	1	0	1	Scordino and Mate (2012)
1987	California	Migratory	3	0	3	Scordino and Mate (2012)
1988	California	Migratory	1	0	1	Scordino and Mate (2012)
1991	California	Migratory	3	0	3	Scordino and Mate (2012)
1993	California	Migratory	1	0	1	Scordino and Mate (2012)
1994	California	Migratory	1	0	1	Scordino and Mate (2012)
1995	California	Migratory	0	3	3	Scordino and Mate (2012)
1995	NBC-NCA	Feeding	1	0	1	Scordino and Mate (2012)
1997	NBC-NCA	Migratory	1	0	1	Scordino and Mate (2012)
1998	California	Migratory	1	3	4	Scordino and Mate (2012)
1999	California	Migratory	1	1	2	Scordino and Mate (2012)
2001	California	Migratory	0	1	1	Scordino and Mate (2012)
2003	California	Migratory	1	0	1	Scordino and Mate (2012)
2005	California	Migratory	2	0	2	Scordino and Mate (2012)
2006	California	Migratory	2	2	4	Scordino and Mate (2012)
2007	California	Migratory	2	0	2	Scordino and Mate (2012)
2008	California	Migratory	2	0	2	Scordino *et al.* (2014)
2009	NBC-NCA	Migratory	1	0	1	Scordino *et al.* (2014)
2009	NBC-NCA	Feeding	0	1	1	Scordino *et al.* (2014)
2009	Puget Sound	Migratory	1	0	1	Scordino *et al.* (2014)
2009	California	Migratory	0	2	2	Scordino *et al.* (2014)
2008	NBC-NCA	Feeding	1	0	1	Scordino *et al.* (2014)
2010	California	Migratory	0	2	2	Scordino *et al.* (2014)
2011	California	Migratory	0	4	4	Scordino *et al.* (2014)

Table 5

Deaths, injuries, and combined total mortality due to bycatch by region, year and season for gray whales in the eastern North Pacific.

Year	Region	Season	Deaths	Injuries	Total	Source	Year	Region	Season	Deaths	Injuries	Total	Source
2008	NBC-NCA	Feeding	1	1	2	(A)	2002	California	Migratory	0	2	2	(B)
2009	NBC-NCA	Feeding	0	2	2	(A)	2003	California	Migratory	0	2	2	(B)
2010	California	Feeding	0	1	1	(A)	2004	California	Migratory	0	2	2	(B)
2011	California	Feeding	1	2	3	(A)	2004	California	Feeding	0	1	1	(B)
2011	Southeast Alaska	Feeding	0	1	1	(A)	2005	California	Migratory	0	1	1	(B)
2012	California	Feeding	1	1	2	(A)	2007	California	Migratory	0	1	1	(B)
2012	NBC-NCA	Feeding	0	1	1	(A)	1978	NBC-NCA	Feeding	1	0	1	(B)
2012	Southeast Alaska	Feeding	0	2	2	(A)	1981	NBC-NCA	Migratory	0	2	2	(B)
2008	California	Migratory	2	0	2	(A)	1983	NBC-NCA	Migratory	2	0	2	(B)
2009	California	Migratory	1	3	4	(A)	1984	NBC-NCA	Migratory	1	1	2	(B)
2009	NBC-NCA	Migratory	1	1	2	(A)	1988	NBC-NCA	Feeding	1	0	1	(B)
2009	Puget Sound	Migratory	1	0	1	(A)	1990	NBC-NCA	Feeding	1	0	1	(B)
2009	Southeast Alaska	Migratory	0	1	1	(A)	1991	NBC-NCA	Migratory	0	1	1	(B)
2010	California	Migratory	1	3	4	(A)	1993	NBC-NCA	Feeding	1	0	1	(B)
2010	NBC-NCA	Migratory	1	2	3	(A)	1994	NBC-NCA	Migratory	2	0	2	(B)
2011	California	Migratory	1	2	3	(A)	1994	NBC-NCA	Feeding	0	1	1	(B)
2012	California	Migratory	2	7	9	(A)	1995	NBC-NCA	Migratory	1	0	1	(B)
2012	Far North	Migratory	0	1	1	(A)	1996	NBC-NCA	Migratory	1	0	1	(B)
2012	NBC-NCA	Migratory	2	1	3	(A)	1997	NBC-NCA	Migratory	0	1	1	(B)
1983	California	Migratory	1	0	1	(B)	1998	NBC-NCA	Feeding	1	0	1	(B)
1984	California	Migratory	2	1	3	(B)	1999	NBC-NCA	Feeding	2	0	2	(B)
1985	California	Migratory	5	14	19	(B)	2002	NBC-NCA	Feeding	1	0	1	(B)
1986	California	Feeding	1	0	1	(B)	2003	NBC-NCA	Migratory	1	2	3	(B)
1987	California	Migratory	2	8	10	(B)	2003	NBC-NCA	Feeding	1	0	1	(B)
1987	California	Feeding	1	1	2	(B)	2004	NBC-NCA	Migratory	2	2	4	(B)
1988	California	Migratory	1	8	9	(B)	2004	NBC-NCA	Feeding	1	0	1	(B)
1988	California	Feeding	0	1	1	(B)	2005	NBC-NCA	Migratory	1	1	2	(B)
1989	California	Migratory	3	4	7	(B)	2005	NBC-NCA	Feeding	1	1	2	(B)
1990	California	Migratory	2	3	5	(B)	2006	NBC-NCA	Migratory	1	1	2	(B)
1991	California	Migratory	2	1	3	(B)	2007	NBC-NCA	Migratory	0	1	1	(B)
1992	California	Migratory	1	2	3	(B)	2007	NBC-NCA	Feeding	0	1	1	(B)
1990	California	Feeding	1	0	1	(B)	1983	NBC-NCA	Migratory	2	0	2	(C)
1991	California	Feeding	0	1	1	(B)	1984	NBC-NCA	Migratory	1	0	1	(C)
1993	California	Migratory	0	1	1	(B)	1988	NBC-NCA	Feeding	1	0	1	(C)
1994	California	Migratory	1	2	3	(B)	1993	NBC-NCA	Feeding	0	1	1	(C)
1995	California	Migratory	1	2	3	(B)	1981	California	Migratory	1	0	1	(D)[a]
1996	California	Migratory	2	2	4	(B)	1982	California	Migratory	1	0	1	(D)[a]
1997	California	Migratory	1	3	4	(B)	1983	California	Migratory	1	0	1	(D)[a]
1998	California	Migratory	0	1	1	(B)	1985	California	Migratory	4	0	4	(D)[a]
1998	California	Feeding	0	2	2	(B)	1986	California	Migratory	0	2	2	(D)[a]
1999	California	Migratory	0	1	1	(B)	1987	California	Migratory	1	1	2	(D)[a]
1999	California	Feeding	1	0	1	(B)	1988	California	Migratory	0	1	1	(D)[a]
2000	California	Migratory	1	2	3	(B)	1989	California	Migratory	0	1	1	(D)[a]
2000	California	Feeding	0	1	1	(B)							

[a]Only reports of bycatch included in Heyning and Lewis (1990) that were not found in the stranding and human interaction databases maintained by NOAA's Southwest Regional Office summarised in Scordino and Mate (2012) were included in this Table.
Sources: (A) Scordino *et al.* (2014). (B) Scordino and Mate (2012). (C) Baird *et al.* (2002). (D) Heyning and Lewis (1990).

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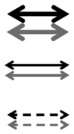
Annex E

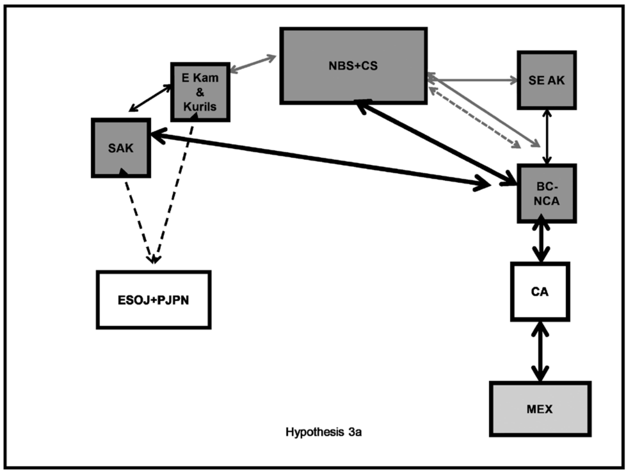
Schematic Representations of the Stock Structure Hypotheses

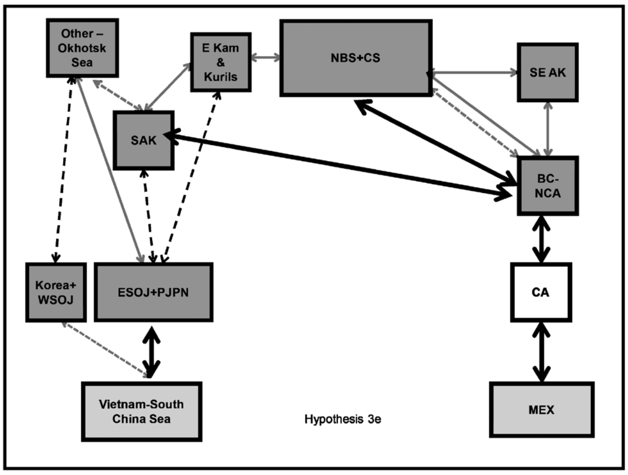
Revised Geographic Diagrams - April 2015 v3

Geographic areas utilised by gray whales are illustrated with shaded boxes:

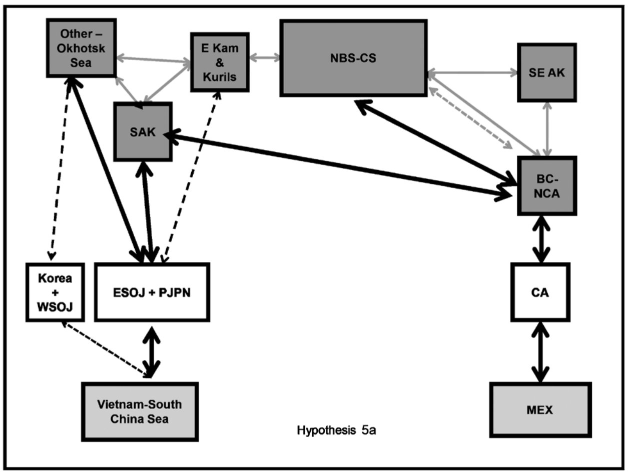
Arrows represent movements between geographic areas, with grey representing movements between feeding regions and black representing migratory movements:

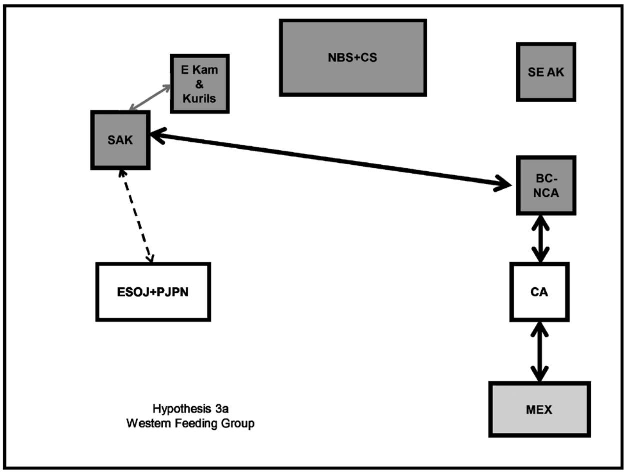


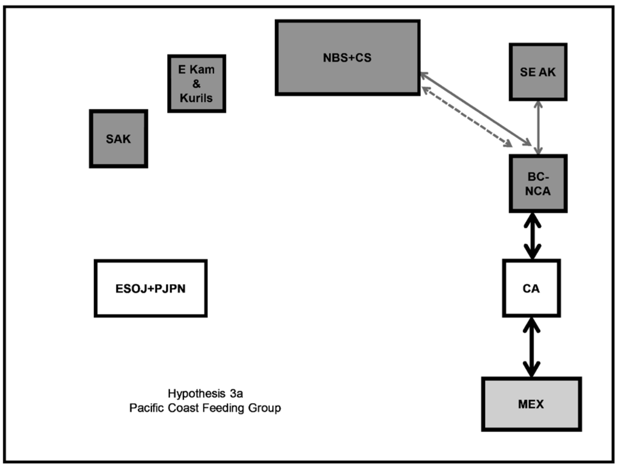


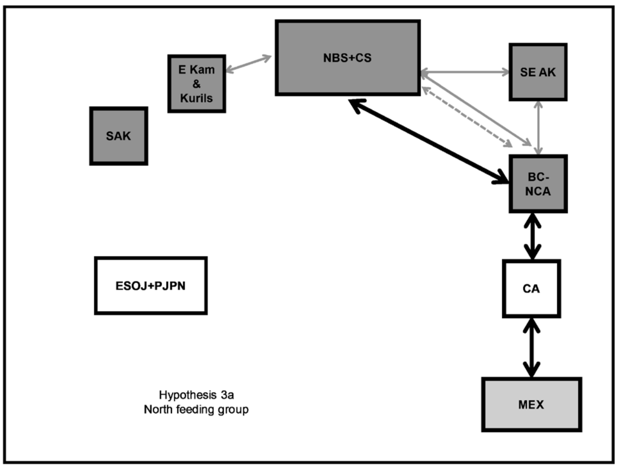


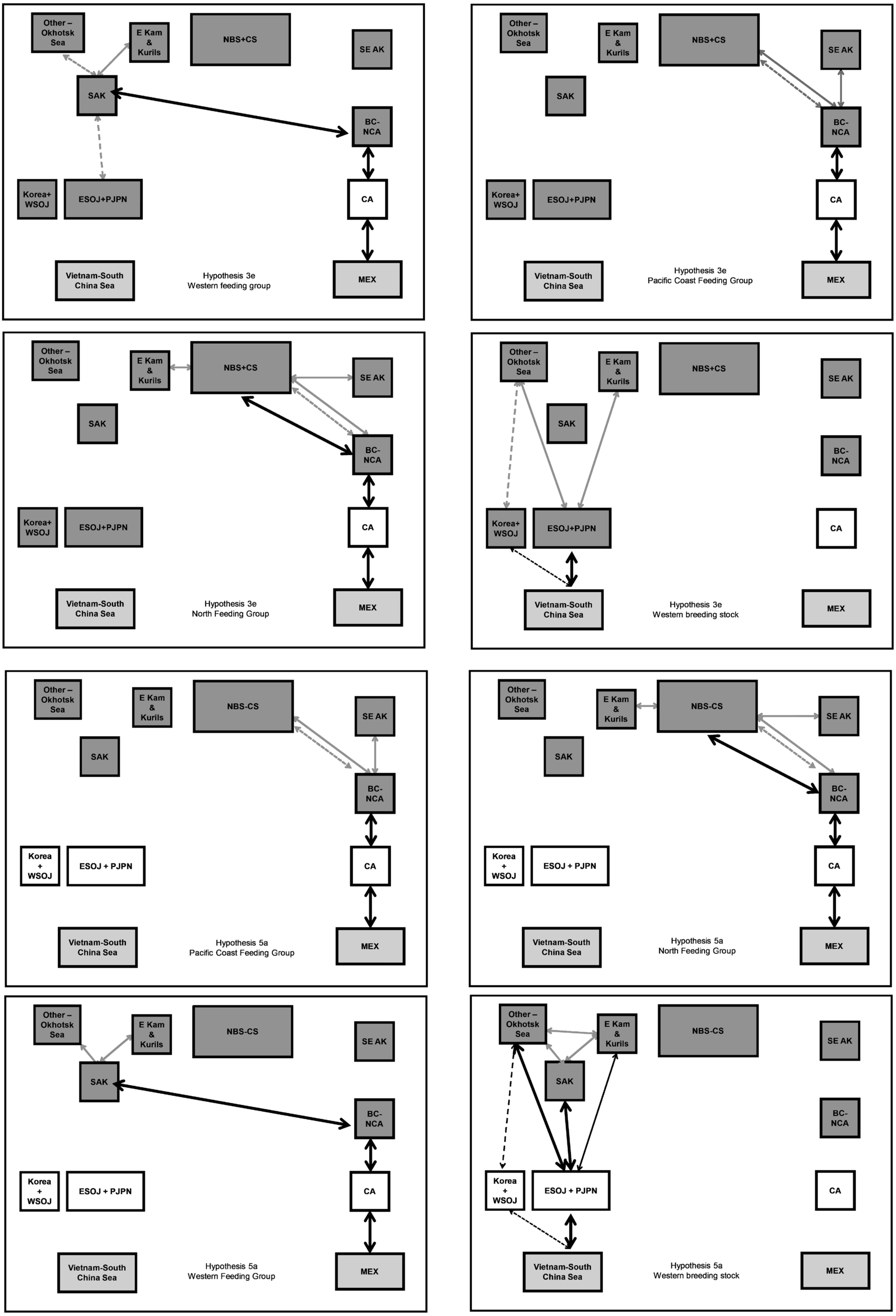
Geographic diagrams X feeding aggregation/stock - April 2015 v3







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SE AK
SAK
BC-NCA
Korea+ WSOJ
ESOJ+PJPN
CA
Vietnam-South China Sea
Hypothesis 3e
Western feeding group
MEX
Hypothesis 3e
Pacific Coast Feeding Group
Hypothesis 3e
North Feeding Group
Hypothesis 3e
Western breeding stock
NBS-CS
Korea + WSOJ
ESOJ + PJPN
Hypothesis 5a
Pacific Coast Feeding Group
Hypothesis 5a
North Feeding Group
Hypothesis 5a
Western Feeding Group
Hypothesis 5a
Western breeding stock