Guidelines for Assessing Marine Mammal Stocks: Report of the GAMMS III Workshop, February 15 – 18, 2011, La Jolla, California

Edited by:
Jeffrey E. Moore and Richard Merrick

With contributions from (listed alphabetically):
Robyn Angliss, Jay Barlow, Shannon Bettridge, Jim Carretta, Tom Eagle, Christina Fahy, Patricia Rosel, Mike Simpkins, Barbara Taylor, and Paul Wade

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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EXECUTIVE SUMMARY

The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) (collectively, the Agencies) are obliged under Section 117 of the Marine Mammal Protection Act (MMPA) to prepare Stock Assessment Reports (Reports) for marine mammal stocks within U.S. waters. The MMPA provides only general guidance on assessment methods and on the content of the Reports. As a result, the Agencies have held a series of workshops since 1994 to develop guidelines that may be consistently applied nationally to marine mammal stock assessments. These guidelines underlie NMFS and USFWS policy for implementing provisions of MMPA section 117.

Since the last workshop in 2004, the need has arisen for additional changes and clarifications to the Guidelines for Assessing Marine Mammal Stocks (GAMMS). To meet this need, the two Agencies convened a workshop (GAMMS III) on 15-18 February 2011 at the Southwest Fisheries Science Center, La Jolla, CA to:

- Consider methods for assessing stock status (i.e., how to apply the Potential Biological Removal framework, or PBR) when abundance data are outdated, nonexistent, or only partially available.
- Develop policies on stock identification and application of PBR to small stocks, transboundary stocks, and situations where stocks mix.
- Develop consistent national approaches to a variety of other issues, including application of mortality and serious injury (M&SI) information in assessments, and consideration of M&SI from recreational fisheries.

Nine specific topics were discussed at the workshop through presented plenary presentations followed by breakout group discussions on each topic. Breakout groups presented their recommendations to the full working group, who developed the recommendations discussed below. The deliberations of these nine topics resulted in a series of suggested modifications to the current Report guidelines (NMFS 2005), which are being proposed for formal adoption by NMFS and USFWS as revised guidance on U.S. marine mammal stock assessments. The proposed revised guidelines are provided as Appendix IV of this report.

Each numbered chapter in this report corresponds to one of the nine agenda topics (Appendix I), presented in the order they were considered during the workshop. Chapters include a background of the issue, a summary of relevant working papers submitted on the topic, a summary of key points of discussion on the topic, and a summary of recommended revisions to relevant sections of the Report guidelines.

Workshop recommendations on those topics are briefly summarized below in the same order as the chapters. However, this ordering is somewhat arbitrary. To facilitate interpretation, recommendations on the nine topics may be functionally grouped into three categories:

- Those that could immediately affect PBR estimates for some stocks, via revision of:
    - How PBR is estimated when abundance estimates are not current (Topic 1), and

- What value for the recovery factor (F_R) is used for stocks that are declining at a rate warranting a "strategic" designation (Topic 6)

- Those that may eventually affect PBR estimates for some stocks, via eventual revision of stock identification (Topic 2)
- Those that revise other content of the Stock Assessment Guidelines or Reports (Topics 3, 4, 5, 7, 8, 9)

PBR calculations with outdated abundance estimates (Topic 1)

For an increasing number of stocks, the most recent abundance estimates are more than 8 years old. Under existing Report guidelines (NMFS 2005), these are considered to be outdated and thus not used to calculate PBR. However, "undetermined" PBR is confusing, does not support management decisions, and may be interpreted in such a way that there is no limit to the level of mortality that could be allowed. Accordingly, the workshop participants investigated methods to calculate PBRs for stocks with old abundance information.

General discussion on this topic surrounded two key sets of issues:

- What to do about N_{min} (and hence PBR) estimates during years 1 – 8 since the last survey:
  - Project uncertainty (and revise N_{min} and PBR) annually?
  - Project uncertainty based on trend models if the data to construct such models are available?
  - Project uncertainty based on a uniform distribution?
- What to do after the 8th year: Continue projecting annual uncertainty as for years 1 – 8, or use a new 'rule'?

Ultimately the workshop participants agreed on the following framework (illustrated in Figure ES-1; see body of the report for details). This will have an immediate effect on PBR estimates for many stocks:

- During years 1-8 after the most recent abundance survey, "uncertainty projections" will be used, based on uniform distribution assumptions, to serially reduce the N_{min} estimate by a small increment each year.
- After 8 years, and assuming no new estimate of abundance has become available, then a worst-case scenario is assumed (i.e., a plausible 10% decline per year since the most recent survey), and so a retroactive 10% decline per year is applied.
- If data to estimate a population trend model are available, such a model can be used to influence the uncertainty projections during the first 8 years.

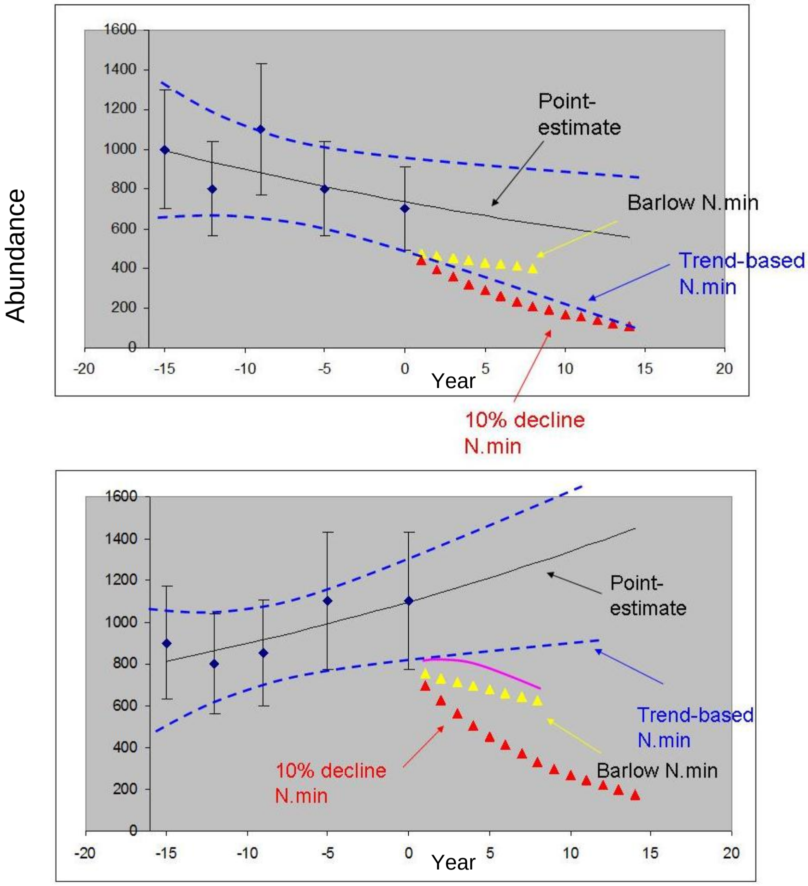

Fig. ES-1. Hypothetical example of how N_{min} would change through time following the most recent survey (Year 0). Blue diamonds and error bars are previous abundance estimates, fitted by a trend line (solid black) with 60% confidence or credible intervals (dotted blue), such that lower bound = N_{min}.

For a population with a declining trend (top panel), the trend-based estimates of N_{min} (lower dotted blue line) are used for years 1-8 after the last survey, since these estimates are more conservative than the estimates from projecting a uniform distribution model (yellow triangles). After year 8, N_{min} is modeled by the red triangles, which describes a 10% annual decline having occurred since the time of last survey.

For a population with an increasing abundance trend (bottom panel), the estimates in years 1 – 8 are a time-weighted average (solid pink line) of the trend-based projection of N_{min} (lower dotted blue line) and the uniform-based projection (yellow triangles). After year 8, N_{min} is modeled by the red triangles, which assumes a 10% annual decline from time of last survey.

Improving stock identification (Topic 2)

The working paper prepared for the workshop on this topic documented that for most species, few stock definition changes have been made since the initial Reports were written. Further, most stocks were defined at scales that were larger than major eco-regions suggesting that the scale is likely too large. Most of the discussion focused on acceleration of the rate at which existing data are used to define defensible stocks. The workshop participants recommended that the Agencies:

- Undertake a systematic review of the data currently available for each species that could be used to define stocks;

- Based on the results of the review, add statements to the Status of Stocks section of each Report indicating whether it is plausible that the stock actually contains multiple demographically independent populations (DIPs);
- Delineate new stocks on a species-by-species basis, with priority given to species for which threats are not evenly spread across the stock's range.

To provide the kind of information that is required to answer the question "is it plausible that there are multiple DIPs within this stock?" the workshop participants also recommended that a national workshop be held to review and summarize information that is relevant to population structure. As possible and appropriate, the workshop will propose revisions to stock structure. A major objective will be to provide a template for how to complete review of all stocks in each region. The workshop participants recommended that until the systematic review of data is completed, the statement within the Reports indicating the plausibility of multiple DIPs within a stock could simply be based on whether or not the stock encompasses multiple eco-regions.

Assessment of very small stocks (Topic 3a)

Participants expressed concern about how different Regions estimate or report bycatch using a small percentage of observer coverage or of rare events in general. Because of their low abundance, the PBR estimate for some stocks may be very small (just a few animals or even less than one). In such cases, low levels of observer coverage may introduce substantial small-sample bias in bycatch estimates (i.e., bycatch estimates may be predictably high or low as a result of sampling artifacts associated with rare events). If true bycatch mortality is low but near PBR, then estimation bias needs to be low enough to allow reliable evaluation of the estimate against a low threshold. This topic therefore considered how different Regions estimate or report bycatch from fisheries with low observer coverage or cases of rare bycatch in general. Report guidelines currently allow use of more than 5 years of data for averaging bycatch estimates if warranted, but this may or may not be sufficient to deal with small-sample bias.

A working paper on this topic included a table, based on simulation analysis, that provides recommendations for the amount of sampling effort (observer coverage and/or number of years of data pooling) required to limit small-sample bias, given a certain PBR level. The workshop participants recommended including this table in the Technical Details section of the Report guidelines. The workshop participants also recommended that if suggested sampling goals (per the table) cannot be met, then mortality should be estimated and reported, but they should be qualified in the Reports by stating they very well could be biased. It should also be noted in such cases that estimates of zero bycatch would not alone constitute sufficient evidence to deem a stock's status as non-strategic.

Assessment of small endangered stocks (Topic 3b)

Calculating PBR is based on the assumption that depleted populations would naturally recover in the absence of human-caused mortality (i.e., that R_{max} is positive). However, some endangered species, like Hawaiian monk seals, are declining with little to no direct human-caused mortality, and so PBR estimates for some endangered species stocks have not been included in Reports. The workshop participants recommended that in such cases, if feasible, PBR should still be calculated and included in the Reports to comply with the MMPA, but it was also noted that Report authors may depart from these guidelines if sound reasons are given in the Report. Thus, authors may choose to not report PBR in exceptional cases like that of monk seal, whose population dynamics do not seem to conform to the assumptions underpinning the PBR system.

Apportioning PBR across feeding aggregations, allocating mortality for mixed stocks, and estimating PBR for transboundary stocks (Topic 4)

The first issue dealt with separate PBRs for stocks with multiple feeding grounds. The Workshop participants recommended that human-caused mortality on the feeding grounds be monitored and evaluated against a PBR calculation made for the feeding aggregation and that the feeding-ground estimates of PBR and mortality be included in the Reports, as is currently done for Pacific humpback whale stocks in Alaska. Workshop participants acknowledged that mortality estimates that were greater than the feeding-ground PBR would not necessarily warrant a strategic designation for the overall breeding stock (unless this mortality estimate exceeded the total stock's PBR), but the participants felt that highlighting the situation in the Report could raise awareness of threats on the feeding grounds and may subsequently lead to management action.

The workshop participants next discussed how to allocate mortality and serious injuries of individuals in an area where several stocks mix, when those individuals cannot be assigned to a particular stock. Participants agreed that for data-rich situations, the preference is to partition mortality and serious injuries based on the relative abundance of the stocks within the region of concern. In data-poor situations, when relative abundances of different stocks in an area are unknown, the total unassigned mortality and serious injuries should be assigned to each stock within the affected geographic area.

Finally, the workshop participants reaffirmed previous workshops' recommendations against extrapolating abundance estimates from one surveyed area to another unsurveyed area to estimate range-wide PBR, but there was agreement that informed interpolation (e.g. based on habitat associations) may be used, as appropriate and supported by existing data, to fill gaps in survey coverage and estimate abundance and PBR over broader areas.

Clarifying reporting of mortality and serious injury incidental to commercial fishing (Topic 5)

This topic dealt with inconsistencies in the manner, content, and format with which Reports are prepared, specifically related to summarizing mortality and serious injury incidental to commercial fishing. The workshop participants recommended that Reports include a fishery mortality and serious injury table with information only from U.S. commercial fisheries, but that all fishery mortality and serious injury (including non-US commercial fisheries such as foreign fisheries and recreational fisheries) should be discussed within the same narrative section of the Report. Participants also recommended that a list be created containing points-of-contact at each Regional Office or Science Center and the Office of Protected Resources (F/PR) to facilitate transmission of information to the Regions from permitting officers in F/PR about takes that occur from mortality sources not currently included in the Reports (such as mortality and injury reported under authorized take permits). Finally, the workshop participants recommended that a subsection entitled "Summary of the most important potential Human-caused Mortality (HCM) and Serious Injury threats that are unquantified" be included in the Reports, and that the Reports should also indicate if there are no major known sources of unquantifiable HCM.

When stock declines are sufficient for a strategic designation (Topic 6)

The topic addressed two issues. First, under the MMPA, one definition of a "strategic" stock is a stock which the Secretary determines to be below its Optimum Sustainable Population (OSP). However, there is no formal process to periodically evaluate the depleted status of non-ESA listed marine mammal stocks, and the current Report guidelines (NMFS 2005) do not provide any guidance for recommending that a stock be designated as depleted. The workshop participants therefore agreed that a 50% decline in stock abundance was sufficient to recommend that a stock be considered depleted, and as a result, the stock would be considered to be strategic. This was not meant to provide a de facto definition of OSP but rather represents the un-arguable case in which a population that had declined by 50% would certainly be below OSP. Arguments could be made to list a stock as depleted that had not declined by as much 50%. It was further recommended that it should be recorded in the Status of Stocks section that a stock was below OSP to ease the process of the Marine Mammal Commission requesting that the Secretary list the stock as depleted.

Under the MMPA, depleted stocks are automatically classified as "strategic," as are stocks of threatened or endangered species (under the Endangered Species Act), or stocks with human-caused mortality and serious injury that exceeds PBR. However, the MMPA also defines a "strategic" stocks as one, "*which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the Endangered Species Act of 1973 within the foreseeable future*." The workshop participants recommended that a stock be designated as strategic in accordance with this definition if a stock is declining and has a greater than 50% probability of a continuing decline of at least 5%/year. Such a decline, if not ceased, would result in a 50% decline in 15 years. The trend estimate should usually be based on data spanning at least 8 years. Finally, because a stock experiencing a strong decline should be given greater protection than a stock of unknown status (which receives a default F_r of 0.5), the workshop participants recommended that the recovery factor (F_r) for a stock that qualified as strategic under this definition be changed from a fixed value of 0.5 to the range of 0.1 to 0.5.

Assessing stocks without abundance estimates or PBR (Topic 7)

In the 17 years since the 1994 amendments to the MMPA, mortality and/or population abundance estimates are still unavailable for some stocks in some regions. Given budget constraints, this situation is not likely to change in the foreseeable future. When mortality and/or population abundance estimates are unavailable, the PBR approach cannot be used to assess populations, in spite of statutory mandate to do so. This situation is common in Alaska and in the US territorial waters surrounding Pacific and Caribbean Islands. However, workshop participants suggested that there are likely ways to make progress in assessment and mortality mitigation for marine mammal stocks despite a lack of data on abundance and mortality. In cases where a stock is vulnerable to sources of anthropogenic mortality known to affect the species elsewhere, there are means described by the stock assessment guidelines for designating stocks as strategic that do not depend on estimating PBR.

Characterizing uncertainty in key Stock Assessment Report elements (Topic 8)

The workshop participants recommended that Report authors describe, in the Status of Stock section, uncertainties in key factors so that the reader could easily gauge how well the status of the stock is known. Preliminarily, the group agreed that the contents of the summary should include: stock status (e.g. strategic/non-strategic under the MMPA, listing under the ESA), most recent survey year, abundance estimate (complete or partial, and level of confidence in the estimate [potential biases, etc.]), human caused mortality and serious injury (including uncertainties about the estimates), fisheries monitored, other known sources of mortality, stock structure, and a statement on whether existing data would be sufficient to detect a precipitous decline if one was occurring.

Whether to expand the Stock Assessment Reports to include non-serious injuries and disturbance (Topic 9)

The workshop participants concluded that the Report guidelines, with respect to the scope of content considered by the Reports, could be retained as they currently stand. However, Report authors are encouraged to routinely consider including information in the Reports about what "other factors" may cause a decline or impede recovery of a particular stock. In particular, Report authors should broaden their consideration of "other factors" to include animals non-seriously injured or disturbed under the terms of a Letter of Authorization or Incidental Harassment Authorization under section 101(a)(5) of the MMPA.

INTRODUCTION

Section 117 of the Marine Mammal Protection Act (MMPA) requires the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) to complete Stock Assessment Reports (hereafter "Reports") for all marine mammal stocks within U.S. waters. The Reports must include information on how stocks are defined, estimates of Potential Biological Removals (PBRs), an assessment of whether incidental fishery takes are "insignificant and approaching zero mortality and serious injury rate," as well as other information relevant to assessing stocks. Because the MMPA provides only limited guidance and because there is a clear need to establish, where possible and appropriate, quantitative criteria that may be consistently applied to marine mammal stocks between NMFS regions for developing the Reports, the NMFS convened a series of workshops with the USFWS to review and move forward on these issues.

An initial workshop was convened in La Jolla, CA on 27-29 June 1994 and produced a set of guidelines used in the first marine mammal stock assessments (Barlow et al. 1995). A second workshop (referred to as the "GAMMS" workshop) held in Seattle, WA on 3-5 April 1996, produced the first revision of the guidelines for assessing stocks and preparing stock assessment reports (Wade and Angliss, 1997). A third workshop (referred to as GAMMS II) was convened in 2003 in Seattle, WA, which led to additional guideline revisions (NMFS 2005); however, no formal report was prepared describing the workshop. Together these guidelines represent a statement of NMFS and USFWS policy for implementing provisions of MMPA section 117.

Applying these guidelines over the past 15+ years has disclosed the need for additional discussions and refinements to the methods and policies used by the two Agencies in developing marine mammal stock assessments. To facilitate this discussion, the two Agencies convened a workshop (GAMMS III) on 15-18 February 2011 at the Southwest Fisheries Science Center, La Jolla, CA, the purpose of which was to assemble scientists and managers to provide recommendations to NMFS and USFWS leadership on further revisions to the guidelines for assessing marine mammal stocks and preparing the Reports pursuant to MMPA section 117.

The objectives of the Workshop were to consider issues related to preparing marine mammal stock assessment reports, and to develop recommendations to Agency leadership on ways to resolve these issues. In particular there was a need to:

- Consider methods for assessing stock status (i.e., how to apply the PBR concept) when abundance data are outdated, nonexistent, or only partially available;
- Develop policies on stock identification and application of PBR to small stocks, transboundary stocks, and situations where stock mix; and
- Develop consistent national approaches to a variety of other issues, including application of mortality and serious injury (M&SI) information in assessments, consideration of recreational fishery induced M&SI, etc.

Specific topics discussed at the workshop are listed in the workshop agenda (Appendix I). Detailed summaries of those discussions follow this Introduction.

The general Workshop format consisted of a morning plenary presentation each day and discussion of white papers on 2-3 topics. Breakout group discussions were held for each topic in the afternoon. It was in the breakout groups that suggested language revisions to the guidelines for preparing Reports were first developed. Breakout group recommendations were then reported out to the larger groups in the afternoon, and discussed the same day and following day until participants reached consensus on revised text for the Report guidelines.

Formal workshop participants included scientists and managers from the USFWS, NMFS, and the Marine Mammal Commission (MMC). USFWS representatives included staff from Headquarters, as well as field regions (notably the Alaska region). NMFS staff was present from Headquarters Offices of Protected Resources and Science & Technology, and all six of the NMFS Science Centers and Regional Offices. Observers were present from the Alaska, Atlantic, and Pacific Scientific Review Groups (SRGs), as well as other organizations and institutions. These latter individuals were invited at intervals to provide input, but were not part of decision making at the workshop. A full list of participants is provided in Appendix II.

This workshop report includes summaries of the presentations and discussions for each of the agenda topics, as well as suggested revisions to the guidance document for preparing Reports. Results are presented by discussion topic, as Sections 1 through 9. Appendices provide a variety of supporting documents, including the full suggested text revision of the Guidelines for Preparing the Stock Assessment Reports (Appendix IV). Additional procedure is required before these revised Guidelines become adopted as NMFS policy. Specifically, NMFS intends to formally provide the proposed revisions to the full text to the public for notice and comment. NMFS will then consider all comments and any new information provided before finalizing the revised Guidelines.

1. DEALING WITH OUTDATED ABUNDANCE (N_{MIN}) INFORMATION IN PBR CALCULATIONS

I. Background to the Issue

The MMPA defines N_{min} as providing "reasonable assurance" that there are at least the estimated number of individuals in a stock, as N_{min} is used in calculating a PBR. In the original guidelines for preparing Reports (Barlow et al. 1995), NMFS noted that the reliability of abundance estimates for calculating PBR is reduced over time. Accordingly, NMFS used a mechanism for ratcheting down the PBR after the survey information used for the abundance estimate became too old by reducing the recovery factor. The original guidelines appended to Barlow et al. (1995) stated, "if 5 years have transpired since the last abundance survey of a stock, the recovery factor for that stock should be decreased by 10 percent each subsequent year until a value of 0.1 is reached…"

This mechanism was criticized in public comments and by Scientific Review Groups (SRGs) because it appeared that NMFS was reducing the abundance of the stock over time and such a reduction was not biologically justifiable. Furthermore, the PBR of an endangered stock of marine mammals (with a default recovery factor of 0.1) could not be reduced to address the decreasing reliability of old abundance data. Therefore, NMFS altered the mechanism for addressing outdated information in a subsequent workshop for evaluating guidelines for preparing Reports (the 1996 GAMMS workshop described in Wade and Angliss (1997)). In that workshop, participants recommended that PBR not be reduced over time even though old information was still considered unreliable. Workshop participants recommended, and NMFS approved after public review and comment, that PBR for a stock be considered "undetermined" after the supporting survey information was more than eight years old, unless there was compelling evidence that the stock had not declined. This remains the current practice for the Reports.

In support of the switch to "undetermined" PBR, Wade and Angliss (1997) stated, "Regarding what to do with old estimates, it was noted that the definition of N_{min} states that there is assurance that "stock size is equal to or greater than the estimate" in the Act. At some point, with old estimates we lose this assurance." The resulting guidelines from this workshop noted also that an "undetermined" PBR is not the same as setting PBR equal to zero and that the status of a stock with undetermined PBR should be made on a case-by-case basis. Stocks for which N_{min} becomes "unknown" should not move from "strategic" to "not-strategic," or vice versa, solely because of an inability to estimate N_{min}.

At the May 2010 meeting of Assistant Regional Administrators and Science Leads for Protected Resources, it was observed that an "undetermined" PBR is confusing, does not support management decisions, and may be interpreted in such a way that there is no limit to the level of mortality that could be allowed. Accordingly, NMFS should investigate alternatives to undetermined PBRs for stocks with old abundance information.

II. Summary of Working Papers Addressing This Issue

Two working papers were submitted on this topic (Appendix III). One (by Jeff Moore, SWFSC, GAMMS III-WP-1) is relevant for cases in which population trend estimates are available for a stock. The other (by Jay Barlow, SWFSC, GAMMS III-WP-2) is relevant for cases in which no trend estimate is available for a stock, but when there is at least one prior abundance estimate that includes an estimate of precision. A third paper by Moore and Barlow (GAMMS III-WP-3) included text recommendations for revising the Report guidelines based on the first two papers.

The problem statements of these papers were that, under current Report guidelines:

1) From 1 - 8 years since the last survey there is no mechanism that allows PBR to account for:
    a. Increasing uncertainty in stock abundance as survey information for a stock becomes increasingly outdated, or
    b. Information that suggests probable near-future changes in abundance (increasing or decreasing trends) over that time horizon.
2) After 8 years NMFS is unable to support conservation decisions under the MMPA (e.g., mortality and serious injury incidental to commercial fishing cannot be evaluated as to whether it exceeds ZRMG or PBR) because the protections of the Act become non-functional without a PBR calculation.

<u>Summary of Working Paper by Jeff Moore (SWFSC):</u> "Trend-based analysis for estimating abundance (N_{min}) in PBR calculations beyond the most recent survey year"

Moore's working paper (and presentation during the workshop) summarized a Bayesian state-space model framework for estimating abundance trends (and more precise abundance estimates) using data from multiple line-transect surveys. The method is generalizable to other types of abundance surveys, and could even apply to situations where different survey methods were used in different years. An analysis of fin whale abundance trends in the California Current was presented as an example. Details of the working paper are presented in full in Moore and Barlow (2011).

State-space models consist of separating the data-generating process into two components: a state process that describes real system dynamics, and an observation process that links the real process to the observed data. In the case of analyzing a time series of line-transect data, the state process model describes how population density (and hence abundance) changes through time, and the observation model describes the detection process (e.g., distance sampling) that links the real or state process (true change in population density) to the observed data (counts and distances to observed groups).

The greatest strength of this approach for addressing the outdated N_{min} problem is the ability to make future predictions of abundance that explicitly incorporate estimates of process and sampling error and all sources of uncertainty in estimated model parameters while also validly accounting for sampling covariance, correlated parameter estimates, etc.

Figure 1 shows fin whale abundance estimates in the California Current survey area during 4 survey years (estimates for a portion of the study area in 1991 and 1993 were also obtained but are not shown in Fig. 1). These estimates are the averages of those obtained from several models (weighted by deviance information criterion, or DIC, model selection), all of which suggested that fin whale abundance is increasing but at a slowing rate. Included in the figure are point estimates, 90% Bayesian credible intervals of the estimates, and the 20th percentile estimate (which is used to calculate PBR under the MMPA). Also shown is predicted abundance (point estimates, 90% credible intervals, and 20th percentile estimates) for 8 future years. There are two sets of projections, one that ignores process error and another that takes account of process error; the latter has wider uncertainty bands and is the more appropriate model to use.

This approach allows the N_{min} used in the PBR equation to change as frequently as annually, in a way that reflects the decreasing dependability (increasing uncertainty) of estimates with time since the last survey. In the current fin whale example, there is strong evidence of an increasing population, so N_{min} (20^{th} percentile) projections are increasing with time. But for many stocks, projected N_{min} estimates would be decreasing with time, even if the mean trend line might be stable or increasing. This approach would provide an objective, transparent, and non-arbitrary tool for allowing PBR to decrease with time as a precautionary measure against the increasing uncertainty associated with survey data becoming progressively outdated.

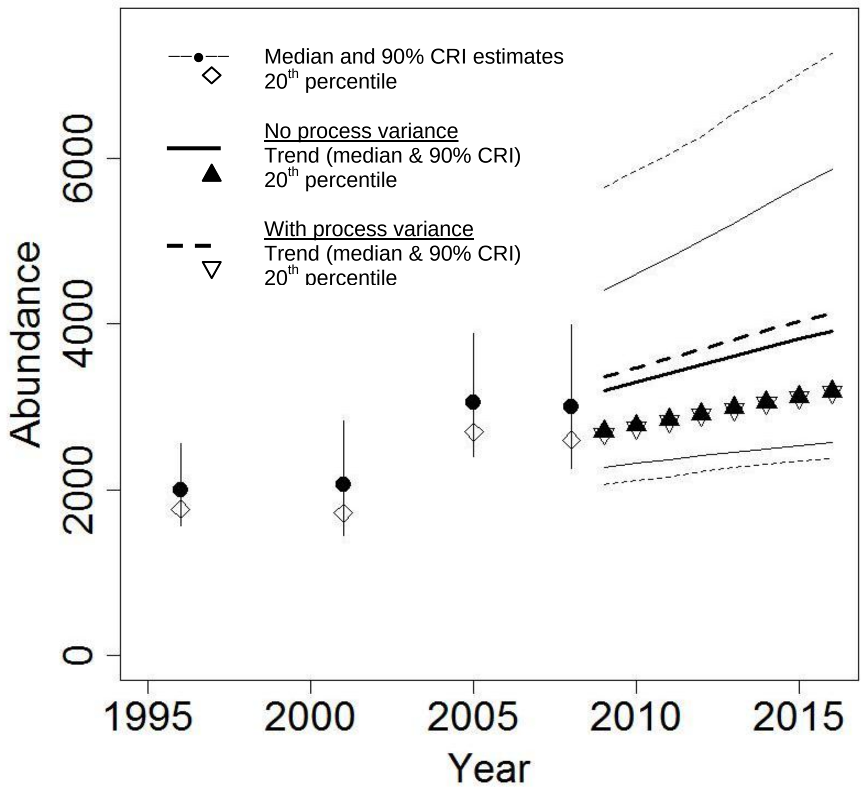

Figure 1. Bayesian posterior estimates of fin whale abundance for the entire California Current study area during 1996 – 2008 surveys and projected 8 years beyond 2008, based on fitted trend model (from Moore and Barlow 2011).

Other considerations

Importantly, abundance projections as described above depend on the assumption that environmental processes underlying the observed population dynamics are not changing in a systematic way (although random annual process change is not problematic). For example, if following 2008 (most recent fin whale survey), the CA Current began experiencing new and permanent ecosystem change, or ship traffic patterns changed resulting in permanent non-trivial increase in annual ship strikes, etc., then the projections would no longer be valid. In spite of this potential problem, for most populations this approach will still yield more precautionary estimates of N_{min} than fixing N_{min} at the level of the most recent estimate or declaring N_{min} undetermined. A suggestion to help address this concern is to estimate future N_{min} as the minimum of the projected 20^{th} percentile estimates and the 20^{th} percentile estimate from the most recent survey year. In other words, N_{min} used in the PBR equation could not increase with time since last survey; it could only decrease or remain constant, as a precautionary measure against possible change in the data-generating process.

Summary of Working Paper by Jay Barlow (SWFSC): "Simulation-based analysis for projecting N_{min} beyond the most recent survey estimate when trends are not estimated and population growth rate is unknown"

Barlow proposed two methods for projecting the uncertainty in population size into the future when the population growth rate is unknown. The first uses a population growth model that brackets a likely range of population growth rates. Each year after an estimate of abundance is made, a new N_{min} can be estimated based on this projection of uncertainty. The second uses an analytical approach to project uncertainty in abundance based on a CV computed from a symmetrical distribution of population growth rates.

For the first method, Barlow used a simple population model (written in R) to project uncertainty in population size based on a population growth rate that is chosen randomly from a uniform distribution between minus 10% per year (roughly, the maximum sustained rate of decline observed for a U.S. marine mammal population; NMFS 2008) and R_{max}. The population growth model does not consider age structure or stochastic variation in population growth rates. Population sizes are assumed to be log-normally distributed. Simulations were done for four cases: for cetaceans with an R_{max} of 4% and coefficients of variation in abundance estimates of 35% and 80% and for pinnipeds with an R_{max} of 12% and coefficients of variation in abundance estimates of 35% and 80%.

The results show that the lower 20^{th} percentiles of the population estimates (N_{min}) decrease with time in all cases due to uncertainty in population growth rate. The rate of decline ranges from roughly 5 - 6% per year for cetaceans with CV(N)= 35% (Fig. 2) to 1.5% per year for pinnipeds with CV(N)= 80% (Fig. 3). The median population size decreases for cetaceans (because the distribution of population growth rates (-0.1 to +0.04) has a mean value of less than zero, and the median population size increase for pinnipeds (because the distribution of population growth rates (-0.1 to +0.12) has a mean value of greater than zero.

If the population growth rate is assumed to be symmetrically distributed around zero (-0.1 to +0.1), the mean population size does not decrease with time, but the 20^{th} percentile decreases at rates of ~3.5% per year for CV(N)= 35% **(**Fig. 4**)** and ~2.1% per year for a CV(N)= 80% (Fig. 5). This approach has some appeal because it does not assume that the expected population growth is either positive or negative.

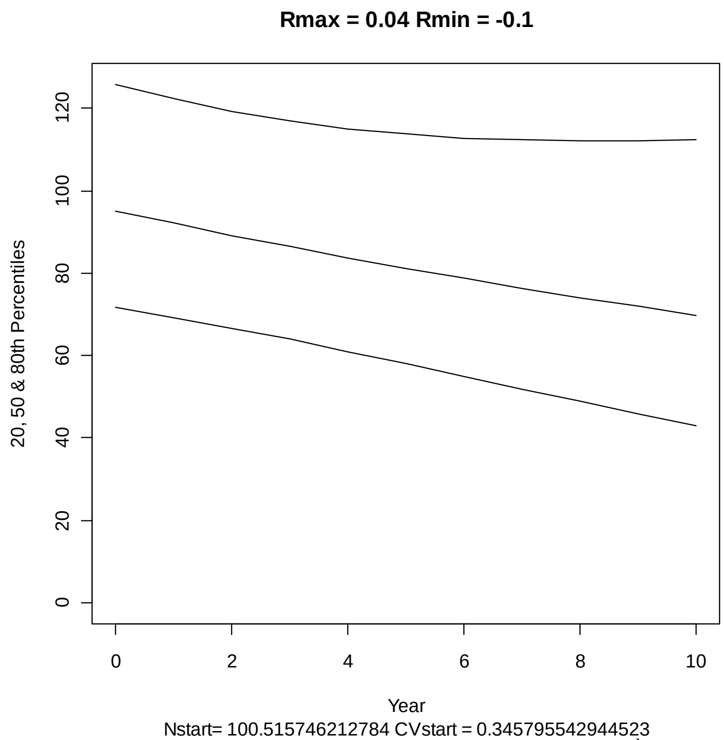

Figure 2. Cetacean example w/ CV= 0.35. Lower 20th percentile decreases at ~5.0% per year.

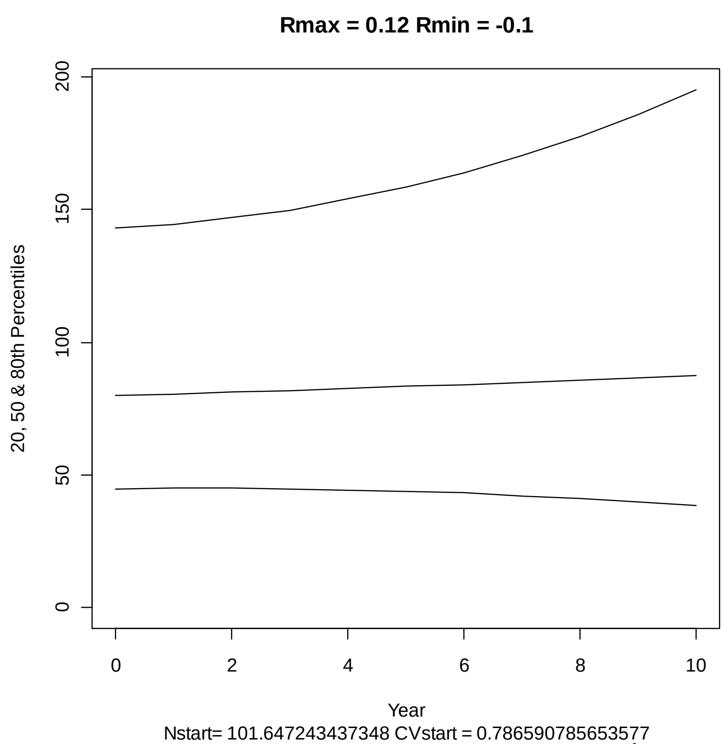

Figure 3. Pinniped example w/ CV= 0.80. Lower 20th percentile decreases at ~1.5% per year.

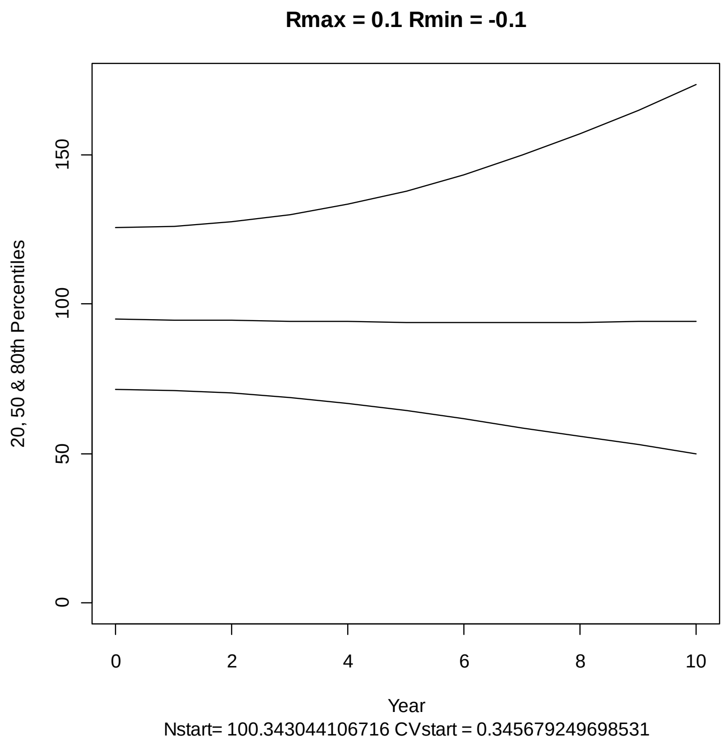

Figure 4. Symmetrical growth rate ~R(-0.1,+0.1) w/ CV= 0.35: Lower 20th percentile decreases at ~3.5% per year.

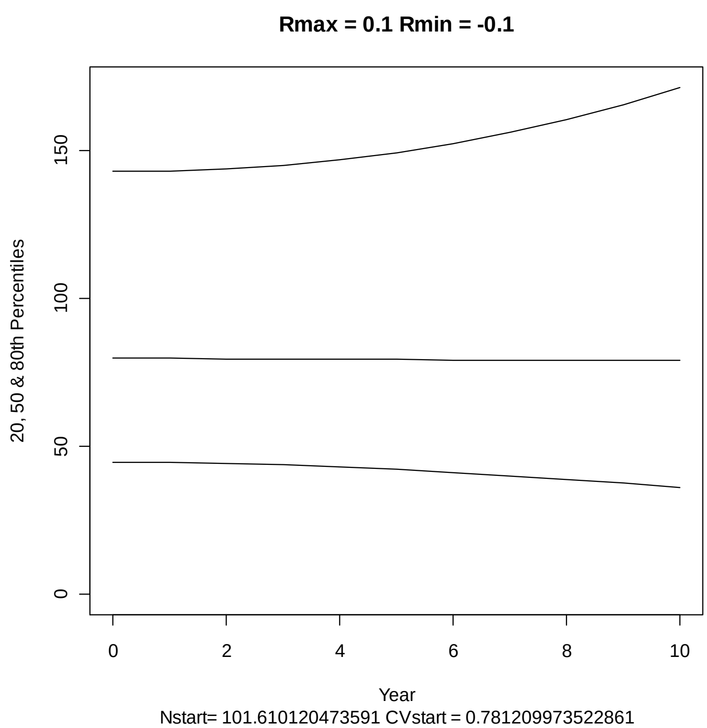

Figure 5. Symmetrical growth rate ~R(-0.1,+0.1) w/ CV= 0.80: Lower 20th percentile decreases at ~2.1% per year.

Barlow's second approach used analytical methods to project uncertainty in future population sizes instead of the simulation model described above. A uniform distribution has a standard error equal to the width of that distribution divided by the square root of 12. If the multiplicative factor of population growth (λ) is uniformly distributed between 0.9 and 1.1, the standard error of that distribution is 0.2/sqrt(12) or 0.0577. Given a mean λ of 1.0, the CV would also be 0.0577. Uncertainty in future population size could be projected from this CV (Fig. 6) without specifying the actual distribution of population growth rates if the resultant population size is still assumed to be log-normally distributed. That is, the CV of N_t can be approximated from the CVs of the original abundance estimate and λ^t as:

$$CV(N_t) = \sqrt{[CV^2(N_0) + CV^2(\lambda^t)]},$$

where:

$CV^2(N_0)$ is estimated empirically as the square of $CV(N_0)$, and
$CV^2(\lambda^t) = [t * 0.2 / \sqrt{12}]^2$

N_{min} should be calculated at the 20th percentile of the distribution of N_t using the usual formulae, using the point estimate for $N_t = N_0$ and $CV(N_t)$ as inputs.

In Barlow's presentation during the workshop, he emphasized this latter approach for its generality (would not require case-specific simulations), transparency, and computational simplicity.

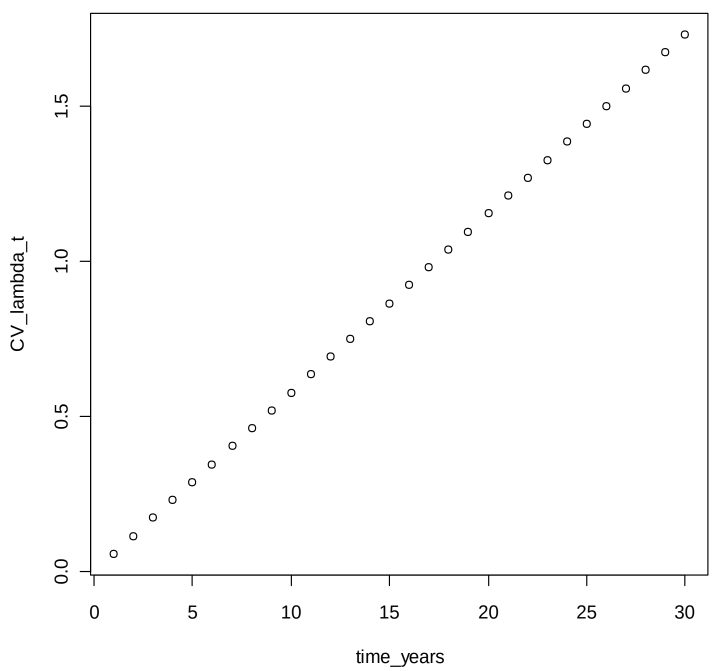

Figure 6. Time (t) vs. $CV(\lambda)^t$, assuming a uniform distribution U[0.9, 1.1] for annual growth rate λ. To estimate N_{min} at time t, assume no change in the point estimate from time 0 to time t, but use $CV(N_t) = \sqrt{[CV^2(N_0) + CV^2(\lambda^t)]}$ to estimate the 20th percentile estimate of a log-normal distribution.

III. Discussion

The general discussion on this topic surrounded two key sets of issues:

- What to do about N_{min} (and hence PBR) estimates during years 1 – 8 since the last survey:
    - Project uncertainty (and revise N_{min} and PBR) annually?
    - Project uncertainty based on trend models (i.e., Moore's working paper) if the data to construct such models are available?
    - Project uncertainty based on a uniform distribution model (Barlow's working paper)?
- What to do after the 8th year: Continue projecting annual uncertainty as for years 1 – 8, or use a new 'rule'?

Discussion on PBR penalties and surrounding incentives:

The group had multiple opinions on whether a change in the calculation of PBR after the current 8 year time frame would change the incentives for the collection of more data after the 8th year as compared to the expiration of PBR after the 8 years.

There was some concern that PBRs resulting from the types of projections presented by Moore's and Barlow's working papers would allow for a false sense of security about how much abundance information was available. That is, calculating "pseudo-PBR" estimates many years after the last true surveys could hurt efforts to obtain ship resources because the continued availability of (projected) N_{min} estimates might provide a disincentive to conduct surveys. Individuals of this opinion suggested that providing a firm cutoff (8 years) for abundance estimate reliability (as per wording of the current guidelines) provides some assurance that surveys will be conducted at that minimum interval and helps the science centers lobby for ship time.

Others noted, though, that the current 8 year cutoff has not adequately ensured that surveys be conducted this frequently and that "undetermined" PBR may not be a legal option under the MMPA, hence the need for this workshop to determine what to do beyond the current 8-yr threshold. Some felt that the new proposed methods could help prioritize which species are most in need of new data since it will highlight those stocks that are closest to exceeding PBR. Additionally, it was stated that an undetermined PBR had no negative consequences for commercial fisheries but environmental groups and scientists are dissatisfied with the lack of data under the current scheme. The alternative proposed approaches would provide an incentive for those interested in the continuation of commercial fisheries to support resources for regular surveys since under these approaches PBR will only decrease with increased uncertainty over time. It was noted that if there are more stocks with PBRs approaching 0 under the new scheme, there will inevitably be more Category I fisheries. Currently, all Category I fisheries have a TRT assigned to them. With many more stocks reaching PBR=0 levels, a TRT for every Category I fishery may not be logistically feasible.

Discussion on the rate and timing of PBR decrease:

The group reached general agreement that PBR should be reduced over time in the absence of trend and abundance information to suggest otherwise. The group then discussed what rate of decrease should be applied to PBR and when it should start being applied.

The group consented that a decrease in PBR should begin in the year following the survey. Any delay in order to accommodate a time lag between cruise date and publication date was determined to be arbitrary and inaccurate from an ecological standpoint. The group also felt that the 8-year time frame already in the guidelines should remain relevant because a population at carrying capacity that declines at 10% per year (considered a plausible worst-case scenario, based on observed decline of Steller's sea lion) would be reduced to less than 50% of its original abundance after 8 years and thereby result in a depleted status. Thus, if 8 years have transpired since the last abundance survey, simply adjusting annually for uncertainty in population growth rates (e.g., based on Moore's or Barlow's models) no longer provides a reasonable assurance that the stock size is equal to or greater than N_{min}. The main discussion then centered on two options:

1) In year 9, apply a retroactive 10% per year decrease in N_{min} that reflects 8 years of decrease at this rate since the original (last empirically determined) survey estimate of N_{min}, or;
2) In year 9, use the most recent model-estimated N_{min} (year 8) and decrease it by 10% to obtain N_{min} in year 9. Decrement N_{min} by 10% per year thereafter.

Ultimately, option 1 was favored. Therefore, it was agreed that after 8 years, lacking evidence to the contrary, the N_{min} for a stock should be decreased by 10 % per year (reflecting the uncertainty that could result from a 10% decline per year), applied retroactively from the time of the last survey estimate. In other words, N_{min} in year 9 corresponds to a 61% reduction, i.e., $100 \times [1 – (1 – 0.1)^9]$ in the estimate of N_{min} from the most recent survey, and it declines 10% per year thereafter. If there is evidence that stock size is stable or increasing, this approach would not be taken.

Discussion on the annual rate of PBR decrease within 8 years since last survey:

Discussion focused on when to use trend models (if multiple abundance surveys have been conducted) or other uncertainty projection models (e.g., based on Barlow's models, when population growth rates are unknown), and issues associated with each.

With respect to Barlow's first method (i.e., requires simulation and selection of min and max growth rate estimates for the bounds of the uniform distribution), there was some debate about how to select the proper range of plausible growth rates, noting that one would not want the upper plausible limit for growth rate to be too high. Barlow's second method (analytical projection of CV) was ultimately favored, in part because it does not require simulation.

There was some discussion about the need for standards by which projected abundance estimates (from a trend analysis) would be considered suitable for use in estimating PBR beyond the most recent survey (e.g., depending on quality of initial abundance estimate, amount of data available for estimating trends, etc.). At what point do trend data become unreliable? Does that point depend on the strength of the data? Ultimately it was recognized that the suitability of information and model for projecting trend-based estimates would have to be determined on case by case bases, and that in any case, a projection should only continue until it is found to be inconsistent with other known information (e.g. regime shift, or other new – including anecdotal – information. One should identify when the projection becomes very unreliable (i.e. no confidence in that projection). The description of the model of projecting future trends should include the caveats and degrees of uncertainty as well as the caution that should be used in its interpretation.

The was also concern with the notion of projecting trends because of inter-annual variability in population processes due to factors such as El Nino, or larger phenomena such as Pacific Decadal Oscillation (PDO). Data on which trend projections are based would need to have encompassed enough years to provide a reasonable representation of such variation, and it was recommended that if trend-based projections were to be used, that the guidelines should emphasize a requirement for using sufficiently long time series of data and that perhaps there should be an environmental point that you stop projecting, e.g. change in PDO.

Moore acknowledged caveats inherent in trend models: that projections could only be reasonably carried out a finite number of years into the future; that all projection models should explicitly include estimation of process error; and that type of projection model should be used on a case by case basis when determined to be appropriate. There was some consideration as to whether half the length of the time series of abundance estimates used to parameterize the trend model should be used as a limit for how many years into the future a the trend could be projected (Moore suggested this as one possibility).

Using either of the two models (trend or uniform-based uncertainty projection), the workshop participants envisioned that the Reports would include a table which shows the projection of N_{min} and PBR out to Year 1, 2, 3, etc. This at least addresses the goal of not having an undetermined PBR, even though the implications of an undetermined PBR are still unclear.

It was noted that it may not be an easy task to obtain constituent approval of the projection / simulation methods.

It was emphasized during these discussions that adjusting the N_{min} parameters within the first 8 years following an abundance estimate is much less important than what you do beginning in year 9 (to account for large changes that have been accumulating for the past 8 years).

Summary

The topic of dealing with outdated N_{min} was revisited and discussed many times during the workshop. Jeff Moore gave a new presentation mid-way through the workshop in attempt to summarize the state of discussion (agreements and disagreements) to that point and submit a revised way forward based the direction of conversation thus far. Ultimately there was agreement on the following:

1) The default approach would be to use “uncertainty projections” (Barlow’s analytical method), from years 1 to 8 since the most recent abundance estimate (to be described in Technical Details of the guideline revision, see part 2 of Appendix IV).

2) After 8 years and assuming no new estimate of abundance, assume the worst-case scenario (retroactive 10% decline in N_{min} per year). Thus, N_{min} in year 9 corresponds to a 61% reduction,

i.e., 100 x $[1 – (1 – 0.10)^9]$, in the estimate of N_{min} from the most recent survey, and it declines 10% per year thereafter.

3) If data to estimate population trends are available, this can influence the uncertainty projections during the first 8 years in the following ways, all of which are precautionary (see Fig. 7, next page):

- If trend-based N_{min} is less than N_{min} from Barlow's analytical method, the trend-based estimate should be used. If trend-based N_{min} is also less than -10% per year, it should be used indefinitely in the absence of new information (rather than applying 10% decrements after 8 years)

- If trend-based N_{min} is *greater* than N_{min} from Barlow's method, use a time-weighted average of the two estimates (trend estimate dominates completely at year 1…the two estimates are equally weighted around year 4…Barlow's method dominates completely at year 8).

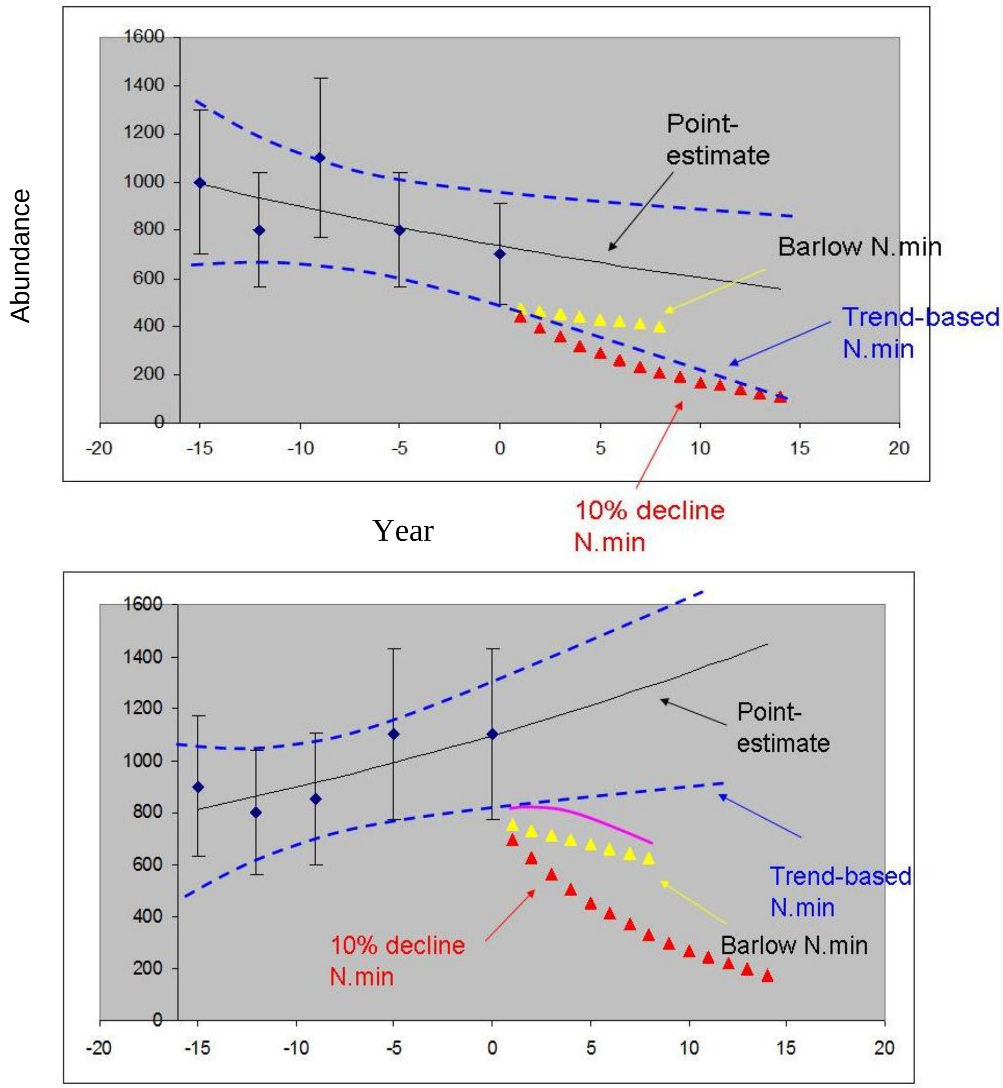

Fig. 7. Hypothetical example of how N_{min} would change through time following the most recent survey (Year 0). Blue diamonds and error bars are previous abundance estimates, fitted by a trend line (solid black) with 60% confidence or credible intervals (dotted blue), such that lower bound = N_{min}. For a population with declining trend (top panel), the trend-based estimates of N_{min} are used for years 1-8 after the last survey, since these estimates are more conservative than the estimates from projecting a uniform distribution model (yellow triangles). After year 8, N_{min} is modeled by the red triangles, which assumes a 10% annual decline from time of last survey. For a population with increasing abundance trend (bottom panel), the estimates in years 1 – 8 are a time-weighted average (solid pink line) of the trend-based projection of N_{min} (lower dotted blue line) and the uniform-based projection (yellow triangles). After year 8, N_{min} is modeled by the red triangles, which assumes a 10% annual decline from time of last survey.

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

Minimum Population Estimate (N_{min})

Abundance estimates become less dependable with time after the last survey has occurred. ~~When abundance estimates become many years old, at some point estimates will no longer meet the requirement that they provide reasonable assurance that the stock size is presently greater than or equal to that estimate. Therefore, unless compelling evidence indicates that a stock has not declined since the last census, the minimum population estimate of the stock should be considered unknown if 8 years have transpired since the last abundance survey of a stock. Eight years was chosen, in part, because a population that declines at 10% per year from carrying capacity would be reduced to less than 50% of its original abundance after 8 years. A 10% decline per year over at least 8 years represents the greatest decline observed for a stock of marine mammals in U.S. waters. If N_{min} is unknown, then PBR cannot be determined, but this is not equivalent to considering PBR equal to zero. If there is known or suspected human-caused mortality of the stock, decisions about whether such stocks should be declared strategic or not should be made on a case-by-case basis. Stocks for which N_{min} becomes unknown should not move from "strategic" to "not-strategic", or v.v., solely because of an inability to estimate N_{min}.~~ Therefore, estimates of N_{min} since the last survey should be reduced annually to explicitly reflect uncertainty in current abundance, and to continue providing reasonable assurance that the true stock size is equal to or greater than N_{min}.

When a population's growth rate is unknown, incorporating uncertainty may be accomplished by projecting N_{min} based on a uniform distribution of plausible growth (see Technical Details). However, at some point even these projected estimates may no longer provide reasonable assurance that the stock size is presently greater than or equal to projected N_{min}, and N_{min} should therefore be decreased to further guard against a plausible worst-case scenario that may have gone undetected. A sustained decline of 10% per year represents the greatest decline observed for a stock of marine mammals in U.S. waters (NMFS 2008), and this rate of decline would decrease the population by 50% in 8 years, which would reduce the population below OSP. Therefore, after 8 years since the most recent survey, the N_{min} for a stock should be decreased by 10 % per year, applied retroactively from the time of the last survey, unless there is evidence against doing so.

For stocks with sufficient information to adequately estimate parameters for trend models (e.g., based on a time-series of abundance estimates or trend site data), such models may be used to help estimate values of N_{min} in years subsequent to the most recent survey. If the trend-based estimates of N_{min} are less than N_{min} projections from the uniform-distribution approach discussed in the previous paragraph, then the trend-based estimates should be used because they provide the stronger assurance that stock size is presently greater than the estimate of N_{min}. Similarly, if the trend-based estimates of N_{min} are declining by > 10% per year, they should continue to be used beyond 8 years since the most recent survey, unless new information provides evidence against doing so. On the other hand, if the trend-based N_{min} estimates are greater than those projected from a uniform distribution of growth rate, then N_{min} should be estimated as a time-weighted average of the two sets of estimates, out to 8 years from the most recent survey, after which the retroactive 10% per year reduction in N_{min} would be applied. Thus, N_{min} would fully reflect the trend-based estimate in the first year after survey but by the 8th year would fully reflect the estimate projected by the uniformly distributed growth rate model. This weighted average recognizes our diminishing confidence through time in the ability of trend-based projections to account for new changes in environmental processes (e.g., regime shifts) or anthropogenic impacts (e.g., change in fisheries, etc). And, it provides a more reasonable assurance that the stock size is presently greater than or equal to projected N_{min}. Trend models used should attempt to appropriately account for random environmental process error and sampling covariance in the data (e.g., see fin whale example by Moore and Barlow 2011), and should not inform the projections of N_{min} if at some point model results become inconsistent with other available information.

2. IMPROVING STOCK IDENTIFICATION

I. Background to the Issue

The PBR system was designed to assure the goal of the MMPA that "population stocks should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part, and, consistent with this major objective, they should not be permitted to diminish below their optimum sustainable population." Minimum abundance, which is critical to successful implementation of the PBR system, can be seriously over-estimated if distinct stocks are not correctly identified (e.g., are inappropriately pooled into one or a few large stocks), and this overestimate can result in incorrect calculation (also overestimates) of PBR. Many stocks defined in the Reports are geographically large, making it likely that the current implementation is failing to meet the MMPA objective. Furthermore, there are few statements in the Reports indicating uncertainty in stock delineation, and no impetus to reduce this uncertainty. Large-scale stocks may also result in no estimate of N_{min} because of the expense and logistics of making the estimates.

II. Summary of Working Paper Addressing This Issue

Barb Taylor (SWFSC), Patricia Rosel (SEFSC) and Karen Martien (SWFSC) presented the only working paper on this topic (GAMMS III-WP-2, Appendix III). This paper attempted to 1) review the current state of delimiting stocks after 15 years of management under the 1994 amendments; 2) characterize the scale at which many stocks are currently delineated in relation to known ecological and marine biogeographic regions; and 3) suggest changes to Report guidelines to improve stock delineation and to ensure characterization in the Reports of the uncertainty of current stock structures for most stocks.

The original guidelines (Barlow et al. 1995) stated, "The clear intent of the MMPA is to restore and maintain stocks within their Optimum Sustainable Population (OSP) level. Therefore, a risk-averse strategy of defining the stocks should be used to be consistent with these goals. A risk-averse strategy requires starting with a definition of stocks based on small groupings that are only "lumped" when there is compelling evidence to do so. Such evidence comes from biological studies." Further, the guidelines stated that "in the event of virtually no biological stock data, a stock should be defined simply as the area from which marine mammals are taken (i.e., the area in which the fishery is operating)."

Despite setting forth this risk-averse definition and in the absence of data to define stocks for most species, nearly all of the 145 stocks defined in that report were for very large geographic regions. For example, of the 31 species found in the Western North Atlantic, only bottlenose dolphins had more than 1 stock (n=2) within that biogeographical region. No stocks corresponded to the area of a fishery when data were poor or absent. At best, when more than one stock was delimited for a species within an SRG region it was because they were named to correspond with distinctive biogeographic areas or isolated habitats within the region (e.g., the Gulf of Mexico and the western Atlantic). The tactic of starting with small stocks and requiring evidence to amalgamate stocks (reversing the burden of proof in an explicitly risk-averse manner) was never implemented, perhaps with the sole exception of estuarine populations of bottlenose dolphins in the Gulf of Mexico.

The comparison of stocks identified in the original 1995 Reports and the most recent (2009) Reports demonstrated that little progress has been made to examine stocks on smaller geographic scales. There are separate stocks for most species that span the range of dramatically different biogeographic regions (for example, species that are found in arctic and temperate waters or in both Hawaii and California or the Northwest Atlantic and the Gulf of Mexico). However, most species found only within one biogeographic region are defined as single stocks. The percentage of stocks that are the only stock for a species in that SRG Region (% species with one stock; Table 1) has not changed greatly in the last 15 years.

Table 1. Summary of number of species, number of stocks, and number of species represented by a single stock in both the original and current Reports.

SRG Region	# species	1995 # stocks	1995 % species with 1 stock	2009 # stocks	2009 % species with 1 stock
Alaska	24	34	79	45	71
Atlantic	39	94	59	111	54
Pacific	33	56	61	78	56

To better quantify the scale at which most stocks have been delimited, and to provide more meaningful biological context to that scale, the number of stocks was compared to two different systems of categorization for marine ecosystems. Longhurst's (1998) biogeographic provinces (Figure 8) encompass very broad biogeographic regions while the ecoregions of Spalding et al. (2007) are on a smaller scale (Figure 9). Details of how stock areas were matched to these regions were provided in the working paper. Given the ever-increasing evidence that many marine mammal species exhibit habitat specialization and therefore limit movements to specific habitats despite the ability to range further, the working paper authors made the assumption that these different ecoregions may well represent areas that are likely to contain multiple demographically independent units and hence have positively biased PBRs that leave them vulnerable to over-exploitation in cases where human-caused mortality is greater in some parts of the stocks' range than in other parts.

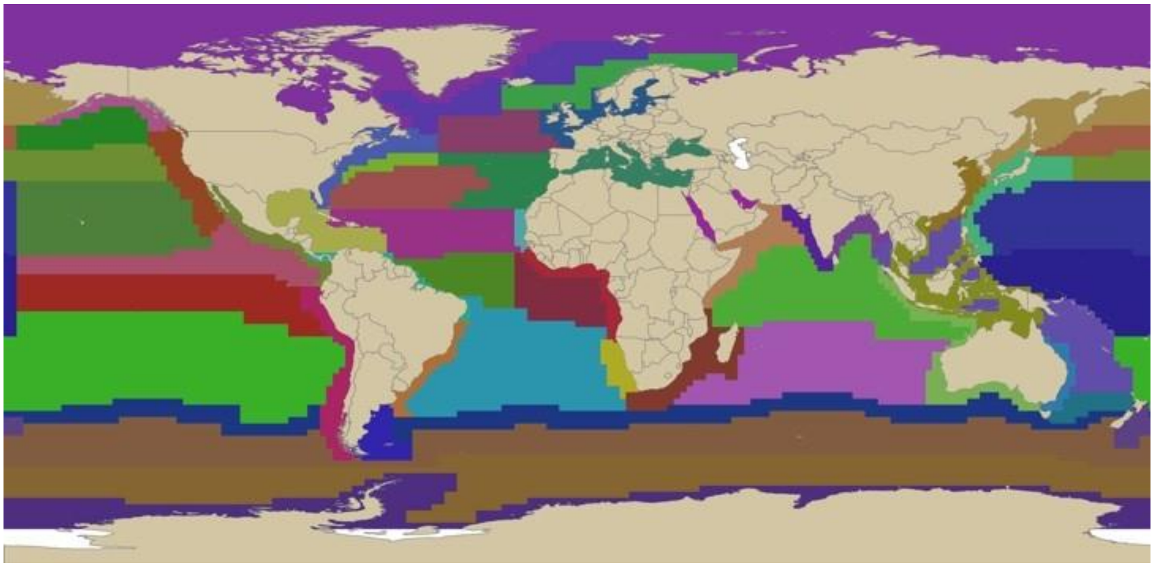

Figure 8. Longhurst's (1998) biogeographic provinces.

Of the 66 species considered by the 2009 Reports, eighty-six percent have 1 or fewer stocks per Longhurst province (Table 2). In other words, for most species, stocks are defined on a scale comparable to or larger than the Longhurst provinces.

Table 2. Percentage of species in different categories of "number of stocks per Longhurst (1998) province."

Average # of stocks per province	Species count	Species percent
< 1	29	44
1	28	42
1 < x ≤ 2	6	9
> 2	3	5

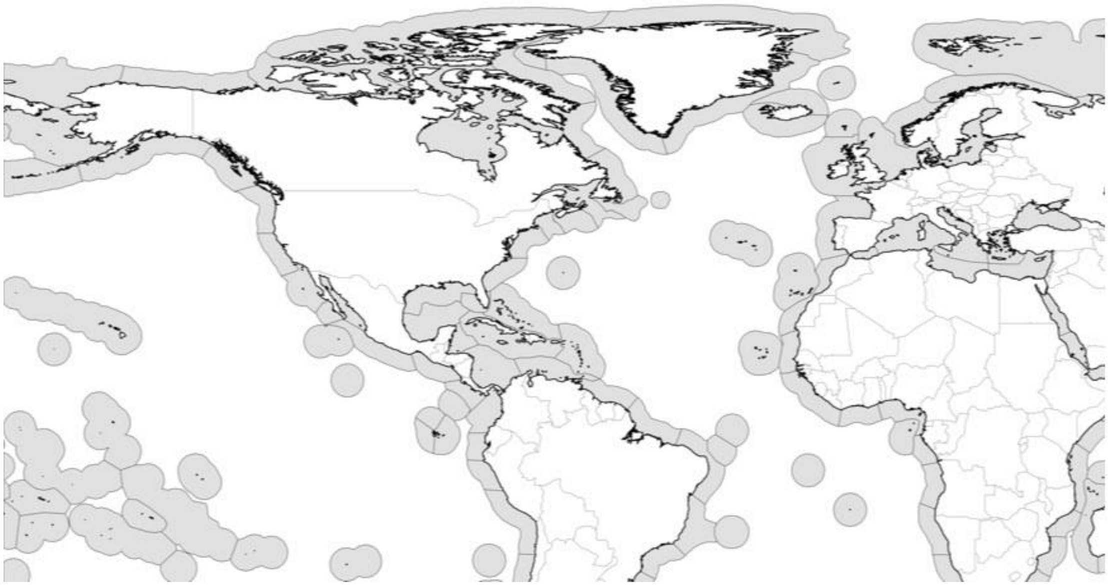

Figure 9. Marine coastal ecoregions (Spalding et al. 2007).

Comparison of stocks to the ecoregions defined by Spalding et al. (2007) did not fare better. Most stocks span multiple ecoregions (Table 3) with 20% of species having 1 stock/ecoregion and 75% having less than 1 stock/ecoregion, meaning that most defined stocks span several ecoregions.

Table 3. Percentage of species in different categories of "number of stocks per Spalding et al. (2007) ecoregion."

Average # of stocks/ecoregion	Species count	Species percent
≤ 0.25	6	9
0.25 < x ≤ 0.50	35	53
0.5 < x ≤ 1	9	14
1	13	20
> 1	3	5

These comparisons highlight that there may be considerable risk to smaller, demographically independent populations of marine mammals in US waters and that both their delineation and risk have not been quantified.

III. Discussion

It was noted that current Report guidelines allow for biogeographic justification in defining new stocks (genetic evidence is not required for new stock designation). In addition, participants agreed that the history of the Reports shows that initial research efforts almost always resulted in identifying stocks too broadly and it was noted that the history of stock splits in the Reports is easy to trace and provides a good model for the evolution of stock recognition and subsequent designation. A suggestion was made to assess current risks to large stocks by examining local human-caused mortality under the assumption that the area of the takes overlaps 1:1 with the stock boundary. Taylor mentioned that the PBR-centric approach to management allows some stocks to "fall through the management cracks". The example she gave was ice seals, which have no known commercial fishery interactions and for which other factors (habitat loss due to global warming) are probably a much greater threat.

The breakout group began by reviewing some of the premises of the working paper, specifically that the large geographic scale of many stocks makes it likely that the current implementation is failing to meet the objectives of the MMPA, that some of the existing guidelines allowing for risk-averse stock definition are currently being followed, and that concerted effort should be expended to improve stock delineations in the near future. All of these points were agreed to by the breakout group members. The group also reviewed the genesis of the current definition of "stocks" as demographically independent populations, and reaffirmed that definition.

Most of the discussion was focused on ways to accelerate the rate at which existing data are used to define defensible stocks, as allowed for under the current Report guidelines. The group outlined the following process to speed progress:

1) Undertake a systematic review of the data currently available for each species that could be used to define stocks.
2) Based on the results of the review, add statements to the Status of Stocks section of each Report indicating whether it is plausible that the stock actually contains multiple demographically independent populations (DIPs) that should be managed as separate stocks and whether human-caused mortality is concentrated within a portion of the range of the stock.
3) The actual delineation of new stocks will proceed on a species-by-species basis, with priority given to species for which threats are not evenly spread across the stock's range. It is expected that the SRGs will play a key role in helping to set these priorities.

In order to provide the kind of information that is required to answer the question "is it plausible that there are multiple DIPs within this stock?" it was recommended that a national workshop be held to review and summarize information that is relevant to population structure. The workshop should include participation from NMFS Headquarters and all Science Centers and Regional Offices, at a minimum. It is unlikely that the workshop could feasibly review all stocks in all areas. Therefore, a list of priority stocks for consideration should be established prior to the workshop. This might efficiently be done by a Steering Committee with stocks to be reviewed proposed from each region. Stocks should be selected to cover a broad range of geographic and taxonomic diversity (e.g., it might be appropriate to review at least one stock each of phocids, otariids, large whales, delphinids, phocoenids, and ziphiids in each region, if presently recognized). Priority should be given to stocks that are geographically large, span multiple bioregions, or potentially experience substantial human-caused mortality in a portion of their range. It would also be appropriate to examine areas of U.S. waters where stocks have not previously been defined (e.g., Guam, Caribbean). The information to be reviewed should include (at least) all information used for defining stocks as recommended in the Report guidelines. This includes distribution and movements, acoustic call types, population trends, morphological differences, differences in life history, genetic differences, contaminants and natural isotope loads, parasite differences, and oceanographic habitat differences (such as marine bioregions). It should be emphasized that the purpose of the workshop is to review and summarize relevant information. As possible and appropriate, the workshop will propose revisions to stock structure. A major objective will be to review the information for these stocks in a manner to provide a template for how to complete review of all stocks in each region.

Due to funding limitations and other logistical constraints, it may be years before the workshop described above could be held. It was suggested that until the systematic review of data can be completed, a statement within the Reports regarding the plausibility of multiple DIPs within a stock could simply be based on whether or not the stock encompasses multiple eco-regions.

There was some concern that including a statement in a Report that stock structure is likely incorrect would leave the agency vulnerable to litigation. However, it was pointed out that simply having incorrect stock structure leaves NMFS vulnerable to litigation whether or not we explicitly acknowledge that shortcoming in the Reports, so we may as well be as transparent as possible.

The group agreed to replace references to "reproductive isolation" and "demographic isolation" in the Report guidelines with references to "demographic independence," as the term "isolation" is likely to be interpreted by some as implying that there should be no interchange between stocks.

There was some disagreement about the implications for management of defining "too many stocks."

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

Definition of "Stock"

Many types of information can be used to identify stocks of a species: *e.g.*, distribution and movements, population trends, morphological differences, differences in life history, genetic differences, <u>differences in acoustic call types,</u> contaminants and natural isotope loads, parasite differences, and oceanographic habitat differences). Different population responses ~~between geographic regions~~(e.g., different trends in abundance) <u>between geographic regions</u> ~~not caused by movement of individuals between regions)~~<u>are</u> ~~is~~ also an indicator of stock structure, as populations with different trends are not strongly linked demographically. When different types of evidence are available to identify stock structure, the report must discuss inferences made from the different types of evidence and how these inferences were integrated to identify the stock.

Evidence of morphological or genetic differences in animals from different geographic regions indicates that these populations are ~~reproductively isolated~~ <u>demographically independent</u>.

~~Reproductive isolation is proof of demographic isolation, and, thus, separate management is appropriate when such differences are found~~. Demographic ~~isolation~~ independence means that the population dynamics of the affected group is more a consequence of births and deaths within the group (internal dynamics) rather than immigration or emigration (external dynamics). Thus, the exchange of individuals between population stocks is not great enough to prevent the depletion of one of the populations as a result of increased mortality or lower birth rates.

Failure to detect genetic or morphological differences, however, does not necessarily mean that populations are not demographically independent ~~or reproductively isolated~~. Dispersal rates, though sufficiently high to homogenize morphological or genetic differences detectable between putative populations, may still be insufficient to deliver enough recruits from an unexploited population (source) to an adjacent exploited population (sink) so that the latter remains a functioning element of its ecosystem. Insufficient dispersal between populations where one bears the brunt of exploitation coupled with their inappropriate pooling for management could easily result in failure to meet MMPA objectives. For example, it is common to have human-caused mortality restricted to a portion of a species' range. Such concentrated mortality (if of a large magnitude) could lead to population fragmentation, a reduction in range, or even the loss of undetected populations, and would only be mitigated by high immigration rates from adjacent areas.

Therefore, careful consideration needs to be given to how stocks are identified. In particular, where mortality is greater than a PBR calculated from the abundance just within the oceanographic region where the human-caused mortality occurs, serious consideration should be given to identifying an appropriate ~~management unit~~ stock in this region. In the absence of adequate information on stock structure and fisheries mortality, a species' range within an ocean should be divided into stocks that represent defensible management units. Examples of such management units include distinct oceanographic regions, semi-isolated habitat areas, and areas of higher density of the species that are separated by relatively lower density areas. Such areas have often been found to represent true biological stocks where sufficient information is available. In cases where there are large geographic areas from which data on stock structure of marine mammals are lacking, stock structure from other parts of the species' range may be used to draw inferences as to the likely geographic size of stocks. There is no intent to identify stocks that are clearly too small to represent demographically isolated biological populations, but it is noted that for some species genetic and other biological information has confirmed the likely existence of stocks of relatively small spatial scale, such as within Puget Sound, WA, the Gulf of Maine, or Cook Inlet, AK.

Each Report will state in the "Stock Definition and Geographic Range" section whether it is plausible the stock contains multiple demographically independent populations that should be separate stocks, along with a brief rationale (e.g., the current stock spans multiple eco-regions). If additional structure is plausible and human-caused mortality or serious injury is concentrated within a portion of the range of the stock, the Reports should identify the portion of the range in which the mortality or serious injury occurs.

3A. ASSESSMENT OF VERY SMALL STOCKS

I. Background to the Issue

Many small population stocks experience bycatch in fisheries or other human-caused mortality. Because of their small population size, their PBR estimate may be very small (just a few animals or even less than one). Just a few examples include several bottlenose dolphin stocks, Hawaii false killer whales (PBR = 0.8), and the Pacific stock of short-finned pilot whales (PBR=0.98). For such small populations, there are considerable imprecision and uncertainty in estimates of abundance and bycatch mortality from year to year. Low levels of observer coverage may introduce substantial small-sample bias in bycatch estimates with respect to low thresholds of concern (i.e., small PBR). Stochastic variation and acute sampling error associated with small sample sizes can result in some stocks fluctuating between strategic and non-strategic (bycatch above and below PBR) with high frequency.

If a stock regularly bounces in and out of strategic status, management is inefficient and confusing to constituents. In an extreme case, a single bycatch observation in one year could push a stock into strategic status, and trigger convening a Take Reduction Team. It is worth considering how calculations of PBR and bycatch mortality could be improved to avoid volatility in the triggering of changes in strategic status. Currently the Guidelines implicitly allow for abundance to be averaged across as many as 8 years, and explicitly recommend averaging mortality over no more than 5 years. This dampens variance in parameter estimates that affect management actions, but other improvements may be possible.

II. Summary of Working Paper Addressing This Issue

Jeff Moore (SWFSC) submitted the only working paper on this topic (GAMMS III-WP-3, Appendix III). It addressed the issue of statistical small-sample bias in bycatch estimates based on small observer coverage levels. The problem is that for stocks with very small PBR and where bycatch is a very rare event, the potential bias associated with small samples (low observer coverage and few years of data pooled) may preclude useful estimation of bycatch mortality for informing management.

The problem was analyzed using a simulation approach to evaluate bias of direct human-caused mortality and serious injury (hereafter, "mortality") estimates across a range of conditions meant to represent the problem of estimating very rare events for very small stocks. The goal of this exercise was to identify situations when the most recent Report recommendation of averaging 5 years of bycatch mortality estimates might not be sufficient for obtaining reliable estimates of average annual mortality for very small stocks and to provide guidance for remedy in such situations. The analysis only addressed statistical bias of estimators due to small samples; it did not deal with bias due to non-representative sampling (e.g., due to observer effects, non-random sampling of vessels, etc.). Also, the analysis did not evaluate estimation precision.

Analytical methods and detailed results were presented in the working paper. A brief summary of the methods follows. Mortality ("true" and "observed") data were simulated. One iteration (or realization) of a simulation consisted of generating a time series (of *t* years) of true deaths (n_t)

and observed deaths (y_t). True deaths each year were generated as Poisson random variables with mean μ (average number of deaths per year). The parameter μ represents the summary outcome from some combination of animal population size, fishing effort, and bycatch rate per effort per animal. Observed deaths each year were treated as binomial random variables with parameters n_t and p, where p is the level of observer coverage expressed as a proportion (e.g., of sets or trips observed). Across all iterations of a given simulation, the value of t, μ, and p remained constant. Thus, each simulation consisted of 1000 iterations of n_t and y_t given a fixed combination of t, μ, and p. For each iteration, bias was calculated as the average of annual mortality estimates across the t years (i.e., $\bar{\hat{n}}$ = mean of the $\hat{n}_t$) minus the average of the true values ($\bar{n}$ = mean of the n_t), where each $\hat{n}_t$ was calculated as the number of observed deaths divided by observer coverage (i.e., y_t / p). The working paper noted that the assumption of observed deaths being a binomial random variable is technically not appropriate for two reasons, but it was explained that the consequences of this should be trivial for estimating bias when dealing with rare events.

Summarizing results of the working paper analysis, the current Report guideline suggestion that mortality estimates be based on 5 years of data is appropriate for ensuring statistically unbiased average mortality estimators under most situations. However, this suggestion is not always adequate for the particular situation of very small stocks, for which PBR might only be around 1 or 2 animals.

The working paper analysis suggests that for very small stocks that have PBR around 1, observer coverage needs to be around ≥ 20% if 4 – 5 years of mortality estimates are being averaged (Fig. 10, Table 4). If observer coverage is lower, then estimates from a greater number of years should be averaged (e.g., 8+ years if PBR = 1 and observer coverage is only 10%), but this is problematic if changes in the fishery or population over the course of a decade make older estimates irrelevant to current environmental and anthropogenic processes. Alternatively, if average estimates are based on only a few years of data (e.g., 3 years), then only those estimates from a high level of observer coverage (> 30%) may be considered reliable when PBR is so low. For stocks with slightly higher PBR (e.g., 2 or 3 years), lower observer coverage (e.g., ≤ 10%) may be acceptable for generating mortality estimates based on 5 years of combined information.

Moore's working paper suggested that average annual mortality estimates based on less robust information (smaller datasets) than what is recommended in Table 4 should be considered unreliable for the purpose of evaluating stock status (strategic or not) when PBR is small. Of course, there may be situations where the average *minimum* mortality estimate per year from an observer program (i.e., sum of observed takes / number of years) exceeds PBR, which would alone provide sufficient evidence for classifying the stock as strategic irrespective of the reliability of the mortality point estimate. Other lines of evidence may similarly allow for strategic classifications to be made in the absence of good statistical point estimates of mortality.

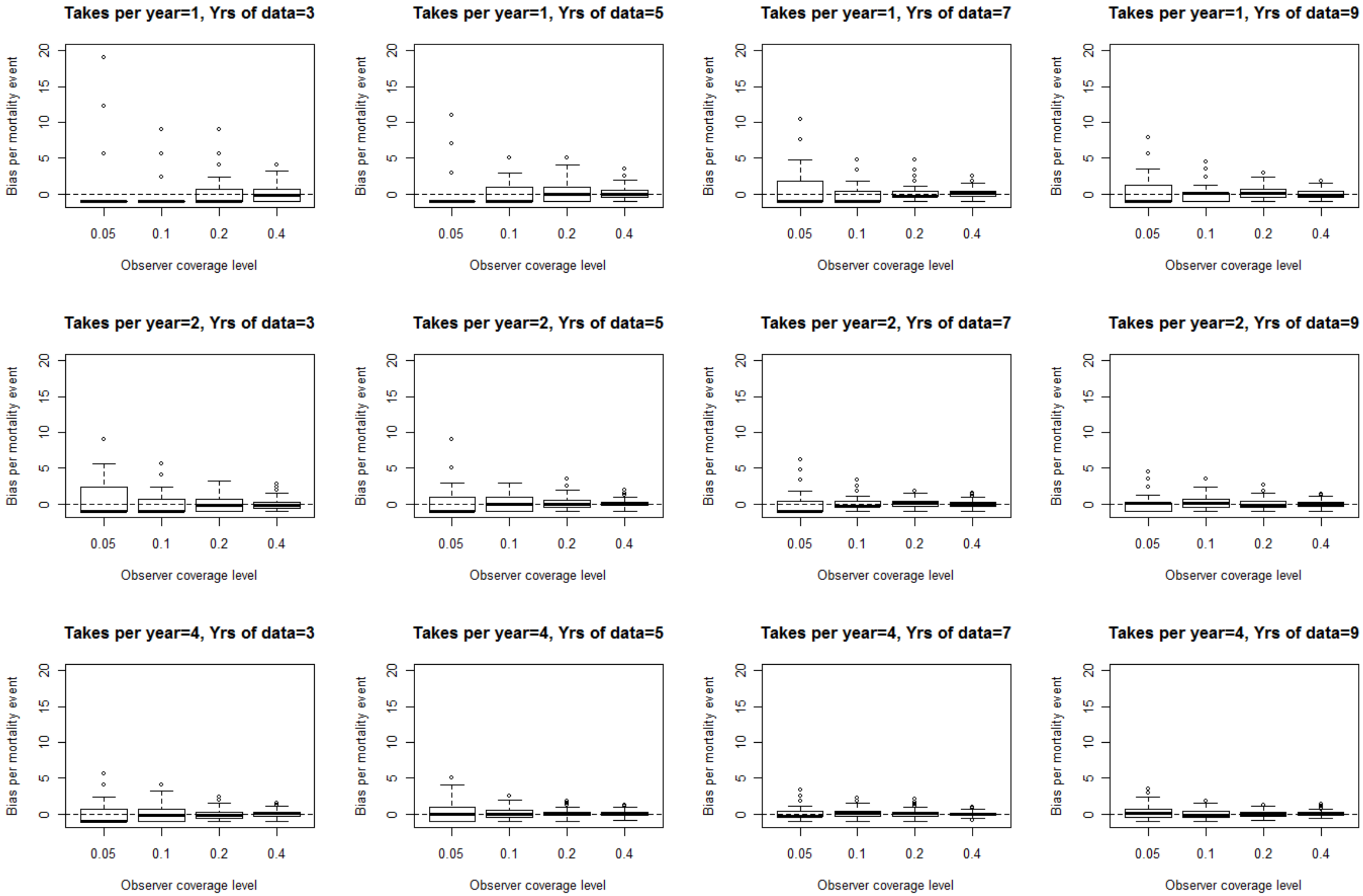

Fig. 10. Boxplot summaries of bias in estimates of average annual mortality, for selected combinations of observer coverage, true morality rate per year (labeled "Takes" in this figure), and the number of years for which information is combined to obtain the estimate. Bias is standardized across plots to represent the amount of bias per true mortality event. Boxes span the middle 50% of observations (1st to 3rd quartiles) with bold line depicting the median; whiskers reach to the most extreme observations within 1.5x the distance of the inter-quartile range.

Table 4. Recommended data levels to attain approximately unbiased estimation of average annual fisheries-related mortality and serious injury, relative to PBR (i.e., if true annual bycatch = PBR). "Approximately unbiased" implies median absolute bias < 25%. The top table recommends minimum observer coverage (annual average), given a certain PBR and level of data pooling (years of information combined). The bottom table recommends minimum levels of data pooling, given a certain PBR and observer coverage. If true bycatch = PBR and sampling effort is below the recommended levels, *median* bias is always negative (i.e., true bycatch > estimate), but the combination of *very* limited sampling (≤ 5% coverage, ≤ 5 yrs data pooling) and *very* low bycatch (e.g., 1/yr) generates bimodal estimation bias, whereby bycatch is always either underestimated (if no bycatch is observed) or overestimated (if ≥ 1 bycatch event is observed) (see upper left panel of Fig. 10).

	Observer program length (years)								
PBR	1	2	3	4	5	6	7	8	9
1	80%	40%	30%	30%	20%	15%	15%	10%	10%
2	40%	20%	15%	10%	10%	7.5%	7.5%	5%	5%
3	30%	15%	10%	7.5%	7.5%	5%	4%	4%	3%
4	20%	10%	7.5%	5%	4%	4%	3%	3%	3%
5	20%	7.5%	7.5%	4%	4%	3%	3%	2%	2%
6	15%	7.5%	5%	4%	3%	3%	2%	2%	2%
7	15%	7.5%	4%	3%	3%	2%	2%	2%	2%
8	10%	5%	4%	3%	2%	2%	2%	2%	2%
9	10%	5%	3%	3%	2%	2%	2%	2%	1%

Required observer coverage

	Observer coverage											
PBR	1%	2%	3%	4%	5%	7.5%	10%	15%	20%	30%	40 - 70%	80%
1	Always biased						8	6	4	3	2	1
2	Always biased				8	6	4	3	2	2	1	1
3	Always biased		9	7	6	4	3	2	2	1	1	1
4	Always biased		7	5	4	3	2	2	1	1	1	1
5	Always biased	8	6	4	4	3	2	2	1	1	1	1
6	Always biased	7	5	4	3	2	2	1	1	1	1	1
7	Always biased	6	4	3	3	2	2	1	1	1	1	1
8	Always biased	5	4	3	2	2	1	1	1	1	1	1
9	9	5	3	3	2	2	1	1	1	1	1	1

Required years of data pooling

III. Discussion

There was some initial discussion about how different Regions estimate or report bycatch from small sample of observer data. It was noted that Report guidelines currently allow use of more than 5 years of data for averaging bycatch estimates if warranted. Some NMFS regions simply do not calculate bycatch estimates in cases where a bycatch event is very rare; they simply report the observed number. Responding to this last point, it was noted that the observed level of bycatch is an even more biased representation of the true level than whatever bycatch estimated would be calculated from those rare-event data.

There was some discussion about the results table presented as part of the working paper (Table 4 above) and its implications. It was clarified that the intent of the table is to demonstrate that observer coverage needs to be at a particular level to produce reliable bycatch estimates when comparing those estimates to small PBR levels. If true bycatch mortality is relatively large, small-sample bias not so problematic, but true bycatch mortality in a population will always be unknown (for less than complete observer coverage), and so we generally do not know if a large bycatch estimate obtained from a rare event (e.g., 1 or 2 bycatches observed) indicates truly high bycatch mortality or an overestimate. If true bycatch mortality is low but near PBR, then estimation bias needs to be low enough to allow reliable evaluation of the estimate against a low threshold.

This prompted some concern among the group, noting that funding or other limitations frequently do not allow the recommended observer coverage levels to be met, that pooling data for many years might not be practical, and that bycatch estimates should not be ignored in these cases. Ultimately, the group agreed with the suggestion that if recommended sampling goals cannot be met, then estimates should be qualified in the Reports by stating they very well could be biased and note that in such cases, observations of zero bycatch would not alone constitute sufficient evidence to deem a stock’s status as non-strategic.

Some modifications were recommended to the version of the Table presented with the working paper; those changes are reflected in the version presented here (Table 4). Suggested modifications included presenting results for a broader distribution of variables than were originally included (PBR and observer coverage). For example, the smallest level of observer coverage considered in the original table was 5%; now it considers coverage down to 1%.

It was also suggested that a Bayesian approach to describing bias be considered (e.g., estimating the probability that PBR has truly been exceeded, of observing a particular outcome, etc).

It was ultimately suggested that Table 4 be included in the revised Report guidelines as part of the Technical Details (see part 2 of Appendix IV).

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

Recommended changes to the “Status of Stocks” section reflects discussion about improving the consistency between Report guideline text and the MMPA. There was concern that the previous language in the guidelines –which was about applying the precautionary principle, and about the “default stock status” being strategic – may not have been consistent with the MMPA.

Annual human-caused mortality and serious injury

The Reports should contain a complete description of what is known about current human-caused mortality and serious injury. Information about incidental fisheries mortality should be provided, including sources such as observer programs, logbooks, fishermen's reports, strandings, and other sources, where appropriate. It is expected that this section of the Reports will include all pertinent information that is subsequently used to categorize fisheries under Sect. 118. Therefore, any additional information that is anticipated to be used to categorize a fishery should be provided here.

If mortality and serious injury estimates are available for more than one year, a decision will have to be made about how many years of data should be used to estimate annual mortality. There is an obvious trade-off between using the most relevant information (the most recent data) versus using more ~~precise~~ information (pooling across a number of years) to increase precision and reduce small-sample bias. It is ~~recognized that it is~~ inappropriate to state ~~give one~~ specific guidance directing ~~rule defining~~ which years of data should be used, because the case-specific choice depends upon the quality and quantity of data. ~~as this depends upon the quality and quantity of data available in each case.~~ Accordingly, ~~It is suggested that~~ mortality estimates could be averaged over as many years as necessary to achieve statistically unbiased estimation with a CV of less than or equal to 0.3~~.~~, but estimates should usually not be averaged over a time period of more than the most recent 5 years for which data have been analyzed. However, information ~~that is~~ more than 5 years old should be used ~~not be ignored~~ if it is the most appropriate information available in a particular case. ~~. Also, in~~

In some cases it may not be appropriate to average over as many as 5 years even if the CV of an estimate is greater than 0.3. For example, if within the last 5 years the fishery has changed (e.g., fishing effort or the mortality rate per unit of fishing effort has changed), it would be more appropriate to use only the most recent relevant data to most accurately reflect the current level of annual mortality. When mortality is averaged over years, an un-weighted average should be used, because true mortality rates vary from year-to-year. When data are insufficient to overcome small-sample bias of mortality estimates for purposes of comparing the estimates to PBR (see Technical Details), a statement acknowledging this elevated potential for small-sample bias should accompany mortality estimates in the Reports.

Status of Stocks

This section of the Reports should present a summary of 4 types of "status" of the stock: 1) current legal designation under the MMPA and ESA, 2) status relative to OSP (within OSP, below OSP ~~depleted~~, or unknown), 3) designation of strategic or non-strategic, and 4) a summary of trends in abundance and mortality.

The MMPA requires a determination of a stock's status as being either strategic or non-strategic and does not specify a category of unknown. If abundance or human-related mortality levels are truly unknown (or if the fishery-related mortality level is only available from logbook data), some ~~judgement~~ judgment will be required to make this determination. If the human-caused mortality is believed to be small relative to the stock size based on the best scientific ~~judgement~~ judgment, the stock could be considered as non-strategic. If human-caused mortality is likely to be significant relative to stock size (e.g., greater than the annual production increment) the stock could be considered as strategic. In cases where information on sources of human-caused mortality and serious injury is insufficient to make a determination that "the level of human-caused mortality and serious injury is not likely to cause the stock to be reduced below its optimum sustainable population" [MMPA Section 117 (a) (5) (A)], the status of the stock should be categorized as strategic in accordance with Section 117 (a) (5) (B). ~~In the complete absence of any information on sources of mortality, and without guidance from the Scientific Review Groups, the precautionary principle should be followed and the default stock status should be strategic until information is available to demonstrate otherwise.~~ For example, if sample sizes from scientific observer programs are too small to overcome small-sample bias in mortality estimation relative to PBR (see Technical Details), then mortality estimates of zero would not constitute sufficient information for determining a stock to be non-strategic.

3B. ASSESSMENT OF SMALL ENDANGERED STOCKS

I. Background to the Issue

Small populations are vulnerable to extinction risk, and human-caused mortality that reduces those populations further will contribute towards this risk. The PBR calculation for non-endangered populations was developed to manage human-caused mortality to ensure that populations stay at or above their OSP level. The PBR for Endangered species (using FR=0.1) was calculated based on the criteria of not delaying time to recovery (OSP) by more than 10%, but for small populations this does not address the stochastic risk of extinction. The model used for the PBR calculations is implicitly deterministic and thus did not investigate the increased threat of extinction that could be caused by human-caused mortality for very small populations, which can have unique population dynamics that are sensitive to stochastic processes.

The assumption has been that any further protection (i.e., a reduced limit for human-caused mortality) for an endangered species would be enacted, if necessary, through mechanisms of the Endangered Species Act (ESA) such as Section 7 consultations, or through MMPA Sec. 101(a)(5)(E) permit conditions or limitations, but this has not always resulted in further protective measures. NMFS has made some negligible impact determinations (NIDs) for threatened and endangered stocks and issued associated permits to incidentally take those stocks during commercial fishing. One NID and the associated permit is for the HI longline fisheries to incidentally take CNP humpbacks. A second NID and associated permit covers several Category II AK groundfish fisheries to incidentally take several stocks: CNP humpbacks, WNP humpbacks, NEP fin whales, NP sperm whales, Western U.S. Steller sea lions, and Eastern U.S. Steller sea lions. It should be noted that none of these stocks (except perhaps WNP humpbacks), though listed as endangered, can be considered “small.” The take of any ESA-listed species in other fisheries is not authorized (meaning that the fishermen can be prosecuted for any take), irrespective of the PBR calculated for a constituent stock.

Over the years, the stock assessment reports for endangered small populations have been somewhat inconsistent. In the 2009 Reports the following endangered small populations had a PBR calculated for the stock: Gulf of Maine humpback whales (PBR=1.1), WNP humpback whales (PBR=2.0), southern Resident killer whales (PBR=0.17), and the Puerto Rico manatee (PBR=0.144). For both the NA right whale and the NP right whales PBR is set to zero (changed to 0.7 for NA right whales in the 2010 Report). For two other endangered stocks, PBR is stated to be undetermined (Cook Inlet beluga, HI monk seal); in these cases this was done because the populations were not recovering as expected. Calculating a PBR in the Report does not over-ride the lack of authorization under Sec 101 of the MMPA.

II. Summary of Working Paper Addressing This Issue

No formal working paper was submitted on this topic. However, Paul Wade provided the background presentation on this topic. He proposed that PBR be calculated and reported for small endangered stocks, but that text be added to the Reports to indicate whether negligible impact determinations had been made under Sec. 101 of the MMPA to clarify whether takes limits implied by PBR are actually authorized. Example text proposed: *"Regardless of the PBR level, because this species is listed under the ESA and no negligible impact determination has been made, no human-caused takes of this population are authorized."*

III. Discussion

The group opted to not include "negligible impact determination" language or a statement of whether takes were "authorized" in the Reports, as it felt that this went beyond the scope of the Reports.

The majority of discussion on this topic focused on whether PBR should be calculated and included in the Reports for endangered species that are presumably below OSP and not increasing for reasons that cannot be attributed to direct human-caused mortality and serious injury. Two stocks represent this issue: Cook Inlet beluga and Hawaiian monk seal. Current Reports list PBR as undetermined for these stocks on the basis that the stocks' dynamics do conform to the underlying assumptions of the PBR model.

Most of the specific ensuing discussion focused on Hawaiian monks seals, for which the observed population growth rate has been negative since 1999. Some participants argued that R_{max} cannot be zero (or negative) because R_{max} is based on the theoretical growth rate in the absence of human-caused mortality (or observed growth rate) and at low population sizes relative to carry capacity (so R_{max} should always be positive). If PBR must be positive, then the assumptions of the PBR model would seem at odds with monk seal dynamics. Others argued that R_{max} can indeed be zero or negative because this parameter represents the potential population growth rate achievable for a stock (not a species) in a particular ecological setting. For example, if the environment changes such that positive population growth rates for a stock are no longer possible, PBR should be allowed to be negative. In this case, the assumptions of the PBR model would not necessarily be at odds with monk seal dynamics.

A participant asked if the agency would consider setting recovery factors to zero, because there is no reserve in the population to allocate to human-caused mortality. Some thought that setting F_r to zero would require a change to the MMPA, and that it would be difficult to defend setting R_{max} to zero for any stock. Beluga whales are an example, where despite a stock decline some sub-stocks were growing. This is one of the complications in calculating PBR for the Hawaiian monk seal (currently "undetermined") as well; the Main Hawaiian Islands population of monk seal is increasing while the stock as a whole is declining. Therefore, setting R_{max} to zero may not be considered a viable option. It was suggested that the GAMMS III workshop report included the recommendation that the next administration MMPA reauthorization bill include the option for setting R_{max} to zero in appropriate cases.

Discussion began on the challenges of calculating PBR for monk seals and the consequences of reporting a PBR for this declining population. PIFSC expressed concern about including an estimate for PBR for monk seals in the Reports, as this could have potential complications for an Incidental Take Statement (ITS) under Section 7 of the Endangered Species Act or otherwise be interpreted as an allowable take estimate. Participants clarified that PBR is not a metric used in developing an ITS and that PBR does not equate to an authorized take level (for example, monk seals would still have to undergo an NID under Sec. 101 of the MMPA).

The Group reviewed the PBR section of the current monk seal Report, and recognized that it was possible that the interaction between R_{max} and the monk seal's environment plays a more significant role in the population decline than any other factor (i.e., fisheries). A similar example is the western DPS of Steller sea lion where environmental factors rather than human-caused mortality are likely driving the decline.

Participants were nevertheless concerned that reporting an "undetermined" PBR seemed out of compliance with the MMPA. It was generally felt that PBR should be calculated and included in the Reports, and that qualifying language could be added to clarify why the reported PBR (based on positive R_{max}) should not be used for management purposes.

Ultimately, most of the participants felt that all stock assessments should include PBR to be consistent and comply with MMPA. As noted above, there was the dissenting opinion that opposed the inclusion of a PBR calculation for the HI monk seal. Suggested revision text to the Report guidelines below is intended to address dissenting concerns, noting that Report authors are not required to rigidly adhere to the guidelines.

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

PBR Elements

The 1994 amendments to the MMPA mandate that, as part of the Reports, PBR estimates must be developed for each marine mammal stock in U.S. waters. The PBR is defined as "the maximum number of animals, not including natural mortality, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." In addition, the MMPA states that PBR is calculated as the product of three elements: the minimum population estimate (N_{min}); half the maximum net productivity rate (0.5 R_{max}); and a recovery factor (F_r). The guidelines for defining and applying each of these three elements are described below. Further specific guidance on the calculation of PBR is provided in part 2 (Technical Details) of this document.

<u>An underlying assumption in the application of the PBR equation is that marine mammal stocks exhibit certain dynamics. Specifically, it is assumed that a depleted stock will naturally grow toward OSP and that some surplus growth may be removed while still allowing recovery. There are</u> ~~In~~ unusual situations, <u>however, where</u> the formula Congress added to the MMPA to calculate PBR (Nmin*0.5Rmax*Fr) results in a number that is not consistent with the narrative definition of PBR (the maximum number of animals, not including natural mortality, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its OSP). ~~An~~

~~underlying assumption in the application of the PBR equation is that marine mammal stocks exhibit certain dynamics. Specifically, it is assumed that a depleted stock will naturally grow toward OSP and that some surplus growth may be removed while still allowing recovery.~~ That is, there are situations where a stock is below its OSP and is declining or stable, yet human-caused mortality is a not a major factor in the population's trend. Thus, for unknown reasons, the stock's dynamics do not conform to the underlying model for calculating PBR. In such unusual situations, the PBR estimate should be qualified in the Report in the PBR section.

~~For example, Hawaiian monk seals are endangered, declining, and below OSP (based upon the abundance prior to the 1970s), yet human-caused mortality is insufficient to account for the decline or a failure to increase. A limited removal would not reduce the population's ability not reach or maintain its OSP after the major factors affecting the stock have been identified and addressed. Therefore, in these unusual situations, NMFS may report PBR as "undetermined".~~

4. APPORTIONING PBR, ALLOCATING MORTALITY FOR MIXED STOCKS, AND ESTIMATING PBR FOR TRANSBOUNDARY STOCKS

I. Background to the Issue

PBRs are estimated on the basis of "population stocks" which consist of individuals that interbreed when mature. Human-caused mortality and serious injury may occur, however, in seasonal habitat which contain a mixture of multiple breeding stocks (e.g., summer habitat of humpback whales in the North Pacific or winter habitat of harbor porpoise along the mid-Atlantic states). Also, one breeding stock may migrate seasonally to multiple distinct habitats (e.g., humpback whales in the North Atlantic). Finally, stocks of species with complex social structure (e.g., killer whales or sperm whales) may be sympatric even in the breeding season.

The MMPA has as a general goal to keep marine mammal populations as functioning elements of their ecosystem. Another goal is to reduce human-caused mortality and serious injury to below PBR for each stock. For most stocks, attainment of the second goal will assure meeting the first goal. However, management becomes more complex when dealing with transboundary stocks, mixed stocks, or stocks with regional substructure such as migratory stocks with demographically independent feeding aggregations.

For transboundary stocks, the problem becomes exacerbated if there is significant human-caused mortality and serious injury by U.S. or foreign activities outside U.S. waters, which cannot be assessed in relation to an EEZ-based PBR estimate. For mixed stocks, the problem lies in allocating human-caused mortalities and serious injuries that cannot be definitively ascribed to one stock. For breeding stocks with regional substructure, one primary concern is the potential for a regional subpopulation to be extirpated if mortality is concentrated within that region. For example, humpback whales in one feeding area of the North Atlantic might cease being functioning elements of their ecosystem if the human-caused mortality in that area was equal to the PBR for the entire West Indies breeding stock. Such a situation would likely fail to meet the MMPA goal of maintaining marine mammals as functioning elements of their ecosystem. How should the total PBR for a stock be apportioned in these situations so that the goals of the MMPA are met?

II. Summary of Working Papers Addressing This Issue

Three working papers were submitted on these topics (Appendix III). Jay Barlow (GAMMS III-WP-4A) submitted a paper regarding apportioning PBR regionally within currently recognized stocks and allocating mortality across mixed stocks. Karin Forney presented work conducted by Marti McCracken of PIFSC (PIFSC WP-10-007), which discussed apportioning mortality for overlapping insular and pelagic stocks of false killer whales. Erin Oleson, Kristy Long, Karin Forney, and Nancy Young submitted a paper (GAMMS III-WP-4B) regarding estimating PBR for transboundary stocks.

The first paper (WP-4A) noted that PBRs are estimated on the basis of "population stocks," which under the MMPA are defined to consist of individuals that interbreed when mature, but that the MMPA's goal of retaining marine mammals as functioning elements of their ecosystem may not be met by simply reducing human-caused mortality and serious injury to below a stock's PBR. The paper specifically highlights cases where humpback whales would cease to be functioning elements of their ecosystem if feeding aggregations were extirpated because the PBR for the entire breeding stock occurred on particular aggregation. To ensure that a stock remains a functioning element of its ecosystem, the paper recommended that PBR for a stock be apportioned as appropriate to different geographic regions occupied by that stock. The entire population stock would be considered strategic if the human-caused mortality and serious injury exceeded the apportioned PBR for any region occupied by that stock.

The first paper also suggested allocating human-caused mortality and serious injury across multiple stocks that co-occur within a habitat. When it is not possible to attribute the human-caused mortality and serious injury in a region to a specific stock, stocks should be considered strategic if the total sum of human-caused mortality and serious injury for that region is greater than either stock's apportioned PBR for that region.

The second paper (PIFSC WP-10-007) presented different methodologies for estimating bycatch in situations that require splitting an estimate of bycatch into two categories (e.g., across two stocks when the stock identities of fishery-killed individuals are unknown). One situation pertained to splitting false killer whale bycatch estimates in the overlap zone into estimates for the Hawaii insular and pelagic stocks. The second situation involved splitting the estimated bycatch of blackfish (a blackfish is either a false killer whale or a short-finned pilot whale but which of these two is unknown) into estimates for false killer whales and short-finned pilot whales.

The third paper (WP-4B) discussed the problem of managing transboundary marine mammal stocks for which PBR is estimated based on abundance from only a portion of each stock's range. The paper pointed out that PBR levels for several transboundary stocks are estimated based on abundance surveys that occur only within the U.S. EEZ. However, mortality and serious injuries caused by U.S. and foreign fleets are known in some cases to also occur outside of the EEZ. Such mortality cannot be counted against the PBR calculated based on abundance inside the EEZ, yet this extra-EEZ mortality may be driving declines in population abundance within U.S waters. The paper noted that previous Report guidelines indicated that the only way to resolve uncertainty in stock abundance when the stock's range has not been completely surveyed is to do more extensive surveys. Although it is inappropriate to simply extrapolate abundance estimates to an unsurveyed area, the paper suggested that informed modeling exercises may be sometimes be appropriate or necessary to formulate management decisions and to ensure that stocks remain as functioning elements of the ecosystem. The paper further suggested that using the point-estimate from the surveyed range as a minimum abundance for the entire stock range may be appropriate when no other information is available for a stock and when successful management requires a range-wide estimated PBR.

III. Discussion

It was generally noted among participants that the current definition of stocks as those that are "interbreeding when mature" can conflict with the MMPA goal of maintaining marine mammal stocks as functioning elements of their ecosystem.

A breakout group met to discuss how to address the following in the Reports: apportioning PBR across regions within currently recognized stocks; allocating mortality and serious injury for mixed stocks; and estimating PBR for transboundary stocks.

Apportioning PBR across feeding aggregations

With respect to apportioning PBR, the discussion focused on whether and how to estimate and use PBRs calculated for different feeding aggregations.

There was considerable discussion about how to evaluate human-caused mortality on both the breeding grounds and feeding areas of species such as humpback whales. Given the definition that a population stock consists of individuals in common spatial arrangement that interbreed when mature, population stocks of species such as humpback whales have generally been defined based on breeding ground stocks. However, given the strong maternal fidelity to feeding grounds, migratory species such as humpback whales can have feeding aggregations that are demographically independent with limited movement of individuals between feeding aggregations. Such feeding aggregations can consist of a portion of one breeding population, or of portions of multiple breeding populations, and can therefore represent a single demographically independent unit, or a mix of two or more demographically independent units. Workshop participants recognized that these demographically independent units may not be sufficiently protected by simply evaluating mortality against the total PBR for a breeding population, if that breeding population comprises members of more than one feeding aggregation. Participants further agreed that the loss of a substantial feeding aggregation (e.g., one that occurs across a relatively large geographic area) would be contrary to the MMPA goal of maintaining marine mammals as a functioning element of their ecosystem.

To address this concern, workshop participants discussed the possibility of basing stocks on feeding aggregations. The general consensus was that each demographically independent unit within a feeding aggregation (i.e., grouping of animals that originate from the same breeding ground) could be identified as a stock, given that the animals (1) are demographically independent from other animals within the breeding population and (2) do interbreed when mature, though in some cases they also interbreed with members of other feeding aggregations on the breeding grounds. It was noted that under the ESA, distinct population segments must be "markedly separated from, but not reproductively isolated from" other populations. Workshop participants discussed the potential to use similar logic to defend identifying feeding aggregations as stocks.

Although this approach of identifying stocks based on feeding aggregations seemed technically and legally feasible, workshop participants felt this approach added significant complexity without providing substantial management advantages. Further, it seemed there was only one case, Pacific humpback whales, for which we have sufficient information to identify demographically independent units within feeding grounds. In the case of Pacific humpback whales, the Reports already report PBRs for the breeding ground stocks and evaluate mortality on the feeding grounds against pseudo-PBRs calculated for feeding aggregations. In this way, those Reports already serve to evaluate risks to feeding aggregations. So, the recommendation was to not make any changes to the Reports guidelines at this point.

Workshop participants discussed how feeding-ground PBRs should be calculated for stocks where there was a desire to monitor potential risks to feeding aggregations. It was recommended that human-caused mortality on the feeding grounds be monitored and evaluated against a PBR calculation made for the feeding aggregation and that the feeding-ground PBR, mortality, and evaluation results be reported in the Reports, as is currently done for Pacific humpback stocks. It was agreed that affecting the feeding aggregation throughout the year (on the breeding grounds or during migration) should be accounted for in such evaluations. It was noted that this could involve allocating mortality that occurs on the breeding grounds back to the feeding areas. Given that it is already necessary to allocate mortalities that occur on the feeding areas to the overall breeding population, it was agreed that it would be simpler to base the feeding-ground PBR on the proportion of time that feeding aggregation spends in the feeding area. It was acknowledged that having mortality greater than the feeding-ground PBR would not make an overall breeding ground stock strategic, but it was hoped that highlighting the situation in the Report would raise awareness of the issue and lead to management action. For example, text could be added to the Report indicating that the estimated level of human-caused mortality is high enough to cause depletion of the feeding aggregation, which could result in the feeding aggregation no longer being a functioning element of the ecosystem.

Allocating mortalities and serious injuries for mixed stocks

Workshop participants discussed how to allocate mortality and serious injuries of individuals in an area where several stocks mix, when those individuals cannot be assigned to a particular stock. Two approaches were discussed. In data rich situations, participants agreed that the preference is to partition mortality and serious injuries based on the relative abundance of the stocks within the region of concern. In data poor situations, when relative abundances are unknown, the total unassigned mortality and serious injuries should be assigned to each stock within the appropriate geographic area. Participants recognized that this latter approach effectively would repeatedly "count" the same deaths and serious injuries against multiple stocks. However, this approach was considered to be the most conservative in terms of ensuring that the most severe possible impacts were considered for each stock. Participants also felt this conservative approach could serve as incentive for additional research, in that, if relative abundances could be determined, then mortality and serious injuries would be partitioned rather than assigned to each stock. Some changes were recommended to the "Annual human-caused mortality and serious injury" section to reflect this guidance regarding allocation of mortality and serious injuries among mixed stocks.

Estimating range-wide abundances of transboundary stocks

Workshop participants recognized the challenges of managing interactions with transboundary stocks without a stock-wide abundance or PBR estimate and without an estimate of human-caused mortality outside the U.S. EEZ. The discussion focused primarily on whether and how to extrapolate or interpolate abundance estimates in order to derive an appropriate stock-wide abundance estimate.

At previous workshops, participants recommended against extrapolating abundance estimates from one area to another unsurveyed area to estimate range-wide PBR. At this workshop, the previous recommendation was reaffirmed. However, there was agreement that informed interpolation (e.g. based on habitat associations) may be used, as appropriate and supported by existing data, to fill gaps in survey coverage and estimate abundance and PBR over broader areas. Some minor modification of the paragraph on transboundary stocks in the "Definition of 'Stock'" section were recommended to provide flexibility to estimate range-wide stock abundances for transboundary stocks, where appropriate.

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

Definition of "Stock" (last paragraph)

In trans-boundary situations where a stock's range spans international boundaries or the boundary of the U.S Exclusive Economic Zone (EEZ), the best approach is to establish an international management agreement for the species and to evaluate all sources of human-caused mortality and serious injury (US and non-U.S.) relative to the PBR for the entire stock range. In the interim, if ~~the~~ a trans-boundary stock is migratory and it is reasonable to do so, the fraction of time the stock spends in U.S. waters should be noted, and the PBR for U.S. fisheries should be apportioned from the total PBR based on this fraction. For~~In a~~ non-migratory trans-boundary stocks ~~situation, the PBR for U.S. fisheries should be calculated based on the abundance estimate of the stock residing in U.S. waters~~ (e.g. stocks with broad pelagic distributions that extend into international waters), if there are estimates of mortality and serious injury from U.S. and other sources throughout the stock's range, then PBR calculations should be based upon a range-wide abundance estimate for the stock whenever possible. In general, abundance or density estimates from one area should not be extrapolated to unsurveyed areas to estimate range-wide abundance (and PBR). But, informed interpolation (e.g. based on habitat associations) may be used~~, as appropriate and supported by existing data,~~ to fill gaps in survey coverage and estimate abundance and PBR over broader areas as appropriate and supported by existing data. If estimates of mortality or abundance from outside the U.S. EEZ cannot be determined, ~~For situations where a species with a broad pelagic distribution which extends into international waters experiences mortalities within the U.S. EEZ,~~ PBR calculations should be based on abundance in the EEZ and compared to mortality within the EEZ.~~. If there is evidence for movement of individuals between the EEZ and offshore pelagic areas and there are estimates of mortality from US and other sources throughout the stock's range, then PBR calculations may be based upon a range-wide abundance estimate for the stock.~~

Annual human-caused mortality and serious injury (paragraph dealing with mixed stock situations)

In some cases, mortality and serious injury occur in areas where more than one stock of marine mammals occurs. When biological information (e.g., genetics, morphology) is sufficient to identify the stock from which a dead or seriously injured animal came, then the mortality or serious injury should be associated only with that stock. When ~~a dead animal~~ one or more deaths or serious injuries cannot be assigned directly to a stock, then ~~mortality~~ those deaths or serious injuries may be partitioned ~~by the abundances of the stocks vulnerable to the mortality (i.e., based on the abundances of each stock within the appropriate geographic area), provided there is sufficient information on stock abundance~~ among stocks within the appropriate geographic area, provided there is sufficient information to support such partitioning (e.g., based on the relative abundances of stocks within the area). When ~~mortality is~~ the mortality and serious injury estimate is partitioned among overlapping stocks ~~proportional to the abundances of the affected stocks~~, the Reports will contain a discussion of the potential for over or under-estimating stock-specific mortality and serious injury. In cases where mortalities and serious injuries cannot be assigned directly to a stock and available information is not sufficient to support partitioning those deaths and serious injuries among stocks, the total unassigned mortality and serious injuries should be assigned to each stock within the appropriate geographic area. When deaths and serious injuries are assigned to each overlapping stock in this manner, the Reports will contain a discussion of the potential for over-estimating stock-specific mortality and serious injury.

5. CLARIFYING REPORTING OF MORTALITY AND SERIOUS INJURY INCIDENTAL TO COMMERCIAL FISHING

I. Background to the Issue

There are inconsistencies in the manner, content, and format with which Reports are prepared, as relates to summarizing mortality and serious injury incidental to commercial fishing. As one example, mortality and serious injuries (removals) of marine mammals incidental to commercial fishing in other countries (e.g., Canada) and recreational fisheries have been included in Reports as fishery-related removals. These removals potentially have a regulatory impact to U.S. commercial fisheries under MMPA section 118; however, the sources of these removals (foreign and recreational fisheries) are not subject to the reductions required under MMPA section 118. Another example relates to including information on unknown or underestimated sources of mortality. Improvements can be made to ensure consistency across the regions in terms of how mortality and serious injury incidental to fishing is reported.

II. Summary of Working Paper Addressing This Issue

No formal working paper was submitted on this topic. However, Tom Eagle (F/PR) provided a brief description of the issue. MMPA section 117 requires NMFS and FWS to prepare Reports, which are to contain, among other things, estimates of annual human-caused removals by source. The Reports have extensive discussion and presentation of information on fishery mortality, including in some cases mortality incidental to fisheries in Canada or to recreational fisheries. Because U.S. fisheries are regulated according to information reported in Reports, reporting as fishery mortality those deaths resulting from activities not subject to regulation under section 118 could cause unnecessary burden to U.S. fisheries. To date, such regulation probably has not happened, but it may occur in the future. For example, the forthcoming Hawaii Pelagic False Killer Whale Take Reduction Plan addresses bycatch only in the U.S. longline fisheries inside the EEZ, but in the future may include bycatch reduction goals for the U.S. fisheries on the high seas, where the U.S. fishery is only a small part of the international longlining effort.

Examples of the reporting of mortality from sources not regulated under section 118 include or formerly included: Steller sea lions shot by aquaculture operations in British Columbia, mortality of harbor porpoise incidental to Canadian fisheries, and HI monk seals entangled in derelict fishing gear (no longer counted as fishery mortality) and recreational fishing gear. Eagle proposed that Reports should include a summary of all documented annual human-caused mortality, whether or not it is regulated under section 118.

III. Discussion

Foreign and recreational fisheries related mortality and serious injury

Currently, Reports typically include U.S. commercial fishery deaths either in a table and/or in text. One suggestion was that each Report should distinguish deaths by those fisheries that are regulated under Section 118 from those that are not. Further discussion determined that, for consistency, Reports should present this information in tabular form. The intent of separating deaths caused by U.S. commercial fisheries from other sources of mortality would be to hold those responsible for those deaths accountable for their actions but to avoid incorrectly assigning a disproportionate amount of mortality to a U.S. fishery (e.g., the source of the deaths may be attributed to a foreign fishery). The group agreed that this should be clarified and made consistent throughout the Reports.

It was recommended that guidelines provide direction to Report authors to include the following information in the fisheries mortality and serious injury section: 1) the fishery mortality and serious injury table should include only U.S. commercial fisheries (i.e., those that are regulated under MMPA Section 118); and 2) all fishery mortality and serious injury should be kept within the same section with inclusion of a sub-heading under "fisheries information" that should be explicit to include non-US commercial fisheries (e.g., foreign fisheries and recreational fisheries).

General inconsistency of reporting on mortality and serious injury

The breakout group identified an inconsistency in how current Report guidelines are implemented. That is, the ex/inclusion of tables within Reports for fishery deaths do not follow current guidelines consistently. The group recommended that the F/PR contact reach out to all authors of Reports to ensure implementation is consistent. The group also decided that all Reports should include an initial summary paragraph about the human-caused mortality/serious injury in the Human Caused Mortality and Serious Injury section. Currently, in those Reports where this information does appear, it is inconsistently located in differing sections of the Reports. Also within this particular section of the Reports and where known and applicable, the group recommended creating subheadings (similar to the subsection "Fisheries Information") within a subsection entitled "Other Sources of Mortality" (e.g., Ship Strikes).

A question was raised as to whether or not there were other sources of mortality and serious injury that have not been included in Reports. For example, in the past, Reports did not include fishery research as a source of marine mammal mortality or serious injury, although many of the Reports have been updated to include this information. In addition, deaths reported under a letter of authorization (LOA) are not currently included. The death and serious injury attributed to a permit issued by the Small Take program are rare, but there is a reporting requirement so the information is available.

The group suggested that sources of other information should be identified and accessed annually to be included in Reports. The method of communication should be clearly defined for Reports authors (point of contact, database access, etc.). The group recommended that a mechanism be in place to provide Reports authors with any death or injury that has occurred in the small take program, for example, specific to the stock.

Participants also recommended that a list be created containing points-of-contact at each Regional Office or Science Center and F/PR to facilitate transmission of information to the Regions from permitting officers in NOAA Headquarters about takes that occur from mortality sources not currently included in the Reports (such as mortality and injury reported under F/PR-authorized take permits). This would help ensure that all known sources of human-caused mortality and serious injury are included by Report authors as well as in, for example, Biological Opinions prepared by the Regional Offices.

Inconsistency with inclusion of self-reports in the Reports

Fishers must report to NMFS if they injure or kill marine mammals as required by the MMPA. NMFS provides under the Marine Mammal Authorization Program (MMAP) injury/mortality reporting forms to participants in Category I and II fisheries to facilitate this reporting. The group noted that there are inconsistencies in the inclusion of these fisher self-reports in the Reports. For example, the authors of the Alaska Reports place fisher self- reports in an Appendix, not in the individual stock section, because self-reports are often not reliable but should still be available to managers. The Pacific Islands stated that, to date, all self-reports received have been from observed trips, so information from self-reports has not been included separately in the Reports. In the future, if self-reports are received from non-observed trips and/or fisheries, they would consider the reports on a case-by-case basis, and where appropriate, include the takes in the applicable table and consider them when calculating mortality estimates. Authors of the Pacific (California Current) Reports stated that they consider self-reports on a case-by-case basis. The authors of the Atlantic Reports stated that they have had a few cases of a self-report and they would include them in the Reports.

Under-reported mortality and serious injury, and request for more quantitative language

Using the CA/OR/WA blue whale stock assessment as an example, the point was made that observed deaths from strandings only represent a minimum known number. If strandings are reported as a measure of annual human caused mortality, then language should be included to qualify that the estimate should be considered a minimum. Report authors should include published studies, as applicable for each species, to evaluate the scale of potential bias (observed stranding mortality vs. true mortality).

It was also proposed that a subsection entitled “Summary of the most important potential Human-caused Morality and Serious Injury threats that are unquantified” be included in the Reports, and that the Reports should also indicate if there are no major known sources of unquantifiable HCM.

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

Annual human-caused mortality and serious injury

The Reports should contain a complete description of what is known about current human-caused mortality and serious injury. Information about incidental fisheries mortality should be provided, including sources such as observer programs, logbooks, fisher's reports, strandings, and other sources, where appropriate. It is expected that this section of the Reports will include all pertinent information that is subsequently used to categorize fisheries under Section 118. Therefore, any additional information that is anticipated to be used to categorize a fishery should be provided here.

A summary of all human-caused mortality and serious injury should be provided in each Report as the first paragraph under "Annual human-caused mortality and serious injury." This summary should include information on all mortality and serious injury (e.g., U.S. commercial fishing, other fishery mortality from recreational gear and foreign fleets, vessel strikes, power plant entrainment, shooting, scientific research, after-action reports from otherwise authorized activities, etc.).

A summary of mortality and serious injury incidental to U.S. commercial fisheries ~~mortality and serious injury~~ should be presented in a table, providing the name of the fishery, the current number of vessels, and for each appropriate year, observed mortality, estimated extrapolated mortality and serious injury and its CV, and percent observer coverage in that year, with the last column providing the average annual mortality estimate for that fishery. Because U.S. commercial fishing or foreign fisheries within the U.S. EEZ are subject to regulation under MMPA section 118, mortality and serious injury from such fisheries should be clearly separated from other fishery-related mortality (e.g., mortality incidental to recreational or foreign fishing beyond the U.S. EEZ) in the Reports. Information should be provided (in either the table or the text) about the number of ~~mortalities~~ deaths and the number of injuries, and how many ~~what~~ of the injuries are "serious" (i.e., ~~leading to mortality~~ likely to result in death)~~if any~~.

For fisheries without observer programs, information about incidental mortality and serious injury from logbooks, fisherman self-reports, strandings, and other sources should be ~~listed~~ included ~~instead~~ where appropriate. Such information should be presented in brackets to distinguish it from estimates of total mortality and serious injury in the fishery. If such information is not included in the table, but reports such as fishermen's self-reports are available, those reports should be described in the text and any concern with the quality of that report should be noted. Fishermen's self-reports of mortality or injuries should not be included if the fishery was observed and incidental mortality and serious injury was estimated based on observer records and associated coverage. All Category I and II fisheries listed as ~~interacting with the~~ causing mortality or serious injury to a stock included in the MMPA List of Fisheries should be listed in the table with as much information as possible. Mortality and serious injury by those fisheries not regulated under MMPA section 118 (i.e., incidental to foreign fisheries or recreational fisheries) should be distinguished from mortality and serious injury incidental to fisheries subject to section 118. Further guidance on averaging human-caused mortality across years and across different sources of mortality can be found in the Technical Details section ~~including a sample table, is provided in the third section~~ of these guidelines.

Summary of the most important potential human-caused mortality sources (HCM) that are unquantified

Because many stocks are subject to human-caused mortality or serious injury that is unmonitored or not fully quantified, authors of the Reports should add a sub-section of the Human-Caused

Mortality and Serious Injury section to include a summary of the most important potential human-caused mortality that are not quantified (e.g., fisheries that have never been observed, or have not been observed recently, and ship strikes). The Reports should ~~include a section that~~ summarize what are thought to be the most important unquantified or undocumented human-caused mortality or serious injury interactions so that readers realize the key sources of potential human-caused mortality and serious injury (e.g., fisheries that use gear that has a high probability of taking the species that have a large degree of overlap with the distribution of the stock, and where the fishing effort may be sufficient to result in a substantial incidental mortality or serious injury). If there are no major known sources of unquantifiable human-caused mortality or serious injury, this should be explicitly stated.

When including strandings and serious injury determinations as a significant component of the measure of annual human-caused mortality, the following language should be added to the Report:

> "It is important to stress that this mortality estimate results from an actual count of verified human-caused deaths and serious injuries and should be considered a minimum. Published studies attempting to evaluate potential bias in estimating human-caused mortality for numerous marine mammal species found that carcass counts accounted for < 1% to 17% (2% on average) of human-caused deaths, amounting to gross underestimates of mortality in those cases (Williams et al. 2011, Conservation Letters 4:228-233)."

6. STOCK ASSESSMENT REPORT GUIDELINES FOR DETERMINING WHEN STOCK DECLINES ARE EVIDENT ENOUGH TO LABEL A STOCK "STRATEGIC"

I. Background to the Issue

The MMPA states (Section 3(1)) "The term "depletion" or "depleted" means any case in which:

> *(A) the Secretary, after consultation with the Marine Mammal Commission and the Committee of Scientific Advisors on Marine Mammals established under title II of this Act, determines that a species or population stock is below its optimum sustainable population; (B) a State, to which authority for the conservation and management of a species or population stock is transferred under section 109, determines that such species or stock is below its optimum sustainable population; or (C) a species or population stock is listed as an endangered species or a threatened species under the Endangered Species Act of 1973.*

Section 3(1)(B) has never been used because no state has received management authority and the application of Section 3(1)(C) is straightforward. Designation as depleted under Section 3(1)(A) has typically been based on evidence of at least a 50% decline in abundance which would put a population below its maximum net productivity level (MNPL) which has been operationally defined as the lower limit of the optimum sustainable population OSP. There is no formal process to periodically evaluate the depleted status of non-ESA listed marine mammal stocks, and the current Report guidelines (NMFS 2005) do not provide any guidance for the recommending a stock be designated as depleted.

Section 3(19) of the MMPA defines a "strategic stock," as one:

> *(A) for which the level of direct human-caused mortality exceeds the potential biological removal level; (B) which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the Endangered Species Act of 1973 within the foreseeable future; or (C) which is listed as a threatened species or endangered species under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), or is designated as depleted under this Act*.

The MMPA allows for management measures to address threats to strategic stocks, such as placing observers on commercial fishing vessels that incidentally kill or seriously injure such marine mammal stocks, forming take reduction teams to work to reduce takes to below PBR over the short term and to insignificant levels approaching a zero mortality and serious injury rate over the long term, or alleviating impacts on key habitats. The Reports generally use the MMPA definitions of strategic under Sec. 3 (19) (A) and (C) to determine whether a stock is strategic, but the current Report guidelines (NMFS 2005) state that the status of stocks should include 4 types of "status": 1) current legal designation under the MMPA and ESA, 2) status relative to OSP (within OSP, depleted, or unknown), 3) designation of strategic or non-strategic, and 4) a summary of trends in abundance and mortality, that latter of which at least partially address the definition under (B). The current Report guidelines do not provide adequate guidance for determining when a decline in a stock's abundance is sufficient to justify designation as a strategic stock under Sec. 3(19)(B), nor for determining when a decline is sufficient to justify its designation as a depleted stock (and hence also a strategic stock under Sec 3. (19)(C).

II. Summary of Working Paper Addressing This Issue

The working paper authored by Barbara L. Taylor, Jay Barlow, Karin A. Forney (SWFSC) and Megan C. Ferguson (AFSC) (GAMMS III-WP-6, Appendix III) addressed two issues that the current Report guidelines do not sufficiently address: 1) the process by which a stock is designated as depleted under section 3(1)(A) of the MMPA; and 2) the process by which a stock is designated as strategic under section 3(19)(B) of the MMPA.

Addressing the first issue, the working paper proposed adding language to the Report guidelines to facilitate designation of a stock as depleted. "Depleted" is defined in the Act as "any case in which— the Secretary, after consultation with the Marine Mammal Commission and the Committee of Scientific Advisors on Marine Mammals established under subchapter III of this chapter, determines that a species or population stock is below its optimum sustainable population." The process of designating a unit as depleted, threatened or endangered has required extensive evidence and a substantial commitment of time (and consequently funds) on the part of the Agency. The authors proposed adding the following language into the Status of Stocks section of the guidelines:

> *"Stocks that have evidence suggesting at least a 50% decline, either based on previous abundance estimates or historical abundance estimated by back-calculation, should be proposed for designation as depleted."*

Addressing the second issue, the working paper proposed adding language to the Report guidelines to facilitate designation of a stock as strategic through use of observed abundance trends of declining stocks (i.e., to clarify when a stock should be considered strategic under Sec. 3(19)B). Consideration of a stock as strategic under the MMPA's Section 3(19)B criteria has never been discussed in the Report guidelines. However, doing so would offer a mechanism to implement provide protection under the MMPA to stocks that have undergone large declines in certain regions, notably western Alaska, but where PBR has never been exceeded (such that stocks may not be designated as strategic under Sec. 3(19)(A)) and the causes of the declines are unknown. Several species were listed under the ESA without ever receiving protection under the MMPA (that is, they were never assigned "depleted" status prior to listing and, therefore, did not qualify for the strategic designation under Sec. 3(19)(C)) or receiving research priority within the NMFS or USFWS. Logically, these declining stocks should have been listed as "strategic" in the NMFS Reports before needing the protection of the ESA.

Although the 1994 amendments to the MMPA required that abundance estimates be made for each stock, the use of trends in abundance for decision making was avoided because scientists recognized that poor precision in abundance estimates meant that detection of negative trends would also be poor. After over a decade of implementation that requires abundance estimates, Taylor et al. (2007) re-examined whether traditional statistical tests for detecting negative trends could be used to find stocks in serious decline. They found that precipitous declines, defined as a 50% decline in 15 years, could *not* be detected for 72% of large whale stocks, 90% of beaked whales, 78% of dolphins and porpoises, 5% of pinnipeds on land, 100% of pinnipeds on ice, and 55% of polar bears/sea otters (based on a one-tailed test, $\alpha = 0.05$). Thus, for most stocks a decline of the magnitude that resulted in Steller sea lions being placed under ESA protection would not be detected under the current MMPA management regime using the traditional hypothesis testing significance criterion. Given that cetaceans live in the same habitat where several pinniped species have experienced large declines, it is likely that for some species the objectives of the MMPA are not being met. This likely poor performance is not apparent when reading the current Reports because the current system has no mechanism to use trend data in determining whether a stock should be strategic nor any measure of how well the status of a stock is being monitored.

Figure 11 shows the proportion remaining through time of a population declining at 5%/year. In 15 years this population would decline to <50% of the abundance in year 1. Beyond that point the population should be listed as depleted and the objectives of the Act have not been met. The declining population depicted is actually at higher risk than merely being depleted because it is experiencing an ongoing rapid decline that will lead either to extinction or perilously close to it within 100 years. Although the terms “threatened” and “endangered” are not quantitatively defined, Figure 11 shows that a continued 5% rate of decline could lead to levels low enough that some may consider the population to be endangered within 50 years. To meet the objectives of the MMPA of not allowing populations to decline below OSP, populations declining at 5%/year with no known cause will require dedicated research to determine the cause of decline.

Therefore the working paper proposed language to the Report guidelines that defines the situation under which a declining stock should be designated as strategic under Sec. 3(19)(B) of the MMPA. Specifically, the suggestion was that a stock be designated as depleted if if has a greater than 50% probability of a decline of at least 5% per year, and where the decline or its causes have not ceased or are not understood or are not reversible. It was proposed that data on which such an evaluation is conducted be based on abundance survey data spanning at least 8 years. The rationale for using at least 8 years of data is that, for most stocks, 8 years would encompass 3 abundance estimates and would provide solid evidence of a worrisome decline (already at least 25% of the population gone, see Figure 11). Waiting for another 4-year survey interval would put the population so close to OSP that maintaining the population above that level when the cause of decline is unknown would be unlikely.

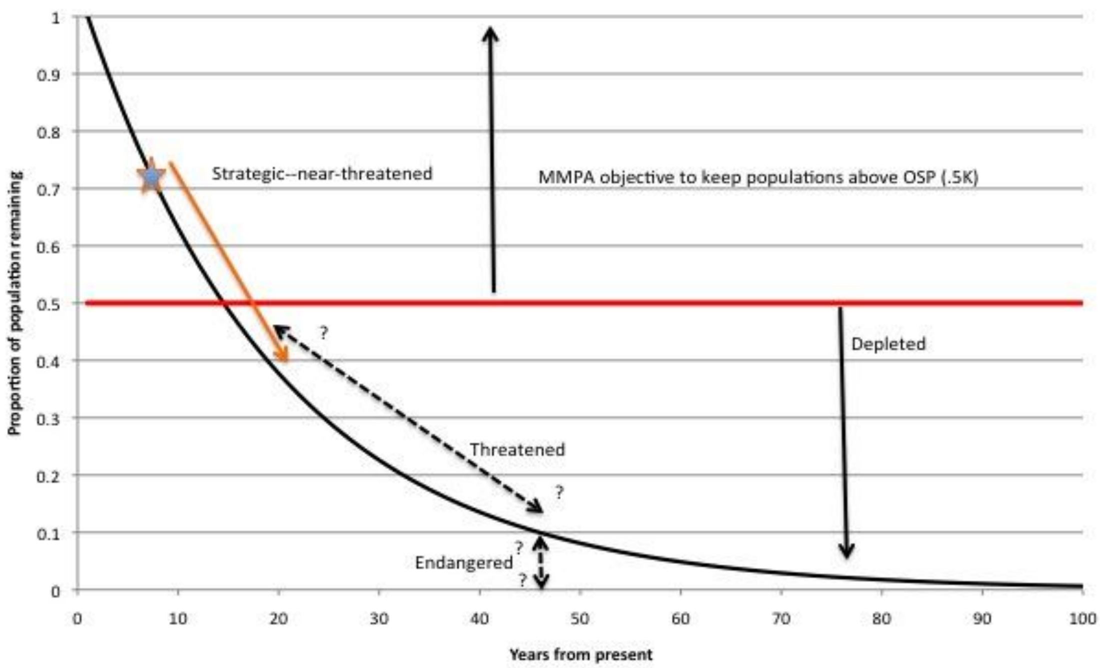

Figure 11. Proportion of a population remaining that is experiencing a 5%/year decline over a 100 year period. The red line at 0.5 represents a best case scenario for OSP because it assumes that the population starts in year 1 at its carrying capacity. The dashed lines for "threatened" and "endangered" represent plausible ranges for "species" with that classification though there is no quantitative definition. The star represents the best case scenario of the status of a population that had been declining at 5% per year over an 8 year period (see discussion below).

The current Report guidelines adjust F_r for stocks below OSP (depleted, threatened or endangered) using F_r values between 0.1 and 0.5, and for stock of unknown status using a default of 0.5. Working paper authors argued that a stock designated as strategic using the above criteria should receive at least as much protection as a stock of unknown status, and that Report guidelines should therefore recommend $F_r = 0.5$ for such stocks, in accordance with Table 5, which categorizes the different criteria upon which a strategic designation is based and proposed attendant consequences.

Table 5. Categories (basis for "strategic" status under Sec. 3 (19)) ordered roughly from least to greatest risk level with both actual (in bold) or suggested consequences. The consequence under "Additional research effort" labeled "Improved $\hat{r}$," where $\hat{r}$ = estimated annual growth rate, suggested targeted effort with funding prioritized roughly by risk

MMPA category	Consequences	
	Additional research effort	Increased protection
(A) PBR exceeded	Improved $\hat{r}$	**Take Reduction Team**
(B) declining, ESA-listing likely	Improved $\hat{r}$, Cause of decline	$F_r = 0.50$
(C) ESA-listed or depleted	Improved $\hat{r}$	**$0.10 < F_r < 0.50$**

III. Discussion

One concern raised was whether use of a 50% decline in the proposed definition of depleted would set a new standard for determining whether a stock is below OSP (OSP has been considered to be > 50% of previous population levels in some cases). It was suggested that the language clarify that the 50% is not a definition of OSP but rather an un-arguable case where a population that had declined by 50% would certainly be below OSP. Arguments could be made to list a stock as depleted that had not declined by as much 50%.

Certain suggestions by the working paper – namely that revised Report guideline text include proposed conservation measures – were generally not considered appropriate for content of the Reports. Rather, it was noted that such issues be dealt with in conservation plans.

The group recommended recording whether a stock was below OSP in the Status of Stocks section to ease the process of the Marine Mammal Commission requesting that the Secretary list the stock as depleted. The group recommended adding a new second paragraph to this section to this effect.

The group recommended language should be added to make the criteria for designation as strategic under MMPA Sec. 3(19)(B) less prescriptive than that proposed by the Taylor et al. working paper (GAMMS III-WP-6). The language should not, for example, preclude a case with a profound decline that had occurred in less than eight years. The group saw no need for qualifying the decline as one "*where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible"* (this text was proposed by the working paper) and preferred that it be omitted. Some of the group thought that Figure 11 from the working paper should be included together with the new guideline text.

The use of 15 years was discussed as a default for defining "foreseeable future" under the wording of Sec 3(19)(B) of the MMPA. The idea is that no one would argue with 15 years as a starting point for "foreseeable future" (i.e., 15 years certainly is a short-enough time frame to be considered foreseeable) and that arguments could be made on a case-by-case basis for longer periods.

The group recommended changing the proposed text for the recovery factor (F_r) for a stock that qualified as strategic under Sec 3(19)(B) from a set value of 0.5 to the range of 0.1 to 0.5. The reasons were that a stock experiencing a strong decline should be given greater protection than a stock of unknown status (which receives a default F_r of 0.5).

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

Recovery Factor (F_r)

The MMPA defines the recovery factor, F_r, as being between 0.1 and 1.0. The intent of Congress in adding F_r to the definition of PBR was to ensure the recovery of populations to their OSP levels, and to ensure that the time necessary for populations listed as endangered, threatened, and depleted to recover was not significantly increased. The use of F_r less than 1.0 allocates a proportion of expected net production towards population growth and compensates for uncertainties that might prevent population recovery, such as biases in the estimation of N_{min} and R_{max} or errors in the determination of stock structure. Population simulation studies (Barlow et al. 1995, Wade 1998) demonstrate that the default F_r for stocks of endangered species should be 0.1, and that the default F_r for depleted and threatened stocks and stocks of unknown status should be 0.5. A stock that is strategic because, based on the best available scientific information, it is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future (sec. 3(19)(B) of the MMPA) should use a recovery factor between 0.1 and 0.5. The default status should be considered as "unknown." Stocks known to be within OSP (e.g., as determined from quantitative methods such as dynamic response or back-calculation), or stocks of unknown status that are known to be increasing, or stocks that are not known to be decreasing taken primarily by aboriginal subsistence hunters, could have higher F_r values, up to and including 1.0, provided that there have not been recent increases in the levels of takes. Recovery factors for listed stocks can be changed from their default values, but only after careful consideration and where available scientific evidence confirms that the stock is not in imminent danger of extinction. Values other than the defaults for any stock should usually not be used without the approval of the regional Scientific Review Group, and scientific justification for the change should be provided in the Report.

Status of Stocks

Stocks that have evidence suggesting at least a 50% decline, either based on previous abundance estimates or historical abundance estimated by back-calculation, should be noted in the Status of Stocks section as likely to be below OSP. The choice of 50% does not mean that OSP is at 50% of historical numbers, but rather that a population below this level would be below OSP with high probability. Similarly, a stock that has increased back to levels pre-dating the known decline may be within OSP; however, additional analyses may determine a population is within OSP prior to reaching historical levels.

The MMPA has a definition of a strategic stock as one "which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the Endangered Species Act of 1973 [16U.S.C. 1531 et seq.] within the foreseeable future" (Sec 3(19)(B)). Under this definition, a stock shall be designated as strategic if it is declining and has a greater than 50% probability of a continuing decline of at least 5% per year. Such a decline, if not stopped, would result in a 50% decline in 15 years and would likely lead to the stock being listed as threatened. The estimate of trend should be based on data spanning at least 8 years. Alternative thresholds for decline rates and duration, as well as alternative data criteria, may also be used if sufficient rationale is provided to indicate that the decline is likely to result in the stock being listed as threatened within the foreseeable future. Stocks that have been designated as strategic due to a population decline may be designated as non-strategic if the decline is stopped and the stock is not otherwise strategic.

7. Assessing stocks without abundance estimates or PBR

I. Background to the Issue

The minimum population size (N_{min}) is a required element for determination of potential biological removal and evaluation of stock status. The 1994 amendments to the MMPA defined (section 3) the "minimum population estimate" as "the number of animals in a stock that: (A) is based on the best available scientific information on abundance, incorporating the precision and variability associated with such information; and (B) provides reasonable assurance that the stock size is equal to or greater than the estimate." When the amendments went into effect there were many stocks for which data were so sparse that it was not possible to produce an N_{min} that could satisfy this definition. That problem still exists today for many stocks.

II. Summary of Working Papers Addressing This Issue

The Alaska Scientific Review Group prepared a working paper (GAMMS III-WP-7, Appendix III) that presented their perspective on assessing marine mammal stocks and reducing marine mammal mortality in Alaska. This was presented by Lloyd Lowry (AK-SRG). The primary theme of the working paper was that the MMPA and specifically the PBR approach to managing commercial fishery bycatch is not working well in Alaska. Minimum abundance has never been estimated for many stocks and is out of date for many others. Fishery bycatch levels have not been estimated for many of the fisheries in Alaska. Similar problems exist in other regions as well. The working paper supposed that this is a result of inadequate budgets for marine mammal stock assessment work.

A background document on this topic (prepared by Lloyd Lowry) suggested three alternatives for alleviating this problem; these include: 1) obtaining substantial additional funding for marine mammal stock assessment work; 2) developing and implementing less costly alternative methods for estimating N_{min}; and 3) modifying the MMPA to allow use of methods other than PBR for evaluating stock status.

The working paper from the Alaska Scientific Review Group also proposed several solutions. These included: (1) identifying alternative methods to PBR for assessing stock status (such as use of trend data from index sites); (2) using methods other than observer programs to determine when, where, and approximately how many marine mammals are being killed in fisheries (e.g., beach surveys for marine mammal carcasses, compilation and review of stranding records, interviews with fishermen, reports from qualified observers, electronic monitoring systems, and geographic information system analyses of fisheries effort and marine mammal distributions); (3) focusing more on the ZMRG mandate of the MMPA, i.e., allocating resources to mitigation, rather than assessment, to reduce bycatch where it occurs; and publish guidelines (List of Acceptable Deterrents) under Sec 101(a)(4) of the MMPA for using methods to safely deter marine mammals from fishing gear.

In his presentation of the topic, Lloyd Lowry (AK-SRG) reviewed the evolution of the MMPA and the implementation of solutions that addressed the joint concerns of commercial fisheries and environmental groups. Initial proposals to have recovery factors that included zero were rejected by the fishing industry because this would create situations where PBR could be zero. The PBR model is difficult to implement in a data-poor environment (where estimates of N_{min} are largely lacking), and Lowry suggests it may be possible to determine stock status in the absence of PBR through the use of trend indices for assessment.

III. Discussion

The GAMMS III workshop participants appreciated the challenges Alaska faces for conducting stock assessments and their suggested measures for dealing with these. However, participants did not feel that most of these points could be specifically addressed in this workshop or the revised Report guidelines, given the workshop's objectives and terms of reference (i.e., to revise the stock assessment report guidelines).

In effort to constructively address some of these issues via the GAMMS III workshop, one suggestion was that the Report guidelines be revised to include explicit language that allows for use of trend indices in assessment. There were some concerns with this suggestion, notably that some sort of criteria for defining an "adequate trend index" would be required and that in most cases, reliable trend estimates are more difficult to estimate than population abundance.

During the breakout session on this topic, the participants acknowledged that in the 17 years since the 1994 amendments to the MMPA, mortality and/or population abundance estimates are still unavailable in some regions for some stocks. Given budget constraints, this situation is not likely to change in the foreseeable future. When mortality and/or population abundance estimates are unavailable, the PBR approach cannot be used to assess populations, in spite of statutory mandate to do so. This situation is common in Alaska and in the US territorial waters surrounding Pacific and Caribbean Islands. However, it was suggested there are likely ways to make progress in assessment and mortality mitigation for marine mammal stocks despite a lack of abundance and mortality information, and we may not be fully capturing these opportunities at present.

The current guidelines state: *"The MMPA requires a determination of a stock's status as being either strategic or non-strategic and does not allow for a category of unknown. If abundance or human-related mortality levels are truly unknown (or if the fishery-related mortality level is only available from logbook data), some judgement [sic] will be required to make this determination. If the human-caused mortality is believed to be small relative to the stock size based on the best scientific judgement [sic], the stock could be considered as non-strategic. If human-caused mortality is likely to be significant relative to stock size (e.g., greater than the annual production increment) the stock could be considered as strategic. In the complete absence of any information on sources of mortality, and without guidance from the Scientific Review Groups, the precautionary principle should be followed and the default stock status should be strategic until information is available to demonstrate otherwise."*

Thus, in cases where a stock is vulnerable to sources of anthropogenic mortality known to affect the species elsewhere, there is currently a mechanism by which to designate such a stock as strategic without estimating PBR. PBR is not an endpoint, but a tool used to designate a stock as strategic or non-strategic, and it is possible to make such a determination in cases where information associated with PBR is incomplete. This could provide an avenue by which creative common-sense mitigation approaches could be implemented. The breakout group focused on modifying the current guidelines to emphasize the utility of trend information in determining stock status. It was recognized that in the absence of a PBR target, setting goals in a take reduction plan for a strategic stock would be difficult. In such situations, creative and/or common sense mitigation approaches known to be successful in other cases (e.g., pingers on fisheries gear) could be applied.

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

Minimum Population Estimate (N_{min})

N_{min} is defined in the MMPA amendments as an estimate of the number of animals in a stock that:

> "(A) is based on the best available scientific information on abundance, incorporating the precision and variability associated with such information; and,
>
> "(B) provides reasonable assurance that the stock size is equal to or greater than the estimate."

Consistent with these MMPA definitions, N_{min} should be calculated such that a stock of unknown status would achieve and be maintained within OSP with 95% probability. Population simulations have demonstrated (Wade 1994) that this goal can be achieved by defining N_{min} as the 20th percentile of a log-normal distribution based on an estimate of the number of animals in a stock (which is equivalent to the lower limit of a 60% 2-tailed confidence interval):

$$N_{min} = N/\exp(0.842 * (\ln(1+CV(N)^2))^{½}) \qquad (1)$$

where N is the abundance estimate and CV(N) is the coefficient of variation of the abundance estimate. If abundance estimates are believed to be biased, appropriate correction factors should be applied to obtain unbiased estimates of N. In such cases, the coefficient of variation for N should include uncertainty in the estimation of the correction factor. In cases where a direct count is available, such as for many pinniped stocks, this direct count could alternatively be used as the estimate of N_{min}. Other approaches could also be used to estimate N_{min} if they provide an ~~the same level~~ adequate level of~~of~~ assurance that the stock size is equal to or greater than that estimate.

Status of Stocks

The MMPA requires a determination of a stock's status as being either strategic or non-strategic and does not specify ~~allow~~ a category of unknown. If abundance or human-related mortality levels are truly unknown (or if the fishery-related mortality level is only available from logbook data), some judgment ~~judgement~~ will be required to make this determination. If the human-caused mortality is believed to be small relative to the stock size based on the best scientific judgment ~~judgement~~, the stock could be considered as non-strategic. If human-caused mortality is likely to be significant relative to stock size (e.g., greater than the annual production increment) the stock could be considered as strategic. Likewise, trend monitoring can help inform the process of determining strategic status. In the complete absence of any information on sources of mortality, and without guidance from the Scientific Review Groups, the precautionary principle should be followed and the default stock status should be strategic until information is available to demonstrate otherwise.

8. Characterizing Uncertainty in Key Stock Assessment Report Elements

I. Background to the Issue

This topic had its origin at the joint SRG meeting in December 2008 where participants discussed the difficulty of inferring the overall uncertainty for key parameters as they were reported in the stock assessment Reports. For example, although abundance estimates give the age of the latest survey and the coefficient of variation (CV) of the estimates, other potential uncertainties (e.g., extent of the range of the stock that was surveyed) have not been consistently reported. Other SAR elements (e.g., human-caused mortality and serious injury) are also subject to biased estimation and other uncertainties. Negatively biased estimates for fishery-related mortality are common because there are no observer data or low observer coverage for many fisheries, or mortality estimates only summarize confirmed stranding reports.

The meeting produced no joint recommendation based upon these discussions; however, the Pacific SRG made recommendations regarding parameter uncertainty in 2009 and again in 2010. NMFS responded to the SRG in 2010 that the recommendation would be included at the GAMMS III workshop for resolution.

In May 2009, protected species leaders from all field offices and headquarters met to discuss national issues, including the topic of uncertainty statements in the Reports. It was noted that performance reporting for NMFS protected species conducted under the Government Performance Review Act (GPRA) included submitting a summary table indicating the levels of information quality for several key elements used to assess the status of protected species or stocks.

II. Summary of the Working Paper Addressing This Issue

A working paper by Taylor and Wade (GAMMS III-WP-8, Appendix III) presented a “report card” that described the quality of each Report for California, Oregon and Washington marine mammal stocks. The report card developed in the working paper was based on information for 4 essential elements used to assess the status of marine mammal stocks:

1. The ability to detect a precipitous decline;
2. The knowledge that the named stock contained only one stock;
3. The knowledge about human-caused mortality; and
4. The knowledge about current trends in abundance.

Although not used to develop the report card presented in the working paper, the authors noted it was also worth thinking about two other elements: biases in abundance estimates, and biases in human-caused mortality estimates. The information in the Reports for California, Oregon, and Washington stocks were subjected to analysis of the ability to detect a 50% decline in a 15-year period, using a statistical power of 0.8. (see section 6 of this report, and the associated recommended addition to the Technical Details of the Report guidelines). These analyses were performed for alpha levels of 0.05 and 0.25. The results indicated that 21 stocks received a grade of D or F, and only 16 stocks received grades of A (3), B (5) or C (8), using the 0.25 alpha level.

The working paper recommended that each stock's Report summarize the rationale for each of the above elements, for purposes of developing the report card. Such a report card would allow a reader to quickly evaluate NMFS' level of understanding about marine mammal stocks.

III. Discussion

There was general agreement that the quality of information for assessing marine mammal stocks was not good in most cases and that including statements about uncertainty of the Report elements would be helpful. The group also saw merit to the report card, but there was general agreement that such information would be better conveyed as a periodic publication (every 2-3 years), such as in a NOAA Technical Memorandum, which could be considered by the SRGs. The group suggested that columns for risk be added to the report card in this context. The group also recommended that work should be done where possible to dovetail with the GPRA process.

The group recommended that Report authors describe, in the Status of Stock section, uncertainties in key factors so that the reader could easily gauge how well the status of the stock. Preliminarily, the group agreed that the contents of the summary should include the following information:

- Stock status (e.g. strategic, ESA, MMPA)
- Most recent survey year
- Abundance
    - complete or partial?
    - level of confidence in the estimate (potential biases, etc)
- Human caused Mortality and Serious Injury (description of uncertainties about the estimates)
- Fisheries monitored (what is the quality of our data – can we quantify mortality? What is the certainty in our estimate and is the estimate likely to be negatively biased? Potentially important fisheries not monitored?)
- Other known sources of mortality*
- Stock structure (number of potential distinct stocks included with the nominal stock, with brief explanation
- Would we be able to detect a precipitous decline [trend]? yes or no (with rationale)

* There was some concern from FWS about identifying subsistence harvest as a threat to stocks

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

1. General Guidelines

Introduction

(Paragraph 4):
It is anticipated that the guidelines themselves will be reviewed and changed based on additional scientific research and on experience gained in their application. In this regard, FWS and NMFS will meet periodically to review and revise, as needed, the guidelines. When the agencies recommend revisions to the guidelines, these revisions will be made available for public review and comment prior to acceptance. Furthermore, the guidelines in this document do not have to be followed rigidly; however, any departure from these guidelines must be discussed fully within any affected Report.

(New paragraph 5):
<u>In the sections of the Report on Stock Definition and Geographic Range, Elements of the PBR Formula, Population Trend, and Annual Human-Caused Mortality and Serious Injury, authors are to provide a description of key uncertainties associated with parameters in these sections and evaluate the effects of these uncertainties in sufficient detail to support a synthesis of how accurately stock status could be assessed.</u>

Status of Stocks

This section of the Reports should present a summary of 4 types of "status" <u>of the stock</u>: 1) current legal designation under the MMPA and ESA, 2) status relative to OSP (within OSP, <u>below OSP</u>, ~~depleted~~, or unknown), 3) designation of strategic or non-strategic, and 4) a summary of trends in abundance and mortality. <u>Authors should synthesize descriptions of levels of uncertainties in the Report sections on Stock Definition and Geographic Range, Elements of the PBR Formula, Population Trend, and Annual Human-Caused Mortality and Serious Injury, including an evaluation of the consequences of these uncertainties on the assessment of the stock's status.</u>

9. Expanding the Stock Assessment Reports to include non-serious injuries and disturbance

I. Background to the Issue

A principal goal of the Reports is to provide a structure for conducting routine assessments of human-related mortality and serious injury of marine mammal stocks relative to their PBR, pursuant to requirements of section 117 of the MMPA, i.e., to highlight situations where the level of mortality and serious injury from commercial fisheries is not sustainable. Currently, many Reports include information on human-related mortality and serious injury from all known sources (not just from commercial fisheries), but they do not include information on human-related non-serious injury or disturbance. PBR estimates reported in the Reports are helpful in a variety of management contexts (e.g., authorizing incidental take or harassment under section 101(a)(5) of the MMPA), so it may make sense to expand the content of the Reports to include more information on a variety of human impacts. This would better reflect how the Reports (and PBR levels) are being used and would provide readers with a more complete understanding of human impacts on marine mammal populations.

II. Summary of Working Paper Addressing This Issue

No formal working paper was submitted on this topic. However, Robyn Angliss (AFSC/NMML) provided detailed background document describing the issue. It notes that NMFS has occasionally been encouraged through public comments, comments from the Marine Mammal Commission, and input from some Scientific Review Groups, to add more complete information about the range of impacts of humans on marine mammals in the Reports. NMFS has often responded positively to these requests and now frequently includes information on habitat concerns and information on mortality due to scientific research. To date, NMFS has not included information on human-related non-serious injuries or disturbance in the Reports because their purpose considered to date is to assess human-related mortality and serious injury.

There is interest in using PBR estimates for assessing the relative severity of human-related impacts besides those from commercial fisheries to a marine mammal stock. In some cases (e.g. Steller sea lions, northern fur seals), applications for scientific research permits have been evaluated in comparison to a stock's PBR level to support an argument that the harassment takes requested are likely to be minor. The number of potential mortalities or injuries proposed for issuance under a Letter of Authorization could be compared to a PBR level prior to issuing the permit. Two related NRC reports have recommended that a PBR-type approach be used in assessing injury and disturbance related to noise impacts, with weighting factors for severity of injury and/or significance of injury and disturbance (e.g., behavioral response) related to noise impacts, to improve the understanding of cumulative effects of human activities on marine mammal stocks.

The MMPA does allow an assessment of impacts other than mortality and serious injury to be included in the Reports for strategic stocks. Section 117(a)(3) states that the Reports "shall . . . estimate the annual human-caused mortality and serious injury of the stock by source and, for a strategic stock, other factors that may be causing a decline or impeding recovery of the stock, including effects on marine mammal habitat and prey." The use of the term "including" could be interpreted broadly to mean "including, but not limited to," and provide authority to include descriptions of non-lethal injuries or disturbance in the Reports, at least for strategic stocks.

III. Discussion

In general, the group felt that the Report guidelines could be retained as they currently stand. However, Report authors are encouraged to routinely consider what "other factors" may cause a decline or impede recovery of a particular stock and include them in Reports as appropriate. In particular, Report authors should broaden their consideration of "other factors" to include animals injured, killed, or disturbed under the terms of a Letter of Authorization (LOA) or Incidental Harassment Authorization (IHA) under section 101(a)(5) of the MMPA. The guidelines should emphasize the inclusion of such information for strategic stocks, but the MMPA does not prohibit the inclusion of information on "other factors" that may be causing a decline or impeding the recovery of non-strategic stocks. However, information on non-lethal "other factors" should be included only when the Report authors make a decision that these factors could cause a decline or impede recovery. If there are no concerns that other factors could impede recovery, the Reports should indicate that other factors were considered and that there are no concerns for that stock in the Status of the Stock section.

This process will require that additional information on non-serious injury, serious injury, and or death reported under LOAs and IHAs be summarized by F/PR or the Regional Offices and transmitted annually to the Report authors. A list of regional points-of-contact would facilitate the transmission of this information from F/PR (also noted under Topic 5). This collection of information should occur routinely and in a timely manner so the Report authors can make the determination as to whether the injury or deaths reported from this source should be included in the Reports in the "Other Mortality" section.

If appropriate, disturbance information should also be considered for inclusion and quantification in the Reports, at the discretion of the Report authors, in the Status of the Stock, Habitat section, or Other Mortality (e.g. spinner dolphins swim with programs in Hawaii) section. If the levels cannot be quantified, but there is concern that the levels could cause a decline or prevent recovery, then qualitative information should be provided.

In order for Report authors to assess whether reported mortality or serious injuries authorized by LOAs, IHAs, and research permits may impede the recovery of a stock, this information needs to be transmitted from F/PR to the regional Science Centers. F/PR should designate a point of contact who can provide information on any non-serious injury, serious injury, and deaths from research fishing, marine mammal research, LOAs, etc. These reports should be provided to Report authors no later than June every year, and reports should include the information from the entire previous year (12 months of data).

IV. Final Proposed Text Changes to the Stock Assessment Report Guidelines

Reflecting input from the Breakout and Plenary Discussions, the following guideline sections are recommended to be revised as below (underline = insertions, strikeout = deletions).

Status of Stocks

The MMPA requires for strategic stocks a consideration of other factors that may be causing a decline or impeding recovery of the stock, including effects on marine mammal habitat and prey, or other lethal or non-lethal factors. Therefore, such issues should be summarized in the Status section for all strategic stocks. If substantial issues regarding the habitat of the stock are important, a separate section titled “Habitat Issues” should be used. If data exist that indicate a problem, they should be summarized and included in the Report. If there are no known habitat issues or other factors causing a decline or impeding recovery, this should be stated in the Status section.

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Months of detailed planning by the GAMMS III Workshop steering committee (Appendix II), including preparation of meeting's scope and agenda, format and organization, and preparation of background documents, made for a smooth and productive workshop. Drs. Cisco Werner and Lisa Ballance made available the facilities of the Southwest Fisheries Science Center to host the workshop. NOAA Offices of Protected Resources and Science & Technology provided funding to support attendance at the workshop by Scientific Review Group representatives. Jeff Moore convened the workshop. Richard Merrick acted as workshop Chair. Lynn Evans and Siri Hakala coordinated accommodations for workshop participants. Special thanks to Jim Carretta for acting as workshop rapporteur, and Siri Hakala for doing a fantastic job coordinating daily meeting logistics. Thanks to the many other participants who acted as rapporteurs during workshop breakout sessions. Jay Barlow and Barb Taylor kindly hosted a wonderful social gathering at their home. Thanks to working papers authors for providing critical discussion material leading to recommended revisions of the Stock Assessment Report guidelines. Many workshop participants drafted the various sections of the GAMMS III report and Tom Eagle assembled the first draft of the revised Report guidelines (Appendix IV). Thanks ultimately to all the workshop participants who contributed ideas, discussion, revision text, and reviews of report drafts that lead to guideline revisions and the creation of this workshop report.

APPENDIX I. COPY OF GAMMS III WORKSHOP AGENDA.

GAMMS III Workshop, Final Agenda
Feb 15 – 18, 2011
Southwest Fisheries Science Center, La Jolla, CA 92037

Each morning "Topic" session will consist of one or more background presentations, and one or more working group presentations. General discussion of Topics in the morning will be limited to discussion of presentations.

Afternoon breakout groups will meet to develop ways forward to the Topic issues and to draft guideline text that will be presented/discussed during the de-briefing session.

The above steps should help make the SAR guideline text revision a streamlined process, as text revisions should already be drafted, following each day's breakout debriefing.

<u>Tuesday, February 15</u>

08:30	Breakfast/coffee/morning reception
09:00	Welcome and Introductions Lisa Ballance – SWFSC Division Chief Cisco Werner – SWFSC Director Jeff Moore (Workshop Organizer) – SWFSC PRD Richard Merrick (Meeting Chair) – NEFSC Division Chief Roundtable of introductions
09:30	Intro presentation: The Development of PBR and a Brief Review of its Current Usage (Paul Wade)
09:40	**Topic 1: Outdated N_{min}** Background and working papers presented by Jeff Moore and Jay Barlow
10:30	Coffee
10:45	Topic 1, continued
11:15	**Topic 2: Inconsistent an unreliable stock identification: implications for assessment** Background and working papers presented by Patty Rosel
12:30	Lunch, *and genetics lab tour*
13:30	**Breakout groups**

16:00 Break

16:15 **Breakout group debriefings and general discussion**

17:30 Adjourn – *head to Barb and Jay's for evening social*

Wednesday, February 16

08:30 Breakfast/coffee/morning reception

09:00 **Topic 3: Estimating PBR for very small stocks (and the special case of small Endangered stocks)**
Background and working papers by Paul Wade and Jeff Moore

10:30 Coffee

10:45 **Topic 4: Apportioning PBR for mixed stocks and transboundary stocks**
Background and working papers by J. Barlow, E. Oleson, and K. Forney

11:45 **Topic 8* : Improving SAR uncertainty statements**
Background and working paper by Richard Merrick and Barb Taylor

12:30 Lunch

13:30 **Breakout groups**

16:00 Break

16:15 **Breakout group debriefings and general discussion**

17:30 Adjourn

Thursday, February 17

08:30 Breakfast/coffee/morning reception

9:00 **Topic 6: Stock decline and depletion as a basis for classifying stocks as "strategic"**
Background and working paper presented by Barb Taylor

10:30 Coffee

10:45 **Topic 7: Estimating PBR or otherwise assessing stocks in the absence of abundance information**

Background and working paper presented by Lloyd Lowry

11:45	**Topic 5*: Clarifying and improving regional consistency of assessment and reporting on mortality and serious injury** Background paper presented by Tom Eagle	
12:30	Lunch	
13:30	**Breakout groups**	
16:00	Break	
16:15	**Breakout group debriefings and general discussion**	
17:30	Adjourn	

Friday, February 18

08:30	Breakfast/coffee/morning reception
09:00	**Topic 9: Whether to expand the scope of SARS to characterize non-serious injuries and disturbances** Background presented by Robyn Angliss
09:45	Overview of SAR guideline revision process, and setting timeline for revised SAR guideline draft
10:00	SAR guideline revision
10:30	Coffee
10:45	SAR guideline revision, continued
12:30	Adjourn

* Schedule order of Topic 5 and 8 have been switched but were not renumbered (to maintain their correspondence with numbered background and working documents)

APPENDIX II. LIST OF PARTICIPANTS AT THE GAMMS III WORKSHOP

Federal, NMFS	
Dee Allen	AFSC
John Bengston	AFSC
Paul Wade*	AFSC
Robyn Angliss*	AFSC
Kaja Brix	AKR
Debi Palka	NEFSC
Mike Simpkins	NEFSC
Richard Merrick*[1]	NEFSC
Richard Pace	NEFSC
Allison Rosner	NER
Kate Swails	NER
Eric Ward	NWFSC
Mike Ford	NWFSC
Donna Darm	NWR
Amanda Bradford	PIFSC
Erin Oleson	PIFSC
Frank Parrish	PIFSC
Lisa Van Atta	PIR
Nancy Young	PIR
Keith Mullin	SEFSC
Patricia Rosel	SEFSC
Stacey Horstman	SER
Barbara Taylor*	SWFSC
Bill Perrin	SWFSC
Jay Barlow*	SWFSC
Jeff Moore*	SWFSC
Jeremy Rusin	SWFSC
Jim Carretta	SWFSC
Karen Martien	SWFSC
Karin Forney	SWFSC
Lisa Ballance	SWFSC
Siri Hakala*	SWFSC
Tomo Eguchi	SWFSC
Monica DeAngelis	SWR
Tina Fahy*	SWR
Jim Lecky	F/PR
Kristy Long	F/PR
Shannon Bettridge	F/PR
Tom Eagle*	F/PR
Mridula Srinivasan	F/ST
Stephen Brown	F/ST
Jason Forman	GCF
Kirsten Erickson	GCF

Federal, Non-NMFS	
Rosa Meehan*	USFWS - AK
Doug Burn*	USFWS - AK
Deanna Lynch	USFWS - DC
Diane Bowen	USFWS - DC
Samantha Simmons	MMC

Non-federal (SRG)	
Lloyd Lowry	AK SRG
Sharon Young	Atl SRG
Michael Scott	Pac SRG
John Calambokidis	Pac SRG
Hannah Bernard	Pac SRG

* Denotes members of the workshop Steering Committee; [1] Chaired the workshop

APPENDIX III. LIST OF WORKING PAPERS SUBMITTED BY PARTICIPANTS IN ADVANCE OF THE GAMMS III WORKSHOP TO ADDRESS AGENDA ITEMS

Moore JE. Trend-based analysis for estimating abundance (N_{min}) in PBR calculations beyond the most recent survey year. GAMMS III – WP – 1A.

Barlow J. Simulation-based analysis for projecting N_{min} beyond the most recent survey estimate when trends are not estimated and population growth rate is unknown. GAMMS III – WP – 1B.

Moore JE, Barlow J. Suggested SAR guideline text revisions for dealing with outdated abundance (N_{min}) information in PBR calculations. GAMMS III – WP – 1C.

Taylor B, Rosel P, and Martien K. Improving unreliable stock identity to increase effective PBR management. GAMMS III – WP – 2.

Moore, JE. Small-sample bias in direct human-caused mortality estimates of very small stocks. GAMMS III – WP – 3.

Barlow J. Suggested SAR guideline text revisions for dealing with "Topic 4: Apportioning PBR for mixed stocks." GAMMS III – WP – 4A.

Oleson E, Long K, Forney K, Young N. Estimating PBR for transboundary stocks. GAMMS III – WP – 4B.

McCracken M. Adjustments to false killer whale and short-finned pilot whale bycatch estimates. PIFSC Working Paper WP-10-007, issued 7 December 2010.

Taylor BL, Barlow J, Forney KA, Ferguson MC. SAR guidelines for determining when stock declines justify a "strategic" designation or designation as depleted under the MMPA: a proposal for discussion. GAMMS III – WP – 6.

AKSRG. Alaska Scientific Review Group (AKSRG) perspectives on assessing marine mammal stocks and reducing incidental takes of marine mammals in Alaska. GAMMS III – WP – 7.

Taylor BL, Wade P. A proposal to depict uncertainty in the SARs using a Status Comprehension Report Card. GAMMS III – WP – 8.

APPENDIX IV. GUIDELINES FOR PREPARING THE STOCK ASSESSMENT REPORTS (PROPOSED REVISION)

Following discussions and recommendations of the GAMMS workshop in February 2011, workshop participants recommend the following revision of the guidelines for preparing the Stock Assessment Reports (next pages). To a large but not total extent, this appendix exactly reflects the recommended language changes described in the individual sections of the main body of this report (sections 1 – 9). Any inconsistencies are a result of the draft-report revision process.

Guidelines for Preparing Stock Assessment Reports Pursuant to Section 117 of the Marine Mammal Protection Act

1. General Guidelines

Introduction

Section 117 of the Marine Mammal Protection Act (MMPA) requires that the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) develop Stock Assessment Reports (Reports) for all marine mammal stocks in waters under U.S. jurisdiction (U.S. waters). These Reports are to be based upon the best scientific information available. Reports are not required for stocks that have a remote likelihood of occurring regularly in U.S. waters (e.g., stocks for which only the margins of the range extends into U.S. waters or that enter U.S. waters only during anomalous current or temperature shifts).

The MMPA requires Reports to include, among other things, information on how stocks were identified, a calculation of Potential Biological Removal (PBR), an assessment of whether incidental fishery takes are "insignificant and approaching zero mortality and serious injury rate," as well as other information relevant to assessing stocks. These reports are to be reviewed annually for "strategic stocks" and for stocks for which new information is available, and at least once every three years for all other stocks. This document provides guidance for how these topics are to be addressed in the Reports.

The MMPA provides some general guidance for developing the Reports. More detailed guidelines were developed at a PBR workshop in June 1994 and were used in writing the original draft Reports. The draft guidelines and initial draft stock assessment reports were subjected to public review and comment in August 1994. Final guidelines and Reports were completed in 1995 (Barlow et al. 1995). In 1996, representatives of NMFS, USFWS, regional Scientific Review Groups, and the Marine Mammal Commission reviewed the guidelines and proposed minor changes, which after public review and comment, were made final in 1997 (Wade and Angliss 1997). The guidelines were officially updated again in 2005, following a similar revision process beginning with workshop in September 2003 (NMFS 2005). In February 2011, NMFS again convened representatives of the review groups and agencies to review and, as appropriate, recommended revisions to the guidelines.

It is anticipated that the guidelines themselves will be reviewed and changed based on additional scientific research and on experience gained in their application. In this regard, USFWS and NMFS will meet periodically to review and revise, as needed, the guidelines. When the agencies recommend revisions to the guidelines, these revisions will be made available for public review and comment prior to acceptance. Furthermore, the guidelines in this document do not have to be followed rigidly; however, any departure from these guidelines must be discussed fully within any affected Report.

In the sections of the Report on Stock Definition and Geographic Range, elements of the PBR formula, Population Trend, and Annual Human-caused Mortality and Serious Injury, authors are to provide a description of key uncertainties in each element and evaluate the effects of these uncertainties associated with parameters in these sections and evaluate the effects of these uncertainties in sufficient detail to support a synthesis of how accurately stock status could be assessed.

The intent of these guidelines is to: (1) provide a uniform framework for the consistent application of the amended MMPA throughout the country; (2) ensure that PBR is calculated in a manner that ensures meeting the goals of the MMPA; (3) provide guidelines for evaluating whether fishery takes are insignificant and approaching a zero mortality and serious injury rate; and (4) make the Government's approach clear and open to the public. Where the guidelines provided here are not incorporated into a particular Report, justification for the departure will be provided within the Report. Similarly, the Reports will explain when deviations are made from specific recommendations from the Scientific Review Groups.

FWS and NMFS interpret the primary intent of the 1994 MMPA amendments and the PBR guidelines developed pursuant to the Act as a mechanism to respond to the uncertainty associated with assessing and reducing marine mammal mortality from incidental fisheries takes. Accordingly, this mechanism is increasingly conservative under increasing degrees of uncertainty. The MMPA requires the calculation of PBR for all stocks, including those that are considered endangered or threatened under the Endangered Species Act (ESA) and those that are managed under other authorities, such as the International Whaling Commission. However, in some cases allowable takes under these other authorities may be less than the PBR calculated under the MMPA owing to the different degrees of "risk" associated with, and the treatment of, uncertainty under each authority. Where there is inconsistency between the MMPA and ESA regarding the take of listed marine mammals, the more restrictive mortality requirement takes precedence. Nonetheless, PBR must still be calculated for these stocks, where possible, and discussed in the text of the Reports. As mandated under the MMPA, the PBR is calculated 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." Therefore, a PBR is an upper limit to removals that does not imply that the entire amount should be taken.

Estimates of PBR, human-caused mortality, and classification as to whether a stock is "strategic" or "non-strategic" are required by Sec. 117 to be included in the Reports for all stocks of marine mammals in U.S. waters. However, it should be noted that the co-management, between the Federal government and Alaska Native organizations, of removals of marine mammals for subsistence purposes between the Federal government and Alaska Native organizations is specifically addressed in Sec. 119. In response to Sec. 119, NMFS and FWS have entered into cooperative agreements with Alaska Native organizations to conserve marine mammals and provide co-management of subsistence use by Alaska Natives. FWS and NMFS believe that it is appropriate to develop management programs for stocks subject to subsistence harvests through the co-management process provided that commercial fisheries takes are not significant and that the process includes a sound research and management program to identify and address uncertainties concerning the status of these stocks. Estimates of PBR and classification as to whether a stock is strategic will be determined from the analysis of scientific and other relevant information discussed during the co-management process.

Definition of "Stock"

"Population stock" is the fundamental unit of legally-mandated conservation. The MMPA defines population stock as "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature." To fully interpret this definition, it is necessary to consider the objectives of the MMPA. Sec. 2 (Findings and Declaration of Policy) of the MMPA states that "...species and populations stocks of marine mammals...should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part, and, consistent with this major objective, they should not be permitted to diminish below their optimum sustainable population." Further on in Sec. 2, it states "...the primary objective of their management should be to maintain the health and stability of the marine ecosystem. Whenever consistent with this primary objective, it should be the goal to obtain an optimum sustainable population keeping in mind the carrying capacity of the habitat." Therefore, stocks must be identified in a manner that is consistent with these goals. For the purposes of management under the MMPA, a stock is recognized as being a management unit that identifies a demographically independent biological population. It is recognized that in practice, identified stocks may fall short of this ideal because of a lack of information, or for other reasons.

Many types of information can be used to identify stocks of a species (e.g., distribution and movements, population trends, morphological differences, differences in life history, genetic differences, differences in acoustic call types, contaminants and natural isotope loads, parasite differences, and oceanographic habitat differences). Different population responses (e.g., different trends in abundance) between geographic regions are also an indicator of stock structure, as populations with different trends are not strongly linked demographically. When different types of evidence are available to identify stock structure, the Report must discuss inferences made from the different types of evidence and how these inferences were integrated to identify the stock.

Evidence of morphological or genetic differences in animals from different geographic regions indicates that these populations are demographically independent. Demographic independence means that the population dynamics of the affected group is more a consequence of births and deaths within the group (internal dynamics) rather than immigration or emigration (external dynamics). Thus, the exchange of individuals between population stocks is not great enough to prevent the depletion of one of the populations as a result of increased mortality or lower birth rates.

Failure to detect genetic or morphological differences, however, does not necessarily mean that populations are not demographically independent. Dispersal rates, though sufficiently high to homogenize morphological or genetic differences detectable between putative populations, may still be insufficient to deliver enough recruits from an unexploited population (source) to an adjacent exploited population (sink) so that the latter remains a functioning element of its ecosystem. Insufficient dispersal between populations where one bears the brunt of exploitation coupled with their inappropriate pooling for management could easily result in failure to meet MMPA objectives. For example, it is common to have human-caused mortality restricted to a portion of a species' range. Such concentrated mortality (if of a large magnitude) could lead to population fragmentation, a reduction in range, or even the loss of undetected populations, and would only be mitigated by high immigration rates from adjacent areas.

Therefore, careful consideration needs to be given to how stocks are identified. In particular, where mortality is greater than a PBR calculated from the abundance just within the oceanographic region where the human-caused mortality occurs, serious consideration should be given to identifying an appropriate stock in this region. In the absence of adequate information on stock structure and fisheries mortality, a species' range within an ocean should be divided into stocks that represent defensible management units. Examples of such management units include distinct oceanographic regions, semi-isolated habitat areas, and areas of higher density of the species that are separated by relatively lower density areas. Such areas have often been found to represent true biological stocks where sufficient information is available. In cases where there are large geographic areas from which data on stock structure of marine mammals are lacking, stock structure from other parts of the species' range may be used to draw inferences as to the likely geographic size of stocks. There is no intent to identify stocks that are clearly too small to represent demographically isolated biological populations, but it is noted that for some species genetic and other biological information has confirmed the likely existence of stocks of relatively small spatial scale, such as within Puget Sound, WA, the Gulf of Maine, or Cook Inlet, AK.

Each Report will state in the Stock Definition and Geographic Range section whether it is plausible the stock contains multiple demographically independent populations that should be separate stocks, along with a brief rationale (e.g., the current stock spans multiple eco-regions). If additional structure is plausible and human-caused mortality or serious injury is concentrated within a portion of the range of the stock, the Report should identify the portion of the range in which the mortality or serious injury occurs.

In trans-boundary situations where a stock's range spans international boundaries or the boundary of the U.S. Exclusive Economic Zone (EEZ), the best approach is to establish an international management agreement for the species and to evaluate all sources of human-caused mortality and serious injury (U.S. and non-U.S.) relative to the PBR for the entire stock range. In the interim, if a trans-boundary stock is migratory and it is reasonable to do so, the fraction of time the stock spends in U.S. waters should be noted, and the PBR for U.S. fisheries should be apportioned from the total PBR based on this fraction. For non-migratory trans-boundary stocks (e.g., stocks with broad pelagic distributions that extend into international waters), if there are estimates of mortality and serious injury from U.S. and other sources throughout the stock's range, then PBR calculations should be based upon a range-wide abundance estimate for the stock whenever possible. In general, abundance or density estimates from one area should not be extrapolated to unsurveyed areas to estimate range-wide abundance (and PBR). But, informed interpolation (e.g. based on habitat associations) may be used to fill gaps in survey coverage and estimate abundance and PBR over broader areas as appropriate and supported by existing data. If estimates of mortality or abundance from outside the U.S. EEZ cannot be determined, PBR calculations should be based on abundance in the EEZ and compared to mortality within the EEZ.

Prospective Stocks

When information becomes available that appears to justify a different stock structure or stock boundaries, it may be desirable to include the new structure or boundaries as “prospective stocks” within the existing Report. The descriptions of prospective stocks would include a description of the evidence for the new stocks, calculations of the prospective PBR for each new stock, and estimates of human-caused mortality and serious injury, by source. The notice of availability of draft Reports with prospective stocks would include a request for public comment and additional scientific information specifically addressing the prospective stock structure. Prospective stocks would be expected to become separate stocks in a timely manner unless additional evidence was produced to contradict the prospective stock structure. Summary information for prospective stocks should be included in the standard table in the Reports that summarizes the minimum population estimate (N_{min}), the maximum net productivity rate (R_{max}), etc. for each stock.

PBR Elements

The 1994 amendments to the MMPA mandate that, as part of the Reports, PBR estimates must be developed for each marine mammal stock in U.S. waters. The PBR is defined as "the maximum number of animals, not including natural mortality, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." In addition, the MMPA states that PBR is calculated as the product of three elements: the minimum population estimate (N_{min}); half the maximum net productivity rate (0.5 R_{max}); and a recovery factor (F_r). The guidelines for defining and applying each of these three elements are described below. Further specific guidance on the calculation of PBR is provided in part 2 (Technical Details) of this document.

An underlying assumption in the application of the PBR equation is that marine mammal stocks exhibit certain dynamics. Specifically, it is assumed that a depleted stock will naturally grow toward OSP and that some surplus growth may be removed while still allowing recovery. There are unusual situations, however, where the formula Congress added to the MMPA to calculate PBR (N_{min}*0.5R_{max}*F_r) results in a number that is not consistent with the narrative definition of PBR (the maximum number of animals, not including natural mortality, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its OSP). That is, there are situations where a stock is below its OSP and is declining or stable, yet human-caused mortality is a not a major factor in the population’s trend. Thus, for unknown reasons, the stock’s dynamics do not conform to the underlying model for calculating PBR. In such unusual situations, the PBR estimate should be qualified in the Report in the PBR section.

Minimum Population Estimate (N_{min})

N_{min} is defined in the MMPA amendments as an estimate of the number of animals in a stock that:

> "(A) is based on the best available scientific information on abundance, incorporating the precision and variability associated with such information; and,
>
> "(B) provides reasonable assurance that the stock size is equal to or greater than the estimate."

Consistent with these MMPA definitions, N_{min} should be calculated such that a stock of unknown status would achieve and be maintained within OSP with 95% probability. Population simulations have demonstrated (Wade 1994) that this goal can be achieved by defining N_{min} as the 20th percentile of a log-normal distribution based on an estimate of the number of animals in a stock (which is equivalent to the lower limit of a 60% 2-tailed confidence interval):

$$N_{min} = N/\exp(0.842 * (\ln(1+CV(N)^2))^{½}) \qquad (1)$$

where N is the abundance estimate and CV(N) is the coefficient of variation of the abundance estimate. If abundance estimates are believed to be biased, appropriate correction factors should be applied to obtain unbiased estimates of N. In such cases, the coefficient of variation for N should include uncertainty in the estimation of the correction factor. In cases where a direct count is available, such as for many pinniped stocks, this direct count could alternatively be used as the estimate of N_{min}. Other approaches could also be used to estimate N_{min} if they provide an adequate level of assurance that the stock size is equal to or greater than that estimate.

Abundance estimates become less dependable with time after the last survey has occurred. Therefore, estimates of N_{min} since the last survey should be reduced annually to explicitly reflect uncertainty in current abundance, and to continue providing reasonable assurance that the true stock size is equal to or greater than N_{min}.

When a population's growth rate is unknown, incorporating uncertainty may be accomplished by projecting N_{min} based on a uniform distribution of plausible growth (see Technical Details). However, at some point even these projected estimates may no longer provide reasonable assurance that the stock size is presently greater than or equal to projected N_{min}, and N_{min} should therefore be decreased further to guard against a plausible worst-case scenario that may have gone undetected. A sustained decline of 10% per year represents the greatest decline observed for a stock of marine mammals in U.S. waters (NMFS 2008), and this rate of decline would decrease the population by 50% in 8 years, which would reduce the population below OSP. Therefore, after 8 years since the most recent survey, the N_{min} for a stock should be decreased by 10 % per year, applied retroactively from the time of the last survey, unless there is evidence against doing so.

For stocks with sufficient information to adequately estimate parameters for trend models (e.g., based on a time-series of abundance estimates or trend site data), such models may be used to help estimate values of N_{min} in years subsequent to the most recent survey. If the trend-based estimates of N_{min} are less than N_{min} projections from the uniform-distribution approach discussed in the previous paragraph, then the trend-based estimates should be used because they provide the stronger assurance that stock size is presently greater than the estimate of N_{min}. Similarly, if the trend-based estimates of N_{min} are declining by > 10% per year, they should continue to be used beyond 8 years since the most recent survey, unless new information provides evidence against doing so. On the other hand, if the trend-based N_{min} estimates are greater than those projected from a uniform distribution of growth rate, then N_{min} should be estimated as a time-weighted average of the two sets of estimates, out to 8 years from the most recent survey, after which the retroactive 10% per year reduction in N_{min} would be applied. Thus, N_{min} would fully reflect the trend-based estimate in the first year after the last survey but by the 8th year would fully reflect the estimate projected by the uniformly distributed growth rate model. This weighted average recognizes our diminishing confidence through time in the ability of trend-based projections to account for new changes in environmental processes (e.g., regime shifts) or anthropogenic impacts (e.g., change in fisheries, etc). And, it provides a more reasonable assurance that the stock size is presently greater than or equal to projected N_{min}. Trend models used should attempt to appropriately account for random environmental process error and sampling covariance in the data (e.g., see fin whale example by Moore and Barlow 2011) and should not inform the projections of N_{min} if at some point model results become inconsistent with other available information.

Population Trend

The Reports will describe information on current population trend including discussion of factors that may affect the reliability of the trend. In cases where trend data could be used in the calculation of N_{min}, the authors should discuss the suitability of the data for N_{min} inferences. The Reports should state whether a future precipitous decline could be detected (see Technical Details). A precipitous decline is defined as a 50% decline in 15 years, a decline which would result in the stock likely being below OSP.

Maximum Rate of Increase (R_{max})

One-half R_{max} is defined in the MMPA as "one-half of the maximum theoretical or estimated “net productivity rate” of the stock at a small population size," where the term “net productivity rate” means “the annual per capita rate of increase in a stock resulting from additions due to reproduction, less losses due to natural mortality." Default values should be used for R_{max} in the absence of stock-specific measured values. To be consistent with a risk-averse approach, these default values should be near the lower range of measured or theoretical values (or 0.12 for pinnipeds and sea otters and 0.04 for cetaceans and manatees). Substitution of other values for these defaults should be made with caution, and only when reliable stock-specific information is available on R_{max} (e.g., estimates published in peer-reviewed articles or accepted by review groups such as the MMPA Scientific Review Groups or the Scientific Committee of the International Whaling Commission).

Details on rounding and precision, and on averaging more than one estimate of abundance to calculate N_{min}, can be found in part 2 (Technical Details) of this document.

Recovery Factor (F_r)

The MMPA defines the recovery factor, F_r, as being between 0.1 and 1.0. The intent of Congress in adding F_r to the definition of PBR was to ensure the recovery of populations to their OSP levels, and to ensure that the time necessary for populations listed as endangered, threatened, and depleted to recover was not significantly increased. The use of F_r less than 1.0 allocates a proportion of expected net production towards population growth and compensates for uncertainties that might prevent population recovery, such as biases in the estimation of N_{min} and R_{max} or errors in the determination of stock structure. Population simulation studies (Barlow et al. 1995, Wade 1998) demonstrate that the default F_r for stocks of endangered species should be 0.1, and that the default F_r for depleted and threatened stocks and stocks of unknown status should be 0.5. A stock that is strategic because, based on the best available scientific information, it is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future (sec. 3(19)B of the MMPA) should use a recovery factor between 0.1 and 0.5. The default status should be considered as "unknown." Stocks known to be within OSP (e.g., as determined from quantitative methods such as dynamic response or back-calculation), or stocks of unknown status that are known to be increasing, or stocks that are not known to be decreasing taken primarily by aboriginal subsistence hunters, could have higher F_r values, up to and including 1.0, provided that there have not been recent increases in the levels of takes. Recovery factors for listed stocks can be changed from their default values, but only after careful consideration and where available scientific evidence confirms that the stock is not in imminent danger of extinction. Values other than the defaults for any stock should usually not be used without the approval of the regional Scientific Review Group, and scientific justification for the change should be provided in the Report.

The recovery factor can be adjusted to accommodate additional information and to allow for management discretion as appropriate and consistent with the goals of the MMPA. For example, if human-caused mortalities include more than 50% females, the recovery factor should be decreased to compensate for the greater impact of this mortality on the population (or increased if less than 50% female). Similarly, declining stocks, especially ones that are threatened or depleted, should be given lower recovery factors, the value of which should depend on the magnitude and duration of the decline. The recovery factor of 0.5 for threatened or depleted stocks or stocks of unknown status was determined based on the assumption that the coefficient of variation of the mortality estimate is equal to or less than 0.3. If the CV is greater than 0.3, the recovery factor should be decreased to: 0.48 for CVs of 0.3 to 0.6; 0.45 for CVs of 0.6 to 0.8; and 0.40 for CVs greater than 0.8.

Recovery factors could also be increased in some cases. If mortality estimates are known to be relatively unbiased because of high observer coverage, then it may be appropriate to increase the recovery factor to reflect the greater certainty in the estimates. Thus, in an instance where the observer coverage was 100% and the observed fishery was responsible for virtually all fishery mortality on a particular stock, the recovery factor for a stock of unknown status might be increased from 0.5 (reflecting less concern about bias in mortality, but continued concern about biases in other PBR parameters and errors in determining stock structure). Recovery factors of 1.0 for stocks of unknown status should be reserved for cases where there is assurance that N_{min}, R_{max}, and the kill are unbiased and where the stock structure is unequivocal.

Annual Human-caused Mortality and Serious Injury

A summary of all human-caused mortality and serious injury should be provided in each Report as the first paragraph under "Annual human-caused mortality and serious injury." This summary should include information on all mortality and serious injury (e.g., U.S. commercial fishing, other fishery mortality from recreational gear and foreign fleets, vessel strikes, power plant entrainment, shooting, scientific research, after-action reports from otherwise authorized activities, etc.).

The Reports should contain a complete description of what is known about current human-caused mortality and serious injury. Information about incidental fisheries mortality should be provided, including sources such as observer programs, logbooks, fishermen's reports, strandings, and other sources, where appropriate. It is expected that this section of the Reports will include all pertinent information that is subsequently used to categorize fisheries under Sect. 118. Therefore, any additional information that is anticipated to be used to categorize a fishery should be provided here.

If mortality and serious injury estimates are available for more than one year, a decision will have to be made about how many years of data should be used to estimate annual mortality. There is an obvious trade-off between using the most relevant information (the most recent data) versus using more information (pooling across a number of years) to increase precision and reduce small-sample bias. It is inappropriate to state specific guidance directing which years of data should be used, because the case-specific choice depends upon the quality and quantity of data. Accordingly, mortality estimates could be averaged over as many years as necessary to achieve statistically unbiased estimation with a CV of less than or equal to 0.3, but estimates should usually not be averaged over a time period of more than the most recent 5 years for which data have been analyzed. However, information more than 5 years old should be used if it is the most appropriate information available in a particular case.

In some cases it may not be appropriate to average over as many as 5 years even if the CV of an estimate is greater than 0.3. For example, if within the last 5 years the fishery has changed (e.g., fishing effort or the mortality rate per unit of fishing effort has changed), it would be more appropriate to use only the most recent relevant data to most accurately reflect the current level of annual mortality. When mortality is averaged over years, an un-weighted average should be used, because true mortality rates vary from year-to-year. When data are insufficient to overcome small-sample bias of mortality estimates for purposes of comparing the estimates to PBR (see Technical Details), a statement acknowledging this elevated potential for small-sample bias should accompany mortality estimates in the Reports.

In some cases, mortality and serious injury occur in areas where more than one stock of marine mammals occurs. When biological information (e.g., genetics, morphology) is sufficient to identify the stock from which a dead or seriously injured animal came, then the mortality or serious injury should be associated only with that stock. When one or more deaths or serious injuries cannot be assigned directly to a stock, then those deaths or serious injuries may be partitioned among stocks within the appropriate geographic area, provided there is sufficient information to support such partitioning (e.g., based on the relative abundances of stocks within the area). When the mortality and serious injury estimate is partitioned among overlapping stocks, the Reports will contain a discussion of the potential for over- or under-estimating stock-specific mortality and serious injury. In cases where mortality and serious injuries cannot be assigned directly to a stock and available information is not sufficient to support partitioning those deaths and serious injuries among stocks, the total unassigned mortality and serious injuries should be assigned to each stock within the appropriate geographic area. When deaths and serious injuries are assigned to each overlapping stock in this manner, the Reports will contain a discussion of the potential for over-estimating stock-specific mortality and serious injury.

A summary of mortality and serious injury incidental to U.S. commercial fisheries should be presented in a table, providing the name of the fishery, the current number of vessels, and for each appropriate year, observed mortality, estimated extrapolated mortality and serious injury and its CV, and percent observer coverage in that year, with the last column providing the average annual mortality estimate for that fishery. Because U.S. commercial fisheries or foreign fisheries within the U.S. EEZ are subject to regulation under MMPA section 118, mortality and serious injury from such fisheries should be clearly separated from other fishery-related mortality (e.g., mortality incidental to recreational fishing or foreign fishing beyond the U.S. EEZ) in the Reports. Information should be provided (in either the table or the text) about the number of deaths and the number of injuries, and how many of the injuries are "serious" (i.e., likely to result in death).

It is often difficult to determine if an injury is serious or not, but outcomes of a NMFS technical workshop in 2007 (Andersen et al. 2008) to differentiate serious from non-serious injury for marine mammals provides useful guidance, and NMFS published its draft national policy on this issue on 18 July 2011 (76 FR 42116). Stocks that have estimated known mortality (not including injuries) that is less than PBR but have total estimated mortalities and injuries that is greater than PBR (or similarly which have estimated known mortality that is less than 10% of PBR but have total estimated mortalities and injuries that is greater than 10% of PBR) should be clearly identified. Determining which injuries are serious will be necessary for such stocks. If injuries have been determined to be serious, the Report should indicate how this determination was made.

There is a general view that marine mammal mortality information from logbook or fisher report data can only be considered as a minimum estimate of mortality, although exceptions may occur. Logbook or fisher report information can be used to determine whether the minimum mortality is greater than the PBR (or greater than 10% of the PBR), but it should not be used to determine whether the mortality is less than the PBR (or 10% of the PBR). Logbook data for fisher reports should not be used as the sole justification for determining that a particular stock is not strategic or that its mortality and serious injury rate is insignificant and approaching zero rate.

For fisheries without observer programs, information about incidental mortality and serious injury from logbooks, fishermen's self-reports, strandings, and other sources should be included where appropriate. Such information should be presented in brackets to distinguish it from estimates of total mortality and serious injury in the fishery. If such information is not included in the table, but reports such as fishermen's self-reports are available, those reports should be described in the text and any concern with the quality of that report should be noted. Fishermen's self-reports of mortality or injuries should not be included if the fishery was observed and incidental mortality and serious injury was estimated based on observer records and associated coverage. All Category I and II fisheries listed as causing mortality or serious injury to a stock included in the MMPA List of Fisheries should be listed in the table with as much information as possible. Mortality and serious injury by those fisheries not regulated under MMPA section 118 (i.e., incidental to foreign fisheries or recreational fisheries), should be distinguished from mortality and serious injury incidental to fisheries subject to section 118. Further guidance on averaging human-caused mortality across years and across different sources of mortality can be found in the Technical Details section of these guidelines.

When including strandings and serious injury determinations as a significant component of the measure of annual human-caused mortality, the following language should be added to the Report:

> "It is important to stress that this mortality estimate results from an actual count of verified human-caused deaths and serious injuries and should be considered a minimum. Published studies attempting to evaluate potential bias in estimating human-caused mortality for numerous marine mammal species found that carcass counts accounted for < 1% to 17% (2% on average) of human-caused deaths, amounting to gross underestimates of mortality in those cases (Williams et al. 2011, Conservation Letters 4:228-233)."

Because many stocks are subject to human caused mortality or serious injury that is unmonitored or not fully quantified, authors of the Reports should add a sub-section of the Human-Caused Mortality and Serious Injury section to include a summary of the most important potential human-caused mortality or serious injury that are not quantified (e.g., fisheries that have never been observed, or have not been observed recently, and ship strikes). The Reports should summarize what are thought to be the most important unquantified or undocumented human-caused mortality or serious injury interactions so that readers realize the key sources of potential human-caused mortality and serious injury (e.g., fisheries that use gear that has a high probability of taking the species that have a large degree of overlap with the distribution of the stock, and where the fishing effort may be sufficient to result in substantial incidental mortality or serious injury). If there are no major known sources of unquantifiable human-caused mortality or serious injury, this should be explicitly stated.

Mortality Rates

Sec. 118 of the 1994 MMPA Amendments reaffirmed the goal set forth in the Act when it was enacted in 1972 that the take of marine mammals in commercial fisheries is to be reduced to insignificant levels approaching zero mortality and serious injury rate, and further requires that this goal be met within 7 years of enactment of the 1994 Amendments (April 30, 2001). This fisheries-specific goal is referred to as the "zero mortality rate goal" (ZMRG). The Reports are not the vehicle for publishing determinations as to whether a specific fishery has achieved the ZMRG. A review of progress towards the ZMRG for all fisheries was submitted to Congress in August 2004.

However, Sec. 117 of the amended MMPA requires that stock assessment reports include descriptions of fisheries that interact with (i.e., kill or seriously injure) marine mammals, and these descriptions must contain "an analysis stating whether such level is insignificant and is approaching a zero mortality and serious injury rate." As a working definition for the Reports, this analysis should be based on whether the total mortality for a stock in all commercial fisheries with which it interacts is less than 10% of the calculated PBR for that stock. The following wording is recommended:

“The total fishery mortality and serious injury for this stock is (or is not) less than 10% of the calculated PBR and, therefore, can (or cannot) be considered to be insignificant and approaching a zero mortality and serious injury rate.”

Status of Stocks

This section of the Reports should present a summary of 4 types of "status" of the stock: (1) current legal designation under the MMPA and ESA, (2) status relative to OSP (within OSP, below OSP, or unknown), (3) designation of strategic or non-strategic, and (4) a summary of trends in abundance and mortality. Authors should synthesize descriptions of levels of uncertainties in the Report sections on Stock Definition and Geographic Range, Elements of the PBR Formula, Population Trend, and Annual Human-Caused Mortality and Serious Injury, including an evaluation of the consequences of these uncertainties on the assessment of the stock’s status.

Stocks that have evidence suggesting at least a 50% decline, either based on previous abundance estimates or historical abundance estimated by back-calculation, should be noted in the Status of Stocks section as likely to be below OSP. The choice of 50% does not mean that OSP is at 50% of historical numbers, but rather that a population below this level would be below OSP with high probability. Similarly, a stock that has increased back to levels pre-dating the known decline may be within OSP; however, additional analyses may determine a population is within OSP prior to reaching historical levels.

The MMPA requires a determination of a stock's status as being either strategic or non-strategic and does not specify a category of unknown. If abundance or human-related mortality levels are truly unknown (or if the fishery-related mortality level is only available from logbook data), some judgment will be required to make this determination. If the human-caused mortality is believed to be small relative to the stock size based on the best scientific judgment, the stock could be considered as non-strategic. If human-caused mortality is likely to be significant relative to stock size (e.g., greater than the annual production increment) the stock could be considered as strategic. Likewise, trend monitoring can help inform the process of determining strategic status. In cases where information on sources of human-caused mortality and serious injury is insufficient to make a determination that "the level of human-caused mortality and serious injury is not likely to cause the stock to be reduced below its optimum sustainable population" [MMPA Section 117 (a) (5) (A)], the status of the stock should be categorized as strategic in accordance with Section 117 (a) (5) (B). For example, if sample sizes from scientific observer programs are too small to overcome small-sample bias in mortality estimation relative to PBR (see Technical Details), then mortality estimates of zero would not constitute sufficient information for determining a stock to be non-strategic.

The MMPA has a definition of a strategic stock as one "which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the Endangered Species Act of 1973 [16U.S.C. 1531 et seq.] within the foreseeable future" (Sec 3 (19)(B)). Under this definition, a stock shall be designated as strategic if it is declining and has a greater than 50% probability of a continuing decline of at least 5% per year. Such a decline, if not stopped, would result in a 50% decline in 15 years and would likely lead to the stock being listed as threatened. The estimate of trend should be based on data spanning at least 8 years. Alternative thresholds for decline rates and duration, as well as alternative data criteria, may also be used if sufficient rationale is provided to indicate that the decline is likely to result in the stock being listed as threatened within the foreseeable future. Stocks that have been designated as strategic due to a population decline may be designated as non-strategic if the decline is stopped and the stock is not otherwise strategic.

The MMPA requires for strategic stocks a consideration of other factors that may be causing a decline or impeding recovery of the stock, including effects on marine mammal habitat and prey, or other lethal or non-lethal factors. Therefore, such issues should be summarized in the Status section for all strategic stocks. If substantial issues regarding the habitat of the stock are important, a separate section titled "Habitat Issues" should be used. If data exist that indicate a problem, they should be summarized and included in the Report. If there are no known habitat issues or other factors causing a decline or impeding recovery, this should be stated in the Status section.

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2. Technical Details

In this section, technical details are given for making appropriate calculations of PBR and mortality. The first section provides details on precision and rounding issues. The second section provides details for combining more than one abundance estimate for calculating $N_{min.}$ The third section contains details for calculating the estimate of annual human caused mortality and its associated variance.

Precision and Rounding

The following rules on precision and rounding should be applied when calculating PBR and other values:

(a) N (the abundance estimate), CV(N), R_{max}, and F_r should be reported in the Report to whatever precision is thought appropriate by the authors and involved scientists, so long as what is reported is exactly what the PBR calculation is based on.
(b) PBR should be calculated from the values for (a) to full precision, and not be calculated from an intermediary rounded off N_{min}. However, N_{min} should be reported as a rounded integer.
(c) PBR and mortality should be reported with one decimal place if they are below 10. Otherwise, PBR and mortality should be reported as a rounded integer.
(d) If PBR and mortality round to the same integer, the Report will report both values to the precision necessary to determine which is larger. This would also be done if 10% of PBR and mortality round to the same integer.

Computation of Average Abundance and its Variance

When estimates of abundance are available for more than one year or from more than one source in the same year, it may be appropriate to combine those estimates into an average abundance for the time period in question. It was agreed that a weighted mean was probably the most appropriate average to use, where the weights are equal to the inverse of the associated variance:

$$mean(a_1, a_2, \ldots a_n) = a = \sum_{i=1}^{n} w_i\, a_i \quad ,$$

where:

$$w_i = \frac{1/var(a_i)}{\sum_{j=1}^{n} 1/var(a_j)} \quad .$$

The variance of a weighted mean of several abundance estimates is calculated as:

$$var(a) = w_1^2 var(a_1) + w_2^2 var(a_2) + \ldots w_2^2 var(a_n) = \sum_{i=1}^{n} w_i^2 var(a_i) \quad .$$

Finally, the variance is parameterized as a CV in the provided equation for calculating N_{min}. The CV is calculated as:

$$CV(a) = \frac{\sqrt{var(a)}}{a}$$

Computation of Average Human-Caused Mortality and its Variance

When estimates of human-caused mortality and serious injury (called here "mortality") are available for more than one year and/or from more than one source, such as a fishery, it is necessary to calculate an estimate of the mean annual mortality along with its associated variance (or CV). The following section provides guidelines for doing this. For convenience, the section refers to averaging the incidental by-catch of fisheries, but the guidelines apply equally well to estimates of human-caused mortality from other sources.

<u>Calculating the overall mean annual by-catch</u>
First, it was agreed that it was most appropriate for the bycatch estimates from a fishery to be averaged UN-WEIGHTED across years, as the true bycatch might be different in each year, and thus is not stationary. This is just the simple average of the available estimates of by-catch. If estimates are available from more than one fishery, a mean annual by-catch from each fishery should be calculated first, and then the annual mean from each fishery should be summed to calculate an overall estimate of the mean annual by-catch.

<u>Calculating the coefficient of variation (CV) of the mean annual by-catch of a single fishery</u>
There are two potential methods for calculating the CV or variance of the mean annual by-catch of a single fishery. Method 1 involves using standard statistical formulas for combining the variances of the individual yearly by-catch estimates (assuming they are available). Method 2 involves estimating the variance empirically from the 2-5 years of point estimates of by-catch, which is done by calculating the standard deviation of the 2-5 mortality estimates and dividing it by the square root of *n*, where *n* is the number of years available. Both methods are valid. However, two points favor Method 1.

First, because the true bycatch might be different in each year, and thus is not stationary, estimating the variance using Method 2 above could over-estimate the true variance of the estimates of bycatch, and this positive bias would be related to how much the bycatch truly varied from year to year independent of observation error.

Second, Method 1 is likely to give a more precise estimate of the variance because it has more degrees of freedom. Using Method 2 involves estimating the variance from a sample size of just 2-5, and ignores the information that is known about the precision of each individual estimate. Obviously, Method 2 is the only method that can be used if there are no estimates of the variance of the bycatch estimates available. Method 1 is the recommended method if the estimates of by-catch in each year do have an estimated variance (or CV).

Method 1

Table 1 outlines the computations needed for estimates of average by-catch mortality by *f* fisheries operating over *n* years. Table 2 gives an example computation for f=3 fisheries operating over a horizon of n=3 years and all of the estimates are non-zero. Most variance estimators will provide an estimate of 0 for the variance when the estimated mortality is zero; however, the true variance is non-zero. In this case, a more realistic estimate of the variance can be developed by averaging the variances for those years which have a positive variance. The variance computations in Table 1 are simply modified by dividing by the square of the number of years with a non-zero variance. The computation of the average is unaffected with the zero included in the average (Table 3). In certain circumstances a fishery may have been operating but was not monitored for mortality. Missing estimates should be dropped both from the calculation of the average and the variance (Table 4).

Method 2

In Method 2 the only change is in how the variance is calculated for the estimate of average by-catch mortality for each fishery over *n* years. In Method 2 the variance of the average by-catch is estimated empirically from the several point estimates of by-catch available from different years. This is done by calculating the variance of those estimates and dividing it by *n*, where *n* is the number of years used in calculating the average:

$$var(m_{i.}) = \frac{\sum_{j=1}^{n} \frac{(m_{ij}-m_{i.})^2}{n-1}}{n} .$$

The above formula would thus be substituted for the formula for $var(m_{1.})$ presented in Table 1. The second step of combining variances across fisheries is identical to Method 1.

Table 1. Computation table for average mortality for n years with f fisheries. The mortality estimate for fishery I during year j is m_{ij} and the corresponding variance estimate is v_{ij}. The estimated total mortality for year j is $m_{.j}$, the sum of mortality estimates for each fishery and the variance is $v_{.j}$, the sum of the variances. The average mortality for fishery I is $m_{I.}$ and its variance is $v_{i.}$, which is the sum of the variances for each year within the fishery divided by the number of years (n) squared.

Fishery	Year 1	Year 2 ...	Year n	Average
1	m_{11} var(m_{11})	m_{12} var(m_{12})	m_{1n} var(m_{1n})	$m_{1.} = \sum_{j=1}^{n} m_{1j}/n \quad var(m_{1.}) = \sum_{j=1}^{n} var(m_{1j})/n^2$
2 . .	m_{21} var(m_{21})	m_{22} var(m_{22})	m_{2n} var(m_{2n})	$m_{2.} = \sum_{j=1}^{n} m_{2j}/n \quad var(m_{2.}) = \sum_{j=1}^{n} var(m_{2j})/n^2$
f	m_{f1} var(m_{f1})	m_{f2} var(m_{f2})	m_{fn} var(m_{fn})	$m_{f.} = \sum_{j=1}^{n} m_{fj}/n \quad var(m_{f.}) = \sum_{j=1}^{n} var(m_{fj})/n^2$
Total				$m_{..} = \sum_{i=1}^{f} m_{i.} \quad var(m_{..}) = \sum_{i=1}^{f} var(m_{i.})$

Table 2. Example computation of average mortality and its variance for 3 fisheries over 3 years.

		Year			
Fishery		**1**	**2**	**3**	**Average**
1	m	10	3	19	10.67
	v	4	2	8	1.56
2	m	2	13	6	7.00
	v	2	14	4	2.22
3	m	6	33	5	14.67
	v	8	23	4	3.89
Total	m				32.33
	v				7.67

Table 3. Example computation of average mortality and its variance for 3 fisheries over 3 years when some estimates are zero.

		Year			
Fishery		**1**	**2**	**3**	**Average**
1	m	10	0	19	9.67
	v	4	0	8	3.00
2	m	2	13	6	7.00
	v	2	14	4	2.22
3	m	0	0	5	1.67
	v	0	0	4	4.00
Total	m				18.33
	v				9.22

Table 4. Example computation of average mortality and its variance for 3 fisheries over 3 years when some estimates are zero and others are missing.

		Year			
Fishery		**1**	**2**	**3**	**Average**
1	m		0	19	9.50
	v		0	8	8.00
2	m	2		6	4.00
	v	2		4	1.50
3	m	0	0	5	1.67
	v	0	0	4	4.00
Total	m				15.17
	v				13.50

Incorporating uncertainty in population growth or decline into PBR calculations

If the population growth rate is unknown, and insufficient survey data exist to project N_{min} from a trend analysis, then uncertainty in population size can be projected based on the assumption that any population growth rate between +10% and -10% per year is equally likely (corresponding to multiplicative population growth rates of 1.10 and 0.90). N_{min} can be calculated as usual (as the lower 20th percentile of the abundance estimate) if this uncertainty in growth is taken into consideration. A sustained decline of 10% per year has been observed for Steller sea lions, which is the basis for this choice for a feasible rate of decline. Rates of increase of 10% per year may not be sustainable for all marine mammal populations, but we use this upper bound for computational simplicity (symmetrical +/- 10% rates) and to assume stable (zero) median population growth. The median should not change since we are not assuming a net growth or decline, but rather we only wish to project uncertainty.

Let the annual multiplicative growth rate, λ, be distributed with a uniform (rectangular) distribution between 0.90 and 1.10, i.e.,

$$\lambda \sim R(0.90,1.10)$$

The analytical standard deviation of this distribution for λ can be estimated as

$$SD(\lambda) = (1.10 – 0.90) / \sqrt{12}$$

Because the expected value of λ is equal to 1.0, the coefficient of variation is equal to the standard deviation:

$$CV(\lambda) = SD(\lambda) = 0.2/\sqrt{12}$$

The population size at time t in the future (N_t) is equal to the initial population estimate (N_0) times λ^t

$$N_t = N_0 * \lambda^t$$

Assuming that the population growth rate is constant, the CV of λ^t can be approximated as

$$CV(\lambda^t) = t * CV(\lambda) = t * 0.2/\sqrt{12},$$

which is illustrated in Figure 1.

Therefore, the CV of N_t can be approximated from the CVs of the original abundance estimate and λ^t as:

$$CV(N_t) = \sqrt{[\, CV^2(N_0) + CV^2(\lambda^t)\,]},$$

where:

$CV^2(N_0)$ is estimated empirically as the square of $CV(N_0)$, and

$$CV^2(\lambda^t) = [t * 0.2 / \sqrt{12}]^2$$

N_{min} should be calculated at the 20th percentile of the distribution of N_t using the usual formulae, using the point estimate for $N_t = N_0$ and $CV(N_t)$.

It is important to note that this method does not assume that the population is declining. Rather it is based on the presumption that the population growth rate is uncertain and that any value between +/-10% is equally feasible.

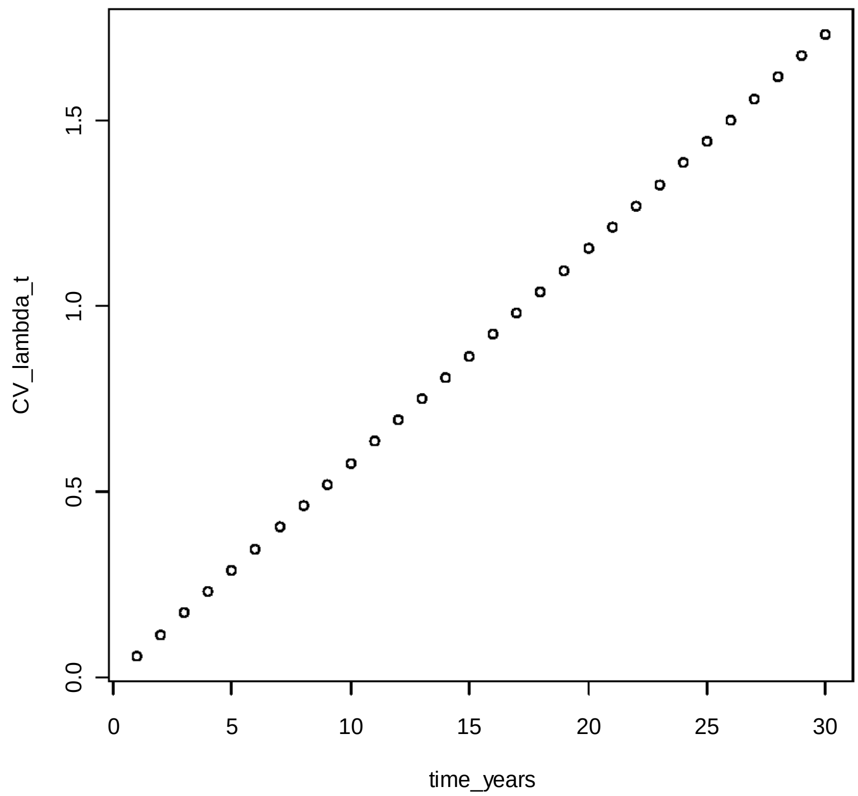

Figure 1. Estimated coefficient of variation of the multiplicative population growth (λ^t) as a function time *t* in years. The mean annual rate of population growth (λ) is assumed to have a uniform distribution between 0.90 and 1.10 (equivalent to +/- 10% change per year).

Assessing the ability to detect a precipitous decline

The metric for the ability to detect a precipitous decline is based on the objective of detecting 80% of stocks that would decline by at least 50% in 15 years. The choice is based on the MMPA goal to maintain stocks at Optimum Sustainable Population (OSP) level that would be at least 50% of historical numbers (i.e., a 50% decline would certainly mean a population was below OSP). Although a Bayesian approach would be better than a hypothesis testing approach and should be encouraged, a hypothesis testing approach is given here for the practical reason that a table could be easily created for use with typical SAR data (CVs and survey interval). Statistical power is not identical to probability, but we chose to interpret the 80% objective above as having a statistical power of 0.8. The significance criterion (alpha) is set at 0.25, which was agreed by GAMMS III meeting members. An alpha of 0.25 equates with a willingness to falsely say in 25% of cases that a population is declining. Note, however, that identifying a potential precipitous decline does not imply a regulatory consequence but rather may result in further investigation as to whether there really is a problem (perhaps more or more precise surveys). The Status of Stock section should explicitly state whether a precipitous decline can or cannot be detected given these criteria.

The program TRENDS (Gerrodette, available online at http://swfsc.noaa.gov/textblock.aspx?Division=PRD&ParentMenuId=228&id=4740) was used to calculate threshold values for CVs to achieve power = 0.8. A number of other assumptions are required:

- Exponential decline of 5%/year
- One-tailed t-test (only testing for a decline)
- equal survey intervals
- CV is proportional to 1/sqrt(N) , where N = best estimate of stock abundance

The time period is 15 time intervals (so the entry in TRENDS is for 16 years). Thus, for a survey interval of 5 years there would be 4 surveys at year 0, 5, 10 and 15. This accounts for the apparently odd result in Table 5 where the threshold CV is not monotonically increasing with increasing survey interval. For intervals of 3 and 5 the entire 15 years of decline are accounted for in the survey. For the interval of 4, the last survey occurs in year 13 thus capturing a smaller total decline and requiring a more precise estimate (lower CV) to detect the decline.

Table 5. Threshold values for CVs to detect a 50% decline in 15 years (corresponding to 5% decline per year) with a power of 0.80 and alpha = 0.25. A stock would need a smaller CV than the threshold value to be detected as declining.

Survey interval (yrs)	Max CV
1	0.65
3	0.40
4	0.29
5	0.35
8	0.18

Guidelines for minimum observer sample size requirements
(Avoiding small-sample bias when PBR is small)

Table 6. Recommended data levels to attain approximately unbiased estimation of average annual fisheries-related mortality and serious injury, relative to PBR (i.e., if true annual bycatch = PBR). "Approximately unbiased" implies median absolute bias < 25%. The top table recommends minimum observer coverage (annual average), given a certain PBR and level of data pooling (years of information combined). The bottom table recommends minimum levels of data pooling, given a certain PBR and observer coverage. If true bycatch = PBR and sampling effort is below the recommended levels, *median* bias is always negative (i.e., true bycatch > estimate), but the combination of *very* limited sampling (≤5% coverage, ≤ 5 yrs data pooling) and *very* low bycatch (e.g., 1/yr) generates bimodal estimation bias, whereby bycatch is always either underestimated (if no bycatch is observed) or overestimated (if ≥ 1 bycatch event is observed).

	Observer program length (years)								
PBR	1	2	3	4	5	6	7	8	9
1	80%	40%	30%	30%	20%	15%	15%	10%	10%
2	40%	20%	15%	10%	10%	7.5%	7.5%	5%	5%
3	30%	15%	10%	7.5%	7.5%	5%	4%	4%	3%
4	20%	10%	7.5%	5%	4%	4%	3%	3%	3%
5	20%	7.5%	7.5%	4%	4%	3%	3%	2%	2%
6	15%	7.5%	5%	4%	3%	3%	2%	2%	2%
7	15%	7.5%	4%	3%	3%	2%	2%	2%	2%
8	10%	5%	4%	3%	2%	2%	2%	2%	2%
9	10%	5%	3%	3%	2%	2%	2%	2%	1%

Required observer coverage

	Observer coverage											
PBR	1%	2%	3%	4%	5%	7.5%	10%	15%	20%	30%	40 - 70%	80%
1	Always biased						8	6	4	3	2	1
2	Always biased				8	6	4	3	2	2	1	1
3	Always biased		9	7	6	4	3	2	2	1	1	1
4	Always biased		7	5	4	3	2	2	1	1	1	1
5	Always biased	8	6	4	4	3	2	2	1	1	1	1
6	Always biased	7	5	4	3	2	2	1	1	1	1	1
7	Always biased	6	4	3	3	2	2	1	1	1	1	1
8	Always biased	5	4	3	2	2	1	1	1	1	1	1
9	9	5	3	3	2	2	1	1	1	1	1	1

Required years of data pooling

3. Descriptions of U.S. commercial fisheries

Fisheries table in each stock assessment report

Sample incidental fisheries mortality table to be included in stock assessment reports. Each fishery noted as interacting with a stock should be included in the table, even if little information is available. Information on the number of incidental injuries and which injuries should be considered serious should be provided in either the table or the text, if appropriate. See discussion in 5.2 of Wade and Angliss (1997).

Table 7. Summary of incidental mortality of stock ___ due to commercial fisheries from 1990 through 1994 and calculation of the mean annual mortality rate. Mean annual mortality in brackets represents a minimum estimate from logbooks or MMPA reports.

*Note -- numbers indicated with an asterisk are optional -- different preferences have been expressed in different regions.

Fishery Name [1]	Years	Current est. # of vessels	Data Type	Range of Observer Coverage	Observed Mort. (in given yrs.)	Estimated Mort. (in given yrs.)	Mean Annual Mort.
groundfish trawl fishery 1	90-94	490	obs data	53-74%	13, 13, 15, 4, 9	13, 19, 21, 6, 11	14 (0.32)
groundfish trawl fishery 2	90-94	490	obs data	33-55%	2, 0, 0, 1, 1	4, 0, 0, 3, 3	2 (0.24)
longline fishery 1	90-94	1064	obs data	23-55%	1, 0, 0, 1, 0	2, 0, 0, 4, 1	1.4 (0.15)
drift gillnet fishery 1	90-91	509	obs data	4-5%	0, 2	0, 29	14.5 (0.42)
Observer program total							31.9 (0.xx)
set gillnet fishery 1	90-93	120	log book	n/a	0, 1, 1, 1	n/a	[≥.75]*
set gillnet fishery 2	90-93	1187	log book	n/a	0, 0, 0, 2	n/a	[≥.5]*
longline fishery 2	94	213	mmpa reports	n/a	1	n/a	[≥ 1]*
Minimum total annual mortality							≥ 34.2*

[1] The name should be consistent with fishery names in the List of Fisheries.

General information about a fishery (not stock-specific)

Information to provide

As discussed at the GAMMS workshop, information on U.S. commercial fisheries should be included either within each Report, as an appendix, or as a companion document. Information on U.S. commercial fisheries was collected during the preparation of the Environmental Assessment for the proposed regulations implementing Sec. 118 (NMFS, 1994). The following information, which was provided for each fishery whenever possible, has direct relevance to managing incidental serious injuries and mortalities of marine mammals:

Fishery name: A description of those fisheries that are classified in Category I or II in the LOF, and those fisheries in Category III that have experienced incidental mortality and serious injury of marine mammals should be provided. The Category of the fishery in the List of Fisheries should be specified in the text.

Number of permitholders: NMFS is required by the MMPA to provide the number of permitholders in each fishery included in the List of Fisheries. Information on the number of permitholders in federal fisheries can often be found in recent amendments to Fishery Management Plans. Information on fisheries that occur within state waters but are managed via an interstate commission may be found in interstate fishery management plans. Information on state fisheries that are managed by individual states can typically be found by contacting the state office responsible for licensing commercial fishing vessels.

Number of active permitholders: Because not all licensed commercial fishers participate actively in each fishery, the number of active permitholders may be different than the number of actual permitholders in a fishery. This is particularly true for fisheries that operate in state waters.

Total effort: Provide an estimate of the total fishing effort, in the number of hours fished, for each fishery. This information is typically available only for fisheries that are both federally managed and observed.

Geographic range: Provide a description of the geographic range of the fishery. The description of the geographic range of the fishery should include any major seasonal changes in the distribution of the fishing effort.

Seasons: Describe the seasons during which the fishery operates.

Gear type: Describe the gear type used in the fishery as specifically as possible. Include mesh size, soak duration, trawl type, depth of water typically fished, etc if the information is available.

Regulations: Indicate whether the fishery is managed through regulations issued by the federal government, interstate fishery commissions, individual states, or treaty.

Management type: Indicate what types of fishery management techniques are used to manage the fishery. Some examples include limited entry, seasonal closures, and gear restrictions.

Comments: Include any additional relevant information on the fishery.

APPENDIX V. ADDITIONAL RECOMMENDATIONS OF THE GAMMS III WORKSHOP

The following recommendation was made by the participants of the GAMMS III Workshop:

(1) In order to provide the kind of information that is required to answer the question “is it plausible that there are multiple demographically independent population stocks (DIPS) within this stock?” (in the revised Definition of Stock section), it is recommended that a national workshop be held to review and summarize information that is relevant to population structure. The workshop should include participation from Headquarters and all Centers and Regions, at a minimum. It is unlikely that the workshop could feasibly review all stocks in all areas. Therefore, a list of priority stocks for consideration should be established prior to the workshop. This might efficiently be done by a Steering Committee with stocks to be reviewed proposed from each region. Stocks should be selected to cover a broad range of geographic and taxonomic diversity (e.g., it might be appropriate to review at least one stock each of phocids, otariids, large whales, delphinids, phocoenids, and ziphiids in each region (if presently recognized). Priority should be given to stocks that are geographically large, span multiple bioregions, or potentially experience substantial human-caused mortality in a portion of their range. It would also be appropriate to examine areas of U.S. waters where stocks have not previously been defined (e.g., Guam, Caribbean). The information to be reviewed should include (at least) all information used for defining stocks as recommended in the SAR Guidelines. This includes distribution and movements, acoustic call types, population trends, morphological differences, differences in life history, genetic differences, contaminants and natural isotope loads, parasite differences, and oceanographic habitat differences (such as marine bioregions). It should be emphasized that the purpose of the workshop is to review and summarize relevant information. As possible and appropriate, the workshop will propose revisions to stock structure. A major objective will be to review the information for these stocks in a manner to provide a template for how to complete review of all stocks in each region.

(2) To recognize that the population dynamics of some stocks (such as Cook Inlet beluga and Hawaiian monk seal) may not conform with the underlying assumptions on which the PBR calculation is based (relevant “PBR elements” section of the guidelines), it was recommended that the next administration MMPA reauthorization bill include the explicit option for setting R_{max} (or F_r) to zero in appropriate cases.

(3) A list of regional and F/PR points-of-contact should be created, in order to implement recommendations of Topics 5 and 9 pertaining to the timely annual transmission of information on non-serious injury, serious injury, and or death reported under LOAs and IHAs from F/PR to Regional Offices and Science Centers (including to Report authors).