SC/68A/CMP/13

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INTERNATIONAL WHALING COMMISSION

# GRAY WHALES' BODY CONDITION IN LAGUNA SAN IGNACIO, BCS, MEXICO DURING 2019 WINTER BREEDING SEASON

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## ABSTRACT

The Eastern North Pacific (ENP) gray whale (*Eschrichtius robustus*) population feeds during the summer around the Bering, Chukchi and Beaufort seas, and migrates to winter breeding and calving grounds along the Pacific coast of Baja California, in Mexico. Measurements of the whales' body condition upon arrival at the breeding grounds is an indicator of "health and reproductive condition," and indirectly is an indicator of the health of the environment. We photographed and evaluated the body condition of 569 gray whales in Laguna San Ignacio (LSI) in Baja California Sur in 2019. Photographs were sorted into two reproductive-sex categories: Females with calves, and Single whales (male or female without a calf). Condition was scored as "good", "fair", or "poor" using a method developed for the Western North Pacific (WNP) gray whales. In 2019 the proportion of single whales with "good condition" was 22.1%; "fair" 54.3% and "poor" 23.6%. The percent of "poor" body condition in 2019 is the highest observed in LSI in the last ten years. The proportion of females with calves with "good," "fair", and "poor" condition in 2019 were 50.0%, 50.0%, and 0%, respectively. The decrease of single whales in "good" condition during 2019 was not reflected in the percent of females with calves, but may be the result of a small sample of female-calf pairs photo-identified in 2019 (n=41), compared to the average of 226 pairs photo-identified each year from 2011 to 2017. We conclude that the body condition of all whales was probably similarly affected; however, comparison and correlation with environmental data from the feeding grounds is needed to understand the factors that contribute to the whales' body and reproductive condition.

*Key words: gray whale, females with calves, single whales, body condition, Laguna San Ignacio.*

## INTRODUCTION

The long-term database for gray whale abundance and photographic-identification in Laguna San Ignacio (LSI) developed during the past 14 winters (2006-2019) by the Laguna San Ignacio Ecosystem Science Program (LSIESP) and Programa de Investigación de Mamíferos Marinos, Universidad Autónoma de Baja California Sur (PRIMMA-UABCS) facilitates the detection, and assessment of trends in abundance, distribution, and fitness of gray whales during the winter breeding season.

After the unusual range-wide mortality event of 1999-2000, some indicators of the whales' body condition and reproductive health have been evident in some years, including: a reduction of breeding females that resulted in lower calf production, as noted by LeBoeuf *et al.* (2000) and Urbán *et al.* (2003); fewer sightings of female-calf pairs in the breeding areas off Baja California's Pacific coast (Urbán *et al.* 2010); and the presence of whales with physical indications of nutritional stress, or "skinny whales".

During the 14-year post-mortality-event period, cohorts of young female gray whales would be increasing each year, maturing and beginning to reproduce successfully. We would then expect to see increasing numbers of females-with calves as these new breeders replace those that were lost during the mortality

event (Swartz *et al*, 2012). The increase in the number of female-calf pairs observed in Laguna San Ignacio since 2011, supports this hypothesis (Urbán *et al.* 2011).

During the 2008 - 2011 period, the body condition of gray whales in Laguna San Ignacio was analyzed from photographic-identification (Photo-ID) images following the numerical scoring method developed for Western North Pacific (WNP) gray whales by Weller *et al*. (2002), and Bradford *et al.* (2012). The scores of "poor" body condition for single whales during this period ranged from 4.9% to 7.6%, while scores for females with calves ranged from 0% to 2.3%. While collection of Photo-ID data continued in LSI, condition analyses were suspended after the 2011 winter.

## METHODS

Each winter during the gray whales' winter breeding and calving season in LSI, Photo-ID surveys are conducted from a 23-ft long, outboard-driven boat (Panga). Additional information collected with each whale sighting included: weather conditions, geographical position, and characteristics of the gray whale groups (*i.e.*, number of whales, and the presence of calves). Whales are photographed with digital SLR cameras (*e.g.*, Nikon D7100) equipped with 70-300 mm telephoto lenses. Efforts are made to photograph the head, scapula and flank of each whale.

Digital images are stored and archived in high resolution JPEG format, every individual whale is assigned an identification number (*e.g.*, 19-0001-D-LSI), and added to the Photo-ID catalog for LSI. The body condition of each individual whale is evaluated and assigned a numerical score using the methodology developed for WNP gray whales by Weller *et al.* (2002) and Bradford *et al.* (2012). A numerical score was assigned to the post cranial area, scapular region and the lateral flanks depending on their condition. The post cranial (head) could be assigned values from 1 to 3, with 3 indicating "good condition" and 1 when it had a visible "depression" indicating a "poorer" condition. The scapular region and the lateral flank were assigned values from 1 and 2, with 2 indicating "good condition" and 1 when a subdermal protrusion of the scapula or a depression along the dorsal aspect of the lateral flanks was apparent in the photographs (Brownell and Weller 2001). These scores were used to rank each whale's condition using the Bradford *et al.* (2012) body condition table (Table 1). Whales were sorted into groups as Females with calves, or single whales (males or females without a calf).

## RESULTS

During the 2019 winter (mid-January to end of March), 47 days and 222.8 hours were spent conducting Photo-ID surveys in Laguna San Ignacio (10 days less than an average breeding season, due to the inclement weather conditions and the low number of whales in the lagoon at the end of the season (*Urbán et al.* 2019). In total 888 adult whales were photographed: 847 single whales; and 41 females with calves, which is the lowest number of female-calf pairs photo-identified in LSI since 2010 (Table 2).

Photographs suitable for condition evaluation were obtained for 569 individual whales: 529 single whales and 40 females with calves. Of these, 22.1% (n=117) of single whales and 50% (n=20) of females with calves were scored as having "good" body condition. "Fair" condition was represented by 54.3% (n=287) of single whales and 50% (n=20) of females with calves. Finally, 23.6% (n=125) of single whales and none of the females with calves had scores indicating "poor" condition, or as “skinny whales” (Table3).

It’s important to note that the percent of single whales with "poor" condition decreased as the winter breeding season progressed; at the beginning of the season (January 15 to February 15), there was a higher percentage of single whales with poor body condition 32.8%, (n= 57) compared to 19.2% (n=68) observed during the remainder of the season (February 15 to March 28 (Table 4).

Finally, after matching all the 2019 Photo-ID data from Laguna San Ignacio and the Bahía Magdalena complex to the south, 5 whales from the WNP gray whale population were identified among the ENP gray whales photographed; 2 whales were photographed in Laguna San Ignacio and 3 whales were photographed in the Bahía Magdalena region. Of these, 3 female whales were in "good" body condition, one male was in "fair" condition, and the condition of a whale of unknown sex could not be analyzed (Table 5).

## DISCUSSION

During the years following the unusual mortality event of 1999-2000, some gray whales (mostly single whales without calves) exhibited indications of nutritional stress; these were "skinny" whales with post-cranial depressions, protruding scapulae, and concave rather than convex flanks. Analysis of the Photo-ID data obtained from 2008 to 2011 revealed that the percent of single whales with "poor" condition ranged from 4.9% (n=17) in 2011 to 7.6% (n=18) in 2009.

From 2012 to 2017, gray whales exhibiting "fair" to "poor" body condition were rarely encountered, and the analysis of gray whale body condition was suspended for whales photographed in LSI. However, beginning in 2018 whales with "fair" and "poor" body condition began to re-appear in LSI, so the analysis of body condition was resumed beginning in 2018. Unfortunately, the body condition of only 35% (n=207) of the single whales photographed could be evaluated in that year, due to the lack of photographs of their post-cranial and scapular regions. Of the 207 single whales evaluated in 2018, 43.5% (n=90) were in "good" condition, 48.3% (n=100) were in "fair" condition, and 8.2% (n=17) were in "poor" condition (Table 3).

The arrival of gray whales in LSI in 2019 was delayed approximately two-weeks compared with arrival times in the previous 10-years. The whales that did arrive during the last two weeks of January to the first two weeks of February included 32.8% (n=57) of "poor" condition whales, while only 19.2% (n=68) of the whales arriving later in the season from 16 February to 28 March exhibited "poor" condition" (Table 4). This suggests that the earlier arrivals at LSI were no able to obtain sufficient food during the previous summer to sustain a "good" or "fair" body condition.

The percent 26.3% (n=125) of single whales with "poor" condition in 2019 was the highest observed in LSI during the past 10-years, and while the condition of females with calves was "good" to "fair", their abundance in 2019 was the lowest recorded the period from 2011 to 2019 following the post-mortality event (Table 3). Additional analyses of Photo-ID data obtained in 2019 from Bahía Magdalena to the south of LSI is currently in progress.

The condition of females with calves observed in 2019 did not exhibit an increase in "poor" body condition similar to that seen with the single whales. However the "good" body condition of females with calves declined from 96.8% (n=30) in 2010 to 43.8% (n=35) by 2018, and was 50% (n=20) by 2019. Similarly, reproducing female whales with "fair" body condition ranged from a low of 3.2% (n=1) in 2010 to 53.8% (n=43) in 2018, and 50% (n=20) in 2019. Both the decline in "good" condition and the increase in "fair" condition for these female whales suggests these has been a trend for declining condition in breeding females over the past 2-years.

Gray whales feed primarily in the high latitudes of the North Pacific, and Arctic regions in summer where primary production rates are high, and their invertebrate prey are most abundant. In the fall they migrate south to mid-latitude breeding areas that do not support similar amounts of prey and where the whales do not feed. Thus, they must feed sufficiently during the summer months to develop sufficient body fat and blubber to make their annual southward migration, breed and birth their calves during the winter, and then make a return migration to the feeding ground the following spring. These migrations and winters between summer feeding are energetically costly, especially for breeding females that must feed sufficiently during the summer to maintain their own body condition while pregnant, birth their calf, and nurse that calf until weaned. In their classic monograph, Rice and Wolman (1971) reported a 30% weight loss between gray

whales, including females, harvested during their fall southward migration to the breeding-calving grounds and those harvested during their spring northward migrations to the feeding grounds.

It is not unreasonable to suspect that if reproductively active females cannot obtain sufficient food during the summer, either because the sea ice conditions limit the time and areas available to feed during the summer (Perryman *et al*. 2002), and/or prey abundance is reduced or not available, reproductive females may not have sufficient energy reserves to successfully bring a calf to term and migrate into and out of the southern breeding and calving areas in Baja California, Mexico. Depending on the their energy stores coming off the summer feeding grounds, and the rate of depletion of their body fat and blubber, successful birthing and survival of calves, and the survival of the females becomes questionable during periods of limited resources.

If there is insufficient food and reduced energy stores for a pregnant female to bring a calf to term, birth and nurse that calf, an individual female whale's calving interval may be expected to increase from the typical 2-year reproductive cycle for gray whales with each year she is not able to reproduce. Support for such a reduction in reproduction in recent years comes from the analysis of Photo-ID records for LSI that identified 5 breeding females with regular 2-year calving intervals that were expected to have a calf in 2019, but they were observed without calves that year. Two additional females with previous 2-year calving intervals have increased breeding intervals of 3-years (Table 6).

Perhaps during the past decade, the ENP gray whale population has reached the current "carrying capacity" of its high-latitude feeding areas, and/or that the capacity for the marine environment to produce gray whale prey has changed. Recent fluctuations in ocean environment conditions associated with warmer-than-normal sea temperatures in the North Pacific/Gulf of Alaska may disrupt seasonal primary production during the summer months in the high latitudes where the gray whales feed (Belles 2016). This could impact and even reduce the availability of seasonal food that gray whales depend on during the summer to obtain sufficient energy to survive the winter and breed successfully. Recent observations of increasing "poor" condition gray whales and low calf production in the breeding and calving lagoons suggest that finding sufficient food is becoming a problem for the gray whales.

## ACKNOWLEDGEMENTS

We wish to thank our field researchers and colleagues that assisted with the abundance and Photo-ID documentation of the gray whales in Laguna San Ignacio. We also thank The Ocean Foundation, for their support of the field work and the analysis of the results. Thanks to the Eco-Tourism Operators of Laguna San Ignacio, to Kuyima Eco-Tourismo and Searcher Natural History Tours for logistical support to sustain our field laboratory and field researchers. This research was conducted as part of the Laguna San Ignacio Ecosystem Science Program (LSIESP) under special scientific research permits No.SGPA/DGVS/013210/18 from the Subsecretaría de Gestión Para La Protección Ambiental, Dirección General de Vida Silvestre, de Mexico.

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Table 1. Body condition categories for gray whales (from *Bradford et al*., 2012)
Scored as: (Post-cranial depression =1-3; Scapula =1-2; Flank =1-2)

Good—322, 321, 32X, 312, 31X, 3X2, 3X1, 3XX;
Fair—311, 222, 221, 22X, 212, 21X, 2X2, 2X1, 2XX;
Poor—211, 122, 121, 12X, 112, 111, 11X, 1X2, 1X1, 1XX;
Unknown—X22, X21, X2X, X12, X11, X1X, XX2, XX1, XXX.

Table 2. Number of females with calves photo-identified every year In Laguna San Ignacio, BCS, Mexico from 2010 to 2019.

| Year | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| Effort (days) | 58 | 55 | 64 | 57 | 66 | 67 | 56 | 59 | 59 | 47 |
| No. Females with calves | 37 | 196 | 233 | 190 | 209 | 287 | 249 | 218 | 86 | 41 |

Table 3. Numbers and percentages of gray whale base on their body condition for Laguna San Ignacio, BCS, Mexico (2008-2011 and 2018-2019)

| Single whales/year | 2008 | 2009 | 2010 | 2011 | 2018 | 2019 |
|---|---|---|---|---|---|---|
| No. whales Photo-identified | 249 | 588 | 718 | 424 | 597 | 847 |
| No. whales categorized | 89 | 236 | 433 | 347 | 207 | 529 |
| Good Condition (%) | 46 (51.7%) | 119 (50.4%) | 206 (47.6%) | 221 (63.7%) | 90 (43.5%) | 117 (22.1%) |
| Fair Condition (%) | 37 (41.6%) | 99 (41.9%) | 200 (46.2%) | 109 (31.4%) | 100 (48.3%) | 287 (54.3%) |
| Poor Condition (%) | 6 (6.7%) | 18 (7.6%) | 27 (6.2%) | 17 (4.9%) | 17 (8.2%) | 125 (23.6%) |
| Females with calves | | | | | | |
| No. whales Photo-identified | 112 | 79 | 38 | 188 | 86 | 41 |
| No. whales categorized | 79 | 70 | 31 | 176 | 80 | 40 |
| Good Condition (%) | 52 (65.8%) | 52 (74.3%) | 30 (96.8%) | 124 (70.5%) | 35 (43.8%) | 20 (50%) |
| Fair Condition (%) | 27 (34.2%) | 18 (25.7%) | 1 (3.2%) | 48 (27.3%) | 43 (53.8%) | 20 (50%) |
| Poor Condition (%) | 0 | 0 | 0 | 4 (2.3%) | 2(2.5%) | 0 |

Table 4. Numbers and percentages of gray whales base on their body condition for Laguna San Ignacio, BCS, Mexico separated in two periods (Jan15-Feb15 and Feb 16-March 28).

| Periods | 15 Jan-15 Feb | 16 Feb-28 Mar |
|---|---|---|
| No. whales Photo-identified | 256 | 591 |
| No. whales categorized | 174 | 355 |
| Good Condition | 35 (20.1%) | 82 (23.1%) |
| Fair Condition | 82 (47.1%) | 205 (57.7%) |
| Poor Condition | 57 (32.8%) | 68 (19.2%) |

Table 5. Photographic identification recaptures between gray whales from Mexico (Laguna San Ignacio-LSI and Bahía Magdalena-BM areas) and Russia (Sakhalin Island region) in 2019, their sex and body condition.

| Mexico ID (LSIESP/UABCS) | Sakhalin ID (Burdin / Weller) | Sex | Body condition |
|---|---|---|---|
| 19-0466-D-LSI | 68 | Male | Fair |
| 19-0905-D-LSI-M | 29 | Female | Good |
| 19-0011-D-BM-M | 38 | Female | Good |
| 19-0013-D-BM-M | 1 | Female | Good |
| 19-0197-D-BM | 181 | Unknown | Unknown |

Table 6. Female gray whales that had breeding intervals of two years, that were expected to have a calf, but did not have a calf in 2019, and female whales that used to have 2 years breeding intervals that reached to 3 years breeding interval. (Mc-Female with calf, S- single or without a calf, --- not seen during the year).

| Id./year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|
| 13-0372-D-LSI-M | --- | Mc | S | Mc | --- | Mc | --- | S |
| 12-0033-D-LSI-M | Mc | --- | --- | Mc | --- | Mc | S | S |
| 12-0047-D-LSI-M | Mc | --- | Mc | --- | --- | Mc | --- | S |
| 14-0052-D-LSI-M | --- | --- | Mc | --- | --- | S | S | S |
| 12-0223-D-LSI-M | Mc | --- | --- | --- | --- | Mc | S | S |
| 12-0043-D-LSI-M | Mc | --- | Mc | --- | Mc | --- | --- | Mc |
| 12-0044-D-LSI-M | Mc | --- | Mc | --- | Mc | --- | --- | Mc |