Gray whales' body condition in Laguna San Ignacio, BCS, Mexico, during 2020 breeding season

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ABSTRACT

The Eastern North Pacific (ENP) gray whale (*Eschrichtius robustus*) population feeds during the summer months in the Bering, Chukchi and Beaufort seas, and migrates to winter breeding and calving grounds along the Pacific coast of Baja California, in Mexico. The assessment of gray whale body condition upon their arrival at the breeding grounds provides an indicator of the whales' "health and reproductive condition," and indirectly is an indicator of the health of the environment. Gray whales were photographed (n= 553) to evaluate body condition in Laguna San Ignacio (LSI) in Baja California Sur in 2020. Photographs were sorted into two reproductive-sex categories: Females with calves, and Single whales (males and females without a calf). The condition of each whale was scored as "good", "fair", or "poor" using a numerical method developed for the Western North Pacific (WNP) gray whales. In 2020 the proportion of females with calves in "good condition" was 70.4% (n=38); "fair" 24.1% (n=13) and "poor" 5.5%(n=3). The proportion of single whales with "good," "fair", and "poor" condition was 33%, 37%, and 30%, respectively. Compared to previous years, the proportion of single whales in "good" condition decreased during 2020, however a similar decrease was not reflected in the percent of females with calves; this may be the result of a small sample of female-calf pairs photo-identified in 2020 (n=57), compared to the average (n= 226) pairs photo-identified each year from 2011 to 2017. The percent of single whales with "poor" body condition in 2020 is the highest observed in LSI in the last eleven years. We conclude that the body condition of all whales was probably similarly affected; however, comparison and correlation with environmental data from the feeding grounds (e.g. prey availability) is needed to understand the factors that contribute to the whales' body and reproductive condition.

INTRODUCTION

The long-term database of gray whale photographs (2006-2020), maintained by the Laguna San Ignacio Ecosystem Science Program (LSIESP) and the Universidad Autónoma de Baja California Sur (UABCS) allows the assessment of the whales' distribution, abundance, reproductive and body condition during the winter breeding season. Following the Unusual

Mortality Event (UME) of 1999-2000, evidence of poor body condition was visible in some individuals whales (e.g. "skinny" whales), and low numbers of female-calf pairs were observed in the breeding lagoons during the period from 2006 to 2010 (Urbán *et al.* 2011; Martínez-Aguilar *et al.,* 2019). The reduction in the number of gray whale calves in the breeding lagoons and fewer sightings of female-calf pairs off the Pacific Coast of Baja California is believed to be the outcome of the loss of breeding females during the 1999-2000 UME (LeBoeuf *et al.,* 2000; Urbán *et al.,* 2010; Swartz *et al* 2012). The abundance of gray whale female-calf pairs observed in LSI increased during the period from 2011 to 2017 as the population recovered from the 1999-2000 UME (Swartz *et al.,* 2012, Urbán *et al.,* 2016). Female-calf pair abundance declined again from 2018-2020 and approached the low numbers observed in the years following the 1999-2000 UME. Observations of “skinny whales" also increased during this period, suggesting the whales were suffering from poor condition and nutritional stress from insufficient feeding during the summer months. In 2019 and continuing into 2020, gray whale strandings increased throughout the whales' range, prompting the U.S. National Oceanic and Atmospheric Administration (NOAA) to declare a second gray whale UME (NOAA 2020).

An analysis of gray whale body condition was conducted using photographic identification (Photo-ID) data for two time periods: 2008-2011, and 2018-2020. Whale photographs were evaluated and body condition scored using a numerical method developed for Western North Pacific (WNP) gray whales (Bradford *et al*., 2012, Weller *et al.,* 2002). Photographs of single whales and those of females with calves were evaluated as two separate groups.

METHODS

Photo-ID surveys were conducted from a 23-foot long open boat (Panga) in Laguna San Ignacio (Figure 1) during the 2018, 2019 and 2020 gray whale breeding seasons. The 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).

Photographs were taken with digital SLR cameras (Nikon D7100) equipped with 70-300 mm telephoto lens, shutter speed of 1/1000 second. When possible, photographs of each whale’s head, scapula and lateral flank were obtained. Digital images were stored, cataloged, and archived in high resolution JPEG format on portable USB-digital computer hard drives, and each individual whale was assigned an identification number (*e.g.,* 20-0001-D-LSI).

Each whale's body condition was evaluated and assigned a numerical score following the methodology of Weller *et al.* (2002) and Bradford *et al.,* (2012). A numerical value (score) was assigned for each of three principal anatomical areas; post-cranial area, scapular region, and the lateral flanks. The post cranial (head) region was evaluated on the extent of "depression" behind the blowholes, and ranked from 1 to 3, with a score of 1 being the worst or "poor" condition, to the score of 3 being the best or "good" condition (Figure 2). The scapular region and the lateral flank were similarly assigned values of 1 or 2; value of 1 when a subdermal protrusion of the scapula was visible, and a value of 2 when normal, and the flank was assigned a value of 1 when a depression along the dorsal aspect of the lateral flanks was apparent, and a value of 2 when

normal (Figure 3) (Brownell and Weller, 2001). These ranges were organized into two separate groups of whales; Female pairs-calves and individual whales.

RESULTS

The Photo-ID surveys in the 2020 winter were conducted from mid-January to March 26th, after which surveys were terminated due to the world-wide COVID-19 virus outbreak. A total of 50 days and 251.5 hours were spent photographing gray whales in LSI. A total of 9,717 photographs were taken, resulting in 489 sightings of which 696 adults whales were photographed: 639 were single whales and 57 were females with calves.

Of these 696 individual whales, photographs of the head, scapula and flank were obtained for evaluation of body condition for 553 individuals; 499 single whales and 54 females with calves. Only 33.3% (n=166) of single whales and 70.3% (n=38) of females with calves were determined to have "good" body condition. Whales in "fair" condition were 36.7% (n=183) of single whales and 24.2% (n=13) of females with calves. Finally, 30% (n=150) of single whales and 5.5% (n=3) of females with calves were in "poor" condition (Table 1).These three Females with calves with poor body condition, were observed from the beginning of March until the end of the season, in the first sightings they had an acceptable condition and later they ended up with a poor condition.

Single whales (males and females without calves) observed in the 2020 winter scored the highest percentage of "poor" body condition of all whales observed during the 2008-2011, and 2008 winters, indicating an ongoing decline in body condition of the whales (Table 1).

DISCUSSION

Following the UME of 1999-2000, some gray whales, mainly single whales (without a calf), exhibited a "skinny" appearance and indications of nutritional stress and food resource limitation (Gulland *et al.,* 2005). Previous analysis of the body condition for data obtained from 2008 to 2011 indicated that single whales with "poor" condition ranged from 7.6% in 2009 to 4.9% in 2011. After 2012 observations of whales with the poor body condition were infrequent, and subsequent analyses of whale body condition were suspended. But the reappearance in 2018 of whales in "poor" body condition justified the resumption of body condition evaluations. Unfortunately, photographs of the postcranial area and scapular region were obtained for only 35% of single whales (207 of 597) in 2018. In 2019, 64% (569 of 888) of the whales' body condition were evaluated, and in 2020, 79% (553 of 696) photo-identified whales were evaluated and body condition categorized.

The percent of single whales with “poor" body condition (30%, n= 150) in the 2020 breeding season in LSI is the highest observed for this location for any year. The body condition of females with calves in 2020 is the worst body condition percentage (5.5%, n=3) of all the years examined (Table 1). In contrast, the percent of whales in "good" condition increased from 22.1% (n= 117) in 2019 to 33% (n= 166) for single whales in 2020, and for females with calves "good" condition increased from 50% (n= 20) in 2019 to 70% (n= 38) in 2020. Compared with

the average percentages of body condition during the previous years from 2008-2011, single whales with "good" condition increased from 51.7% (n= 46) in 2008 to 63.7% (n= 221) in 2011, and then declined to 33% (n= 166) by 2020. Single whales in "fair" condition ranged from 46.2% (n= 200) to 31.4% (n= 109) during the period 2008-2011, then declined to 37% (n= 183) in 2020. Single whales in "poor" condition were 4.9% (n= 17) in 2011, and increased more than four times to 30% (n= 150) in 2020. Overall, the body condition of single whales declined continuously from 2011 to their lowest values in 2020 (Ronzón-Contreras *et al.,* 2019)

Females with calves in "good" condition ranged from 65.8% (n= 52) to 96.8% (n= 30) during the period 2008 to 2011, and increased from 43.8% (n=35) in 2018 to 70.3% (n=38) in 2020, suggesting an improving trend in breeding female condition in recent years. In contrast, female's in "poor" condition increased from 2.5% (n=2) in 2018 to 5.5% (n=3) in 2020, although sample sizes were reduced in these most recent years owing to the overall decline in female-calf pairs in the lagoon in the most recent winters (*i.e.*, 2018 - 2020).

Body condition may influence female calving-interval; if they are in "good" condition at the time that they breed on the winter breeding grounds, they may have sufficient energy to migrate from the breeding grounds to the summer feeding grounds, feed all summer while pregnant, and make the return migration and successfully birth their calves in the following winter (Perryman *et al.*, 2002). However, if they do not feed sufficiently during the summer, the southward fall migration and gestation of a calf may deplete their energy reserves and reduce their body condition sufficiency that may not be able to bring their pregnancy to term and/or birth a healthy calf. If food resources are limited, reproducing females may not be able to produce a calf every other year as is the gray whales' normal reproductive cycle (Urbán *et al.,* 2019). If food resources are limited, they may forgo reproduction for two or more years until they develop sufficient energy/condition reserves to accomplish their Fall and Spring migrations, and the birth and nurse of a calf in the winter (Ronzón-Contreras *et al.,* 2019). These possibilities would support the observed departures from the two year calving cycle for some gray whales.

For example, the Photo-ID database for Laguna San Ignacio contains 81 known breeding female whales identified during 2019 that were photographically recaptured between 2005-2018. Of those females, 5 had calving intervals of 2 years in previous years, and would have been expected to produce calves in 2020, but were observed single whales without calves. Additional known females that previously produced calves every two years, changed their calving interval to three years (Table 2). These females suggest that gray whales may forego reproduction if their condition is not sufficient to bring a pregnancy to term, and "rest" two or more years to allow their body condition to improve and increase their likelihood of producing a calf.

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TABLES AND FIGURES

Figure 1. Study area, primary gray whale winter aggregation: Laguna San Ignacio.

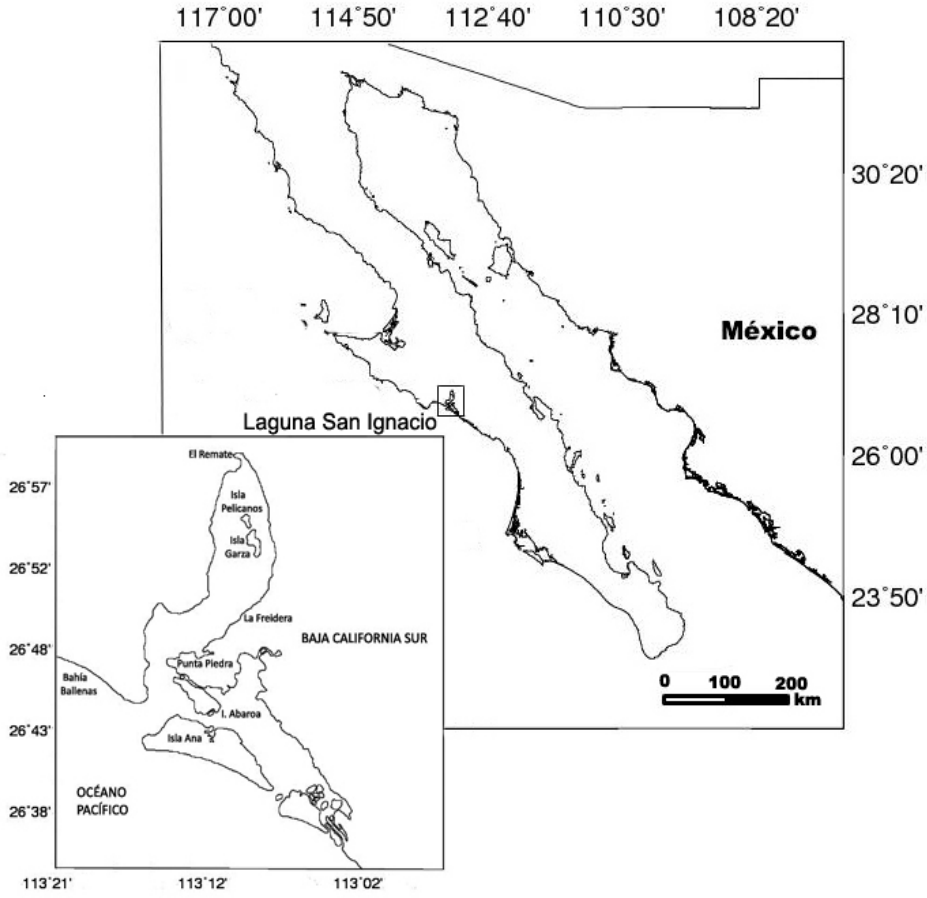

Figure 2. Example of the values assigned to determine body condition for the postcranial area. The value number 3 is for the whales without depression in the postcranial area, 2 is for moderate postcranial depression and 1 is for the significant postcranial depression.

Head/Post-craneal area

Figure 3. Example of the values assigned to determine body condition for the scapular region and dorsal-fluke. The value number 2 is for the scapula and dorsal-fluke is not visible, and 1 is for whales that see the scapula or depression on the back.

Table 1. Numbers and percentages of gray whale base on their body condition for Laguna San Ignacio, BCS, Mexico (2008-2011 and 2018-2020)

Single whales

Year	2008	2009	2010	2011	2018	2019	2020
No. whales Photo-identified	249	588	718	424	597	847	696
No. whales categorized	89	236	433	347	207	529	553
Good Condition n (%)	46 (51.7%)	119 (50.4%)	206 (47.6%)	221 (63.7%)	90 (43.5%)	117 (22.1%)	166 (33.3%)
Fair Condition n (%)	37 (41.6%)	99 (41.9%)	200 (46.2%)	109 (31.4%)	100 (48.3%)	287 (54.3%)	183 (36.7%)
Poor Condition n (%)	6 (6.7%)	18 (7.6%)	27 (6.2%)	17 (4.9%)	17 (8.2%)	125 (23.6%)	150 (30%)

Female and calf

Year	2008	2009	2010	2011	2018	2019	2020
No. whales Photo-identified	112	79	38	188	86	41	56
No. whales categorized	79	70	31	176	80	40	54
Good Condition n (%)	52 (65.8%)	52 (74.3%)	30 (96.8%)	124 (70.5%)	35 (43.8%)	20 (50%)	38 (70.3%)
Fair Condition n (%)	27 (34.2%)	18 (25.7%)	1 (3.2%)	48 (27.3%)	43 (53.8%)	20 (50%)	13 (24.2%)
Poor Condition n (%)	0	0	0	4 (2.3%)	2 (2.5%)	0	3 (5.5%)

Table 2. Gray whales that had breeding intervals of two years, that didn´t have a calf this year, and 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