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2024 GRAY WHALE ABUNDANCE IN LAGUNA SAN IGNACIO AND THE BAHÍA MAGDALENA LAGOON COMPLEX, B.C.S., MÉXICO.

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ABSTRACT

Declining gray whale body condition, low calf counts, and higher mortality rates were documented in Laguna San Ignacio (LSI) and in the Bahía Magdalena (BM) complex beginning in the winter of 2018, and were indications of the pending gray whale Unusual Mortality Event (UME) which continued from 2019 through 2023. Observations during the 2024 winter included fewer individual whales in "poor" body condition, and fewer gray whale mortalities suggesting that the UME may be slowing. However, counts of female-calf pairs were the lowest recorded since abundance surveys in these winter aggregation and breeding areas since abundance surveys began in 2006, suggesting a major decline in the reproductive capacity of this population in recent years. In LSI the highest number of single adult (non-calf) whales counted in vessel surveys during 2024 was 201 whales on 25 February, which was higher than counts observed during the previous five winters of the UME.

Counts of females with calves continued to remain low during the UME winters. In 2024 calf counts were the lowest recorded numbering fewer than 9 calves throughout the birthing period from January through February, with the highest count of only 15 female-calf pairs observed on 14 March; this high calf count included mostly calves judged by their size and coloration to 1-2 months old and immigrating late in the winter into LSI from other areas. The highest gray whale survey count in BM was obtained on 24 February in the most southerly aggregation area of Bahía Almejas and was 243 single adult whales and no female-calf pairs. In central Bahía Magdalena gray whale counts were greatest on 23 February with 35 adult whales and no female-calf pairs. In the northern Canal de Santo Domingo, a high count of 17 single whales was observed on 19 February, and a count of only 2 female-calf pairs.

Key words: gray whales, calves, skinny whales, low reproduction, Unusual Mortality Event (UME) Laguna San Ignacio, Bahía Magdalena, Santo Domingo, Bahía Almejas.

INTRODUCTION

Observations in Laguna San Ignacio (LSI) and in the Bahía Magdalena (BM) lagoon complex during the 2024 winter reproductive season were characterized by improved gray whale body condition compared to the previous five winters, low mortality rates, and, however, the lowest calf counts ever recorded in these gray whale winter aggregation areas. Observations of fewer individual whales in "poor" body condition (Lobo-Barrera *et al.* 2024), and fewer stranded dead whales in this lagoon (Martinez-Aguilar *et al.* 2024) suggest that the gray whale Unusual Mortality Event (UME) of 2019-2023 (NOAA 2023) may be slowing, but the reproductive output of the gray whale population has been significantly reduced compared to years before the UME.

Low numbers of gray whale female-calf pairs observed in LSI and BM from 2018 to 2024 were similar to the decreased calf abundances observed during the winter breeding seasons from 2007 to 2011 following a previous range-wide "unusual mortality event" (UME) from 1999 to 2000 (LeBoeuf *et al.* 2000, Gulland *et al.* 2005). Low calf counts were again observed in the wintering aggregation areas and lagoons proceeding

the gray whale UME of 2019-2023 (NOAA 2023). This range wide increase in gray whale mortality may have resulted from multiple causes, including mortality linked to killer whale predation, fishing gear entanglements, vessel strikes, and poor body condition possibly associated with limited availability to prey resources resulting from climate driven ecosystem changes in sub-Arctic and Arctic feeding areas (Christiansen *et al.* 2021, Moore *et al.* 2022).

METHODS.

Boat Surveys for Abundance Trend Estimation: Boat surveys are conducted to document seasonal trends in gray whale abundance and to estimate the minimum number of gray whales within the primary gray whale winter aggregation and breeding lagoons along the Pacific coast of Baja California during the winter breeding season (Urbán *et al.* 2003, Fig. 1). Each survey utilizes a hand-held Global Position System (GPS) device to follow a predetermined survey track line that passes through the deep-water areas (i.e., > 3-m deep) utilized by gray whales in each lagoon area. Observer and sighting protocols are specified for each lagoon's unique characteristics and are used to obtain and record whales' counts along each track line. This method allows duplication of survey effort to compare within-year survey counts along identical survey tracks in each lagoon area, and for comparison with historical counts from previous years (Jones and Swartz 1984, Urbán *et al.*, 2003).

Boat surveys are conducted from 7-8-m long outboard-powered boats (Pangas), which follow each predetermined GPS survey track line at a speed of 11-km/hr during the whale counts. Speed and course along the track line are continuously verified using a hand-held GPS. This survey speed minimized the likelihood that whales (which typically travel at 7 to 9-km/hr) do not move ahead of the survey boat and are counted more than once. It also allows observers sufficient time to detect surfacing whales along the track line (Jones and Swartz 1984).

For each survey, two pairs of observers (one pair searching to the left and one pair searching to the right sides of the boat) note the number of whales seen they pass abeam of the survey boat, thereby documenting the distribution of whale sightings along the track line. A fifth person records each sighting on printed survey forms, noting: the time of each sighting, the number of whales in each group, their direction of movement, and whether they are single whales or female-calf pairs. The recorder also notes for each portion of the survey the prevailing environmental conditions (i.e., visibility, Beaufort Sea state, wind direction, cloud cover, surface water temperature, and depth. Surveys were not conducted during or were aborted when wind and sea state conditions exceeded Beaufort 3 sea state (winds greater than 18 km/hr with consistent white caps).

By convention, "female-calf pairs" (i.e., female whales with calves of the year) are counted as a single unit, and the number of these pairs observed are equivalent to calf counts. "Single whales" refer to non-parturient females, adult males, and immature or juvenile animals. Counts of "adult whales" are the sum of all non-calf whales observed (i.e., single adult whales and female-calf pairs).

Laguna San Ignacio: Boat surveys in LSI first began in the winter of 2006 and continue to the present. Each survey follows a 30-km long GPS track line that begins at the north end of Isla Garzas in the northernmost end of the lagoon (North End Basin) to the west end of Isla Ana at Punta Holcombe at the lagoon entrance (Fig. 2). The survey track line is divided into five "zones" or segments to record the whales' distribution within the lagoon. The maximum distance from the survey track line to the 2-m depth contour along the shore is 2.5 km, and the minimum distance is 0.8 km; thus, water sufficiently deep to be inhabited by whales and both shorelines are visible to the observers at all points along the track line. Whales in the "North End Basin" (north of the survey track line) are counted from the center of this area by observers searching in 360-degrees around the stationary boat.

Bahía Magdalena: Boat surveys of gray whales in the BM lagoon complex duplicated surveys conducted in previous winters from 2016-2023. The surveys included three different areas where gray whales aggregate within the larger BM lagoon complex: Canal de Santo Domingo in the north from Boca la Soledad south to La Florida; in Bahía Magdalena's center region, west and southwest areas; and in Bahía Almejas in the south from a point in the center of the bay south of Puerto el Dátil north to the north-east of Puerto Cortés on Isla Santa Margarita (Fig. 3).

RESULTS

Laguna San Ignacio: In LSI, 11 surveys of gray whales were completed in 2024 to monitor the seasonal abundance and habitat use. Surveys began on 18 January and continued until 20 March (Table 1). The arrival of gray whales began in mid-January and was similar to that seen previous winters from 2018 to 2023. However, departure times in 2024 were approximately two weeks earlier than in the UME years from 2019 to 2023 suggesting a trend of earlier departure in 2024 than during the period of the UME (Fig. 4).

The highest count of single adult whales (breeding males and females without calves) was 201 whales obtained on the 25 February survey (Fig. 4, Table 1). The numbers of these whales were generally lower to those observed in previous winters, with maximum counts ranging from 5 during the last survey on 20 March to the highest count of 201 on 25 February.

Counts of females with calves in LSI remained low throughout the entire 2024 winter season ranging from 2 to 9 pairs during January and February, with the highest number of 15 pairs counted on 14 March (Fig. 5, Table 1). Analysis of photographic identification data from previous winters indicate that many of the female calf pairs observed in LSI at the end of the season had previously been in the Bahía Magdalena area. This “end of the season” increase of female-calf pair counts has historically occurred in LSI since the 1980’s (Jones and Swartz 1984), however it did not occur during the UME from 2019 to 2023. The 2024 female-calf pair counts in LSI are the lowest number of pairs recorder for this lagoon since the surveys began in 2006.

Bahía Magdalena: The 2024 gray whale surveys in the BM lagoon complex were conducted in three different areas during four different periods: 20-25 January, 4-6 February, 19-24 February, and 9-11 March (12-surveys in all) (Table 2). The highest counts of gray whales were obtained on 24 February in the most southerly aggregation area of Bahía Almejas with 243 adult whales and no female-calf pairs observed. In central Bahía Magdalena, counts were greatest on 23 February with 35 adult whales and no calves observed. In Canal de Santo Domingo, the highest single whale counts from 17 individuals were obtained on the 19 February survey, along with 2 female-calf. Compared to previous years, gray whale abundance was generally low in all areas of BM after the first week in March, and further surveys were discontinued due to the departed from the BM complex earlier than in previous winters (Table 2).

DISCUSSION

Since January 2019 and continuing into 2023, an increase of dead gray whale strandings occurred along the west coast of North America from Mexico through Alaska, resulting in the declaration of an "Unusual Mortality Event" (UME) for gray whales (Fauquier *et al.*, 2023; NOAA 2023).

Observations of increasing numbers of “skinny” gray whales and mortalities and declining calf counts in LSI and BM detected an impending UME as early as 2018. Increased numbers of dead and “skinny” gray whales and low calf counts occurred during the UME years 2019, 2020, 2021 and again in 2022. Specifically, long-term abundance monitoring (18-years) in these gray whale winter aggregation areas and

photographic-identification data confirmed significant declines in winter calf counts, increasing percentages of "skinny" and "emaciated" whales (Ronzón-Contreras *et al.* 2020, 2021; Valerio-Conchas, *et al.* 2023), the delayed arrival of the whales each winter, and the late departure of whales in 2023.

The number of mother-calf pairs observed in LSI and BM during the 2024 winter were the lowest numbers recorded since the beginning of the UME in 2019. While a slight increase in of female-calf pairs observed occurred in late-March of 2024, this late season increase was not attributable to additional births of calves, rather these calves were judged from their size and color to be calves born earlier in the season. Jones and Swartz (1984) previously documented these late season increases in calf counts in LSI in March and April, and photographic identification data confirmed that females with calves entering LSI late in the season included females-calf pairs from other aggregation areas particularly from BM to the south of LSI.

Of all the potential contributors to the 2019-2023 UME, prey resource limitation may have been largely responsible for reduced female calf production, presumably by preventing conception, preventing bringing pregnancies to term, or mortality of immature calves. Similar low calf counts were observed from 2007-2010 following the 1998-2000 range wide UME when an estimated 33% of the North Eastern Pacific (NEP) population was lost (LeBoeuf *et al.* 2000, Gulland *et al.* 2005). It is estimated that the size of the ENP gray whale population has declined during the 2019-2023 UME from 27,000 in 2020 to 14,500 whales in 2023 (Stewart *et al.* 2023).

The numbers of female-calf pairs observed in LSI increased in the winters following the 1999-2000 UME in LSI suggesting a continuing recovery of the number of breeding females in the population (Urbán *et al.* 2011, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023). If the prey resources for the resources remain abundant and available to gray whales, we cannot rule out a similar recovery of the reproductive capacity of the population will follow the current UME in the future.

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TABLES AND FIGURES

Table 1. Boat survey counts of gray whales: Female-calf pairs, Singles (adult whales without calves), and total Adults counted in Laguna San Ignacio during the 2024 winter breeding and calving season. Number of female-calf pairs equals the number of calves observed.

Survey	Date	Female-calf Pairs	Single whales	Total Adults
1	18-Jan-24	2	10	12
2	24-Jan-24	2	11	13
3	29Jan-24	3	17	20
4	03-Feb-24	4	42	46
5	08-Feb-24	5	69	74
6	13-Feb-24	4	115	119
7	20-Feb-24	3	113	116
8	25-Feb-24	9	201	210
9	01-Mar-24	4	90	94
10	07-Mar-24	12	61	73
11	14-Mar-24	15	37	52
12	20-Mar-24	2	5	7

Table 2. Boat survey counts of gray whales (Female-calf pairs, Singles (whales without calves), and total Adults) in three areas within the Bahía Magdalena complex during the 2024 winter breeding and calving season. Number of female-calf pairs equals the number of calves observed.

Location	Date	Female-calf pairs	Single whales	Total adults
Bahía Almejas	25-Jan-24	0	64	64
	06-Feb-24	0	219	219
	24-Feb-24	0	243	243
	10-Mar-24	0	40	40
Bahía Magdalena	20-Jan-24	0	1	1
	04-Feb-24	0	10	10
	23-Feb-24	0	35	35
	09-MAR-24	0	5	5
Canal de Santo Domingo	21-Jan-24	0	0	0
	05-Feb-24	0	4	4
	19-Feb-24	2	17	19
	11-Mar-24	0	1	1

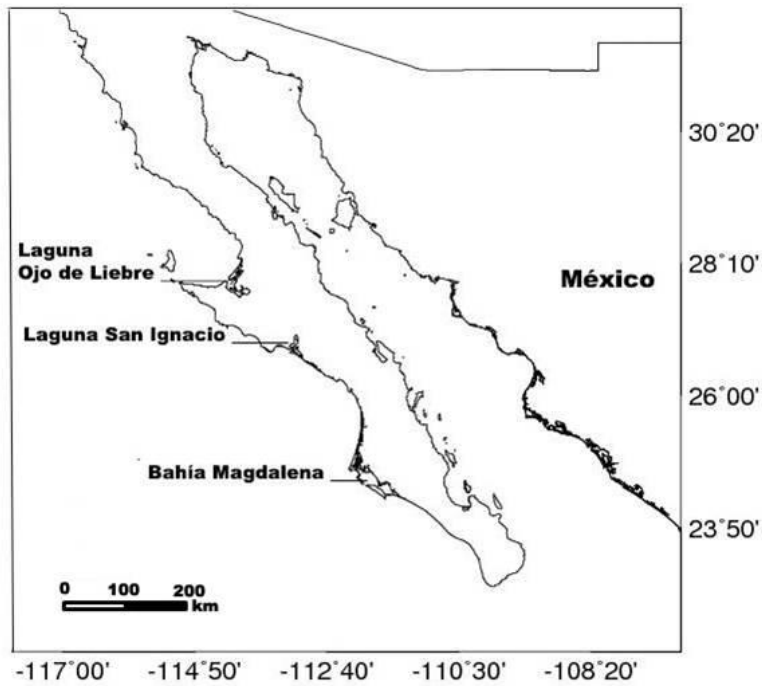


Figure 1. Primary gray whale winter aggregation areas and lagoons along the Pacific coast of Baja California, Mexico: Ojo de Liebre (Scammon's Lagoon); Laguna San Ignacio; and the Bahía Magdalena complex.

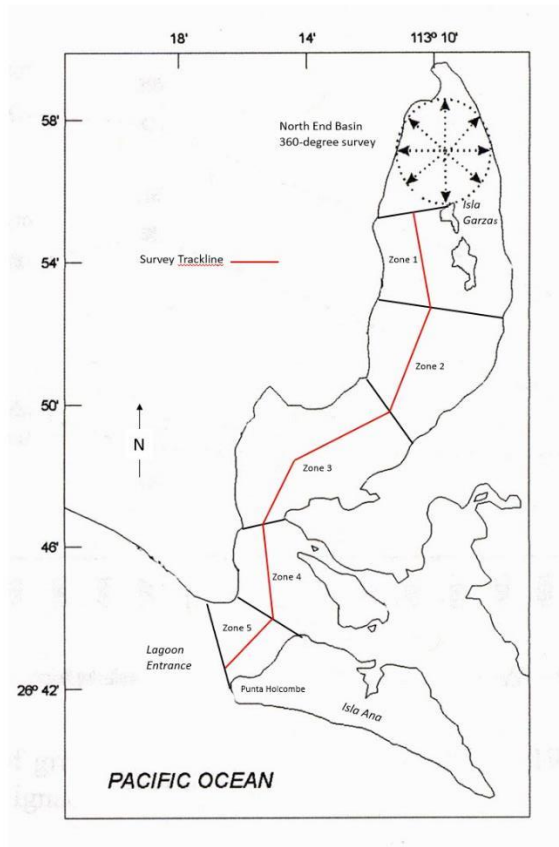


Figure 2. Boat survey track-line for estimating minimum abundance of gray whales in Laguna San Ignacio. Counts of gray whales in the "North End Basin" portion of the lagoon are obtained from a 360° scan of the area. The GPS survey track line continues 30 km south from Isla Garzas (Zone 1) over the deepest central portions of the lagoon to Punta Holcombe on the west end of Isla Ana at the entrance of the lagoon (Zone 5).

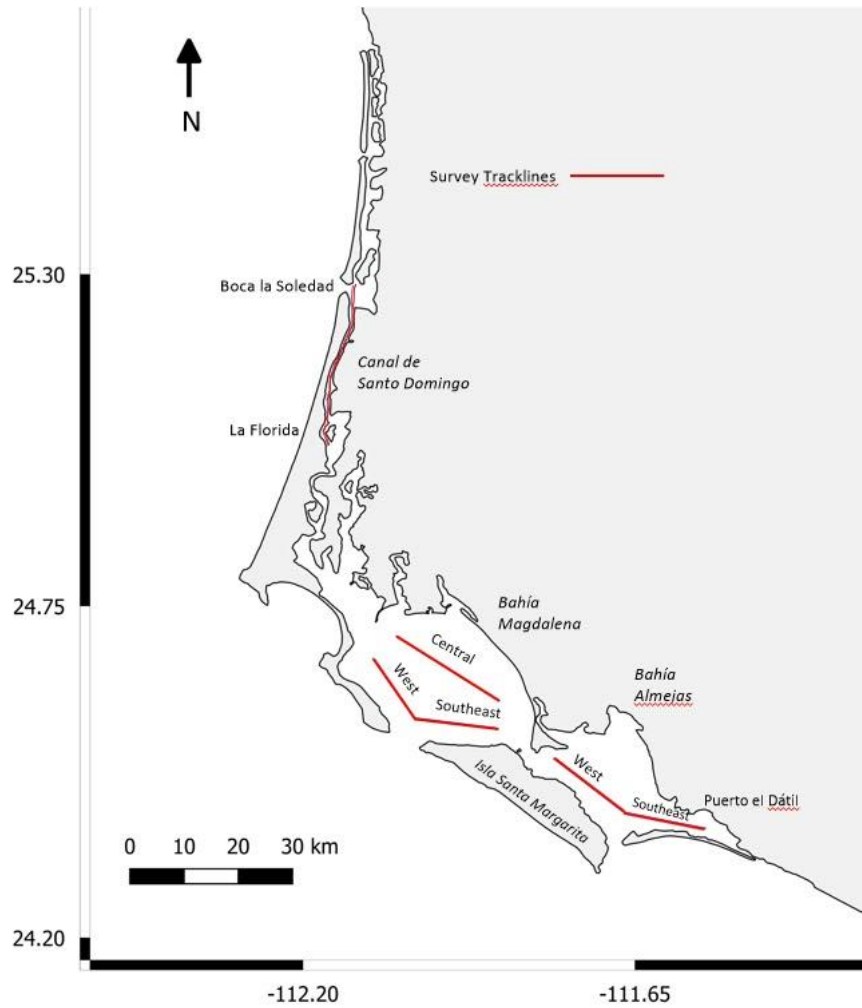


Figure 3. Boat survey track-lines for estimating gray whale abundance in the Bahía Magdalena lagoon complex in three areas where gray whales aggregate: Canal de Santo Domingo in the north; Bahía Magdalena’s center, west and southwest areas; and in Bahía Almejas in the south.

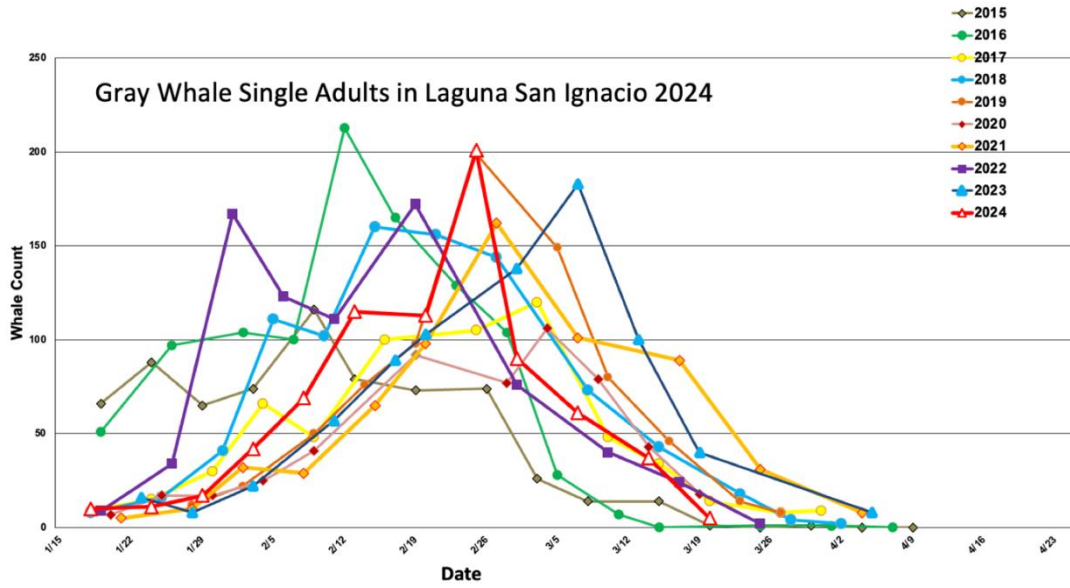


Figure 4. Numbers of single whales (adult males and females without calves) counted in Laguna San Ignacio during the winter seasons: 2015-2024

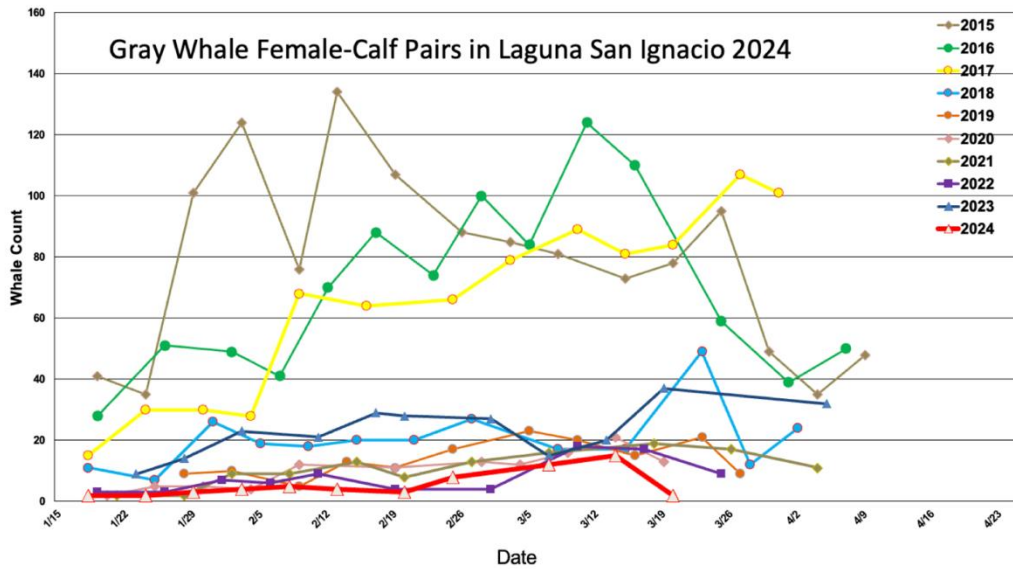


Figure 5. Numbers of female-calf pairs (females with young of the year) counted in Laguna San Ignacio during the winter seasons: 2015-2024.