Laguna San Ignacio Ecosystem Science Program
A Project of the Ocean Foundation in Baja California Sur, Mexico

Annual Gray Whale Research Report for Laguna San Ignacio and Bahía Magdalena, B.C.S., México During Winter 2022

May 2022

In this report we present details of a number of outstanding events that occurred during our research and monitoring of the Eastern North Pacific gray whales in Baja California Sur, México in 2022 winter. These include:

* Launching of our new research panga the RV MASAM (Mayan word for "Whale"): Page 5.

* Abundance of single gray whales in both areas were greater than that observed in recent years, but the numbers of female-calf pairs continued lower than historical records: Page 6.

* Photo-Identification surveys document the number and residence times of individual whales that visited Laguna San Ignacio and Bahía Magdalena in 2022: Page 10.

* The continuing elevated mortality of adult and juvenile gray whales in Baja California suggests that Unusual Mortality Event (UME) that started in 2019 is still affecting the gray whale population: Page 13.

* Drone photogrammetry and boat-based photographic identification surveys continue to document high proportions of "skinny" single whales while the body condition mother-calf pairs of whales were in good condition: Page 14.

* Strandings & Mortalities in Laguna San Ignacio and Bahía Magdalena in 2022: Page 18.

* Return of "Old Timers - Female gray whales first see in Laguna San Ignacio from 1977 to 1982 returned to the lagoons and were photographed in 2022, revising the minimum age estimate for female gray whales: Page 21.

* Six gray whales photographed in Laguna San Ignacio and Bahía Magdalena were matched with photographs of whales from the Western North Pacific population: Page 22.

* Killer whales (*Orcinus orca*) entered Laguna San Ignacio for the 1st time in history: Page 24.

* Team members successfully disentangled a gray whale calf that was wrapped in fish trap lines and floats: Page 25.

* Researchers and eco-tour boat drivers collaborated to free an adult gray whale that was stranded on a shallow sand bar: Page 28.

* Team members were able to give a limited number of lectures to ecotourism groups visiting Laguna San Ignacio, and several "virtual Webinars" about the lagoon research and the gray whale UME were presented to select natural history and university groups: Page 29.

You can read more about each of these and other notable findings from the 2022 winter gray whale research in the following pages…

RESEARCH STAFF IN 2022

The Laguna San Ignacio Ecosystem Science Program (LSIESP) is a project of The Ocean Foundation in collaboration with the Programa de Investigación de Mamíferos Marinos (PRIMMA) de Universidad Autónoma de Baja California Sur (UABCS), La Paz, B.C.S., México.

Drs. Jorge Urbán R., Steven L. Swartz, Sergio Martínez Aguilar (Laguna San Ignacio), and Lorena Viloria Gómora (Bahía Magdalena) directed the 2022 gray whale research. Collaborating researchers in 2022 included at Laguna San Ignacio: Andrés Gonzáles Cisneros, Minerva Valerio Conchas, Regina Lobo Barrera., and Adrián Zamora Zavala.

Laguna San Ignacio 2022 gray whale research team.

In Bahía Magdalena collaborating researchers included: Omar García C., Mario Márquez, S., Lorena Magallón F., Monserrat Castillo O., and Barbara Diogo.

Bahía Magdalena 2022 gray whale research team.

Dr. Aaron Thode from Scripps Institute of Oceanography deployed and recovered underwater recording equipment for the ongoing acoustic monitoring of ambient sound and recording gray whale calls in the lagoon.

Our UAV-drone pilot was Fabián Missael Rodríguez González assisted by Job Ailton Olguin Hernández.

Dr. Aaron Thode and his hydrophones and our drone pilots Fabián Missael Rodríguez González and Job Ailton Olguin Hernández.

This research was supported by grants from The Marisla Foundation, The Ocean Foundation, Natural Habitat Adventures Foundation, and private individual donors. In-kind support for logistics was provided by Kuyima Eco-Turismo, Searcher Natural History Eco-Tours, and Baja Discovery Whale-Watching. In Bahía Magdalena, we collaborated with “Mar Vivo” in its Community Science Project. All field research was conducted under Scientific Research permit SCPA/DCVS/10021/2i from the Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT), Subsecretaría de Gestión Para La Protección Ambiental, Dirección General De Vida Silvestre, de México.

2022 RESEARCH OVERVIEW

Our gray whale research teams arrived in Laguna San Ignacio and Bahía Magdalena in mid-January to begin the 2022 gray whale research season. Our field research station at Laguna San Ignacio, the "Francisco 'Pachico' Mayoral" laboratory, opened on January 19th and research activities continued through the first week in April. Gray whale surveys in Bahía Magdalena were completed during three periods: 21-23 January, 7-9 February, and 1-3 March (9-surveys in all) in 2022.

While our researchers were able to complete their winter research programs, the ongoing COVID pandemic did limit traditional interactions with student groups and eco-tour visitors to these lagoons. As a precaution, we continued to isolate our field laboratory at Laguna San Ignacio from all persons except member of our research teams. In both lagoons the safety protocols developed the previous winter continued to be followed to minimize possible exposure to and/or contracting any illness from the COVID virus.

The first notable event of the 2022 gray whale research season was the launching of our new research panga the RV MASAM (Mayan word for "Whale") which was built specifically to support the gray whale research program in Laguna San Ignacio. We are grateful to our generous supporters for providing the resources to replace our previous 20-yr old panga, the RV RHACHIANECTES (the original Genus name for the Pacific gray whale), with this new boat.

Unfortunately, the gray whales continue to feel the effects of the range-wide Unusual Mortality Event (UME) that began in 2019. The winter of 2022 was the fourth consecutive gray whale breeding season (2019-2022) in Laguna San Ignacio and Bahía Magdalena that was characterized by: 1) very low numbers of calves-of-the-year; 2) increased adult mortality in the gray whale breeding lagoons and aggregation areas of Baja California, and 3) an increase in the percent of "skinny, poor condition" adult whales.

GRAY WHALE ABUNDANCE: LAGUNA SAN IGNACIO AND BAHÍA MAGDALENA

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. Hand-held Global Position System (GPS) devices are used 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 whale 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.

The 2022 winter occupation of Laguna San Ignacio and Bahía Magdalena by gray whales was characterized by low numbers of calves-of-the-year, an increased percentage (19.5 %) of whales in poor body condition, and an unexpected early departure of whales from both areas. Ten surveys were completed in Laguna San Ignacio with the highest number of 172 single adult whales counted on 19 February, similar to high counts observed in previous winters (Table 1).

Table 1. Boat survey counts of gray whales: Female-calf pairs, Singles (whales without calves), and total Adults in Laguna San Ignacio during the 2022 winter breeding and calving season. Number of female-calf pairs equals the number of calves observed.

Survey	Date	Female-calf Pairs	Singles	Total Adults
1	19-Jan-22	3	9	12
2	26-Jan-22	3	34	37
3	01Feb-22	7	167	174
4	06-Feb-22	6	123	129
5	11-Feb-22	9	111	120
6	19-Feb-22	4	172	176
7	1-Mar-22	4	76	80
8	10-Mar-22	18	40	58
9	17-Mar-22	17	24	41
10	25-Mar-22	9	2	11

Departure times of single whales in 2022 were approximately two weeks earlier than in previous years (Fig. 1). Compared to previous winters, counts of females with calves remained low throughout the 2022 winter season, with the highest count of only 18 pairs observed on 10 March 2022 (Fig. 2).

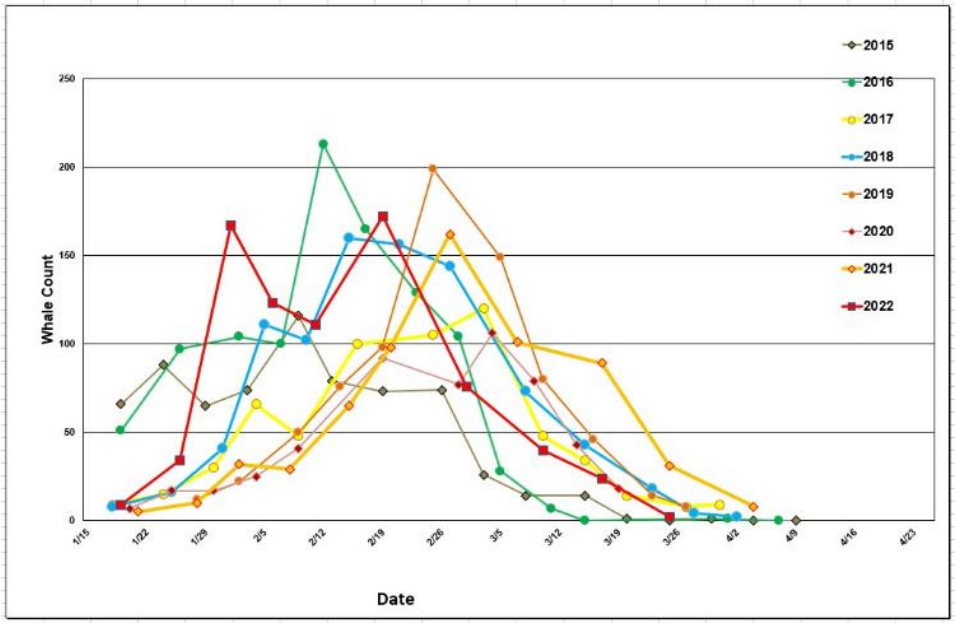


Figure 1. Counts of single adult whales observed in boat surveys in Laguna San Ignacio from 2015 to 2022.

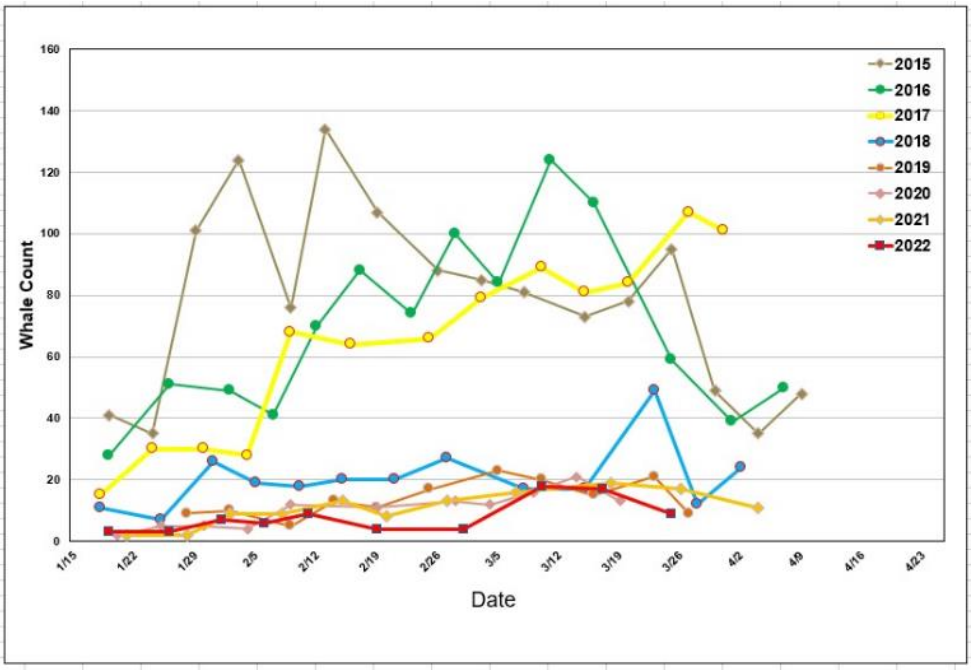


Figure 2. Counts of female-calf pairs observed in boat surveys in Laguna San Ignacio from 2015 to 2022.

The 2022 gray whale surveys in the Bahía Magdalena lagoon complex were conducted in three different areas during three different periods: 21-23 January, 7-9 February, and 1-3 March (9-surveys in all) (Fig. 3, and Table 2). The highest counts of gray whales were obtained on 9 February in the most southerly aggregation area of Bahía Almejas with 173 adult whales and no female-calf pairs. In central Bahía Magdalena, counts were greatest on 23 January with 42 adult whales and no calves observed. In Canal de Santo Domingo, 36 single whales and 2-female-calf pairs were counted on 7 February. Gray whale abundance then declined in all areas of Bahía Magdalena after the first week in March, and further surveys were discontinued due to the paucity of whales. In 2022, gray whales departed from the Bahía Magdalena complex earlier than in previous winters, as was also observed in Laguna San Ignacio in 2022.

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.

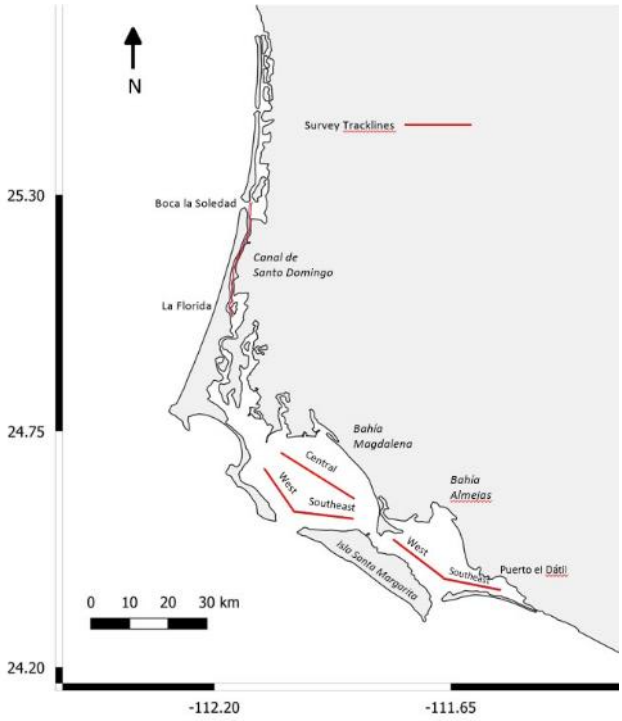


Table 2. Boat survey counts of gray whales (Female-calf pairs, Singles (whales without calves), and total Adults) in three areas within the Bahía Magdalena complex during the 2022 winter breeding and calving season. Number of female-calf pairs equals the number of calves observed.

LOCATION	DATE	FEMALE-CALF PAIRS	SINGLE WHALES	TOTAL ADULTS
Bahía Almejas	22-Jan	0	146	146
	09-Feb	0	173	173
	02-Mar	1	23	24
Bahía Magdalena	23-Jan	0	42	42
	08-Feb	1	38	39
	01-Mar	0	9	9
Canal de Santo Domingo	21-Jan	1	22	23
	07-Feb	2	36	38
	03-Mar	0	0	0

For more details on gray whale abundance in these lagoon areas in 2022, see the following paper:

Urbán R., et al. 2022. Gray whale abundance in Laguna San Ignacio and Bahía Magdalena lagoon complex, B.C.S., México for 2022 breeding season. Rep. Intl. Whal. Commn. SC/68D/CMP/07- LINK:

https://www.sanignaciograywhales.org/wp-content/uploads/2022/05/SC_68D_CMP_071-Urbán-et-al-abundance.pdf

PHOTOGRAPHIC IDENTIFICATION SURVEYS

The naturally occurring pigmentation patterns, “white” scars, and other markings are characteristic of each whale and, because these are permanent features, they are used to identify each individual (Fig. 4). During photo-identification surveys digital photographs were taken of both the left and right sides of individual gray whales with Digital Single Lens Reflex (DSLR) cameras (e.g., Nikon D7500) fitted with Zoom telephoto lenses (e.g., 70mm-300mm). Shutter speeds of 1/1000 second and ISO setting at 400 are used to insure sharp images of the details of the markings on each whale.

All photographs are sorted and catalogued, especially noting those whales that are encountered and photographed multiple times during the winter season. The time periods between the first and last time an individual whale was photographed provides an estimate of the minimum amount of time that individual remained in the area, or a minimum residence time during that winter. Minimum residence times are calculated for single adults (males and females without calves), and for females with calves. Each catalog is then compared with catalogs from previous winters to identify individual whales that have visited an area in multiple years. Interannual sightings of whales are used to evaluate site fidelity to a particular lagoon or winter aggregation area.

Figure 4. Example of the distinctive markings on a gray whale that are used to identify individuals within and among winter breeding seasons.

In both Laguna San Ignacio and in Bahía Magdalena whales were photographed from open outboard motor drives boats (Pangas) from distances typically of 20 m to 30 m. Photographs

from both areas are compared to evaluate the exchange and movements of whales between these winter aggregation areas.

LAGUNA SAN IGNACIO PHOTOGRAPHIC IDENTIFICATION: In Laguna San Ignacio photo-identification surveys were conducted on 55 days, for a total effort of 253.1 hours, and yielded 414 sightings of gray whales. All 9,532 images obtained were sorted into catalogs and included 788 individual whales: 42 were females with calves of the year, and 746 were single adult whales (males and females without calves).

The average minimum residence time for females with calves was 32.3 days with a maximum residence time of 73 days. The average minimum residence time for single adults was 7.0 days with a maximum residence time of 30 days. Table 3 shows average and maximum residence times for gray whales in Laguna San Ignacio in previous years 2010 to 2022.

	Residence Times for Female-Calf Pairs		Residence Times for Single Adult Whales	
Year	Average (days)	Maximum (days)	Average (days)	Maximum (days)
2010	(n=33) 31.9	73	(n=77) 6.9	20
2011	(n=123) 39.1	84	(n=30) 16.3	72
2012	(n=138) 37.5	81	(n=48) 11.0	67
2013	(n=118) 35.3	80	(n=46) 9.4	56
2014	(n=139) 37.6	89	(n=49) 7.6	34
2015	(n=212) 31.5	82	(n=52) 9.6	68
2016	(n=171) 29.3	80	(n=42) 8.0	31
2017	(n=153) 32.7	74	(n=47) 13.2	68
2018	(n=64) 43.2	80	(n=34) 5.2	22
2019	(n=37) 31.7	60	(n=108) 6.4	34
2020	(n=43) 24.5	62	(n=75) 6.7	44
2021	(n=42) 36.4	71	(n=127) 9.3	62
2022	(n=36) 32.3	73	(n=120) 7.0	30

Table 3. Average and maximum residence times for gray whales photographed in Laguna San Ignacio from 2010 to 2022.

We can see that between 2010 and 2022 the average residency times for females with calves range from 24.5 days to 43.2 days, with maximum days between the first and last time they were photographed ranging from 60 days to 89 days. Single adult whales spend much less time in a particular location with their average residency times 5.2 days to 16.3 days, with maximum residency times estimated at 20 days to 72 days. This suggests, along with inter-lagoon photographic matches, that single whales move around more than females with calves of the year.

BAHÍA MAGDALENA PHOTOGRAPHIC IDENTIFICATION: In the Bahía Magdalena study area, gray whale photo-identification surveys were conducted in three areas in 2022: Bahía Magdalena, Bahía Almejas, and in Canal de Santo Domingo for a total of 253 hours. During these surveys 171 gray whale sightings were made and 5,373 digital images were obtained. From these images 613 individual whales were identified and include 601 single adults (males and females without calves) and 12 females with calves of the year. Maximum duration of stay in these areas was 22 days for single whales and 32 days for females with calves.

Individual Gray Whales Visiting Laguna San Ignacio		
Year	Single Whales	Females-Calf pairs
2005	271	114
2006	191	54
2007	272	74
2008	152	88
2009	440	75
2010	515	38
2011	321	187
2012	332	211
2013	292	183
2014	443	195
2015	230	274
2016	350	218
2017	305	195
2018	411	83
2019	575	40
2020	419	54
2021	500	43
2022	532	41
TOTAL	**6551**	**2167**

The photographic identification data also provides another estimate of the total number of individual gray whales that visit a particular breeding lagoon and aggregation area during a winter.

Table 4 lists the numbers of individual whales that visited and were photographed at least once in Laguna San Ignacio during each 3-month winter breeding season from 2005 to 2022. While the number of single adult whales (males and females without calves) have remained relatively constant between 2009 (n=440) and 2021 (n=500), their estimated numbers have increased slightly in the 2022 winter.

The estimated number of females with calves ranged about 200 pairs from 2011 to 2017, but then their numbers declined significantly beginning in 2018 and continue to remain low (less than 100 pairs) from 2019 through 2022. This decline in reproduction is presumed to be related to the Unusual Mortality Event and the range-wide increase in mortalities of adult female whales.

Table 4. Number of individual gray whales that visited Laguna San Ignacio between 2005 and 2022 estimated from photographic identification data.

(See page 13 for more information on the gray whale UME).

ADDITIONAL 2022 PHOTO-IDENTIFICATION FINDINGS: Comparison of catalogs from the Western North Pacific (Asian) gray whale population with photographs from Laguna San Ignacio and Bahía Magdalena identified three individuals from the Western population that visited the winter breeding and aggregation areas in Baja California Sur during the 2022 winter.

(See page 22 for more information on Western gray whales migrating to Mexico with Eastern gray whales).

In addition, 6 gray whales that were originally photographed in Laguna San Ignacio between 1977 and 1982 were re-photographed in 2022 in Laguna San Ignacio and Bahía Magdalena, which suggests they are likely 50+ years old or older.

(*See page 20 for more information on "Old Timers" returning to the lagoons of Baja California).*

GRAY WHALE UNUSUAL MORTALITY EVENT (UME)

Since January 2019 and continuing into 2022, an increase of dead gray whale strandings occurred along the west coast of North America from Mexico through Alaska, resulting in the declaration by NOAA of an "Unusual Mortality Event" (UME) for gray whales.

NOAA National Marine Fisheries Service Photo.

Low numbers of gray whale female-calf pairs observed in Laguna San Ignacio and Bahía Magdalena from 2018 to 2022 is similar to the decreased calf abundances observed during the winter breeding seasons from 2007 to 2010 following the previous range-wide "unusual mortality event" (UME) of 1999 to 2000. Low calf counts were observed in in the Baja California breeding lagoons beginning in 2018, and continuing into this winter proceeding the gray whale UME of 2019-2022. To date a primary cause of the current gray whale UME has not been identified. It is likely that this event may have multiple contributors, including mortality linked to killer whale predation, fishing gear entanglements, vessel strikes, and poor body condition possibly associated with ecosystem changes in sub-Arctic and Arctic feeding areas.

Changing environmental conditions in the gray whales' northern feeding areas may be reducing the availability of food during the summer months, necessitating additional searching time to find food. While insufficient prey could contribute to the reduced reproduction and apparent decline in the body condition of some gray whales, disease and environmental stressors *(e.g.,* climate change) cannot be ruled out.

For more information on the gray whale UME and probable contributing causes, see the following articles:

Christiansen, F., et al. 2021. Poor body condition associated with an unusual mortality event in gray whales. Marine Ecology Progress Series Vol. 658: 237-252.
(https://www.sanignaciograywhales.org/wp-content/uploads/2021/01/Christiansen-et-al.-GW-Condition-FINAL-21-Jan-2021.pdf)

Fauquier, D., et al. 2022. Update on the Eastern North Pacific Gray Whale (*Eschrichtius robustus*) 2019-2022 Unusual Mortality Event. ***International Whaling Commission Scientific Committee Annual Meeting 2022 Paper Submission – Conservation Management*** *Plans (https://www.sanignaciograywhales.org/wp-content/uploads/2022/05/Final_IWC-GW-UME_Update2022_07Apr2022.pdf)*

Moore, S.E. et al. 2022. Changes in gray whale phenology and distribution related to prey variability and ocean biophysics in the northern Bering and eastern Chukchi seas. PLoS ONE 17(4): e0265934, doi;10.1371/journal.pone.0265934. 26pp. *(https://www.sanignaciograywhales.org/wp-content/uploads/2022/05/Moore.etal_.2022.GrayWhaleEclolg-BeringChukchiSeas_PONE-1.pdf)*

GRAY WHALE BODY CONDITION

Gray whale body condition is an indication of the whales' success at seasonal foraging, which in turn is indicative of reproductive trends of individuals and of the population. We analyzed gray whale body condition in Laguna San Ignacio during the 2022 winter with two different methods: First, digital photographic images taken from a small boat (24 feet long) were used to evaluate three body areas (the head, scapula, and flank). Each were assigned a numerical score and classified as "good", "fair" or "poor" condition depending on the amount of body fat-tissue in these regions.

Second, UAV-drones with high definition (HD) video cameras photographed gray whales as they surfaced to breathe. Digital images of the backs of each whale were selected from the videos and were catalogued by age and sex of the whales as females with calves and single adults without calves (Fig.5). Body condition was then evaluated based on the measurements of the width and length ratios of each photographed whale compared to measurements of known healthy individuals. All drone photographs were sorted into age class categories based on total body length (eg. calves, juveniles, adults). Analysis of the UAV-drone data will continue over the 2022 summer and will be reported as those results become available.

Figure 5. A UAV-drone photograph of a "skinny" or "flaca" gray whale used for condition evaluation.

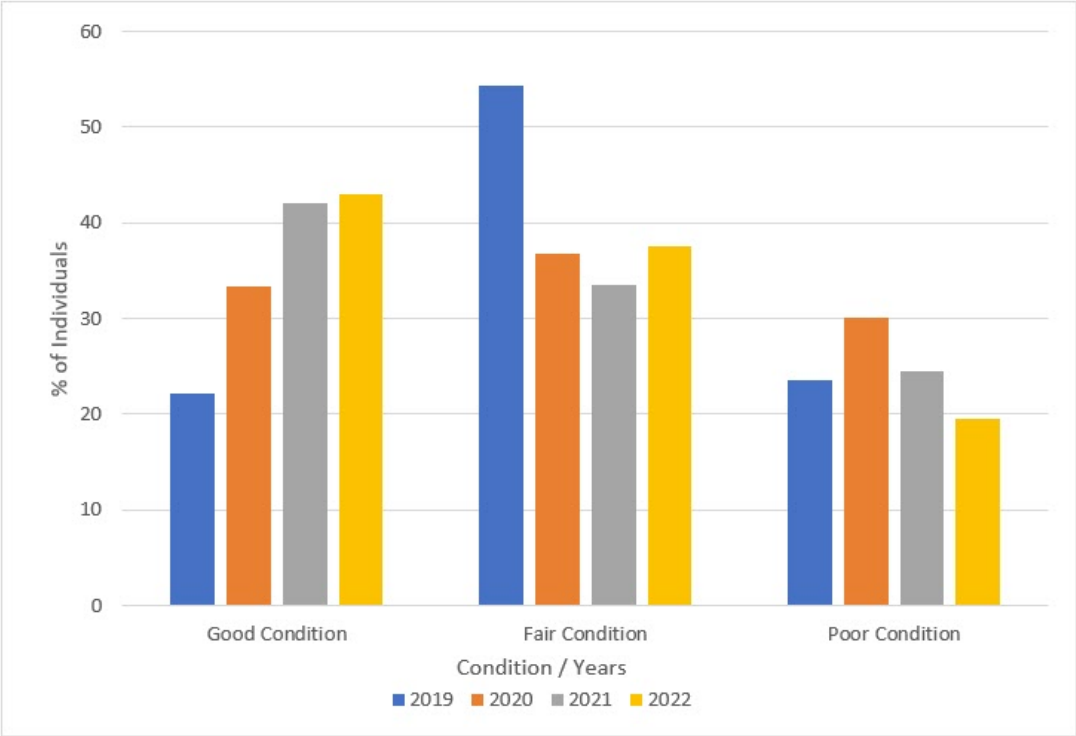
Analysis of the boat-based photographs from Laguna San Ignacio obtained in 2022 revealed that the percentage of single whales with good body condition was 43%, an increased compared with 42% in 2021, and has been the highest percentage for single whales for the last four years. Single whales in "fair" condition were 37.5%in 2022 compared with 33% in 2021. Finally, the percentage of single whales with poor body condition was 19.5% in 2022, and was the lowest since the beginning of the current Unusual Mortality Event in 2019 (Table 5). The decreasing percentages of "poor condition" whales suggest that a slow recovery of the whales' condition may be underway since 2020. However, a more extensive analysis of the data from other breeding areas is needed to understand if this trend is local or is occurring in the entire Eastern North Pacific population (Fig. 6).

Table 5. Number and percentage of gray whales by body condition category and group type (Mc and Single whales) photographed by boat from 2019 to 2022.

Singles / Year	2019	2020	2021	2022
No. whales Photo-identified	847	696	746	746
No. whales categorized	529	553	658	626
Good Condition	117	166	259	269
	22.1%	33.3%	42.1%	43.0%
Fair Condition	287	183	206	235
	54.3%	36.7%	33.5%	37.5%
Poor Condition	125	150	150	122
	23.6%	30.0%	24.4%	19.5%

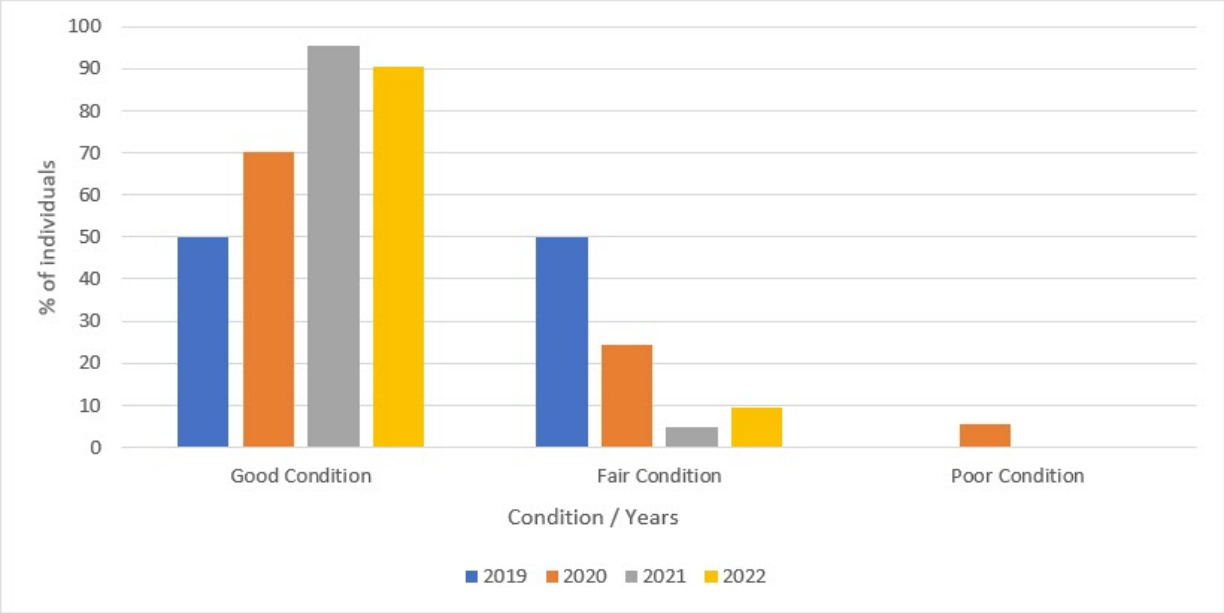
Mc / Year	2019	2020	2021	2022
No. whales Photo-identified	41	56	43	42
No. whales categorized	40	54	41	42
Good Condition	20	38	41	38
	50.0%	70.3%	95.3%	90.5%
Fair Condition	20	13	2	4
	50.0%	24.2%	4.7%	9.5%
Poor Condition	0	3	0	0

Figure 6. Percentage of single whales' body condition from boat-based photographs in Laguna San Ignacio from the 2019 to 2022 winters.



The body condition of females with calves photographed from the research boat in Laguna San Ignacio in 2022 was 90.5% good condition, which was similar to females with calves observed during the last 3 years, and no females with poor body condition were observed (Figure 7). While females with calves were generally in "good" body condition, it doesn´t mean that the breeding females are not being affected by the factors that are reducing the condition of single whales. For example, when a breeding age female is pregnant but does not obtain sufficient food during the summer feeding season, she may not be possible to bring the calf to term, and successfully birth and nurse the calf the next winter. Without a calf, these breeding females would be considered single whales and increase the number/percent of "fair" or "poor" body condition single whales observed in the lagoon. Future analysis will focus on identifying known breeding age females with known reproductive histories, and that are expected to have calves during a winter, but are seen with or without calves. Ongoing analysis could help to explain the fewer numbers of calves seen in the lagoons in recent years.

Figure 7. Body condition of females with calves evaluated from boat-based photographs in Laguna San Ignacio from the 2019 to 2022 winters.



To learn more of the details of our investigations of gray whale body condition, see the following paper:

Valerio-Conchas, M. ***et al***. 2022. Gray whales' body condition in Laguna San Ignacio, Baja California Sur, México for winter breeding season 2022. Rep. Intl. Whal. Commn. LINK:

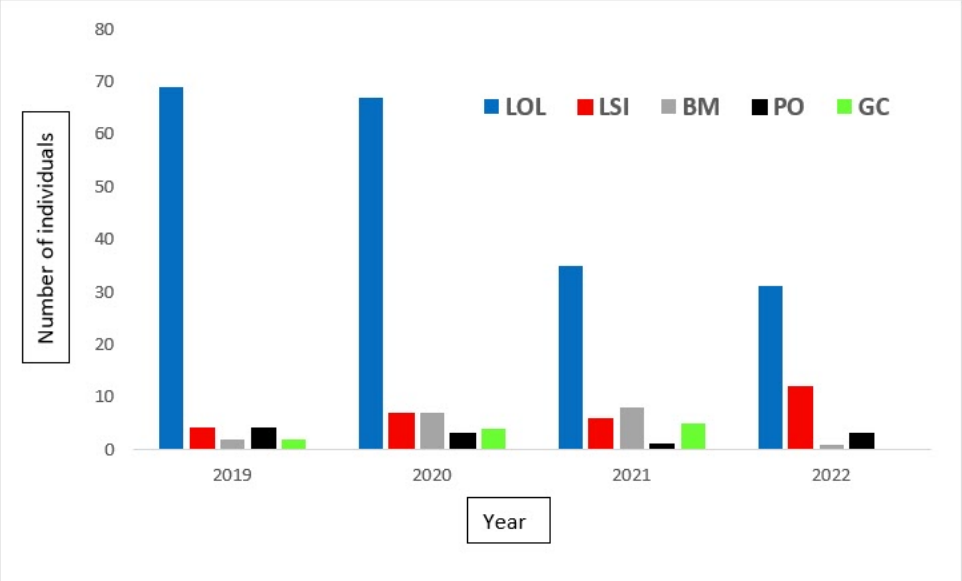
https://www.sanignaciograywhales.org/wp-content/uploads/2022/05/SC_68D_CMP_08-Valerio-et-al-body-condition.pdf

GRAY WHALE STRANDINGS AND MORTALITIES

During the last two decades, the North Eastern Pacific gray whale population has experienced two range-wide Unusual Mortality Events (UMEs): the first occurred from 1999-2000, with at least 319 stranded dead whales discovered in the breeding and calving areas in Mexico, and the second UME during 2019-2021 with 226 stranded whales discovered in the gray whales' breeding and aggregation areas of Baja California. Some of the stranded whales appeared to be "skinny", suggesting that they were suffering from nutritional stress. Analysis of the possible causes of the 1999-2000 UME, suggested that the increase in gray whale mortality was a result of the population increasing to an abundance level that exceeded the "carrying capacity" of the gray whales' feeding grounds. After the 2019 UME was declared, renewed efforts to monitor and report gray whale strandings throughout their range in Mexico were undertaken.

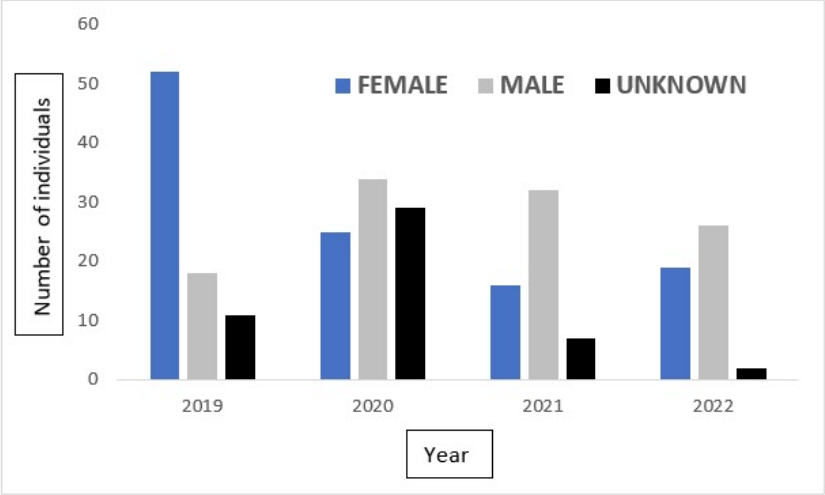
Stranding data collected in 2022 from the gray whale aggregation and breeding lagoons in Baja California included Laguna Ojo de Liebre, Laguna Guerrero Negro, Manuela lagoon, Laguna San Ignacio, the Bahia Magdalena-Bahía Almejas complex, and from media reports of gray whales stranded along the Pacific coast of Baja California Peninsula (Fig. 8).

Figure 8. Total number of gray whales stranded in Mexico by area, during (2019-2022) UME. LOL (Ojo de Liebre lagoon), LSI (San Ignacio lagoon), BM (Bahía Magdalena), PO (Pacific Ocean), GC (Gulf of California).



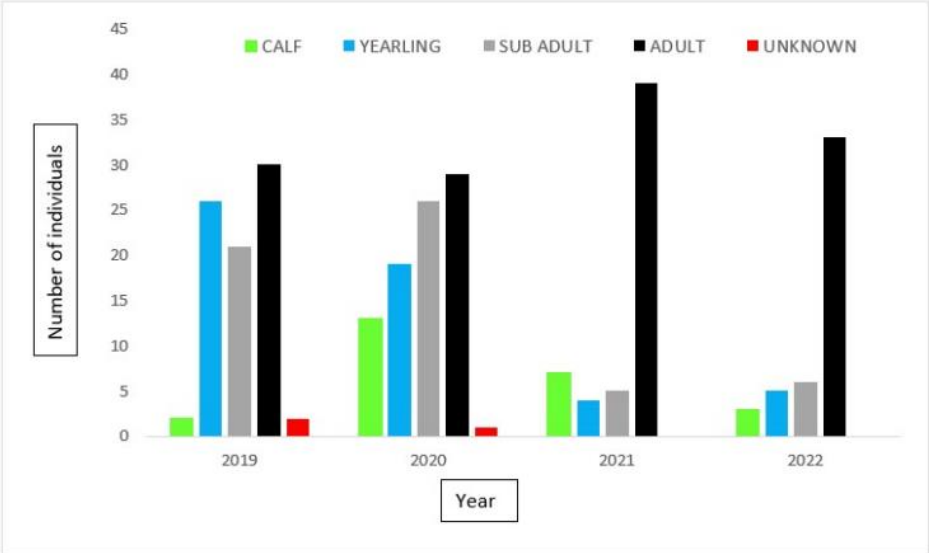
Comparing data from 2022 against the data from 2019-2021, the proportion of the sexes of the stranded whales were highest for males in 2020, 2021 and 2022 and only during 2019 was the number of stranded females greater (almost triple) that of stranded males. (Fig. 9). The greater number of stranded females 2019 to 2020 could be a factor in the overall reduction in the number of calves born each winter since 2018.

Figure 9. Total number of gray whales stranded in Mexico by sex during (2019-2022) UME



The most common category of stranded whales in Baja California was adults, followed by subadults, and may be related to the greater amount of food that the adults need to carry out their functions (migrating, breeding or calving) (Fig. 10). In contrast, before the UME, calves were the most frequent age class stranded, but the low numbers of dead calves observed in 2019-2021, is likely related to higher proportion of mature females stranding in 2019, and the overall decline of female-calf pairs observed in Laguna San Ignacio and Bahía Magdalena since 2018.

Figure 10. Age categories of stranded gray whales in Mexico in 2022.



The number of reported gray whale strandings is likely an underestimate of actual mortalities, because of the differences in detectability, the dimensions of the area where the gray whales

are distributed along the Baja California Peninsula, an undetermined number of dead whales may drift out to sea and do not arrive on the coastal beaches, and the differences in search effort conducted in all areas.

This year, 12 stranded dead gray whales were found in Laguna San Ignacio, and one stranded adult in Bahía Magdalena. Half of these were extremely skinny, suggesting that they have been unable to find sufficient food during the summer months in the North Pacific and Arctic waters (Table 5). Unfortunately, it appears that the gray whale Unusual Mortality Event that began in 2019 is continuing to result is higher than normal strandings and deaths of adult gray whales.

See the NOAA webpage describing the gray whale UME at:
*(*https://www.fisheries.noaa.gov/national/marine-life-distress/2019-2022-gray-whale-unusual-mortality-event-along-west-coast-and)

Table 5. Stranded gray whales discovered and examined in Laguna San Ignacio during the 2022 winter breeding season.

No	Species	Date	Sex	Age Class	Length (m)
LSI-001	Gray Whale	26-Jan-22	Male	Adult	11.27
LSI-002	Gray Whale	06-Feb-22	Male	Adult	11.3
LSI-003	Gray Whale	09-Feb-22	Male	Adult	12.13
LSI-004	Gray Whale	15-Feb-22	Female	Joven	8.62
LSI-005	Gray Whale	15-Feb-22	Female	Adult	12.54
LSI-006	Gray Whale	16-Feb-22	Undermined	Adult	11.65
LSI-007	Gray Whale	17-Feb-22	Female	Adult	12.34
LSI-008	Gray Whale	21-Feb-22	Female	Adult	12.27
LSI-009	Gray Whale	25-Feb-22	Female	Adult	12.84
LSI-010	Gray Whale	28-Feb-22	Male	Adult	11.82
LSI-011	Gray Whale	15-Mar-22	Female	Adult	12.78
LSI-012	Gray Whale	15-Mar-22	Female	Adult	12.95

To read more details of the impact of the current UME on gray whales, please see the following papers:

Fauquier *et al.* 2022. Update on the Eastern North Pacific Gray Whale (*Eschrichtius robustus*) 2019-2022 Unusual Mortality Event. *International Whaling Commission Scientific Committee Annual Meeting 2022 Paper Submission – Conservation Management Plans (https://www.sanignaciograywhales.org/wp-content/uploads/2022/05/Final_IWC-GW-UME_Update2022_07Apr2022.pdf)*

Martínez *et al.* 2022. Gray whale stranding records in México, during the 2022 winter breeding season. Rep. Intl. Whal. Commn. SC/68D/CMP/10. LINK:

https://www.sanignaciograywhales.org/wp-content/uploads/2022/05/SC_68D_CMP_10-Martínez-et-al-strandings.pdf

OLD TIMERS RETURN TO THE BAJA LAGOONS AND REVISE AGE ESTIMATES

During our 2022 photographic identification surveys, we encountered some gray whales that were first photographed in Laguna San Ignacio by Mary Lou Jones and Steven Swartz during the 1977 to 1982 time period.

The first was a single female that bears a large white "patch" or "saddle" on her back (Fig. 11). She was first photographed during the 1979 winter, and at that time she had a calf. She has been re-photographed 15 times over the past 45 years with at least 6 calves. In 2022 she was first photographed on January 29th in Bahía Almejas in the southern portion of Bahía Magdalena. Then on February 20 she was photographed once again in Laguna San Ignacio. On each occasion she looked in good health. Gray whales attain reproductive age at between 7 to 9 years. So, if she was observed with a calf in 1979, and again 45 years later this year, we estimate her minimum age to be 52-54 years.

Figure 11. Female gray whale "White Patch" first photographed in 1979 winter.

As the 2022 season progressed two additional "Old Timers" were photographed in Laguna San Ignacio. These included another known female with a distinctive grey blaze on her right flank just below the dorsal ridge (Fig. 12). She was first photographed in Laguna San Ignacio in 1981 and has been re-photographed 8 times, including twice with a calf, during the last 34 years. Her estimated minimum age would be 40-42 years.

Figure 12. Female gray whale with "grey blaze" first photographed in1981.

The third whale was first photographed 1979 and bears a large notch-scar where it's dorsal ridge should be (Fig. 13). This whale has been re-photographed 8 times over the past 43 years, and it is presumed to be a male because it has never been seen with a calf. Because it has not been re-sighted with a calf It's estimated minimum age would be at least 43 years.

Figure 13. Probable male gray whale first photographed in 1979.

It is always great to welcome back our "old timers" to the lagoons. The oldest known gray whale was reported to be an 80-yr old female described by Dale Rice and Alan Wolman in their 1971 monograph on the North Pacific gray whale.

Learn more about gray whale re-sightings in Laguna San Ignacio and Bahía Magdalena in the power-point presentation "Edad de Ballenas-2022". (https://www.sanignaciograywhales.org/wp-content/uploads/2022/05/Edad-ballenas-2022-REVISED-WEB.pdf)

MORE WESTERN NORTH PACIFIC GRAY WHALES IDENTIFIED IN BAJA CALIFORNIA

The gray whale (*Eschrichtius robustus*) has been historically considered to consist of two extant populations, the Western North Pacific and Eastern North Pacific populations. The Eastern population ranges from calving areas off Baja California, Mexico, to feeding areas in the Bering,

Beaufort, and Chukchi Seas. The Western population feeds in the Okhotsk Sea off Sakhalin Island, Russia, and in nearshore waters of the southeastern Kamchatka Peninsula. The Eastern population has recovered from 19th century exploitation and numbers between 20,000-25,000 individuals, whereas the Western population is estimated to include 300-400 individual whales and is listed by IUCN as critically endangered.

Here we present an update on trans-Pacific movements of gray whales that were photo-identified in the Western North Pacific and the whales' Mexican breeding grounds. Comparison of photo-identification data from Russia and Mexico have revealed a total of 48 matches of Western gray whales migrating to Baja California during the winter breeding season, confirming additional trans-Pacific movements of gray whales between the gray whale populations in the Western and Eastern North Pacific. These included 21 females, 14 males, and 13 whales of unknown sex (Table 6).

Table 6. Number of photographic "recaptures" (matches) between WNP feeding areas: Sakhalin (SAK) and Kamchatka (KAM) and Mexican breeding and calving areas: Ojo de Liebre lagoon (LOL), Laguna San Ignacio (LSI) and Bahia Magdalena-Bahia Almejas complex (BM).

	LOL	LSI	BM	LSI/BM	LSI/LOL	BM/LOL	LOL-LSI-BM	MEXICO
SAKHALIN	6	15	5	2	---	---	---	28
KAMCHATKA	0	4	3	0	---	---	---	7
SAK-KAM	1	8	2	2	---	---	---	13

In 2022, 6 whales from Western North Pacific were photographed in Mexico; 2 of them in Laguna San Ignacio, and 4 in Bahía Magdalena-Bahia Almejas, and two of these were documented in Mexican waters for the first time.

To learn more details of the movements of Western North Pacific gray whales to Baja California, Mexico, please see the following publication:

Martínez-Aguilar, et al. 2022. Gray whale (*Eschrichtius robustus*) migratory movements between the Western North Pacific and the Mexican breeding grounds: 2022 update. Rep. Intl. Whal. Commn. SC/68D/CMP/09. LINK: https://www.sanignaciograywhales.org/wp-content/uploads/2022/05/SC_68D_CMP_09-Martínez-et-al-movements-west-east.pdf

KILLER WHALES ENTER LAGUNA SAN IGNACIO

The 19th century Yankee whalers that hunted gray whales along the Baja California peninsula reported sighting killer whales (*Orcinus orca*) along the coast, but they never reported killer whales inside of the gray whales breeding and calving lagoons. In fact, we are not aware of any historical accounts of killer whales entering the lagoons, until this winter.

On January 23, 2022 a group of whale-watching tourists led by Daniel Aguilar sighted a group of 6 killer whales in the lower portion of Laguna San Ignacio, which is the deepest part of the lagoon near its entrance from the ocean (Fig. 14). Daniel notified our researchers, who encountered these killer whales in front of Isla Abaroa where they were chasing bottlenose dolphins (*Tursiops truncatus*).

Figure 14. Pod of 6 killer whales (Orcinus orca) that entered Laguna San Ignacio in 2022.

Our researchers stayed with this group of killer whales for approximately 2-hrs, and were able to photograph all the members of the group for later photo-identification. They were also able to make video recordings of the killer whales' attacks on the bottlenose dolphins. The killer whales eventually exited the lagoon carrying a dead dolphin with them (Fig. 15). A second sighting of killer whales in the lagoon was made on January 31, but no sufficiently clear photos were obtained to determine if they were the same group that was seen earlier.

Figure 15. Killer whale attacking bottlenose dolphin (Tursiops truncatus) in Laguna San Ignacio in 2022.

Two dead bottlenose dolphin carcasses were later discovered on the northern shore of the lagoon in the area where the killer whales were observed. Both carcasses had bite and rake-marks on them that were characteristic of the wounds made by the conical teeth of the killer whales.

To our knowledge, this is the first documented incident of killer whales entering Laguna San Ignacio and hunting bottlenose dolphin. Killer whales are also known to prey on gray whale calves; however, we were not able to confirm if any gray whales were attacked by these killer whales. We want to thank Daniel Aguilar for initially reporting the presence of these killer whales in the lagoon.

Link here…View the video of this killer whale incident in Laguna San Ignacio:
(https://vimeo.com/user40471778)

DISENTANGLEMENT OF GRAY WHALE CALF IN LAGUNA SAN IGNACIO

The morning of February 8th 2022, our gray whale research team received a report of an entangled gray whale calf that had a rope and buoy dragging behind it. A day later on February 9th the LSIESP team found the calf and they observed that it had a 3/8 blue line through and around its mouth, and was dragging a 30 cm wide buoy with more than 30 meters long blue line behind its body (Fig. 16). All of our researchers are trained to perform the "RABEN" disentanglement protocol to respond to and attempt to free entangled whales.

Figure 16. Gray whale calf entangled in fishing gear in Laguna San Ignacio.

Using a "Grampin" (a special hook device) a security line with a large orange float was attached to the blue line that was wrapped around the calf to slow it's swimming and to better see the calf's location (Fig. 17). The team then began to guide both mother and calf towards the Northern interior of the lagoon, so they would not to end up outside of the lagoon. The team spent more than one hour over 10 km trying to stop the whales by employing the Nantucket sleigh-ride procedure (holding onto the line with float to further slow and tire the whales).

However, the calf reacted by pulling more forcefully on the float line while its mother stayed close by and continued to protect her calf.

Figure 17. Two boats approaching entangled gray whale calf trailing floats and lines.

Dr. Martínez then requested a second boat for assistance, and developed a coordinated plan to distract the whales. While one boat held the security line with the orange float, the second boat approached the whales from the opposite side to distract them while the first boat attempted to cut the blue line wrapped around the calf.

However, the mother-calf pair reacted negatively, and avoided the boats. With the help of the drone's camera, the team could see that the mother was trying to protect the calf by keeping it afloat above her most of the time. At this point both boats made slow approaches to the whales, keeping both whales in between the two boats to distract them long enough to cut the rope on the calf. This maneuver was successful: by making the first cut in the line above the calf's head, the tension on the line was reduced, and a second cut released the line, freeing the calf completely. The material removed from the calf included 30 meters of blue line, and a 30 cm yellow buoy (Fig. 18).

Figure 18. Cutting and removing fishing lines and floats around the gray whale calf.

Finally, two days later on February 11th both whales were observed and photographed by our UAV-drone, providing confirmation that the calf was completely disentangled, and both mother and calf were swimming peacefully in the lagoon.

We would like to thank all the boat drivers involved for their reports of the entangled gray whale calf and its location, and for remaining with the whale until our RABEN team arrived. We also wish to thank Kuyimá Eco-Turismo for their support and providing the second boat, and both boat drivers Alejandro Ramírez Gallegos "Hardy" and Alejandro Gallegos "Chino" for their help in accomplishing a successful disentanglement procedure (Fig. 19).

Figure 19. The Team of LSIESP researchers and boat drivers that successfully disentangled the gray whale calf.

To learn more about this successful disentanglement of this gray whale calf please read the report by Dr. Martínez,(https://www.sanignaciograywhales.org/wp-content/uploads/2022/05/DISENTANGLEMENT-REPORT-9-FEB-2022.pdf) and view the video of this incident (https://vimeo.com/user40471778).

STRANDED GRAY WHALE RESCUE IN LAGUNA SAN IGNACIO

On February 6th an attempt was made to save a “flaca” or “skinny” adult whale that became stranded on a shallow “bajo” or sand bar in Laguna San Ignacio (Fig. 20).

Figure 20. LSIESP researchers evaluate the condition of a stranded gray whale.

With the assistance of eco-tour boat drivers, the LSIESP research team slipped a tow line under the whale and behind it’s pectoral flippers (Fig. 21). Then the small boats began to gently tow the whale toward deeper water. After one hour of effort, a third boat joined the rescue effort. As the whale neared deeper water, the tow line was removed, and the whale swam off into the deeper portion of the lagoon.

Figure 21. Boats use tow lines attached to the whale to move it into deeper water.

UAV-drones were used to follow the whale and to obtain video of the entire rescue. Unfortunately, due to its poor condition 9-days later the whale stranded again, and this time it did not survive (Fig. 22).

Figure 22. Stranded dead gray whale that was previously rescued from a shallow sand bar in Laguna San Ignacio.

Watch the video of this rescue of a live stranded gray whale in Laguna San Ignacio at …
(https://vimeo.com/user40471778)

OUTREACH EFFORTS IN 2022

With the COVID-19 pandemic ongoing in 2022, it was necessary to continue to isolate our research teams and to minimize their interactions with visitors to the lagoons. As a result, we were not able to host visiting university student groups, or to make as many presentations to eco-tour groups as we have in previous years. One senior researcher (Swartz) made a few presentations to select eco-tour groups visiting Laguna San Ignacio in facilities large enough to allow safe social distancing. As an outreach alternative, we used internet social media sites (e.g., website, Facebook and Instagram) to present "virtual" lectures on gray whales and our research activities to interested public, eco-tourists and naturalists, the local communities, public media, and to wildlife managers. "Virtual" internet presentations were made to: The American Cetacean Society – San Diego and Monterey Bay Chapters, Monterey Bay Sea Otters Dive Club, the 35th Annual Pacific Rim Whale Festival, and The Pulse of the Salish Sea.

YOU CAN MAKE IT HAPPEN: We are grateful to our family of sponsors whose generous support each year allows the laguna San Ignacio Ecosystem Science Program to conduct research on gray whales and their lagoon aggregation and breeding areas in Baja California.

We urge you to consider becoming a supporter of our program by making a monthly donation through our fiscal sponsor The Ocean Foundation. Setting up your monthly donations is safe and secure at the following link: https://www.sanignaciograywhales.org/donate/. Thank You!

ACKNOWLEDGEMENTS: We wish to thank all of the research teams from the Laguna San Ignacio Ecosystem Science Program and the Programa de Investigación de Mamíferos Marinos, Universidad Autónoma de Baja California Sur, La Paz, B.C.S., México that have worked to monitor the gray whales that reside within in Laguna San Ignacio and Bahía Magdalena during the winter months. We thank the "Mar Vivo Community Science Project" in Bahía Magdalena for their collaboration. This research was supported by grants from The Marisla Foundation, the Ocean Foundation, Natural Habitat Adventures Foundation, the Whaleman Foundation, and private individual donors, with in-kind logistic support provided by Kuyima Eco-Tourismo, Inc, and Baja Discovery whale-watching tours.

HAVE QUESTIONS OR WANT MORE INFORMATION? Please contact us on our website and we will do our best to address your questions and provide more information on the gray whales and their winter breeding lagoons in Baja California:

https://www.sanignaciograywhales.org/contact-us/.

Photo by Sergio Martínez A. The Milky Way viewed from our field research camp on the south shore of Laguna San Ignacio.