



## Protected Species Mitigation and Monitoring Report

Marine Geophysical (Seismic) Survey  
Southeastern Gulf of Mexico

Loop Current in the Gulf of Mexico  
17 July 2022 – 26 July 2022

*R/V Justo Sierra*

Prepared for:

Scripps Institution of Oceanography  
8622 Kennel Way, La Jolla, CA 92037, USA

for submission to:

National Marine Fisheries Service, Office of Protected Resources  
1315 East-West Hwy, Silver Spring, MD 20910-3282

<b>Project No.</b>	218499	RPS
<b>Cruise ID No.</b>	JS2203	20405 Tomball Parkway Building 2, Suite 200
<b>Authors</b>	Yessica Vicencio	Houston, Texas 77070, USA Tel: (281) 448-6188
<b>Reviewer(s)</b>	Travis Lay	Fax: (281) 448-6189
<b>Submittal Date</b>	26 August 2022	E-mail: Travis.Lay@rpsgroup.com Website: www.rpsgroup.com

## Final (Draft)

Report Reviewer	
Name	Date of Review
Travis Lay	18 August 2022
Katherine Gideon	22 August 2022

Final Report Approval	
Name	
Title	
Signature	
Date	

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## Acronyms and Abbreviations

ADCP – Acoustic doppler current profiler  
 BioOp – Biological Opinion (US)  
 BOEM – Bureau of Ocean Energy Management  
 BSS – Beaufort Sea States  
 BZ – Buffer Zones  
 DAQ – Data acquisition  
 dB - decibels  
 DSLR – Digital Single Lens Reflex  
 EPU – Electronic Processing Unit  
 ESA – Endangered Species Act (US)  
 EEZ – Economic Exclusion Zone  
 EZ – Exclusion Zone  
 FONSI – Finding of No Significant Impact (US)  
 GPS – Global Positioning System  
 HF – High Frequency  
 HZ - Hertz  
 IHA – Incidental Harassment Authorization (US)  
 ITS – Incidental Take Statement (US)  
 LF – Low Frequency  
 MBES – Multibeam Echosounder  
 MCS - multichannel seismic  
 MMPA – Marine Mammal Protection Act (US)  
 NMFS – National Marine Fisheries Service (US)  
 NRP – Navigation Reference point  
 NSF – National Science Foundation (US)  
 OCS – Outer Continental Shelf  
 OEIS – Overseas Environmental Impact Statement (US)  
 PAM – Passive Acoustic Monitoring  
 PEIS – Programmatic Environmental Impact Statement (US)  
 PI – Principal Investigator  
 PTS – Permanent threshold shift  
 PSO – Protected Species Observer  
 RME – PAM sound card manufacturer company name (not an acronym)  
 RMS – Root mean square  
 RPS- PSO Provider company name (not an acronym)  
 R/V – Research vessel  
 SBP – Sub bottom Profiler  
 TOAD – Time of Arrival Distance  
 TVG – Transverse Gradiometer  
 UNAM – Universidad Nacional Autonoma de Mexico  
 US – United States  
 UTC – Coordinated Universal Time

## 1. EXECUTIVE SUMMARY

(R/V) *Justo Sierra*, owned and operated by Universidad Nacional Autonoma de Mexico (UNAM), conducted a low energy two-dimensional (2D) survey in the Southeastern Gulf of Mexico along the Campeche Bank and in the deep water north of the Yucatán Channel from 17 July 2022 to 26 July 2022 (referred to herein as “seismic survey”). The operational activities were conducted in support of research proposed by Principal Investigators (PIs) Dr. Christopher Lowery (University of Texas at Austin’s Institute for Geophysics), and Dr. Jaime Urrutia (UNAM), and funded by the National Science Foundation (NSF). Additional researchers collaborating on the project were from the University of Texas Institute of Geophysics and UNAM.

The goal of the proposed action was to image sediment drifts along Campeche Bank and in the deep water north of Yucatán Channel to reconstruct bottom water current changes through the Cenozoic era. The data would provide essential constraints for addressing important societally relevant questions on climate evolution and circulation changes.

This report was prepared to meet the reporting requirements for the survey required under the US Marine Mammal Protection Act (MMPA) and the US Endangered Species Act (ESA). On 17 March 2020, the Scripps Institute of Oceanography (SIO) submitted an IHA application to NOAA Fisheries Office of Protected Resources and the NMFS Permits Division. NMFS Permits Division deemed the Incidental Harassment Authorization (IHA) application adequate and complete on 26 May 2020. On 04 March 2022, the final IHA from the NMFS Permits Division was received Appendix A.

Mitigation measures were implemented to minimize potential impacts to protected marine mammals and endangered or threatened species, to include sea turtles during the survey. These measures included, but were not limited to, the use of NMFS approved Protected Species Observers (PSOs) for visual monitoring, and the designation of buffer zones (BZ) and exclusion zones (EZ) (where the presence of a protected species would trigger a mitigation action), ramp-up procedures, and mitigation actions (including delayed operations, and shut-downs). Continuous protected species observation coverage during the survey was provided by RPS, the environmental consulting company contracted by SIO for the project. PSOs monitored and reported on the presence and behavior of protected species and directed the implementation of the mitigation measures as described in the regulatory documents issued for the survey.

Additionally, PSO activities were consistent with the PSO standards identified in the Programmatic Environmental Impact Statement (PEIS) / Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the NSF or conducted by the U.S. Geological Survey and Record of Decision (referred to herein as the PEIS), to which the NSF Environmental Assessment (EA) tiered. Three PSOs, one of which was designated as the Lead, were present on board the *Justo Sierra* throughout the survey to conduct visual monitoring.

Visual observations for the survey totaled 137 hours and 56 minutes.

The acoustic source was active for a total of 129 hours and 22 minutes, of which 41% was during nighttime hours, with no visual monitoring.

There was a total of 17 protected species detections during the survey, which consisted of 14 detections of dolphins and three detections of sea turtles. The dolphin sightings included: one sighting of Atlantic spotted dolphins, seven sightings of bottlenose dolphins, and one sighting of pantropical spotted dolphins. The sea turtle detections consisted of one green sea turtle and two sightings of a single individual of a Kemp’s Ridley sea turtle.

Protected species detections did not result in the implementation of any mitigation action, as all the sightings occurred during transit.

NMFS issued an IHA authorizing 2197 takes for 17 species of marine mammals, including one species listed as endangered. All the takes were authorized only for Level B takes. For this report, Level A and Level B are used in the same definition as found in the MMPA and the NMFS issued BiOp description. During the survey, there were no potential takes recorded.

The BiOp is included in Appendix B.

A summary sheet of observation, detection, and operational totals for the seismic survey can be found in Appendix C.



## 2. INTRODUCTION

The following report details protected species monitoring and mitigation as well as seismic survey operations undertaken as part of the 2D marine geophysical survey on board the *Justo Sierra* in the Southeastern Gulf of Mexico along the Campeche Bank and in the deep water north of the Yucatán Channel from 17 July 2022 to 26 July 2022.

This document serves to meet the reporting requirements dictated in the IHA issued to SIO by NMFS on 29 June 2022. The IHAs authorized takes of specific protected species, incidental to the marine seismic survey. NMFS has stated that seismic source received sound levels equal to or greater than 160 dB re 1  $\mu\text{Pa}$  root mean square (rms) (160 dB) could potentially disturb marine mammals, temporarily disrupting behavior, such that they could be considered non-lethal ‘takes’ (Level B harassment). In July 2016, NMFS released new technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing, which established new thresholds for permanent threshold shift (PTS) onset, Level A harassment (auditory injury), for marine mammal species. Predicted distances to Level A harassment vary based on species specific hearing groups – low frequency cetaceans, mid frequency cetaceans, high frequency (HF) cetaceans, phocid pinnipeds, otariid pinnipeds, sea otters, and sea turtles – and how each group’s hearing range overlaps with the frequencies produced by the sound source. For sea turtles, per the ESA, NMFS has stated that received sound levels equal to or greater than 175 dB represents the current best understanding of the threshold at which they exhibit behavioral responses.

NMFS require that measures such as buffer zones (BZs), exclusion zones (EZs), delayed operations, ramp-ups, power-downs, and shut-downs be implemented to mitigate for potentially adverse effects of the acoustic source sounds on protected species. The BZs and EZs were established from any element on the acoustic source array as areas where the presence of a protected species would trigger the implementation of a mitigation action (delayed operations for the BZ and shut-downs for the EZ depending on the species – see section 3.1). For marine mammals and sea turtles, the occurrence of an individual detected approaching, entering, or within their designated EZ would trigger the implementation of a shut-down of the acoustic source. NMFS specified a 100 meter EZ for marine mammals and sea turtles as it encompasses all zones within which auditory injury (Level A harassment) could occur on the basis of instantaneous exposure, provides additional protection from the potential for more severe behavioral reactions for marine mammals at relatively close range to the acoustic source, provides a consistent area for PSOs to conduct effective observational effort, and is a distance within which detection probabilities are reasonably high for most species under typical conditions.

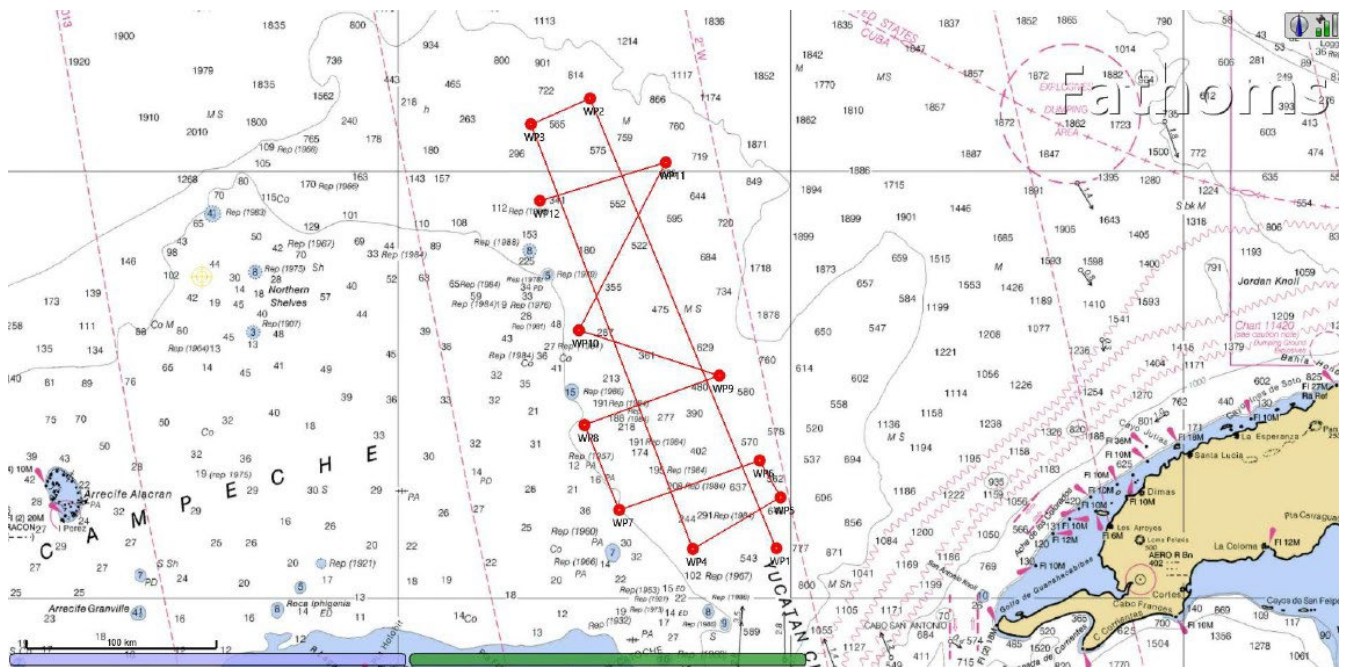
### 2.1. PROJECT OVERVIEW AND LOCATION

The research activities involved a 2D multichannel seismic (MCS) survey in the Southeastern Gulf of Mexico along the Campeche Bank and in the deep water north of the Yucatán Channel between approximately 22 to 25 degrees North and approximately 86 to 87 degrees West. The survey location was within the exclusive economic zones (EEZ) of Mexico and Cuba, in the Southeastern Gulf of Mexico (Figure 1). Water depths in the survey area ranged between approximately 200 meters and 1555 meters.

The purpose of the research was to acquire data along Campeche Bank and in the deep water north of the Yucatán Channel that will be used to characterize: 1) reconstruct bottom water current changes through the Cenozoic era; 2) reconstruct bottom water current changes associated with Loop Current in the Gulf of Mexico; 3) provide age control, velocity data, and some stratigraphic ground-truthing; and 4) determine the age of the sediment drifts by tracing key surfaces within them to cores taken within the study area by the Deep Sea Drilling Project.

All acoustic source data acquisition operations were conducted solely by R/V *Justo Sierra*. The vessel is 50 meters (164 feet) in length. R/V *Justo Sierra*’s cruising speed was approximately nine to 11 knots during transits and varied between 2.9 and 6.4 knots during the seismic survey.

Seismic data acquisition operations were conducted between 18 July 2022 and 24 July 2022. There was a total of 10 survey lines acquired during the seismic survey totaling 1069 kilometers.



**Figure 1. Location and survey lines of the marine geophysical survey.**

### 2.1.1. Energy Source and Receiving Systems

The energy source utilized during the surveys consisted of one towed acoustic source, with two source elements, deployed eight meters aft of the vessel. The source array utilized two 45 cubic inches (in<sup>3</sup>) elements, with frequency components ranging from 20 to 100 Hertz (Hz). The source elements were towed at a depth of three meters, and the source elements were situated eight meters astern of the vessel.

The maximum source volume utilized during the seismic survey was 90 in<sup>3</sup> with two active elements. During times when acoustic source arrays were brought on board for maintenance or repair, the sources were turned off. The shot point interval was 12 meters (approximately every 82 seconds). During acquisition the source elements emitted a brief (approximately 0.1 second) pulse of sound. During the intervening periods of operations, the source elements were silent.

The receiving system for the seismic survey consisted of a two-generator injector (GI) airgun array, with one 1,500 meter (4,921.3 feet) towed solid-state hydrophone streamer behind the vessel and an airgun array to conduct the two-dimensional low-energy seismic survey. The long streamer length allows for more accurate measurements of seismic velocities and provides a large amount of data redundancy for enhancing seismic images during data processing.

### 3. MITIGATION AND MONITORING METHODS

The PSO monitoring program on the *Justo Sierra* was established to meet the standards set forth in the PEIS, NSF EA, NMFS IHA and BiOp, requirements. Survey mitigation measures were designed to minimize potential impacts of the *Justo Sierra*'s seismic activities on marine mammals and sea turtles. The following monitoring protocols were implemented to meet these objectives.

- Visual observations were conducted to provide real-time sighting data, allowing for the implementation of mitigation procedures as necessary.

In addition to the mitigation objectives outlined in the IHA and BiOp, PSOs collected and analyzed necessary data mandated by the IHAs (see Appendix A and Appendix B).

#### 3.1. MITIGATION METHODOLOGY

Mitigation actions were established for visual detections of protected species, including marine mammals, and sea turtles, as outlined in the IHA and BiOp. These actions included the establishment of BZs and EZs, and the implementation of delayed operations, and shutdowns for protected species detected approaching, entering, or within their designated BZ and EZ.

Before the acoustic source could be activated from silence (day and night), two PSOs conducted a clearance survey of the BZs and EZs. The length of the clearance survey was 30 minutes. In the event of a detection of protected species within their designated zones (Table 2) or as outlined in Table 1, a delay of source operations would be implemented. Source operations would not be cleared to begin until the protected species were observed exiting their designated zones. If the protected species were not observed exiting their designated zones (i.e., if they dove/submerged within the zone and were not re-sighted), operations would not be cleared to begin until a specific time following the final detection of the animals. For detections of small odontocetes or sea turtles, this time was 15 minutes following last sighting. For detections of mysticetes and other large odontocetes (including sperm whales and beaked whales) this time was 30 minutes following last sighting.

Once the acoustic source was active, the BZ from any element on the acoustic source arrays were established as areas in which the presence of a protected species would initiate an alert to the seismic operators that the animal was detected, and that the implementation of a mitigation action may soon be required. PSOs would keep in frequent contact with the seismic operators, relaying information on the location and movement of the protected species, and the implementation of any needed mitigation actions.

The EZs from any active source element were established as areas in which the detection of a protected species would trigger a shut-down of the acoustic source. For marine mammals and sea turtles, the detection of one approaching, entering, or within their 100-meter EZ would trigger a shut-down. Upon special events, the EZ would increase to 500 meters, such cases included when an aggregation of six or more whales was encounter or when a mother/calf pair was sighted.

Upon the implementation of a shut-down for a detection of protected species, a ramp-up was required to resume source activity if the silent period was greater than 15 minutes. After a shutdown, if the protected species could not be confirmed to have exited their respective exclusion zones (i.e., if they submerged/dove within the zone and were not re-sighted), clearance for source activity to resume would not be given until a specific time following the last sighting of the individuals within the zones. For detections of small odontocetes and sea turtles, this time was 15 minutes following last sighting. For detections of mysticetes and other large odontocetes (including sperm whales and beaked whales) this time was 30 minutes following last sighting.

The IHA, also outlined additional mitigation actions for specific protected species while the acoustic source was active as outlined in Table 1. The shut-down requirement was waived for small dolphins in the

genera *Delphinus*, *Lagenodelphis*, *Stenella*, *Steno*, and *Tursiops*. If PSOs could identify the dolphins sighted as one of these species, no mitigation action was required if they were observed approaching, entering, or within the 100-meter exclusion zone. If there was any uncertainty regarding the species identification, visual PSOs were to use their best professional judgment in making the decision to call for a shut-down.

**Table 1: Specific detections of protected species and their required mitigation actions.**

Detection of:	Mitigation Action Required
A large whale (defined as a sperm whale or any mysticete species) with a calf (defined as an animal less than two-thirds the body size of an adult and observed in close association with an adult) observed at 500 meters from the vessel.	Delayed operation of inactive source and shutdown of active source.
An aggregation of six or more large whales observed at 500 meters from the vessel.	Delayed operation of inactive source and shutdown of active source.
Any marine mammal species not authorized for take observed approaching, entering, or within the 160-decibel radius.	Delayed operation of inactive source and shutdown of active source.
Any marine mammal species for which the total authorized takes has been met observed approaching, entering, or within the 160-decibel radius.	Delayed operation of inactive source and shutdown of active source.
Any other protected species detected approaching, entering, or within their designated buffer zones.	Delayed operation of inactive source and a warning call that a mitigation action may soon be required for an active source.
Any other protected species detected approaching, entering, or within their designated exclusion zones.	Delayed operation of inactive source and shutdown of active source.
Any dolphin species with a shut-down exemption detected approaching, entering, or within their designated exclusion zones.	None.

**Table 2: Separation distances, and buffer and exclusion zone sizes for each species/species group expected to occur in the survey area.**

Species / Species Groups	Separation Distance (m)	Buffer Zone (m)	Exclusion Zone (m)
Mysticetes	100	200 (6+) 500 (Adult +calf) 500	100 (6+) 500 (Adult +calf) 500
Sperm whales	100	200 (6+) 500 (Adult +calf) 500	100 (6+) 500 (Adult +calf) 500
Beaked whales / pygmy and dwarf sperm whales	100	200 (6+) 500 (Adult +calf) 500	100 (6+) 500 (Adult +calf) 500
Killer whales / Risso's dolphins	50	200	100
Delphinids / Porpoise	50	200	100
Pinnipeds	50	200	100
Sea turtles	50	200	100

<sup>1</sup>Sightings of an aggregation of six or more individuals or an adult with a calf have BZ and EZ- of 500 meters.

<sup>2</sup> Except exempt species per the NMFS IHA.

Specific acoustic source operation procedures outlined in the IHAs included:

1. Brief periods (less than 30 minutes) of operational silence for reasons other than a protected species shut-down did not require a ramp-up to resume full volume source operations provided that: (1) PSOs maintained constant visual observation, and (2) no detections of protected species occurred within the applicable exclusion zone during that silent period. For any brief period of silence at night or in periods of poor visibility (e.g., BSS of four or greater), a ramp-up was required, but if constant observation was maintained, a pre-start clearance watch was not required. For any longer shut-down, both a pre-start clearance watches and a ramp-up were required.

Table 3 describes the predicted 160 decibel radius (Level B harassment zone for marine mammals) and the predicted 175 decibel radius (behavioral harassment zone for sea turtles). Table 4 describes the predicted Level A harassment zones for each protected species hearing group per the NMFS guidelines, and the species that could occur in the survey area assigned to each group; as noted previously however, shutdowns would occur at each species designated EZs (e.g., 500m, 1500m, etc.).

**Table 3: Predicted 160/175/195 Decibel Zones\* Implemented during the seismic survey.**

Source	Volume (in <sup>3</sup> )	Water Depth (m)	160 dB radius – Level B harassment zone for marine mammals	175 dB radius – behavioral harassment zone for sea turtles
2 elements	90	>1,000	539	95
		100-1,000	809	142
*Distances are from any single element on the array				

**Table 4: Predicted Level A Harassment Zones\* for each Marine Mammal Hearing Group Implemented during the seismic survey.**

Source	Volume (in <sup>3</sup> )	Water Depth (m)	Mid-frequency cetaceans	High-frequency cetaceans
2 elements	90	>1,000	1.0	34.6
		100-1,000		
*Distances are from any single element on the array				

### 3.2. VISUAL MONITORING SURVEY METHODOLOGY

There were three PSOs onboard the *Justo Sierra* during the seismic survey to conduct monitoring for protected species, record and report detections, and request mitigation actions in accordance with the NSF EA, PEIS, IHA, and BiOp. The PSOs on board were NMFS approved and held certifications from a recognized Bureau of Ocean Energy Management (BOEM) course. Visual monitoring was primarily carried out from the bridge wings (Figure 2) located 6.90 meters above the surface of the water, which allowed a good viewpoint around the vessel and acoustic source.



**Figure 2. Protected Species Observer stern view of the observation spot on the starboard bridge wing.**

The PSOs were equipped with SLR cameras, Fujinon 7x50 binoculars, as well as one mounted 25x150 Big-eye binocular located on the bow of the vessel, 4.5 meters above the surface of the water (Figure 3). Two Butler Creek PVS-7-night vision devices were also available for visual monitoring during reduced/restricted lighting conditions if needed. Inside the bridge, the monitors displayed pertinent information about the vessel including position; speed; heading; water depth; sea temperature; wind speed and direction and air temperature. Environmental conditions along with vessel and acoustic source activity were recorded at least once an hour, or every time there was a change in one or more of the above variables. Most visual monitoring was held from the bridge wings; however, during severe weather, monitoring would be conducted from the bridge or the bow.



**Figure 3. Protected Species Observer view of the observation spot on the bow where the big eyes where located.**

Visual monitoring methods were implemented in accordance with the survey requirements outlined in the IHAs. Two PSOs visually monitored for protected species during daylight hours throughout the survey program, from port to port. Visual monitoring during the transits between the ports and the survey area were conducted for vessel strike avoidance and to gather baseline data on the presence and abundance of protected species in the areas during periods of acoustic source silence. Throughout the survey program, visual monitoring was conducted each day from 30 minutes before sunrise until 30 minutes after sunset as required by the IHAs. Observation times ranged between 10:40 to 01:25 Coordinated Universal Time (UTC) (06:40 to 20:25 local time). Scheduled watches were a maximum of four hours in duration followed by at least one hour of scheduled break time.

Visual observations were conducted around the entire area of the vessel and acoustic source, divided between the two PSOs on watch. The smaller monitoring area for each observer increased the probability of protected species being sighted. PSOs searched for blows, fins, splashes or disturbances of the sea surface, large flocks of feeding sea birds, and other sighting cues indicating the possible presence of a protected species. Upon the visual detection of a protected species, PSOs would identify the animals' range to the vessel and acoustic source. Range estimations were made using reticle binoculars, the naked eye, and by relating the animal(s) to an object at a known distance, such as the acoustic source arrays and streamer head float. PSOs would also identify to species, if possible, upon initial detection to ensure that the proper mitigation measures were implemented, should any be required.

As required by the IHA (section 5(d)(iii)), PSOs recorded the following information for each protected species detection:

- I. Date, time of first and last sighting, observers on duty during the detection, location of the observers, vessel information (e.g., position, speed, heading), water depth, and acoustic source activity (e.g., volume and number of active elements).
- II. Species, detection cue, group size (including number of adults, juveniles, and calves), visual description (e.g., overall size, shape of the head, position and shape of the dorsal fin, shape of the flukes, height and direction of the blow), observed behaviors (e.g., porpoising, logging, diving,

- etc.), and the initial and final pace, heading, bearing, and direction of travel in relation to both the vessel and the source (e.g., towards, away, parallel, perpendicular, etc.).
- III. Initial, closest, and final distance to the vessel and the source, time when entering and exiting the exclusion zones, type of mitigation action implemented, total time of the mitigation action, description of other vessels in the area, and any avoidance maneuvers conducted.

During or immediately after each sighting event, the PSOs recorded the detection details per the requirements of the IHAs in a detection datasheet. Each sighting event was linked to an entry on an effort datasheet where specific environmental conditions (e.g., Beaufort Sea state, wind force, swell height, visibility, and glare) and vessel activity were logged.

Species identifications were made whenever the distance from the observer, length of the sighting, and visual observation conditions allowed. Whenever possible during detections, photographs were taken with SLR cameras. Marine mammal identification manuals (*Whales, Dolphins and Other Marine Mammal of the World*; *Guide to Marine Mammals of the world*; *Marine mammals and sea turtles of the Gulf of Mexico*) were consulted, and photos were examined to confirm identifications were consulted, and photos were examined to confirm identifications.



## 4. MONITORING EFFORT SUMMARY

### 4.1. SURVEY OPERATIONS SUMMARY

#### 4.1.1. General survey parameters

The Low-Energy Marine 2D Survey in the Southeastern Gulf of Mexico began on 17 July 2022 when the *Justo Sierra* departed port in Progreso, Yucatan and concluded on 26 July 2022 when the *Justo Sierra* arrived at port in Tuxpan, Veracruz (Table 5). The dates and times of acquisition for each survey line can be found in Appendix F.

**Table 5: Survey parameters of the program.**

Survey Parameter	Date	Time (UTC)	Location
Mobilization	15 July 2022	17:00	Progreso, Yucatán
First Source Activity	18 July 2022	17:19	Survey area
Start of Acquisition	18 July 2022	22:56	Survey area
End of Acquisition	24 July 2022	07:35	Survey area
Demobilization	26 July 2022	20:20	Tuxpan, Veracruz

During the seismic survey, data was acquired continuously according to the survey plan, with source operations only suspended when operationally necessary, as outlined in Table 6.

**Table 6: Suspension of source operations during the seismic survey.**

Date	Time Source silenced	Date	Time Source Re-activated	Reason for Interruption in Acquisition
18 July 2022	18:08	18 July 2022	21:37	Source disabled and recovered for repair. Source re-activated with a ramp-up.
20 July 2022	03:25	20 July 2022	03:57	Source turned off without notice from the operators as the trigger stopped communicating. Source repaired and turned back to full volume.
20 July 2022	04:18	20 July 2022	05:01	Upon realizing a pre-watch was needed before turning the source back on, the seismic operators turned the source off and requested a pre-watch followed by a ramp-up.
21 July 2022	18:58	21 July 2022	19:02	Source off to switch compressor cables.

#### 4.1.2. Acoustic source operations

The acoustic source was active for a total of 129 hours and 22 minutes throughout the seismic survey. This total included: 26 minutes of ramp-up, 121 hours and 45 minutes of operations on a survey line and seven hours 11 minutes of operations of full volume while not on a survey line. Table 7 summarizes the acoustic source operations over the course of the seismic survey.

The acoustic source was ramped up three times, all to commence source operations from a period of silence. Two ramp-ups were conducted during daylight hours and one ramp-up was conducted during hours of darkness. All ramp-ups were cleared by visual monitoring. Ramp-ups averaged eight minutes in duration and were conducted by manually activating each of the two elements; the first element was activated and seven-eleven minutes later, the second one.

There were no operations with only a single 40 in<sup>3</sup> source element conducted.

**Table 7. Total acoustic source operations during the seismic survey.**

Acoustic Source Operation	Number	Duration
<b>Source Tests</b>	00	00:00
<b>Ramp-up</b>	03	00:26
Day-time ramp-ups from source silence	02	00:18
Night-time ramp-ups from source silence	01	00:08
<b>Full volume (90 in<sup>3</sup>) on a Survey Line</b>		121:45
<b>Full volume (90 in<sup>3</sup>) not on a Survey Line</b>		07:11
<b>Single Source Element (40 in<sup>3</sup>)</b>		00:00
<b>Total Time Acoustic Source Was Active</b>		129:22

The geospatial data for source operations are provided as a shapefile attachment to this report. The volume of the acoustic source did not change along the survey.

#### 4.1.3. Interactions with Other Vessels

There were no interactions with other vessels.

## 4.2. VISUAL MONITORING SURVEY SUMMARY

Visual monitoring was conducted by two PSOs during all daylight hours, beginning 30 minutes before sunrise and ending 30 minutes after sunset each day, initiating when the vessel left the dock at the beginning of the program and terminating upon the vessels return to dock at the end of the program (Table 8). This included times when the vessel was in transit and deploying and retrieving equipment. Visual monitoring during transit was conducted for vessel strike avoidance, and visual monitoring during times with no source operations was conducted to collect baseline data about protected species abundance in the survey areas. During nighttime hours, there were 40 minutes of visual monitoring to clear the BZ and conduct a ramp-up.

**Table 8: Initiation and termination of visual monitoring during the seismic survey.**

Visual Monitoring	Date	Time (UTC)
Initiation for the seismic survey	17 July 2022	12:00
Termination for the seismic survey	26 July 2022	20:20

Visual monitoring was conducted over a period of 10 days for a total of 137 hours and 56 minutes. Of the overall total visual monitoring effort, 55.2% (76 hours and 11 minutes) was undertaken while the acoustic source was active, and 44.8% (61 hours and 45 minutes) was undertaken while the acoustic source was silent. Visual monitoring while the acoustic source was silent was mainly conducted during the transits to and from the survey site. Table 9 details visual monitoring with acoustic source operations throughout the seismic survey.

**Table 9. Total visual monitoring effort during the seismic survey.**

Visual Monitoring Effort	Duration (hh:mm)	% of Overall Visual Monitoring Effort
Total monitoring while acoustic source active	76:11	55.2
Total monitoring while acoustic source silent	61:45	44.8
<b>Total monitoring effort</b>	<b>137:56</b>	-

Visual observations were preferentially conducted from the bridge wings, which provided a 360-degree view of the water around the vessel and the acoustic source. Visual watches were conducted from other locations, including the bridge, and bow if monitoring conditions could not be undertaken from the bridge wings, such as during rough weather like extreme heath. PSOs conducted visual monitoring from the bridge wings (77%) more often than any other location (Table 10). Monitoring was conducted from inside the bridge or the bow when the heath and sun did not allow for any shade under the umbrellas on the bridge wings.

**Table 10: Total visual monitoring effort from observation locations during the seismic survey.**

Observation Location During Visual Effort	Duration (hh:mm)	% of Overall Effort
Bridge wings	106:27	77
Bridge	23:04	17
Other (bow)	08:25	6

### 4.3. ENVIRONMENTAL CONDITIONS

Environmental conditions can have an impact on the probability of detecting protected species. The environmental conditions present during visual observations undertaken were generally considered to be very good. Visibility was classified as ‘excellent’ if it extended greater than 10 kilometers and “very good” if it was between seven and 10 kilometers. Due to the size of the Justo Sierra, the furthest visibility was estimated to be eight kilometers. During the seismic survey 91.92% of monitoring effort was undertaken at ‘very good’ visibility levels (Table 11). The entire predicted harassment zone radii, BZs, and EZs were not visible during 2.98% of the monitoring effort, mainly due to precipitation. During these times, it is possible that protected species were not detected within these zones.

**Table 11. Visibility during the seismic survey.**

Total	<0.05 km	0.05-0.1 km	0.1-0.3 km	0.3-0.5 km	0.5-1 km	1-2 km	2-5 km	5-7 km	7-10 km	>10 km
Duration (hh:mm)	00:00	00:13	00:52	01:39	01:23	01:30	02:16	03:16	126:47	00:00
% of effort	0.00	0.16	0.63	1.20	1.00	1.09	1.64	2.37	91.92	0.00

Reduced visibility was mainly attributed to the brief periods of reduced lighting before sunrise and after sunset. Precipitation in the form of light rain was recorded during visual monitoring for a total of 21 minutes, and haze was recorded for a total of nine minutes. The rest of the time (99.64%), there were clear precipitation conditions (Table 12).

**Table 12. Precipitation during the seismic survey.**

Total	None	Heavy Rain	Moderate Rain	Light Rain	Heavy Fog	Moderate Fog	Thin Fog	Haze
Duration (hh:mm)	137:26	00:00	00:21	00:00	00:00	00:09	00:00	00:00
% of effort	99.64	0.00	0.25	0.00	0.00	0.11	0.00	0.00

The Beaufort Sea state recorded during visual monitoring ranged from level one to level four. The majority of visual observations were undertaken in conditions where the Beaufort state was level two (57.38%) or level three (41.53%), which were considered good conditions for the detection of protected species (Table 13).

**Table 13. Beaufort Sea State during the seismic survey.**

Total	B1	B2	B3	B4
Duration (hh:mm)	00:30	79:09	57:17	01:00
% of effort	0.36	57.38	41.53	0.72

Wind speeds recorded during visual monitoring ranged between one and 22 knots. The majority of visual monitoring occurred during recorded wind speeds of less than 10 knots (53.70%) and less between 10 to 15 knots (25%) (Table 14).

**Table 14. Wind speed during the seismic survey.**

Total	<10	10-15	16-20	21-25	26-30	>30
Duration (hh:mm)	74:04	55:37	07:22	00:53	00:00	00:00
% of effort	53.70	40.32	5.34	0.64	0.00	0.00

Swell heights during visual observations were always less than two meters (Table 15).

**Table 15. Swell Height during the seismic survey.**

Total	<2m	2-4m	>4m
Duration (hh:mm)	137:56	00:00	00:00
% of effort	100	00:00	00:00

Most of the visual monitoring effort was conducted with severe or moderate glare (36.07% and 28.23% respectively) (Table 16). During times of moderate to severe glare, it is possible that the detections of protected species was hindered.

**Table 16. Glare during the seismic survey.**

Total	None	Mild	Moderate	Severe
Duration (hh:mm)	18:05	31:10	38:56	49:45
% of effort	13.11	22.60	28.23	36.07

## 5. MONITORING AND DETECTION RESULTS

### 5.1. VISUAL DETECTIONS

Visual monitoring efforts resulted in a total of 17 visual detections of protected species (summarized in Appendix H). This total included 14 detections of dolphins, and three detections of sea turtles (Figure 4). Table 17 lists the total number of detections and total number of animals recorded for each protected species observed. Photographs taken of visual detections can be found in Appendix I.

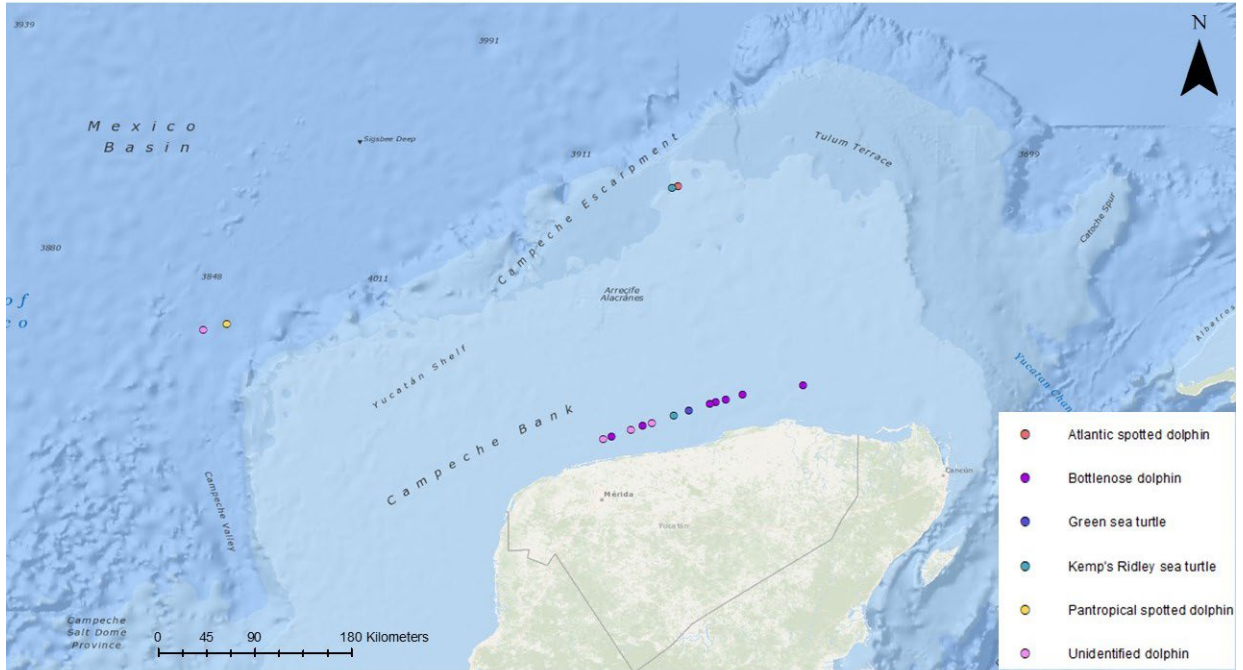
**Table 17. Number of visual detection records collected for each protected species during the seismic survey.**

Species	Project Totals	
	Total Number Detection Records	Total Number Animals Recorded
<b>Dolphins</b>		
Atlantic spotted dolphin	1	2
Bottlenose dolphin	7	55
Pantropical spotted dolphin	1	7
Unidentifiable Dolphin	5	9
<b>Sea turtles</b>		
Green sea turtle	1	1
Kemp's Ridley sea turtle	2	2
<b>TOTAL</b>	<b>17</b>	<b>76</b>

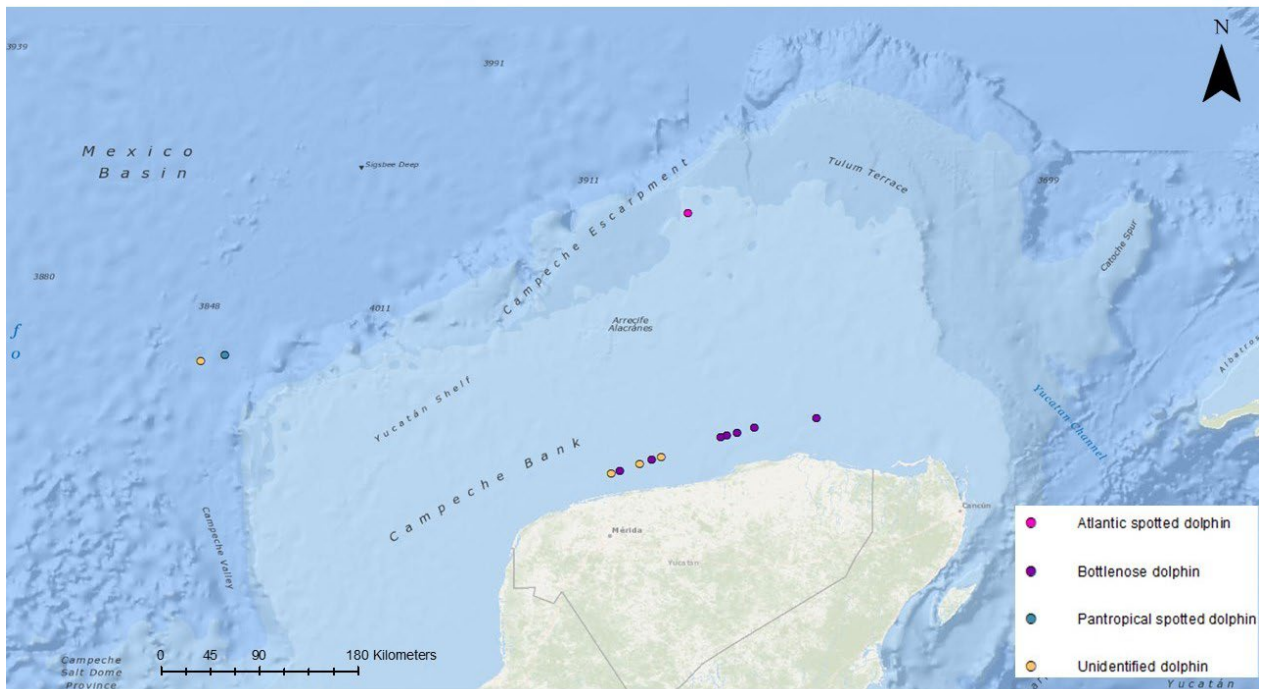
Bottlenose dolphins were the most frequently observed species during the survey, totaling 41.18% of all visual detections of protected species (Figure 5). This species was also the most numerous observed species, totaling 72.37% of all individuals visually observed during the survey. Most of the detection consisted of less than 10 individuals, with two sightings of bottlenose dolphins of 12 and 15 individuals. One of the sightings of bottlenose dolphins and the sighting of pantropical spotted dolphins included at least one calf.

There was a total of three sea turtle detections. One detection of a single green sea turtle and two detections of a single Kemp's Ridley sea turtle (Figure 6).

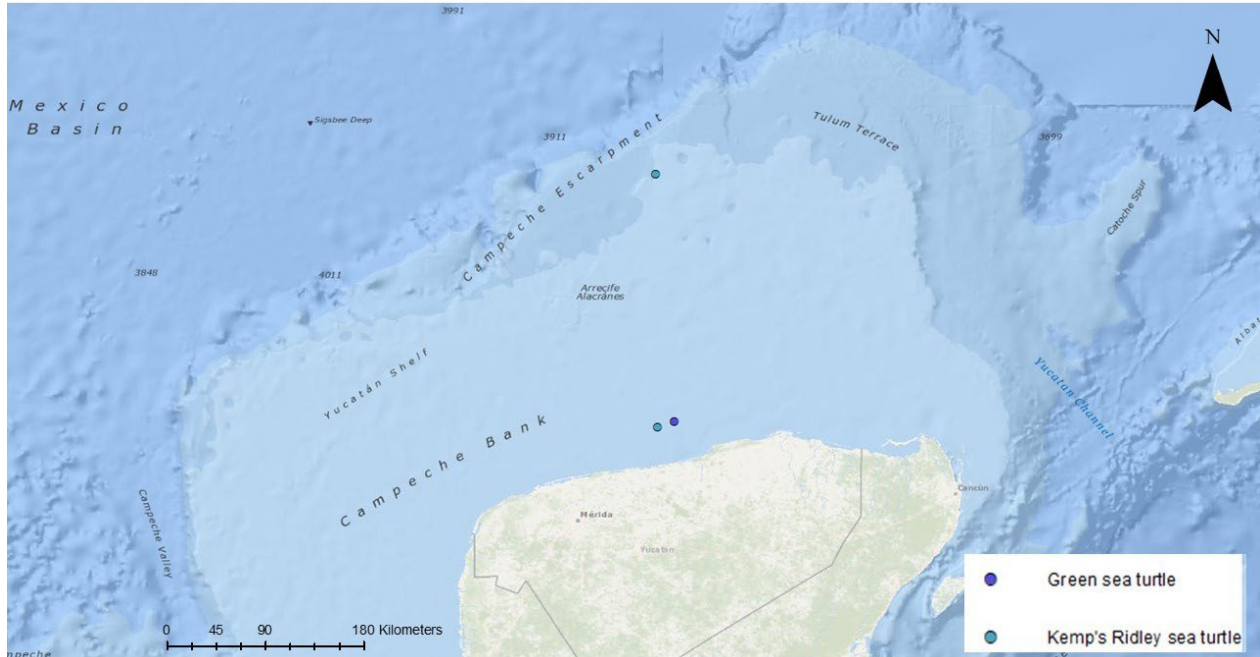
All the sightings occurred during transit with the acoustic source onboard. Of the total, 12 detections occurred from port to the survey area and five while in transit from the survey area to port upon completing the seismic survey. Most of the sightings (88.24%) occurred in water depths of less than 100 meters, however, the sighting of pantropical spotted dolphins and one of the sightings of unidentifiable dolphins occurred in water depths of 1490 and 1556 meters respectively.



**Figure 4: All protected species detections during the survey activities.**



**Figure 5: All dolphin detections during the survey**



**Figure 6: All sea turtle detections during the survey**

**5.1.1. Other Wildlife**

Observations of other wildlife included 31 species of birds, five species of fish, and two species of marine invertebrates. A complete list of birds and other marine wildlife observed and identified, in addition to the approximate number of individuals observed and the number of days on which they were observed, can be found in Appendix M. No impacts to any other wildlife species were observed during the survey.

## 6. MITIGATION ACTION SUMMARY

There were no mitigation actions implemented during the seismic survey.

### 6.1. PROTECTED SPECIES KNOWN TO HAVE BEEN EXPOSED TO 160 DECIBELS OR GREATER OF RECEIVED SOUND LEVELS

Numerous protected species are known to occur within the survey area, including the sperm whale.

NMFS granted an IHA for the marine seismic survey authorizing a total of 2197 takes from 17 species, including two species of whales, and 14 species of dolphins. All authorized takes were for Level B harassment takes (exposure to sound pressure levels equal to or greater than 160 dB re: 1  $\mu$ Pa (rms) where there is a potential for behavioral changes. There were no allowed Level A takes (exposure to sound pressure levels where there is a potential for auditory injury based upon each species hearing range).

Throughout the seismic survey, there were no potential takes recorded. [Table 18](#) details the authorized takes granted for the seismic survey.

Weather conditions have a large impact on the ability to visually detect protected species, particularly smaller or unobtrusive species such as sea turtles, and beaked whales. Visual monitoring was conducted for 76 hours and 11 minutes while the acoustic source was active. Of this time, 26 hours and 52 minutes were undertaken while severe glare, which were considered moderate to poor conditions for visually sighting protected species. In addition, there were several occasions where the entire predicted radii and zones were not entirely visible, mainly due to reduced lighting in the dawn/dusk hours and precipitation.

**Table 18. Number of authorized Level B Harassment Takes during the seismic survey.**

Species common name	IHA Authorized Level B Takes
Sperm Whale	17
Atlantic spotted dolphin	130
Beaked whale	25
Common bottlenose	343
Clyme dolphin	90
False killer whale	28
Fraser's dolphin	65
Killer whale	7
Melon-headed whale	100
Pantropical spotted dolphin	864
Short-finned pilot whale	25
Pygmy killer whale	19
Risso's dolphin	56
Rough-toothed dolphin	56
Spinner dolphin	298
Striped dolphin	46
kogia sp	28



## 6.2. IMPLEMENTATION AND EFFECTIVENESS OF THE BIOLOGICAL OPINION'S AND IHAs

In order to minimize the potential impacts to marine mammals and sea turtles during the seismic survey, SIO and PSOs were prepared to implement mitigation measures whenever these protected species were detected approaching, entering, or within their designated exclusion zones as outlined in the IHAs, BiOp. There were no mitigation actions implemented for protected species. The confirmation of the implementation of each term and condition of the project permit documents are described in this report.

In the event that an injured or dead protected species was discovered, the incident was to be reported to the NMFS Office of Protected Resources (OPR), and the NMFS Marine Standing Network Coordinator as soon as possible. The report would include a detailed description of the incident (time, date, location, species identification, description of the animal, condition of the animal/carcass, observed behaviors if the animal was alive, and general circumstances under which the animal was discovered), including pictures when possible. There were no sightings of dead or injured protected species during the seismic survey.

In order to prevent the occurrence of the vessel striking a marine mammal during transits, PSOs and vessel crew members maintained a vigilant watch for marine mammals, and the vessel was prepared to slow down, stop, or alter course as appropriate to avoid striking a protected species. The vessel speed had to be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans were observed near the vessel. The vessel had to maintain the minimum separation distances as described in (Table 2) in Section 3.1. If a marine mammal was sighted during transits, the vessel was to act as necessary to avoid violating the relevant separation distances (e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal left the area). If marine mammals were sighted within the relevant separation distances, the vessel was required to reduce speed, shift the engines to neutral, and not engage the engines until the animals were clear of the area. These requirements did not apply in any case where compliance would create an imminent and serious threat to a person or vessel, or if the vessel was restricted in maneuverability due to towed equipment. There were no vessel strike avoidance measures implemented during the seismic survey.

In the event of a ship strike of a marine mammal, the incident was to be reported to NMFS Office of Protected Resources (OPR), and the NMFS Marine Standing Network Coordinator as soon as possible as soon as feasible. The report would include a detailed description of the incident (date, time, location, species identification, description of the animal(s) involved, vessel speed leading up to the incident, vessel's course/heading and what operations were being conducted, status of all sound sources in use, description of avoidance measures taken if any, environmental conditions, description of the animals behavior preceding and following the strike, and estimated fate of the animal), including pictures when possible. There were no instances of the vessel striking a protected species during the seismic survey.

PSOs likely did not detect some animals present during seismic activities; however, it is highly unlikely that the actual number of animals present during survey operations reached anywhere near the fully authorized levels for all species. The combination of conservative predicted mitigation zones combined with conservative take estimation by NMFS (*i.e.*, the precautionary approach), appears for most species to have resulted in an overestimation of take and of overall impact on marine species from the activity. The monitoring and mitigation measures required by the IHAs and ITSs appear to have been an effective means to protect the marine species encountered during survey operations.

On 20 July, a potential non-compliance action occurred when the software stopped triggering and the sound source stopped firing during nighttime hours while no visual monitoring was performed. After 32 minutes of silence, the source operator re-activated the source at full volume. Source operator realized that the PSO team had not been notified such that they could conduct a pre-clearance search and then clear the vessel to conduct a ramp-up. PSOs and crew held a meeting to review the protocols in the IHA relevant to this situation and there were no further occurrences during the remainder of the cruise

**APPENDIX A: Incidental Harassment Authorization.**

**APPENDIX B: Biological Opinion**

### APPENDIX C: Basic Data Summary Form

BASIC DATA FORM			
Project Number			
Seismic Contractor		Scripps	
Area Surveyed During Reporting Period		~22-25 degrees North and ~86-87 degrees West	
Survey Type		2D MCS	
Vessel and/or Rig Name		R/V <i>Justo Sierra</i>	
Permit Number		IHAs and BiOps issued by NMFS	
Location / Distance of Source Deployment		eight meters astern (from the NRP in the PSO tower)	
Water Depth	Min	200	
	Max	1555	
Dates of protect		16 July 2022	Through 26 July 2022
Total time source operating – all power levels:		129:22	
Time source operating on survey lines:		121:45	
Time source operating not on a survey line:		07:11	
Amount of time single 40 in <sup>3</sup> element operations:		00:00	
Amount of time in ramp-up:		00:26	
Number daytime ramp-ups:		2	
Number of nighttime ramp-ups:		1	
Number of ramp-ups from mitigation source:		0	
Amount of time conducted in source testing:		00:00	
Duration of visual observations:		137:56	
Duration of observations while source active:		76:11	
Duration of observation during source silence:		61:45	
Duration of acoustic monitoring:		00:00	
Duration of acoustic monitoring while source active:		00:00	
Duration of acoustic monitoring during source silence:		00:00	
Duration of simultaneous acoustic and visual monitoring:		00:00	
Lead Protected Species Observer:		Yessica Vicencio	
Protected Species Observers on the Langseth:		Andrea Zavala, Elsy Olivares	
Number of Marine Mammals Visually Detected:		14	
Number of Marine Mammals Acoustically Detected:		N/A	
Number of Simultaneous Visual and Acoustic Detections:		N/A	
Number of Sea Turtles detected:		3	
Total Number of Protected Species Detections:		17	
List Mitigation Actions		None	
Duration of Mitigation Actions:		00:00	

## **APPENDIX D: Survey Lines Acquired**

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced (UTC)	Date Acquisition Completed	Time Acquisition Completed (UTC)	Comment
1001	2022-07-18	22:56	2022-07-20	05:13	Potential non-compliance when the source stopped firing and they were fixed and restarted after 32 minutes of silence.
1002	2022-07-20	06:21	2022-07-20	10:52	
1003	2022-07-20	11:43	2022-07-21	18:46	
1004	2022-07-21	19:11	2022-07-22	01:44	
1004a	2022-07-22	02:00	2022-07-22	03:20	
1005	2022-07-22	03:49	2022-07-22	13:22	
1005a	2022-07-22	13:35	2022-07-22	17:45	
1006	2022-07-22	18:34	2022-07-23	03:08	
1007	2022-07-23	03:52	2022-07-23	12:41	
1008	2022-07-23	13:03	2022-07-23	24:00	
1009	2022-07-24	00:23	2022-07-24	07:35	

## **APPENDIX E: Changes in Acoustic Source Volume During Survey Operations**

There were no changes in the source volume.

## APPENDIX F: Summary of Visual Detections of Protected Species during the Seismic Survey.

**Movement Codes:** **TV:** towards vessel; **AV:** away from vessel; **PV/SD:** parallel vessel, same direction; **PV/OD:** parallel vessel, opposite direction; **PE (AH/BH):** perpendicular (crossing ahead or behind); **MI:** milling; **SA:** stationary; **V:** variable, **UN:** unknown; **OM:** other movement

**Behavioral Codes:** **NS:** normal swimming; **FT:** fast travel; **ST:** slow travel; **PO:** porpoising; **SS:** swimming below surface; **MI:** milling; **BR:** bow/wake riding; **BA:** resting/basking at surface; **FL:** floating; **SA:** surface active (lob tailing/pectoral slapping, full/partial breaching); **R:** rolling; **DI:** dive; **DF:** dive with fluke; **FF:** feeding/foraging; **SB:** social behavior; **MT:** mating behavior; **BV:** blow visible (whale); **SV:** only splashes visible (dolphins); **DV:** dorsal fin visible; **OB:** other behavior

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Water Depth	Comments
1	2022-07-17	01:18	Unidentifiable dolphin	2	21.45885°N 089.60753°W	Not deployed	TV	NS, SS, DI	N/A	None	9.5	Detection occurred within Mexican waters
2	2022-07-17	14:43	Unidentifiable dolphin	1	21.53625°N, 089.38042°W	Not deployed	AV	DV	N/A	None	18	Detection occurred within Mexican waters
3	2022-07-17	15:17	Common bottlenose dolphin	5	21.56917°N, 089.28167°W	Not deployed	PV/SD	SS, DV, DI	N/A	None	19.3	
4	2022-07-17	15:44	Unidentifiable dolphin	2	21.59193°N, 089.21205°W	Not deployed	PV/OD	DV, SS	N/A	None	19.3	
5	2022-07-17	16:19	Common bottlenose dolphin	10	21.48187°N, 089.53948°W	Not deployed	PV/OD	NS, SA	N/A	None	19	
6	2022-07-17	16:54	Kemp's Ridley sea turtle	1	21.65102°N, 089.03038°W	Not deployed	TV	BA, DI	N/A	None	20	
7	2022-07-17	17:39	Green sea turtle	1	21.68888°N, 088.91090°W	Not deployed	PV/OD	SS	N/A	None	20	
8	2022-07-17	18:59	Common bottlenose dolphin	12	21.75680°N, 088.69383°W	Not deployed	TV, PV/OD, AV	NS, SA, SS	N/A	None	18	
9	2022-07-17	19:30	Common bottlenose dolphin	9	21.78297°N, 088.60707°W	Not deployed	PV/SD, PV/OD	DV, SA	N/A	None	19	
10	2022-07-17	19:42	Common bottlenose dolphin	15	21.74383°N, 088.73603°W	Not deployed	TV, AV	FT, SS	N/A	None	18	

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Water Depth	Comments
11	2022-07-17	20:22	Common bottlenose dolphin	3	21.82303°N, 088.47310°W	Not deployed	PV/SD	FT, DI	N/A	None	20	
12	2022-07-17	23:19	Common bottlenose dolphin	1	21.89340°N, 087.98498°W	Not deployed	PE/AH	DI	N/A	None	22	
13	2022-07-24	19:19	Atlantic spotted dolphin	2	23.51373°N, 088.99885°W	Not deployed	TV, PV/SD	SA, SS, DI	N/A	None	80	
14	2022-07-24	19:34	Kemp's Ridley sea turtle	1	23.49718°N, 089.04838°W	Not deployed	PV/OD	BA	N/A	None	92	
15	2022-07-25	16:13	Pantropical spotted dolphin	7	22.39630°N, 092.66080°W	Not deployed	TV, PV/SD	NS, SA, BR, DI	N/A	None	1490	
16	2022-07-25	17:15	Unidentifiable dolphin	1	22.34763°N, 092.85195°W	Not deployed	PV/OD	SW, SS	N/A	None	1556	
17	2022-07-26	19:50	Unidentifiable dolphins	3	20.98072°N 097.28513°W	Not deployed	PV/OD	SS, DI	N/A	None	12	Detection occurred within Mexican waters.



**APPENDIX G: Photographs of Protected Species Visually Detected during the Survey Program.**



**Figure 7: Unidentified dolphin observed on 17 July 2022 (VD01).**



**Figure 8: Bottlenose dolphins observed on 17 July 2022 (VD02).**



**Figure 9: Kemp's Ridley sea turtle observed on 17 July 2022 (VD06).**



**Figure 10: Bottlenose dolphins observed on 17 July 2022 (VD09).**



**Figure 11: Bottlenose dolphin observed on 17 July 2022 (VD10).**



**Figure 12: Bottlenose dolphins observed on 17 July 2022 (VD12).**



**Figure 13: Atlantic spotted dolphins observed on 24 July 2022 (VD13).**



**Figure 14: Kemp's Ridley sea turtle observed on 24 July 2022 (VD14).**



**Figure 15: Pantropical spotted dolphin with a calf observed on 24 July 2022 (VD15).**



**Figure 16: Unidentified dolphin observed on 24 July 2022 (VD16).**



**Figure 17: Unidentified dolphin observed on 24 July 2022 (VD17).**

### Appendix H: Species of Birds and Other Wildlife Observed during the Seismic Survey

Birds: Common Name	Taxonomic Identification	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Brown booby	<i>Sula leucogaster</i>	14	7
Brown Pelican	<i>Pelecanus occidentalis</i>	4	2
Laughing gull	<i>Leucophaeus atricilla</i>	4	3
Magnificent frigatebird	<i>Fregata magnificens</i>	4	3
Red-footed booby	<i>Sula sula</i>	1	1
Royal tern	<i>Thalasseus maximus</i>	13	1
Sandwich tern	<i>Thalasseus sandvicensis</i>	3	1
Swallow sp.	<i>Hirundinidae</i>	7	4

Fish: Common Name	Taxonomic Identification	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Black-tip shark	<i>Carcharhinus melanopterus</i>	1	1
Cownose rays	<i>Rhinoptera bonasus</i>	14	1
Flying fish	<i>Exocoetidae</i>	842	9
Mahi mahi	<i>Coryphaena hippurus</i>	6	2