Gulf of Mexico Incidental Take Regulation (ITR) Annual Report

Project No. 318160-36423 Doc No. 318160-36423-EN-MEM-0005

Comprehensive Reporting Requirement

The *Incidental Take Regulation for Taking Marine Mammals Incidental to Geophysical Surveys Related to Oil and Gas Activities in the Gulf of Mexico* published on January 19, 2021 with an effective date of April 19, 2022 (86 Federal Register [FR] 5322) requires industry members who receive Letters of Authorization (LOAs) under this regulation provide a comprehensive annual report.

"In addition, on an annual basis, LOA-holders will also collectively be responsible for compilation and analysis of those data for inclusion in subsequent annual synthesis reports. Individual LOA-holders may collaborate to produce this report or may elect to have their trade associations support the production of such a report. These reports would summarize the data presented in the individual LOA holder reports, provide analysis of these synthesized results, discuss the implementation of required mitigation, and present any recommendations. This comprehensive annual report would be the basis of an annual adaptive management process."
(86 FR 5233)

To achieve this collective reporting for LOA-holders, the EnerGeo Alliance and its industry organization collaborators have developed the U.S. Gulf of Mexico Proactive Regulatory and Observational Program (GOM-PROP), which provides regulatory support for all companies with exploration and/or production activities in the GOM, with particular focus on the needs of the members of the EnerGeo Alliance, the American Petroleum Institute, the Offshore Operators Committee, and the National Offshore Industry Association as the leading trade associations for companies with operations in the region. The GOM-PROP has created a collective database for LOA-holders who are members of GOM-PROP to upload data for annual reporting.

As part of the annual reporting, EnerGeo Alliance is also including examples of the important research the industry is conducting or sponsoring to help minimize and understand impacts to marine mammals from geophysical survey activities and reduce cumulative impacts on marine mammals in the Gulf of Mexico and beyond.

Research Reporting

The research section of the annual report is meant to provide a better understanding of the tremendous volume of research undertaken by GOM-PROP members.

Research initiatives included the following:

- Alternative source technology development;
- Sound source characterization and propagation;
- Physical, physiological, and hearing effects of sound;
- Behavioral reactions and biological significance;
- Mitigation and monitoring;
    - Research tools;
    - Communication/ masking;
    - Examination of existing marine mammal observer data; and
    - Baseline abundance and distribution.

Research in the Gulf of Mexico is emphasized, but examples of relevant initiatives outside of the Gulf of Mexico are also included, such as Joint Industry Programme Sound and Marine Life initiatives. Initiatives that generally affect marine mammal conservation were also included, such as the Ghost Net Initiative.

2.5M+

pounds of debris collected between 2017 and 2021

Research Report:

EnerGeo Alliance Ghost Net Initiative

The Ghost Net Initiative (GNI), started in 2016 by EnerGeo Alliance, employs a collaborative effort for removal of marine debris and derelict fishing gear—often referred to as 'ghost gear. According to the United Nations Environment Program (UNEP), between 600,000–800,000 metric tonnes of lost fishing gear enter the oceans each year. This gear can stretch for miles and is mainly comprised of plastic that can take up to 600 years to break down, becoming microplastic as it degrades. The seismic industry has been removing marine debris for decades, and this initiative provides an opportunity to quantify the benefit of that work. Since its inception, the GNI has removed >2.5 million pounds of marine debris from the ocean. This program demonstrates EnerGeo Alliance's members are committed to creating a healthier ocean environment by clearing marine debris, which is among the greatest dangers to marine life.

UNEP 2018 Annual Report

Research Report:

GOM-PROP Companies' R&D

Examples of Sound Source Research and Innovation

In 2021, Sercel conducted sea trials in the Gulf of Mexico for its Tuned Pulse Source (TPS) technology. This new technology is addressing two objectives, to get a lower frequency output from the source than conventional sources and to reduce the sound emitted during a seismic survey. In addition, Sercel performed a sea trial in the Bay of Biscay in 2021 with their Bluepulse technology. This technology was also developed to reduce the sound emitted by a seismic survey. Sercel performed measurements of the acoustic near field and far field of these technologies in order to evaluate the benefits of TPS and Bluepulse over conventional sources.

Sercel has been involved with several other research initiatives. Sercel is collaborating with Stanford University on a source modeling program and is engaged with a consortium with other partners to respond to the Joint Industry Programme (JIP) Oceans' call for underwater noise studies. In addition to these initiatives, Sercel has internal investments developing new technology and a sea trial program in 2022.

PXGEO is actively engaged with a JIP project for the commercialization of a marine vibrator source technology. Discussions with exploration and production company partners commenced in 2021, with progress anticipated in 2022 to provide an effective, alternative seismic energy source for the future.

PXGEO is also conducting a study on using real, near-field measurements rather than modeled, far-field calculations of sound pressure levels to develop more accurate values for sound received levels for wildlife. This investigation has been presented to NMFS as a concept in coordination with EnerGeo Alliance. In addition, PXGEO has been evaluating effective, smaller sources to support transition of seismic operations to lower-impact technologies.

Passive Acoustic Monitoring

Passive acoustic monitoring (PAM) systems are improving, and the seismic industry is incorporating new technologies into operations to better detect marine mammals. PAM systems are being permanently installed on some seismic vessels, and the industry is increasingly using remote PAM systems, allowing PAM operators to operate and monitor activity from onshore in near-real-time.

A study was performed to develop new methods for PAMGuard Quality Assurance while using PAM systems to detect marine mammals acoustically. The study was performed to determine a method to establish the 'miss rate' of a PAM system in real-time because no standard method currently exists for determining this. It also included methods for establishing whether a planned or continuing operation can be reasonably expected to be able to detect marine mammal signals of interest. An open-source Signal Injection and Detection Evaluator (SIDE) software module within the PAMGuard software suite was produced. This new module has the ability to predict detection performance, documenting the effectiveness between automated detection and human operator effectiveness as a function of distance (i.e., range) between a detector and the sound source—all in real-time. The module was tested by injecting signals for nine different species clusters into the PAMGuard data stream. It was then evaluated to determine whether those sounds were detected by automatic detectors or flagged by human operators. The module has been available for training and operator use since August 2020.

Sercel's QuietSea system, first developed in 2014, has continued to move forward with additional developments and performance verifications on the system. The system is an integrated and automatic PAM system built into the seismic streamers. The system was approved for use in 2017 by the U.S. Bureau of Safety and Environmental Enforcement in the Gulf of Mexico and in 2019, for use in the United Kingdom by the Joint Nature Conservation Committee and Department for Business, Energy and Industrial Strategy. Improved detection of baleen whale calls has been a continuous focus for development of PAM systems.

In 2018, aboard two CGG vessels, the QuietSea system had automatic localization detections of sei whales, which is an important milestone. Sercel published a paper in 2018 outlining the methods for baleen whale detections, which rely on sparse representations assuming calls lie in a linear subspace.

Research Report:

Exploration, Production Sound & Marine Life Joint Industry Programme

12
project reports

8
fact sheets

40
peer-reviewed scientific papers

The Sound and Marine Life Joint Industry Programme (JIP) has one of the most extensive industry research programs focused on sound in the marine environment. Their focus is on identifying, addressing, and answering key questions around the impact of exploration and production activities, which have not been tackled systematically by the existing body of science. Working with multinational groups, experts, and non-government organizations, the JIP has committed more than $55 million towards research.

The JIP's research is divided into six categories, which are complementary and designed to allow the JIP to explore and understand the issues and potential effects associated with underwater sound from oil and gas exploration and production activities. The categories move progressively from those designed to understand how sound travels underwater, to the possible effects of sound on marine fauna's physical and behavioral well-being, and finally, how sound can be controlled, and potential impacts mitigated.

From 2017 to 2021, 40 studies were published in the peer-review literature, in addition to the development of 12 project reports and eight fact sheets that were funded or co-funded by JIP. Example research projects funded by the JIP are further detailed here in a list of research categories.

Sound Source Characterization

The JIP supports efforts to better understand the characteristics of sound sources, increasing our understanding of how sound propagates in the ocean. This understanding is critical to predicting how sound may impact marine life. JIP's focus is the measurement of the sound characteristics of compressed air sources, which is the most commonly used seismic source by the industry. Specific areas of focus include:

- 3-D sound source characterization;
- single compressed air source and compressed air source array sound signatures and source modeling;
- review of existing data on underwater sound;
- exploration of sound attenuation technologies;
- development of standards for acquiring and analyzing seismic and non-seismic acoustic data; and
- environmental assessment of marine vibroseis.

A Modeling Comparison of the Potential Effects on Marine Mammals from Sounds Produced by Marine Vibroseis and Air Gun Seismic Sources

A study was published in 2021 focusing on potential acoustic exposure of marine mammals via modeling the sound propagation, source signal, and animal movement in representative survey scenarios for seismic arrays and marine vibroseis. While both source types could be expected to expose few marine mammals to potentially injurious sound levels, fewer were predicted for marine vibroseis arrays because the lower source amplitudes are less likely to exceed marine mammal injury thresholds. The selection of evaluation criteria determined the estimated number of marine mammals exposed to sound levels associated with behavioral disturbance. Due to the marine vibroseis being a non-impulsive sound source, the lower sound pressure level threshold caused the marine vibroseis to be predicted to have higher potential behavior effects based on NMFS' criteria. The opposite was found when using frequency-weighted sound fields and a multiple-step, probabilistic threshold function.

Physical and Physiological Effects and Hearing

The JIP aims to understand the potential effects of sound from exploration and production activities on the physiology and hearing of different types of marine animals. The JIP has focused on conducting studies to understand the potential physical effects of sound from seismic surveys on a variety of marine mammals and fish. Studies have focused on temporary threshold shifts in odontocetes, hearing abilities of baleen whales, diving physiology of bottlenose dolphins, modeling baleen whale hearing, vocalizations of minke whales, seismic source impacts to arctic seals, hearing capabilities of loggerhead sea turtles, and a workshop to address auditory tissue damage in fish.

Marine mammal noise exposure criteria: assessing the severity of marine mammal behavioral responses to human noise

A study of marine mammal sound exposure criteria developed new approaches for evaluating the response severity of marine mammal exposures to sound, building upon the previous criteria developed by Southall et al. in 2007 and further developed by Southall et al. in 2019. With new methodologies for studying marine mammal responses, scientific data have been expanded in this area leading to broadened spatial, temporal, and population scales of potential disturbance studies. Critical errors in predicting effects can occur when a simplified all-or-nothing threshold is applied to broad taxonomic groups and sound types relating to single sound exposure parameter and behavioral responses. Variability in the probability and severity of behavioral responses can be caused by differences between species, among individuals, across situational contexts, and with the temporal and spatial scales over which exposures occur. Studies that account for such factors and the variability they cause can provide far more accurate probability functions for predicting effects and can reduce variability related to exposure level and response. To that end, several new approaches were developed in the study for evaluating response severity in laboratory and field conditions in terms of effects on vital rates. These were applied to selected studies of marine mammal behavioral response to demonstrate their application in more consistently addressing acute exposure contexts for individuals or discrete groups.

Research Report:

Exploration, Production Sound & Marine Life Joint Industry Programme (continued)

Behavioral Reactions and Biological Effects

The JIP aims to understand the effects of exploration and production sound on animal behavior. The potential behavioral impacts of sound are complex and difficult to study. Context can be more important than the sound itself; for example, animals will respond differently if they are feeding, hunting, or looking for a mate. The JIP has invested significant resources to understand behavioral influences and the linkages between these effects and overall population impacts.

Example studies include behavioral responses of humpback whales to seismic surveys, workshops on behavioral responses of fish to seismic surveys, responses of marine mammals to seismic survey start-up operations, population-level consequences of acoustic disturbance, cetacean stock assessments and detecting impacts of seismic operations, and use of existing data to develop sound-related environmental risk assessments.

International Protected Species Observer Data Analysis Report

The study of Protected Species Observer (PSO) data evaluated the quality of existing PSO data, collated PSO data from three regions including the Gulf of Mexico and tested how a global database could address inquiries about the potential impacts of seismic surveys on sea turtles and marine mammals. Conclusions from this study identified several areas where data management could be improved. The need for a standardized approach to data collection and data quality was emphasized to ensure analysis of data could be more efficient. Data exchange and accessibility was also recognized as an area of improvement where a global database could allow sufficient collation, processing/analysis, archiving, quality control, and sharing of PSO data. Data on cetacean detections in the Gulf of Mexico indicated that cetaceans were observed at further distances from the source array when it was active compared to periods of silence, suggesting a lateral spatial avoidance. Cetaceans were observed more frequently and for longer periods of time when the source was silent.

Mitigation and Monitoring

The JIP takes an active role in providing information to understand and reduce the risk of potential impacts of exploration and production sound on marine life. The JIP has a research stream dedicated to developing monitoring and mitigation techniques, technologies, and methods. For example, the JIP supported development of PAMGuard, a software system for detecting the presence of marine mammals near seismic operations.

A Review of Unmanned Vehicles for the Detection and Monitoring of Marine Fauna

A study of unmanned vehicles reviewed the present status of unmanned vehicles suitable for marine animal monitoring in relation to industrial offshore activities. Realistic alternatives to traditional marine animal survey methods have been made available due to recent technological developments. The study investigated which system(s) could be suitable for three monitoring types: mitigation, population, and focal animal monitoring. The target species and its behavior determined the selection of a specific sensor/platform combination. The study found that the technical specifications of sensors and unmanned platforms needed to be selected based on the surrounding conditions of the specific offshore project, which could include the area of interest, operational constraints, and the survey requirements. Benefits to these advancements include longer survey durations, mission repeatability, reduced operational costs, and improved mission safety.

Research Tools

The JIP has researched and developed a range of tools that are used to help understand the behavior of marine mammals in their environment. Current studies include developing animal tagging technology, testing new GPS/time-depth tags on sperm whales, low visibility detection techniques, and a review of unmanned aerial surveys to track large whales. These tools have advanced general scientific knowledge of marine animals.

Communications

The JIP communications topic area focuses on the development of JIP-produced factsheets, with eight produced between 2018 and 2021. These factsheets are intended to outline JIP research initiatives, ongoing research, and research conclusions.

Summary of Sound and Marine Life Joint Industry Programme Data Products by Research Category

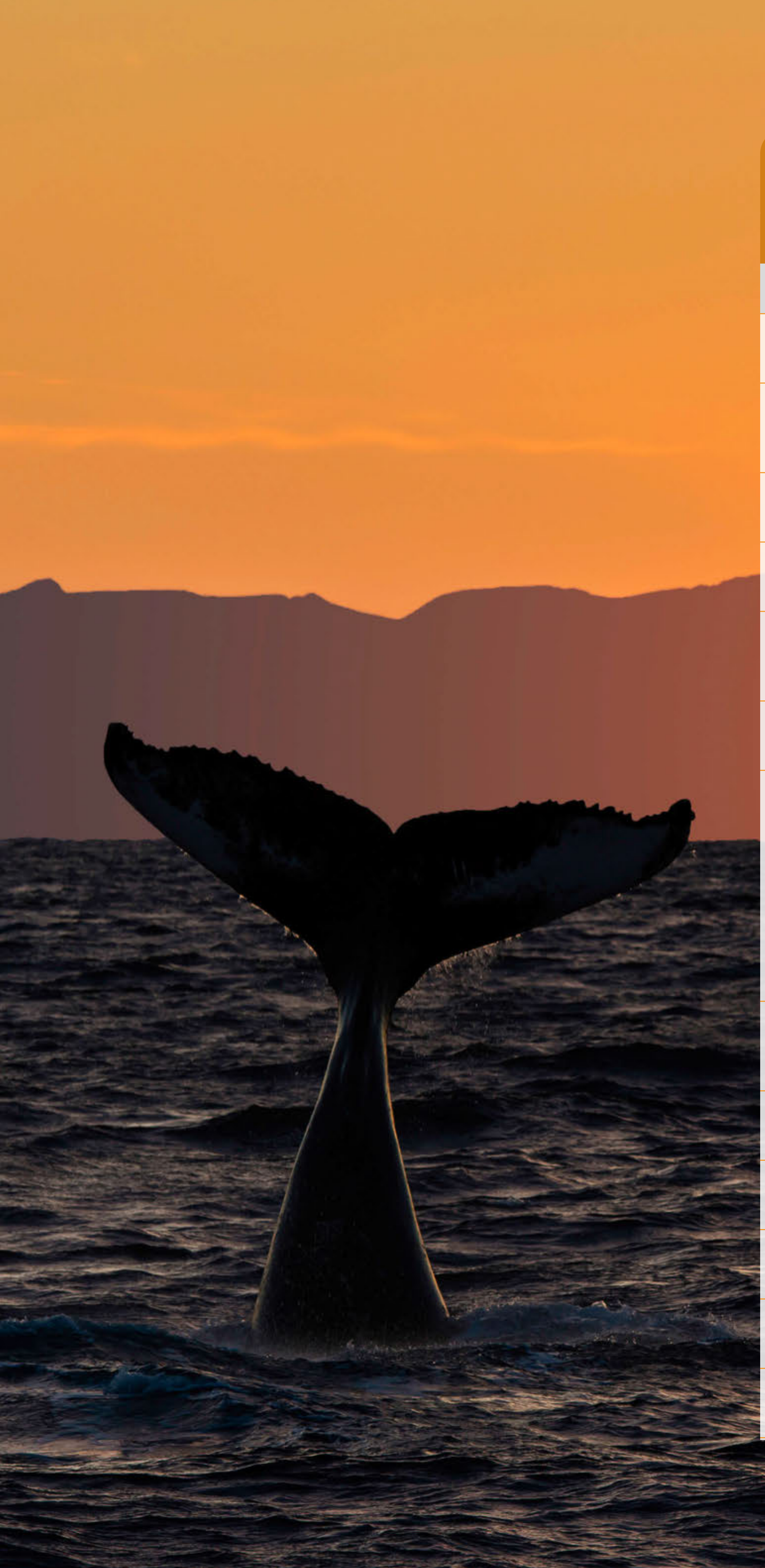
JIP Research Category	Peer Reviewed Publication	Project Report	Fact Sheet / Poster	Total Products
Sound Source Characterization & Propagation	1	5		6
Physical, Physiological & Hearing Effects of Sound	12	1		13
Behavioral Reactions & Biological Significance	24	3		27
Mitigation & Monitoring	2	3		5
Research Tools				0
Communication			8	8

Fact Sheets

Factsheet Title	Description
Fish-Related Research	Factsheet on research focusing on the impacts to fish from sound generated by exploration and production, such as, the *Population Level Consequences Of Seismic Surveys On Fish* project, workshops on behavioral responses of fish to seismic airguns, and a fish tissue injury workshop and modeling.
Behavioural Responses of Australian Humpback Whales to Seismic Surveys (BRAHSS)	Factsheet on BRAHSS project which is investigating the effects of seismic air guns on the behavior of migrating humpback whales along the Australian coast.
JIP Research Protecting Marine Life	Displays the mapped outcomes of JIP studies against a risk assessment framework that found over 90% of the JIP projects mapped produced outcomes which inform one or more of the risk assessment stages.
Population Consequences of Acoustic Disturbance Fact Sheet	Outlines an energetic model to quantitatively assess the energy animals spend on feeding and their allocation of resources. In the bioenergetics model, the costs associated with disturbance are linked to reductions in foraging success.
A Quick Guide to the Data Maps	A review of outcomes from research supported by the Sound and Marine Life JIP is improving risk assessment for oil & gas exploration and production (E&P) activity.
Hearing in Arctic Seals	JIP co-sponsors research to understand the potential physical effect of sound from seismic surveys on Arctic seals as oil and gas exploration expand into the Arctic.
Mysticete Hearing: Progressing the Science of Baleen Whale Hearing	Dominant airgun frequencies could overlap with Mysticetes hearing ranges, which could make them potentially more sensitive than other marine mammals to low-frequency sound sources.
Long-Term Acoustic Monitoring	Research into the potential for long-term passive acoustic monitoring (PAM) used to track changes in the populations of vocalizing marine mammals in a certain location.

Peer-reviewed Scientific Papers

Title	Author	Journal	Year
JIP Category 1: Sound Source Characterization			
A Modeling Comparison of the Potential Effects on Marine Mammals from Sounds Produced by Marine Vibroseis and Air Gun Seismic Sources	Marie-Noël R. Matthews, Darren S. Ireland, David G. Zeddies, Robert H. Brune, Cynthia D. Pyc	Journal of Marine Science and Engineering, 9(1), 12	2021
JIP Category 2: Physical and Physiological Effects and Hearing			
Marine Mammal Noise Exposure Criteria: Assessing the Severity of Marine Mammal Behavioral Responses to Human Noise	Brandon L. Southall, Douglas P. Nowacek, Ann E. Bowles, Valeria Senigaglia, Lars Bejder, Peter L. Tyack	Aquatic Mammals, 47(5)	2021
Evolutions in Marine Mammal Noise Exposure Criteria	Brandon L. Southall	Acoustics Today, Volume 17, issue 2: 52-60	2021
Functional Analyses of Peripheral Auditory System Adaptations for Echolocation in Air vs Water	Darlene R. Ketten, James A. Simmons, Hiroshi Riquimaroux, Andrea Megela Simmons	Frontier in Ecology and Evolution; 9:661216	2021
Lack of reproducibility of temporary hearing threshold shifts in a harbor porpoise after exposure to repeated airgun sounds	Ronald A. Kastelein, Lean Helder-Hoek, Suzanne A. Cornelisse, Alexander M. von Benda-Beckmann, Frans-Peter A. Lam, Christ A. F. de Jong, Darlene R. Ketten	The Journal of the Acoustical Society of America 148, 556	2020
Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects	Ronald A. Kastelein, Lean Helder-Hoek, Suzanne A. Cornelisse, Alexander M. von Benda-Beckmann, Frans-Peter A. Lam, Christ A. F. de Jong, Darlene R. Ketten	The Journal of the Acoustical Society of America 148, 556	2020
Effect of a Bubble Screen on the Behavioral Responses of Captive Harbor Porpoise *Phocoena phocoena* Exposed to Airgun Sounds	Ronald A Kastelein, Alexander M. von Benda-Beckmann, Frans-Peter A. Lam, Erwin Jansen, Christ A. F. de Jong	Aquatic Mammals 45(6), 706-716	2019
The Role of Material Properties in Cetacean Hearing Models: Knowns and Unknowns	Andrew A. Tubelli, Darlene R. Ketten	Aquatic Mammals 45(6), 706-716	2019
Aligning Basilar Membrane Spirals to Two-Dimensional Images of Point-Stiffness Experiments	Graham E. Voysey, Aleks Zosuls, Darlene R. Ketten	Aquatic Mammals 45(6), 733-738	2019
A model and experimental approach to the middle ear transfer function related to hearing in the humpback whale *Megaptera novaeangliae*	Tubelli, A., Zosuls, A., Ketten, D.R. & Mountain, D.C	The Journal of the Acoustical Society of America 144, 525	2018
The influence of temporally varying noise from seismic air guns on the detection of underwater sounds by seals	Sills, J., Southall, B., Reichmuth, C.	Journal of Acoustical Society of America, 141: 996-1008	2017
A review of the history, development, and application of auditory weighting functions in humans and marine mammals	Houser, D., Yost, W., Burkard, R., Finneran, J. et al.	The Journal of the Acoustical Society of America, 141: 1371-1413	2017
Temporary hearing threshold shift in a harbor porpoise *Phocoena phocoena* after exposure to multiple airgun sounds	Kastelein, R.A., Helder-Hoek, L., Van de Voorde, S., von Benda-Beckmann, A.M., Lam, F-P. A., Jansen, E., de Jong, C. A. F. & Ainslie, M. A.	The Journal of the Acoustical Society of America 142, 2430	2017



Peer-reviewed Scientific Papers

Title	Author	Journal	Year
JIP Category 3: Behavioral Reactions and Biological Effects			
Auditory masking in killer whales *Orcinus orca*: Critical ratios for tonal signals in Gaussian Noise	Brian K. Branstetter, Michael Felice, Todd Robeck	Journal of Marine Science and Engineering, 9(1), 12	2021
Masking Release at 4kHz in harbor porpoises *Phocoena phocoena* associated with sinusoidal amplitude-modulated masking noise	Ronald A. Kastelein, Lean Helder-Hoek, Jennifer Covi, John M. Terhune, Georg Klump, et al.	The Journal of the Acoustical Society of America 150, 1721	2021
Population-level consequences of seismic surveys on fishes: An interdisciplinary challenge	Slabbekoorn, H., Dalen, J., de Haan, D., Winter H.V., Radford, C., Ainslie, M.A., Heaney, K.D., van Kootenj, T., Thomas, L., Harwood, J.	Fish and Fisheries; 1-33	2019
Effects of broadband sound exposure on the interaction between foraging crab and shrimp - A field study	Jeroen Hubert, James Campbell, Jordy G. van der Beek, Manon F. den Haan, Rik Verhave, Laura S. Verkade, Hans Slabbekoorn	Environmental Pollution 243	2018
A dynamic state model of migratory behavior and physiology to assess the consequences of environmental variation and anthropogenic disturbance on marine vertebrates	Pirotta, E., M. Mangel, D. P. Costa, B. Mate, J. Goldbogen, D. M. Palacios, L. A. Huckstadt, E. A. McHuron, L. Schwarz, and L. New	The American Naturalist - E-Article	2018
The energetic consequences of behavioral variation in a marine carnivore	E McHuron, SH Peterson, LA Huckstadt, SR Melin, JD Harris, and DP Costa	Ecology and Evolution.	2018
Convergence of marine megafauna movement patterns in coastal and open oceans	Sequeira, A. M. M., J. P. Rodriguez, V. M. Eguiluz, R. Harcourt, M. Hindell, D. W. Sims, C. M. Duarte, D. P. Costa, J. Fernandez-Gracia, L. C. Ferreira, G. C. Hays, M. R. Heupel, M. G. Meekan, A. Aven, F. Bailleul, A. M. M. Baylis, M. L. Berumen, C. D. Braun, J. Burns, M. J. Caley, R. Campbell, R. H. Carmichael, E. Clua, L. D. Einoder, A. Friedlaender, M. E. Goebel, S. D. Goldsworthy, C. Guinet, J. Gunn, D. Hamer, N. Hammerschlag, M. Hammill, L. A. Huckstadt, N. E. Humphries, M. A. Lea, A. Lowther, A. Mackay, E. McHuron, J. McKenzie, L. McLeay, C. R. McMahon, K. Mengersen, M. M. C. Muelbert, A. M. Pagano, B. Page, N. Queiroz, P. W. Robinson, S. A. Shaffer, M. Shivji, G. B. Skomal, S. R. Thorrold, S. Villegas-Amtmann, M. Weise, R. Wells, B. Wetherbee, A. Wiebkin, B. Wienecke, and M. Thums	Proceedings of the National Academy of Sciences	2018
Constrained by consistency? Repeatability of foraging behavior at multiple timescales for a generalist marine predator	Mchuron, E. & Hazen, E.L.	Marine Biology 165:122	2018
Movements and dive behavior of juvenile California sea lions from Año Nuevo Island	McHuron, E, Block, B.A & Costa, D.P.	Marine Mammal Science, 34(1): 238–249	2018
A state-dependent model for assessing the population consequences of disturbance on income-breeding mammals	McHuron, E.A., Schwarz, L.K., Costa, D.P. & Mangel, M.	Ecological Modelling, Volume 385, Pages 133-144	2018
Suite of simple metrics reveals common movement syndromes across vertebrate taxa	Abrahms, B., D. P. Seidel, E. Dougherty, E. L. Hazen, S. J. Bograd, A. M. Wilson, J. Weldon McNutt, D. P. Costa, S. Blake, J. S. Brashares, and W. M. Getz	Movement Ecology 5:12	2017
Evidence for the functions of surface-active behaviors in humpback whales	Kavanagh, A.S., Williamson, K., Blomberg, S., Noad, M. et al.	Marine Mammal Science.	2017
Temporary hearing threshold shift in a harbor porpoise (Phocoena phocoena) after exposure to multiple airgun sounds	Kastelein, R.A., Helder-Hoek, L., Van de Voorde, S., von Benda-Beckmann, A.M., Lam, F-P. A., Jansen, E., de Jong, C. A. F. & Ainslie, M. A.	The Journal of the Acoustical Society of America 142, 2430	2017

Peer-reviewed Scientific Papers

Title	Author	Journal	Year
JIP Category 3: Behavioral Reactions and Biological Effects (*continued*)			
Factors driving the variability in diving and movement behavior of migrating humpback whales *Megaptera novaeangliae*: implications for anthropogenic disturbance studies.	Kavanagh, Ailbhe S.; Noad, Michael J. et al.	Marine Mammal Science.	2017
Determining the behavioral dose-responsive relationship of marine mammals to air gun noise and source proximity	Dunlop, R., Noad, M., McCauley, R., Scott-Hayward, L. et al.	Journal of Experimental Biology, 220: 2878-2886	2017
Comparing methods suitable for monitoring marine mammals in low visibility conditions during seismic surveys	Verfuss, U., Gillespie, D., Gordon, J. et al.	Marine Pollution Bulletin, Volume 126, Pages 1-18	2017
The behavioral response of migrating humpback whales to a full seismic airgun array	Rebecca A. Dunlop, Michael J. Noad, Robert D. McCauley, Eric Kniest, Robert Slade, David Paton, Douglas H. Cato	Proceedings of the Royal Society B, Volume 284, Issue 1869	2017
Evaluating gain functions in foraging bouts using vertical excursions in northern elephant seals	Ferraro, M. S., R. R. Decker, D. P. Costa, P. W. Robinson, D. S. Houser, and D. E. Crocker	Animal Behaviours 129:15-24	2017
East or west: the energetic cost of being a gray whale and the consequence of losing energy to disturbance	Villegas-Amtmann, S., L. K. Schwarz, G. Gailey, O. Sychenko, and D. P. Costa	Endangered Species Research 34:167-183	2017
Development of a bioenergetic model for estimating energy requirements and prey biomass consumption of the bottlenose dolphin *Tursiops truncatus*	Bejarano, A. C., R. S. Wells, and D. P. Costa	Ecological Modelling 356:162-172	2017
Energy and prey requirements of California sea lions under variable environmental conditions	McHuron, E. A., M. Mangel, L. K. Schwarz, and D. P. Costa	Marine Ecology Progress Series 567:235-247	2017
Oxygen minimum zone: An important oceanographic habitat for deep-diving northern elephant seals, *Mirounga angustirostris*	Naito, Y., D. P. Costa, T. Adachi, P. W. Robinson, S. H. Peterson, Y. Mitani, and A. Takahashi	Ecology and Evolution 7:6259-6270	2017
The extra burden of motherhood: reduced dive duration associated with pregnancy status in a deep-diving mammal, the northern elephant seal	Hückstädt, L. A., Holser, R. R., Tift, M. S., and Costa, D. P	Biol Lett; 14(2).	2017
Energetics	Costa, D.P & Maresh, J.L.	Pages 329-335 in B. Würsig, J. G. M. Thewissen, and K. Kovacs, editors. Encyclopedia of Marine Mammals. Academic Press	2017
Big data analyses reveal patterns and drivers of the movements of southern elephant seals	Rodríguez, J.P, Fernández-Gracia, J et al.	Scientific Reports, volume 7, Article number: 112	2017
JIP Category 4: Mitigation and Monitoring			
A review of unmanned vehicles for the detection and monitoring of marine fauna	Verfuss, U.K., Aniceto, A.S., Harris, D.V., Gillespie, D., Fielding, S., Jiménez, G., Johnston, P., Sincalir, R.R., Sivertsen, A., Solbø, S.A., Storvold, R., Biuw, M., Wyatt, R.	Marine Pollution Bulletin, Volume 140, Pages 17-29	2019
Climate mediates the success of migration strategies in a marine predator	Abrahms, B., E. L. Hazen, S. J. Bograd, J. S. Brashares, P. W. Robinson, K. L. Scales, D. E. Crocker, and D. P. Costa	Ecology Letters, 21: 63-71	2018

GOM-PROP MEMBERS

BEACON OFFSHORE ENERGY
BHP
bp
CGG
Chevron
enven ENERGY VENTURES
ExxonMobil

HESS
HE HOUSTON ENERGY
KOSMOS ENERGY
ion
LLOG exploration
magseis fairfield
OXY

PGS
PXGEO
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Gulf of Mexico Incidental Take Regulation Annual Report – April 2021-April 2022: Data Reporting and Analysis

ENERGEO

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
3D	Three Dimensional
4D	Four Dimensional
API	American Petroleum Institute
BF	Beaufort
BOEM	Bureau of Ocean Energy Management
GIS	Geographic Information System
GOM	Gulf of Mexico
GOM-PROP	Gulf of Mexico Proactive Regulatory and Observational Program
hr	hour
ITR	Incidental Take Regulations
km	kilometer
LOA	Letter of Authorization
ND	No Data
NTL	Notice to Lessees
OBN	Ocean Bottom Node
PAM	Passive Acoustic Monitoring
PAMO	Passive Acoustic Monitoring Observer
PSO	Protected Species Observer
UTC	Coordinated Universal Time
VSP	Vertical Seismic Profiling

1 INTRODUCTION

Per the Incidental Take Regulation (ITR) for Taking Marine Mammals Incidental to Geophysical Surveys Related to Oil and Gas Activities in the Gulf of Mexico (GOM), an annual research and monitoring report has been developed by industry, detailing and summarizing the research and monitoring conducted by EnerGeo Alliance, American Petroleum Institute (API), Offshore Operators Committee, and National Ocean Industries Association and their member companies relevant to potential effects of geophysical surveys on marine mammals in the Gulf of Mexico (GOM).To achieve this collective reporting for Letter of Authorization (LOA)-holders, the EnerGeo Alliance and its industry organization collaborators developed the U.S. Gulf of Mexico Proactive Regulatory and Observational Program (GOM-PROP) to collect, manage, and synthesize Protected Species Observer (PSO) data, as described in the ITR. The monitoring portion of this report focuses on the requirements of the ITR (86 Federal Register 5322).

The requirements include the following for comprehensive, collective reporting by LOA-holders:

- Summary of geophysical activity;
- Summary of monitoring effort by acoustic source status, location, and visibility conditions;
- Summary of mitigation measures implemented by survey type and location;
- Sighting rates of marine mammals and variables that could affect detectability;
- Summary and conclusions from monitoring; and
- Recommendations for adaptive management

The limitations and uncertainties associated with marine mammal observer data have been taken into consideration. The proposed report will consider the core issues described above and discuss our ability to evaluate these issues in the context of monitoring data, with an emphasis on discussion of processes that can increase confidence in outcomes of analyses. Monitoring data include sightings and passive acoustic monitoring, and both data types will be considered for quantitative and qualitative ways to address questions in the context of validating risk modelling, informing behavioral response science, and evaluating existing mitigation approaches.

1.1 Objectives

The objective of this report was to process and assess the PSO data collected during the first year of implementation of the ITR by GOM-PROP members. Majority (>95%) of the authorizations were issued to GOM-PROP members which are represented in this report. Other authorizations issued to non-GOM-PROP members are not represented in this report as companies are not required to join this Program. GOM-PROP members include the following companies (in alphabetical order):

- Beacon Offshore Energy
- BHP
- British Petroleum

- CGG
- Chevron
- ExxonMobil
- Hess Corporation
- Houston Energy
- Kosmos Energy
- Ion
- LLOG Exploration
- Magseis Fairfield
- Occidental Petroleum Corporation
- Petroleum Geo-Services
- PXGEO
- Quarter North Energy
- Schlumberger
- Shell
- Talos
- TGS

This analysis included processing the observer data collected during the geophysical surveys conducted in the GOM, statistically analyzing data, and creating visualizations of these data on multiple spatial and temporal scales. Examples of the types of statistical analyses of interest in reporting include those conducted in Barkaszi et al. (2012, 2019), such as evaluating differences in recorded behavior when the sound source is on or off.

Based on recommendations from Barton et al. (2008), a standard suite of data fields as described in Bureau of Ocean Energy Management (BOEM) NTL 2016-G02 was collected aboard geophysical survey vessels in the GOM, allowing for integration and analysis of datasets for large-scale evaluation across multiple surveys. It is recognized that the ongoing effort is to use monitoring data products as appropriate to address the following questions for each species (or stock as possible):

- Behavioral response (or lack of response) to seismic and other geophysical survey types;
- Species/hearing group behavioral sensitivity to seismic and other geophysical surveys;
- Effectiveness of shutdown, power-down, and soft-start mitigations to reduce potential impacts/take; and
- Quantification as possible of efficacy of mitigation and marine mammal responses with respect to adjustment of take estimates to improve models.

While the extent of observations of marine mammals for the limited number of surveys that occurred in the first year of the ITR are not adequate to address all of these questions, we use this opportunity to assess data quality and data collection to be able to address these questions in the future as more data are collected and to make recommendations for changes to data collection methods where necessary.

2 METHODS

2.1 Data Collection and Entry

PSOs and passive acoustic monitoring operators (PAMOs) recorded data on monitoring effort, environmental conditions, source operations, cetaceans, and sea turtle sighting/detection events using customized electronic spreadsheets (Microsoft Excel). The vessel crew provided source operational times from daily logs, which were cross-referenced with data collected by the PSOs and PAMOs while on watch.

For this report, we define visual sightings of protected species as ‘observations’ and occurrences detected through PAM as ‘detections’. For each observation/detection event, the time (Coordinated Universal Time [UTC]), vessel position, vessel course, water depth, species, number of animals, group age/sex composition, sighting/detection distance and bearing, animals heading and movement, the animal(s) behavior, vessel activity, the source operational status, and environmental data were recorded to the best of the PSO/PAMOs ability (Table A-2 and Table A-3). Distance estimations of marine fauna to the observation platform (i.e., observer) were determined by the use of reticle scale binoculars.

Species identification was confirmed where possible, with reference to marine mammal identification guides. Where marine fauna could not be conclusively identified at species level (either due to distance from observer, weather/sea state, glare from the sun or other factors), a record was made of the closest identifiable cetacean group based upon known identifying parameters (Table A-4). If positive species identification could not be made, marine fauna sightings were recorded as unidentified (e.g., unidentified large cetacean; Table A-4).

2.2 Data Analysis

2.2.1 Summary of Geophysical Activity

To assess the effort data, we first mapped the data using the associated geographic coordinates and overlayed it with the seven management zones identified in the ITR for the GOM (Figure 2-1). We then assigned a management zone to each entry for effort and for each marine mammal observation and detection.

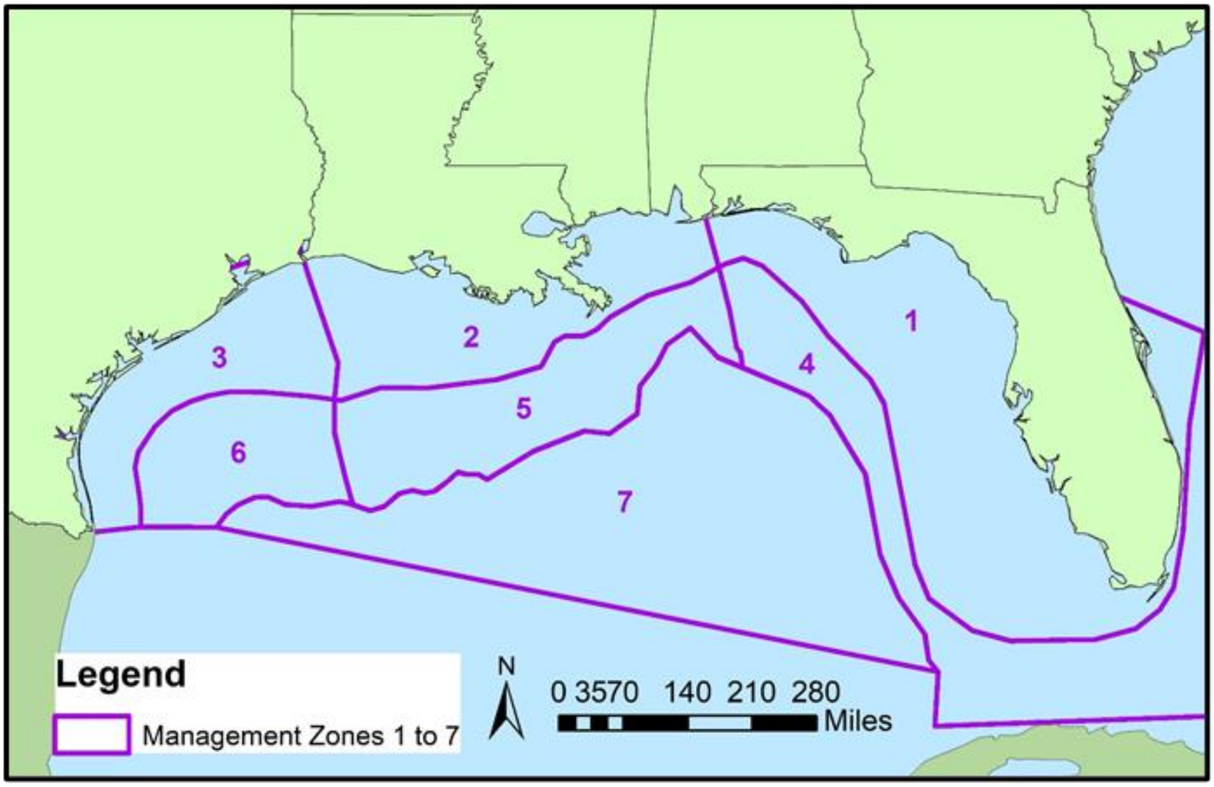

Figure 2-1. Gulf of Mexico with the seven management zones used in the ITR highlighted with purple lines.

We next focused on the vessel activity codes (Table 2-1; Appendix A). We sorted those into three categories, active source, inactive source, and transit. Transit also implies an inactive source; however, it also separates data collected on-site for surveys as opposed to time spent traveling to the survey site. The 'Other' vessel activity code indicated a variety of special activities including clearance, ramp-up, marine mammal or sea turtle mitigation shutdown or pause, and troubleshooting/maintenance. Given that the active source codes represented more that 75% of the survey time (see the Results section), we considered both the 'Other' code and empty fields ('No Data') as active source. In total there were 3.45 hours of effort with no vessel activity code recorded ('No Data') and 55.7 hours of effort recorded as 'other', resulting 4.6% of active source effort or 3.5% of all effort.

We summarize the effort data by total hours/day for each survey permit number by month and zone. For each entry, we determined the total time represented by the entry by subtracting the end time by the start time (see Appendix A for fields in the database). We summed these times across permit number, month, and zone.

Table 2-1. Vessel activity codes reported in the effort data sorted by source activity category.

Vessel Activity Code	Category
Data Acquisition	Active Source
Deploying/Retrieving Equipment	Inactive Source
Line Change	Active Source
Standby	Inactive Source
Testing	Active Source
Transit	Transit
Other	Active Source
No Data	Active Source

Effort in year one of the ITR is not necessarily reflective of typical or expected effort, as LOAs were difficult to obtain, and surveys experienced significant delays as a result of issues with accessing LOAs. Estimation of future of effort should not rely on these data.

2.2.2 Summary of Monitoring Activity

We next applied the same three categories, (Active Source, Inactive Source and Transit) this time sorting the data by the type of monitoring: PAM only, PAM and visual, and visual only. We summarized these data by both time (hours [hr]) and distance (kilometers [km]) for the amount of time/distance of monitoring for each type and activity category in each zone. Time was calculated as described above. To calculate distance, we took the average of start vessel speed and end vessel speed for each entry (see Appendix A for fields in database). We then averaged vessel speed for each vessel activity code (Table 2-1) and zone. We converted these values from knots to km/hr and multiplied these values by total time to get distance traveled in km.

Next, we considered environmental conditions of visibility and Beaufort sea state. We summarized the data by the amount of time represented by each of the environmental condition codes for all data and for data collected while the source was active.

2.2.3 Summary of Mitigation Measures

We first summarized the marine mammal observations and detections for both visual and acoustic monitoring methods. We then summarized these detections and observations by the three activity codes (Active Source, Inactive Source, Transit) and by zone. For observations and detections that occurred while the source was active, we summarize mitigation measures and total mitigation shutdown times. For all summaries we report both number of groups (i.e., number of observations) and total number of individuals.

2.2.4 Sighting rates

We calculated sighting rates for both groups and individuals by dividing the number of groups/individuals by total monitoring effort. We considered both hours and km for total monitoring effort in our calculations. Sighting rates were calculated for each zone and for each activity code (Active Source, Inactive Source, Transit). We then considered the potential impact of visibility and Beaufort sea state on sighting rates by comparing visibility and Beaufort sea states when there were marine mammal observations with visibility and Beaufort sea states for all effort.

3 RESULTS

3.1 Summary of Geophysical Activities

Three types of surveys were performed in the Gulf of Mexico during this reporting period: ocean bottom node (OBN), vertical seismic profiling (VSP), and four-dimensional (4D) high resolution survey. OBN surveys consist of autonomous recording nodes which are laid on the seabed by Remotely Operated Vehicles while a streamer with the sound source is towed from a vessel over the nodes. VSP surveys consist of a sound source being lowered into the well or borehole and are used to perform seismic profiling. Four-dimensional seismic surveys are time-lapse surveys repeating three-dimensional (3D) surveys over time.

During the first year of ITR implementation, we received data for four surveys (Table 3-1). Table 3-2 shows the amount of survey effort (in hours) for each survey across zones and months for all vessel activity codes. There were 10 records in the dataset that were outside of the GOM and therefore likely had inaccurate location data. We classified these as ‘unknown zone.’ Active surveys with powered sources occurred in Zones 5, 6 and 7 (Table 3-3) with the most (50%) occurring in Zone 7, followed by Zone 5 (31%) and Zone 6 (19%).

Only vessel transit occurred in Zone 2 (Table 3-4). The vessel activity was primarily transit for Zone 3 (Table 3-4); however, there were records for line change, which we classified as an activity with a powered source (Table 3-3), and for standby (Table 3-5), but no other vessel activities. Therefore, it is likely that the line change activities recorded for Zone 3 were not conducted with a powered source. No transit monitoring effort was reported for permit A-00005 because the vessel used for the survey performed non-survey-related work in the immediate vicinity of the well that was surveyed before and after the survey. Transits to and from the area were many weeks before and after the survey. The PSO and PAM crew were flown to and from the vessel just for the survey.

Survey effort when the source was not active (excluding transit) represented 20.2% of all survey time (Table 3-5). For all vessel activities recorded in the database and representing total time on the water, transit represented 5.4% of the total time on water; source active codes represented 75.5%; and source off represented 19.1% of the total time on water.

Table 3-1 Survey type and zones for the 4 permits that completed surveys in the first year.

Permit	Survey Type	Zones of Active Survey
T20-004	OBN	6, 7
L21-014	VSP	5, 7
T21-001	4D High-Resolution Survey	6, 7
A-00005	Zero Offset VSP	5

Table 3-2 Total effort (hours) by survey, zone and month for all vessel activity codes.

Permit	Month							
	July 2021	August 2021	September 2021	October 2021	November 2021	February 2021	Survey TOTAL	Zone TOTAL hours (days)
	Unknown Zone							
T20-004	2.0	-	-	-	-	-	2.0	5.9 (0.24)
T21-001	-	-	1.8	2.0	-	-	3.8	
	Zone 2							
L21-014	7.5	0.3	-	5.0	3.8	-	8.8	8.8 (0.37)
	Zone 3							
T20-004	13.7	2.9	-	-	-	-	16.6	59.7 (2.5)
L21-014	-	-	-	1.5	2.3	-	3.8	
T21-001	-	5.3	34.0	-	-	-	39.2	
	Zone 5							
A-00005	-	-	-	-	-	7.8	7.8	464.6 (19.4)
L21-014	-	-	-	277.6	179.2	-	456.8	
	Zone 6							
T20-004	151.6	39.6	-	-	-	-	191.2	480.4 (20.0)
T21-001	-	51.1	151.3	86.7	-	-	289.2	
	Zone 7							
T20-004	113.4	33.0	-	-	-	-	146.4	667.2 (27.8)
T21-001	-	5.0	249.8	261.0	-	-	515.8	
L21-014	-	-	-	5	-	-	5	
Total Effort by Month	280.8	136.9	436.9	638.8	185.3	7.8	1686.6 hours (70.3 days)	

** Zone totals are reported in hours with days in parentheses. Dashes indicate no effort reported for that combination of permit, month, and zone.*

***There were no surveys reported in April-June 2021 and Mar-Apr 2022. Some surveys started in year 1 of the ITR but were not complete by April 2022 and are therefore not included in the analysis at this time*

Table 3-3 Total effort (hours) by survey, zone and month for vessel activity codes indicating the source was powered (i.e., data acquisition, line change or testing) or possibly powered (i.e., other and unknown).

Permit	Month							
	July 2021	August 2021	September 2021	October 2021	November 2021	February 2021	Survey TOTAL	Zone TOTAL hours (days)
	Unknown Zone							
T20-004	1.0	-	-	-	-	-	1.0	4.2 (0.18)
T21-001	-	-	1.2	2.0	-	-	3.2	
	Zone 3							
T20-001	7.5	0.3	-	-	-	-	7.8	7.8 (0.32)
	Zone 5							
A-00005	-	-	-	-	-	7.3	7.3	404.1 (16.8)
L21-014	-	-	-	233.7	163.2	-	396.9	
	Zone 6							
T20-004	117.2	31.4	-	-	-	-	148.6	251.4 (10.5)
T21-001	-	2.3	27.5	73.0	-	-	102.8	
	Zone 7							
T20-004	110.6	20.0	-	-	-	-	129.1	606.6 (25.3)
T21-001	-	-	224.6	246.5	-	-	471.1	
L21-014	-	-	-	5	-	-	5	
Total Effort by Month	236.2	54.1	253.2	560.2	163.2	7.8	1274.1 hours (53.1 days)	

**Zone totals are reported in hours with days in parentheses. Dashes indicate no effort reported for that combination of permit, month, and zone.*

***There were no surveys reported in April-June 2021 and Mar-Apr 2022. Some surveys started in year 1 of the ITR but were not complete by April 2022 and are therefore not included in the analysis at this time*

Table 3-4 Total effort (hours) by survey, zone and month for vessel transit.

Permit	Month							
	July 2021	August 2021	September 2021	October 2021	November 2021	February 2021	Survey TOTAL	Zone TOTAL hours (days)
	Zone 2							
L21-205	5.0	3.8	-	-	-	-	8.8	8.8 (0.37)
	Zone 3							
T20-004	-	2.6	-	-	-	-	2.6	31.3 (1.3)
L21-205	-	-	-	1.5	2.3	-	3.8	
T21-001	-	5.3	19.7	-	-	-	25.0	
	Zone 5							
L21-205	-	-	-	8.0	8.0	-	16.0	16.0 (0.7)
	Zone 6							
T20-004	8.0	6.2	-	-	-	-	14.1	34.8 (1.5)
T21-001	-	5.6	14.4	0.7	-	-	20.7	
Total Effort by Month	13.0	23.5	34.1	10.2	10.3	0.0	91.0 hours (3.8 days)	

**Zone totals are reported in hours with days in parentheses. Dashes indicate no effort reported for that combination of permit, month, and zone*

***There were no surveys reported in April-June 2021 and Mar-Apr 2022. Some surveys started in year 1 of the ITR but were not complete by April 2022 and are therefore not included in the analysis at this time*

Table 3-5 Total effort (hours) by survey, zone and month when the source was likely inactive or status unknown (deploying/retrieving equipment; standby; weather patterns; and no data).

<table>
<tr><th rowspan="2">Permit</th><th colspan="6">Month</th><th colspan="2"></th></tr>
<tr><th>July 2021</th><th>August 2021</th><th>September 2021</th><th>October 2021</th><th>November 2021</th><th>February 2021</th><th>Survey TOTAL</th><th>Zone TOTAL hours (days)</th></tr>
<tr><td></td><td colspan="8">Unknown Zone</td></tr>
<tr><td>T21-001</td><td>-</td><td>-</td><td>0.7</td><td>-</td><td>-</td><td>-</td><td>0.7</td><td rowspan="2">1.7 (0.07)</td></tr>
<tr><td>T20-004</td><td>1.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1.0</td></tr>
<tr><td></td><td colspan="8">Zone 3</td></tr>
<tr><td>T21-001</td><td>-</td><td>-</td><td>14.3</td><td>-</td><td>-</td><td>-</td><td>14.3</td><td rowspan="2">20.6 (0.9)</td></tr>
<tr><td>T20-004</td><td>6.3</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>6.3</td></tr>
<tr><td></td><td colspan="8">Zone 5</td></tr>
<tr><td>A-00005</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.6</td><td>0.6</td><td rowspan="2">44.5 (1.9)</td></tr>
<tr><td>L21-205</td><td>-</td><td>-</td><td>-</td><td>36.0</td><td>8.0</td><td>-</td><td>44.0</td></tr>
<tr><td></td><td colspan="8">Zone 6</td></tr>
<tr><td>T21-001</td><td>-</td><td>43.2</td><td>109.4</td><td>13.1</td><td>-</td><td>-</td><td>165.7</td><td rowspan="2">194.2 (8.1)</td></tr>
<tr><td>T20-004</td><td>26.5</td><td>2.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>28.5</td></tr>
<tr><td></td><td colspan="8">Zone 7</td></tr>
<tr><td>T21-001</td><td>-</td><td>5.0</td><td>25.3</td><td>14.5</td><td>-</td><td>-</td><td>44.7</td><td rowspan="2">60.6 (2.5)</td></tr>
<tr><td>T20-004</td><td>2.9</td><td>13.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>15.9</td></tr>
<tr><td>Total Effort by Month</td><td>36.6</td><td>63.2</td><td>149.6</td><td>63.5</td><td>8.0</td><td>0.6</td><td colspan="2">321.5 hours (13.4 days)</td></tr>
</table>

**Dashes indicate no effort reported for that combination of permit, month, and zone.*

***There were no surveys reported in April-June 2021 and Mar-Apr 2022. Some surveys started in year 1 of the ITR but were not complete by April 2022 and are therefore not included in the analysis at this time*

3.2 Summary of Monitoring Effort

General Monitoring Effort

Table 3-6 Summary of monitoring effort by zone and source status. Data presented as distance (km)

Monitoring Type	Source Powered (km)	Transit (km)	Source not powered (km)	Totals	
		Unknown Zone		**Total Unknown Zone:**	39.3
PAM only (night)	10.7	0.0	0.0	**PAM only (night):**	10.7
Visual and PAM (day)	18.1	0.0	0.0	**Visual and PAM (day):**	18.1
Visual only (day)	0.0	0.0	10.6	**Visual only (day):**	10.6
		Zone 2		**Total Zone 2:**	146.6
PAM only (night)	0.0	146.6	0.0	**PAM only (night):**	146.6
		Zone 3		**Total Zone 3:**	679.6
PAM only (night)	1.9	0.0	0.0	**PAM only (night):**	1.9
Visual and PAM (day)	43.2	0.0	2.2	**Visual and PAM (day):**	45.4
Visual only (day)	2.0	524.1	106.3	**Visual only (day):**	632.3
		Zone 5		**Total Zone 5:**	3469.0
PAM only (night)	1439.0	0.0	30.7	**PAM only (night):**	1469.6
Visual and PAM (day)	1579.8	0.0	42.3	**Visual and PAM (day):**	1622.2
Visual only (day)	0.0	278.7	98.4	**Visual only (day):**	377.1
		Zone 6		**Total Zone 6:**	3481.5
PAM only (night)	759.6	0.0	107.4	**PAM only (night):**	867.0
Visual and PAM (day)	799.1	0.0	201.4	**Visual and PAM (day):**	1000.5
Visual only (day)	126.1	544.9	943.1	**Visual only (day):**	1614.1
		Zone 7		**Total Zone 7:**	4470.6
PAM only (night)	1829.2	0.0	73.5	**PAM only (night):**	1902.7
Visual and PAM (day)	2231.8	0.0	151.5	**Visual and PAM (day):**	2383.3
Visual only (day)	29.3	0.0	155.3	**Visual only (day):**	184.6
Total	8869.8	1494.3	1922.6	**Total Distance (km):**	12286.6

Table 3-7 Summary of monitoring effort by zone and source status. Data represent time (hours)

Monitoring Type	Source Powered (hr)	Transit (hr)	Source not powered or status unclear (hr)	Totals	
	Unknown Zone			**Total Unknown Zone:**	5.9
PAM only (night)	1.6	0.0	0.0	**PAM only (night):**	1.6
Visual and PAM (day)	2.6	0.0	0.0	**Visual and PAM (day):**	2.6
Visual only (day)	0.0	0.0	1.7	**Visual only (day):**	1.7
	Zone 2			**Total Zone 2:**	8.8
PAM only (night)	0.0	8.8	0.0	**PAM only (night)**	8.8
	Zone 3			**Total Zone 3:**	59.7
PAM only (night)	0.3	0.0	0.0	**PAM only (night):**	0.3
Visual and PAM (day)	7.1	0.0	0.4	**Visual and PAM (day):**	7.6
Visual only (day)	0.3	31.3	20.1	**Visual only (day):**	51.8
	Zone 5			**Total Zone 5:**	464.6
PAM only (night)	191.2	0.0	8.3	**PAM only (night):**	199.5
Visual and PAM (day)	212.9	0.0	11.6	**Visual and PAM (day):**	224.5
Visual only (day)	0.0	16.0	24.6	**Visual only (day):**	40.6
	Zone 6			**Total Zone 6:**	480.4
PAM only (night)	111.8	0.0	16.9	**PAM only (night):**	128.7
Visual and PAM (day)	117.7	0.0	31.5	**Visual and PAM (day):**	149.2
Visual only (day)	21.9	34.8	145.8	**Visual only (day):**	202.6
	Zone 7			**Total Zone 7:**	667.2
PAM only (night)	271.0	0.0	11.8	**PAM only (night):**	282.8
Visual and PAM (day)	330.5	0.0	24.4	**Visual and PAM (day):**	354.9
Visual only (day)	5.2	0.0	24.4	**Visual only (day):**	29.6
Total	1274.1	91.0	321.5	**Total Time (hr):**	1686.6

Environmental conditions may have an impact on the probability of detecting protected species in a survey area. The environmental conditions present during observations undertaken during the four survey programs within the GOM are outlined below.

3.3 Visibility

Visibility conditions were only recorded during daytime operations (Figure 3-1). When visibility was recorded, 91.1% of records indicate visibility was greater than 5 km. Visibility was between 2 and 5 km 5.3% of the time, between 0.5 and 2 km 1.8% of the time, and less than 500 meters 1.8% of the time.

For effort only when the source was active, the pattern is similar; however, PAM (either PAM only or PAM and visual) detection was used 99.9% of the time (Figure 3-2). When visibility was recorded, 95.0% of records indicate visibility was greater than 5 km. Visibility was between 2 and 5 km 2.6% of the time, between 0.5 and 2 km 1.2% of the time, and less than 500 meters 1.2% of the time.

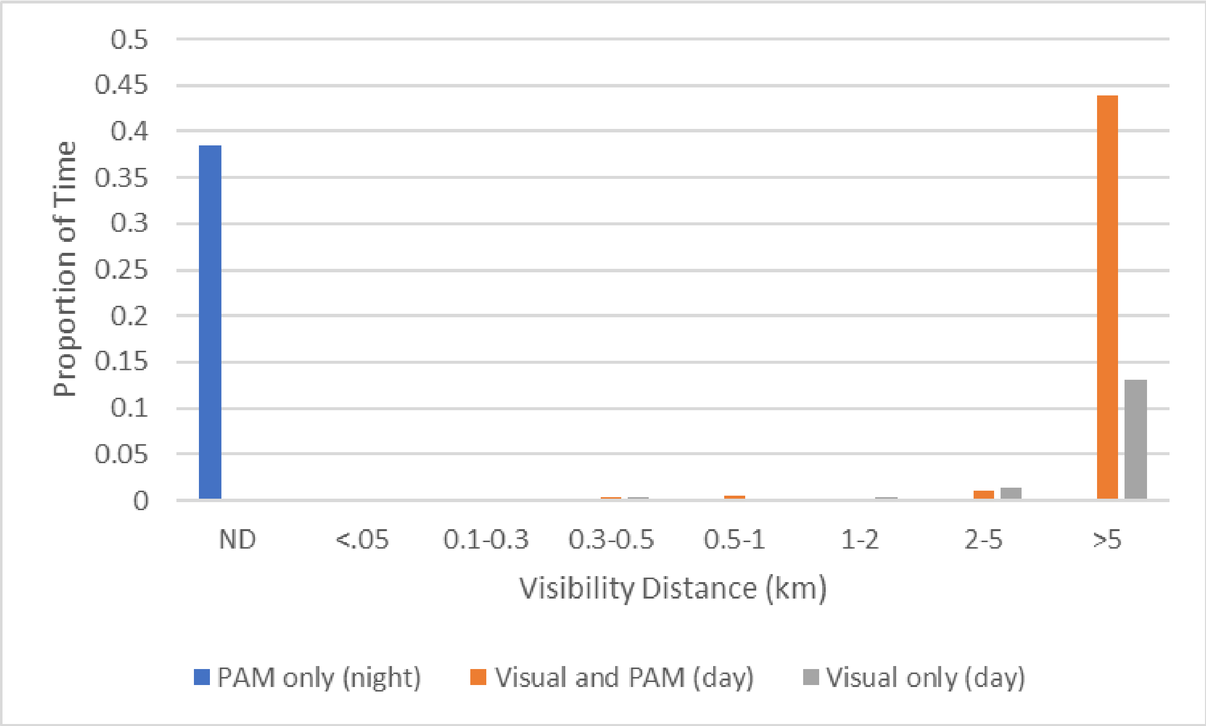

Figure 3-1 Proportion of time with specific visibility distance for all survey effort.

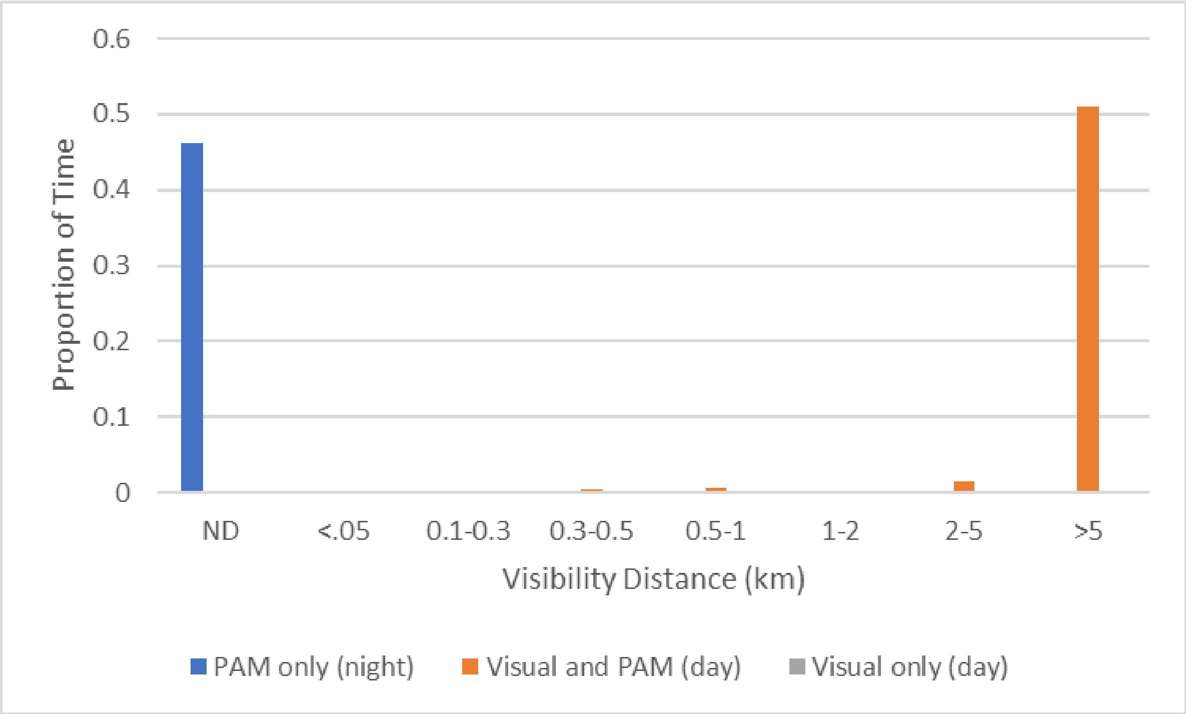

Figure 3-2. Proportion of time with specified visibility distances when source is active. ND = no data.

Beaufort sea state

Marine mammal detectability can be impacted by Beaufort sea state according to studies (e.g., Barlow, 2015). Sea conditions and wind speed combine to create the Beaufort scale which goes from 1 to 8. Some marine mammal species' detectability decreases substantively with an increase in Beaufort state, especially above Beaufort 5, such as beaked whales (Barlow, 2013; Barlow, 2015).

The Beaufort sea state recorded during visual monitoring ranged from Beaufort (BF) 1 to BF7 over the course of the survey programs. There were no BF data collected for PAM-only survey periods, as demonstrated in Figure 3-3 and Figure 3-4. A majority of the surveys were at BF2, BF3, and BF4 which represented 26.5%, 24.6%, and 27.2% of active source surveys respectively when BF data were collected (i.e., excluding PAM only), or 78.3% of active survey time overall when BF data were collected (Figure 3-4). BF values for the remainder of the surveys were BF1 or BF5-BF7, and the pattern was similar for all effort data (Figure 3-3) as with the active survey data (Figure 3-4).

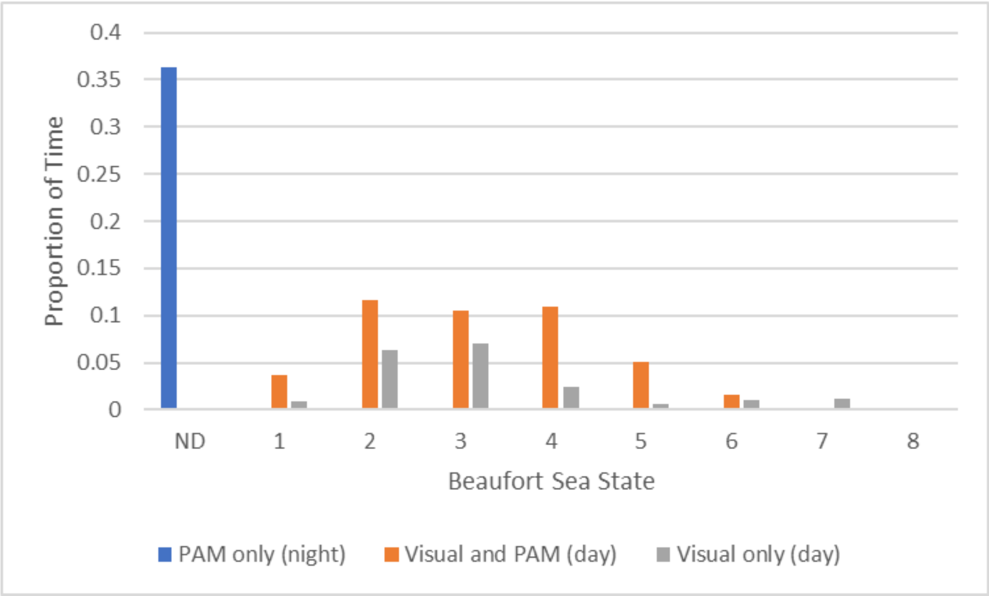

Figure 3-3. *Proportion of time with each reported Beaufort sea state for all survey effort. ND = no data.*

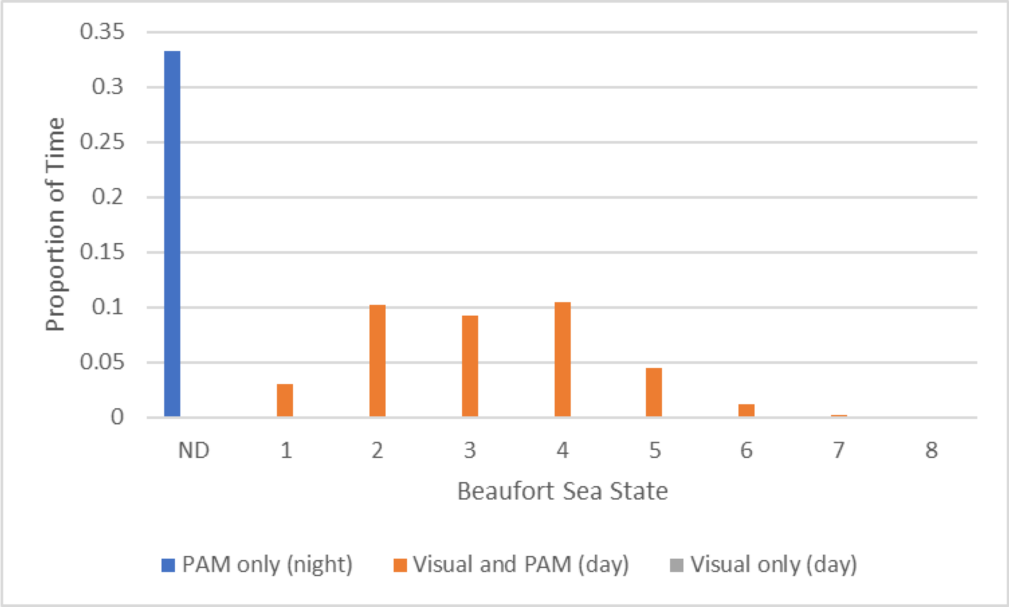

Figure 3-4. *Proportion of time with each reported Beaufort sea state when the source was active. ND = no data.*

3.4 Summary of Mitigation Measures

In total there were 26 instances of marine mammal visual observations representing an estimated 106 individuals (Table 3-8; Table 3-9). Six of the observations (representing 12 individuals) occurred while the source was powered: four involving sperm whales (eight individuals), one involving unidentifiable dolphins (two individuals) and one involving unidentified cetaceans (two individuals). The unidentifiable dolphin observation occurred during the Permit T21-001 survey (4D High Resolution) and the remaining occurred during the Permit T20-004 surveys (OBN)

In total there were 10 acoustic detections representing an estimated 25 individuals. These were all classified as unidentifiable dolphins. Five of the detections occurred while the source was powered, four when the source was not powered (three during deploying/retrieving equipment and one during standby), and one during the soft-start/ramp-up. One of the acoustic detections (the one for unidentifiable dolphins) was also a visual observation. The remaining acoustic detections were not detected visually. All of these detections occurred during the Permit T21-001 survey (4D High Resolution).

The remaining two surveys (Permits L21-014 and A-00005) did not report any marine mammal observations/detections.

Three of the four sperm whale visual observations that occurred while the source was powered resulted in shutdowns with a total mitigation time of 1 hour and 28 minutes (time ranged from 12 minutes to 36 minutes). The remaining sperm whale observation was not in the shutdown zone. The unidentifiable cetacean observations also resulted in a shutdown lasting 12 minutes. Total mitigation time was 1 hour and forty minutes (time ranged from 12 minutes to 36 minutes) (Table 3-10).

From the ITR, the requirements for shutdown durations are

Upon implementation of shutdown, the source may be reactivated after the animal(s) has been observed exiting the exclusion zone or following a 30-minute clearance period with no further observation of the animal(s).

For the shutdowns lasting less than 30 minutes (Table 3-10), the animals were observed exiting the exclusion zones and therefore the source was powered back up. For the shutdowns lasting more than 30 minutes and distance at last sighting within the exclusion zone, those distances represent the last location where the animal was seen, and a 30-minute clearance period ensued during which the animals were not resighted.

One of the acoustic detections that occurred during equipment deployment resulted in a 38-minute delay to soft-start/ramp-up. The acoustic detections that occurred while the source was powered (all remaining detections) did not result in shutdowns as the source was already powered and surveys underway when the small delphinid detection occurred.

Table 3-8. Summary of all visual observations by source activity.

	Active Source		Inactive Source		Transit			
Species	**Groups**	**Individuals**	**Groups**	**Individuals**	**Groups**	**Individuals**	**Total Groups**	**Total Individuals**
Atlantic spotted dolphin	0	0	0	0	1	6	1	6
Clymene dolphin	0	0	1	3	0	0	1	3
Common bottlenose dolphin	0	0	1	3	2	10	3	13
Gervais' beaked whale	0	0	1	2	0	0	1	2
Pantropical spotted dolphin	0	0	1	7	1	23	2	30
Risso's dolphin	0	0	2	20	0	0	2	20
Sperm whale	4	8	4	5	0	0	8	13
Unidentifiable cetacean	1	2	0	0	0	0	1	2
Unidentifiable dolphin	1	2	4	11	1	2	6	15
Unidentifiable whale	0	0	1	2	0	0	1	2
Total	**6**	**12**	**15**	**53**	**5**	**41**	**26**	**106**

Table 3-9. Summary of all visual observations by management zone.

	Zone							
	3		6		7			
Species	**Groups**	**Individuals**	**Groups**	**Individuals**	**Groups**	**Individuals**	**Total Groups**	**Total Individuals**
Atlantic spotted dolphin	1	6	0	0	0	0	1	6
Clymene dolphin	0	0	1	3	0	0	1	3
Common bottlenose dolphin	3	13	0	0	0	0	3	13
Gervais' beaked whale	0	0	0	0	1	2	1	2
Pantropical spotted dolphin	1	7	0	0	1	23	2	30
Risso's dolphin	0	0	2	20	0	0	2	20
Sperm whale	0	0	4	5	4	8	8	13
Unidentifiable cetacean	0	0	1	2	0	0	1	2
Unidentifiable dolphin	3	10	2	3	1	2	6	15
Unidentifiable whale	0	0	0	0	1	2	1	2
Total	**8**	**36**	**10**	**33**	**8**	**37**	**26**	**106**

Table 3-10. Summary of behavior and mitigations for marine mammal observations when the source was active

Survey Type	Zone	Species	Behavior1	Behavior2	Behavior3	Behavior4	Shutdown Zone (m)	Closest Approach to Active Source (m)	Distance at last Sighting (m)	Mitigation	Mitigation Downtime
OBN	7	Sperm Whale	Blowing	Stationary	Surfacing	Diving	1,500	702	511	shutdown of source	0:36
OBN	7	Sperm whale	Blowing	Surfacing	Swimming	Diving with flukes / Fluking	1,500	2049	2,049	None	0:00
OBN	7	Sperm Whale	Blowing	Swimming below surface	Fast travel	Diving with flukes / Fluking	1,500	1331	1,068*	shutdown of source	0:35
OBN	6	Unidentifiable cetacean	Blowing	Swimming below surface	Fast travel	--	1,500	1250	1,950	shutdown of source	0:12
OBN	7	Sperm whale	Blowing	Surfacing	Swimming below surface	Breaching / Jumping / Acrobatic behavior	1,500	1409	3,353	shutdown of source	0:17
4D	7	Unidentifiable Dolphin	Swimming	Diving	--	--	500	316	366	none	0

**Distance at last observation, 30-minute waiting period ensued before source was restarted.*

3.4.1 Sighting Rate

We summarize visual observations per hour in Table 3-11 and detections per kilometer in Table 3-12. Dolphins were most commonly sighted in Zone 3 with Common Bottlenose Dolphins being the most frequently sighted at 0.22 individuals/hr (Table 3-11) or 0.02 individuals/km (Table 3-12) for all effort. In Zone 6, Risso's and Pantropical Spotted Dolphins were the most commonly sighted delphinids at 0.042 and 0.048 individuals/hr respectively (Table 3-11). Sperm Whales were the most commonly sighted whale and were visually detected in Zones 6 and 7 at approximately 0.01 individuals/hr for both zones (Table 3-11).

With so few observations reported in the first year of surveys, we cannot make any inferences regarding environmental factors that may affect visual observations. We looked at the number of observations (groups) at the range of reported visibility distances (Figure 3-5) and Beaufort sea states (Figure 3-6) and found patterns similar to those of all effort (Figure 3-1, Figure 3-3). Excluding effort and observations with no data reported for visibility, 95% of effort reported visibility greater than 5 km. As would be expected with 95% of visibility reported to be greater than 5 km, 100% of whales and 83% of dolphins were detected when visibility was greater than 5 km (these values exclude the single record for an unidentifiable cetacean). The mean Beaufort sea state for all survey effort was 3.2, while the mean Beaufort sea state for all observations was 2.6. Again, with so few visual observations, it is difficult to make inferences about this difference but as more data are collected, Beaufort sea state may be found to impact sightings with fewer visual observations at higher sea states, consistent with the findings in other studies (Barlow, 2013; Barlow, 2015).

Table 3-11. Sighting rates per hour by zone and source activity for visual observations.

	Active Source		Inactive Source		Transit		All Effort	
Species	**Groups**	**Individuals**	**Groups**	**Individuals**	**Groups**	**Individuals**	**Groups**	**Individuals**
Zone 3								
Atlantic spotted dolphin	0.0000	0.0000	0.0000	0.0000	0.0319	0.1916	0.0168	0.1006
Common bottlenose dolphin	0.0000	0.0000	0.0487	0.1460	0.0639	0.3193	0.0503	0.2179
Pantropical spotted dolphin	0.0000	0.0000	0.0487	0.3406	0.0000	0.0000	0.0168	0.1174
Unidentifiable dolphin	0.0000	0.0000	0.0973	0.3893	0.0319	0.0639	0.0503	0.1676
Zone 6								
Clymene dolphin	0.0000	0.0000	0.0052	0.0155	0.0000	0.0000	0.0021	0.0062
Risso's dolphin	0.0000	0.0000	0.0103	0.1030	0.0000	0.0000	0.0042	0.0416
Pantropical spotted dolphin	0.0000	0.0000	0.0000	0.0000	0.0287	0.6606	0.0021	0.0479
Sperm whale	0.0000	0.0000	0.0206	0.0258	0.0000	0.0000	0.0083	0.0104
Unidentifiable cetacean	0.0040	0.0080	0.0000	0.0000	0.0000	0.0000	0.0021	0.0042
Unidentifiable dolphin	0.0000	0.0000	0.0103	0.0155	0.0000	0.0000	0.0042	0.0062
Zone 7								
Gervais' beaked whale	0.0000	0.0000	0.0165	0.0330	-	-	0.0015	0.0030
Sperm whale	0.0066	0.0132	0.0000	0.0000	-	-	0.0060	0.0120
Unidentifiable dolphin	0.0016	0.0033	0.0000	0.0000	-	-	0.0015	0.0030
Unidentifiable whale	0.0000	0.0000	0.0165	0.0330	-	-	0.0015	0.0030

Zeros indicate there was effort but no sightings, dashes indicate no effort for that zone and activity.

Table 3-12. Sighting rates per km by zone and source activity.

	Active Source		Inactive Source		Transit		All Effort	
Species	**Groups**	**Individuals**	**Groups**	**Individuals**	**Groups**	**Individuals**	**Groups**	**Individuals**
Zone 3								
Atlantic spotted dolphin	0.0000	0.0000	0.0000	0.0000	0.0019	0.0114	0.0015	0.0088
Common bottlenose dolphin	0.0000	0.0000	0.0092	0.0277	0.0038	0.0191	0.0044	0.0191
Pantropical spotted dolphin	0.0000	0.0000	0.0092	0.0645	0.0000	0.0000	0.0015	0.0103
Unidentifiable dolphin	0.0000	0.0000	0.0184	0.0738	0.0019	0.0038	0.0044	0.0147
Zone 6								
Clymene dolphin	0.0000	0.0000	0.0010	0.0029	0.0000	0.0000	0.0003	0.0009
Risso's dolphin	0.0000	0.0000	0.0020	0.0195	0.0000	0.0000	0.0006	0.0063
Pantropical spotted dolphin	0.0000	0.0000	0.0000	0.0000	0.0017	0.0395	0.0003	0.0072
Sperm whale	0.0000	0.0000	0.0039	0.0049	0.0000	0.0000	0.0013	0.0016
Unidentifiable cetacean	0.0006	0.0013	0.0000	0.0000	0.0000	0.0000	0.0003	0.0006
Unidentifiable dolphin	0.0000	0.0000	0.0020	0.0029	0.0000	0.0000	0.0006	0.0009
Zone 7								
Gervais' beaked whale	0.0000	0.0000	0.0031	0.0063	-	-	0.0002	0.0005
Sperm whale	0.0011	0.0021	0.0000	0.0000	-	-	0.0010	0.0019
Unidentifiable dolphin	0.0003	0.0005	0.0000	0.0000	-	-	0.0002	0.0005
Unidentifiable whale	0.0000	0.0000	0.0031	0.0063	-	-	0.0002	0.0005

**Zeros indicate there was effort but no sightings, dashes indicate no effort for that zone and activity.*

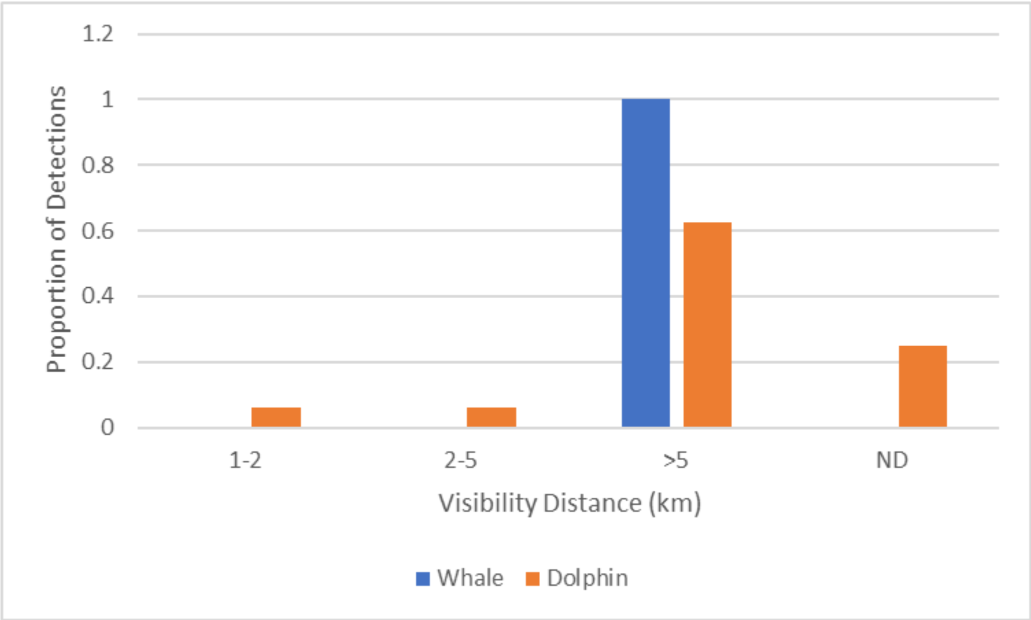

Figure 3-5. Proportion of observations that occurred in each visibility distance bin. ND is no data reported.

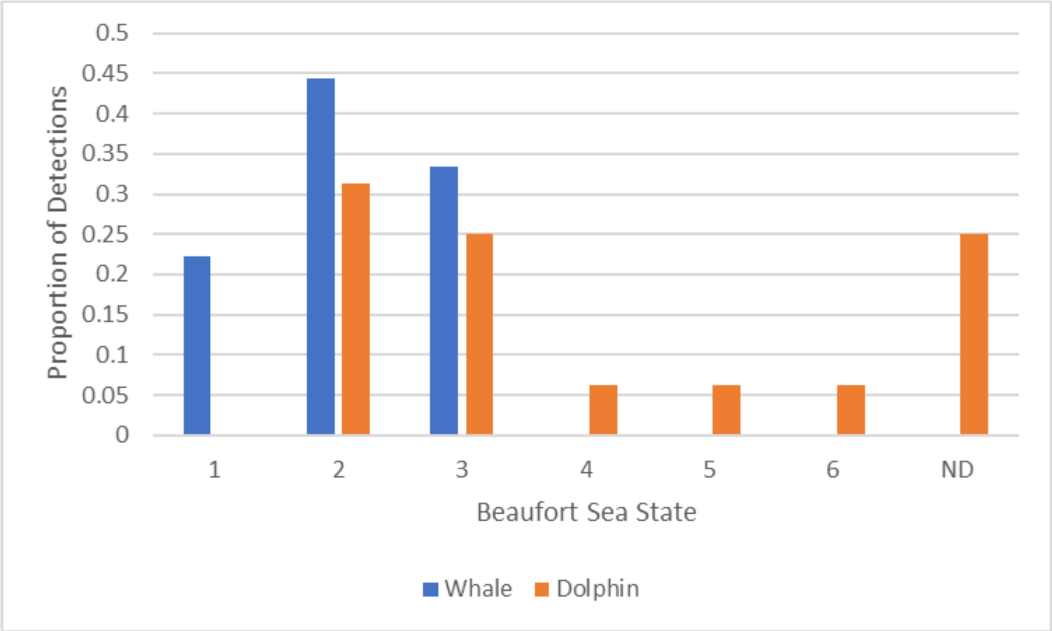

Figure 3-6. Proportion of observations that occurred at each Beaufort sea state. ND is no data reported.

3.5 Data Quality Management

Accurate data input and management is an integral part of allowing for analysis of data. The following challenges were encountered during data analysis:

Format on time of observation for Visual Observations was unreadable (all came out as midnight) and we had to access the comments for time. This will need to be addressed for year two to improve efficiency in uploading data to the database.

Determining when the source is active from the provided codes is not entirely clear. For example, for one of the marine mammal visual observations, the effort table indicated the vessel activity was Data Acquisition at the time of the observation, implying active source; however, the Visual Observations table had the source recorded as Not Firing. A clear code that is consistent between Effort and Observations/Detections would improve the accuracy of the provided effort data and the ease with which the data can be summarized.

While we can estimate distance from time and vessel speed, we cannot know the actual area that this distance covered, if it was a straight line or if it involved turns. Therefore, it would be helpful if tracklines accompany the data. See below for additional details.

- Issues with accuracy of geographical positions entered into data forms:
  - Data quality issues involving geographical positions seem to be attributed to manual input into forms. A recommended action would be a geospatial enabled application for capturing the different PSO required activities, minimizing possible manual errors in 6-10 digit latitude/longitude data points.
  - Time entries were not consistent throughout the data. Standardized time entries and consistency in how time format is entered will assist with future data analysis. The same is applicable for date entries.

4 SUMMARY AND CONCLUSIONS

Most of the monitoring effort occurred while the source was active (75.5%) and not all surveys collected data when the source was not active, such as during transit. Collecting effort data during all phases of the surveys when the vessel is on the water is important to understanding factors that affect observation/detection rates, and ideally this can be addressed in future years. All active survey activity (i.e., with the source powered) occurred in zones 5, 6, and 7; of the active surveys, 28.8% occurred in zone 5, 29.8% in zone 6, and 41.4% in zone 7.

With only four surveys completed in the first year of the ITR we have limited data on which to make inferences regarding our key objectives:

- Behavioral response (or lack of response) to seismic and other geophysical survey types;
- Species/hearing group behavioral sensitivity to seismic and other geophysical surveys;
- Effectiveness of shutdown, power-down, and soft-start mitigations to reduce potential impacts/take; and
- Quantification as possible of impact of mitigation and marine mammal responses with respect to adjustment of take estimates to improve models.

There are not enough data to assess behavioral responses at this time. Based on visual observations, we estimate that seven sperm whales, two unidentified cetaceans, and two unidentified dolphins were potentially taken across the four surveys based on closest distance to an active source being within the exclusion zone and assuming all individuals in the group were exposed. From the limited amount of data on observations, this is significantly below the number of 'takes' authorized.

Of the four instances where a shutdown was implemented, during three of them the animals were already within the exclusion zone when first detected. In the fourth instance, the animals (sperm whales) were observed for 1 hour and 9 minutes outside of the exclusion zone before one was observed inside the zone and the shutdown called. From this we can infer the shutdowns likely minimized impacts to the animals in terms of reducing time of exposure to sound levels in exceedance of NMFS criteria for behavioral harassment; however, observations of a group of sperm whales in the area of the vessel for over an hour suggests the whales were not avoiding the seismic survey.

For environmental conditions that may affect sightings rates, again, there are not enough data to make statistical inferences. Similar to other studies (Barlow 2013, 2015), we found that the Beaufort sea states were lower when sightings occurred than sea states reported across all effort, suggesting sightings may be negatively affected (i.e., animals are harder to see) at higher sea states.

5 RECOMMENDATIONS FOR ADAPTIVE MANAGEMENT

As noted previously, the limited survey data and marine mammal sightings/detections do not allow us to make detailed assessments regarding our key objectives for assessing behavioral responses/sensitivity and the impact of mitigation on reducing potential take. Our focus for this report is assessing data collection methods and data analysis approaches that will allow us to better focus on these objectives in future years.

Areas of focus for adaptive management will be:

- Identifying environmental conditions that affect sighting rates and employing methods to improve sightings rates under those conditions. GOM-PROP initiatives for improved PAM systems may provide methods to enhance detection rates.
- Assessment of species-specific behavioral responses to sound produced by seismic sources with recommendations for refining exclusion zones and distances that constitute take. Ideally this will incorporate new information from GOM-PROP sound source research and development initiatives from Sound and Marine Life Joint Industry Programme studies on behavioral reactions to sound.
- Assessment of the effectiveness of current mitigation for minimizing take and recommendations for changes to mitigation for improved minimization of take.
- Identifying alternative methods for monitoring marine fauna such as thermal imaging and unmanned vehicles which is being investigated through the Sound and Marine Life Joint Industry Programme research projects.

5.1 Data Recommendations

Below we outline several data collection recommendations which will assist with future data interpretation and analysis.

- Vessel activity codes – Consistency in recording when the source is active, not active, or at reduced power (i.e., data acquisition, line change, testing). Clarification in vessel activity codes that reflect the source status coupled with the vessel activity such as when the vessel is on a line change – is the source at full or reduced power.
- Clarification in the use of 'Other' vessel activity code – the use of 'Other' vessel activity code requires reading comment fields to ascertain the likely status of the source. For the purpose of this report, we assumed the source was powered for the 'Other' code. To be more precise in the future, additional fields should be added to vessel activity to minimize the use of this code. In our analysis, we found it is generally used when there are multiple activities taking place in sequence such as Cable deployed/Clearance initiated/ Clearance given/Ramp-up initiated/Ramp-up complete/Full Volume, or when the source is paused and resumed. Maintenance and troubleshooting also represented about half of the 'Other' codes. Based on a review of the comment fields for the 'Other' code, here are recommended additional field codes:

    - Cable Deployed/Pre-clearance initiated
    - Ramp-up Initiated
    - Ramp-up Complete/Full Volume
    - Marine Mammal Mitigation
    - Sea Turtle Mitigation
    - Maintenance/Troubleshooting
- Data collection standardization - To ensure better analysis in the future on PSO data, PSO providers and industry should adopt a standardized format of data collection. A standardized format would help facilitate data being loaded into programs for analysis without the need for manual manipulation of data.
    - Recommendation is a baseline, standardized template that at a minimum would be consistent for the reporting and analytics of the program and help to prevent inaccurate representations.
- Geographical information - It would be a useful visualization tool to have the PSO observations and effort data coupled with the seismic survey tracklines to ensure accurate geographical entry. The ship track could be provided in a Geographical Information System (GIS) format by the seismic operator to the PSO provider or PSOs on board the vessel.
    - Operations and Effort are centric to vessel location data. Interfacing with ship related positional data such as Automated Identification System could improve the accuracy of metrics such as distance travelled, actual speed, idle time, etc. With PSOs recording effort at a minimum every hour including geographic location, gaps of location data for 30-60 minutes an hour over the course of a month could have significant impact on key metrics for analysis.
    - Interfacing with Automated Identification System can improve the visibility of possible surrounding vessel and platform impacts to the marine mammal operations.
- Additional Quality Control procedures should be implemented at regular intervals to confirm data are being entered correctly and accurately. This would include at a minimum, source statuses, date and time formats, species nomenclature, species group types, and geographical information.
    - Data quality issues involving geographical positions seem to be attributed to manual input into forms. A recommended action would be a geospatial enabled application for capturing the different PSO required activities, minimizing possible manual errors in 6-10 digit latitude/longitude data points.
    - Time entries were not consistent throughout the data. Standardized time entries and consistency in how time format is entered will assist with future data analysis. The same is applicable for date entries.
- As recommended by RPS (2019), it would be useful to have infill time or distance due to mitigation for marine animals in order to better assess the operational costs of mitigation for marine mammals. At a minimum this would include the infill related to protected species and should be recorded and potentially assigned to an observation/detection.

- Unidentified categories used by the PSO operator included the categories listed below. We suggest adding a category that captures "Unidentified Cetacean – Not Large Whale" to address the situation in which a PSO is unsure of identification but is confident the marine mammal was not a baleen whale or sperm whale. The purpose of capturing this information is to avoid confusion about whether an ESA-listed species was exposed or not. Currently, if the PSO is not sure if the animal is a particular guild (like dolphin or beaked whale), the only choice would be unidentifiable cetacean, which does not indicate a difference between a completely unidentified animal and an animal that is unidentified but was clearly not a large whale. Alternatively, it may be useful to add a secondary dropdown menu to "unidentified" categories to avoid the need to read comments to determine whether an ESA-species may have been involved. It may also make sense to remove inapplicable categories of species for activities in Gulf of Mexico for more simplicity in data collection (See Appendix A for full description of categories). We recommend the use of the following unidentifiable categories to minimize uncertainty:
    - Unidentifiable baleen whale
    - Unidentifiable beaked whale
    - Unidentifiable cetacean
    - Unidentifiable dolphin
    - Unidentifiable Kogia whale
    - Unidentifiable porpoise
    - Unidentifiable right whale
    - Unidentifiable Sea Lion
    - Unidentifiable Seal
    - Unidentifiable shelled sea turtle
    - Unidentifiable whale

5.2 Improved Training

From reviewing data for this report, we recommend additional PSO data collection training during PSO training courses. While current PSO training courses do have this element of training, the current training should be more thorough and repeated as a refresher after a certain period of time to ensure data collection is still being performed at the highest level of accuracy.

6 LITERATURE CITED

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APPENDIX A FIELDS AND DROP-DOWN MENU OPTIONS FOR DATA COLLECTION SHEETS (INFORMED BY RPS)

Table A-1. Fields and drop-down menu options for the Effort data collection sheet.

Database Headings		Drop-down Menu Options															
Date																	
Type (visual, acoustic, or both VS day or night)		Visual Only (Day)	Visual Only (Night)	PAM Only (Day)	PAM Only (Night)	Visual and PAM (Day)	Visual and PAM (Night										
Number PSOs on Visual Watch		1	2	3	4	5											
If acoustic, location of monitoring		Remote	Vessel														
PAM Operator Initials																	
PSO Initials																	
Vessel Activity		Data Acquisition	Line Change	Testing	Weather Patterns	Deploying/Retrieving Equipment	Transit	Docked	At Anchor	Bunkering	Standby	Other					
Start of Observations	**Time**																
	Latitude																
	Longitude																
	Vessel Heading in degrees																
	Vessel Speed in Knots																
	GIS Latitude																
	GIS Longitude																
	Water depth (metres)																
End of Observations	**Time**																
	Latitude																
	Longitude																
	Vessel Heading in degrees																
	Vessel Speed in Knots																
	GIS Latitude																
	GIS Longitude																
	Water depth (metres)																
Duration of visual only (day) observation																	
Duration of source activity during visual only (day) observations																	
Duration of visual only (night) observation																	

Database Headings	Drop-down Menu Options															
Duration of source activity during visual only (night) observations																
Duration of PAM only (day) monitoring																
Duration of source activity during PAM only (day) monitoring																
Duration of PAM only (night) observation																
Duration of source activity during PAM only (night) observations																
Duration of visual and PAM (day) monitoring																
Duration of source activity during visual and PAM (day) monitoring																
Duration of visual and PAM (night) monitoring																
Duration of source activity during visual and PAM (night) monitoring																
For acoustic, hydrophone depth (m)																
Wind Speed (knots)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Wind Direction	0	1	2	3	4	5	6	7	8	9	10	11	12			
Beaufort Scale	<2	2-4	>4													
Swell (metres)	<0.05	0.05-0.1	0.1-0.3	0.3-0.5	0.5-1	1-2	2-5	>5								
Visibility (km)																
Cloud Coverage (%)	None	Mild	Moderate	Severe												
Glare	Clear	Haze	Light Rain	Heavy Rain	Thin Fog	Heavy Fog	Sleet	Snow								
Precipitation	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Comments																

Table A-2. Fields and drop-down lists for visual sightings data collection sheet.

Database Headings		Drop-down Menu Options										
Date												
Visual detection number												
Acoustic detection number if detection was correlated												
Time at first detection (HH:MM)												
Time at last detection (HH:MM)												
Visual observer(s)												
Detection was first made		visually by observer keeping a continuous watch	incidentally by visual observer or someone else	acoustically by PAM	both visually and acoustically before observers informed each other							
Detection Cue - Visual Detections		Blow	Dorsal Fin	Body	Splash	Breach	Other Wildlife Nearby	Other (describe in comments)				
Latitude												
Longitude												
GIS Latitude												
GIS Longitude												
Compass heading of vessel (degrees)												
Water depth (meters)												
Common name		NOTE: See Table A-4 for the common name, scientific name and family drop down lists										
Scientific name												
Family												
Certainty of identification		Definite	Probable	Possible								
Number of Adults	**High Estimate**											
	Low Estimate											
	Best Estimate											
Number of Juveniles	**High Estimate**											
	Low Estimate											
	Best Estimate											

Database Headings		Drop-down Menu Options										
Total number of animals												
Visual Description (include features such as overall size; shape of head; colour and pattern; size, shape, and position of dorsal fin; height, direction, shape of blow, sex/age if determinable, etc.)												
Select behaviours observed during the detection event. You do not need to complete all six columns if six different behaviours were not observed. If more than six behaviours were observed, select the five behaviours after the initial behaviour that were observed most often or by the most animals.	**Behaviour 1**	NOTE: See Table A-5 for a list of the behavior options										
	Behaviour 2											
	Behaviour 3											
	Behaviour 4											
	Behaviour 5											
	Behaviour 6											
If any bow-riding behavior observed, record total duration during detection (HH:MM)												
	Bearing to animal(s) at first detection (degrees)											
	Range of animals to vessel at first detection (meters)											
	Range of animals to source at first detection (meters)											
	Bearing to animal(s) at first detection (degrees)											
	Method of Distance Determination	Eyeball estimate	Reticule	Laser range finder	Range stick							
	Initial heading of animal(s) (degrees)											
	Animal(s) Pace at Initial Detection											
	Direction of travel (relative to vessel) at Initial Detection	towards vessel	away from vessel	parallel in same direction as vessel	parallel in opposite direction as vessel	crossing ahead of vessel	crossing astern of vessel	variable	milling	stationary	other	unknown
	Location/ direction of travel (relative to the Exclusion Zone) at Initial Detection	Outside	Approaching	Entering	Within							

Database Headings		Drop-down Menu Options										
	Bearing to animal(s) at last detection (degrees)											
	Range of animals to vessel at last detection (meters)											
	Range of animals to source at last detection (meters)											
	Method of Distance Determination											
	Final heading of animal(s) (degrees)											
	Animal(s) Pace at Final Detection											
	Direction of travel (relative to vessel) at Final Detection											
	Location/ direction of travel (relative to the Exclusion Zone) at Final Detection											
Source activity at initial detection												
Source activity at final detection												
	Applicable mitigation zone (meters)											
	Did the animal enter the mitigation zone during the detection event?											
	Number of animals during the detection event observed inside the mitigation zone											
	Was the source active when the animals entered the mitigation zone?											
	Closest distance of animals to active source (metres)											
	Power level of source (cu inches)											
	Time at closest approach to active source (hh:mm)											
	Closest distance of animals to silent source (metres)											
	Time at closest approach to silent source (hh:mm)											

Database Headings	Drop-down Menu Options										
Source mitigation action required	shutdown of source	delay to initiation of source followed by shutdown of source	powerdown of source	delay to initiation of source followed by powerdown of source	powerdown of source followed by shutdown of source	voluntary turtle pause					
Mitigation Downtime (HH:MM)											
Total duration of silence between mitigation shutdown and soft start (HH:MM)											
Avoidance maneuvers required	alter course	speed reduction and alter course	shift in to neutral								
Visual Detection Narrative (be as detailed as possible - include all information relevant to the detection, especially any changes in relation to source activity and distances from the source and EZ - times, distances, behaviours, locations, headings, mitigation actions, etc.)											
Photographs (list file names)											
Other notes or comments											

Table A-3. Fields and drop-down lists for acoustic detections data collection sheet.

Database Headings	Drop-down Menu Options							
Date								
Visual detection number if detection was correlated								
Acoustic detection number								
Time at first detection (HH:MM)								
Time at last detection (HH:MM)								
Acoustic observer(s)								
Detection was first made	visually by observer keeping a continuous watch	incidentally by visual observer or someone else	acoustically by PAM	both visually and acoustically before observers informed each other				
Detection Cue - Acoustic Detection	Aurally by PAM Operator	Visually by Operator on a Spectrogram	Visually by Operator on a Click Detector	Visually by Operator on a different module	Aurally and visually detected simultaneously			
Latitude								
Longitude								
GIS Latitude								
GIS Longitude								
Compass heading of vessel (degrees)								
Water depth (meters)								
Common name	NOTE: See Table A-4 for the common name, scientific name and family drop down lists							
Scientific name								
Family								
Certainty of identification	Definite	Probable	Possible					
Number of Animals – **High Estimate**								
Number of Animals – **Low Estimate**								
Number of Animals – **Best Estimate**								
Acoustic Description (include features of detection, such as type(s) and nature of vocalizations, registered amplitudes, etc)								

Database Headings		Drop-down Menu Options							
Acoustic Detections: Select from the drop-down list the methods/modules on which vocalizations were detected during the event. You do not need to complete all six columns.	**1**	Aural detection of clicks and/or pulsed sounds	Aural detection of tonal sounds	Visual detection of clicks and/or pulsed sounds on a spectrogram	Visual detection of tonal sounds on a spectrogram	Detection of tonal sounds by an automated Whistle Moan Detector	Detection of clicks by an automated Click Detector	Other (described in detection description)	
	2	Aural detection of clicks and/or pulsed sounds	Aural detection of tonal sounds	Visual detection of clicks and/or pulsed sounds on a spectrogram	Visual detection of tonal sounds on a spectrogram	Detection of tonal sounds by an automated Whistle Moan Detector	Detection of clicks by an automated Click Detector	Other (described in detection description)	
	3	Aural detection of clicks and/or pulsed sounds	Aural detection of tonal sounds	Visual detection of clicks and/or pulsed sounds on a spectrogram	Visual detection of tonal sounds on a spectrogram	Detection of tonal sounds by an automated Whistle Moan Detector	Detection of clicks by an automated Click Detector	Other (described in detection description)	
	4	Aural detection of clicks and/or pulsed sounds	Aural detection of tonal sounds	Visual detection of clicks and/or pulsed sounds on a spectrogram	Visual detection of tonal sounds on a spectrogram	Detection of tonal sounds by an automated Whistle Moan Detector	Detection of clicks by an automated Click Detector	Other (described in detection description)	
	5	Aural detection of clicks and/or pulsed sounds	Aural detection of tonal sounds	Visual detection of clicks and/or pulsed sounds on a spectrogram	Visual detection of tonal sounds on a spectrogram	Detection of tonal sounds by an automated Whistle Moan Detector	Detection of clicks by an automated Click Detector	Other (described in detection description)	
	6	Aural detection of clicks and/or pulsed sounds	Aural detection of tonal sounds	Visual detection of clicks and/or pulsed sounds on a spectrogram	Visual detection of tonal sounds on a spectrogram	Detection of tonal sounds by an automated Whistle Moan Detector	Detection of clicks by an automated Click Detector	Other (described in detection description)	
Initial Detection Information	**Bearing to animal(s) at first detection (degrees)**								
	Range of animals to hydrophones at first detection (meters)								
	Range of animals to source at first detection (meters)								
	Method of Distance Determination	Operator estimation	Pamguard localization	Other software utilized					
	Bearing to animal(s) at last detection (degrees)								

Database Headings		Drop-down Menu Options							
Final Detection Information	**Range of animals to hydrophones at last detection (meters)**								
	Range of animals to source at last detection (meters)								
	Method of Distance Determination								
Source activity at initial detection									
Source activity at final detection									
Mitigation Zone (Exclusion or Buffer)	**Applicable mitigation zone (meters)**								
	Did the animal enter the mitigation zone during the detection event?								
	Was the source active when the animals entered the mitigation zone?								
Active source only	**Closest distance of animals to active source (metres)**								
	Power level of source (cu inches)								
	Time at closest approach to active source (hh:mm)								
Silent Source Only	**Closest distance of animals to silent source (metres)**								
	Time at closest approach to silent source (hh:mm)								
Source mitigation action required		none	delay to initiation of source	shutdown of source	delay to initiation of source followed by shutdown of source	powerdown of source	delay to initiation of source followed by powerdown of source	powerdown of source followed by shutdown of source	voluntary turtle pause

Database Headings	Drop-down Menu Options							
Mitigation Downtime (HH:MM)	none	delay to initiation of source	shutdown of source	delay to initiation of source followed by shutdown of source	powerdown of source	delay to initiation of source followed by powerdown of source	powerdown of source followed by shutdown of source	voluntary turtle pause
Total duration of silence between marine mammal mitigation shutdown and soft start (HH:MM)								
Acoustic Detection Narrative (be as detailed as possible - include all information relevant to the detection, especially any changes in relation to source activity and distances from the source and EZ - times, distances, bearings, tow depth of the hydrophone cable, mitigation actions, etc.)								
Screengrabs and recordings (list file names)								
Other notes or comments								

Table A-4. Species list for the drop down menus in Table A-2.

Common Name	Scientific Name	Family
Andrews' beaked whale	*Mesoplodon bowdoini*	Ziphiidae
Antarctic Fur Seal	*Arctocephalus gazella*	Otariidae
Antarctic minke whale	*Balaenoptera bonaerensis*	Balaenopteridae
Arnoux's beaked whale	*Berardius arnuxii*	Ziphiidae
Atlantic humpback dolphin	*Sousa teuszii*	Delphinidae
Atlantic spotted dolphin	*Stenella frontalis*	Delphinidae
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Delphinidae
Australian Fur Seal	*Arctocephalus pusillus doriferus*	Otariidae
Australian Sea Lion	*Neophoca cinerea*	Otariidae
Bahamonde's beaked whale	*Mesoplodon bahamondi*	Ziphiidae
Baikal Seal or Nerpa	*Phoca sibirica*	Phocidae
Baird's beaked whale	*Berardius bairdii*	Ziphiidae
Bearded Seal	*Erignathus barbatus*	Phocidae
Beluga whale	*Delphinapterus leucas*	Monodontidae
Blainville's beaked whale	*Mesoplodon densirostris*	Ziphiidae
Blue whale	*Balaenoptera musculus*	Balaenopteridae
Boto	*Inia geoffrensis*	Iniidae
Bowhead whale	*Balaena mysticetus*	Balaenidae
Bryde's whale	*Balaenoptera edeni*	Balaenopteridae
Burmeister's porpoise	*Phocoena spinipinnis*	Phocoenidae
California Sea Lion	*Zalophus californianus californianus*	Otariidae
Caspian Seal	*Phoca caspica*	Phocidae
Chilean dolphin	*Cephalorhynchus eutropia*	Delphinidae
Clymene dolphin	*Stenella clymene*	Delphinidae
Commerson's dolphin	*Cephalorhynchus commersonii*	Delphinidae
Common bottlenose dolphin	Tursiops truncatus	Delphinidae

Common Name	Scientific Name	Family
Common dolphin	*Delphinus delphis*	Delphinidae
Common minke whale	*Balaenoptera acutorostrata*	Balaenopteridae
Cook Inlet beluga whale	*Delphinapterus leucas*	Monodontidae
Crabeater Seal	*Lobodon carcinophagus*	Phocidae
Cuvier's beaked whale	*Ziphius cavirostris*	Ziphiidae
Dall's porpoise	*Phocoenoides dalli*	Phocoenidae
Dugong	*Dugong dugon*	Dugongidae
Dusky dolphin	*Lagenorhynchus obscurus*	Delphinidae
Dwarf sperm whale	*Kogia sima*	Kogiidae
False killer whale	*Pseudorca crassidens*	Delphinidae
Fin whale	*Balaenoptera physalus*	Balaenopteridae
Finless porpoise	*Neophocaena phocaenoides*	Phocoenidae
Flatback sea turtle	*Natator depressus*	Cheloniidae
Florida Manatee	*Trichechus manatus latirostris*	Trichechidae
Franciscana	*Pontoporia blainvillei*	Pontoporiidae
Fraser's dolphin	*Lagenodelphis hosei*	Delphinidae
Galapagos Sea Lion	*Zalophus californianus wollebaeki*	Otariidae
Gervais' beaked whale	*Mesoplodon europaeus*	Ziphiidae
Ginkgo-toothed beaked whale	*Mesoplodon gingkodens*	Ziphiidae
Gray Seal	*Halichoerus grypus*	Phocidae
Gray whale	*Eschrichtius robustus*	Eschrichtiidae
Gray's beaked whale	*Mesoplodon grayi*	Ziphiidae
Green sea turtle	*Chelonia mydas*	Cheloniidae
Guadalupe Fur Seal	*Arctocephalus townsendi*	Otariidae
Harbor porpoise	*Phocoena phocoena*	Phocoenidae
Harbor Seal	*Phoca vitullina*	Phocidae
Harp Seal	*Phoca groenlandica*	Phocidae
Hawaiian Monk Seal	*Monachus schauinslandi*	Phocidae

Common Name	Scientific Name	Family
Hawksbill sea turtle	*Eretmochelys imbricata*	Cheloniidae
Heaviside's dolphin	*Cephalorhynchus heavisidii*	Delphinidae
Hector's beaked whale	*Mesoplodon hectori*	Ziphiidae
Hector's dolphin	*Cephalorhynchus hectori*	Delphinidae
Hooded Seal	*Cystophora cristata*	Phocidae
Hourglass dolphin	*Lagenorhynchus cruciger*	Delphinidae
Hubbs' beaked whale	*Mesoplodon carlhubbsi*	Ziphiidae
Humpback whale	*Megaptera novaeangliae*	Balaenopteridae
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	Delphinidae
Indo-Pacific humpback dolphin	*Sousa chinensis*	Delphinidae
Irrawaddy dolphin	*Orcaella brevirostris*	Delphinidae
Juan Fernandez Fur Seal	*Arctocephalus philippi*	Otariidae
Kemp's Ridley sea turtle	*Lepidochelys kempii*	Cheloniidae
Killer whale	Orcinus orca	Delphinidae
Leatherback sea turtle	*Dermochelys coriacea*	Dermochelyidae
Leopard Seal	*Hydrurga leptonyx*	Phocidae
Loggerhead sea turtle	*Caretta caretta*	Cheloniidae
Long-beaked common dolphin	*Delphinus capensis*	Delphinidae
Long-finned pilot whale	*Globicephala melas*	Delphinidae
Longman's beaked whale	*Mesoplodon pacificus*	Ziphiidae
Marine Otter	*Lutra felina*	Mustelidae
Mediterranean Monk Seal	*Monachus monachus*	Phocidae
Melon-headed whale	*Peponocephala electra*	Delphinidae
Narwhal	*Monodon monoceros*	Monodontidae
New Zealand Fur Seal	*Arctocephalus forsteri*	Otariidae
New Zealand Sea Lion	*Phocarctos hookeri*	Otariidae
North Atlantic right whale	*Eubalaena glacialis*	Balaenidae
North Pacific right whale	*Eubalaena japonica*	Balaenidae

Common Name	Scientific Name	Family
Northern bottlenose whale	*Hyperoodon ampullatus*	Ziphiidae
Northern Elephant Seal	*Mirounga angustirostris*	Phocidae
Northern Fur Seal	*Callorhinus ursinus*	Otariidae
Northern right whale dolphin	*Lissodelphis borealis*	Delphinidae
Olive Ridley sea turtle	*Lepidochelys olivacea*	Cheloniidae
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	Delphinidae
Pantropical spotted dolphin	*Stenella attenuata*	Delphinidae
Peale's dolphin	*Lagenorhynchus australis*	Delphinidae
Polar Bear	*Ursus maritimus*	Ursidae
Pygmy beaked whale	*Mesoplodon peruvianus*	Ziphiidae
Pygmy killer whale	*Feresa attenuata*	Delphinidae
Pygmy right whale	*Caperea marginata*	Neobalaenidae
Pygmy sperm whale	*Kogia breviceps*	Kogiidae
Ribbon Seal	*Histriophoca fasciata*	Phocidae
Ringed Seal	*Phoca hispida*	Phocidae
Risso's dolphin	*Grampus griseus*	Delphinidae
Ross Seal	*Ommatohoca rossii*	Phocidae
Rough-toothed dolphin	*Steno bredanensis*	Delphinidae
Sea Otter	*Enhydra lutris*	Mustelidae
Sei whale	*Balaenoptera borealis*	Balaenopteridae
Shepherd's beaked whale	*Tasmacetus shepherdi*	Ziphiidae
Short-finned pilot whale	*Globicephala macrorhynchus*	Delphinidae
South African Fur Seal	*Arctocephalus pusillus*	Otariidae
South American Fur Seal	*Arctocephalus australis*	Otariidae
South American Sea Lion	*Otaria byronia*	Otariidae
South Asian river dolphin	*Platanista gangetica*	Platanistidae
Southern bottlenose whale	*Hyperoodon planifrons*	Ziphiidae
Southern Elephant Seal	*Mirounga leonina*	Phocidae

Common Name	Scientific Name	Family
Southern right whale	*Eubalaena australis*	Balaenidae
Southern right whale dolphin	*Lissodelphis peronii*	Delphinidae
Sowerby's beaked whale	*Mesoplodon bidens*	Ziphiidae
Spectacled porpoise	*Phocoena dioptrica*	Phocoenidae
Sperm whale	*Physeter macrocephalus*	Physeteridae
Spinner dolphin	*Stenella longirostris*	Delphinidae
Spotted Seal	*Phoca largha*	Phocidae
Stejneger's beaked whale	*Mesoplodon stejnegeri*	Ziphiidae
Steller Sea Lion	*Eumetopias jubatus*	Otariidae
Strap-toothed whale	*Mesoplodon layardii*	Ziphiidae
Striped dolphin	*Stenella coeruleoalba*	Delphinidae
Subantarctic Fur Seal	*Arctocephalus tropicalis*	Otariidae
True's beaked whale	*Mesoplodon mirus*	Ziphiidae
Tucuxi	*Sotalia fluviatilis*	Delphinidae
Unidentifiable baleen whale	n/a	Balaenopteridae
Unidentifiable beaked whale	n/a	Ziphiidae
Unidentifiable cetacean	n/a	
Unidentifiable dolphin	n/a	Delphinidae
Unidentifiable Kogia whale	n/a	Kogiidae
Unidentifiable porpoise	n/a	Phocoenidae
Unidentifiable right whale	n/a	Balaenidae
Unidentifiable Sea Lion	n/a	Otariidae
Unidentifiable Seal	n/a	Phocidae
Unidentifiable shelled sea turtle	n/a	Cheloniidae
Unidentifiable whale	n/a	
Vaquita	*Phocoena sinus*	Phocoenidae
Walrus	*Odobenus rosmarus*	Odobenidae
Weddell Seal	*Leptonychotes weddellii*	Phocidae

Common Name	Scientific Name	Family
West African Manatee	*Trichechus senegalensis*	Trichechidae
West Indian Manatee	*Trichechus manatus*	Trichechidae
Whale shark	*Rhincodon typus*	Rhincodontidae
White-beaked dolphin	*Lagenorhynchus albirostris*	Delphinidae
Spinner Dolphin	*Stenalla longirostris*	Delphinidae
Spotted Seal	*Phoca largha*	Phocidae
Stejneger's Beaked Whale	*Mesoplodon stejnegeri*	Ziphiidae
Steller Sea Lion	*Eumetopias jubatus*	Otariidae
Strap-toothed Beaked Whale	*Mesoplodon layardii*	Ziphiidae
Stripped Dolphin	*Stenalla coeruleoalba*	Delphinidae
Subantarctic Fur Seal	*Arctocephalus tropicalis*	Otariidae
True's Beaked Whale	*Mesoplodon mirus*	Ziphiidae
Tucuxi	*Sotalia fluviatilis*	Delphinidae
Unidentifiable Baleen Whale	*N/A*	Balaenopteridae
Unidentifiable Beaked Whale	*N/A*	Ziphiidae
Unidentifiable Cetacean	*N/A*	N/A
Unidentifiable Dolphin	*N/A*	Delphinidae
Unidentifiable Fur Seal	*N/A*	Otariidae
Unidentifiable Kogia Whale	*N/A*	Kogiidae
Unidentifiable Pilot Whale	*Globicephala sp.*	Delphinidae
Unidentifiable Porpoise	*N/A*	Phocoenidae
Unidentifiable Right Whale	*N/A*	Balaenidae
Unidentifiable Sea Lion	*N/A*	Otariidae
Unidentifiable Seal	*N/A*	Phocidae
Unidentifiable Shelled Sea Turtle	*N/A*	Chelonnidae
Unidentifiable Whale	*N/A*	N/A
Vaquita	*Phocoena sinus*	Phocoenidae
Walrus	*Odobenus rosmarus*	Odobenidae

Common Name	Scientific Name	Family
Weddell Seal	*Leptonychotes weddellii*	Phocidae
West African Manatee	*Trichechus senegalensis*	Trichechidae
West Indian Manatee	*Trichechus manatus*	Trichechidae
White-beaked Dolphin	*Lagenorhynchus albirostris*	Delphinidae
Yangtze Finless Porpoise	*Neophocaena asiaeorientalis asiaeorientalis*	Phocoenidae
Yangtze River Dolphin	*Lipotes vexillifer*	Lipotidae

Table A-5. Behavior options for the drop-down menu in Table A-2.

Behavior
Blowing
Bow riding
Breaching / Jumping / Acrobatic behaviour
Dead / Injured
Diving
Diving with flukes / Fluking
Fast travel
Feeding
Hauling out
Mating
Milling
Porpoising
Resting at surface / Logging
Spy hopping
Stationary
Surfacing
Swimming
Swimming below surface
Tail or pectoral fin slapping
Other (Describe in Detection Description)
Undetermined