

# **Recommended standards for marine mammal observers (MMOs) and passive acoustic monitoring (PAM) operators engaged during offshore geophysical surveys in Canada: qualification, training, data collection, and reporting**

Heather R. Smith, Hilary B. Moors-Murphy, Jack W. Lawson

Marine Mammal and Biodiversity Science Branch  
National Capital Region  
Fisheries and Oceans Canada  
200 Kent Street  
Ottawa, ON K1A 0E6  
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Heather R. Smith<sup>1</sup>, Hilary B. Moors-Murphy<sup>2</sup>, Jack W. Lawson<sup>3</sup>

<sup>1</sup> Marine Mammal and Biodiversity Science Branch  
National Capital Region  
Fisheries and Oceans Canada  
200 Kent Street  
Ottawa, ON K1A 0E6

<sup>2</sup> Ocean and Ecosystem Sciences Division  
Maritimes Region  
Fisheries and Oceans Canada  
Bedford Institute of Oceanography  
PO Box 1006  
Dartmouth, NS B2Y 4A2

<sup>3</sup> Marine Mammal Section  
Newfoundland and Labrador Region  
Fisheries and Oceans Canada  
NAFC  
80 East White Hills Road  
St. John's, NL A1C 5X1

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## ABSTRACT

Smith, H.R., Moors-Murphy, H.B, and Lawson, J.W. 2026. Recommended standards for marine mammal observers (MMOs) and passive acoustic monitoring (PAM) operators engaged during offshore geophysical surveys in Canada: qualification, training, data collection, and reporting. Can. Tech. Rep. Fish. Aquat. Sci. 3772: vii + 44 p. <https://doi.org/10.60825/bnyz-8s03>

In Canada, the 2008 *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment* provides the minimum standards for mitigation and monitoring requirements during seismic activities that use air source arrays, as well as techniques to minimize the effects of seismic sound on marine fauna. While the *Statement* specifies the need for qualified and trained marine mammal observers (MMOs) and passive acoustic monitoring (PAM) operators to conduct required mitigation measures and monitoring activities, it does not define what it means for MMOs or PAM operators to be “qualified” or “trained”. The *Statement* also does not specify any data collection protocols and templates, or any type of post-survey reporting. This document outlines recommended standards, from a scientific perspective, for the qualification, training, data collection, and reporting by MMOs and PAM operators working on geophysical surveys. These standards were developed by DFO Science as part of the Ministerial commitment made in June 2020 that DFO develop, communicate, and implement standards/certifications for MMOs that set out specific training and experience requirements for these personnel. The recommended standards are meant to be applicable in all three of Canada's oceans, and though they apply specifically to MMOs and PAM operators engaged during geophysical surveys, many elements outlined in this document may also be relevant in other situations where marine mammal monitoring is undertaken.

## RÉSUMÉ

Smith, H.R., Moors-Murphy, H.B, and Lawson, J.W. 2026. Recommended standards for marine mammal observers (MMOs) and passive acoustic monitoring (PAM) operators engaged during offshore geophysical surveys in Canada: qualification, training, data collection, and reporting. Can. Tech. Rep. Fish. Aquat. Sci. 3772: vii + 44 p. <https://doi.org/10.60825/bnyz-8s03>

*Au Canada, l'Énoncé des pratiques canadiennes d'atténuation des ondes sismiques en milieu marin* (ÉPC, 2008) établit les normes minimales pour les exigences d'atténuation et de surveillance lors des activités sismiques utilisant des réseaux de sources d'air, ainsi que les techniques visant à minimiser les effets du son sismique sur la faune marine. Bien que l'ÉPC précise la nécessité que les observateurs de mammifères marins (OMM) et les opérateurs de surveillance acoustique passive (SAP) doivent être qualifiés et formés pour mettre en œuvre les mesures d'atténuation et les activités de surveillance requises, il ne définit pas ce que signifie « qualifiés » ou « formés » pour ces rôles. L'ÉPC ne précise pas non plus de protocoles ni de modèles pour la collecte de données, ni aucun type de rapport post-levé. Ce document présente d'un point de vue scientifique, les normes recommandées concernant la qualification, la formation, la collecte de données et le reportage par les OMM et les opérateurs de SAP travaillant le cadre des levés géophysiques. Ces normes ont été élaborées par les Sciences du MPO dans le cadre de l'engagement ministériel pris en juin 2020, visant à ce que le MPO développe, communique et mette en œuvre des normes/certifications pour les OMM établissant des exigences précises en matière de formation et d'expérience pour ce personnel. Les normes recommandées sont conçues pour être applicable dans les trois océans du Canada, et bien qu'elles s'appliquent spécifiquement aux OMM et opérateurs de SAP engagés lors des levés géophysiques, plusieurs éléments décrits dans ce document peuvent également être pertinents dans d'autres contextes où la surveillance des mammifères marins est effectuée.

# 1. Introduction

## 1.1 Background

In Canada, the [\*Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment \(2008\)\*](#) (hereafter the “*Statement*”) provides the minimum standards for mitigation and monitoring requirements during seismic activities that use air source arrays, as well as guidance for avoiding or minimizing the effects of seismic air source sounds on marine fauna. The *Statement* is applied and implemented by different regulatory authorities across the country including the Canada-Newfoundland and Labrador Offshore Energy Regulator and the Canada-Nova Scotia Offshore Energy Regulator. Marine mammal observers (MMOs) and passive acoustic monitoring (PAM) operators are required to conduct many of the monitoring activities and mitigation measures outlined in the *Statement* that are designed with the goal of minimizing potential impacts on marine mammals.

MMOs make visual observations of marine mammals and are required by the *Statement* to continuously monitor a pre-defined “safety zone” around an acoustic air source array for at least 30 minutes prior to the activation of the air source array and when the air source is active while the safety zone is visible. When particular species of marine mammals or sea turtles are observed within or about to enter the safety zone, MMOs ask the vessel operator to initiate mitigation techniques (e.g., delaying the start of, or shutting down, the air source array) designed to reduce adverse impacts of seismic air source sound exposure on those species. PAM operators use acoustic monitoring equipment to detect vocalizing marine mammals below the water’s surface that may be within the vicinity of the air source array and may also use the same mitigation techniques as MMOs. The use of PAM technology is required by the *Statement* when the entire safety zone is not visible in combination with certain other conditions.

Though the *Statement* specifies that MMOs be “qualified” and “trained”, it does not define these terms, nor does it provide requirements associated with them. Similarly, the *Statement* makes no mention of the qualification or training for personnel operating the PAM equipment. The *Statement* also does not require a detailed description of the monitoring procedures to be implemented, nor does it specify data collection protocols and templates, or any type of post-survey reporting. Because the *Statement* does not define the requirements for data collection and reporting comprehensively, the data collected and reports produced are generally inconsistent between programs and across individual seismic operators making it difficult or impossible to compile data from multiple surveys. DFO has recognized these shortcomings in reviews (Harwood and Joynt 2009; Moors-Murphy and Theriault 2017; DFO 2020), and is working to update the 2008 *Statement* in response to these and other recommended changes.

MMOs and PAM operators working on geophysical surveys often have unique opportunities to collect data not readily available to researchers, and may therefore help fill important data gaps about species biology, as well as the impacts of geophysical surveys (Wright and Cosentino 2015; Stone et al. 2017; Barkaszi and Kelly 2024). The compilation of MMO and PAM data from multiple surveys will support more informed and effective assessments of species occurrence in areas of interest for geophysical and other industrial activities, inform risk and impact assessments, help evaluate and improve mitigation efficacy, and could be integrated with other oceanic data to provide valuable insight into species that would otherwise not be possible.

On 29 February 2020, the Committee responsible for conducting the *Regional Assessment of Offshore Oil and Gas Exploratory Drilling East of Newfoundland and Labrador* (the “RA”) submitted its final [Report](#) to the Governments of Canada and Newfoundland and Labrador. Recommendation 27 in the RA is that “DFO develop, communicate and implement standards/certifications for marine mammal observers that set out specific training and experience requirements for these personnel”. The RA also identified the importance of the DFO Newfoundland and Labrador Region’s Marine Mammals Sightings Database as a key source of information on marine mammal and sea turtle distribution used in previous environmental assessments (EAs) for offshore exploratory drilling projects in the region. However, the RA noted several caveats with the use of this dataset as the majority of sightings in the database are collected opportunistically and data collection - including observer competences - is not standardized. The Sightings Database referenced in the RA does include data collected by MMOs involved in oil and gas related operations off the eastern coast of Newfoundland and Labrador. A similar database, the DFO Maritimes Region’s Whale Sightings Database (WSDB: <https://www.mar.dfo-mpo.gc.ca/en/maritimes-region-whale-sightings-database>, MacDonald et. al 2017) exists in Maritimes Region, which also includes data collected by MMOs during geophysical surveys, and is used to provide information on the occurrence of cetaceans off Nova Scotia.

On 4 June 2020, the Ministers responsible for taking action related to the RA recommendations released their [Response](#) to the report. In the Response, the Minister of Fisheries, Oceans, and the Canadian Coast Guard committed DFO to the completion of Recommendation 27 and further identified that such standards should apply nationwide and would require dedicated resources.

## 1.2 Objective and scope

This document outlines recommended standards, from a scientific perspective, for the qualification, training, data collection, and reporting by MMOs and PAM operators working on geophysical surveys. The recommended standards were developed by DFO Science and meant to be applicable in all three of Canada's oceans, and were developed as part of the Ministerial commitment made in June 2020.

Though RA Recommendation 27 only references “marine mammal observers”, these standards have been developed for both MMOs and PAM operators because the *Statement* identifies both as being responsible for detecting marine mammals during geophysical surveys and because the lack of standards for both is a known issue. Data collection and reporting standards were also developed to ensure that MMO and PAM data are collected in a manner that is consistent across surveys and promotes the production of high-quality data, are compatible with DFO’s existing sighting databases and include the type of information needed for robust analyses that could be used to assess risk, impacts, and mitigation efficacy. Standards for training and data collection were developed concurrently to help ensure that MMO and PAM operator training aligns with the new data collection requirements.

Though the standards in this document were developed specifically in the context of MMOs and PAM operators engaged in geophysical surveys, many elements outlined in this document may also be relevant in other situations. These standards could therefore serve as a basis on which to develop standards for other situations (e.g., pile driving, ice breaking, active sonar use, cable laying, explosives use in coastal construction, and oil rig decommissioning). In anticipation of the interest to use these standards more broadly, some of the data collection templates are flexible enough to record data on

operational aspects, animal behaviour, or mitigation measures outside of those currently described in the *Statement*. However, the templates would need to be reviewed on a case-by-case basis and modified as needed. The data collection templates include fields that could be used to analyze the effectiveness of some of the mitigation measures described in the *Statement* – these are data that can only be collected in the course of conducting geophysical surveys and so it is important that they be collected by MMOs working on these surveys. This type of data is regularly collected by MMOs in other jurisdictions (Stone et al. 2017; Barkaszi and Kelly 2024).

Because these standards have been written to be applicable in all three of Canada’s oceans, they do not include content that is specific to any particular region. If a regionally specific mitigation or data collection requirement is identified during the planning phase of a geophysical survey (e.g., the need to identify particular species of marine mammals), this can be accommodated in the project-specific technical training program (Section 2.2.1.3) and by adding data fields to the standardized data collection templates provided here.

These training and data collection standards for MMOs reference sea turtles and sharks in addition to marine mammals. Sea turtles are currently included in the monitoring and mitigation requirements in the *Statement*, and it has been proposed that sharks be included in the *Statement* in the future.

Other gaps related to data collection by MMOs and PAM observers engaged in geophysical surveys have been identified in reviews by DFO and external parties (Harwood and Joynt 2009; Moors-Murphy and Theriault 2017; Moulton et al. 2019; DFO 2020), but are outside the scope of this particular project. Out-of-scope issues include the number of each type (i.e., Lead, Experienced, Entry-level) of MMOs and PAM operators required on board each project vessel, the number of MMOs and PAM operators on duty at a given time, on-duty (or “watch”) duration, watch rotation (including breaks between watches, the maximum number of on-duty hours and the distribution of on-duty hours over a 24-hr period), and MMO and PAM equipment requirements.

The standards outlined in this document also do not include training related to marine safety or survival or general human health assessment as requirements for the protection of the health and safety of all offshore workers are addressed in the current regulatory system for geophysical activities.

### 1.3 Methods

An external consultant, LGL Limited, was contracted to develop initial recommendations for the qualification, training, data collection, and reporting for both MMOs and PAM operators for the purpose of geophysical surveys. LGL was selected because of their extensive expertise and experience conducting marine mammal monitoring and research programs related to seismic exploration for oil and gas or academic research for over 25 years. Their final report (LGL Limited 2025) includes an overview of MMO and PAM operator qualification and data collection standards from select international jurisdictions and the rationale for each of their recommendations.

LGL’s recommendations were reviewed, and with input from DFO regional scientists with expertise in MMO and PAM data collection and familiarity with the types of datasets collected by MMOs and PAM operators during geophysical surveys in Canada, were altered as deemed relevant and reformatted to create the standards in this document. Qualification and training standards have been developed for

three levels of MMOs: Entry-level, Experienced, and Lead. Higher qualification standards coincide with greater levels of responsibility. Responsibilities and qualification standards for each of the three levels are outlined for MMOs in Section 2 and for PAM operators in Section 3.

## 2. Marine mammal observers (MMOs)

### 2.1 Responsibilities

#### 2.1.1 *MMO - all levels*

- Visually scan, typically using the naked eye or reticle binoculars, the ocean surface in all directions around the vessel and acoustic source (e.g., air source array) for the presence of marine mammals, sea turtles, and sharks, with a focus on animals within or approaching the established safety zone.
- Record (and when possible, verify) marine mammal, sea turtle, and shark sightings reported by the vessel crew.
- Immediately communicate marine mammal sightings to PAM operators on duty.
- Immediately advise the seismic crew to enact mitigation measures as necessary (e.g., delay start, or call for the shutdown, of the acoustic source).
- Use standardized electronic data forms to record<sup>1</sup>:
  - details of all marine mammal, sea turtle, and shark sightings
  - implementation of mitigation measures
  - environmental and sighting conditions
  - acoustic source and vessel operating conditions
  - visual survey effort
- If required, save, store, and maintain backup copies of photographs/videos collected.
- Behave professionally and adhere to all human health and safety requirements.
- Participate in debrief activities conducted by the regulator (e.g., to assess whether training provided was adequate and discuss implementation of mitigation measures).

#### 2.1.2 *Experienced MMO*

In addition to the responsibilities listed in 2.1.1, an Experienced MMO is expected to:

- Mentor and work alongside Entry-level MMOs.
- Using their best professional judgement, assess the ability of Entry-level MMOs to work alone.

#### 2.1.3 *Lead MMO*

In addition to the responsibilities listed in 2.1.1 and 2.1.2, a Lead MMO is expected to:

- Lead project-specific technical training for the monitoring/mitigation team (in conjunction with the Lead PAM operator and input from the seismic operator).
- Coordinate the MMO observation shift<sup>2</sup> schedule.
- Determine most appropriate observation post(s) on vessel.
- Establish and maintain clear lines of communication with PAM operators, and the vessel and seismic crews.
- Use standardized electronic data forms to record survey information (e.g., survey details, MMO details).

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<sup>1</sup> See Section 5 for details on data collection requirements.

<sup>2</sup> Observation shifts are when MMOs are “on duty”, are often 1-4 hours in length, and have specified minimum rest periods in between.

- Daily quality assurance/quality control (QA/QC) and back-up of MMO data.
- On-board and other reporting as required (e.g., daily summary for seismic operator).
- Maintain and inventory relevant equipment (e.g., computers, binoculars, field guides, GPS).

## 2.2 Qualification and training

### 2.2.1 Entry-level MMO

Must:

#### 2.2.1.1 Education

- Have a bachelor's degree in a related field such as biology or oceanography and/or a wildlife technician diploma. In some cases, the requirement for a degree or diploma can be waived if previous and directly relevant skills and experience (e.g., previous work experience observing or conducting wildlife surveys, traditional or Indigenous knowledge holders with experience observing wildlife gained through subsistence or other traditional activities) can be demonstrated.

#### 2.2.1.2 Experience

- Have previous experience conducting wildlife field observations and recording data according to specified protocols.
- Have previous experience doing data entry on computer or electronic tablet.
  - In some cases, the requirements for previous experience recording data according to specified protocols and entering data on a computer or electronic tablet may be waived if previous and directly relevant skills and experience (e.g., conducting routine wildlife observations in the context of subsistence or other traditional activities, experience using a smart phone) can be demonstrated.

#### 2.2.1.3 Training and certification

- Have successfully completed an MMO training course that must:
  - include classroom and practical vessel-based at-sea components
  - include an assessment or evaluation of each trainee
  - require a minimum passing grade of 80% for successful completion
  - be reviewed and approved by DFO (course requirements are listed in Appendix A)
- Receive project-specific technical training (provided/arranged by the MMO provider<sup>3</sup>) prior to their first deployment<sup>4</sup> on a given seismic survey project<sup>5</sup>. Training must include:
  - identification of marine mammal, sea turtle, and shark species likely to be encountered in the project area
  - project-specific data collection, recording, and reporting protocols
  - project-specific equipment set-up and use
  - project-specific monitoring and mitigation protocols
  - project-specific regulatory regime
  - vessel-specific communication protocols with PAM operators, vessel, and seismic crews
  - roles and responsibilities of monitoring/mitigation team
  - description of the debrief activities to be conducted at the end of a deployment

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<sup>3</sup> The MMO provider is the entity that provides MMO services. It is expected that the MMO provider is an independent entity from the seismic operator. A single entity may provide both MMO and PAM operator services.

<sup>4</sup> In the context of staffing, surveys are broken down into deployments – deployments are often 4-6 weeks in length, and crew changes typically occur at the end of each deployment.

<sup>5</sup> Survey (or “project”) means the entire duration of continuous survey activities in a specified program area during a given period of time – surveys may be many months in duration.

#### 2.2.1.4 Working alone

- Work observation shifts alone only after they have gained enough experience to confidently perform MMO duties alone (as assessed by an Experienced or Lead MMO).

#### 2.2.1.5 Additional skills

- Be able to effectively communicate orally with the marine mammal team (i.e., other MMOs and PAM operators), vessel and seismic crew in English and/or in French, depending on the language spoken by the crew(s), unless otherwise specified.

#### 2.2.1.6 Other considerations

- Be independent, meaning they are hired by an outside contractor and are not directly associated with, or influenced by, the industry or vessel personnel.
- Be task dedicated, meaning they are responsible for MMO duties only and no other tasks including PAM.

### 2.2.2 Experienced MMO

Must meet the standards for being an Entry-level MMO and must also:

#### 2.2.2.1 Experience

- Have previous experience detecting and identifying marine mammals at sea and conducting monitoring and implementing mitigation measures aboard a seismic vessel. A minimum duration (90 days at sea) of experience acting as a MMO aboard a seismic vessel is required. However, the experience need not have any expiration/time limits placed on it.

#### 2.2.2.2 Training and certification

- Exceptions may be made for those who have not completed an observer training course but have demonstrated a minimum of 90 days MMO experience at sea aboard seismic vessel(s) in the Canadian region in which they will be deployed.

### 2.2.3 Lead MMO

Must meet the standards for being an Experienced MMO and must also:

#### 2.2.3.1 Experience

- Have experience (minimum 90 days at sea aboard a seismic vessel) in the Canadian region in which they will be deployed within the last 10 years, preferably within the last 5 years.

#### 2.2.3.2 Additional skills

- Have demonstrated leadership skills including experience supervising personnel in a field setting, communicating with industry clients, and using professional judgement.
- Ability to communicate effectively in writing.

## 3. Passive acoustic monitoring (PAM) operators

### 3.1 Responsibilities

#### 3.1.1 PAM operator - all levels

- Operate PAM equipment and continually monitor PAM output to acoustically detect, and if possible, identify and/or localize vocalizing marine mammals.
- Immediately communicate marine mammal detections to MMO(s) on duty.
- Immediately advise the seismic crew to enact mitigation measures as necessary (e.g., delay start, or call for the shutdown of the acoustic source).
- Use standardized electronic data forms to record:
  - details of all marine mammal acoustic detections

- implementation of mitigation measures
- acoustic source and vessel operating conditions
- PAM survey effort, including the identification of times when PAM was not conducted and troubleshooting/repairs undertaken
- If required, save, store, and maintain backup copies of raw/processed acoustic data.
- Behave professionally and adhere to all human health and safety requirements.
- Participate in debrief activities conducted by the regulator (e.g., to assess whether training provided was adequate and discuss implementation of mitigation measures).

### 3.1.2 *Experienced PAM operator*

In addition to the responsibilities listed in 3.1.1, an Experienced PAM operator is expected to:

- Deploy, retrieve, test, optimize, diagnose, and repair issues with PAM hardware and/or software.
- Mentor and work alongside Entry-level PAM operators.
- Using their best professional judgement, assess the ability of Entry-level PAM operators to work alone.

### 3.1.3 *Lead PAM operator*

In addition to the responsibilities listed in 3.1.1 and 3.1.2, a Lead PAM operator is expected to:

- Lead the PAM components of project-specific technical training for the monitoring/mitigation team (in conjunction with the Lead MMO and input from the seismic operator).
- Coordinate PAM operator monitoring shift<sup>6</sup> schedule.
- Establish and maintain clear lines of communication with MMOs, and vessel and seismic crews.
- Use standardized electronic data forms to record survey information (e.g., seismic equipment, PAM details).
- Daily quality assurance/quality control QA/QC and back-up of PAM data.
- On-board and other reporting as required.
- Maintain and inventory relevant equipment (e.g., computers, PAM hardware and software)

## 3.2 Qualification and training

### 3.2.1 *Entry-level PAM operator*

Must:

#### 3.2.1.1 *Education*

- Have a bachelor's degree in a related field such as biology, bioacoustics, or oceanography and/or a relevant technical diploma. In some cases, the requirement for a degree or diploma can be waived if previous and directly relevant experience conducting PAM for marine mammals can be demonstrated.

#### 3.2.1.2 *Experience*

- Have previous experience conducting PAM for marine mammals and recording data according to specified protocols. Specific experience as a PAM operator on a seismic vessel is not required.
- Have previous experience doing data entry on a computer.

#### 3.2.1.3 *Training and certification*

- Have successfully completed a PAM training course that must:

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<sup>6</sup> Monitoring shifts are when PAM operators are "on duty", are often 1-4 hours in length, and have specified minimum rest periods in between.

- include classroom and practical vessel-based at-sea components
- include an assessment or evaluation of each trainee
- require a minimum passing grade of 80% for successful completion
- be reviewed and approved by DFO (course requirements are listed in Appendix A)
- Receive project-specific technical training (provided/arranged by the PAM operator provider<sup>7</sup>) prior to their first deployment offshore on a given seismic survey project. Training must include:
  - acoustic identification of marine mammal species likely to be encountered in the project area
  - project-specific data collection, recording, and reporting protocols
  - project-specific PAM hardware and software set-up and use
  - project-specific monitoring and mitigation protocols and regulatory regime
  - vessel-specific communication protocols with MMOs, vessel and seismic crews
  - roles and responsibilities of monitoring/mitigation team
  - description of the debrief activities to be conducted at the end of a deployment

#### 3.2.1.4 Working alone

- Work monitoring shifts alone only after they have gained enough experience to confidently perform PAM operator duties alone (as assessed by an Experienced or Lead PAM operator).

#### 3.2.1.5 Additional skills

- Be able to effectively communicate orally with the monitoring/mitigation team, vessel and seismic crew in English and/or in French, depending on the language spoken by the crew(s), unless otherwise specified.

#### 3.2.1.6 Other considerations

- Be independent, meaning they are hired by an outside contractor and are not directly associated with, or influenced by, the industry or vessel personnel.
- Be task dedicated, meaning they are responsible for PAM duties only and no other tasks including MMO watch duties.

### 3.2.2 Experienced PAM operator

Must meet the standards for being an *Entry-level PAM operator* and must also:

#### 3.2.2.1 Experience

- Have previous experience recording and identifying marine mammal acoustic detections at sea using PAM equipment. A minimum of 90 days at sea experience serving as a PAM operator aboard a seismic vessel within the last five years is required.

### 3.2.3 Lead PAM operator

Must meet the standards for being an experienced PAM operator and must also:

#### 3.2.3.1 Experience

- Have experience (minimum 90 days at sea aboard a seismic vessel in the last five years) in the Canadian region in which they will be deployed.

#### 3.2.3.2 Additional skills

- Have demonstrated leadership skills including experience supervising personnel in a field setting, communicating with industry clients, and using professional judgement.

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<sup>7</sup> The PAM operator provider is the entity hired to provide PAM operator services. It is expected that the PAM operator provider is an independent entity from the seismic operator. A single entity may provide both MMO and PAM operator services.

- Ability to communicate effectively in writing.

#### 4. Data collection

Data collected by MMOs and PAM operators must be categorized according to the type of data collected. Data collection requirements are specified for each data type, and include

- The party responsible for data collection/recording,
- The frequency of collection/recording (i.e., how often is each type of data collected), and
- The list of standard data fields, including definitions, measurement units, and acceptable field values.

In addition to recording data in the required data fields, the MMOs and PAM operators should include additional information in the COMMENTS field to note or describe relevant details that are not adequately captured by the codes in the data fields. For example, when recording Effort and Environmental data, comments such as “Leaving port to head out to study area” or “Airguns shutdown because of a compressor problem” should be included. For Visual Sightings and Acoustic Detections, recording additional information regarding behaviour or movement that is not fully described by the codes should be encouraged.

Identifying animals at the species level can be very challenging in the marine environment. The use of the various “unknown” codes allows MMOs and PAM operators to code the animal to the highest taxonomic level of which they are certain. When using the “unknown” codes, it is mandatory to also include a comment regarding what was (or was not) observed during the sighting. For example, if an MMO saw a bushy blow, fluke and dorsal fin of a large whale but could not identify the species, they would enter “Unidentified baleen whale” in the SPECIES\_ID field, and would include the following description in the COMMENTS field “Bushy blow, fluke seen while diving - large whale. Dorsal fin seen.”

It is important to fill out as many data fields as possible, although implementing mitigation measures in a timely fashion takes priority over recording data. Data fields should not be left blank; if data is not collected for a particular detection, “X” should be entered in place of the missing data.

MMOs and PAM operators are additionally required to document their effort, defined as a measurable amount of work applied to data collection, in terms of hours of observation time (Sections 4.7 and 4.8). Recording these metadata provides data transparency and increases the overall value and utility of MMO and PAM data from geophysical surveys. For example, effort data are required to calculate meaningful population metrics (e.g., density estimates) and allow for comparison with other data sources.

It is expected that data will be recorded electronically using commercially available or custom-built software during the survey and that latitude and longitude will be automatically recorded by the software (i.e., the MMO or PAM operator does not manually transfer these values from a handheld GPS unit to the data recording software). If data are unable to be recorded electronically during the survey, data may be recorded manually on paper, but those data must be then entered electronically in order to meet reporting requirements specified in Section 5.

#### 4.1 Survey details

- One record is completed for the entire survey.
- Collected/recorded by: Lead MMO.
- Frequency of collection/recording: Once, at the beginning of the survey.

Table 4.1. Survey details – standard data fields.

<b>Field name</b>	<b>Definition / acceptable field values</b>
Survey name	Name of the geophysical survey.
Survey location	General location of survey (country, region, water body) where the survey is taking place.
Survey area size	Size of the survey area in square kilometres (km <sup>2</sup> ).
Survey type	Type of geophysical survey (e.g., 2D, 3D, etc.).
Geophysical authorization number	Number assigned to the survey by the regulator.
Operator/contractor	Name of the geophysical survey operator/contractor.
Client	Company for which the geophysical survey is being conducted.
Survey start date	Day when vessel(s) leaves port. If the parameters do not change during the survey (e.g., survey type, number of source vessels), there will be a single record for the start and end date of the survey. If parameters change, there could be more than one record with different start and end dates. Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
Survey end date	Day when vessel(s) arrives back in port. Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
No. of source vessels	Number of source vessels involved in the survey.
Source vessel details	Required for each vessel: <ul style="list-style-type: none"> <li>• Vessel name (do not include "R/V")</li> <li>• MMSI (9-digit Maritime Mobile Service Identity)</li> <li>• Length in metres (m)</li> <li>• VID = vessel ID, a 3-letter code created for use in the Sighting ID (Section 4.9) and filenames (Section 5.3)</li> </ul>
Survey speed	Operational speed of source/seismic vessel(s), in knots (kts).
No. of support vessel(s)	Number and name of support vessels (if any). This may include vessels used to carry PAM equipment.
Support vessel details	Required for each vessel: <ul style="list-style-type: none"> <li>• Vessel name (do not include R/V)</li> <li>• MMSI (9-digit Maritime Mobile Service Identity)</li> <li>• Length in metres (m)</li> <li>• VID = vessel ID, a 3-letter created for use in the Detection ID (Section 4.10) and filenames (Section 5.3)</li> </ul>
Comments	

## 4.2 Seismic equipment

- A separate record must be completed for each source vessel.
- Collected/Recorded by: Lead MMO.
- Frequency of collection/recording: At the beginning of the survey and if/when seismic equipment is changed during a survey.

Table 4.2. Seismic equipment – standard data fields.

Field name	Definition / acceptable field values
Vessel name	Vessel name (do not include R/V).
Source start date	Day when the source is first activated during the survey. If the parameters do not change during the survey (e.g., number of airguns, total source volume, source level), there will be a single record for the entire survey. If parameters change, there could be more than one record with different start and end dates. Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
Source end date	Day when source is last used during the survey. Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
Source type	Type of acoustic source used (e.g., airgun array, vibroseis).
No. of airguns	Number of airguns in the air source array. <b>NA</b> Not applicable (i.e., no airguns).
Total source volume	Total discharge volume of acoustic source (e.g., cubic inches (in <sup>3</sup> )).
Smallest source volume	Smallest discharge volume possible, in cubic inches (in <sup>3</sup> ). In the case of an airgun array, would be the discharge volume of the smallest airgun.
Frequency of source	Range of frequencies over which peak acoustic energy of the acoustic source is emitted, in hertz (Hz).
Source level	The primary peak-to-peak amplitude, in dB or bar metres (m), of the acoustic source (dB re 1 µPA or bar m). Note in the COMMENTS whether this value is estimated using modelling or measured <i>in situ</i> during operations.
Tow depth of source	Depth at which acoustic source is towed, in metres (m).
Source distance behind vessel	Distance at which the nearest element of the acoustic source is towed behind the vessel, in metres (m).
Shot interval distance	Interval between airgun shots, in metres (m). <b>NA</b> Not applicable.
Shot interval time	Interval between airgun shots, in seconds (s). <b>NA</b> Not applicable.
Operational pressure	Pressure of air used to operate airguns, in pounds per square inch (psi). <b>NA</b> Not applicable.
Other acoustic source parameters	Provide details of relevant parameters for acoustic sources other than airgun arrays. For example, for vibroseis, include details for: <ul style="list-style-type: none"> <li>• Signal duration, in seconds (s)</li> <li>• Between-signal duration, in seconds (s)</li> <li>• Between-signal distance, in metres (m)</li> <li>• Output signal type (zonal, sweeping)</li> </ul>
Type of streamer	What type of streamer is being used (e.g., solid, gel-filled).
No. of streamers	Number of streamers used during the survey.
Streamer length	Length of streamers used during survey, in metres (m).

Field name	Definition / acceptable field values
Streamer distance behind vessel	Distance at which streamers are towed behind vessel, in metres (m).
Streamer separation distance	Distance between streamers, in metres (m).
Streamer depth	Depth at which streamers are towed, in metres (m).
Source and streamer diagram	Provide a diagram of the source and streamers showing the spacing and position of the various elements, and the array tow distance behind the vessel. A single diagram should also show the relative positions of vessels for multi-vessel surveys.
Safety zone	Radius of the safety zone as measured from the outer perimeter of the acoustic source, in metres (m).
Comments	

### 4.3 MMO operational specifications

- A separate record must be completed for each vessel carrying MMOs.
- Collected/recorded by: Lead MMO.
- Frequency of collection/recording: At the beginning of the survey and if/when MMO operational specifications change during a survey.

Table 4.3. MMO specifications – standard data fields.

Field name	Definition / acceptable field values
Vessel name	Vessel name (do not include R/V).
Observation location(s)	List all locations where MMOs observe from (See Section 4.7a). For each location, briefly describe: <ul style="list-style-type: none"> <li>• Field of view, including any obstructions</li> <li>• Other conditions that may affect observations</li> </ul>
Safety zone obstructed	<b>Yes/No</b> For each observation location, are there any obstructions that prevent the MMO from viewing the entire safety zone? If yes, then describe the obstructed area(s) in the COMMENTS.
MMO location height	Height of MMO eye level above water at each observation location, in metres (m). Use the average MMO eye height for all MMOs if data is collected by more than one MMO.
MMO location distance to source	Distance from the observation location to centre of acoustic source, in metres (m).
MMO equipment	MMO equipment used, binoculars (including Brand and magnification), GPS, software used to record data.
MMO distance estimation	Method used to estimate distance (e.g., eye, reticle, rangefinder).
Comments	

### 4.4 PAM specifications

- A separate record must be completed for each vessel carrying PAM equipment.
- Collected/recorded by: Lead PAM operator.

- Frequency of collection/recording: At the beginning of the survey and if/when PAM equipment is changed during a survey.

Table 4.4. PAM specifications – standard data fields.

Field name	Definition / acceptable field values
Vessel name	Vessel name (do not include R/V).
Towed array ID (TAID)	A unique 4-letter code used to identify the array. This code is used in file names (Section 5.3).
Array length	Length of towed PAM array in metres (m).
No. of hydrophones	Number of hydrophone elements in the array.
Hydrophone spacing	Spacing of hydrophone elements in the array in metres (m).
Distance behind ship	Distance at which centre of array is towed behind vessel in metres (m).
Array on source vessel	<b>Yes/No</b> Is the PAM equipment carried on a source vessel? If no, then describe the general position of the PAM vessel relative to the source vessel(s) in the COMMENTS field.
Distance of PAM array from source	Distance of PAM array from centre of acoustic source in metres (m). <b>NA</b> Not applicable – PAM array not on source vessel. Use the COMMENTS field to provide a general description of the position of the PAM array relative to source.
Bearing of PAM array from source	Bearing of PAM array from acoustic source relative to direction of travel in degrees (°). <b>NA</b> Not applicable – PAM array not on source vessel.
Custom array	<b>Yes/No</b> Is the PAM array custom built?
Array make/model	Make and model of the PAM array. <b>NA</b> Not applicable (i.e., custom built).
Hydrophone specs	For each hydrophone element in the array: <ul style="list-style-type: none"> <li>• Frequency response – effective recording frequency bandwidth in hertz (Hz)</li> <li>• Recording sampling rate in hertz (Hz)</li> <li>• Gain or filter settings – describe any gain or filter settings applied to each channel of the system</li> <li>• Make and model</li> </ul>
Depth of PAM array	Depth in metres (m) at which the PAM hydrophones are towed. Provide information from a depth sensor if available, or the target depth.
Array diagram	Provide a diagram of the array showing the spacing and position of the various hydrophone elements, and the array tow distance behind the vessel. Diagram must also show the position of the array (distance and bearing) relative to the acoustic source if PAM equipment is towed from a source vessel.
PAM software	Provide details for: <ul style="list-style-type: none"> <li>• Software name and version number</li> <li>• Gains or filters applied at processing step</li> <li>• Detector-classifiers applied</li> <li>• Recording setup (if acoustic data is stored/archived)</li> </ul>
Validation protocol	Describe how:

Field name	Definition / acceptable field values
	<ul style="list-style-type: none"> <li>Data are analyzed/reviewed (e.g., spectrogram/display settings used to monitor the real-time audio data, and to validate/confirm potential calls of interest and autodetections)</li> <li>Detections/sounds of interest are confirmed in real-time</li> <li>Localization measurements are made in real-time</li> </ul>
PAM equipment provider	Company providing the PAM array.
Comments	

#### 4.5 MMO details

- A separate record must be completed for each vessel carrying MMOs for each deployment.
- Collected/recorded by: Lead MMO.
- Frequency of collection/recording: At the beginning of each deployment and if/when there is a change in MMO personnel aboard a vessel during a deployment.

Table 4.5. MMO details – standard data fields

Field name	Definition / acceptable field values
Vessel name	Vessel name (do not include R/V).
Deployment start date	Start date of deployment Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
Deployment end date	End date of deployment Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
Service provider	Name of company providing MMOs.
No. of MMOs	Number of MMOs.
Name, designation, and code for each MMO	For each MMO, list their: <ul style="list-style-type: none"> <li>Name</li> <li>Designation, such as "Lead"</li> <li>MMO Code – a unique 8-digit code assigned to an MMO for the duration of the survey. Follow the format: <b>FLNN-<i>MMO</i></b>, where FL=first and last initial of the MMO; NN=2-digit ID #, starting at 01 and increasing consecutively for each MMO with identical initials, e.g., JD01-<i>MMO</i>, JD02-<i>MMO</i>. Note that all MMO Codes end with "-<i>MMO</i>" in order to distinguish them from PAM operators.</li> </ul>
Comments	

#### 4.6 PAM operator details

- A separate record must be completed for each vessel carrying PAM equipment for each deployment.
- Collected/recorded by: Lead PAM operator.
- Frequency of collection/recording: At the beginning of each deployment and if/when there is a change in PAM operator personnel aboard a vessel during a deployment.

Table 4.6. PAM operator details – standard data fields.

Field name	Definition / acceptable field values
Vessel name	Vessel name (Do not include R/V).

Field name	Definition / acceptable field values
Deployment start date	Start date of deployment. Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
Deployment end date	End date of deployment. Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
Service provider	Name of company providing PAM operators.
No. of PAM Operators	Number of PAM operators.
Name, designation, and code for each PAM operator	For each PAM operator, list their: <ul style="list-style-type: none"> <li>• Name</li> <li>• Designation, such as "Lead"</li> <li>• PAM Operator Code – a unique 8-digit code assigned to a PAM operator for the duration of the survey. Follow the format: <b>FLNN-PAM</b>, where FL=first and last initial of the PAM operator; NN=2-digit ID #, starting at 01 and increasing consecutively for each operator with identical initials, e.g., JD01-PAM, JD02-PAM. Note that all PAM Operator Codes end with "-PAM" in order to distinguish them from MMOs</li> </ul>
Comments	

#### 4.7 Observation effort and environmental data - MMO

- Records are completed at the beginning, end, and throughout each observation session<sup>8</sup>.
- Collected/Recorded by: MMO on duty
- These data must be collected/recorded at each of the following times:
  - At the beginning and end of each continuous observation session
  - At the start and end of each seismic line
  - When the acoustic source activity changes
  - When environmental conditions change
  - When MMO effort changes (i.e., when MMOs go on or off duty)
  - Every 30 minutes (even if no other change)

Table 4.7a. MMO observation effort and environmental data – standard data fields.

Field name	Definition / acceptable field values
Vessel_Name	Vessel name (do not include R/V).
Recorded_By	MMO Code for the MMO recording the data. See Section 4.5.
MMOs_On_Duty	Number of MMOs on duty.
MMO_Location	<u>Location of the observation station.</u> <b>BR</b> (Bridge) Sometimes referred to as the wheelhouse on smaller vessels. This will be the usual MMO Location. <b>OD</b> (Observer Deck) The deck above the Bridge. <b>ST</b> (Stern) Specify the location of the stern observation station in the COMMENTS. <b>OT</b> (Other) Describe in the COMMENTS.
Date_UTC	Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).

<sup>8</sup> Observation sessions are continuous periods of MMO effort when MMOs are "on duty" or "on watch", are likely to cover all daylight hours, and are likely to be composed of multiple observation shifts.

Field name	Definition / acceptable field values
Time.UTC	Use 24-h clock (e.g., 14:30:15) in UTC.
Vessel_Latitude	Vessel latitude, in decimal degrees to 4 decimal points (e.g., 43.5555).
Vessel_Longitude	Vessel longitude, in decimal degrees to 4 decimal points (e.g., -43.5555).
Water_Depth	Water depth to sea floor. Likely on display on a monitor on the ship's bridge. <b>NA</b> Not applicable (i.e., water depth not available).
Water_Depth_Units	Specify units used to measure water depth. <b>M</b> Metres <b>F</b> Fathoms <b>OT</b> (Other) Specify in the Comments.
Watch_Status	<b>WS</b> (Watch Start) The start of an observation session. This continuous period of MMO effort may last many consecutive hours and include more than one MMO over several observation shifts. Note in the COMMENTS the status of the seismic operations before the watch start (e.g., seismic operations began during the night or how long the acoustic source has been inactive.) <b>WA</b> (Watch Active) A period during continuous MMO effort; the watch period between WS and WE. <b>WE</b> (Watch End) The end of (or break in) observations when MMOs are not on-watch. A Watch End signifies that there will be a break in the observations (i.e., MMOs will not be on watch for an interval). A watch should never end at the same time (i.e., in the same record) that a shutdown (SZ or SD) is recorded for SOURCE_ACTIVITY. Instead, continue the watch for >3 minutes after the shutdown, then complete a record to end the watch using the OT (Other) SOURCE_ACTIVITY code. <b>OW</b> (Off-Watch) Use when MMOs are off-watch, but opportunistic data was collected (perhaps by vessel crew). Note in the COMMENTS details about sightings made by vessel crew, including level of confidence in accuracy of sighting as reported.
Vessel_Heading	Vessel heading provided in compass degrees (e.g., 90° if heading due east).
Heading_Type	<b>MA</b> (Magnetic) Typically from a vessel compass. <b>TR</b> (True) Typically from a GPS compass.
Vessel_Speed	Vessel speed over ground, in knots (kts).
Source_Active	<b>Yes/No</b> Is the vessel conducting survey/seismic operations (e.g., seismic testing, ramp up, line shooting, or between-line shooting)?
Source_Activity	<u>Type of activity being conducted by the survey vessel.</u> <b>RU</b> (Ramp-up) This is the process whereby the acoustic source is gradually "ramped-up" (also termed "soft start") over a period of time. For example, with an airgun array, ramp-up begins by first activating one airgun and then adding additional airguns in sequence until the full array is activated. The MMO or PAM operator should receive notice from the crew about when ramp-up begins. The MMO will probably not be able to tell when the ramp-up is complete and the acoustic source is fully activated,

Field name	Definition / acceptable field values
	<p>therefore the MMO should be notified by the crew when the ramp-up is complete. The MMO must note in the COMMENTS if the start of ramp-up was delayed because a “shutdown species”<sup>9</sup> designated in the <i>Statement</i> is within or about to enter the safety zone – and include the species that caused the delay and the extent of the delay.</p> <p><b>LS</b> (Line Shooting) Used when acoustic source is typically at full power and seismic data are being collected.</p> <p><b>ST</b> (Seismic Testing) Acoustic source activating pattern tends to be irregular and sporadic. For example, with an airgun array, there may be several seconds between individual shots, or several shots in succession followed by silence for several seconds.</p> <p><b>SZ</b> (Shutdown for Marine Animal) Acoustic source shutdown because a “shutdown species” designated in the <i>Statement</i> is within or about to enter the safety zone. There should never be two SZ in sequence; use OT (with appropriate comments) after a SZ for prolonged shutdowns.</p> <p><b>SD</b> (Shutdown) Acoustic source shutdown for repairs or at end of line. Use when the shutdown was not caused by a “shutdown species” designated in the <i>Statement</i> within or about to enter the safety zone. Include a comment to explain why the acoustic source has been shut down. There should never be two SD in sequence; use OT after a SD for prolonged shutdowns.</p> <p><b>OT</b> (Other) Enter in the COMMENTS to describe what the “Other” activity is.</p> <p><b>TR</b> (Transit) Transiting at higher vessel speeds. Acoustic source not active.</p> <p><b>OS</b> (On station) On station deploying equipment, not moving. Acoustic source not active.</p>
Line_Number	Obtain this number from the crew (usually on display on a monitor on the bridge).
Airguns_Active	<p>The number of airguns in the array that are activated. Or, use one of the following codes if the number of airguns is changing.</p> <p><b>88</b> Used during Ramp-up - indicates a changing array size.</p> <p><b>99</b> Used when an unknown or variable number of airguns active, e.g., during seismic testing. Indicate, if possible, in a comment approximately how many guns were activated, e.g., 2-4, 5-8, etc.</p> <p><b>NA</b> Not applicable (i.e., acoustic source not an airgun array).</p>
Source_Volume	Total volume of the acoustic source when fully activated.

<sup>9</sup> The 2008 *Statement* requires shutdowns for marine mammal or sea turtle species listed as endangered or threatened on Schedule 1 of the *Species at Risk Act*, as well as for other species identified by an environmental review process as possibly experiencing significantly-adverse population-level impacts if exposed to seismic sound.

Field name	Definition / acceptable field values
	<b>99</b> Used when array volume is unknown (e.g., during ramp-up or variable seismic testing).
Vessels_10_Km	Total number of other vessels within 10 km (including any guard vessels). For example, if only the guard vessel is within 10 km, enter 1. However, if there is a fishing boat along with the guard vessel within 10 km, enter 2.
Closest_Vessel_Distance	Distance of the nearest vessel to the source vessel, in kilometres (km). If >2 vessels visible, record information for closest vessel. Exact distance can be obtained from radar. Also, enter "Where At" position for vessel locations relative to source vessel in the COMMENTS (e.g., "Closest vessel at 1:00 relative to source vessel". See how to describe positions of objects relative to the source vessel in the field definition for WHERE_TO and WHERE_AT in Section 4.9). <b>NA</b> Not applicable (i.e., no vessel(s) within 10 km).
Closest_Vessel_Type	Choose the closest vessel type. <b>CH</b> Chase boat <b>SU</b> Supply boat <b>FI</b> Fishing boat <b>OT</b> (Other) Write in the COMMENTS to describe vessel type <b>NA</b> Not applicable (i.e., no vessel(s) within 10 km).
Visibility	Estimate the greatest distance from the source vessel in kilometres (km) at which the MMO thinks it is possible to see the sea surface. This value will change as the level of light changes at sunset and sunrise. The maximum value is 10. Use decimal values for distances less than 1 km. For example, 250 m = 0.25 km; 50 m = 0.05 km.  <b>10</b> Visibility is 10 km or greater (includes when horizon is clearly visible) <b>&lt;1</b> Visibility is variable, but less than 1 km <b>&gt;1</b> Visibility is variable, but greater than 1 km <b>99</b> Visibility is changing frequently, e.g., when travelling through fog patches. Include in the COMMENTS the approximate range of visibility, minimum to maximum distances. For example, "patchy fog, visibility 0.05 km to 2 km."  If in doubt, ask the captain or mate on duty as they must make estimates of visibility for their own hourly watch records.
Light_Level	<b>LI</b> Light <b>TW</b> Twilight <b>DK</b> Dark
Glare_Amount	Brightness on the water caused by the sun that limits MMO's ability to see the water's surface and marine mammals or sea turtles within the glare area. <b>NO</b> (None) No glare present. <b>LI</b> (Light) Light glare present, but a marine mammal could still be seen (with a bit of difficulty) in the area of glare. The MMO's ability

Field name	Definition / acceptable field values
	<p>to identify the marine mammal to the species level could be impacted, especially for smaller animals.</p> <p><b>MO</b> (Moderate) Moderate glare present that would fall between LI and SE glare amounts.</p> <p><b>SE</b> (Severe) Severe glare such that a marine mammal could not be detected in the area of glare.</p>
Glare_From & Glare_To	<p>Position of glare is described as hours on a clock face, with 12 o'clock directly in front of the vessel, in-line with the center of the bow. Do NOT use a colon. If the glare is continuous between 1:30 and 3:00 code as <b>130</b> and <b>300</b>. Use <b>X</b> in both columns if no glare is present or in the To column if glare does not cover more than one clockface direction.</p> <p>Use the following codes if simple clockface description does not suffice.</p> <p><b>VAR</b> (Variable) Use in the From column if the vessel is idling or circling and the position of the glare is constantly changing.</p> <p><b>FOR</b> (Forward) Use in the To column if VAR is used and the glare is primarily forward of the vessel.</p> <p><b>AFT</b> (Aft) Use in the To column if VAR is used and the glare is primarily aft (towards the stern) of the vessel.</p> <p><b>POR</b> (Port) Use in the To column if VAR is used and the glare is primarily on the port side of the vessel.</p> <p><b>STA</b> (Starboard) Use in the To column if VAR is used and the glare is primarily on the starboard side of the vessel.</p>
Cloud_Percent	Percentage of cloud cover 0-100. (Specify the number only, do not include the % sign when entering data).
Precipitation_Type	<p>Type of precipitation present. Select the most appropriate type.</p> <p><b>FG</b> Fog</p> <p><b>RN</b> Rain</p> <p><b>SN</b> Snow</p> <p><b>MX</b> Mix</p> <p><b>NO</b> None</p> <p><b>OT</b> Other - Enter in COMMENTS to describe, e.g., hail, sleet.</p>
Safety_Zone_Visible	<b>Yes/No</b> Is the entire safety zone visible? Note in the COMMENTS the reason (e.g., precipitation, glare, light) and approximately how much of the safety zone is not visible.
Beaufort_Wind_Force	The Beaufort Wind Force scale ranges from 0–12 (0=calm, 12=hurricane; see table below). Record based on true wind speed and wave type. It is often useful to ask bridge crew for their opinion as to this value. This is not the same as “sea state”.
Sightability	Estimation of the likelihood of an MMO being able to detect a small target like a harbour porpoise or sea turtle. It is a combination of environmental factors including ambient light, sea state, glare and presence of whitecaps, therefore, the Sightability value should be consistent with the variables above (i.e., visibility, light, glare, precipitation, and Beaufort Wind Force).

Field name	Definition / acceptable field values
	<p><b>EX</b> (Excellent) Sighting conditions are ideal; can detect small (e.g., porpoise or sea turtle) animals readily.</p> <p><b>GO</b> (Good) Unlikely to miss a small animal at the surface.</p> <p><b>MO</b> (Moderate) More likely to detect than to miss a surfaced animal.</p> <p><b>PO</b> (Poor) More likely to miss than to detect a surfaced animal.</p>
Comments	

Table 4.7b. Beaufort wind force scale.

Beaufort Wind Force	Wind Speed		World Meteorological Organization Terms	Description
	knots	m/s		
0	<1	<0.5	Calm	Sea like a mirror.
1	1–3	0.5–1.5	Light air	Ripples with the appearance of scales are formed, but without foam crests.
2	4–6	2.1–3.1	Light breeze	Small wavelets, short but more pronounced. Crests have glassy appearance and don't break.
3	7–10	3.6–5.1	Gentle breeze	Large wavelets. Crests begin to break. Perhaps scattered white caps.
4	11–16	5.7–8.2	Moderate breeze	Small waves, becoming longer. Fairly frequent white caps.
5	17–21	8.7–10.8	Fresh breeze	Moderate waves, taking a pronounced long form. Many white caps. Chance of spray.
6	22–27	11.3–13.9	Strong breeze	Large waves forming; white foam crests more extensive everywhere. Probably spray.
7	>27	14.4–17.0	Near gale	Ranges from a near gale (7) to a hurricane (12). Marine mammal observations are rare at BF ≥7. Seismic production has usually stopped.

#### 4.8 Monitoring effort – PAM

- Records are completed at the beginning, end and throughout each PAM session<sup>10</sup>.
- Collected/Recorded by: PAM operators on duty
- These data must be collected/recorded at each of the following times:
  - At the beginning and end of each continuous PAM session
  - At the start and end of each seismic line
  - When the acoustic source activity changes
  - When PAM effort changes (i.e., when PAM operators go on or off duty), and
  - Every hour (even if no other change).

<sup>10</sup> PAM sessions are continuous periods of PAM effort when PAM operators are “on duty” and are likely to be composed of multiple monitoring shifts.

Table 4.8. PAM monitoring effort – standard data fields.

Field name	Definition / acceptable field values
Vessel_Name	Vessel name (do not include R/V).
Recorded_By	PAM Operator Code for PAM operator recording the data. See Section 4.6.
PAM_Ops_On_Duty	Number of PAM operators on duty.
Date.UTC	Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
Time.UTC	Use 24-h clock (e.g., 07:30:15).
Vessel_Latitude	Vessel latitude, in decimal degrees to 4 decimal points (e.g., 43.5555).
Vessel_Longitude	Vessel longitude, in decimal degrees to 4 decimal points (e.g., -43.5555).
Water_Depth	Water depth, in metres (m) to sea floor. Likely on display on a monitor on the ship's bridge. <b>NA</b> Not applicable (water depth not available).
Monitoring_Status	<b>MS</b> (Monitoring Start) The start of a continuous monitoring session; not the start of an individual person's shift. A monitoring session may last many consecutive hours and include more than one PAM operator over several shifts. Note in the COMMENTS the status of the seismic operations before the watch start (e.g., seismic operations have been active since date/time or how long the acoustic source has been inactive.) <b>MA</b> (Monitoring Active) A period during continuous monitoring; the monitoring period between MS and ME. <b>ME</b> (Monitoring End) The end of (or break in) monitoring when PAM operators are not on-watch (if there is ever a time when a PAM operator is not on duty, for example, when equipment needs repair). Never code ME on same line as shut down (SZ/SD); continue monitoring >3 minutes after SZ/SD, code Activity as OT during that period, and complete a non-seismic record to end the watch. A MONITORING END signifies that there will be a break in the monitoring (i.e., no PAM operator(s) will be actively monitoring for an interval). Note in the COMMENTS if monitoring has ended because the PAM system needs to be repaired.
Vessel_Heading	Vessel heading provided in compass degrees (e.g., 90° if heading due east).
Vessel_Speed	Vessel speed over ground, in knots (kts).
Source_Active	<b>Yes/No</b> Is the vessel conducting survey/seismic operations (e.g., seismic testing, ramp up, line shooting or between line shooting)?
Source_Activity	<u>Type of activity being conducted by the survey vessel.</u> <b>RU</b> (Ramp-up) This is the process whereby the acoustic source is gradually "ramped-up" (also termed "soft start") over a period of time. For example, with an airgun array, ramp-up begins by first activating one airgun and then adding additional airguns in sequence until the full array is activated. The MMO or PAM Operator should receive notice from the crew about when ramp-up begins. The MMO will probably not be able to tell when the ramp-up is complete and the acoustic source is fully activated, therefore the MMO should be notified by the crew when the ramp-up is complete. The MMO must note in the COMMENTS if the

Field name	Definition / acceptable field values
	<p>start of ramp-up was delayed because a “shutdown species” designated in the <i>Statement</i> is within or about to enter the safety zone – and include the species that caused the delay and the extent of the delay.</p> <p><b>LS</b> (Line Shooting) Used when acoustic source is typically at full power and seismic data are being collected.</p> <p><b>ST</b> (Seismic Testing) Acoustic source activating pattern tends to be irregular and sporadic. For example, with an airgun array, there may be several seconds between individual shots, or several shots in succession followed by silence for several seconds.</p> <p><b>SZ</b> (Shutdown for Marine Animal) Acoustic source shutdown because a “shutdown species” designated in the <i>Statement</i> is within or about to enter the safety zone. There should never be two SZ in sequence; use OT (with appropriate comments) after a SZ for prolonged shutdowns.</p> <p><b>SD</b> (Shutdown) Acoustic source shutdown for repairs or at end of line. Use when the shutdown was not caused by a “shutdown species” designated in the <i>Statement</i> within or about to enter the safety zone. Include a comment to explain why the acoustic source has been shut down. There should never be two SD in sequence; use OT after a SD for prolonged shutdowns.</p> <p><b>OT</b> (Other) Write in the COMMENTS to describe what the “Other” activity is.</p> <p><b>TR</b> (Transit) Transiting at higher vessel speeds. Acoustic source not active.</p> <p><b>OS</b> (On station) On station deploying equipment, not moving. Acoustic source not active.</p>
Line_Number	Obtain this number from the crew (usually on display on a monitor).
Airguns_Active	<p>The number of airguns in the array that are activated. Or, use one of the following coded if the number of airguns is changing.</p> <p><b>88</b> Used during Ramp-up - indicates a changing array size.</p> <p><b>99</b> Used when an unknown or variable number of airguns active, e.g., during seismic testing. Indicate, if possible, in a comment approximately how many guns were activated, e.g., 2-4, 5-8, etc.</p> <p><b>NA</b> Not applicable (i.e., acoustic source not an airgun array).</p>
Source_Volume	<p>Total volume of the acoustic source when fully activated.</p> <p><b>99</b> Used when array volume is unknown (e.g., during ramp-up or variable seismic testing).</p>
Comments	

## 4.9 Visual sightings

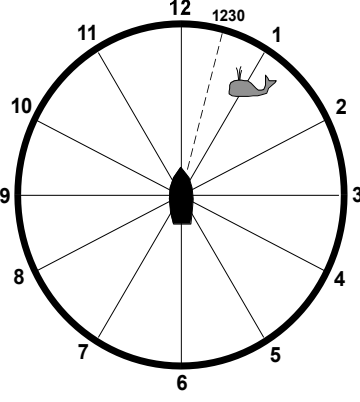
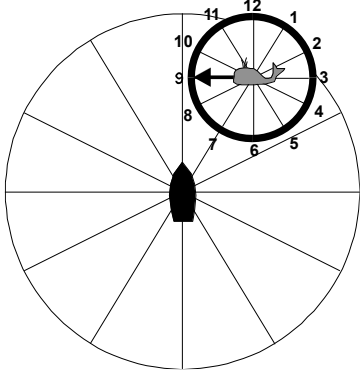
- Collected/recorded by: MMOs on duty

- Frequency of collection/recording: A record must be entered for every initial visual sighting of an individual or group of animals. Subsequent sightings should also be recorded and indicated as such.

Table 4.9. Visual sightings – standard data fields.

Field name	Definition / acceptable field values
Vessel_Name	Name of vessel from which sighting is made (do not include R/V).
Date.UTC	Use 'YYYYMMDD' format (e.g., 20070815 for 15 August 2007).
Sighted_By	<b>MMO Code</b> For sightings made by MMOs. <b>OTHER</b> For sightings made by people other than an MMO. Use the COMMENTS field to include their full name, position on the vessel, and any other relevant comments about the sighting and the level of certainty associated with it.
Sighting_Start.UTC	The time the animal(s) was first observed, using 24-h clock.
Sighting_End.UTC	The time the animal(s) was last observed, using 24-h clock.
Vessel_Latitude	Vessel latitude, in decimal degrees to 4 decimal points(e.g., 43.5555).
Vessel_Longitude	Vessel longitude, in decimal degrees to 4 decimal points(e.g., 43.5555).
Sighting_ID	A consecutive number for each unique sighting. Use the following format: <b>YYYY_OID_VID_VS_NNNNN</b> , where YYYY=year; OID=3-letter seismic operator code e.g., PGS, GXT; VID=3-letter vessel ID code; VS=visual sighting; NNNNN=5-digit sighting #. Note that sighting numbers are continuous throughout the survey.
Species_ID	Identify marine mammals and turtles to the furthest possible taxonomic level – if it cannot be identified to species level then use more general classifications (e.g., unidentified baleen whale, unidentified seal, unidentified toothed whale, dolphin species, etc.). Making a correct general classification is preferable to making an incorrect more specific identification.  Use the COMMENTS field to include more specific identification information (e.g., population or individual ID) if known.  <b>Species codes are listed in Appendix B.</b>
ID_Certainty	This is an MMO's assessment of how certain they are that the animal has been correctly identified. <b>HI</b> Highly certain/definite/confident. <b>PR</b> Probable/probably correct. <b>UN</b> Uncertain /unsure/possible.
Resight	<b>Yes/No</b> Entry option for subsequent sightings of the same animal(s). This can be used to link sighting records together if 'yes' is selected. Sighting records should only be linked when the MMO is confident that the same animal(s) is re-sighted.

Field name	Definition / acceptable field values
	Use the COMMENTS field to identify what sighting record the resight should be linked if there could be some confusion, e.g., “humpback whale observed at 14:23:20”.
MMO_Location	<u>Location of the observation station.</u> <b>OD</b> (Observer Deck) The deck above the Bridge. <b>BR</b> (Bridge) Sometimes referred to as the wheelhouse on smaller vessels. This will be the usual MMO Location. <b>ST</b> (Stern) Specify the location of the stern observation station in the comments.
Photograph_Taken	<b>Yes/No</b> Photographs should be raw image files in the highest possible resolution (do not downsample images to lower resolution). Video files also acceptable.  Use the following naming format for image files: <b>YYYY_OID_VID_VS_NNNNN_IID</b> (i.e., the Sighting ID followed by a 3-digit image ID number). The list of image files should be added to the COMMENTS field, though this should be done after the observation shift when the MMO is not on watch.
Group_Size	Best estimate of the total number of individuals (adults, juveniles and calves/pups combined) seen in the group being observed.  Individuals may be considered to belong to a group if the approximate distance between individuals is within two body lengths for baleen whales, 10 m for odontocetes, or five body lengths for pinnipeds.
Number_Of_Calves	Number of positively identified calves or pups seen in the group. The number of calves/pups must be less than or equal to the number of individuals. <b>UN</b> Uncertain.
Where_At	Position of the animal relative to vessel, in clock face coordinates, when it is first sighted (see figures below). For example: <b>1200</b> - directly in front of the vessel. <b>1230</b> - 15 degrees off the vessel’s trackline to starboard. <b>600</b> - directly behind the vessel. <b>300</b> - perpendicular to the vessel’s trackline to starboard.
Where_To	Direction of movement of the animal relative to vessel, in clock face coordinates, when it is first sighted. For example: <b>1200</b> - travelling in the same direction as the vessel. <b>600</b> - travelling in the opposite direction of the vessel. <b>300</b> - travelling to starboard, 90 degrees off the vessel’s trackline. <b>900</b> - travelling to port, 90 degrees off the vessel’s trackline.  <b>NO</b> - not travelling. Use also for “milling” Movement type.

Field name	Definition / acceptable field values
	<p><b>UN</b> - Unknown or could not be determined (e.g., if the observation was only of a single blow).</p> <p>e.g., Where At = 100 <span style="margin-left: 200px;">e.g., Where To = 900</span></p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div>
Sighting_Distance	<p>Approximate distance to the animal, in whole metres (e.g., 50 m), as measured by the reticle binoculars, laser rangefinder or estimated by eye. The distance and bearing to the animal are measured from the MMO location. MMOs will round distance estimates by eye, to the nearest 10 m; estimates made using the reticle binoculars will be rounded to the nearest half reticle. Due to the nature of the optical system in the reticle binoculars, reticle estimates are more precise for animals sighted closer to the vessel.</p>
Sighting_Method	<p>How sighting distance was estimated.</p> <p><b>EY</b> (Eye) Distance estimated with the “naked eye”.</p> <p><b>LR</b> (Laser rangefinder).</p> <p><b>0.5 to 14</b> Number of reticles (if reticle binoculars used).</p>
Sighting_Latitude	<p>In decimal degrees to 4 decimal points (e.g., 43.5555). This may be calculated in real-time at-sea by the software used to record data, or may be calculated post-survey.</p>
Sighting_Longitude	<p>In decimal degrees to 4 decimal points (e.g., -43.5555). This may be calculated in real-time at-sea by the software used to record data, or may be calculated post-survey.</p>
Sighting_Cue	<p>This is the feature that initially draws the MMO’s attention to the animal.</p> <p><b>HE</b> Head.</p> <p><b>BO</b> Body.</p> <p><b>BL</b> Blow – visible above the water’s surface.</p> <p><b>SP</b> Splash – resulting from an animal’s dive/breach/slap.</p> <p><b>OT</b> Other – Include a description in the COMMENTS field for cues that don’t fall into the above categories (e.g., seabirds feeding, “flukeprints”).</p>
Behaviour_1 & Behaviour_2	<p><u>Behaviour_1</u> is the behaviour of the marine mammal or turtle when sighted initially.</p>

Field name	Definition / acceptable field values
	<p data-bbox="516 237 1414 300"><u>Behaviour 2</u> describes whether an animal stayed at the surface or dove, and what it did at the surface or how it dove.</p> <p data-bbox="516 342 1414 510">If more than two behaviour types are observed, this can be described in the COMMENTS field (or as a Resight of the same animal). For example, a seal might dive then resurface farther away. In that case, the MMO would begin a new sighting record for any observations after the seal resurfaced. "Resight" is used to indicate a sighting is connected to a previous record.</p> <p data-bbox="516 552 1414 625"><b>BH</b> (Breach) Whales or dolphins leaping or jumping out of the water and "slamming" its body on the surface.</p> <p data-bbox="516 636 1414 709"><b>BL</b> (Blow) When a cetacean expels air from its lungs as it surfaces. Visible as cloud of warm, moist air.</p> <p data-bbox="516 720 1414 793"><b>BO</b> (Bottling) When a pinniped surfaces with its head above water and then sinks below water.</p> <p data-bbox="516 804 1414 909"><b>BR</b> (Bow Riding) When toothed cetaceans place themselves immediately ahead of the vessel or large whale to experience assisted locomotion provided by the pressure wave.</p> <p data-bbox="516 919 1414 982"><b>DE</b> (Dead) Dead marine mammal or turtle is observed. Note condition of animal. Take photos if possible.</p> <p data-bbox="516 993 1414 1056"><b>DI</b> (Dive) When a marine mammal or turtle dives below the surface of the water. Use the more specific codes below when possible.</p> <p data-bbox="516 1066 1414 1140"><b>FD</b> (Front Dive) A head-first dive, as opposed to sinking hind flippers or fluke first back underwater.</p> <p data-bbox="516 1150 1414 1213"><b>FE</b> (Feeding) Act of gathering food; maybe through skim or plunge feeding.</p> <p data-bbox="516 1224 1414 1287"><b>FL</b> (Fluking) When a cetacean brings its tail out of the water before a dive.</p> <p data-bbox="516 1297 1414 1455"><b>FS</b> (Flipper Slap) When large cetaceans slap their foreflippers against the surface of the water. This activity often accompanies lunge feeding, where a cetacean swims forward "on their side" with one foreflipper out of the water.</p> <p data-bbox="516 1465 1414 1612"><b>LO</b> (Look) A marine mammal (typically a pinniped) in an upright posture and <b>not travelling</b>, with its head out of the water looking at the source vessel. (Movement field would be coded "NO" for a marine mammal that only looked.)</p> <p data-bbox="516 1623 1414 1686"><b>LT</b> (Lobtail) When a cetacean slaps the water surface with its flukes, sometimes repeatedly.</p> <p data-bbox="516 1696 1414 1801"><b>NO</b> (None) When only a sign is observed and not the animal itself, such as ripples on the water surface left by a seal; OR under Behaviour #2 when there is no second behaviour.</p> <p data-bbox="516 1812 1414 1833"><b>OT</b> (Other) Describe with a comment in the COMMENTS field.</p>

Field name	Definition / acceptable field values
	<p><b>PO</b> (Porpoising) When cetaceans and seals make low, arcing leaps as they travel rapidly near the surface. This behaviour is especially typical of small cetaceans.</p> <p><b>RA</b> (Rafting) When marine mammals or turtles are not swimming but are more or less motionless on the surface, in a horizontal position. This behaviour is typical of sperm whales where they take on a “log” appearance.</p> <p><b>SF</b> (Swim Fast) This refers to a marine mammal swimming at a fast pace at the surface.</p> <p><b>SH</b> (Spyhop) When a cetacean raises its head vertically out of the water so that its eyes are clear of the surface.</p> <p><b>SI</b> (Sink) When a marine mammal sinks straight back down underwater, hind flippers or fluke first, with an upright posture (usually applies to seals, not whales or dolphins).</p> <p><b>SM</b> (Swim Medium) This refers to a marine mammal swimming at a medium pace at the surface.</p> <p><b>SS</b> (Swim Slow) This refers to a marine mammal swimming slowly at the surface.</p> <p><b>SW</b> (Swim) Use the three more specific codes above when possible.</p> <p><b>TH</b> (Thrash) A particularly “frantic” or “violent” dive; this is a subjective evaluation.</p> <p><b>UN</b> Unknown.</p> <p><b>WR</b> (Wake Riding) Swimming in the waves or turbulence behind a moving vessel.</p>
Pace	<p>Subjective assessment of the rate (“Pace”) at which the animal is performing a behavioural act.</p> <p><b>SE</b> (Sedate) Appear relatively relaxed or are moving slowly.</p> <p><b>VI</b> (Vigorous) Animals that appear agitated, move frantically, or dive or move rapidly away from the seismic ship.</p> <p><b>MO</b> (Moderate) Intermediate states.</p> <p><b>UN</b> Unknown.</p>
Movement	<p>Describe the general direction in which the marine mammal or turtle appears to be moving relative to the source vessel. This refers only to movement at the water surface. Do not use these codes to indicate in which direction a marine mammal or turtle dove because we do not know if the animal changed direction underwater.</p> <p><b>ST</b> Swimming Toward the source/seismic vessel.</p> <p><b>SA</b> Swimming Away from the source/seismic vessel at a relatively “normal” speed. (“Normal” is a subjective estimation. See “Fleeing” below.)</p>

Field name	Definition / acceptable field values
	<p><b>SP</b> Swimming Parallel to the source/seismic vessel. This could be swimming in the same direction as the vessel is travelling, or in the opposite direction.</p> <p><b>PE</b> Swimming Perpendicular to the vessel.</p> <p><b>FL</b> Fleeing. When an animal is hurriedly or frantically swimming away from the vessel.</p> <p><b>MI</b> Mill. Swimming “leisurely” in a limited area with no consistent direction of movement (“swimming in circles”).</p> <p><b>NO</b> No movement relative to the vessel. The animal stayed in one place.</p> <p><b>UN</b> Unknown. Movement relative to the vessel was not observed (e.g., if only one blow was observed, the MMO cannot determine the marine mammal’s direction of travel).</p> <p><b>OT</b> Other. A movement that does not fit the other categories. Include a description in the COMMENTS field.</p> <p>If more than one direction of movement is observed, add subsequent movement codes as a “Resight” record. For example, if a marine mammal was first seen swimming toward the vessel, then stopped and swam away during a subsequent sighting, put the code “ST” on the initial sighting record and “SA” on the resight record (and make a note in the COMMENTS).</p>
CPA_Time	Time at closest point of approach (CPA) of the animal to the vessel (i.e., where the MMO is located).
CPA_Distance	The closest (approach) distance, in metres (m), the animal(s) came to the vessel (i.e., where the MMO is located; also record CPA to acoustic source in the COMMENTS data field). For a “loosely formed” group of mammals, use the closest individual to the vessel for the distance estimate. This may or may not be the same value as the initial Sighting Distance.
CPA_Where_At	Where At position of marine mammal at the moment it was closest to the vessel, based on a 12-h clock face, with 1200 in line with the center of the bow.
Water_Depth	Water depth to sea floor. Likely on display on a monitor on the ship’s bridge. <b>NA</b> Not applicable (i.e., depth information not available).
Water_Depth_Units	Specify units used to measure water depth. <b>M</b> Metres <b>F</b> Fathoms <b>OT</b> (Other) Specify in the Comments.
Source_Active	<b>Yes/No</b> Is the vessel conducting survey/seismic operations (e.g., seismic testing, ramp up, line shooting or between line shooting)?
Mitigation_Required	Request for the acoustic source to be shutdown. <b>SZ</b> (Shutdown - mitigation) Acoustic source shutdown in response to a “shutdown species” designated in the <i>Statement</i> within or about to enter the safety zone.

Field name	Definition / acceptable field values
	<p><b>CA</b> (Course alteration) Vessel course was altered to avoid marine mammals or sea turtles.</p> <p><b>RS</b> (Reduce Speed) Reduction in vessel speed.</p> <p><b>OT</b> (Other) Comment on any “other” mitigative measure on taken.</p> <p><b>NO</b> No mitigation required.</p> <p>Include in the COMMENTS field details about the speed with which the mitigation was implemented, including the effectiveness of communication when the mitigation request was made, and any additional observations of animals for which mitigation was implemented.</p>
Comments	

#### 4.10 Acoustic detections

- Collected/recorded by: PAM operators on duty
- Frequency of collection/recording: A record should be entered for each acoustic detection made.

Table 4.10. Acoustic detections – standard data fields.

Field name	Definition / acceptable field values
Vessel_Name	Name of vessel from which detection is made (do not include R/V).
Date.UTC	Use ‘YYYYMMDD’ format (e.g., 20070815 for 15 August 2007).
Detected_By	Pam Operator Code for person making the detection.
Encounter_Start.UTC	The time the animal was first detected, using 24-h clock.
Encounter_End.UTC	The time the animal was last detected, using 24-h clock.
Vessel_Latitude	Vessel latitude, in decimal degrees to 4 decimal points (e.g., 43.5555).
Vessel_Longitude	Vessel longitude, in decimal degrees to 4 decimal points (e.g., 43.5555).
Detection_ID	<p>A consecutive number for each unique detection. Use the following format <b>YYYY_OID_VID_AD_NNNNN</b>, where YYYY=year; OID=3-letter seismic operator code e.g., PGS, GXT; VID=3-letter vessel ID code; AD=acoustic detection; NNNNN=5-digit detection #.</p> <p>Note that detection numbers are continuous throughout the survey (i.e., they do not start back at one at the beginning of each observation shift or for each MMO).</p>
Species_ID	<p>Identify marine mammals to the furthest possible taxonomic level – if it cannot be identified to species level then use more general classifications (e.g., unidentified baleen whale, unidentified seal, unidentified toothed whale, dolphin species, etc.). Making a correct general classification is preferable to making an incorrect more specific identification.</p> <p>Species codes are listed in <b>Appendix B</b>.</p>
ID_Certainty	<p>This is a PAM operator’s assessment of how certain they are that the animal has been correctly identified.</p> <p><b>HI</b> Highly certain/definite/confident.</p> <p><b>PR</b> Probable/probably correct.</p> <p><b>UN</b> Uncertain /unsure/possible.</p>
First_Detected_Method	<p>Was the detection initially made</p> <p><b>VI</b> Visually, by MMO on watch.</p>

Field name	Definition / acceptable field values
	<p><b>IN</b> Incidentally, by MMO or another observer (e.g., vessel crew).</p> <p><b>AC</b> Acoustically, by PAM operator on watch.</p> <p><b>BO</b> Both visually and acoustically before MMOs or PAM operators informed each other.</p>
Localization	<b>Yes/No</b> Was localization achieved?
Bearing_To_Animal	Bearing to animal from the PAM array in degrees. <b>NA</b> Not applicable (i.e., localization information not available).
Range_Of_Animal	Distance of animal from the PAM array when first detected, in metres (m). <b>NA</b> Not applicable (i.e., localization information not available).
Localization_Uncertainty	Uncertainty of localization information in metres (m). <b>NA</b> Not applicable (i.e., localization information not available).
Localization_Latitude	In decimal degrees to 4 decimal points(e.g., 43.5555). This may be calculated in real-time at-sea by the software used to record data, or may be calculated post-survey. <b>NA</b> Not applicable (i.e., localization information not available).
Localization_Longitude	In decimal degrees to 4 decimal places (e.g., 43.5555). This may be calculated in real-time at-sea by the software used to record data, or may be calculated post-survey. <b>NA</b> Not applicable (i.e., localization information not available).
Screenshot_Taken	<p><b>Yes/No</b> Was a screenshot of the spectrogram taken when the animal was detected? <b>Screenshot should be taken if possible.</b></p> <p>Use the following naming format for image files:  <b>YYYY_OID_VID_AD_NNNNN_SID</b> (i.e., the Detection ID followed by a 3-digit screenshot ID number)</p>
Signal_Description	Description of signal characteristics. What type of signals were observed? How did you ID the species? E.g., clicks with upsweeps, blue whale tonal call, moan, clicks without upsweeps, frequency range.
CPA_Time	Time of the closest point of approach (CPA) of detection to the PAM array. <b>NA</b> Not applicable (i.e., localization information not available).
CPA_Distance	The closest (approach) distance, in meters (m), that the call was detected from the PAM array. <b>NA</b> Not applicable (i.e., localization information not available).
CPA_Bearing	The bearing to the detection when it was at the closest distance to the PAM array. <b>NA</b> Not applicable (i.e., localization information not available).
Movement	Describe the general direction in which the marine mammal appears to be moving relative to the PAM array. <p><b>ST</b> Swimming Toward the PAM array.</p> <p><b>SA</b> Swimming Away from the PAM array.</p> <p><b>SP</b> Swimming Parallel to the PAM array. This could be swimming in the same direction as the PAM array is travelling, or in the direct opposite direction.</p> <p><b>PE</b> Swimming Perpendicular to the PAM array.</p>

Field name	Definition / acceptable field values
	<p><b>NO</b> No movement relative to the PAM array. The animal stayed in one place.</p> <p><b>UN</b> Unknown - localization information not available or unable to determine direction of movement.</p> <p><b>OT</b> Other. A movement that does not fit the other categories. Include a description in the COMMENTS field.</p>
Source_Active	<b>Yes/No</b> Is the vessel conducting survey/seismic operations (e.g., seismic testing, ramp up, line shooting or between line shooting)?
Time_SZ_Enter_UTC	Time the call was detected in the safety zone, using 24-h clock. <b>NA</b> Not applicable (i.e., animal did not enter safety zone).
Time_SZ_Left_UTC	Time the call was no longer detected in the safety zone, using 24-h clock. <b>NA</b> Not applicable (i.e., animal did not enter safety zone).
Mitigation_Required	<p>Request for the acoustic source to be shutdown.</p> <p><b>SZ</b> (Shutdown - mitigation) Acoustic source shutdown in response to a “shutdown species” designated in the <i>Statement</i> within or about to enter the safety zone.</p> <p><b>CA</b> (Course alteration) Vessel course was altered to avoid marine mammals or sea turtles.</p> <p><b>RS</b> (Reduce Speed) Reduction in vessel speed.</p> <p><b>OT</b> (Other) Comment on any “other” mitigative action taken.</p> <p><b>NO</b> No mitigation required.</p> <p>Include in the COMMENTS field details about the speed with which the mitigation was implemented, including the effectiveness of communication when the mitigation request was made, and any additional observations of animals for which mitigation was implemented.</p>
Comments	

## 5. Reporting

Reporting requirements for raw data files, as well as weekly and final reports, are detailed below. All reports and data must be submitted to the Regulator and DFO. Requirements identify:

- Reporting period
- When the reports/data must be submitted
- Format for submission
- Required content.

### 5.1 Weekly report

- Weekly reports cover the 7-day period starting on a Monday (or as otherwise specified by the regulator).
- Weekly reports are due by noon (local time) on Monday (or as otherwise specified by the regulator).
- Content must be organized according to headings outlined below.
- Weekly reports may be submitted as Word or PDF files.
- Sighting/detection details must also be submitted as a .csv file.

- Weekly reports must be named according to the following naming convention **YYYY\_WR\_MMDD\_OID**, where YYYY=year; WR=weekly report; MMDD=month and day for the first day of the reporting period; and OID=3-letter seismic operator code e.g., PGS, GXT.

Table 5.1. Weekly report – required content.

<b>Heading</b>	<b>Content</b>
Survey name	Name of the geophysical survey.
Geophysical authorization number	Number assigned to the survey by the regulator.
Reporting period	Start and end dates of reporting period.
Summary of vessel activity	Provide a general description of the area of survey activity. - Include the number of kilometres and hours spent deploying equipment, in transit, in operation, delays, etc.
Summary of visual observation effort	For the week as a whole and for each source vessel: <ul style="list-style-type: none"> <li>• Total number of hours on effort.</li> <li>• Number of hours conducted while the source was active.</li> <li>• Number of hours conducted while the source was inactive.</li> </ul>
Summary of acoustic monitoring effort	For the week as a whole and for each vessel carrying PAM hardware: <ul style="list-style-type: none"> <li>• Total number of hours on effort.</li> <li>• Number of hours conducted while the source was active.</li> <li>• Number of hours conducted while the source was inactive.</li> </ul>
Summary of visual sightings	For the week as a whole and for each vessel carrying MMOs, provide a table for each period of source activity (i.e., source active and source inactive).  For each species sighted (or most specific taxonomic group identified), list the <ul style="list-style-type: none"> <li>• Total number of sightings.</li> <li>• Total number of individuals sighted.</li> <li>• SARA status.</li> </ul>
Summary of acoustic detections	For the week as a whole and for each vessel carrying PAM hardware, provide a table for each period of source activity (i.e., source active and source inactive).  For each species detected (or most specific taxonomic group identified), list the <ul style="list-style-type: none"> <li>• Total number of detections.</li> <li>• SARA status.</li> </ul>
Summary of mitigation actions	Provide separate tables for mitigation actions resulting from sightings and acoustic detections.  For each type of mitigation action implemented (e.g., delay in start-up, shutdown), list the <ul style="list-style-type: none"> <li>• Total number of actions implemented.</li> <li>• Species for which mitigation action was implemented.</li> </ul>

Heading	Content
	<ul style="list-style-type: none"> <li>Name of vessel carrying the MMO or PAM operator that called for the mitigation action.</li> </ul>
Sighting/detection details	<p>For each visual sighting or acoustic detection</p> <ul style="list-style-type: none"> <li>Date.</li> <li>Time.</li> <li>Vessel latitude.</li> <li>Vessel longitude.</li> <li>Vessel name (platform from which the sighting or acoustic detection was made).</li> <li>Sighting/detection latitude.</li> <li>Sighting/detection longitude.</li> <li>Type of detection - visual or acoustic?</li> <li>Species (or most specific taxonomic group identified).</li> <li>SARA status.</li> <li>Number of individuals (if known).</li> <li>Detection distance.</li> <li>Did animal(s) enter the safety zone? (yes/no).</li> <li>Type of mitigation action implemented (e.g., none, delay start-up, shutdown).</li> </ul>

## 5.2 Final report

- Final reports cover the entire survey period
- Final reports are due six months after the completion of the survey (or as otherwise specified by the regulator)
- Content must be organized according to headings outlined below.
- Final reports may be submitted as Word or PDF files.
- Sighting/detection details must also be submitted as a .csv file.
- Final reports must be named according to the following naming convention **YYYY\_FR\_OID**, where YYYY=year; FR=final report; and OID=3-letter seismic operator code e.g., PGS, GXT.

Table 5.2. Final report – required content.

Heading	Content
Survey name	Name of the geophysical survey.
Geophysical authorization number	Number assigned to the survey by the regulator.
Reporting period	Start and end dates of reporting period.
Description of the seismic program	<ul style="list-style-type: none"> <li>Description of the survey location (details from Section 4.1), including a map of area.</li> <li>Seismic equipment used (details from Section 4.2).</li> <li>Monitoring and mitigation protocols.</li> </ul>
Monitoring and data collection methodology for visual sightings	<ul style="list-style-type: none"> <li>Number of MMOs per vessel.</li> <li>Number of MMOs per observation shift.</li> <li>Observation shift schedule for MMOs.</li> <li>Details from Section 4.3.</li> </ul>

Heading	Content
Monitoring and data collection methodology for acoustic detections	<ul style="list-style-type: none"> <li>• Number of PAM operators per vessel.</li> <li>• Number of PAM operators per monitoring shift.</li> <li>• Monitoring shift schedule for PAM operators.</li> <li>• Details from Section 4.4.</li> </ul>
Summary of vessel activity	<ul style="list-style-type: none"> <li>- Provide a general description of the area of survey activity.</li> <li>- Include the number of kilometres and hours spent deploying equipment, in transit, in operation, delays, etc.</li> </ul>
Summary of visual observation effort	<ul style="list-style-type: none"> <li>- Total number of hours on effort – for the survey as a whole and for each vessel carrying MMOs, summarized according to <ul style="list-style-type: none"> <li>• When the source was active and inactive.</li> <li>• Levels of Beaufort wind force.</li> <li>• Light levels.</li> <li>• Visibility.</li> <li>• Precipitation.</li> <li>• Sightability.</li> </ul> </li> </ul>
Summary of acoustic monitoring effort	<ul style="list-style-type: none"> <li>- Total number of hours on effort – for the survey as a whole and for each vessel carrying PAM hardware, summarized according to whether the source was active and inactive.</li> </ul>
Summary of visual sightings	<ul style="list-style-type: none"> <li>-For the survey as a whole and for each vessel carrying MMOs, provide a table for each period of source activity (i.e., source active and source inactive). For each species sighted (or most specific taxonomic group identified), list the <ul style="list-style-type: none"> <li>• Total number of sightings.</li> <li>• Total number of individuals sighted.</li> <li>• SARA status.</li> <li>• Range of sighting distances (min, max, mean).</li> <li>• Behaviour types observed.</li> </ul> </li> <li>- For the survey as a whole and for each vessel carrying MMOs, provide summary tables showing visual sighting by species (or most specific taxonomic group identified) according to <ul style="list-style-type: none"> <li>• Levels of Beaufort wind force.</li> <li>• Light levels.</li> <li>• Visibility.</li> <li>• Precipitation.</li> <li>• Sightability.</li> </ul> </li> <li>- Provide a map for each vessel carrying MMOs showing all sightings by species (or most specific taxonomic group identified). Map must also show source vessel track(s) that indicates status of acoustic source.</li> </ul>
Summary of acoustic detections	<ul style="list-style-type: none"> <li>- For the survey as a whole and for each vessel carrying PAM hardware, provide a table for each period of source activity (i.e., source active and source inactive). For each species detected (or most specific taxonomic group possible), list the <ul style="list-style-type: none"> <li>• Total number of detections.</li> <li>• SARA status.</li> </ul> </li> </ul>

Heading	Content
	<ul style="list-style-type: none"> <li>• Range of CPA distances (min, max, mean).</li> <li>• Range of CPA bearings.</li> <li>• Types of movement detected.</li> </ul> <p>- Provide a map for each vessel carrying PAM hardware showing all detections by species (or most specific taxonomic group identified). Map must also show source vessel track that indicates status of acoustic source.</p>
Mitigation actions	<p>- Provide separate tables for mitigation actions resulting from sightings and acoustic detections. For each type of mitigation action implemented (e.g., delay in start-up, shutdown), list the</p> <ul style="list-style-type: none"> <li>• Total number of actions implemented.</li> <li>• Species for which mitigation action was implemented.</li> <li>• Name of vessel carrying the MMO or PAM operator that called for the mitigation action.</li> </ul> <p>- Provide a map showing the locations of all mitigation actions implemented. Map must display mitigation actions by type of mitigation action implemented and by species for which mitigation implemented.</p> <p>- Each mitigation action implemented must also be described in detail.</p>
Sighting/detection details	<p>For each visual sighting or acoustic detection</p> <ul style="list-style-type: none"> <li>• Date.</li> <li>• Time.</li> <li>• Vessel latitude.</li> <li>• Vessel longitude.</li> <li>• Vessel name (that sighting or acoustic detection was made from).</li> <li>• Sighting/detection latitude. (N/A if not localized)</li> <li>• Sighting/detection longitude. (N/A if not localized)</li> <li>• Type of detection - visual or acoustic?</li> <li>• Species (or most specific taxonomic group identified).</li> <li>• SARA status.</li> <li>• Number of individuals.</li> <li>• Detection distance.</li> <li>• Did animal(s) enter the safety zone? (yes/no)</li> <li>• Type of mitigation action implemented (e.g., none, delay start-up, shutdown).</li> </ul>

### 5.3 Raw data

- Final reports must be accompanied by raw data collected by MMOs and PAM operators. Raw data means all of the data collected during the entire survey as specified in Section 4 of this document.
- Field values must be used as specified in Section 4.
- Raw data files must be provided in the following formats and named according to the following naming conventions (where YYYY=year; OID=3-letter seismic operator code e.g., PGS, GXT).
- The use of commas must be avoided in the data entry process as this is a common database field separator – semi-colons should be used instead, if necessary.

Table 5.3. Raw data requirements.

Raw data	Naming convention	File format
Sections 4.1 through 4.6	YYYY_OID_SurveyInformation	.doc or .pdf
Section 4.7	YYYY_OID_MMOfEffortEnv	.csv
Section 4.8	YYYY_OID_PAMEffort	.csv
Section 4.9	YYYY_OID_MMOSightings	.csv
Section 4.10	YYYY_OID_PAMDetections	.csv
Photos taken by MMOs	YYYY_OID_VID_VS_NNNNN_IID (i.e., the Sighting ID followed by a 3-digit image ID number) OR YYYY_OID_MMDD_WHAT (year, operator code, month and day of photo, and brief description of image, e.g., 2023-GXT-0611-NavyShip)	Raw image files in the highest possible resolution - do not downsample images. Video files are also acceptable.
Screenshots taken by PAM operators	YYYY_OID_VID_AD_NNNNN_SID (i.e., the Detection ID followed by a 3-digit screenshot ID number)	.jpg
PAM – all raw acoustic data for entire survey	YYYY_OID_VID_TAID_CHID_YYYYMMDD_HHMMSS, where VID = 3-digit vessel code (as defined in Section 4.1). TAID = 4-digit towed array ID code (as defined in Section 4.5). CHID = code for specific channel/hydrophone (optional/use if needed; many arrays record all channels of data in one file in which case this would not be needed). YYYYMMDD = recording start date (UTC). HHMMSS = recording start time (UTC).	.wav Note that a backup copy of each recording is required.

## 6. Acknowledgements

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## Appendix A – Course requirements

It is expected that training courses offered by external providers will expose and prepare candidates to competently perform the varied and general responsibilities of MMOs and PAM operators conducting marine mammal monitoring and mitigation activities during geophysical surveys. The general training outlined here must be complemented by project-specific training (Sections 2.2.1.3 and 3.2.1.3) tailored to the region/protocols of a given project, and required for all MMOs and PAM operators prior to their first deployment offshore on a given seismic survey project.

### A1. Training course requirements for Entry-level MMOs.

- Classroom session(s) should include a thorough review of the following topics:
  - Background on potential effects of noise, with emphasis on seismic surveys, on marine mammals and sea turtles.
  - Visual survey protocols.
  - Species identification (marine mammals, sea turtles, sharks).
  - Distance estimation.
  - Equipment use (e.g., reticule binoculars).
  - Implementation of mitigation measures.
  - Regulatory authority.
  - Communication procedures.
  - Data collection protocols, including prioritization of data collected.
  - Prioritization of activities/responsibilities under scenarios likely to be encountered at sea, including:
    - Monitoring in areas of high animal density.
    - Maintaining effort over the entire monitoring area in the presence of individual animals exhibiting vigorous or repeated behaviours.
  - Data quality assurance/quality control (QA/QC) and back-up.
  - Reporting requirements.
  - Ethics, conflicts of interest.
  - Standards of conduct.
  - Data confidentiality.
  - Life at sea, MMO duties, addressing fatigue and stress issues.
- At-sea component must allow the trainees to:
  - Make real-time species identifications.
  - Record observations.
  - Practice implementing mitigation measures.

### A2. Training course requirements for Entry-level PAM operators.

- Classroom session(s) must include a thorough review of the following topics:
  - Marine mammal acoustics and underwater sound.
  - Background on potential effects of noise, with emphasis on seismic surveys, on marine mammals.
  - Species/group identification via vocalizations of marine mammals in real-time.
  - Distance and bearing estimation procedures of detected vocalizations, including understanding associated uncertainties and the implications. For example, if the safety zone is 500 m, and the estimated distance to the animals is 600 m with an uncertainty of +/-200 m, then that means the animal could be in the safety zone.
  - Hardware/software use, optimization, trouble-shooting and repair.

- Implementation of mitigation measures.
- Regulatory authority.
- Communication procedures.
- Data collection protocols.
- Data QA/QC and back-up.
- Reporting requirements.
- Ethics, conflicts of interest.
- Standards of conduct.
- Data confidentiality.
- Life at sea, PAM operator duties, addressing fatigue and stress issues.
- At-sea component must allow trainees to practice:
  - Deploying and retrieving PAM equipment.
  - Setup and calibration of hardware and software.
  - Making and recording real-time marine mammal detections and species/group identifications.
  - Implementing mitigation measures in various assumed scenarios involving range/bearing estimation.

## Appendix B – Species codes

Species code	Scientific name	Common name (English)	Common name (French)
<b>CETACEAN SPECIES</b>			
<b>Species Group: Unidentified Whale</b>			
UNKN	-	Unidentified cetacean	Baleine non identifiée
UNLW	-	Unidentified large whale	Grande baleine non identifiée
<b>Species Group: Small Toothed Whale</b>			
BNDO	<i>Tursiops truncatus</i>	Atlantic bottlenose dolphin	Grand dauphin de l'Atlantique
SPDO	<i>Stenella longirostris</i>	Spinner dolphin	Dauphin à long bec
STDO	<i>Stenella coeruleoalba</i>	Striped dolphin	Dauphin bleu
SADO	<i>Delphinus delphis</i>	Short-beaked common dolphin	Dauphin commun à bec court
FRDO	<i>Lagenodelphis hosei</i>	Fraser's dolphin	Dauphin de Fraser
WBDO	<i>Lagenorhynchus albirostris</i>	White-beaked dolphin	Dauphin à bec blanc
AWDO	<i>Lagenorhynchus acutus</i>	Atlantic white-sided dolphin	Dauphin à flancs blancs
PWDO	<i>Lagenorhynchus obliquidens</i>	Pacific white-sided dolphin	Dauphin à flancs blancs du Pacifique
NRDO	<i>Lissodelphis borealis</i>	Northern right whale dolphin	Dauphin du nord
GRAM	<i>Grampus griseus</i>	Risso's dolphin	Dauphin de Risso
FKWH	<i>Pseudorca crassidens</i>	False killer whale	Fausse orque
HAPO	<i>Phocoena phocoena</i>	Harbour porpoise	Marsouin commun
DAPO	<i>Phocoenoides dalli</i>	Dall's Porpoise	Marsouin de Dall
PSWH	<i>Kogia breviceps</i>	Pygmy sperm whale	Petit cachalot
DSWH	<i>Kogia sima</i>	Dwarf sperm whale	Cachalot nain
ASDO	<i>Stenella frontalis</i>	Atlantic spotted dolphin	Dauphin tacheté de l'Atlantique
UNDO	-	Unidentified dolphin	Dauphin non identifiée
UNPO	-	Unidentified porpoise	Marsouin non identifiée
UNDP	-	Unidentified dolphin/porpoise	Dauphin/marsouin non identifiée
UNKO	-	Unidentified <i>Kogia</i>	<i>Kogia</i> non identifiée
UNST	-	Unidentified Small Toothed Whale	Petite baleine à dents non identifiée
<b>Species Group: Large Toothed Whale</b>			
SFPW	<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	Globicéphale tropical
LFPW	<i>Globicephala melas</i>	Long-finned pilot whale	Globicéphale commun
KIWH	<i>Orcinus orca</i>	Killer whale	Orque
BELU	<i>Delphinapterus leucas</i>	Beluga	Béluga
NRWH	<i>Monodon monoceros</i>	Narwhal	Narval

Species code	Scientific name	Common name (English)	Common name (French)
SPWH	<i>Physeter macrocephalus</i>	Sperm whale	Cachalot
BABW	<i>Berardius bairdii</i>	Baird's beaked whale	Béradie de Baird
CUBW	<i>Ziphius cavirostris</i>	Goose beaked whale (previously Cuvier's beaked whale)	Baleine à bec d'oie (précédemment Baleine à bec de Cuvier)
NBWH	<i>Hyperoodon ampullatus</i>	Northern bottlenose whale	Baleine à bec commune
TRBW	<i>Mesoplodon mirus</i>	True's beaked whale	Baleine à bec True
GEBW	<i>Mesoplodon europaeus</i>	Gervais' beaked whale	Baleine à bec Gervais
HUBW	<i>Mesoplodon carlhubbsi</i>	Hubb's beaked whale	Baleine à bec de Hubbs
STBW	<i>Mesoplodon stejnegeri</i>	Stejneger's beaked whale	Baleine à bec de Stejneger
SBWH	<i>Mesoplodon bidens</i>	Sowerby's beaked whale	Baleine à bec de Sowerby
BLBW	<i>Mesoplodon densirostris</i>	Blainville's beaked whale	Baleine à bec de Blainville
UNMP	-	Unidentified mesoplodon beaked whale	Baleine mesoplodon inconnue
UNLT	-	Unidentified large toothed whale	Grande baleine à dents non identifiée
UNLB	-	Unidentified large beaked whale	Grande baleine à bec non identifiée
UNBW	-	Unidentified beaked whale	Baleine à bec non identifiée
<b>Species Group: Baleen Whale</b>			
BOWH	<i>Balaena mysticetus</i>	Bowhead whale	Baleine boréale
MIWH	<i>Balaenoptera acutorostrata</i>	Minke whale	Petit rorqual
SEWH	<i>Balaenoptera borealis</i>	Sei whale	Rorqual boréal
BRWH	<i>Balaenoptera edni</i>	Bryde's Whale	Rorqual de Bryde
BLWH	<i>Balaenoptera musculus</i>	Blue whale	Baleine bleue
FIWH	<i>Balaenoptera physalus</i>	Fin whale	Rorqual commun
GRWH	<i>Eschrichtius robustus</i>	Gray whale	Baleine grise
NARW	<i>Eubalaena glacialis</i>	North Atlantic right whale	Baleine noire de l'Atlantique nord
NPRW	<i>Eubalaena japonica</i>	North Pacific right whale	Baleine noire du Pacifique nord
HUWH	<i>Megaptera novaeangliae</i>	Humpback whale	Rorqual à bosse
SEFI	-	Unidentified sei/fin whale	Rorqual boréal/commun non identifiée
BLFI	-	Unidentified blue/fin whale	Baleine bleue / Rorqual commun non identifiée
UNBA	-	Unidentified baleen whale	Baleine à fanons non identifiée
<b>PINNIPED SPECIES</b>			
UNPE	-	Unidentified pinniped with ears	Pinnipède non identifié avec oreilles
UNPN	-	Unidentified pinniped	Pinnipède non identifié
<b>Species Group: Sea Lion</b>			

Species code	Scientific name	Common name (English)	Common name (French)
CASL	<i>Zalophus californianus</i>	California sea lion	Otarie de Californie
STSL	<i>Eumetopias jubatus</i>	Steller sea lion	Otarie de Steller
UNSL	-	Unidentified sea lion	Otarie non identifiée
<b>Species Group: Fur Seal</b>			
NOFS	<i>Callorhinus ursinus</i>	Northern (Pribilof) fur seal	Otarie à fourrure du Nord
GUFS	<i>Arctocephalus townsendi</i>	Guadalupe fur seal	Otarie de L'île Guadalupe
UNFS	-	Unidentified fur seal	Otarie à fourrure non identifiée
<b>Species Group: True Seal / Earless Seal</b>			
HOSE	<i>Cystophora cristata</i>	Hooded seal	Phoque à capuchon
BESE	<i>Erignathus barbatus</i>	Bearded seal	Phoque barbu
GRSE	<i>Halichoerus grypus</i>	Grey seal	Phoques gris
HPSE	<i>Pagophilus groenlandicus</i>	Harp seal	Phoque du Groenland
RGSE	<i>Phoca hispida</i>	Ringed seal	Phoque annelé
HASE	<i>Phoca vitulina Linnaeus</i>	Harbour seal	Phoque commun
SPSE	<i>Phoca largha</i>	Spotted seal	Phoque tacheté
RISE	<i>Histiophoca fasciata</i>	Ribbon seal	Phoque rubané
NESE	<i>Mirounga angustirostris</i>	Northern elephant seal	Éléphant de mer du nord
UNSE	-	Unidentified true seal / earless seal	Phoque non identifiée / Phocidés sans oreilles
<b>Species Group: Walrus</b>			
ATWA	<i>Odobenus rosmarus rosmarus</i>	Atlantic walrus	Morse de l'Atlantique
<b>OTHER MARINE MAMMAL SPECIES</b>			
SEOT	<i>Enhydra lutris</i>	Sea otter	Loutre de mer
UNSO	-	Unidentified sea / river otter	Loutre de mer / rivière non identifiée
POBE	<i>Ursus maritimus</i>	Polar bear	Ours polaire
UNCA	-	Unidentified carnivora	Carnivora non identifié
<b>SEA TURTLE SPECIES</b>			
LBTU	<i>Dermochelys coriacea</i>	Leatherback turtle	Tortue luth
LOTU	<i>Caretta caretta</i>	Loggerhead turtle	Tortue caouanne
KRTU	<i>Lepidochelys kempii</i>	Kemp's Ridley turtle	Tortue de Kemp
GRTU	<i>Chelonia mydas</i>	Green turtle	Tortue verte
UNTU	-	Unidentified turtle	Tortue non identifiée
<b>SHARK SPECIES</b>			
BASH	<i>Cetorhinus maximus</i>	Basking shark	Requin-pèlerin
WHSB	<i>Carcharodon carcharias</i>	White shark	Grand requin blanc
CTSH	<i>Alopias vulpinus</i>	Common thresher shark	Renard marin
SMSH	<i>Isurus oxyrinchus</i>	Shortfin mako shark	Requin-taupe bleu
PBSH	<i>Lamna nasus</i>	Porbeagle shark	Maraîche
BLSH	<i>Prionace glauca</i>	Blue shark	Requin bleu
UNSH	-	Unidentified shark	Requin non identifiée
<b>OTHER</b>			

<b>Species code</b>	<b>Scientific name</b>	<b>Common name (English)</b>	<b>Common name (French)</b>
OCSU	<i>Mola mola</i>	Ocean sunfish	Poisson lune
TUNA	-	Tuna	Thon
OTHR	-	Other – describe in COMMENTS	Autre - décrire dans les commentaires