Marine mammal records collected by the at-sea observer program in Arctic, Newfoundland and Labrador, and Maritimes regions: A summary of challenges and opportunities for future research

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2024

Marine mammal records collected by the at-sea observer program in Arctic, Newfoundland and Labrador, and Maritimes regions: A summary of challenges and opportunities for future research

by

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ABSTRACT

Feyrer, L.J., Babin, A., Moors-Murphy, H., Corbett, S., Touchie, E., Croft, G., Lawson, J., Peters, C.A., Inkpen, T., Treble, M., Ferguson, S. 2024. Marine mammal records collected by the at-sea observer program in Arctic, Newfoundland and Labrador, and Maritimes regions: A summary of challenges and opportunities for future research. Can. Tech. Rep. Fish. Aquat. Sci. 3573: vi +55 p.

The interaction between marine mammals and fisheries presents a number of risks, including entanglement, injuries, fatalities, and altered foraging behavior due to depredation. Canada's At-Sea Observer (ASO) program monitors fisheries catch and compliance, and offers a unique opportunity for independent observation of marine mammals. Currently marine mammal sightings and interactions reported by ASOs are held by Fisheries and Oceans Canada (DFO) regions.This project consolidated 4,572 ASO marine mammal sightings, along with 4,483 photographs and 699 videos collected between 1990 and 2022 across three DFO regions: the Arctic, Newfoundland and Labrador, and the Maritimes. ASOs recorded sightings of 30 marine mammal species, including 12 species at risk. Incidents reported included depredation behaviour (consuming fishing catch and discards), entanglement, and apparent anthropogenic injuries. Marine mammal sightings in ASO reports have declined over time, although the reason is unclear. Challenges remain, but recommendations for improvement are identified, including standardizing and centralizing the collection and storage of ASO marine mammal data. We highlight how this data is directly relevant to the mandates of DFO science and management sectors, and could support multiple program priorities including marine mammal research, monitoring, and the management of threats related to fisheries interactions in the North Atlantic.

RÉSUMÉ

Feyrer, L.J., Babin, A., Moors-Murphy, H., Corbett, S., Touchie, E., Croft, G., Lawson, J., Peters, C.A., Inkpen, T., Treble, M., Ferguson, S. 2024. Marine mammal records collected by the at-sea observer program in Arctic, Newfoundland and Labrador, and Maritimes regions: A summary of challenges and opportunities for future research. Can. Tech. Rep. Fish. Aquat. Sci. 3573: vi +55 p.

L'interaction entre les pêches et les mammifères marins présente un certain nombre de risques, à savoir un risque d'empêtrement, de blessure, de décès et de modification du comportement d'alimentation en raison de la déprédation. Le Programme des observateurs en mer du Canada surveille les prises et le respect des lois régissant la pêche, et offre une occasion unique d'observer les mammifères marins de façon indépendante. Actuellement, les observations de mammifères marins et les interactions signalées par les observateurs en mer sont gérées par les régions de Pêches et Océans Canada (MPO). Ce projet a permis de regrouper 4 572 observations de mammifères marins, ainsi que 4 483 photographies et 699 vidéos recueillies entre 1990 et 2022 dans trois régions du MPO : l'Arctique, Terre-Neuve-et-Labrador et les Maritimes. Les observateurs en mer ont enregistré des observations pour 30 espèces de mammifères marins, dont 12 espèces en péril. Les incidents signalés comprenaient des comportements de déprédation (consommation de prises de pêche et de rejets), des empêtrements et des blessures apparentes d'origine anthropique. Le nombre d'observations de mammifères marins consignées dans les rapports des observateurs en mer a diminué au fil du temps, mais on ignore encore pourquoi. Certains défis subsistent, mais des recommandations d'amélioration ont été formulées, notamment en ce qui a trait à la normalisation et à la centralisation de la collecte et du stockage des données sur les mammifères marins recueillies par les observateurs en mer. Nous expliquons ici comment les données sur les mammifères marins recueillies par les observateurs en mer s'inscrivent directement dans le mandat des Sciences, des Espèces en péril, de la Gestion des pêches et d'autres secteurs du MPO, et comment elles peuvent soutenir de nombreuses priorités des programmes, comme la recherche sur les mammifères marins, la surveillance et la gestion des menaces liées aux interactions avec les pêches dans l'Atlantique Nord.

INTRODUCTION

Marine mammal (MM) interactions with fisheries in the North Atlantic are poorly understood but are considered to pose a threat to all MM species, and are of significant concern for MM species at risk (SAR). An “interaction,” which can include a broad range of behaviours or events, occurring with fisheries, fishers, vessels, gear and MMs, is sometimes used interchangeably with the term “incident.” Here, we consider the idea of MM-fishery interactions broadly, similar to the definition used by Gulland (1986), who proposes there are two levels of MM-fisheries interactions: (1) primary or directly operational interactions, involving a physical encounter between MMs and fisheries (i.e., an incident), potentially resulting in gear damage, loss of catch, and death or injury to MMs, and (2) secondary, ecological, biological, or behavioural interactions. Examples of secondary ecological interactions might include the MM competition with fisheries or altered MM migratory behaviour. Biological interactions could involve altered foraging energetics due to MM depredation behaviour or other sub-lethal impacts of non-fatal injuries (van der Hoop et al. 2016; Skern-Mauritzen et al. 2022). Behavioural interactions include MMs demonstrating reduced risk aversion or dangerous habituation to vessels, as well as the potential for negative human perception of MMs, retaliatory interventions by fishers, and alteration of fishing practises to avoid MM incidents (Oyarbide et al. 2023).

As many Canadian fisheries occur in remote areas, our understanding of the risks and distribution of threats to MMs from fisheries has been limited by a lack of research. Many MMs are considered “at risk” in Canada, and fisheries related incidents are considered to be a primary threat to species recovery (Fisheries and Oceans Canada 2016, 2016, 2022; Bourque et al. 2020; Feyrer et al. 2021). Here, MM SAR are defined as those species that have one or more Atlantic populations with a status assigned as “At-Risk” (e.g., Endangered, Threatened, Special Concern) by either the *SARA* and/or the Committee On the Status of Endangered Wildlife in Canada (COSEWIC) (Fisheries and Oceans Canada 2023).

Canada's At-Sea Observer (ASO) program monitors fishing industry compliance with fishing regulations and licence conditions, as well as collects scientific data, by placing private-sector observers aboard fishing vessels (Fisheries and Oceans Canada 2017). Because levels of ASO coverage and effort across regions and fisheries has been varied, scientific data collected by ASOs is largely used to provide a qualitative view of fisheries bycatch, and identify vulnerable species and risks associated with different gear types (e.g., DFO 2016).

Fisheries and Oceans Canada (DFO) Maritimes Region Industry Survey Database (ISDB) stores ASO data on non-retained catch or bycatch (McMahon and Bowlby 2021). During 1979-2018, there were 2,013 records of reported MM incidents, but only one involved a large whale (Moors-Murphy 2019). Under-reporting of incidents with large whales, which can break lines and escape with gear attached, highlights one of the many challenges of relying on ASO data for information and statistics on MM incidents. Additional challenges with ASO MM data include uneven distribution of ASO effort across fisheries, a high turn-over in trained ASOs, and a reluctance to report incidents for fear of harassment and intimidation by others onboard the vessels (DFO 2016; Thomson 2022). However, the ASO program does offer an opportunity for collecting additional opportunistic scientific data, including specimens, samples, measurements, photos, videos, and sightings.

In the DFO regions **Arctic (AR)**, **Newfoundland and Labrador (NL)**, and **Maritimes (MAR)** (Figure 1), ASOs have a history of using regionally designed forms to report MM sightings. Historically, DFO regional programs have provided MM species identification training, and sometimes low-cost digital cameras for observers to collect photographs and video recordings

of MM. Individual ASOs have also used their personal cameras and mobile devices to record and share visual media files of MMs with DFO. Each DFO region has developed their own data management protocols for storage and review of MM sightings that, to date, has limited broader assessment of content and trends. Opportunistic MM sightings may have also been collected by ASOs in other DFO regions (i.e., Quebec (QC), Gulf (GULF), Pacific (PAC)), however, only data from Atlantic regions where ASOs are asked to complete a MM sightings form have been included in this review.

Reporting of MM incidents became mandatory under the *Fisheries Act* in July 2018. A national MM Interaction Form (MMIF, see Appendix Figure 1.1 for form and links) was developed for ASOs and vessel operators (as a condition of licence) to report all incidents with MMs. However, this form explicitly excludes MM sighting information, and is strictly focused on incidents.

Understanding when and where MMs interact with fisheries could provide additional context for monitoring and mitigating risks to MM from a range of potentially harmful interactions. For the first time, this report brings together ASO MM sightings data collected across three contiguous DFO regions (i.e., AR, NL, MAR). We provide a summary of the methods used to collate the dataset across regions, characterizing the limitations and trends in data quantity and structure over time and between regions. This report includes a basic analysis of trends observed within MM sightings reports and visual media files recorded by ASOs, as well as DFO's national MMIF up to 2022. Our review is intended to help support the Department's sectors and mandates related to MM research, monitoring, risk assessment, management, and reporting on fishery interactions in these areas. A glossary of terms is provided to help clarify definitions and acronyms used within this project.

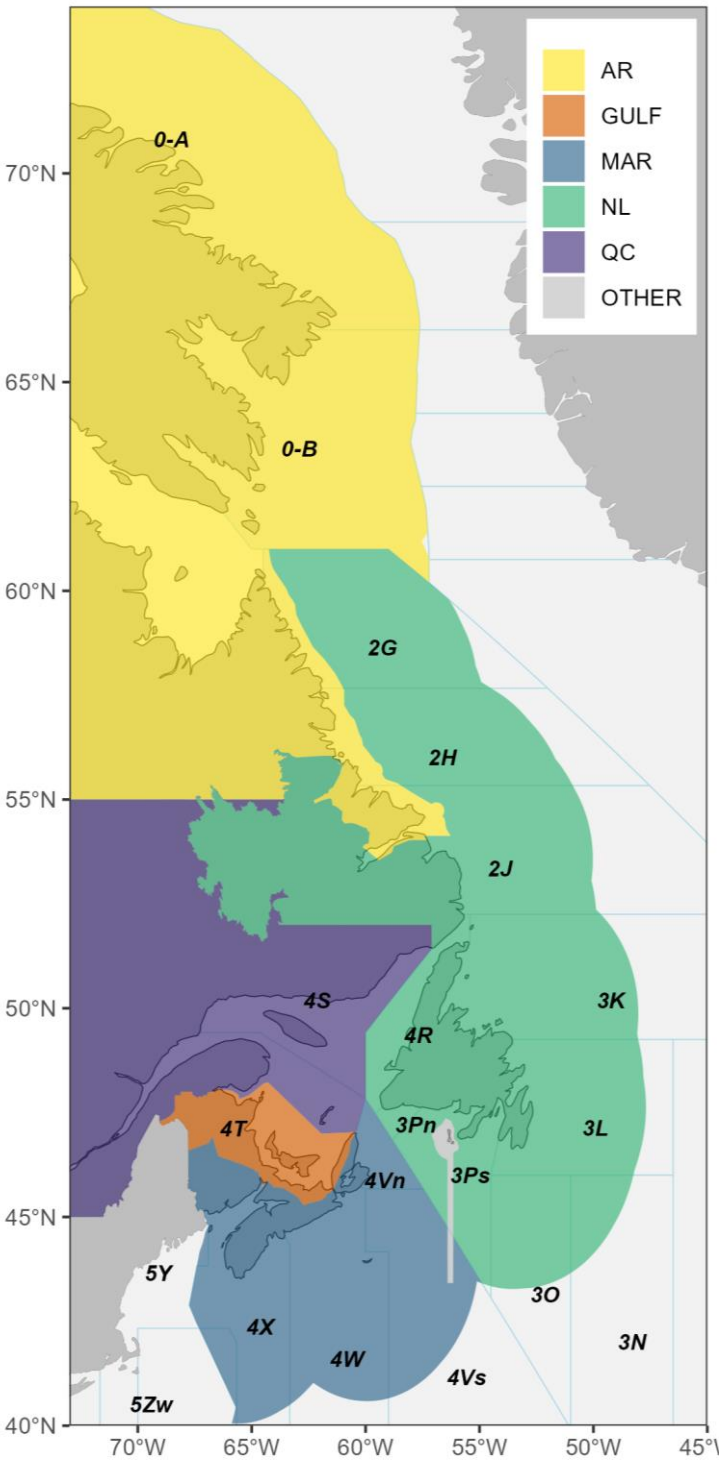


Figure 1: North Atlantic Fisheries Organization (NAFO) division boundaries and DFO regions. *DFO regions are: Arctic (AR - yellow), Newfoundland and Labrador (NFLD - green), Maritimes (MAR - blue), Gulf (GULF - orange), Quebec (QC - purple), and Other (grey) for any area outside Canadian jurisdiction. NAFO divisions are outlined in blue and labeled in the centre of each polygon.*

OBJECTIVES OF THIS REPORT

The specific objectives of this project were to:

1. Describe ASO program data collection efforts for MMs, including sightings and incidents, and outline how DFO receives and stores this information.
2. Compile all ASO MM sightings reports (1990-2022) into one dataset for reference and analysis.
3. Compile all ASO MM photographs and videos into a digital catalogue using photo management software. Characterize the number, quality, and nature of MM photographs and videos.
4. Compare the nature and extent of available ASO MM data by source region, record location, and year.
5. Assess the nature and distribution of MM incidents and frequency of MM SAR sightings within ASO MM sightings reports and visual media.
6. Describe the challenges with using ASO MM data for future analysis.
7. Identify improvements to data collection and storage that would facilitate accessibility and analysis of ASO MM data.
8. Summarize how ASO MM data could be used to support DFO sectors and mandates.

OBJECTIVE 1: DESCRIBE HOW DFO STORES AND COLLECTS MARINE MAMMAL DATA FROM THE AT-SEA OBSERVER PROGRAM

The objective of the ASO program, as described by DFO, is to provide an independent third-party verification of fish harvesting activities (Government of Canada 2022). The program provides catch and sampling data for monitoring and scientific research purposes, on which DFO and the fishing industry rely to provide accurate management strategies for all fisheries (Government of Canada 2022).

ASO monitoring, actual coverage (number of fishing trips that carry an ASO), and target coverage levels have varied over time, by region and fishery (Government of Canada 2022). Prior to 2013, when a national open bidding system was implemented, there was one dedicated ASO company for each region (except AR). Storage and collection protocols of ASO data within DFO were also changed in 2013 to accommodate national contracting of ASO companies. As ASO companies transitioned to work in other regions, differences in regional requirements and protocols occasionally resulted in confusion in the delivery and storage of ASO reports within DFO. As of 2022, ASO companies working in AR, NL, and MAR are SeaWatch, Biorex, and Javitech.

ASO companies submit reports on fishing operations to DFO in two parts or “packages”:

(1) the Conservation and Protection (C&P) Observer Trip Information System (OTIS) package, which contains a series of forms developed nationally, used for compliance and fisheries management purposes across all regions, and;

(2) the Science package, which contains a series of forms developed regionally, to record set and catch details (catch, bycatch, and discards), biological sub-sampling (length frequency and otolith sampling for age determination), and sightings of large pelagic species, turtles, MMs, and seabirds (Government of Canada 2022).

MM sightings forms should be included in the Science data package for AR and NL regions, and in the C&P package for MAR Region. However, sometimes they have been inadvertently included in the AR C&P package, or sent directly by the ASO company to MM researchers (Figure 2).

Data collected by ASOs may be received by one or more DFO programs based on the following forms and protocols:

1. MM incidents (i.e., MMs captured, entangled or interacting with fishing gear) that are observed by an ASO working on a vessel licenced in AR, NL, or MAR regions, should be recorded as bycatch or discards on the set and catch datasheets for the trip, as part of the ASO Science package. For NL and MAR licenced vessels, ASO catch data are entered into regional catch databases (e.g., ISDB in MAR). For AR licenced vessels ASO catch data prior to 2013 was entered in the region the ASO company was registered in (e.g., NL, MAR, or QC). After the 2013 program changes, the ASO catch data for AR licenced vessels have been archived in the QC Region ASO database.

2. MM sightings may be recorded by ASOs on a paper MM sightings form (see Appendix Figure 1.2 for variation in forms used by different regions over the years). However, effort in recording information on MM sightings is inconsistent among different observers and/or companies, and the sightings form has changed over time. Details of incidents with MMs may also be noted on the paper sightings form. Sightings (non-incidents) of MM are *NOT* recorded on the ASO catch datasheet or entered into regional catch databases.

3. NL MM protocols asks ASOs to take photographs of MMs. They have a small number of low-cost digital/ waterproof cameras available on request. However most observers chose to take photographs and videos of MMs using personal phone cameras. Across all regions ASOs occasionally share visual media files as part of their company reports and/or directly with DFO MM scientists. Visual media may or may not be linked to specific sighting records. MAR also had an ASO camera loan program for a brief period in the early 2000's, however photos are not part of the current protocols outside NL.

4. Data on MM interactions recorded on the national MMIF are submitted to a national DFO email address. These reports are compiled in an Excel spreadsheet by National Fisheries Management. DFO regional programs do not typically receive copies of these records unless they are directly requested.

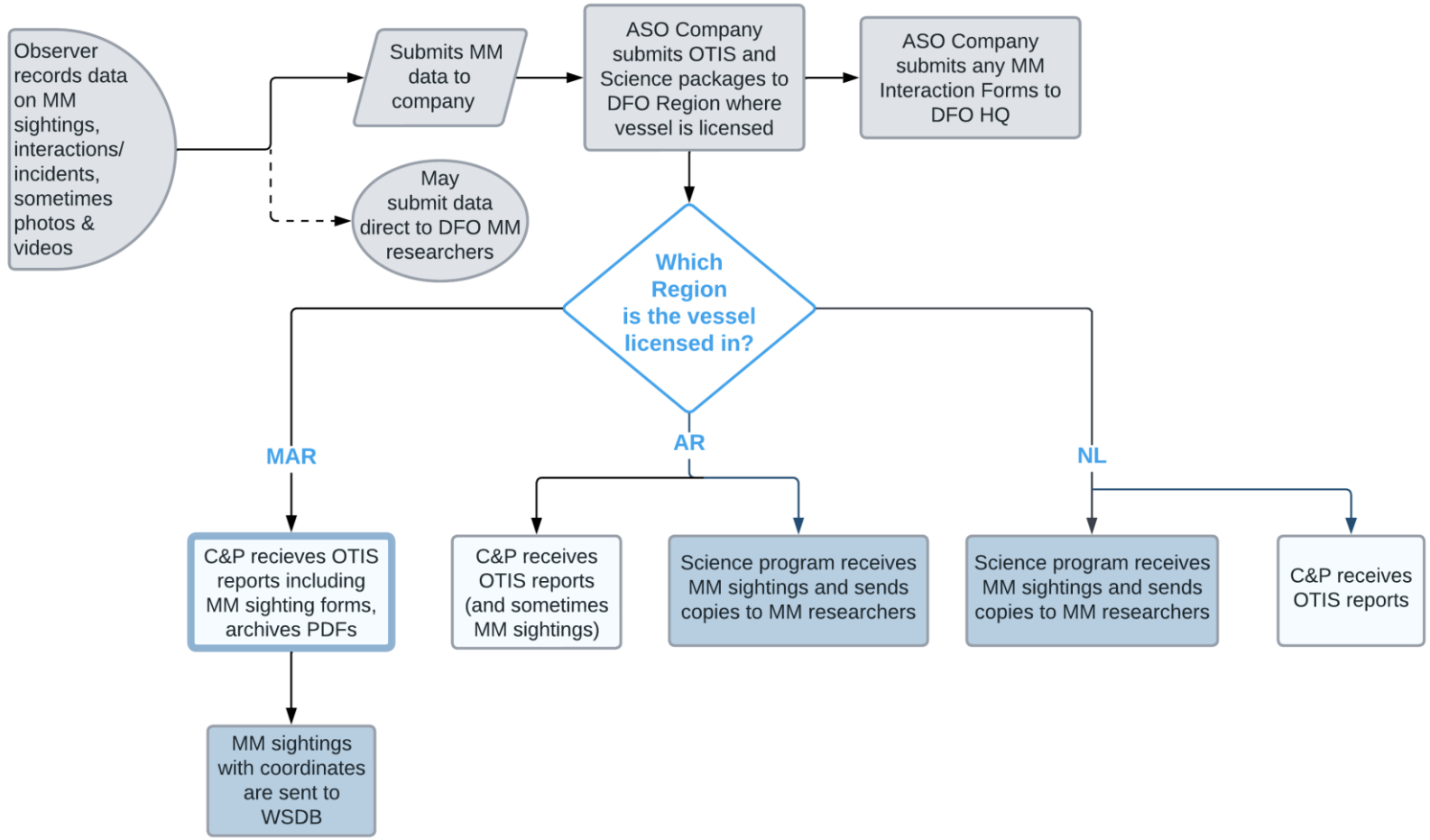


Figure 2: How ASO marine mammal sightings and interaction information is processed by DFO Headquarters (HQ), Arctic (AR), Newfoundland and Labrador (NL), and Maritimes (MAR) Regions. *Grey boxes represent actions taken by ASOs and ASO Companies; light blue boxes represent transmission of the Observer Trip Information System (OTIS) to Conservation and Protection (C&P); and dark blue boxes represent the MM sightings forms ultimate destination in the Science programs (e.g., MAR Region Science program manages the Whale Sightings Database (WSDB)). Solid lines represent the protocol regularly followed for the flow of information, and the dashed line represents an occasional exception.*

Other Potential Sources Of Data On Marine Mammal Fisheries Interactions Collected By DFO

Throughout conversations with DFO C&P and Fisheries Management two other potential sources of MM data related to fisheries interactions were mentioned. Our initial investigation suggests they do not contain MM data, as described in the following section. These results were included for additional context on the lack of alternative sources of MM fisheries interaction data collected by DFO.

- **Commercial fisheries logbooks / databases that contain logbook data** - The purpose of logbooks is to report catch and bycatch of commercial fish species. Logbooks are rarely designed with space to record bycatch of non-commercial species, including MMs. Additionally, MMs are always discarded, and bycatch discards are not typically captured in logbooks. One example is the Maritime Fishery Information System (MARFIS) Database. As expected, searches conducted as part of this review found no MM records in this database. Logbook databases in other regions were not checked.
- ***Species At Risk Act* (*SARA*) logbooks** - Almost all marine commercial fisheries have a *SARA* logbook, as licence holders must report interactions with *SARA* listed species where DFO has issued either a permit or an exemption allowing for “harm”. Since no scope for harm has been identified for any whale species currently listed under SARA, there are no permits or exemptions for fishing activities to impact SARA MM. As a result SARA logbook reports are not required for recording MM interactions. As SARA Logbooks are not expected to contain MM data, they were not reviewed as part of this report.

METHODS

The following sections describe the processing of the ASO MM data received for this project as part of Objective one, and how MM sightings records and photos were organized as part of Objectives two and three.

In January 2022, copies of all ASO MM sightings forms and visual media were requested from AR, NL, and MAR regions. Through our data requests and discussions with DFO staff that work with ASO data (such as C&P and Science program leads), it became apparent that each region has adopted a unique approach to managing ASO program data, including where it is stored and who might have access. The flow of ASO MM information (i.e., how it is received, reviewed, recorded, and stored) is described in this section and outlined in Figure 2.

There have been several changes over the last 20 years to how each region receives, reviews, records, and stores ASO data. The forms used to record MM sightings have differed over time (in format, but sometimes only in name) between regions, within regions, and within ASO companies. Which forms are used on a particular trip may sometimes depend on what the ASO has available to them (e.g., the Marine Mammal Observation Sheet used by an ASO assigned to an AR trip in 2018 was an old form that was not developed by AR or NL region and was not used prior to or since 2018). The variety of different report forms are documented here for reference and future discussion (see Appendix Table 1.1 and Figure 1.2).

I. Arctic

Before 2013, ASOs assigned to vessels licenced to fish by AR used QC, NL, and MAR regions ASO data packages, depending on which region the hired ASO company was based. For example, Biorex, SeaWatch, and Javitech observers would use the QC, NL, and MAR ASO data packages, respectively. MM sightings forms developed for ASOs by NL and MAR regions would typically be forwarded on to their respective regional program leads along with the rest of the paper forms. During the expansion of the Greenland halibut fishery (1999 to approx. 2012) and prior to the changes in the ASO deployment system in 2013, the MM sightings forms from AR licenced fishing trips were typically retained by the other regions. Copies of these forms were not always forwarded to AR Science, and most of the original sightings forms are presumed lost.

In 2013, AR established their own ASO protocol that described data collection and handling for AR licenced fishing vessels. The Science package included a MM sightings form (i.e., the NL version). QC Region had been receiving the packages for the majority of AR licenced fishing trips prior to 2013 (Biorex was often hired to provide ASOs to AR trips) and QC data managers agreed to continue to host the electronic science data collected on AR trips. The paper OTIS package is received and archived by AR C&P, and the paper portion of the Science package is received and archived by AR Science, with copies of the MM forms forwarded to regional MM scientists.

It has been noted that in recent years the MM sightings form has sometimes been included in the OTIS package submitted to AR C&P. As such, a number of MM sightings forms that had been included in the OTIS packages between 2016-2022 were received by this project late in 2023 (n = 27). The MM records from these reports were added to the dataset and have been included in this report.

II. Newfoundland and Labrador

The NL Science program had paper copies of MM sightings forms and photographs and videos from 2007 onwards. Older records were not available. Internally MM sightings forms and digital photographs are shared with MM science researchers. However it was noted that MM records may not always be sent to science, as ASO companies based in other regions may send them to C&P with OTIS package. C&P has been requested to redirect these MM sightings forms when this occurs, however, due to limited manual review of OTIS packages (see below) some forms may have been missed.

Paper copies of OTIS packages are collected and stored by NL C&P. Unless there are noted compliance issues, only OTIS packages from shrimp and groundfish vessels >65' are manually reviewed. Due to recent changes in program staff, it is unclear whether and how OTIS reports were reviewed prior to 2019. Prior to 2020, OTIS reports were stored as paper copies; however, now they are also being received and stored in digital format.

For this report ASO MM sightings data were requested from NL ASO programs in C&P and Science, and the MM research programs. Science staff digitized paper copies of sightings forms and saved photographs and videos onto a hard drive for this project.

III. Maritimes

In MAR, the MM sightings form is part of the OTIS data package and packages are sent by ASO companies in digital and paper format to the C&P program. MM sightings forms, which have dates and coordinate information, are sent to MM science researchers at the Bedford Institute of Oceanography (BIO) and records of live MMs are entered into the Whale Sightings Database (WSDB) (MacDonald et al. 2017). Biological data (i.e., the Science package) is sent to Science (Population Ecology Division) and is entered into the ISDB.

OBJECTIVE 2: COMPILE MARINE MAMMAL SIGHTINGS DATA FROM ASO REPORTS

ASO MM data available from AR, NL, and MAR regions varied considerably in terms of quantity and type. All scanned reports were compiled using a file-folder structure organized by source region. The WSDB was also checked for records of ASO MM sightings. The initial number of ASO sightings records reviewed was 4,707.

ASO sightings data were transcribed to an Excel spreadsheet for each region and formatted to the WSDB import requirements. Potential duplicates were checked by reviewing records with matching date, species, and location. No duplicate ASO records between regions were found. For some ASO MM records already in the WSDB, corresponding ASO reports (paper or scanned forms) could not be found.

Species codes used by ASOs differed between regions, and over time, which required creating a regional legend of species codes (Appendix Table 1.2). For example AR has MM sightings forms that have used species codes from NL, MAR and QC. For consistency and data management purposes, all species codes were translated to those used by MAR Region. On review, there were 83 records of non-MM species included in the ASO sightings data. These included reports of leatherback (*Dermochelys coriacea)*, loggerhead (*Caretta caretta*), and unspecified sea turtle species (N = 64), sunfish (*Mola mola*; N = 6), sharks (N = 9), tuna (N = 3), and seabirds (N = 1). This may be due to earlier versions of the ASO sightings forms combining sightings information on "MM & Turtle Sightings Forms" (in AR and NL, see Appendix Table 1.1). Only records of MM species (N = 4,572) were included in analysis and data summaries for

this project. The number of ASO sightings records by MM species identified is summarized in Table 1.

Any information within the comments made by ASOs that could be considered private was redacted. Redacted information included vessel names, person's names, gear types, set numbers, and target species. In these cases, only the relevant words were redacted in the comments field and replaced by [VESSEL NAME], [PERSONS NAME], [GEAR TYPE], [SET], and [SPECIES]. Information from ASO comments and other fields on the various sightings forms was also extracted and used to populate codes for the records representing incidents (Table 2).

I. Arctic

Data were received on USBs and CDs, with some paper forms attached. Paper forms and labelled CD covers were scanned, and files remained organized within the original source's folder structure. Data included MM sightings forms (N = 93, Appendix Table 1.3), as well as visual media within Northwest Atlantic Fisheries Organization (NAFO) divisions 0A, 0B. There were 542 sightings records collected and retained for AR licenced trips between 2004-2022 (Figure 3). Targeted levels for ASO coverage of fisheries in the region are as follows: 100% for shrimp and groundfish trawlers, 100% for gillnetters fishing in NAFO Division 0A, and 20% for gillnetters fishing in NAFO Division 0B.

II. Newfoundland and Labrador

Data were received on a hard drive and included folders of scanned MM sightings forms as PDFs (N = 426, Appendix Table 1.3), as well as visual media. C&P provided a confidential report on MM entanglement that included records of MM bycatch from 2014-2018 and appears to compare data from OTIS reports to data from MM sightings forms, noting some inconsistencies. There were 1,648 sightings records collected and retained between 2001-2021 (Figure 3). C&P indicated that they only had coverage information for 2021 ASOs for NL licenced vessels >65' fishing in NAFO Subareas 3, 2, 0, and it was 100% for shrimp, while groundfish was lower (below 58%).

III. Maritimes

Data were received in folders organized by year for 1999-2021. Folders contained MM sightings forms (N = 635, Appendix Table 1.3), as well as visual media. There were 1,495 MM sightings records digitized from the ASO reports provided. There were an additional 880 MM sightings records attributed to ASO data sources in the WSDB between 1990-2021, which were reviewed and included as MAR sources of ASO MM sightings data (Figure 3). Some of the original ASO forms associated with records already contained within the WSDB could not be found and are presumed lost. Data on ASO coverage of fisheries in the region were not available for this project.

Table 1: Number of ASO sightings records by marine mammal species.

Common Name	***Scientific Name***	**Records (N)**
Atlantic Bottlenose Dolphin	*Tursiops truncatus*	11
Atlantic Spotted Dolphin	*Stenella frontalis*	1
Atlantic White-Sided Dolphin	*Lagenorhynchus acutus*	197
Baleen Whale (NS)	*Mysticeti sp.*	8
Bearded Seal	*Erignathus barbatus*	2
Beluga Whale	*Delphinapterus leucas*	3
Blue Whale	*Balaenoptera musculus*	6
Bowhead Whale	*Balaena mysticetus*	3
Common Dolphin	*Delphinus delphis*	87
Dolphins/Porpoise (NS)	*Delphid sp.*	295
False Killer Whale	*Pseudorca crassidens*	2
Fin Whale	*Balaenoptera physalus*	109
Grey Seal	*Halichoerus grypus*	42
Harbour Porpoise	*Phocoena phocoena*	84
Harbour Seal	*Phoca vitulina*	28
Harp Seal	*Pagophilus groenlandicus*	289
Hooded Seal	*Cystophora cristata*	72
Humpback Whale	*Megaptera novaeangliae*	273
Killer Whale	*Orcinus orca*	44
Long-Finned Pilot Whale	*Globicephala melas*	863
Minke Whale	*Balaenoptera acutorostrata*	119
Narwhal	*Monodon monoceros*	6
North Atlantic Right Whale	*Eubalaena glacialis*	49
Northern Bottlenose Whale	*Hyperoodon ampullatus*	681
Northern Fur Seal	*Callorhinus ursinus*	2
Polar Bear	*Ursus maritimus*	20
Ringed Seal	*Pusa hispida*	2
Risso's Dolphin	*Grampus griseus*	6
Seals (NS)	*Phocid sp.*	213
Sei Whale	*Balaenoptera borealis*	11
Sperm Whale	*Physeter macrocephalus*	877
Whale-Beaked (NS)	*Ziphiid sp.*	4
Whales (NS)	*Cetacea sp.*	151
White-Beaked Dolphin	*Lagenorhynchus albirostris*	12
Total		4,572

NS = Species Not Specified.

OBJECTIVE 3: COMPILE AND CHARACTERIZE VISUAL MEDIA OF MARINE MAMMALS COLLECTED BY ASOs

Folders of opportunistically collected visual media files (photos and videos) were organized by DFO source region (AR, NL, and MAR) and imported into Adobe Lightroom image management software. Approximately 64% of the photographs and videos included in the data received contained MM. Photos were annotated with species keywords, which were used to build a MM collection and filter images for summary analysis. Further details on visual media collected by ASOs are described in the following sections.

I. Annotating Visual Media With Metadata

Keywords were added to MM visual media based on the file metadata, content, and cross-referencing with ASO trip reports (e.g., year, trip number, vessel name, fishery, etc.). A list of keywords used can be found in the Appendix Table 1.4.

Metadata embedded in the files (i.e., date, time, coordinates), were reviewed, validated with trip information, and missing data were added when possible. File datetime stamp information in photographs was sometimes inconsistent with trip information, but could often be reconciled based on time zone or daylight-savings time offsets.

II. Image Location Information

Location coordinates for visual media files were entered into the catalogue from available metadata (i.e., photo datasheets, set locations when available, coordinates from associated photos, and coordinates from related ASO sightings). Coordinates were occasionally available as part of the photograph file information. However, validation of these locations typically found erroneous coordinates (e.g., where photographs were taken with cell phones the position was on land).

Coordinates were added to the metadata for photographs and videos when location information was missing but could be estimated. For example, when set locations could be used to determine location, photographs were matched based on the closest date/time of a trip's set. Location information associated with photographs was only considered approximate to the vessel location on a given day.

Location information derived from photos should not be used for any purpose that requires precise MM sightings location information.

Confidence ratings were assigned to each photograph and video when location had to be estimated. The confidence rating scale ranged from 4 (high) to 1 (low) based on whether the following attributes between ASO sighting records and visual media files matched: (4) date, species, and deployment/trip number, (3) date and species or date and deployment/trip number, (2) only date, (1) for AR, a centroid location for division 0A or 0B were used. Centroids were not applied to NL or MAR regions because these sightings could not be reliably located to a specific NAFO area.

III. Quality rating and annotation of photographs and videos

As there are existing photo-identification catalogues for northern bottlenose whales and sperm whales (Levenson et al. 2015), photos and videos of these species were reviewed and rated using existing quality (Q) rating systems (Gero et al. 2007; Feyrer et al. 2021). Additional keywords were added for potential identification purposes (e.g., dorsal fin notches, scars, and anthropogenic-caused markings, Appendix Table 1.4).

Videos were Q-rated based on the total duration, resolution, proportion of time with whales present, and clarity of whale behaviour (Appendix Table 1.5). Each video was reviewed and a narrative description of whale behaviour during the recording was documented for future analysis.

IV. Arctic

Data were received in a folder system based on vessel or ASO company, and included datasheets of photo metadata (N = 4), photographs (N = 2,217), and videos (N = 184) taken between 2013 and 2020. There was a total of 342 photographs and 58 videos containing MMs.

V. Newfoundland and Labrador

Data were received in folders based on year and/or ASO name (N = 28), and included photographs (N = 4,768), and videos (N = 1,073) taken between 2004 and 2020. There were 4,133 photographs and 649 videos of MMs, and 26 photos of turtles.

VI. Maritimes

Data were received in a folder system based on year, and included a small number of photographs (N = 25) and videos (N = 1) taken between 2012-2020. There were 22 photographs and one video of MMs, and three photos of turtles.

RESULTS

OBJECTIVE 4: DESCRIBE MARINE MAMMAL DATA BY SOURCE AND LOCATION

Currently, ASO MM sightings data are collected and managed by the region the vessel is licenced in; however, the vessel may fish or transit between DFO regions, resulting in differences between the management region and MM sighting location. There were 1,473 MM records where the source region did not match the region the sightings were actually located in. This complicates the use and review of ASO MM sightings data as DFO's management of MMs is typically administered by the region the animal is actually located in, with some exceptions for SAR where there is a lead region designated for particular species. Thus, the ASO may collect data on MMs observed in one region, but the sightings record will be submitted to and stored by another region where management responsibility for the MM species may not reside. The following sections summarize the trends in ASO MM sightings and visual media by both source (vessel licencing) region and location where the species were sighted.

I. Marine Mammal Sightings Records By Source Region

The spatial distribution of ASO MM sightings identified by source region is mapped in Figure 3a. MAR had the longest and largest dataset with 2,397 ASO MM records spanning 1990-2021. NL had 1,633 records spanning 2006-2021, and AR had 542 records which spanned 2004-2022.

Absence of MM sightings across years could be due to a lack of ASO coverage, a reduction in reporting of MMs by ASO companies, or differences in ASO record keeping protocols during these periods by DFO. The retention of ASO data differed by region, and holding onto ASO MM data being prioritized by individuals rather than programs. It was not confirmed if there is a legal requirement for ASO data retention. Temporal trends in ASO MM records by source region can be seen in Figure 3.

Annually, ASOs submitted ~80 MM sightings on average to NL (mean = 77.8 ± 92.3) and MAR (mean = 79.9 ± 81.7), with AR receiving around half as many sightings per year (mean = 49.3 ± 50.6). There appears to be a downward trend in ASO MM sightings over the last five years. Records and forms peaked in AR in 2019, in NL in 2011, and in MAR in the 1990's (Figure 3b, Appendix Table 1.3).

Differences between source region and sightings location were not distributed evenly, with AR only collecting 41 records outside the regional area while NL (N = 915) and MAR (N = 517) regions collected substantially more records from other regional areas.

II. Marine Mammal Sightings Records By Location

MM sightings records collected by ASOs extend beyond the administrative and political boundaries managed by the DFO regions contributing to this report (Figure 1**,** Figure 4). The number of MM sightings located in AR Region (N = 1,345), was more than twice the number of records of MMs received from ASOs by the AR Region (N = 542). MMs sightings from other regions included: Gulf Region (N = 7), QC Region (N = 7), and outside Canada's Exclusive Economic Zone (EEZ; N = 361). The largest number of MM sightings were located in MAR (N = 1,884), while NL Region had substantially fewer sightings (N = 968).

III. Marine Mammal Visual Media

Visual media files analyzed in this report were collected between 2006 and 2020 (photographs N = 4,483, videos N = 699). The number of files (photos or videos) and date ranges differed by source region (i.e., AR = 399, NL = 4754, MAR = 29; Figure 5). MM species identified included: sperm whales (N = 2,713), northern bottlenose whales (N = 1,649), seals (N = 352), killer whales (N = 150), dolphins (N = 84), polar bears (N = 64), minke whales (N = 29), beluga whales (N = 38), pilot whales (N = 32), humpback whales (N = 31), harbour porpoise (N = 1), and unknown MMs (N = 21). An additional 18 photos of sea turtles were also provided.

Less than half of the visual media had reliable coordinate information (N = 2,376), leaving the location of most files unconfirmed. Visual media files with locations are mapped in Figure 5a. Temporal trends in visual media were similar to the MM sightings records, with a decline in the number of files submitted and/or retained over time (Figure 5b).

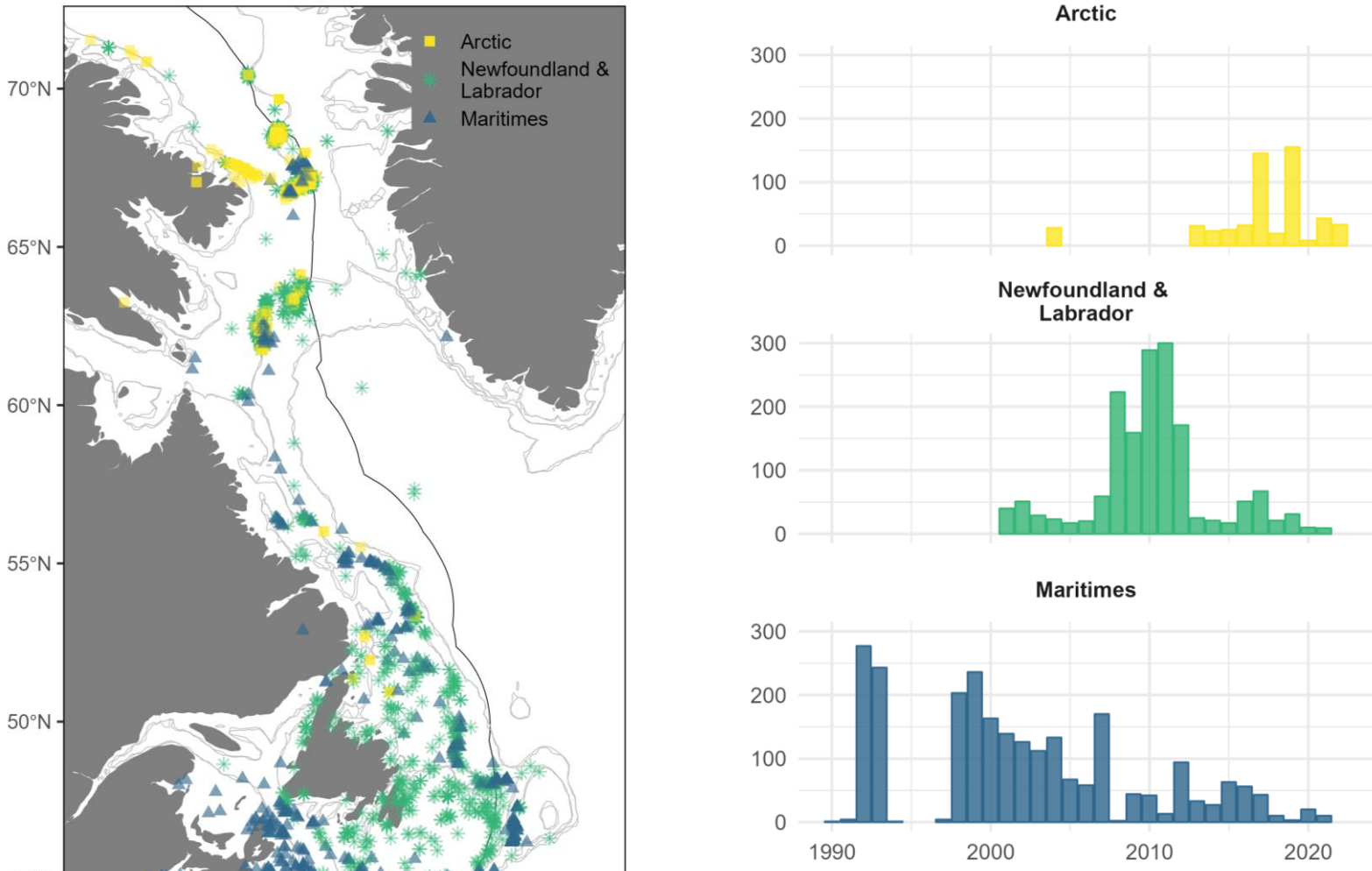
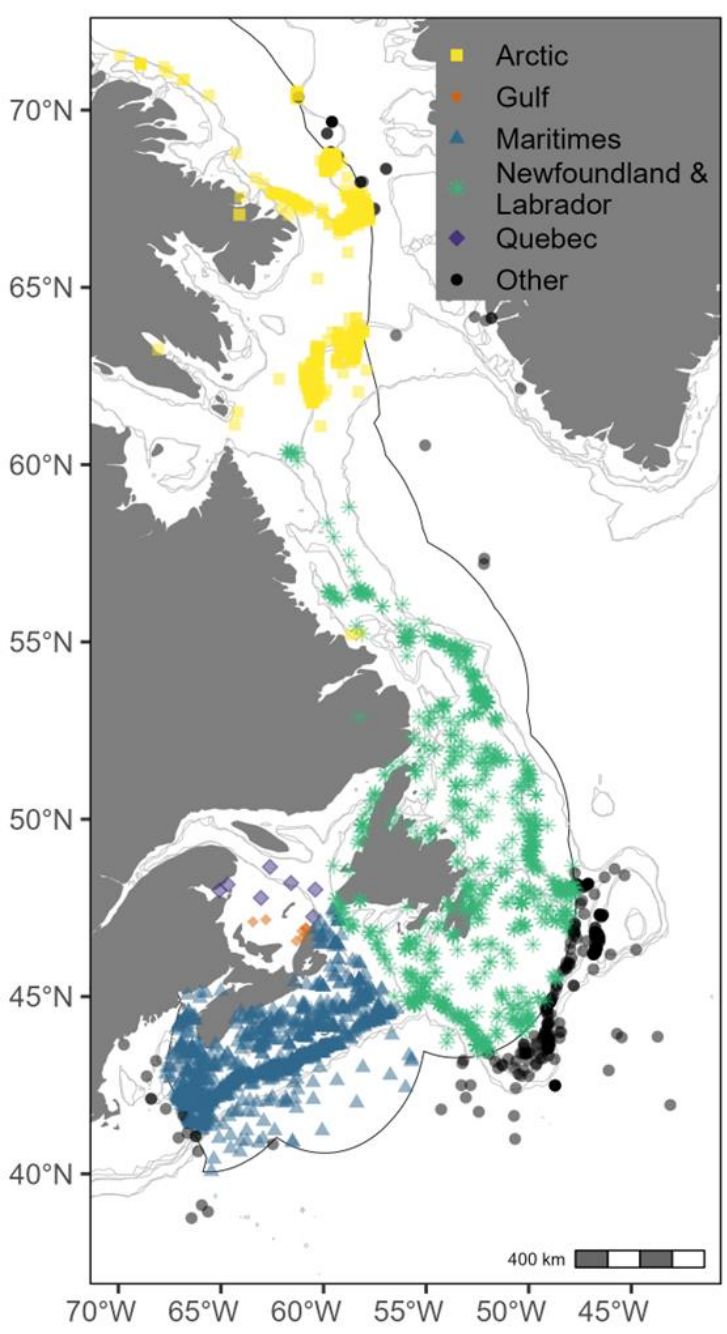


Figure 3: ASO marine mammal sightings by DFO source region. *Includes all reports received from Arctic (AR = 542), Newfoundland & Labrador (NL = 1633), Maritimes (MAR = 2397) regions. Plots left-right: (a) map of sightings reported by ASOs to each region and (b) trend in sightings records for each region, 1990-2022.*



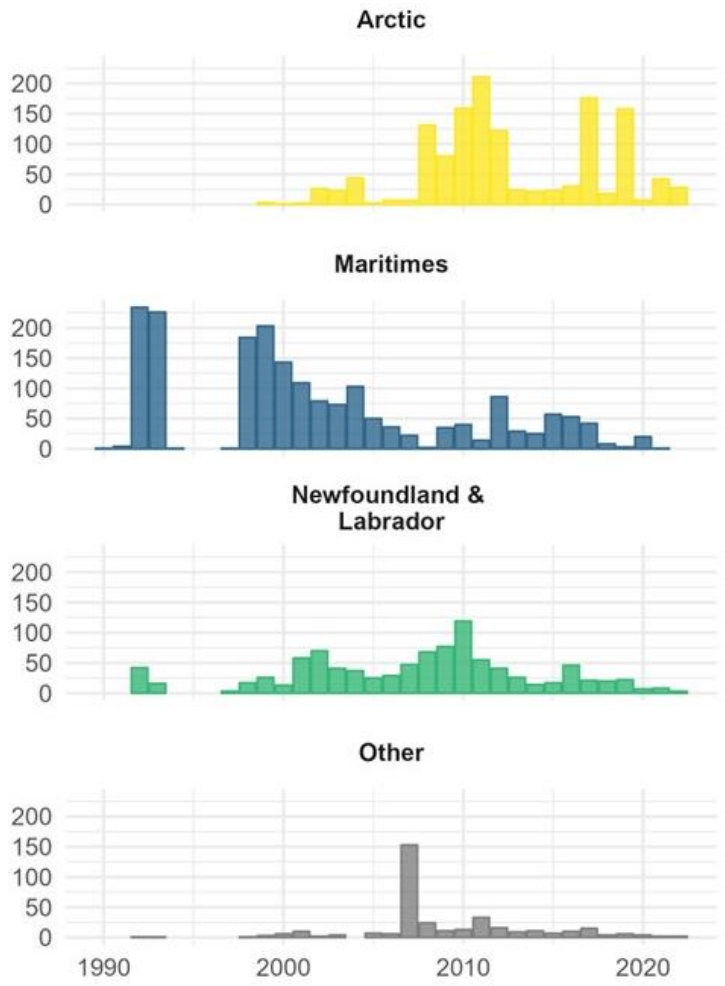
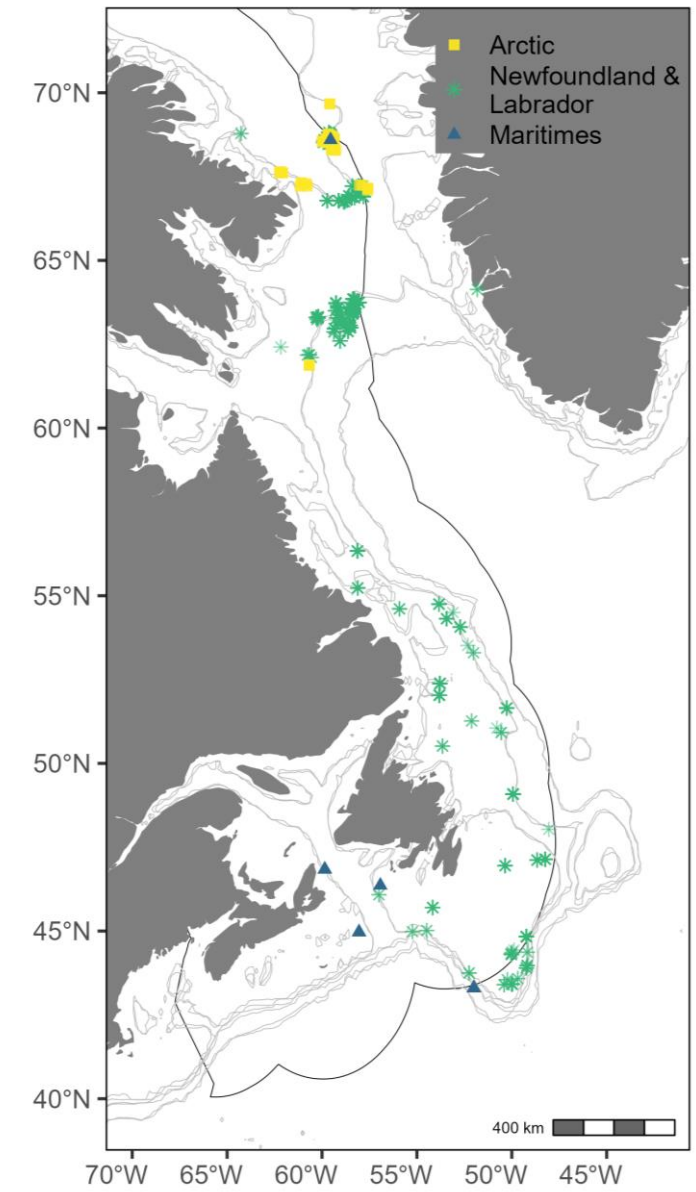


Figure 4: ASO marine mammals sightings by DFO region location. *Includes all reports located in Arctic (N = 1345), Newfoundland & Labrador (N = 968), Maritimes (N = 1884) regions, and Other (Outside Canada's Exclusive Economic Zone = 361). There were N = 7 in both Gulf and Quebec regions. Plots Left-Right: (A) Map of locations, and (B) Trend over time, 1990-2022.*



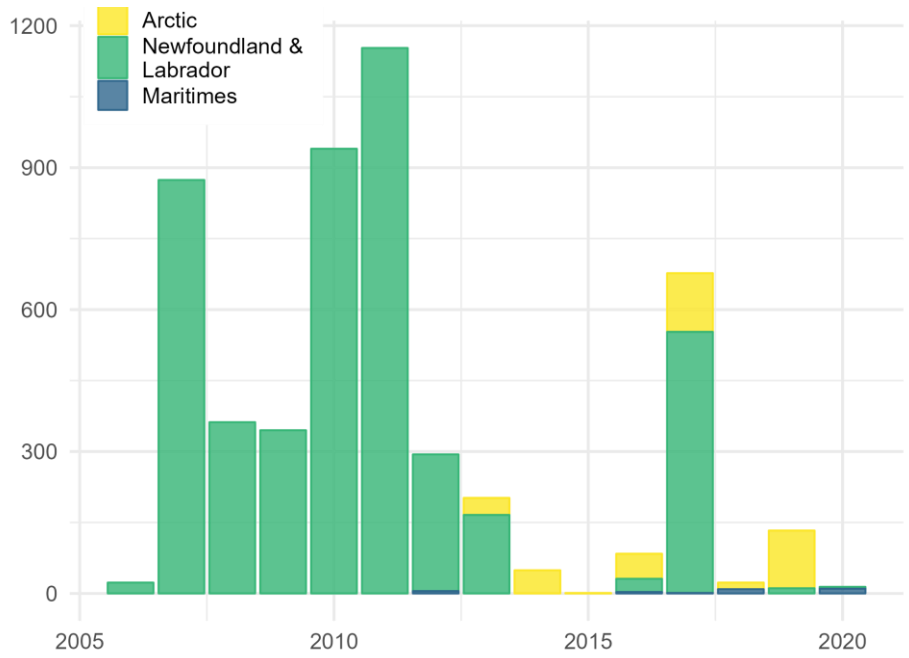


Figure 5: Photos and videos taken by ASOs. *Plots left-right: (a) map of visual media with GPS locations, and (b) trend in visual media received by ASOs over time, 2001-2020. Media dates and locations are based on camera time, available GPS or related metadata, and may or may not be linked to a specific ASO MM sighting record. Less than half of the MM media files had associated GPS locations that could be mapped (N = 2,376).*

OBJECTIVE 5: IDENTIFY MARINE MAMMAL INCIDENTS AND SPECIES AT RISK OBSERVED BY ASOs

The following sections summarize the extent of data and trends of MM incidents and SAR from sightings records and visual media documented by ASOs.

I. Incidents Described in Marine Mammal Sightings Records

Analysis of incidents included records of MMs that were dead, entangled in gear, injured, struck by a vessel, or feeding on fishery catch or discards. These incidents were coded based on ASO comments extracted from the sightings records, or visual media keywords annotated during the review of photos and videos (Table 2).

Overall, there were 1,078 MM sightings (24% of all records) describing one or more incidents. Based on sighting location, NL had the highest number and proportion of incident reports (41%, N = 398), followed by AR (23%, N = 306), MAR (10%, N = 186), and QC (14%, N = 1). There were an additional 187 records (52%) of MM incidents occurring in waters outside Canada's EEZ, which appear largely distributed along the Grand Banks off Newfoundland Figure 6).While a single MM incident event could involve multiple types of incidents (e.g., a report of an entanglement might also mention a visible injury), the incident type associated with the most MM sightings records was *feeding on catch or discards* (N = 518), followed by *entanglement in fishing gear* (N = 475). There were 190 records of MM *dead in fishing gear* and two of MM *disentangled and released alive*. A summary of all MM incidents recorded in the ASO MM sightings dataset is presented in Table 2**.**

Records associated with incidents were primarily of whales (N = 707), with fewer records of seals (N = 371). Seals were most often reported as *entangled in fishing gear* (79% of incidents). Whales (particularly sperm and northern bottlenose whales) were most often reported *feeding on catch or discards* (68% of incidents), and 29% of incidents recorded were of whales *entangled in fishing gear* (Figure 6).

Table 2. Number of ASO sightings records describing incidents of marine mammals (Total N = 1,078) and species at risk (SAR, N = 263). *One or more codes may apply to a single MM incident, so sum of incidents ≠ number of records.*

Incident code	Incident type	Marine Mammals	SAR
0	DEAD, IN WATER	23	3
2	DEAD, ENTANGLED IN FISHING GEAR	190	20
5	VISIBLE INJURY	13	2
55	FEEDING ON FISHERY CATCH OR DISCARDS	518	199
92	ENTANGLED IN FISHING GEAR	475	47
98	STRUCK BY VESSEL	1	-
112	DISENTANGLED RELEASED ALIVE	2	-

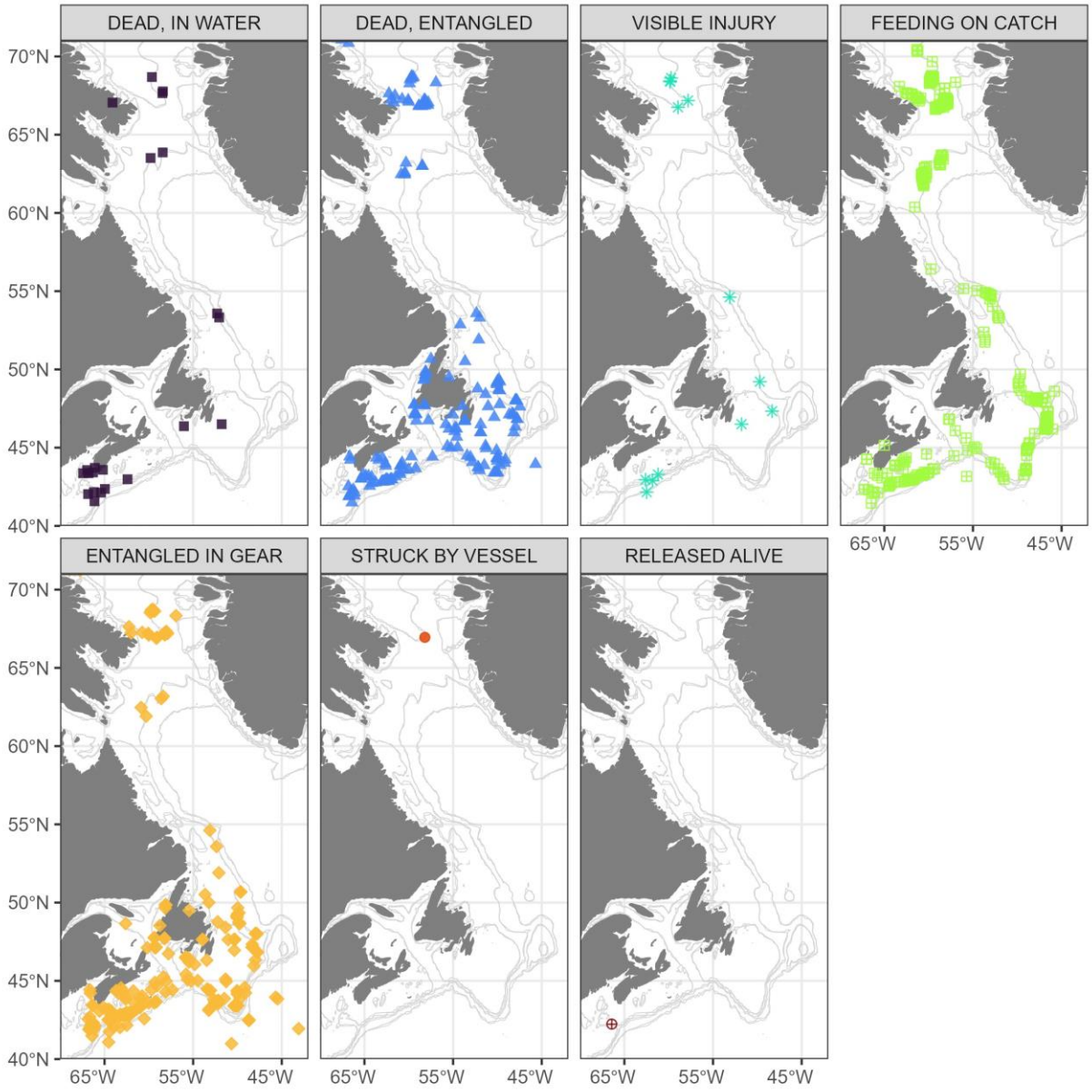


Figure 6: Maps of marine mammal incidents by incident type

(N = 1,078). Incident types correspond to those summarized in Table 2.

II. Incidents Identified in Marine Mammal Visual Media

Within the ASO photos and videos, there were 755 files documenting one or more incidents including entanglement (N = 109), dead (N = 46), feeding on catch or discards (N = 131), and visible injuries, including scars (N = 469). There were often multiple photos of the same incident or individual, so the file numbers are not a reflection of the number of separate incidents. MM species involved in the incidents within the visual media were primarily northern bottlenose whales (N = 448), followed by sperm whales (N = 238), minke whales (N = 22), beluga whales (N = 19), seals (N = 18), humpback whales (N = 2), pilot whales (N = 2), polar bears (N = 1), and unknown MMs (N = 2). Additionally, there were several incidents where fishers were recorded baiting or feeding northern bottlenose whales with fish (commonly called "provisioning"). Provisioning was not noted in the sightings records comments.

III. Species At Risk Identified in Marine Mammal Sightings Records

Of 14 possible SAR in the study area, 12 species were identified by ASOs including: fin whale, North Atlantic right whale, blue whale, bowhead whale, sei whale, beluga whale, northern bottlenose whale, narwhal, killer whale, harbour porpoise, ringed seal, and polar bear. There were no records of Sowerby's beaked whale or North Atlantic walrus.

There were 1,018 records of MM SAR reported across all regions (Figure 7). The majority were located in AR (N = 580), followed by MAR (N = 224), NL (N = 116), QC (N = 4), and GULF (N = 1) regions. There were an additional 93 records of MM SAR from waters outside Canada's EEZ, which appear largely distributed along the Grand Banks off Newfoundland (Figure 7).

IV. Incidents Involving Species At Risk from Marine Mammal Sightings Records

For SAR, there were 271 incidents reported. Most of these incidents were records of *feeding on catch or discards* (73%), with 17% of SAR *entangled in fishing gear*. The other incidents reported for MM SAR are noted in Table 2.

V. Species At Risk Identified in Marine Mammal Visual Media

Within the ASO photos and videos, there were 1,882 files of five MM SAR. Because coordinate information was not available for all images, MM SAR images were compared by source region, with the most files submitted to NL (N = 1,674), followed by AR (N = 205), and MAR (N = 3). Images of MM SAR were primarily of northern bottlenose whales (N = 1,635), followed by killer whales (N = 145), polar bears (N = 64), beluga whales (N = 37), and one image of a harbour porpoise.

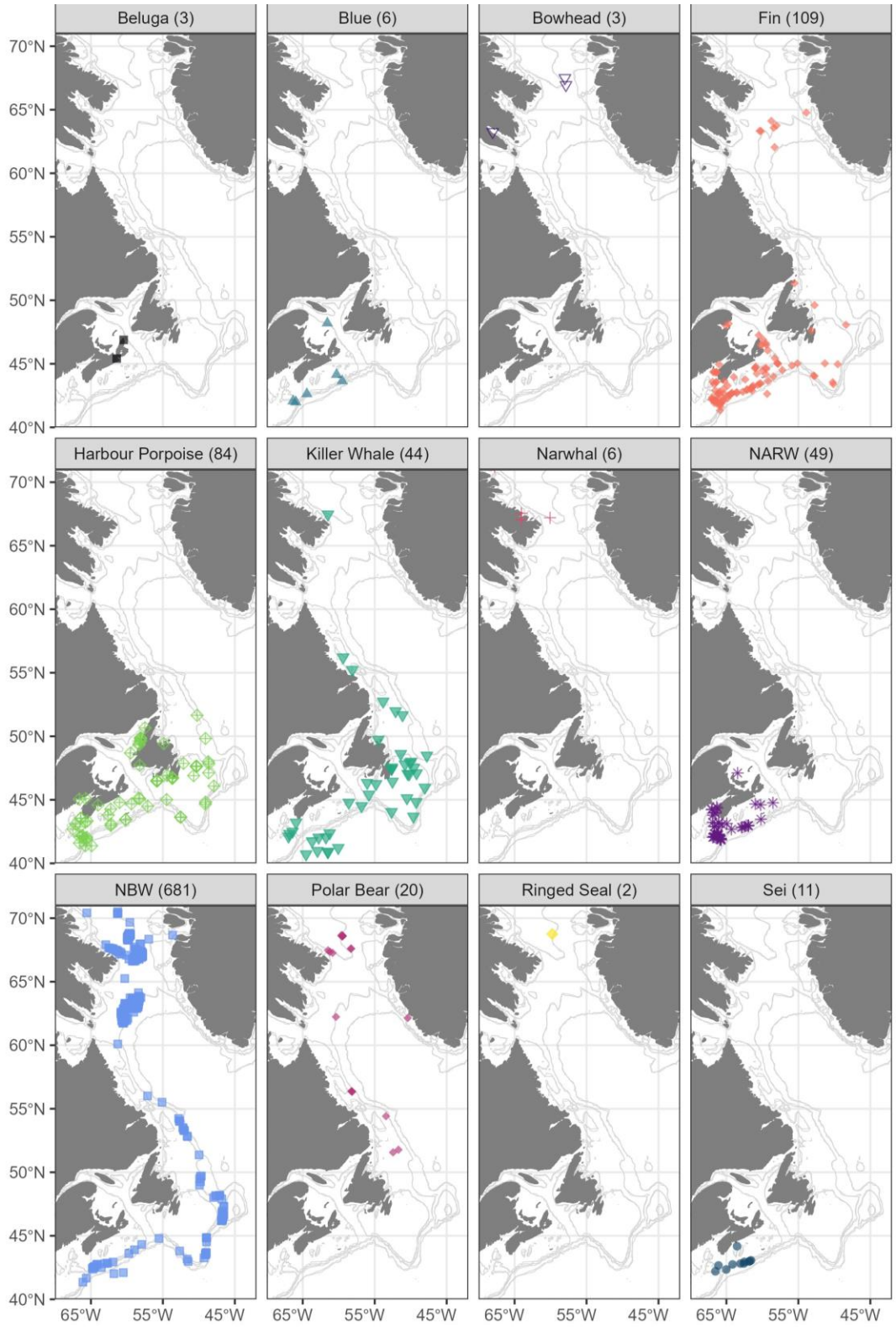


Figure 7*: *ASO sightings records for marine mammal species at risk. *(N) is number of records. NARW = North Atlantic Right Whale, NBW = Northern Bottlenose Whale.*

DISCUSSION

OBJECTIVE 6: CHALLENGES WITH USING ASO MARINE MAMMAL DATA FOR ANALYSIS

By compiling both sightings forms and visual media collected by ASOs on MM sightings, we identified a unique, relevant, and independent source of information on the distribution of MMs in remote areas, and MM interactions with Canadian fisheries. The MM sightings dataset compiled for this report will be available on the Government of Canada's open data website in 2024 (See Feyrer, L.J. et al. 2024). However, the shifting nature of ASO priorities in the field and differences in data collection and storage of ASO data across DFO regions present significant challenges for assessing trends or patterns in the distribution or behaviour of MMs, including fishery interactions. In general, MM sightings by ASOs are opportunistic and should be considered minimum estimates of MM associations with fisheries, sightings rates and distribution.

Currently, ASO reports are the only effort-based source of information on bycatch and incidents with MM across Canada's commercial fisheries. However, as standardized estimates of ASO coverage are not readily available across regions or fisheries, ASO MM reports can only be considered a minimum estimate. Understanding MM incidental catch rates also requires adhering to a systematic survey design. This is not the current situation, where DFO Fishery Management sector priorities and C&P objectives determine ASO deployment, resulting in highly variable coverage across fisheries and regions. Additionally, while fishing occurs around the clock, MM observations largely occur during daylight hours. To calculate fishery- or species-specific MM sighting or interaction rates would require significant changes to the distribution, coverage, and monitoring protocols for MMs by ASOs (Themelis et al. 2016).

Differences between ASOs background, training, and species identification skills can also affect reliability in MM reporting. Although DFO MM scientists have supported the ASO program with MM identification training in the past, training has not been consistent. With high turnover in ASOs, it is unclear what level and frequency of training in MM identification new ASOs receive. It is also unclear whether and what identification reference materials are available, and how training varies between companies and across regions. While there can be multiple reasons for unidentified species (e.g., sighting conditions, animal size, distance, etc.), 15% of records (N = 671) were of unidentified species, suggesting there is room for improvement (Table 1).

Regional differences in the format of MM sightings forms presented a challenge for analysis of these data. Originally designed for opportunistic MM data collection, differences between regions and within regions over time in data fields and species codes made reviewing and digitizing information for analysis time consuming (Appendix Tables 1.2. and 1.3, Figure 1.2). We found that including required fields does not guarantee they will be filled out in a meaningful way (e.g., species = "whale"). The comments section often contained information most relevant to the management of MM, including details on behaviour, such as feeding on catch (depredation) or close approaches with MM associating with vessels. Leaving space for comments allows recording of information that may not be reported or captured correctly elsewhere. Although comments are more time consuming to extract, code, and analyse, the narrative nature of the hundreds of MM sightings and incident reports we have reviewed suggests adding additional check boxes or fields may not result in higher quality data. Narrative reports provide critical details and context on MM interactions that may otherwise be lost if there is only a check box. A MM sightings data form should carefully balance capturing necessary details without being overly demanding for the ASO in the field, while leaving space for those ASOs who prefer to provide a narrative description of their encounter.

Another challenge identified is the decline in MM reporting over time. During 2018-2021, there have been very few ASO MM sightings forms received by AR, NL, or MAR Science programs (Figure 3, Appendix Table 1.3). Coincidently, during this time period (2018) DFO's national MMIF became mandatory for both ASOs and a condition of licence for fishers. While the MMIF focuses only on interactions and is intended to *exclude sightings* reports of MMs, it has also seen a general decline across all regions in the number of reports submitted since it was implemented (Table 3). As the MMIF requirements are relatively new, the MMIF data reviewed as part of this project did not include all metadata (specific time, date or location) required to identify duplicate or matching incident records, so the full extent of the overlap between sources of MM incident data provided by ASOs is currently unknown. MM incidents recorded on ASO MM sightings forms appear to provide different or additional information than what is asked for on the MMIF and the extent of overlap should be further examined.

Possible explanations for the decline in MM sightings reports from ASOs include:

- uncertainty about the difference between MMIF and regional MM sightings forms
- increased number of forms and burden in MM reporting (and/or other forms/reporting)
- lower prioritization of the regional MM sightings forms by DFO Science, Fisheries Management, and/or ASO companies
- companies no longer providing MM sightings forms given the national MMIF requirement
- a drop in overall observer coverage
- staffing challenges or higher turnover in ASOs
- a lack of training or emphasis on MM sighting protocols
- COVID-19 disruptions
- other logistical challenges associated with the ASO data collection program.

Table 3: Number of marine mammal reports submitted to DFO through the marine mammal interaction form. *Records include submissions by ASOs (N = 18), harvesters (N = 264, includes 39 NIL reports) and the public (N = 57) to the National Fisheries and Oceans incident reporting system (see forms in Appendix Figure 1.1). *Data summary current up to October 2022.*

Year	**Arctic**	**Newfoundland and Labrador**	**Maritimes**	Gulf	Quebec	Pacific	UNK	Total
2018	3	3	12	16	1	32	2	69
2019		3	9	7	2	114	1	136
2020		1	7	6		67	1	82
2021		1	3	7		13	1	25
2022*	2	2	8	2		6	7	27
Total	**3**	**15**	**51**	**16**	**6**	**221**	**4**	**339**

OBJECTIVE 7: IMPROVEMENTS THAT WOULD FACILITATE FUTURE USE OF ASO MM DATA

Our review and analyses of the ASO MM sightings data identified several gaps and challenges from field data collection by ASOs to data storage and management by DFO. The effort and investment in the ASO program has primarily focused on the enumeration and sampling of commercial fish species, compliance and accidental catch, while MM sightings data are considered opportunistic and supplementary. However, the unique position of ASOs as independent observers represents a significant data collection opportunity for MM scientists and species managers. Our summary and analyses of information derived from these records revealed, there is considerable data on MM incidents within the ASO sightings. Given the challenges identified, some of the MM data (i.e., incident descriptions, visual media) may not be documented anywhere else. We were unable to determine whether all incidents identified in the ASO MM records or visual media data had also been reported as part of the MMIF or regional catch/bycatch databases.

Our primary recommendation is that accessibility, accuracy, and utility of the ASO data be improved through a more standardized and coordinated data collection, storage, and management approach.

This echoes the recommendation from DFO (2016), that ASO "effort-based data collection on human-induced cetacean injury and mortality should be standardized nationally and made available for analysis."

Additional recommendations are summarized below for ASO MM sightings data collection and storage as well as improvements required for future analyses.

1. Update ASO MM training protocols and policies. MM identification training should be a requirement for ASOs, and consistent training materials should be provided by companies and reviewed by DFO.
2. Develop a standardized digital MM sighting form for the AR, MAR and NL ASO programs (with potential inclusion of QC and GULF regions) to help keep data fields consistent across regions and streamline future data compilation.
3. Use consistent MM species codes across regions on ASO forms. Include a code dictionary with the MM sightings form. Standardizing MM species codes is now being implemented across DFO multiregional data collection efforts and is recommended by MM scientists and managers for future database development (Appendix Table 1.6).
4. Emphasize critical data fields for MM sightings records (species, location, and date/time). Request digital versions of MM reports (scans, fillable PDFs) from ASO companies to facilitate file management and data sharing within DFO.
5. Continue the development of the ASO MM dataset established during this project to include new MM sightings submitted by ASOs. Consider centralization of data submission/ collection/ organization within DFO and long-term custodial solutions (e.g., the multiregional Cetacean Sightings Database (CSDB) initiative). This would make the data available to all regions to address research questions, mandates and priorities across DFO sectors (e.g., Table 4).
6. Renew requests for photos of MM sightings from ASOs when possible. Determine where the visual media files and catalogue should be held and maintained.
7. Prioritize acquisition of actual ASO coverage levels by region, fishery, and year on an annual basis to enable analysis of trends in ASO MM sightings data.

OBJECTIVE 8: ***HOW ASO MM DATA COULD INFORM AND SUPPORT DFO'S MANDATES***

The current ASO MM dataset provides a foundation for future analyses and an opportunity to address new and existing management questions. Following recommendations for improvement, ASO data could be used to inform and support DFO's science and management sectors' needs on an ongoing basis for MM. A summary of the research and management questions that rely on MM incident data were identified by the Marine Mammal Accidental Catch Working Group, Maritimes Region (Table 4). Although issues with regionally divided ASO MM data management remain, ASO MM data has the potential address many of the current gaps in our understanding of MM interactions with fisheries. The summary provided in Table 4 is not exhaustive and may vary in response to evolving DFO mandates, MM status assessments, emerging threats, etc. Many of the questions are also applicable to other marine species and SAR, such as sharks and turtles.

Table 4. Summary of how ASO MM data could be applied to address research and management questions relevant to DFO sectors, programs, and mandates.

DFO Sector/ Program	Mandate(s)	Question(s)
Science	▪ CSAS requests ▪ Monitoring MM populations and threats ▪ Identifying effective mitigation measures	• What is the amount/rate of mortality from fisheries incidents that may have to be accounted for when determining total allowable catch or total allowable harvest for subsentence or commercial seal hunts? • Is the current amount/rate of mortality from fisheries incidents exceeding potential biological removal for MM species? • What fisheries/gear types pose the highest risk of incidents to a given species based on co-occurrence in space and time with MM? • What fisheries/gear types are associated with incidents and how might these be related to results from scarring rate studies of MM? • What are the likely mechanisms for entanglement for a given MM species and fishery? • Can ASO photos contribute to ongoing photo-identification research for MM population assessments? • Are there MMs in the ASO photographs that match with individuals in existing photo identification catalogues?

DFO Sector/ Program	Mandate(s)	Question(s)
Fish & Fish Habitat Protection Program	▪ Impact assessments ▪ Regulatory review ▪ Cumulative effects assessments	• How does MM incidents contribute to cumulative effects assessments for species / areas/ projects?
Species at Risk	▪ SAR listing ▪ SAR recovery planning, implementation & reporting	• What are the knowledge gaps in relation to fisheries incidents with each MM SAR? • Are fisheries incidents jeopardizing survival or recovery of MM SAR? • How can incidents inform our understanding of physical space as a feature of SAR Critical Habitat and fishing activity as an Activity Likely To Destroy Critical Habitat? • Which fisheries have documented incidents with SAR? • How many documented incidents are there for each SAR? • What percentage of SAR incidents are likely to result in mortality (even in the absence of observed mortalities, i.e. Cryptic mortality), injury or sublethal impacts? • What gear types (e.g., rope strength, rope diameter, end line vs groundline) are associated with SAR incidents? • Which area(s) have the highest risk of incidents for each SAR? • What factors (e.g. Spatial and temporal overlap, seasonality) contribute to the risk of incidents for each SAR? • What are the mechanics of entanglement for each SAR? (e.g. whale behaviour in specific areas and how this impacts risk, which specific parts of the gear contribute to entanglement)? • Are mitigation measures needed to reduce incidents with each SAR? • What mitigation measures (spatial, temporal, or gear specifications) could work for SAR?

DFO Sector/ Program	Mandate(s)	Question(s)
		• What is the effectiveness of implemented threat mitigation methods? • Do existing threat mitigation measures require further refinement or evaluation? • What are the impacts of species specific threat mitigation measures on other SAR (i.e. Do they benefit or harm other SAR)? • What is the risk (likelihood, impact) of incidents with SAR for an existing/new/returning/ expanding/changing/specific fishery? • What are the information needs for each species under listing consideration and how can ASO data contribute to the development of management scenarios?
Fisheries Management	▪ MITS ▪ Monitoring Fisheries Interactions ▪ New fisheries assessments ▪ Monitoring Fisheries Interactions ▪ Respond to MMPA	• What are the number of ASO reported incidents per MM species, fisheries, etc.? • Are MM incidents reported by ASOs on sightings forms also recorded on the MMIF? • Has a MM incident occurred in an experimental/exploratory fishery? • Which areas and gear types pose the highest risk of incidents with MMs? • Is there mortality or injury data on MM species associated with a given fishery? • Is there a monitoring program associated with a given fishery that can demonstrate that no mortality or injury to MM occurs? • What is the annual ASO coverage of a fishery? Is it consistent over time and across regions? • What is the mortality rate of a MM species from incidents? • Are MM species present in the area at any time where a given fishery occurs?

DFO Sector/ Program	Mandate(s)	Question(s)
Marine Planning & Conservation	▪ Risk assessment ▪ Adaptive management decision-making ▪ Informing MPA monitoring indicators	• What is the distribution of MMs in targeted Areas of Interest (AOIs), Marine Protected Areas (MPAs), and other effective area-based conservation measures (OECMs)? • What is the risk and rate of incidents of MMs within AOIs, MPAs, and OECMs?
Eco-certification	▪ Marine Stewardship Council certification audits ▪ Assessing effectiveness of management measures	• What are the number of incidents, per MM species, gear type, fishing fleet, etc.? • Are current management measures and enforcement actions adequate for reducing MM incidents?
Atlantic Marine Mammal Hub (NHQ)	▪ Monitoring fisheries incidents	• What is the frequency with which specific fisheries lose gear and how does this affect entanglement risk? • What type of ghost gear (lost gear) has been implicated in incidents with MMs? Is it reported or unreported lost gear?
Communications	▪ Responding to media	• What are the summary statistics on the number of entanglements and other incidents of each MM species?

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GLOSSARY

Accidental catch: A term broadly intended to mean any accidental contact between MMs and fishing gear, such as entanglements, entrapments, hooking, ingestion of fishing gear, or other similar incidents, regardless of whether these are temporary or longer-term, lethal, or non-lethal. This term is meant to capture incidental catch, bycatch, accidental contact, or other similar terms often used to describe these incidents.

AR: DFO's Arctic Region

ASO: At-Sea Observer. In Canada, this is an individual who works aboard fishing vessels to: monitor fishing activities; collect scientific data; and monitor industry compliance with fishing regulations and licence conditions. ASOs work for private sector companies that are contracted by DFO.

BIO: Bedford Institute of Oceanography

Bycatch*:* Defined here to mean any retained species or specimens that the harvester was not licenced for but is required or permitted to retain, and all non-retained catch, including catch released from gear and entanglements, whether alive, injured, or dead, whether the target species or a non-target species.

CSAS: Canadian Science Advisory Secretariat

CSDB: Cetacean Sightings Database, a multiregional DFO database currently under development for storing information on cetacean sightings

C&P: Conservation and Protection

COSEWIC: Committee On the Status of Endangered Wildlife in Canada

DFO: Department of Fisheries and Oceans Canada

Depredation: The damage or removal of fish or bait from fishing gear by no-target predators, such as whales

EEZ: Exclusive Economic Zone. The area of the ocean extending up to 200 nautical miles (370 km) immediately offshore from a country's land coast in which that country retains exclusive rights to the exploration and exploitation of natural resources.

Fisheries interaction: Similar to the broad definition used by Gulland (1986), we consider there are two levels of MM-fisheries interactions: (1) primary or directly operational interactions, usually involving a physical encounter between mammals and fisheries (i.e., an incident), potentially resulting in gear damage, loss of catch, and death or injury to MMs, and (2) secondary, biological, ecological or behavioural interactions. Examples of secondary ecological interactions might include the MM competition with fisheries or altered MM migratory behaviour. Biological interactions would involve altered foraging energetics due to MM depredation behaviour or other sub-lethal impacts of non-fatal injuries (van der Hoop et al. 2016; Skern-Mauritzen et al. 2022). Behavioural interactions include MMs demonstrating reduced risk aversion or dangerous habituation to vessels, as well as the potential for negative human perception of MMs, retaliatory interventions by fishers, and alteration of fishing practises to avoid MM incidents.

Incident*:* The occurrence of a operational impact from fishing activities on a MM. Incidents can range from harassment to acute impacts such as entanglement, injury, or death, and may also be identified by dead or live-stranded animals on the shore. This report defines incidents as records

of MMs that were dead, entangled, injured, struck by a vessel, or feeding on fishery catch or bycatch.

Incidental catch: Within the MM Regulations of Canada's *Fisheries Act*, "incidental catch" is defined as any fish (or MM) unintentionally caught in a person's fishing gear that is not the primary target for which that person's fishing gear is set and is not retained. See section 33 of the *Fisheries Act* for specific use of term "Incidental catch."

ISDB: Industry Survey Database

MAR: DFO's Maritimes Region

MM: Marine mammal (e.g., whales, dolphins, porpoises, seals, sea lions, polar bears)

MMIF: DFO's national Marine Mammal Interaction Form established in 2018 under Schedule V of the *Fisheries Act*

Marine-life Incident Tracking System (MITS): An internal multimedia database currently under development by MAR DFO for documenting, tracking, and storing information on MM incidents

MPA: *Oceans Act* Marine Protected Area

MARFIS: Maritime Fishery Information System

NAFO: Northwest Atlantic Fisheries Organization

NL: DFO's Newfoundland and Labrador Region

OTIS: Observer Trip Information System

Provisioning: Feeding of animals by humans

Q: Quality, as in quality rating of a photo or video

SAR: Species At Risk. Used here to refer to MM species which have one or more Atlantic populations with a status identified as "At-Risk" (e.g., endangered, threatened, special concern) by either the *SARA* and/or COSEWIC.

***SARA**: Species At Risk Act*

Sightings form: A paper template form for ASOs to document MM sightings

Sightings record: A unique sighting of a MM recorded on an ASO sightings form

Sightings report: A group of MM sightings forms from one or more observers compiled by ASO companies and submitted to DFO

WSDB: Whale Sightings Database. A database of opportunistic marine mammal sightings owned and maintained by MAR Region Science sector. Sightings are submitted by multiple sources within and outside DFO. The WSDB primarily focuses on live whale sightings reported to DFO MAR region, but includes MM sightings across other DFO regions, as well as all ASO sightings of live MMs analyzed as part of this report.

APPENDIX: SUPPLEMENTARY TABLES AND FIGURES

Table 1.1: VARIATIONS IN MARINE MAMMAL SIGHTINGS FORMS NAMES AND FORMAT, BY DFO REGION AND YEAR.

Form Name	AR	NL	MAR
“MM Incident Log”	-	-	1999-2016
“MM Observation Record”	-	-	2003
“MM Incident/Sightings Log”	-	-	2016-2018
“Whale Sighting Record”	-	2006	-
“MM and Turtle Sighting Record”	-	2006, 2008	-
“Whale, MM and Turtle Sightings Record”	2004	2008-2010, 2012	-
“Observer NL - MM and Turtle Sighting Record”	2013	2007-2014, 2016-2019	-
“MM Observation Sheet”	2018	-	-
“MM and Turtle Sighting Record - At-Sea Observer Program - NL Region”	2013-2022	2013-2020	-

Table 1.2: SPECIES CODES USED BY ASOS IN ARCTIC (AR), NEWFOUNDLAND AND LABRADOR (NL), AND MARITIMES (MAR) REGIONS. Multiple codes were sometimes used on AR sightings forms. See Table 1.6 for recommended MM species codes.

Arctic			Newfoundland and Labrador			Maritimes		
AR Code	**Common Name**	**Scientific**	**NL Code**	**Common Name**	**Scientific**	**MAR Code**	**Common Name**	**Scientific**
						7036	Cetacean	Cetacea
1010	Whales	Cetacea	1010	Whale		920	Whales	
920 + 1011	Baleen whales	Mysticeti	1011	Baleen Whale		7030	Baleen Whale	
1031	Beaked whales	Ziphiidae	1031	Beaked Whales		924	Whale-Beaked	
1052	Beluga	*Delphinapterus leucas*	1052	Beluga	*Delphinapterus leucas*	7029	Whale-Beluga	*Delphinapterus leucas*
1034	Dense-beaked whale	*Mesoplodon densirostris*				7039	Whale-Blainville's Beaked	*Mesoplodon densirostris*
1016	Blue whale	*Balaenoptera musculus*	1016	Blue Whale	*Balaenoptera musculus*	7026	Whale-Blue	*Balaenoptera musculus*
1023	Bowhead whale	*Balaena mysticetus*	1023	Bowhead Whale	*Balaena mysticetus*	7032	Whale-Bowhead	*Balaena mysticetus*
1038	Goosebeak whale	*Ziphius cavirostris*				925	Whale-Cuvier's Beaked	*Ziphius cavirostris*

AR Code	Common Name	Scientific	NL Code	Common Name	Scientific	MAR Code	Common Name	Scientific
1015	Fin whale	*Balaenoptera physalus*	1015	Fin Whale	*Balaenoptera physalus*	7021	Whale-Fin	*Balaenoptera physalus*
						7040	Whale-Fin/Sei	*Balaenoptera physalus/borealis*
						7033	Whale-Grey	*Eschrichtius robustus*
1020	Humpback whale	*Megaptera novaeangliae*	1020	Humpback Whale	*Megaptera novaeangliae*	7024	Whale-Humpback	*Megaptera novaeangliae*
1076	Killer whale	*Orcinus orca*	1076	Killer Whale	*Orcinus orca*	7028	Whale-Killer	*Orcinus orca*
			1071	Long-finned Pilot Whale	*Globicephala malaena*	7031	Whale-Long-Finned Pilot	*Globicephala melas*
1032	Beaked whales	*Mesoplodon sp.*				7041	Whale-Mesoplodont	*Mesoplodon* spp.
1014	Minke whale	*Balaenoptera acutorostrata*	1014	Minke Whale	*Balaenoptera acutorostrata*	7022	Whale-Minke	*Balaenoptera acutorostrata*
1051	Narwhal	*Monodon monoceros*	1051	Narwhal	*Monodon monoceros*	9489	Whale-Narwhal	*Monodon monoceros*
1024	Black right whale	*Eubalaena glacialis*	1024	Right Whale	*Eubalaena glacialis*	7023	Whale-North Atlantic Right	*Eubalaena glacialis*
922 + 1039	Northern bottlenose whale	*Hyperoodon ampullatus*				922	Whale-Northern Bottlenose	*Hyperoodon ampullatus*

AR Code	Common Name	Scientific	NL Code	Common Name	Scientific	MAR Code	Common Name	Scientific
1041 + 1042	Pygmy sperm whales	*Kogia* sp. + *Kogia breviceps*	1042	Pygmy Sperm Whale	*Kogia breviceps*	7019	Whale-Pygmy Sperm	*Kogia breviceps*
1017	Sei whale	*Balaenoptera borealis*	1017	Sei Whale	*Balaenoptera borealis*	7027	Whale-Sei	*Balaenoptera borealis*
1033	Sowerby's beaked whale	*Mesoplodon bidens*				923	Whale-Sowerby's Beaked	*Mesoplodon bidens*
1040 + 1045	Sperm whale(s)	*Physeteridae* + *Physeter catodon*	1045	Sperm Whale	*Physeter catodon*	7020	Whale-Sperm	*Physeter macrocephalus*
1056 + 1077	Dolphins + Porpoises	Delphinidae + Phocoenidae				930	Dolphins/ Porpoise	
1064	Spotted dolphin	*Stenella plagiodon* + *Stenella frontalis*				937	Dolphin-Atlantic Spotted	*Stenella frontalis*
1066	Frasers dolphin	*Lagenodelphis hosei*				938	Dolphin-Fraser's	*Lagenodelphis hosei*
1061 + 1062	Spinner/Bridled dolphin	*Stenella longirostris*				7038	Dolphin-Long Snouted Spinner	*Stenella longirostris*
						7034	Dolphin-Pacific White-Sided	*Lagenorhynchus obliquidens*

AR Code	Common Name	Scientific	NL Code	Common Name	Scientific	MAR Code	Common Name	Scientific
931 + 1067	Bottlenose(d) dolphin	*Tursiops truncatus*	1067	Bottlenosed Dolphin	*Tursiops truncatus*	931	Dolphin-Atlantic Bottlenose	*Tursiops truncatus*
933+ 1059	Atl./Atlantic white-sided dolphin	*Lagenorhynchus acutus*	1059	Atl. White Sided Dolphin	*Lagenorhynchus acutus*	933	Dolphin-Atlantic White-Sided	*Lagenorhynchus acutus*
1069	Saddlebacked dolphin	*Delphinus delphis*	1069	Common Dolphin	*Delphinus delphis*	934	Dolphin-Common	*Delphinus delphis*
			1068	Risso's Dolphin	*Grampus griseus*	935	Dolphin-Risso's	*Grampus griseus*
1063	Striped dolphin	*Stenella coeruleoalba*				936	Dolphin-Striped	*Stenella coeruleoalba*
			1058	White Beaked Dolphin	*Lagenorhynchus albirostris*	932	Dolphin-White-Beaked	*Lagenorhynchus albirostris*
1075	False killer whale	*Pseudorca crassidens*	1075	False Killer Whale	*Pseudorca crassidens*	7037	False Killer Whale	*Pseudorca crassidens*
						7035	Porpoise-Dall's	*Phocoenoides dalli*
1078	Harbour porpoise	*Phocoena*	1078	Harbour Porpoise	*Phocoena*	7025	Porpoise-Harbour	*Phocoena*
1080 + 1082	Seal(s)	Pinnipedia + *Phoca* sp.				900	Seals	

AR Code	Common Name	Scientific	NL Code	Common Name	Scientific	MAR Code	Common Name	Scientific
						7209	Sea Lion-Stellar	*Eumetopias jubatus*
1087	Bearded seal	*Erignathus barbatus*	1087	Bearded Seal	*Erignathus barbatus*	7201	Seal-Bearded	*Erignathus barbatus*
1088	Grey seal	*Halichoerus grypus*	1088	Grey Seal	*Halichoerus grypus*	902	Seal-Grey	*Halichoerus grypus*
1083	Harbour seal	*Phoca vitulina*	1083	Harbour Seal	*Phoca vitulina*	901	Seal-Harbour	*Phoca vitulina*
1085	Harp seal	*Phoca groenlandica*	1085	Harp Seal	*Phoca groenlandica*	7202	Seal-Harp	*Pagophilus groenlandicus*
1089	Hooded seal	*Cystophora cristata*	1089	Hooded Seal	*Cystophora cristata*	7203	Seal-Hooded	*Cystophora cristata*
						7204	Seal-Northern Fur	*Callorhinus ursinus*
						7206	Seal-Ribbon	*Histriophoca fasciata*
1084	Ringed seal	*Pusa hispida*	1084	Ringed Seal	*Pusa hispida*	7205	Seal-Ringed	*Pusa hispida*
						7207	Seal-Spotted	*Phoca largha*
910 + 1090 + 1091	Walrus(es)	Odobenidae + *Odobenus rosmarus*	1091	Walrus	*Odobenus rosmarus*	7208	Walrus	*Odobenus rosmarus*
1099	Polar bear	*Ursus maritimus*	1099	Polar Bear	*Ursus maritimus*	7220	Bear-Polar	*Ursus maritimus*

AR Code	Common Name	Scientific	NL Code	Common Name	Scientific	MAR Code	Common Name	Scientific
930 + 1030	Toothed whales	Odontoceti	1030	Toothed Whale				
1043	Dwarf sperm whale	*Kogia simus*	1043	Dwarf Sperm Whale	*Kogia simus*			
1074	Pygmy killer whale	*Feresa attenuata*	1074	Pygmy Killer Whale	*Feresa attenuata*			
900 + 1081	True seals	Phocidae	1081	True Seals				
1035	Antillean beaked whale (Gervais)	*Mesoplodon europaeus*						
1036	True's beaked whale	*Mesoplodon mirus*						
921 + 1071	Atlantic pilot whale	*Globicephala melaena*						
1072	Short-finned pilot whale	*Globicephala macrorhynchus*						
1018	Bryde’s whale	*Balaenoptera edeni*						
1022	Right whales	Balaenidae						
1012 + 1013	Rorqual whales	Balaenopteridae + Balaenoptera sp.						

AR Code	Common Name	Scientific	NL Code	Common Name	Scientific	MAR Code	Common Name	Scientific
1057 + 1060	Dolphin	*Lagenorhynchus* sp. + *Stenella sp.*						
1054	Rough-toothed dolphin	*Steno bredanensis*						

Table 1.3: NUMBER OF ASO MARINE MAMMAL SIGHTINGS FORMS RECEIVED PER YEAR BY DFO REGION. AR = Arctic, NL = NEWFOUNDLAND AND LABRADOR; MAR =MARITIMES. Forms were not available for ASO MM sightings records prior to 1999. AR Region provided additional forms for 2022, not available in this report for MAR or NL.

Year	AR	NL	MAR
1999	0	0	58
2000	0	0	75
2001	0	0	68
2002	0	0	51
2003	0	0	39
2004	1	0	53
2005	0	0	41
2006	0	2	1
2007	0	8	1
2008	0	61	4
2009	0	54	20
2010	0	74	24
2011	0	64	11
2012	0	38	40
2013	11	15	20
2014	7	12	14
2015	8	13	35
2016	9	24	36
2017	31	22	25
2018	11	11	10
2019	14	18	0
2020	2	5	8
2021	11	5	1
2022	7	-	-
Total	**112**	**426**	**635**

Table 1.4: LIGHTROOM KEYWORDS AND THEIR DEFINITIONS. Keywords were used to annotate photographs and videos in the Lightroom catalogue developed for ASO visual media.

Keyword	Definition
AR	DFO Arctic Region
Bear	Polar bear (*Ursus maritimus*)
Beluga	Beluga whale (*Delphinapterus leucas*)
Birds	Gulls or shearwaters (unknown species)
Bottom Otter Trawl	Gear type used by vessel
Bycatch	MM caught during fishing
Dead	Animal is not alive
Dolphin	Unspecified but likely Atlantic white-sided dolphin (*Lagenorhynchus acutus*)
Dorsal Fin	Fin located on the back of a MM
Duplicate	Duplication of a photo or video
Entanglement	MM entangled in fishing gear
FIM	Fish in the mouth of a MM
Fin Notch	Dorsal fin notch (includes small nicks to severe fin mutilations)
Gillnet	Gear type used by vessel
Greenland Halibut	Species (*Reinhardtius hippoglossoides*) targeted by fishery
Hauling	Where the net is brought onto vessel and fish are removed from net, or “taking back”
Humpback	Humpback whale (*Megaptera novaeangliae*)
KW	Killer whale (*Orcinus orca*)
MAR	DFO Maritimes Region
Melon	Forehead of whales
Minke	Minke whale (*Balaenoptera acutorostrata*)

MM	Marine Mammal
Mouth	Upper and lower jaw are visible, either under or above the surface of the water
Mouth open	Visible gape between upper and lower jaw, either under or above the water
Multiple Species	More than one species seen in the frame
Multiple Whales	More than one individual whale seen in the frame
NBW	Northern bottlenose whale (*Hyperoodon ampullatus*)
NL	DFO Newfoundland and Labrador Region
Pilot Whale	Long-finned pilot whale (*Globicephala melas melas*)
Porpoise	North Atlantic harbour porpoise (*Phocoena phocoena*)
Scar	Highly identifiable scar or distinct marking that is white to grey
Seal	Unspecified, includes harp seal *(Pagophilus groenlandicus*), hooded seal (*Cystophora cristata*), and grey seal (*Halichoerus grypus*)
SW	Sperm whale (*Physeter macrocephalus*)
Trawl	Gear type used by vessel
Trip	Trip number consisting of a 6-figure code containing one letter representing the name of the ASO company, the last two numbers of the calendar year, and three digits representing the latest trip number for that company and year (e.g., J18165)
Turtle	Leatherback turtle (*Dermochelys coriacae*) or Loggerhead turtle (*Caretta caretta*)
Unknown MM	Unidentified MM
Vessel	Vessel name
Year	Calendar year associated with fishing trip

Table 1.5: VIDEO QUALITY (Q) RATING SCALE.

Q-rating	Resolution	Focus	Distance	Framing	Focal animal	Description
Q1	Low	Out of focus; shaking	Too close or too far	MM not fully in frame	MM seen for <3 s (behaviour indistinguishable)	Short duration, not long enough to see MM behaviour
Q2	Low	Shaking	Too close or too far	MM fully in frame	MM seen for 3-10 s (behaviour not fully clear)	
Q3	Medium	In and out of focus/ stability	Good	MM fully in frame	MM seen for <10 s (behaviour is distinguishable)	Lacks 1-2 key criteria of Q4
Q4	High	In focus/ stable	Good	MM fully in frame	MM seen for >10s (behaviour is distinguishable)	Focuses on MM for entire duration, long enough to see MM behaviour)

Table 1.6: RECOMMENDED STANDARDIZED SPECIES CODES. Species codes for marine mammal (MM) species occurring in Canadian waters, including species found in the Atlantic, Arctic, and Pacific Oceans. These species codes are letter based and already widely used within Fisheries and Oceans Canada across multiregional MM surveys and MM databases as they are easier to remember by MM observers than numeric codes. Internationally standardized numeric MM species codes use the Integrated Taxonomic Information System (ITIS) and are included here for reference (https://www.itis.gov/). Generic species codes above the species level do not have an associated ITIS code (e.g., “fin whale/sei whale”, “unknown whale”, “unknown dolphin”).

Species Code	ITIS Code	Scientific Name	Common Name (English)	Common Name (French)
Small Toothed Whales				
BNDO	180426	*Tursiops truncatus*	Atlantic bottlenose dolphin	Grand dauphin de l'Atlantique
SPDO	180429	Stenella longirostris	Spinner dolphin	Dauphin à long bec
STDO	180434	*Stenella coeruleoalba*	Striped dolphin	Dauphin bleu
SADO	180438	*Delphinus delphis*	Short-beaked common dolphin	Dauphin commun à bec court
FRDO	180440	*Lagenodelphis hosei*	Fraser’s dolphin	Dauphin de Fraser
WBDO	180442	*Lagenorhynchus albirostris*	White beaked dolphin	Dauphin à bec blanc
AWDO	180443	*Lagenorhynchus acutus*	Atlantic white-sided dolphin	Dauphin à flancs blancs
PWDO	180444	Lagenorhynchus obliquidens	Pacific white-sided dolphin	Dauphin à flancs blancs du Pacifique
NRDO	180454	Lissodelphis borealis	Northern right whale dolphin	Dauphin du nord
GRAM	180457	*Grampus griseus*	Risso’s dolphin	Dauphin de Risso
FKWH	180463	*Pseudorca crassidens*	False killer whale	Fausse orque

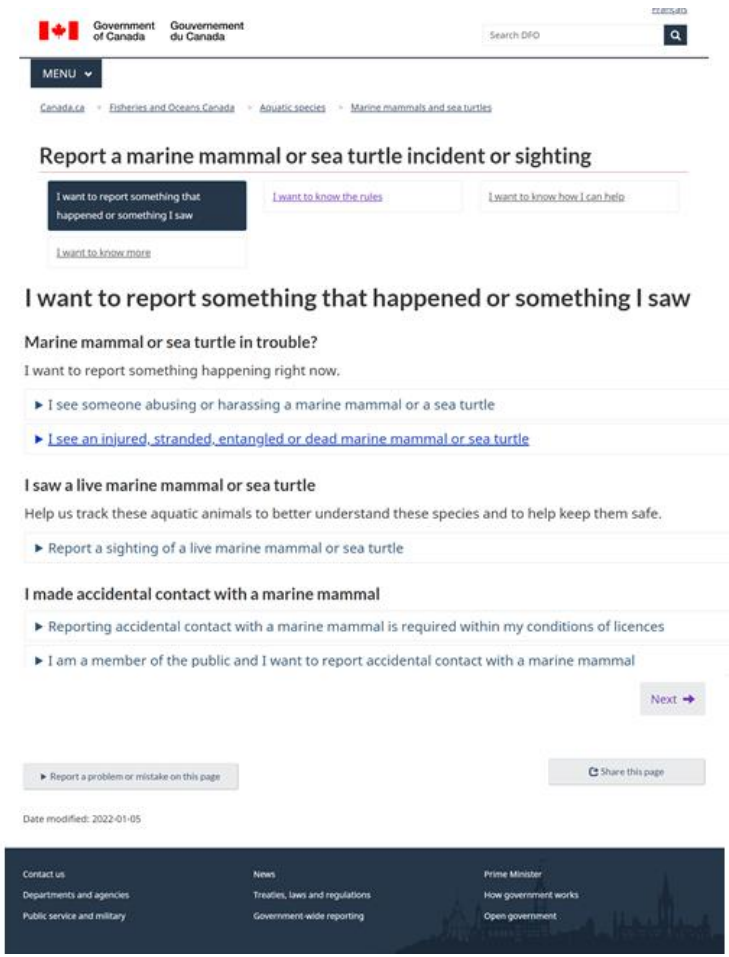
Species Code	ITIS Code	Scientific Name	Common Name (English)	Common Name (French)
HAPO	180473	*Phocoena*	Harbour porpoise	Marsouin commun
DAPO	180480	Phocoenoides dalli	Dall's Porpoise	Marsouin de Dall
PSWH	180491	*Kogia breviceps*	Pygmy sperm whale	Petit Cachalot
DSWH	180492	*Kogia sima*	Dwarf sperm whale	Cachalot nain
ASDO	552460	*Stenella frontalis*	Atlantic Spotted Dolphin	Dauphin tacheté de l'Atlantique
UNDO	Null	-	Unidentified dolphin	Dauphin non identifiée
UNDP	Null	-	Unidentified dolphin/porpoise	Dauphin/marsouin non identifiée
UNKO	Null	-	Unidentified kogia	Kogia non identifiée
UNST	Null	-	Unidentified Small Toothed Whale	Petite baleine à dents non identifiée
Large Toothed Whales				
SFPW	180466	*Globicephala macrorhynchus*	Short-finned pilot whale	Globicéphale tropical
KIWH	180469	*Orcinus orca*	Killer whale	Orque
BELU	180483	*Delphinapterus leucas*	Beluga whale	Béluga
NRWH	180485	*Monodon monoceros*	Narwhal	Narval
SPWH	180489	*Physeter macrocephalus*	Sperm whale	Cachalot

Species Code	ITIS Code	Scientific Name	Common Name (English)	Common Name (French)
BABW	180496	*Berardius bairdii*	Baird's beaked whale	Béradie de Baird
CUBW	180498	*Ziphius cavirostris*	Cuvier's beaked whale	Baleine à bec de Cuvier
NBWH	180504	*Hyperoodon ampullatus*	Northern bottlenose whale	Baleine à bec commune
TRBW	180508	*Mesoplodon mirus*	True's beaked whale	Baleine à bec True
GEBW	180509	*Mesoplodon europaeus*	Gervais' beaked whale	Baleine à bec Gervais
HUBW	180512	Mesoplodon carlhubbsi	Hubb's beaked whale	Baleine à bec de Hubbs
STBW	180514	Mesoplodon stejnegeri	Stejneger's beaked whale	Baleine à bec de Stejneger
SBWH	180515	*Mesoplodon bidens*	Sowerby's beaked whale	Baleine à bec de Sowerby
BLBW	180517	*Mesoplodon densirostris*	Blainville's beaked whale	Baleine à bec de Blainville
LFPW	552461	*Globicephala melas*	Long-finned pilot whale	Globicéphale commun
UNBW	Null	-	Unidentified beaked whale	Baleine à bec non identifiée
UNMP	Null	-	Unidentified mesoplodon beaked whale	Baleine mesoplodon inconnue
UNLT	Null	-	Unidentified large toothed whale	Grande baleine à dents non identifiée
Baleen Whales				
GRWH	180521	*Eschrichtius robustus*	Gray whale	Baleine grise

Species Code	ITIS Code	Scientific Name	Common Name (English)	Common Name (French)
MIWH	180524	*Balaenoptera acutorostrata*	Minke whale	Petit rorqual
BRWH	180525	*Balaenoptera edni*	Bryde's Whale	Rorqual de Bryde
SEWH	180526	*Balaenoptera borealis*	Sei whale	Rorqual boréal
FIWH	180527	*Balaenoptera physalus*	Fin whale	Rorqual commun
BLWH	180528	*Balaenoptera musculus*	Blue whale	Baleine bleue
HUWH	180530	*Megaptera novaeangliae*	Humpback whale	Rorqual à bosse
BOWH	180533	*Balaena mysticetus*	Bowhead whale	Baleine boréale
NARW	180537	*Eubalaena glacialis*	North Atlantic right whale	Baleine noire de l'Atlantique nord
NPRW	612591	*Eubalaena japonica*	North Pacific right whale	Baleine noire du Pacifique nord
SEFI	Null	-	Unidentified sei/fin whale	Rorqual boréal/commun non identifiée
BLFI	Null	-	Unidentified blue/fin whale	Baleine bleue / Rorqual commun non identifiée
UNBA	Null	-	Unidentified baleen whale	Baleine à fanons non identifiée
Unidentified Whales				
UNKN	Null	-	Unidentified cetacean	Baleine non identifiée
Sea Lions				

Species Code	ITIS Code	Scientific Name	Common Name (English)	Common Name (French)
CASL	180621	*Zalophus californianus*	California sea lion	Otarie de Californie
STSL	180625	*Eumetopias jubatus*	Steller sea lion	Otarie de Steller
UNSL	Null	-	Unidentified sea lion	Otarie non identifiée
Fur Seal				
NOFS	180627	*Callorhinus ursinus*	Northern (Pribilof) fur seal	Otarie à fourrure du Nord
GUFS	180636	*Arctocephalus townsendi*	Guadalupe fur seal	Otarie de L'Ile Guadalupe
UNFS	Null	-	Unidentified fur seal	Otarie à fourrure non identifiée
True Seal				
SPSE	180642	*Phoca largha*	Spotted seal	Phoque tacheté
GRSE	180653	*Halichoerus grypus*	Gray seal	Phoques gris
BESE	180655	*Erignathus barbatus*	Bearded seal	Phoque barbu
HOSE	180657	*Cystophora cristata*	Hooded seal	Phoque à capuchon
NESE	180672	*Mirounga angustirostris*	Northern elephant seal	Eléphant de mer du nord
RGSE	622018	*Phoca Hispida*	Ringed seal	Phoque annelé
RISE	622021	*Histriophoca fasciata*	Ribbon seal	Phoque rubané
HPSE	622022	*Pagophilus Groenlandicus*	Harp seal	Phoque du Groenland

Species Code	ITIS Code	Scientific Name	Common Name (English)	Common Name (French)
HASE	622048	*Phoca vitulina Linnaeus*	Harbour seal	Phoque commun
UNSE	Null		Unidentified seal	Phoque non identifiée
Walrus				
ATWA	622043	*Odobenus rosmarus*	Atlantic walrus	Morse de l'Atlantique
Sea Otter				
SEOT	622038	*Enhydra lutris*	Sea otter	Loutre de Mer



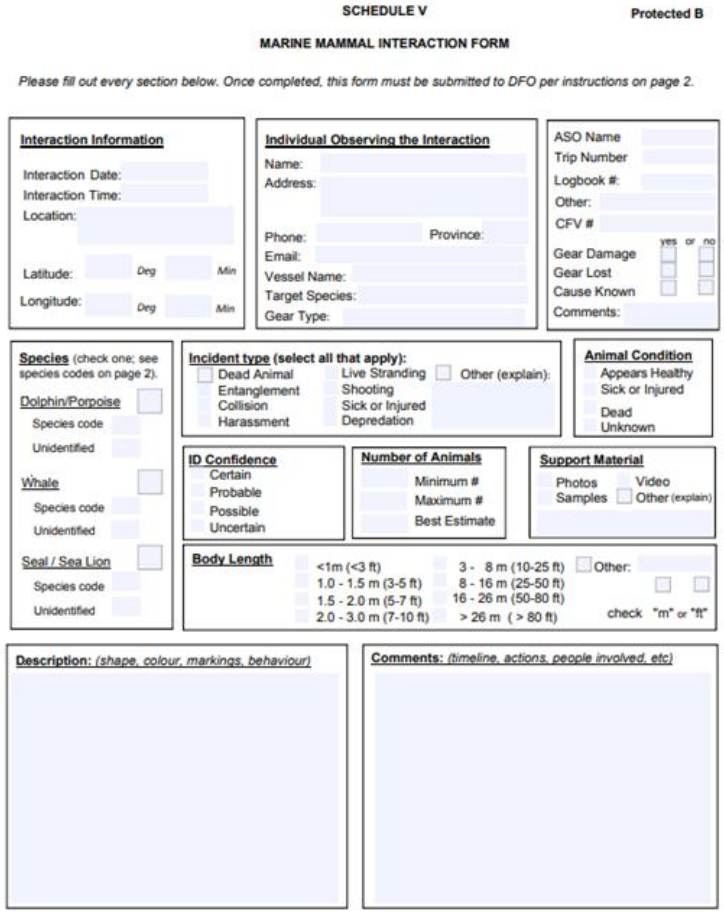
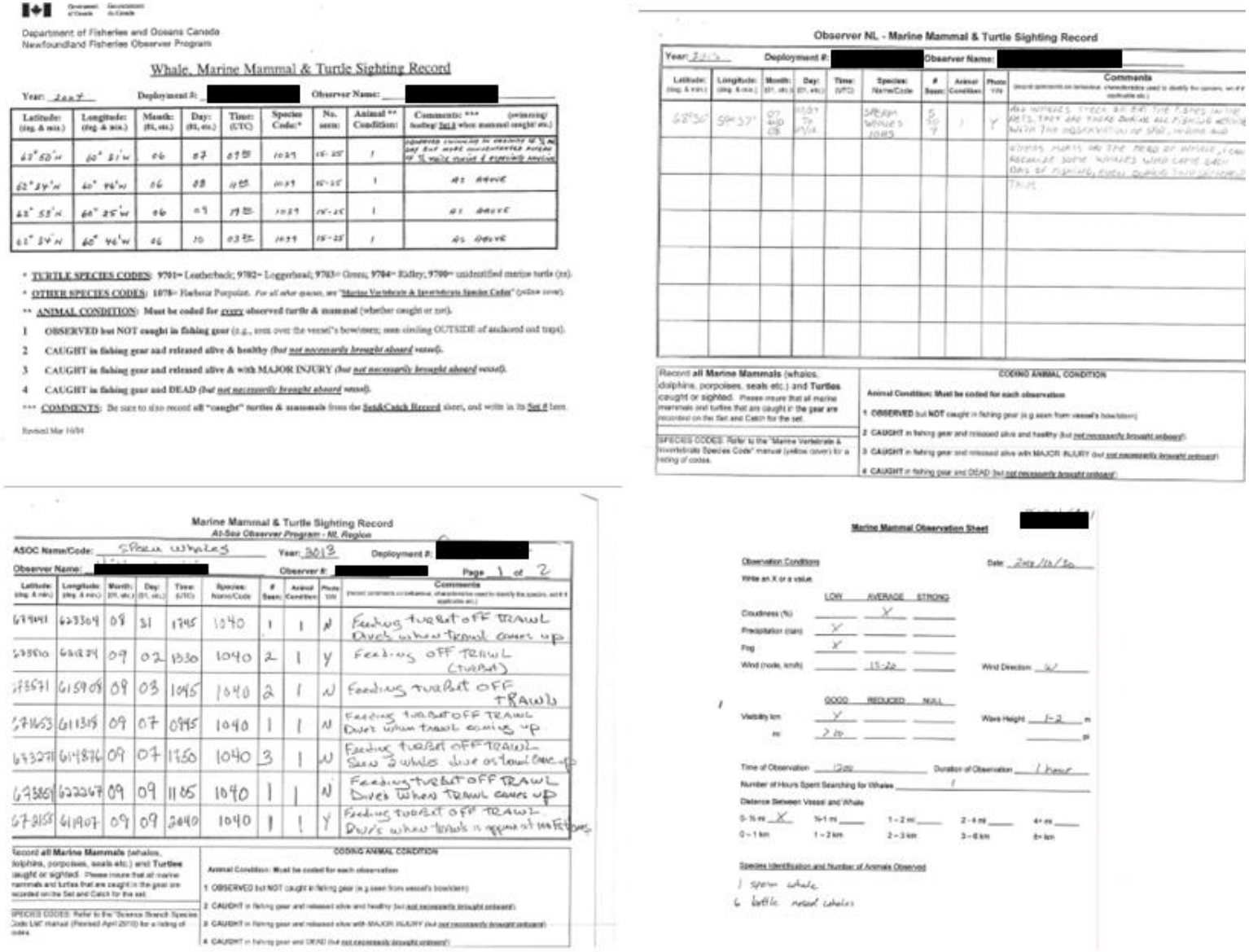


Figure 1.1: DFO'S NATIONAL MARINE MAMMAL INTERACTION FORM (MMIF) FOR ASOS The MMIF form is provided for fishers (e.g., Fish harvester form), ASOs (e.g., ASO form), and the public (e.g., public form) to report interactions with marine mammals. These forms are sent directly to a national Fisheries and Oceans email (DFO.NAT.InteractionsMM-InteractionsMM.NAT.MPO@dfo-mpo.gc.ca).



Department of Fisheries and Oceans Canada
Newfoundland Fisheries Observer Program

Whale, Marine Mammal & Turtle Sighting Record

Year: 2007 Deployment #: [redacted] Observer Name: [redacted]

Latitude: (deg. & min.)	Longitude: (deg. & min.)	Month: (01, etc.)	Day: (01, etc.)	Time: (UTC)	Species Code:*	No. seen:	Animal ** Condition:	Comments: *** (swimming/ feeding/ Set # when mammal caught/ etc.)
62°50'N	60° 31'W	06	27	0755	1039	15-25	1	[illegible]
62°39'N	60° 46'W	06	28	1105	1039	15-25	1	#1 ABOVE
62° 53'N	60° 25'W	06	29	1955	1039	15-25	1	#1 ABOVE
62° 34'N	60° 46'W	06	30	0335	1039	15-25	1	#1 ABOVE

* TURTLE SPECIES CODES: 9701= Leatherback; 9702= Loggerhead; 9703= Green; 9704= Ridley; 9700= unidentified marine turtle (rt).
* OTHER SPECIES CODES: 1078= Harbour Porpoise. For all other species, see "Marine Vertebrate & Invertebrate Species Codes" (yellow cover).
** ANIMAL CONDITION: Must be coded for every observed turtle & mammal (whether caught or not).
1 OBSERVED but NOT caught in fishing gear (e.g., seen over the vessel's bow/stern; seen circling OUTSIDE of anchored cod traps).
2 CAUGHT in fishing gear and released alive & healthy (but not necessarily brought aboard vessel).
3 CAUGHT in fishing gear and released alive & with MAJOR INJURY (but not necessarily brought aboard vessel).
4 CAUGHT in fishing gear and DEAD (but not necessarily brought aboard vessel).
*** COMMENTS: Be sure to also record all "caught" turtles & mammals from the Set&Catch Record sheet, and write in its Set # here.

Revised Mar 16/04

Observer NL - Marine Mammal & Turtle Sighting Record

Year: 2005 Deployment #: [redacted] Observer Name: [redacted]

Latitude: (deg. & min.)	Longitude: (deg. & min.)	Month: (01, etc.)	Day: (01, etc.)	Time: (UTC)	Species: Name/Code	# Seen:	Animal Condition:	Photo Y/N	Comments (record comments on behaviour, characteristics used to identify the species, set # if applicable etc.)
62°50	59°37'	07 AND 08	31/07 To 01/08		SPERM WHALES 1085	5 50 9	1	Y	[illegible]
									[illegible]
									[illegible]

Record all Marine Mammals (whales, dolphins, porpoises, seals etc.) and Turtles caught or sighted. Please ensure that all marine mammals and turtles that are caught in the gear are recorded on the Set and Catch for the set.

SPECIES CODES: Refer to the "Marine Vertebrate & Invertebrate Species Code" manual (yellow cover) for a listing of codes.

CODING ANIMAL CONDITION

Animal Condition: Must be coded for each observation

1 OBSERVED but NOT caught in fishing gear (e.g seen from vessel's bow/stern)
2 CAUGHT in fishing gear and released alive and healthy (but not necessarily brought onboard)
3 CAUGHT in fishing gear and released alive with MAJOR INJURY (but not necessarily brought onboard)
4 CAUGHT in fishing gear and DEAD (but not necessarily brought onboard)

Marine Mammal & Turtle Sighting Record
At-Sea Observer Program - NL Region

ASOC Name/Code: SPERM WHALES Year: 2013 Deployment #: [redacted]
Observer Name: [redacted] Observer #: [redacted] Page 1 of 2

Latitude: (deg. & min.)	Longitude: (deg. & min.)	Month: (01, etc.)	Day: (01, etc.)	Time: (UTC)	Species: Name/Code	# Seen:	Animal Condition:	Photo Y/N	Comments (record comments on behaviour, characteristics used to identify the species, set # if applicable etc.)
679941	623304	08	31	1745	1040	1	1	N	Feeding turbot OFF TRAWL Dives when trawl comes up
679910	624824	09	02	1330	1040	2	1	Y	Feeding OFF TRAWL (TURBOT)
675671	615905	09	03	1045	1040	2	1	N	Feeding turbot OFF TRAWL
671653	611315	09	07	0945	1040	1	1	N	Feeding turbot OFF TRAWL Dives when trawl comes up
693278	614876	09	07	1750	1040	3	1	N	Feeding turbot OFF TRAWL Saw 3 whales dive as trawl came up
693865	622267	09	09	1105	1040	1	1	N	Feeding turbot OFF TRAWL Dives when trawl comes up
678158	619107	09	09	2040	1040	1	1	Y	Feeding turbot OFF TRAWL Dives when trawls is [illegible]

Record all Marine Mammals (whales, dolphins, porpoises, seals etc.) and Turtles caught or sighted. Please ensure that all marine mammals and turtles that are caught in the gear are recorded on the Set and Catch for the set.

SPECIES CODES: Refer to the "Science Branch Species Code List" manual (Revised April 2010) for a listing of codes.

CODING ANIMAL CONDITION

Animal Condition: Must be coded for each observation

1 OBSERVED but NOT caught in fishing gear (e.g seen from vessel's bow/stern)
2 CAUGHT in fishing gear and released alive and healthy (but not necessarily brought onboard)
3 CAUGHT in fishing gear and released alive with MAJOR INJURY (but not necessarily brought onboard)
4 CAUGHT in fishing gear and DEAD (but not necessarily brought onboard)

Marine Mammal Observation Sheet [redacted]

Observation Conditions Date: 2012/08/30

Write an X or a value.

	LOW	AVERAGE	STRONG
Cloudiness (%)		X	
Precipitation (rain)	X		
Fog	X		
Wind (code, km/h)		15-20	

Wind Direction: W

	GOOD	REDUCED	NULL
Visibility km	X		
mi	2 to		

Wave Height: 1-2 m / ft

Time of Observation: 1200 Duration of Observation: 1 hour

Number of Hours Spent Searching for Whales: 1

Distance Between Vessel and Whale

0- ½ mi	½-1 mi	1 - 2 mi	2 - 4 mi	4+ mi
X				
0 - 1 km	1 - 2 km	2 - 3 km	3 - 6 km	6+ km

Species Identification and Number of Animals Observed

1 sperm whale
6 bottle nosed whales

Figure 1.2: EXAMPLES OF REGIONAL ASO MARINE MAMMAL SIGHTINGS FORMS (A) ARCTIC REGION.

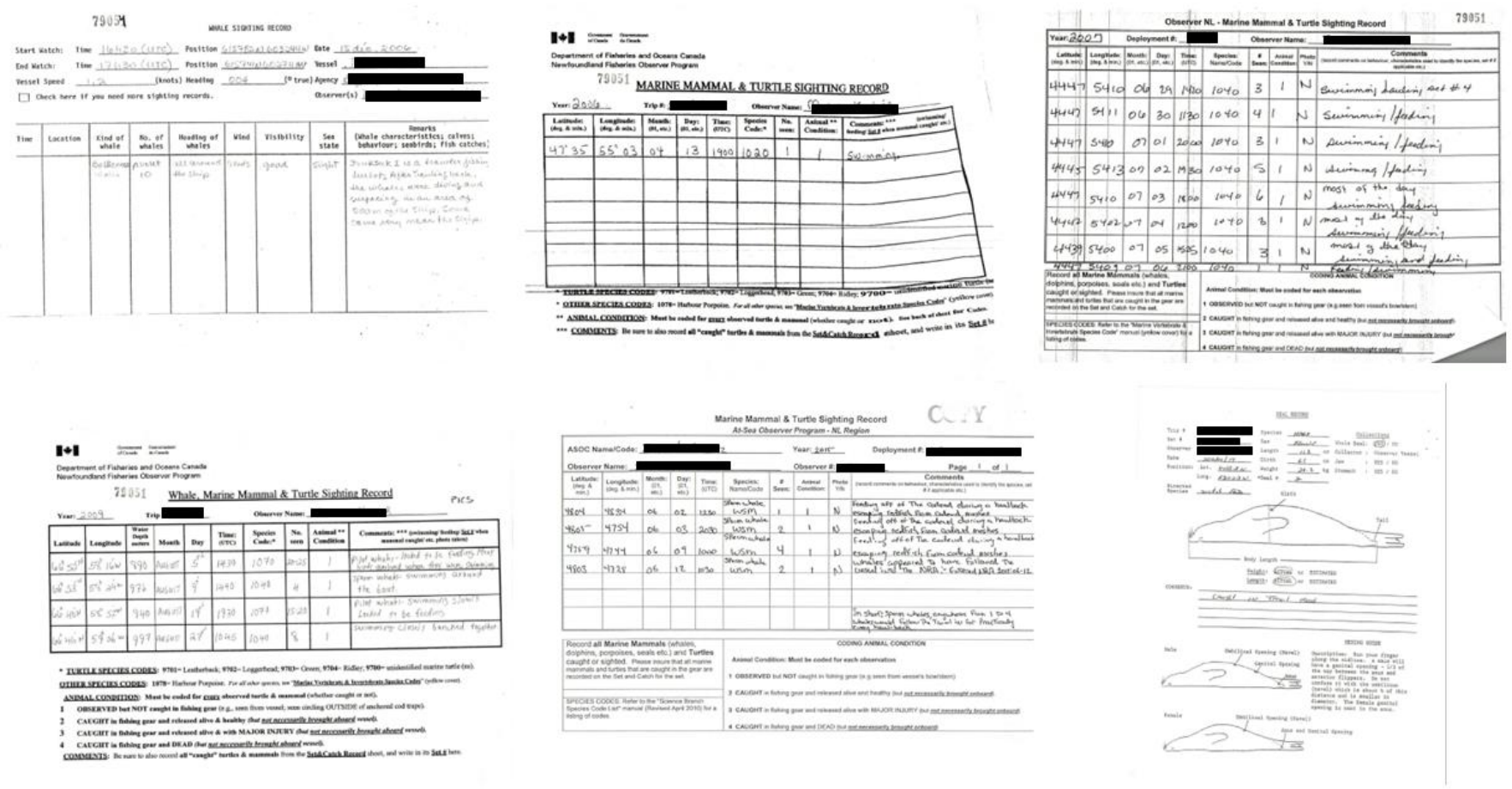


Figure 1.2: EXAMPLES OF REGIONAL ASO MARINE MAMMAL SIGHTINGS FORMS (B) NEWFOUNDLAND AND LABRADOR REGION.

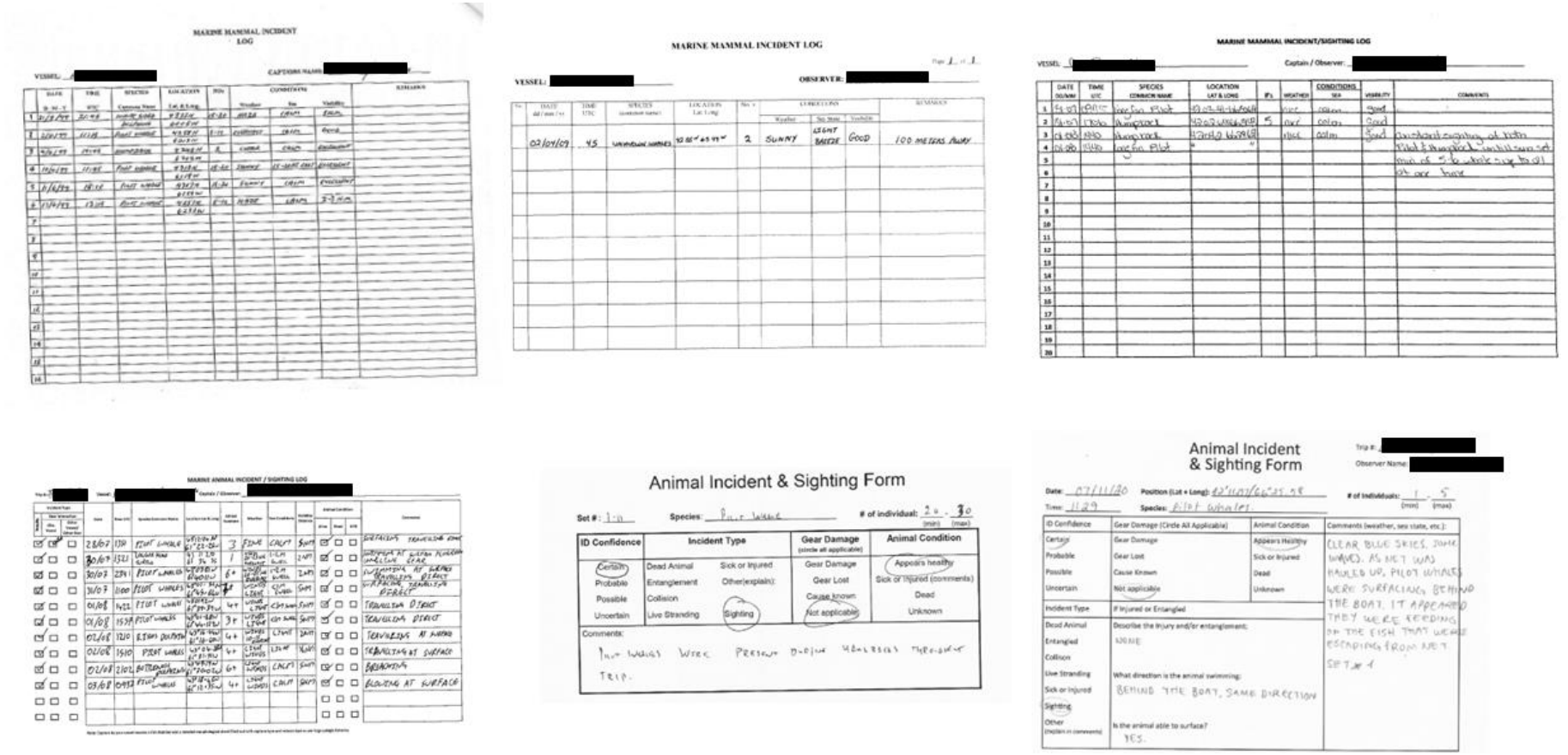


Figure 1.2: EXAMPLES OF REGIONAL ASO MARINE MAMMAL SIGHTINGS FORMS (C) MARITIMES REGION.