TECHNICAL DATA REPORT - FINAL

2018 Ship-based Observer Program

Baffinland Iron Mine

Submitted to:

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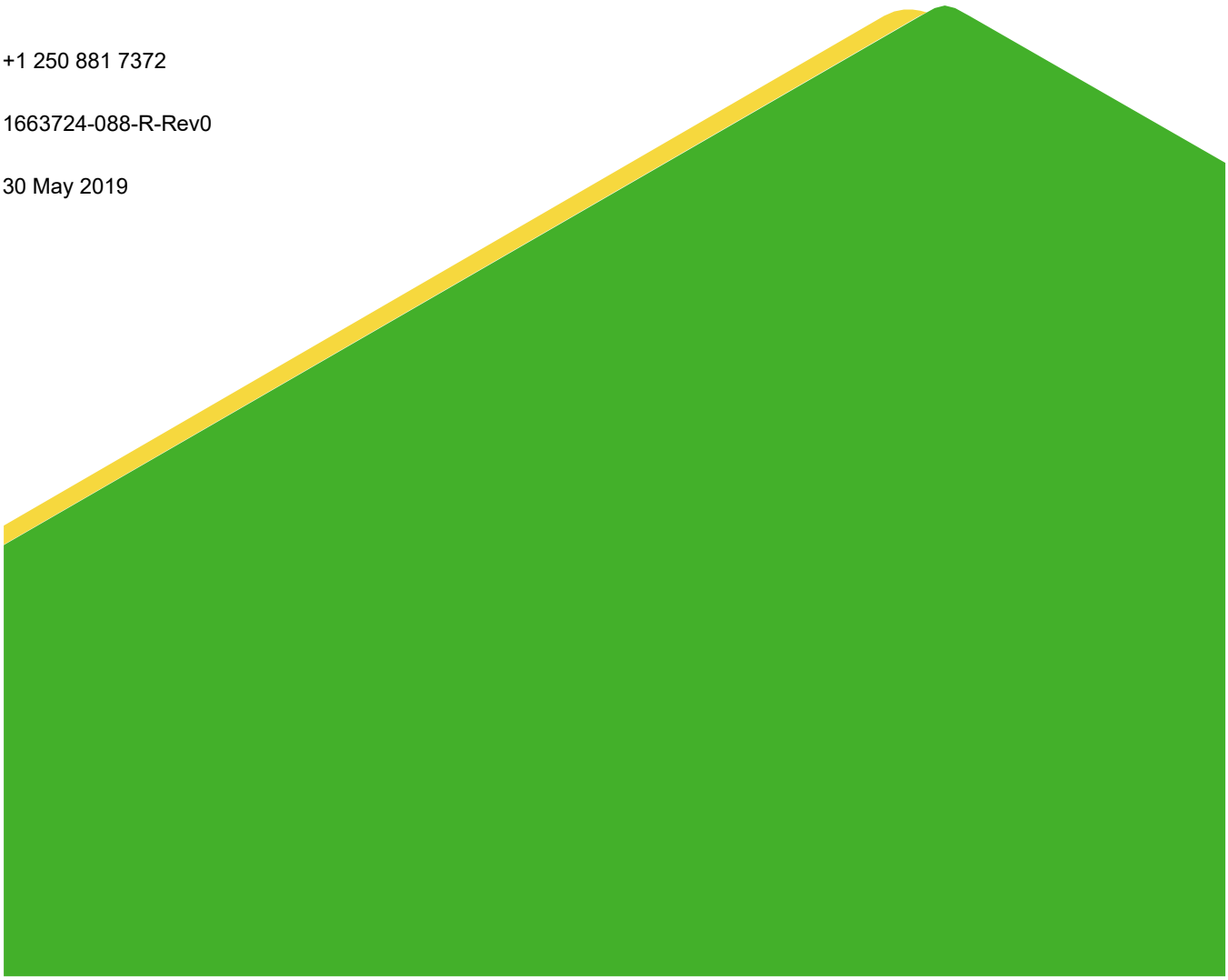

Distribution List

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Executive Summary

From 28 July to 7 August and 28 September to 17 October 2018, Golder Associates Ltd. (Golder), on behalf of Baffinland Iron Mines Corporation (Baffinland), conducted a Ship-based Observer (SBO) Program designed to collect wildlife data in Milne Inlet and Eclipse Sound. The SBO Program was designed to assess presence, distribution, and behavioural response of narwhal (*Monodon monoceros*) and other marine mammals to vessel traffic and associated activity during the 2018 shipping shoulder seasons. In addition to marine mammal observations, information on seabirds was collected using the Canadian Wildlife Service's (CWS) Eastern Canada Seabirds at Sea (ECSAS) protocol. The objective of the SBO Program was to collect localized observational data to describe the distribution, occurrence, relative abundance, and behavioural response of marine wildlife to shipping activity. To achieve this objective, MWOs recorded details of wildlife sightings aboard the MSV *Botnica*.

Prior to the start of the SBO Program, Marine Wildlife Observers (MWOs) from Pond Inlet, NU, were trained by the Golder field lead in Pond Inlet from 17 to 22 July 2018. A second training session was completed from 26 to 27 September 2018 for participants in the second survey period. Upon completion of the MWO training (Arctic Marine Safety Training and a Marine Wildlife Identification and Observation course), five candidates were selected to carry out the MWO Program on board the MSV *Botnica* between 28 July to 7 August 2018 (summer surveys) and 28 September to 17 October 2018 (fall surveys).

Two types of observations were carried out each day from the bridge of the vessel by MWOs: marine mammal and seabird observations. Marine mammal observations were completed across a daily monitoring period covering 16 hours in the summer and approximately 7–12 hours in the fall depending on available daylight. Regarding seabirds, a one- to two-hour survey period was conducted in the morning and a one to three-hour survey period was conducted in the afternoon. Total hours often varied depending on visibility and other sightability conditions. The maximum daily bird survey period was five hours. Marine wildlife sightings, environmental conditions and vessel information were entered into a program-specific database. Entries in the database underwent daily quality assurance and quality control by the Golder field lead.

A total of 552 sightings totalling 2,766 individual marine mammals were observed during the 2018 SBO Program. A total of five different species of marine mammals were observed during the SBO program: narwhal, ringed seal (*Pusa hispida*), harp seal (*Pagophilus groenlandicus*), bearded seal (*Erignathus barbatus*), and polar bear (*Ursus maritimus*). During summer surveys, 269 sightings of 1,681 individual marine mammals were observed. The most common species identified was ringed seals (194 sightings of 754 individuals), followed by harp seals (41 sightings of 292 individuals), narwhals (seven sightings of 19 individuals), and bearded seals (five sightings of five individuals). During fall surveys, 283 sightings of 1,085 individual marine mammals were observed. The most common species were ringed seal (146 sightings of 315 individuals), followed by harp seal (64 sightings of 462 individuals), narwhal (34 sightings of 156 individuals), and two polar bears. Sightings of four sets of polar bear tracks on the sea ice (not associated with the two recorded polar bear sightings) were also made, including tracks of an adult with a single cub.

For the summer seabird survey, a total of 13 species were identified (136 confirmed sightings and 14 unidentified individuals belonging to the Laridae family). The most common species recorded during summer were northern fulmar (*Fulmarus glacialis*), king eider (*Somateria spectabilis*), black-legged kittiwake (*Rissa tridactyla*), and thick-billed murre (*Uria lomvia*). For the fall survey seabird survey, a total of five species were identified (704 confirmed sightings and 15 unidentified individuals). The most common species recorded during fall were glaucous gull (*Larus hyperboreus*), black-legged kittiwake, and northern fulmar.

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ᑕᐃᒃᑲᖕᓚᑦ 28 ᔪᓚᐃ ᑎᑭᓪᓗᒍ 7 ᐋᒍᓯ ᐊᒻᒪᓗ 28 ᓯᑎᐱᕆ ᑎᑭᓪᓗᒍ 17 ᐅᒃᑑᐸ 2018, ᒍᑐ ᐱᓇᓯᐊᖃᑎᖏᑦ ᑎᒥᖓ (ᒍᑐ), ᑭᒡᒐᖅᑐᖅᖢᒋᑦ ᐸᕙᓐᓛᓐᑦ ᓴᕙᖅᓴᒃᓴᓂᒃ ᐅᔭᕐᓂᐊᖅᕕᒃ ᑯᐊᐳᕆᓴᓐ (ᐸᕙᓐᓛᓐᑦ), ᐱᓕᕆᓚᐅᖅᑐᑦ ᐅᒥᐊᔪᐊᕐᒦᓪᖢᑎᒃ ᖃᐅᔨᓴᖅᑎᑦ ᖃᐅᔨᓴᖅᑎᑦ ᐱᓕᕆᑎᑦᑎᔾᔪᑕᐅᔪᖅ ᓴᓇᓯᒪᔪᖅ ᓄᐊᑦᑎᓗᑎᒃ ᓂᕐᔪᑎᓂ ᕿᓐᖑᐊᓃᑦᑐᓂᒃ ᐊᒻᒪᓗ ᑕᓯᐅᔭᖅ. ᐱᓕᕆᓚᐅᖅᑐᑦ ᐅᒥᐊᔪᐊᕐᒦᓪᖢᑎᒃ ᖃᐅᔨᓴᖅᑎᑦ ᖃᐅᔨᓴᖅᑎᑦ ᐱᓕᕆᑎᑦᑎᔾᔪᑕᐅᔪᖅ ᓴᓇᓯᒪᓪᓗᓂ ᖃᐅᔨᓇᓱᒃᓗᑕ ᐱᑕᖃᕐᒪᖔᑕ, ᓇᒧᖔᓯᒪᖕᒪᖔᑕ, ᐊᒻᒪᓗ ᖃᓄᐃᓕᖓᓕᕈᓯᕆᖃᑦᑕᖅᑕᖏᑦ ᑑᒑᓕᑦ ᕿᓚᓗᒐᐃᑦ ᐊᒻᒪᓗ ᐊᓯᖏᑦ ᓂᕐᔪᑎᑦ ᐳᐃᔾᔨᑦ ᑕᒪᑐᒧᖓ ᐅᒥᐊᔪᐊᑦ ᐃᖏᕐᕋᔭᒃᑐᓄᑦ ᐊᒻᒪᓗ ᑖᒃᑯᓇᖓᑦ ᖃᓄᐃᓕᐅᖅᑕᐅᔪᑦ ᑕᐃᒃᑯᓂ 2018 ᐅᓯᑲᖅᑕᕐᓇᐅᑎᓪᓗᒋᑦ ᐅᒥᐊᔪᐊᖅᑲᕐᓇᐅᑎᓪᓗᒍ. ᖄᖓᒍᑦ ᐳᐃᔾᔨᑦ ᑕᑯᔭᐅᔪᑦ, ᖃᐅᔨᔭᐅᔪᓪᓗ ᐊᒻᒪᓗ ᑕᓇᐅᑉ ᑎᖕᒥᐊᖏᓐᓂᒃ ᓄᐊᑕᐅᓪᓗᑎᒃ ᐊᑐᖅᓯᓪᓗᑎᒃ ᑲᓇᑕᒥ ᓂᕐᔪᓯᕆᓂᕐᒧᑦ ᐱᔨᑦᑎᖅᑎᑦ ᑕᐃᒪᓗ ᐅᑭᐅᖅᑕᖅᑐᐊ ᑲᓇᑕᐅᑉ ᑕᕆᐅᕐᒥᐅᑕᖏᑦ ᓯᒡᔭᒥᐅᑕᐃᑦ ᑎᖕᒥᐊᑦ ᐱᓪᓗᒋᑦ ᐃᓄᖕᓂ ᑕᕆᐅᕐᒦᑦᑐᖃᖅᑎᓪᓗᒍ ᐊᑐᖅᑕᐅᔭᕆᐊᓕᖅ. ᐅᓇ ᑐᑭᓕᐅᕈᑕᐅᒐᓯᐊᖅᑐᖅ ᐅᒥᐊᔪᐊᕐᒦᓪᖢᑎᒃ ᖃᐅᔨᓴᖅᑎᑦ ᐱᓕᕆᑎᑦᑎᔾᔪᑕᐅᔪᖅ ᓄᐃᑦᑎᓪᓗᑎᒃ ᓄᓇᓕᖕᓂ ᑕᑯᔭᐅᕙᒃᑐᑦ ᑭᓲᖕᒪᖔᑕ ᓇᒧᖔᓯᒪᖕᒪᖔᑕ, ᖃᖓᐅᓚᐅᕐᓂᖓ ᐊᑯᓚᐃᓚᐅᕐᒪᖔᓪᓗ, ᖃᓄᖅ ᐅᓄᖅᑎᒋᔪᑦ, ᐊᒻᒪᓗ ᖃᓄᐃᓕᖓᓚᐅᖅᐸᑦ ᐳᐃᔾᔨᑦ ᐊᑐᓕᖅᑕᖅᑎᑦ ᐱᓪᓗᒋᑦ ᐅᒥᐊᔪᐊᑦ ᐅᓯᒃᑕᖅᑐᑦ. ᑕᒪᓐᓇ ᐱᔭᕇᖅᓯᒪᓐᓂᐊᕐᓗᒍ ᑐᑭᓕᐅᕈᑕᐅᕙᓪᓕᐊᔪᖅ, ᑕᓇᐅᕐᒥ ᖃᐅᔨᓴᖅᑎᑦ ᑎᑎᖅᐸᓪᓕᐊᓚᐅᖅᑐᑦ ᓇᓗᓇᐃᔭᐅᑎᐊᖅᓯᒪᓪᓗᑎᒃ ᓂᕐᔪᑎᑦ ᑕᑯᔭᐅᒃᑲᖅᑕᖅᑐᑦ ᐃᑭᒪᓪᓗᑎᒃ ᐅᒥᐊᔪᐊᖅ *ᐳᑦᓂᑲ.*

ᐱᕆᐊᓚᐅᖅᑎᓐᓇᒍ ᐅᒥᐊᔪᐊᕐᒦᓪᖢᑎᒃ ᖃᐅᔨᓴᖅᑎᑦ ᐱᓕᕆᑎᑦᑎᔾᔪᑕᐅᔪᖅ, ᑕᓇᐅᕐᒥ ᓂᕐᔪᑎᓂᒃ ᑕᑯᓇᖃᑦᑕᖅᑐᓄᑦ ᒥᑦᑎᒪᑕᓂᖕᒥᑦ, ᓄᓇᕗᑦ, ᐱᔭᕆᐅᖅᓴᑎᑕᐅᓚᐅᖅᑐᑦ ᒍᑐ ᓄᓇᒥ ᓯᕗᓪᓗᐊᒃᑎᕆᔭᐅᔪᑦ ᒥᑦᑎᒪᑕᓕᒦᓪᓗᑎᒃ 17-ᒥᑦ 22-ᒧᑦ ᔪᓚᐃ 2018. ᐱᖁᑖ ᐱᔭᕆᐅᖅᓴᑎᑦᑎᕝᕕᐅᔪᖅ ᑲᑎᒪᓪᓗᑎᒃ ᐱᔭᕇᓚᐅᖅᑐᖅ 26-ᒥᑦ 27-ᒧᑦ ᓯᑎᐱᕆ 2018 ᐃᓚᐅᔪᖃᖅᖢᓂ ᐱᖁᑖᓂ ᖃᐅᔨᓴᓕᖅᑎᓪᓗᒋᑦ. ᐱᔭᕇᕐᒪᑕ ᑕᒪᑐᒥᖓ ᑕᓇᐅᕐᒥ ᖃᐅᔨᓴᕐᑎᐅᓂᖅ (ᐅᑭᐅᖅᑕᖅᑐᒥ ᑕᓇᐅᕐᒥ ᐱᕐᕈᓗᐊᕿᑦᑕᐃᓕᑎᑦᑎᓂᖅ ᐱᔭᕆᐅᖅᓴᔭᐅᓪᓗᓂ ᐊᒻᒪᓗ ᐳᐃᔾᔨᑦ ᑭᓲᖕᒪᖔᑕ ᓇᓗᓇᐃᖅᑕᐅᓪᓗᑎᒃ ᐊᒻᒪᓗ ᑕᑯᔭᐅᒃᑲᖅᑕᖅᑐᓄᑦ ᖃᐅᔨᓴᖅᑎᑦ ᐃᓕᓐᓂᐊᖅᑕᐅᓪᓗᑎᒃ), ᑕᓪᓕᒪᑦ (5) ᐃᖅᑲᓇᐃᔭᖅᑎᑦ ᓂᕈᐊᖑᓚᐅᖅᑐᑦ ᐱᓕᕆᖅᑯᓪᓗᒋᑦ ᑕᓇᐅᕐᒥ ᖃᐅᔨᓴᖅᑐᓄ ᐱᓕᕆᑎᑦᑎᔾᔪᑕᐅᔪᖅ ᐃᑭᒪᓗᑎᒃ ᓯᑯᓯᐅᑎᒥ ᐅᒥᐊᔪᐊᖅ *ᐳᑦᓂᑲ* ᐊᕙᑖᓂᑦ 28 ᔪᓚᐃ ᑎᑭᓪᓗᒍ 7 ᐋᒍᓯ 2018 (ᐊᐅᔭᖅ ᖃᐅᔨᓴᖅᑐᑦ) ᐊᒻᒪᓗ 28 ᓯᑎᐱᕆ ᑎᑭᓪᓗᒍ 17 ᐅᒃᑑᐸ 2018 (ᐅᑭᐊᒃᓵᖅ ᖃᐅᔨᓴᖅᑐᑦ).

ᒪᕐᕉᖕᓂᒃ ᖃᐅᔨᓴᓇᓱᒃᐸᓪᓗᑎᒃ ᑕᑯᓇᓱᒃᖢᑎᒃ ᑲᐅᑕᒫᑦ ᐅᒥᐊᔪᐊᒥ ᑖᒃᑯᐊ ᑕᓇᐅᕐᒥ ᖃᐅᔨᓴᖅᑎᑦ: ᑕᓇᐅᕐᒥ ᐳᐃᔾᔨᑦ ᐊᒻᒪᓗ ᑕᓇᐅᑉ ᑎᖕᒥᐊᖏᑦ. ᐳᐃᔾᔨᑦ ᑕᑯᔭᐅᓇᓱᒃᑐᑦ ᐱᔭᕐᖀᐸᐅᖅᑐᑦ ᖃᐅᑕᒫᑦ ᒥᐊᓂᕆᓪᖢᑎᒃ 16 ᐃᑲᕐᖏᓄᑦ ᐊᐅᔭᒃᑯᑦ ᐊᒻᒪ ᖃᓂᒋᔭᖕᓂ 7-12 ᐃᑲᕐᖏᓄᑦ ᐅᑭᐊᒃᓵᒃᑯᑦ ᒪᓕᒃᖢᒍ ᑖᒍᐊᖅᐸᑦ. ᐱᔾᔪᑎᒋᓪᓗᒋᑦ ᑕᓇᐅᑉ ᑎᖕᒥᐊᖏᑦ, ᐊᑕᐅᓯᖅ ᐃᓛᓐᓂᒃᑯᑦ ᒪᕐᕉᖕᓄᑦ ᖃᐅᔨᓴᕐᕕᖃᖅᑎᖕᒥᒃ ᐅᓪᓛᒃᑯᑦ ᐊᒻᒪᓗ ᐊᑕᐅᓯᐊᖅᖢᑎᒃ ᐃᑲᕐᖏᓄᑦ ᐱᖕᖑᓯᓄᑦ ᖃᐅᔨᓴᖅᑐᑦ ᐱᓕᕆᔭᐅᓚᐅᖅᑐᖅ ᐅᓐᓄᒃᓴᒃᑯᑦ. ᑲᑎᓪᓗᒋᑦ ᐃᑲᕐᖏᑦ ᐊᔾᔨᒌᖕᓂᐊᖅᑐᑦ ᒪᓕᒃᖢᒍ ᑕᑯᒃᓴᐅᔭᐅᓇᓐᖏᑦᑕᕐᕿᖑᓚᑦ ᐊᒻᒪᓗ ᐊᓯᖏᑦᑕᐅᖅ ᑕᑯᔭᓇᖅᑎᑦᑎᖕᖏᑉᐸᑕ. ᐊᑯᓂᐅᓛᖅ ᖃᐅᑕᒫᑦ ᑎᖕᒥᐊᓂᒃ ᖃᐅᔨᓴᖅᑐᑦ 5 ᐃᑲᕐᖏᑦ. ᑕᓇᐅᕐᒥ ᐳᐃᔾᔨᑦ ᑕᑯᔭᐅᔪᑦ, ᐊᕙᑎᖓ ᖃᓄᐃᓕᖓᓂᖕᒪᒃ ᐊᒻᒪᓗ ᐅᒥᐊᔪᐊᕐᒥᒃ ᖃᐅᔨᒪᓕᑎᑦᑎᔨᑎᖕᒥ ᑎᑎᖅᑲᐅᓪᓗᑎᒃ ᐱᓕᕆᑎᑦᑎᔾᔪᑕᐅᔪᓄᑦ-ᐱᓯᒪᔪᑦ ᖃᕆᑕᐅᔭᒧᑦ ᑲᑎᑕᐅᓪᓗᑎᒃ. ᑎᑎᖅᑕᐅᕙᓪᓕᐊᔪᑦ ᑕᐃᑯᖓ ᖃᕆᓴᐅᔭᒧᑦ ᖃᐅᑕᒫᑦ ᑲᒪᒋᔭᐅᑦᑎᐊᖅᐳᖅ ᐱᔾᑎᕋᑎᑦᑎᐊᖅᐳᑦ ᐊᒻᒪᓗ ᐊᐅᓚᑕᐅᑦᑎᐊᖅᑐᑦ ᒍᑐ ᓄᓇᒥ ᓯᕗᓕᐅᕆᓴᖕᒋᑦ.

ᑲᑎᓪᓗᒋᑦ 551 ᑕᑯᔭᐅᔪᑦ 2,765 ᐊᑕᐅᓯᐅᑦᑕᖅᑐᑦ ᐳᐃᔾᔨᑦ ᑕᑯᔭᐅᔪᑦ 2018 ᐅᒥᐊᔪᐊᕐᒦᓪᖢᑎᒃ ᖃᐅᔨᓴᖅᑐᑦ ᐱᓕᕆᑎᑦᑎᔾᔪᑕᐅᔪᖅ. ᑲᑎᓪᓗᒋᑦ ᑕᓪᓕᒪᑦ ᐊᔾᔨᒌᖏᑦᑐᑦ ᓂᕐᔪᑎᑦ ᑕᓇᐅᕐᒥ ᐳᐃᔾᔨᑦ ᑕᑯᔭᐅᔪᑦ ᑕᒪᐅᓇ ᐅᒥᐊᔪᐊᕐᒦᓪᖢᑎᒃ ᖃᐅᔨᓴᖅᑐᑦ ᐱᓕᕆᑎᑦᑎᔾᔪᑕᐅᔪᖅ: ᑑᒑᓕᒃ, ᓇᑦᑎᖅ, ᐅᒡᔪᒃ, ᐊᒻᒪᓗ ᓇᓄᖅ. ᑕᐃᒃᑲᓂ ᐊᐅᔭᒃᑯᑦ ᖃᐅᔨᓴᖅᑐᑦ, 269 ᑕᑯᓚᐅᑦᑐᑦ 1,681 ᐊᑕᐅᓯᐅᕗᓪᖢᑎᒃ ᐳᐃᔾᔨᑦ ᑕᑯᔭᐅᔪᑦ. ᑕᐃᒃᑯᐊ ᓇᓗᓇᐃᖅᑕᐅᕙᔪᓚᐅᖅᑐᑦ ᐆᒪᔪᐃᑦ ᓇᑦᑏᑦ (194 ᑕᑯᔭᑦ 754 ᐊᑕᐅᓯᕐᓂᒃ), ᑖᒃᑯᐊᓗ ᖃᐃᕈᓕᒃ (41 ᑕᑯᔭᑦ 292 ᐊᑕᐅᓯᕐᓂᒃ), ᑑᒑᓕᑦ ᕿᓚᓗᒐᐃᑦ (7 ᑕᑯᔭᑦ 19 ᐊᑕᐅᓯᕐᓂᒃ), ᐊᒻᒪᓗ ᐅᒡᔪᐃᑦ (5 ᑕᑯᔭᑦ 5 ᐊᑕᐅᓯᕐᓂᒃ). ᐅᑭᐊᒃᓵᒃᑯᑦ ᖃᐅᔨᓴᖅᑐᑦ, 282 ᑕᑯᔭᐅᔪᑦ ᑖᒃᑯᓇᖓᑦ 1,084 ᐊᑕᐅᓯᐅᑦᑕᖅᑐᑦ ᐳᐃᔾᔨᑦ ᑕᑯᔭᐅᔪᑦ. ᑕᒪᕐᒥᒃ ᓇᓗᓇᐃᖅᓯᓯᒪᓚᐅᖅᑐᑦ ᐆᒪᔪᐃᑦ ᓇᑦᑏᑦ (146 ᑕᑯᔭᑦ 315 ᐊᑕᐅᓯᕐᓂᒃ), ᑖᒃᑯᐊᓗ ᖃᐃᕈᓖᑦ (64 ᑕᑯᔭᑦ 461 ᐊᑕᐅᓯᕐᓂᒃ), ᑑᒑᓕᑦ ᕿᓚᓗᒐᐃᑦ (34 ᑕᑯᔭᑦ 156 ᐊᑕᐅᓯᕐᓂᒃ), ᐊᒻᒪᓗ ᓇᓄᐃᑦ. ᑕᑯᔪᖃᓚᐅᖅᑐᖅ ᑎᓴᒪᐅᓐᓂᖅᖢᑎᒃ ᓇᓄᐃᑦ ᐃᓂᖏᑦ ᑕᓇᐅᑉ ᓯᑯᐊᓂ (ᐊᑕᐅᑦᑎᒃ ᒪᕐᕉᖕᓂᒃ ᑎᑎᖅᑕᐅᓯᒪᔪᓂ ᓇᓄᕐᓂᒃ ᑕᑯᔪᕕᓂᕐᓂᑦ) ᑕᐃᒪᓐᓇᐅᓕᖓᓚᐅᖅᑐᑦ, ᐃᓚᒋᔭᐅᓪᓗᑎᒃ ᐃᓂᖏᑦ ᐃᓐᓇᐃᑦ ᐊᒻᒪᓗ ᐊᑎᖅᑕᖓ.

ᐊᐅᔭᒥ ᑕᓇᐅᑉ ᑎᖕᒥᐊᖏᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᑦ, ᑲᑎᓪᓗᒋᑦ 13 ᑎᖕᒥᐊᑦ ᐊᔾᔨᒌᖏᑦᑐᑦ ᓇᓗᓇᐃᑦᑕᐅᕗᑦ (136 ᑕᑯᔭᐅᓯᒪᔪᑦ ᐊᒻᒪᓗ 14 ᖃᐅᔨᒪᔭᐅᓂᖏᑦᑐᑦ ᑎᖕᒥᐊᑦ). ᐱᑕᖃᐃᓐᓇᓂᖅ ᑎᑎᖅᑕᐅᓯᒪᔪᖅ ᑕᐃᒃᑲᓂ ᐊᐅᔭᖑᓂ ᖃᖁᒡᓗᐃᑦ, ᕿᖓᓖᑦ, ᑎᕋᑎᖅᓵᑦ, ᐊᒻᒪᓗ ᐊᒃᐸᐃᑦ. ᐅᑭᐊᒃᓵᒃᑯᑦ ᑎᖕᒥᐊᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᑦ, ᑲᑎᓪᓗᒋᑦ 5 ᑎᖕᒥᐊᑦ ᓇᓗᓇᐃᖅᑕᐅᔪᑦ (704 ᑕᑯᔭᐅᔪᑦ ᐊᒻᒪᓗ 15 ᖃᐅᔨᒪᔭᐅᓂᖏᑦᑐᑦ ᑎᖕᒥᐊᑦ.) ᑕᒪᕐᒥᒃ ᑎᖕᒥᐊᑦ ᑎᑎᖅᑕᐅᒃᑲᖅᑕᐅᕙᓃᑦ ᐅᑭᐊᒃᓵᒃ ᓇᐅᔭᐃᑦ, ᑎᕋᑎᖅᓵᑦ ᐊᒻᒪᓗ ᖃᖁᒡᓗᖅ.

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1.0 INTRODUCTION

This report presents the results of the marine mammal and seabird Ship-based Observer (SBO) Program conducted in the Regional Study Area (RSA) along the Northern Shipping Route during the 2018 shipping shoulder seasons. The 2018 SBO Program is a component of the environmental effects monitoring plan undertaken in support of Baffinland Iron Mines' (Baffinland) Mary River Project (the Project). Visual survey data collected aboard the MSV *Botnica* were analyzed to assess presence, distribution, and behaviour of narwhal (*Monodon monoceros*) and other marine mammals relative to ship traffic and associated vessel activity. Information on seabirds was also collected to fill an information gap in the Canadian Wildlife Service's (CWS) Eastern Canada Seabirds at Sea (ECSAS) database. This was the first year that ship-based monitoring occurred during the shoulder shipping seasons for the Mary River Project.

1.1 Project Background

The Mary River Project (Project) is an operating open-pit iron ore mine located in the Qikiqtani Region of North Baffin Island, Nunavut (Figure 1). Baffinland is the owner and operator of the Project. The operating Mine Site is connected to a port at Milne Inlet (Milne Port) via the 100-km long Milne Inlet Tote Road. Future, but yet undeveloped, components of the Project include a South Railway connecting the Mine Site to a future port at Steensby Inlet (Steenbsy Port).

Project Certificate No. 005, amended by the Nunavut Impact Review Board (NIRB) on 27 May 2014, authorizes the Company to mine up to 22.2 million tonnes per annum (Mtpa) of iron ore from Deposit No. 1. Of this 22.2 Mtpa, the Company is currently authorized to transport 18 Mtpa of ore by rail to Steensby Port for year-round shipping through the Southern Shipping Route (via Foxe Basin and Hudson Strait), and 4.2 Mtpa of ore by truck to Milne Port for open water shipping through the Northern Shipping Route using chartered ore carrier vessels. A Production Increase to ship 6.0 Mtpa from Milne Port was approved for 2018 and 2019. The Northern Shipping Route encompasses Milne Inlet, Eclipse Sound, Pond Inlet, and adjacent water bodies. Therefore, primary concerns identified along the Project's Northern Shipping Route include potential acoustic disturbance effects from shipping that may lead to changes in narwhal distribution, abundance, migration patterns, and subsequent availability of narwhal for harvesting by local communities. Mother-calf pairs are present along the shipping corridor (e.g., Marcoux et al. 2009) and may be particularly susceptible to potential acoustic disturbance effects given a calf's close association with its mother in the echelon position, thus potentially reducing the pair's travel speed and ability to manoeuvre away from vessel traffic.

In accordance with existing Terms and Conditions of the Project Certificate, Baffinland is responsible for the establishment and implementation of the Marine Environmental Effects Monitoring Program (MEEMP), which comprises environmental effects monitoring studies that are conducted over a sufficient time period to meet the following objectives:

- Measure the relevant effects of the Project on the marine environment.
- Confirm that the Project is being carried out within the terms and conditions relating to the protection of the marine environment.
- Assess the accuracy of the predictions contained in the Final Environmental Impact Statement (FEIS) for the Project.

LEGEND

- PROJECT SITE
- COMMUNITY
- FUTURE SOUTH RAILWAY
- MILNE INLET TOTE ROAD
- NUNAVUT SETTLEMENT AREA
- SHIPPING ROUTE
- SIRMILIK NATIONAL PARK
- WATER

0 125 250

1:5,000,000 KILOMETRES

REFERENCE(S)

BASE MAP: © ESRI DATA AND MAPS (ONLINE) (2016). REDLANDS, CA: ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE. ALL RIGHTS RESERVED.

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

TITLE
PROJECT LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	DC
PREPARED	AA
REVIEWED	DC
APPROVED	PA

PROJECT NO.	CONTROL	REV.	FIGURE
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25mm

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PATH: I:\2016\1663724\Mapping\MXD\Wildlife\20000_2018ShipBasedNWO\1663724_20000_SBO_Fig01_ProjectLocation_Rev0.mxd PRINTED ON: 2019-02-14 AT 11:43:51 AM

Baffinland's MEEMP has integrated two major components: marine mammals (MEEMP – Mammals) and marine ecology (MEEMP – Ecosystem). While the regulatory drivers for both components are similar, reporting requirements for each component are undertaken separately. The SBO Program represents one of several programs that collectively make up the MEEMP for Marine Mammals, in accordance with Project Certificate (PC) terms and conditions issued for the Project.

The 2018 SBO Program specifically addresses the following PC conditions:

- Condition No. 106 - "The Proponent shall ensure that shipboard observers are employed during seasons where shipping occurs and provided with the means to effectively carry out assigned duties. The role of shipboard observers in shipping operations should be taken into consideration during the design of any ore carriers purpose-built for the Project, with climate controlled stations and shipboard lighting incorporated to permit visual sightings by shipboard observers during all seasons and conditions."
- Condition No. 123 - "The Proponent shall provide sufficient marine mammal observer coverage on project vessels to ensure that collisions with marine mammals and seabird colonies are observed and reported through the life of the Project. The marine wildlife observer protocol shall include, but not be limited to, protocols for marine mammals, seabirds, and environmental conditions and immediate reporting of significant observations to the ship masters of other vessels along the shipping route, as part of the adaptive management program to address any items that require immediate action".
- Condition No. 126 - "The Proponent shall design monitoring programs to ensure that local users of the marine area in communities along the shipping route have opportunity to be engaged throughout the life of the Project in assisting with monitoring and evaluating potential project-induced impacts and changes in marine mammal distributions."

Baffinland first initiated its SBO Program in 2013 (SEM 2014), concurrent with initial ship transport of fuel and supplies to Milne Port using vessels transiting between Quebec City, QC, and Milne Inlet, NU. In 2014 and 2015, an SBO Program was conducted during the Project construction phase. Ship-based observers conducted marine wildlife monitoring on-board fuel tanker and sealift vessels transiting along the Northern Shipping Route, embarking at Pond Inlet and disembarking at Milne Port. Results for these programs are presented in SEM (2015 and 2016). Survey effort in 2014 and 2015 was limited to three one-way ship transits per season, with nine hours of survey effort completed in each year. Low numbers of marine mammals and seabirds were observed along the shipping route during the 2014 and 2015 programs (SEM 2015, 2016). Potential explanations included: 1) the time of year (mid-August to late September) which might not have provided adequate sighting opportunities; 2) the short length of the transit; 3) the limited number of daylight hours (two to four hours) available for observations and, 4) the observer position on the bridge did not allow sufficient viewing opportunities. In 2016, Baffinland suspended the SBO Program due to safety concerns of the observers boarding the vessel at-sea, and the program was not reinstated until 2018.

With the proposed introduction of the *Botnica* in 2018 to support Baffinland's shipping operations during the shipping shoulder seasons (July and October), there was an opportunity to revise and re-establish the SBO Program for implementation during the 2018 shipping season. This report provides details of the design and implementation of the 2018 SBO Program in accordance with existing terms and objectives of Project Certificate No. 005.

1.2 Study Objective

The objective of the SBO Program was to collect observational data to describe the distribution, occurrence, relative abundance, and the response behaviours of marine wildlife to shipping activity. To achieve this objective, Marine Wildlife Observers (MWOs) recorded details of wildlife sightings aboard the MSV *Botnica*. The data will contribute information for the purpose of meeting the environmental effects monitoring objectives of the Project.

1.3 MWO Training and Crew

Prior to the start of the SBO Program, MWO candidates from Pond Inlet, NU, were trained by Golder in Pond Inlet from 17 to 22 July 2018 (Appendix A). A second training session was completed from 26 to 27 September 2018 for participants in the second survey period.

The MWO training involved:

- Marine Vessel Safety Training component (Life at Sea, Emergency Response, Signalling and Marine Survival; Golder 2018a)
- Marine Wildlife Identification and Observation course which included detailed instructions and hands-on training using handheld notebook computers, Global Positioning System (GPS) units, binoculars and marine wildlife monitoring protocols (Golder 2018b)
- Seabird identification and ECSAS sampling and data entry protocols (Gjerdrum et al. 2012) as provided by the CWS

Upon completion of the MWO training, two resident candidates were selected to carry out the SBO Program on board the MSV *Botnica* between 28 July and 7 August 2018:

- Ryan Arnakallk (Pond Inlet, NU)
- Michael Inuarak (Pond Inlet, NU)

Three candidates were selected to carry out the SBO Program on board the MSV *Botnica* between 28 September and 17 October 2018:

- Ryan Arnakallk (Pond Inlet, NU)
- Adrian Ootoova (Pond Inlet, NU)
- Johnny Takawgak (Pond Inlet, NU)

The observers alternated monitoring every two hours (total of 8 hours maximum of monitoring per observer) across a daily monitoring period covering 7–12 hours. The MWOs were responsible for wildlife observations, data recording, picture taking, and note taking. The MWOs also completed Transport Canada's Mariner medical screening process prior to joining the vessel.

It should be noted that the candidates each had extensive TK (traditional knowledge) especially regarding the identification, sighting, and assessment of behaviour of marine mammals, birds, and other marine entities. The MWIO course served well for them to apply those skills in surveys and other studies requiring formal organization and recording of observations.

A different Golder marine biologist served in the following capacities in each the summer and fall surveys: 1) supervisor and lead of the MMO team; 2) oversee quality control; 3) and to participate in data collection as needed.

2.0 MARINE MAMMALS

The SBO Program took place in the waters from Eclipse Sound and Milne Inlet, NU, within the Marine Mammal RSA along the Northern Shipping Route (Figure 2). The SBO program was completed over two rounds of surveys; from 28 July to 7 August and from 28 September to 17 October 2018. Observations of marine mammals were recorded from inside the bridge of the MSV *Botnica*, which is 97 m in length. The bridge of the MSV *Botnica,* which sits ~20 m above sea level, offered good visibility from 90 degrees to port and 90 degrees to starboard. Seabird observations were also collected using the Eastern Canada Seabirds at Sea (ECSAS) protocol (Gjerdrum et al. 2012). Methods related to marine mammal and seabird data collection are described below.

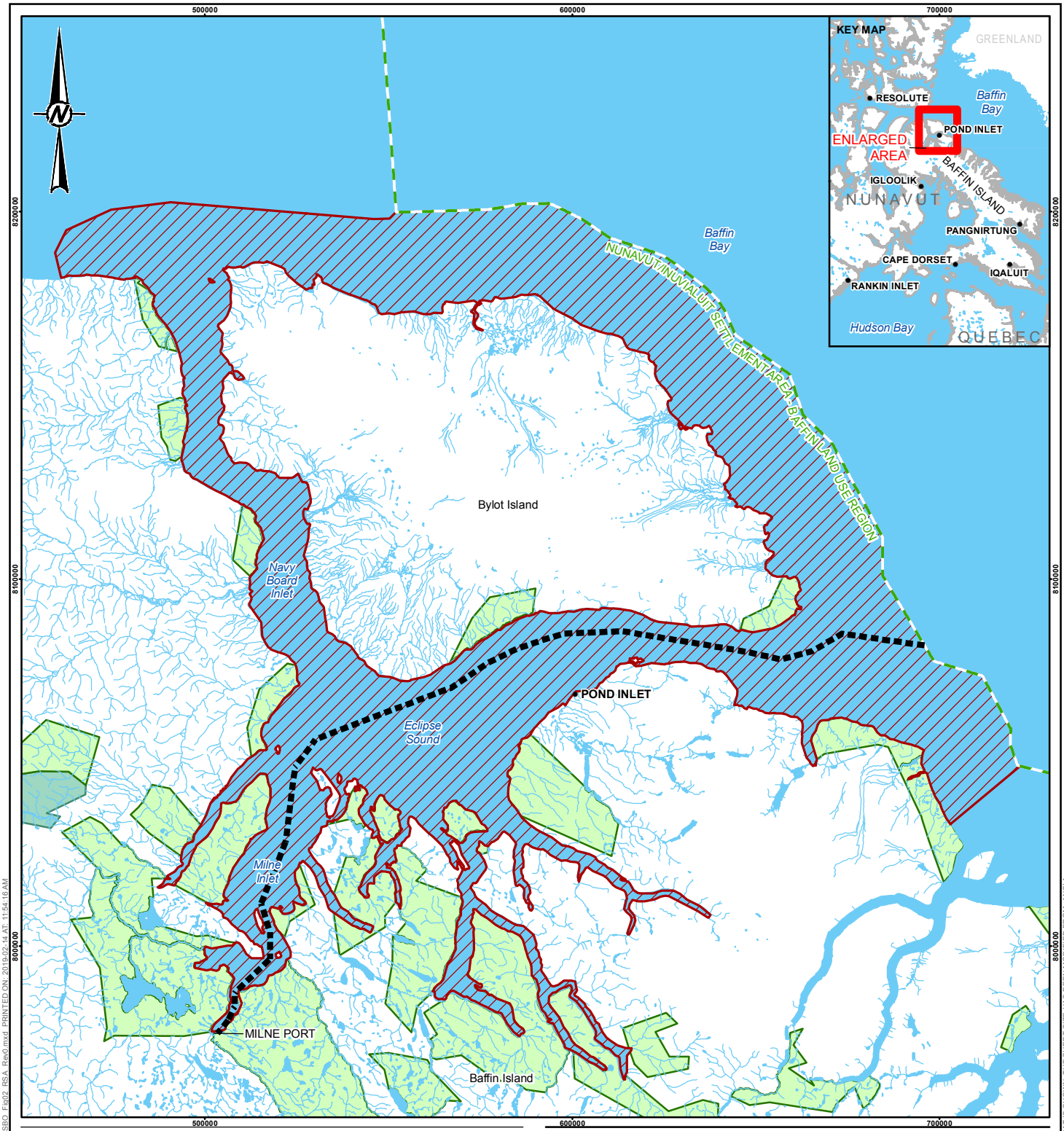
2.1 Methods

Each MWO completed up to four two-hour watches daily covering up to a total of 16 hours of active marine mammal observing (from 06:00 to 22:00 EST) during the summer. Fall surveys also included up to four two-hour watches but were often reduced due to limited daylight and sightability with maximum survey time of 12 hours/day. A Golder biologist crew lead alternated between teams to mentor the MWOs during active watch periods, help with data recording and to review data quality. At the beginning of each observation period, a GPS track file was initiated to record the path and speed of the survey and to record the location of observations by matching observation times with track times.

While the vessel was in transit, the MWOs surveyed from the bow of the ship at 0° to 90° on both sides of the bow of the moving vessel (vessel speeds were on average 8.3 knots; Figures 3 and 4). When the vessel was stationary, the MWOs attempted to survey for marine mammals around the entire vessel (Figure 4), although the design of the vessel made this somewhat impractical. Regardless, the vessel was rarely stationary and no stationary surveys were completed at all during the fall survey period.

Two types of scanning techniques were used to detect marine mammals: S-scans consisting of scanning the water parallel to the horizon (in an s-shaped pattern) and U-scans consisting of scanning the water perpendicular to the horizon (shaped like the letter u) (Figure 5). Both U- and S-scans were used to search for marine mammal detection cues including among others the animal's body, blows, splashes, footprints, and nearby birds. When detection cues were observed, MWOs attempted to identify the species with the aid of 10x40 binoculars, 7x50 reticle binoculars or 25x to 40x Big-Eye binoculars. Marine mammals known to occur or that have distributions overlapping the RSA include:

- Narwhal *(Monodon monoceros)*
- beluga whale (*Delphinapterus leucas*)
- killer whale (*Orcinus orca*)
- bowhead whale (*Balaena mysticetus*)
- ringed seal (*Pusa hispida*)
- harp seal (*Pagophilus groenlandicus*)
- bearded seal (*Erignathus barbatus*)
- walrus (*Odobenus rosmarus*)
- polar bear (*Ursus maritimus*)



LEGEND

- COMMUNITY
- SHIPPING ROUTE (APPROXIMATE)
- WATERCOURSE
- NUNAVUT SETTLEMENT AREA BOUNDARY
- MARINE MAMMAL REGIONAL STUDY AREA
- NUNAVUT LAND CLAIMS AGREEMENT – ARCTIC BAY INUIT OWNED LAND
- NUNAVUT LAND CLAIMS AGREEMENT – POND INLET INUIT OWNED LAND
- WATERBODY

0 25 50

1:1,500,000 KILOMETRES

REFERENCE(S)

ABORIGINAL LANDS, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. NUNAVUT SETTLEMENT AREA DATA OBTAINED FROM NUNAVUT TUNNGAVIK INC., OCTOBER 9, 2012.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – 2018 SHIP-BASED OBSERVER PROGRAM

TITLE
MARINE MAMMAL REGIONAL STUDY AREA

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	DC
PREPARED	AA
REVIEWED	DC
APPROVED	PA

PROJECT NO.	CONTROL	REV.	FIGURE
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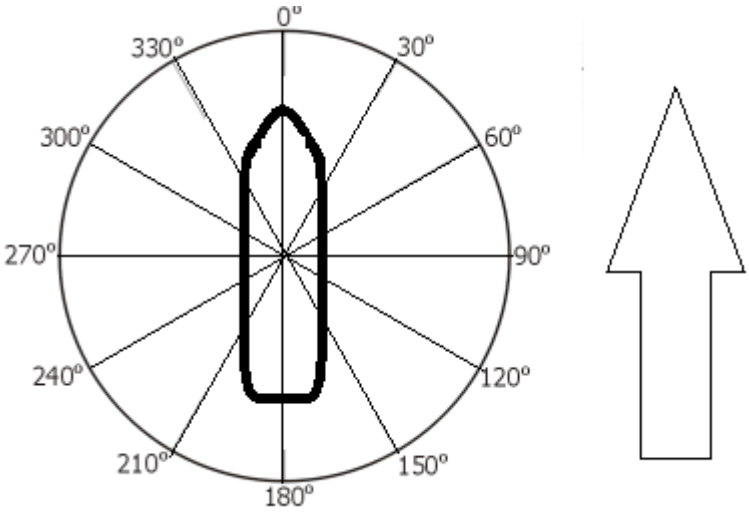


Figure 3: Bearing of Observations Relative to Vessel

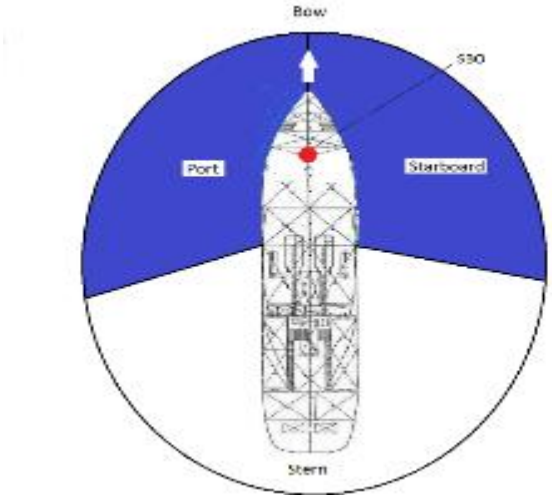


Figure 4: Approximate Field of Observation for Marine Wildlife Observers.

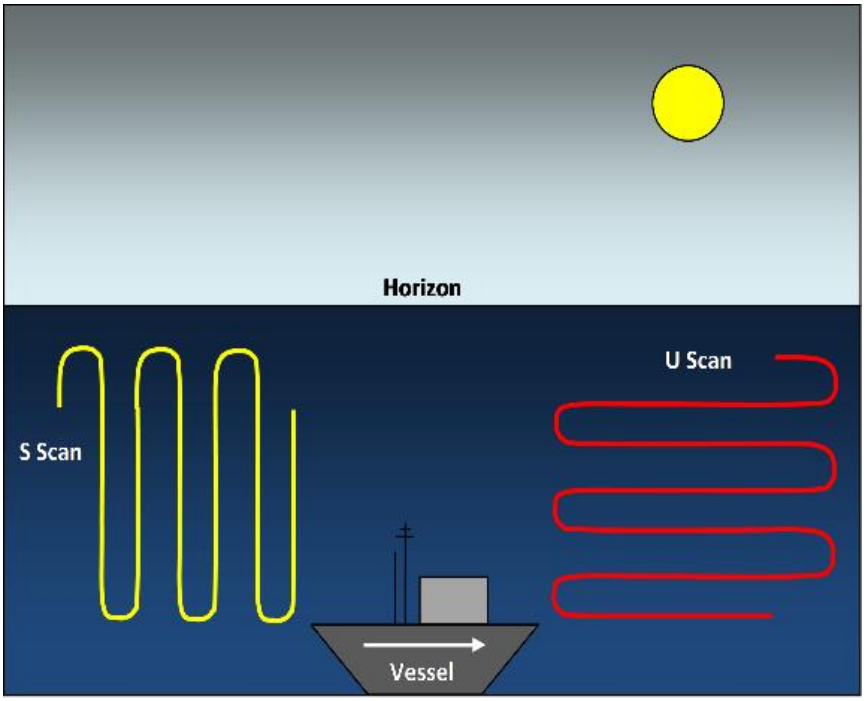


Figure 5: S and U Scanning Techniques used during Marine Mammal Observations

When species identification was uncertain, animals were recorded as unidentified to the most recognizable level (e.g., unidentified seal or whale). Observations were entered into a computer database. In addition to detection cues and species (including confidence level), MWOs recorded the number of animals observed and their behaviour (breaching, flipper slapping, lobtailing, diving, fluking, blowing, resting, looking, feeding, hauled-out, milling, swimming, surfacing), swim speed (fast or slow), observation distance from vessel, minimum distance from vessel (i.e., closest distance to the ship referred to in this report as the ‘closest point of approach’ or CPA as vessel was underway), bearing from vessel, and movement direction. Other vessels (hunting, fishing, research) observed during the survey were also recorded. The distances to the animals were often estimated with the naked eye because the horizon was rarely visible during the survey due of the high elevation of the terrain surrounding the Northern Shipping Route. When it was visible, reticle binoculars were used to record estimated observation distances.

2.1.1 Data Analyses

This section provides a detailed description of the methods used for analyses on environmental conditions, observer effort and marine wildlife sightings.

Temporal and Spatial Observation Effort

Temporal (hours) and spatial (km) marine mammal observation effort were defined as the effort dedicated to marine mammal observations. MWO spatial effort was calculated as linear kilometres using GPS coordinates recorded at the start and end of each MWO shift. The same start and end times were used to determine temporal effort (i.e., the time spent during these observations).

Environmental Variables

Environmental variables are important to record because they can alter the observer's ability to detect and identify marine mammals as well as to influence an animal's movement and/or distribution. Environmental variables were recorded at the beginning of each watch and anytime they changed during a watch. These included ice cover (percent as estimated by MWOs), wind speed and direction, sea state (Beaufort scale), weather (e.g., precipitation and cloud conditions), visibility, sun glare and sightability (combination of weather, glare, and sea state, etc.). Relative representation of environmental conditions (e.g., ice cover, weather conditions, sea state, wind force, visibility and sightability) encountered during the entire SBO Program and entered into a specially designed electronic database were calculated as percentages of the observation effort.

Detection Rates

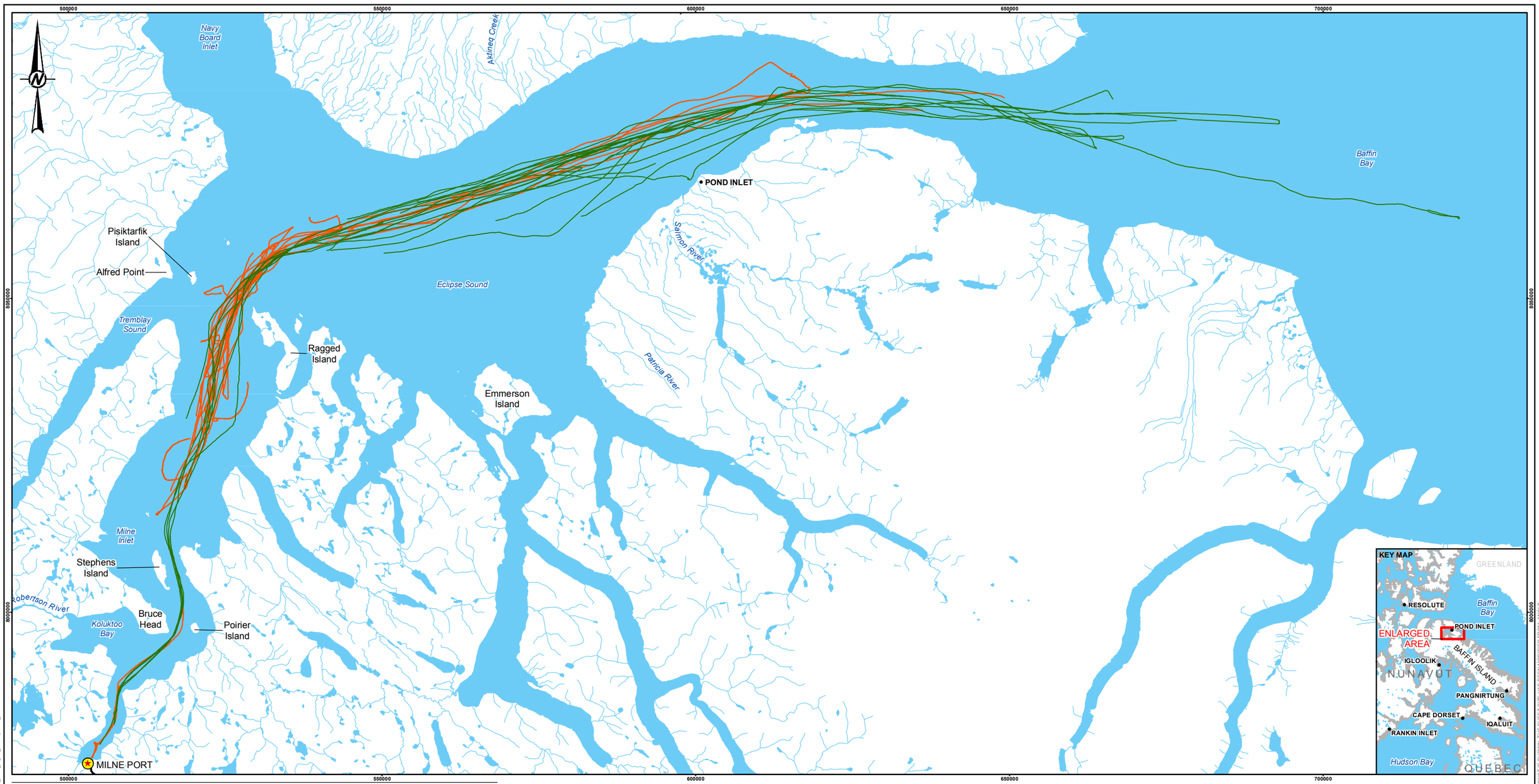
To be able to compare the results of the 2018 SBO Program with other studies in the area (or elsewhere), detection rates were calculated and expressed as sightings per unit effort (SPUE; number of sightings / spatial observation effort). Sightings were therefore expressed relative to the spatial observation effort consistent with other studies and methods (Nichols et al. 2005).

2.2 Results

Unlike SBO programs completed from 2013 to 2015, marine mammal monitoring occurred during the shipping shoulder seasons and aboard a single vessel for the entire survey period. In 2018, observations took place aboard the MSV *Botnica* from July 28 and continued daily until 7 August (Summer Surveys). A second survey period during fall occurred from 28 September to 17 October (Fall Surveys).

2.2.1 Survey Effort

Over the summer and fall surveys, a total of 287.4 hours (temporal effort) and 3,154 km (geographic effort) of marine mammal observations were conducted through multiple transits along the Northern Shipping Route (Figure 6). Summer surveys had a total of 143.1 hours and 1104.9 km of marine mammal observations, whereas fall surveys had a total of 144.3 hours and 2049.1 km of marine mammal observations. Fall surveys lasted for a longer period (six days longer than the summer survey), although both surveys had similar temporal effort due to the reduced hours of daylight during fall surveys. Fall surveys included almost twice the geographic effort compared to summer surveys even though temporal effort was similar. This is attributable to the difference in the support required from the *Botnica* during both shoulder seasons resulting in the vessel speeds being slower and the stand-by time being more frequent during the summer surveys resulting in a reduced geographic effort.



LEGEND

- COMMUNITY
- MILNE PORT
- MILNE INLET TOTE ROAD
- WATERCOURSE
- SURVEY TRACK (JULY 28 - AUGUST 7, 2018)
- SURVEY TRACK (SEPTEMBER 29 - OCTOBER 17, 2018)
- WATERBODY

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT MAY 28, 2018 AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	DC
PREPARED	AA
REVIEWED	DC
APPROVED	PA

TITLE
DISTRIBUTION OF SURVEY EFFORT, 2018

PROJECT NO.	CONTROL	REV.	FIGURE
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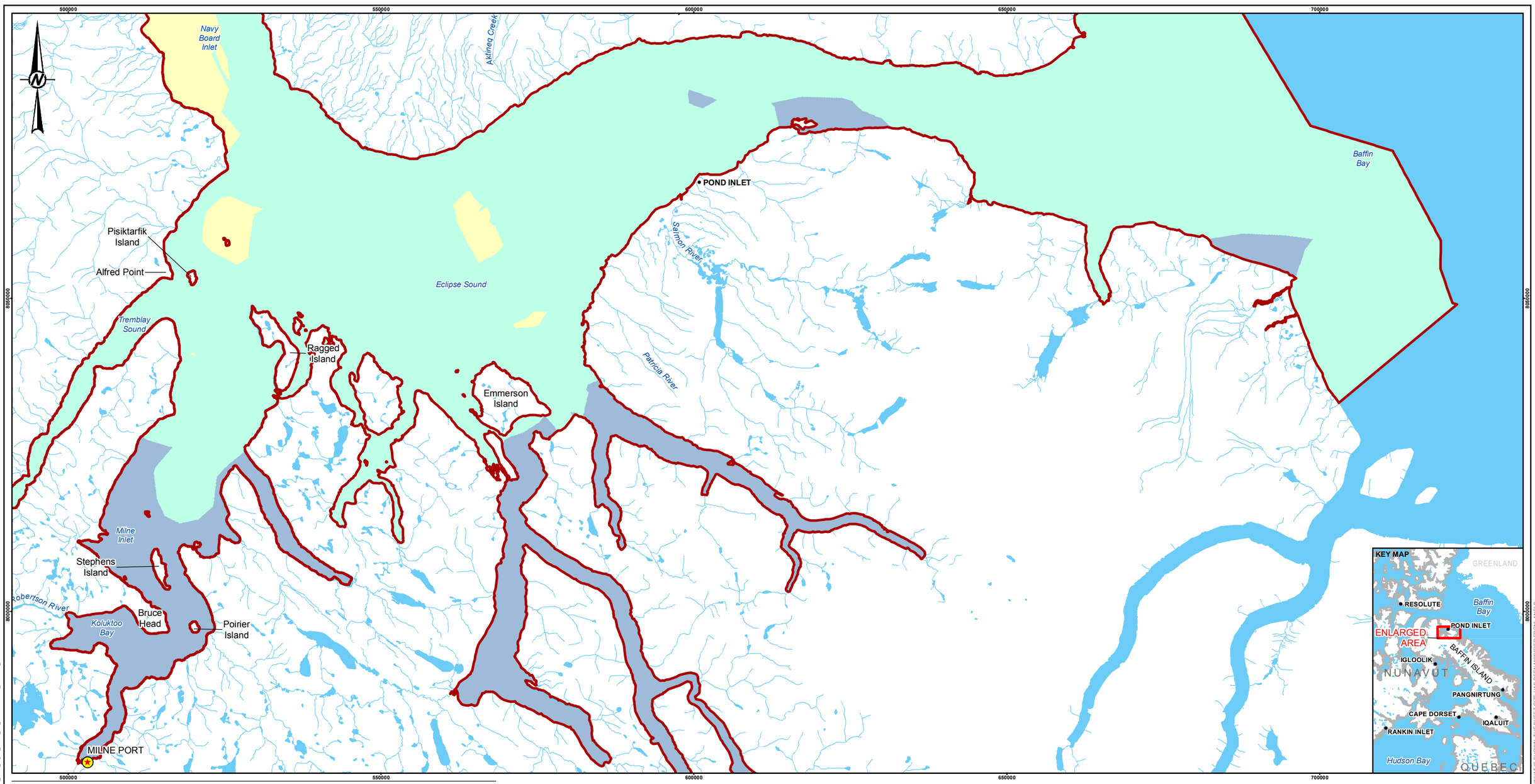
2.2.2 Environmental Variables and Sighting Conditions

Ice Concentrations

In addition to recording percent and type of ice cover by MWOs during the survey, daily ice concentration charts were downloaded from the Canadian Ice Service (CIS) archive. Daily CIS Ice charts for each survey period were layered through time in Geographic Information System (ArcGIS, Redlands CA) and clipped to the RSA. A raster analysis at a 100 m x 100 m scale was completed to exhibit typical (average) ice cover (percent) encountered during each survey period (Figures 7 and 8). The fall survey period had more extensive ice coverage than the summer survey period.



LEGEND

- COMMUNITY
- MILNE PORT
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

MEAN PERCENT ICE CONCENTRATION

- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY, ACCESSED NOVEMBER 23, 2018. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	DC
PREPARED	LB/AA
REVIEWED	DC
APPROVED	PA

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

TITLE
MEAN OF PERCENT ICE CONCENTRATION FOR THE NORTHERN SHIPPING ROUTE - SUMMER (JULY 29 TO AUGUST 7)

PROJECT NO.	CONTROL	REV.	FIGURE
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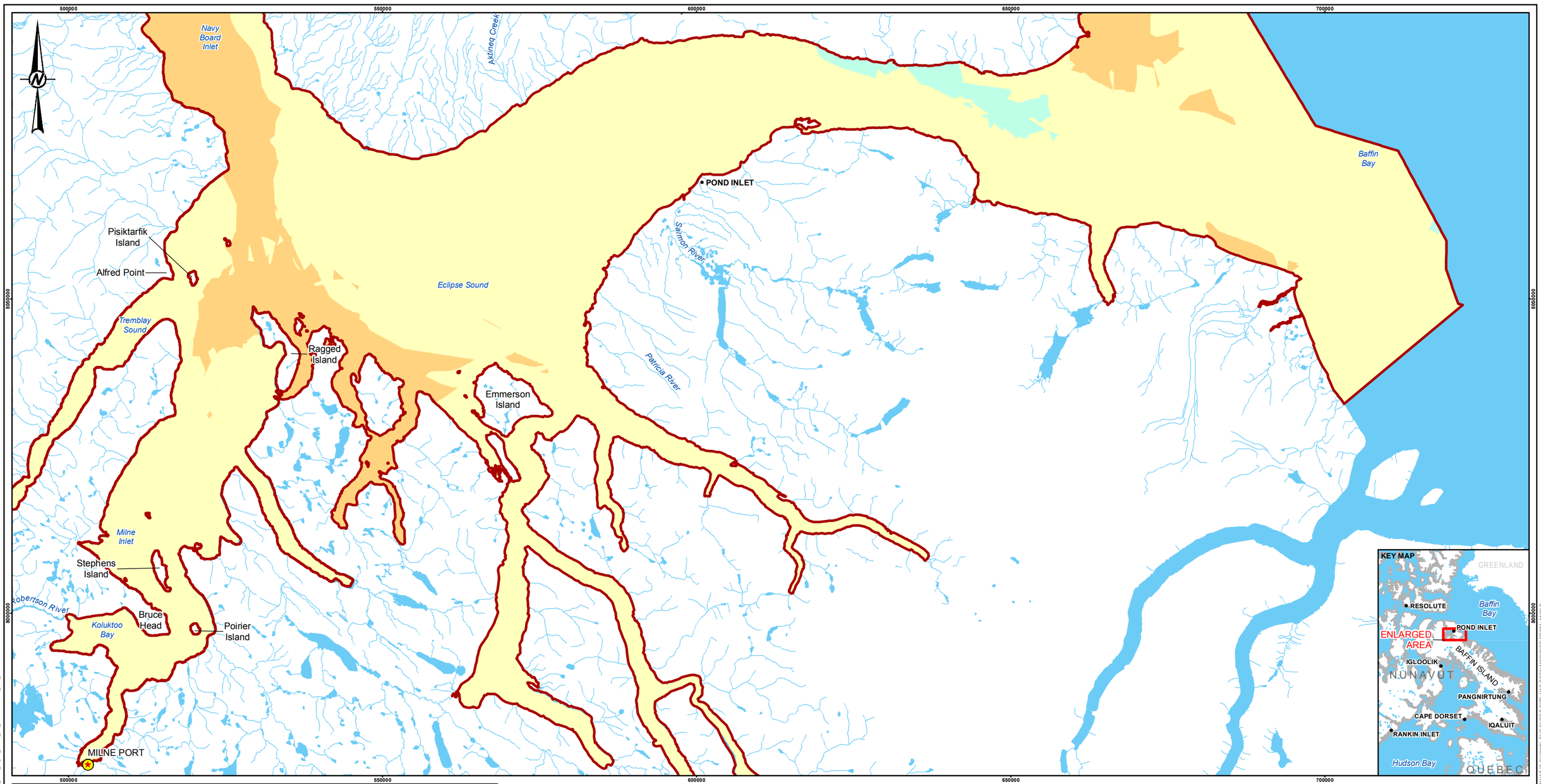

LEGEND

- COMMUNITY
- MILNE PORT
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

MEAN PERCENT ICE CONCENTRATION

- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018.
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PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	DC
PREPARED	LB/AA
REVIEWED	DC
APPROVED	PA

TITLE
MEAN OF PERCENT ICE CONCENTRATION FOR THE NORTHERN SHIPPING ROUTE - FALL (SEPTEMBER 28 TO OCTOBER 17)

PROJECT NO.	CONTROL	REV.	FIGURE
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2.2.2.1 Sighting Conditions

MWOs recorded sighting conditions at the beginning and end of a watch and anytime the environmental variables changed. Sighting conditions were evaluated based on percent of geographic effort (survey effort) where each condition was observed.

Ice Cover

Ice cover during the 2018 SBO Program ranged from Ice Free to 100% ice cover (Figure 9). Ice cover ranging from 81–100% accounted for 32% of the total survey effort followed by 1–10% ice cover with 19% of survey effort. Ice cover ranging from 31–60%, 11–30% and Ice Free accounted for 15%, 14%, and 12% of survey effort, respectively. Periods of 61–80% ice cover accounted for only 7% of survey effort.

During summer surveys most of the survey effort (86%) occurred in ice cover between 0–60%, compared to fall surveys where 47% of survey effort occurred in ice cover between 0–60%.

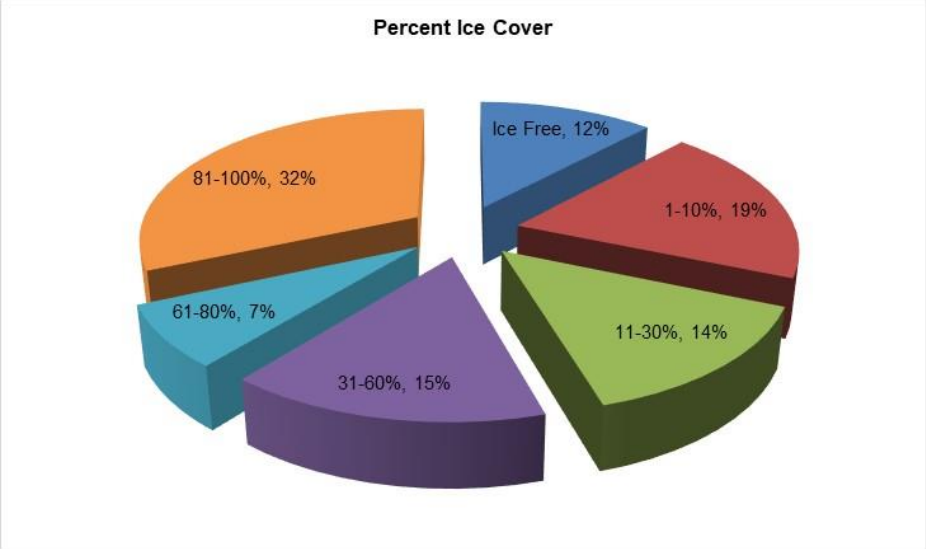


Figure 9: Ice Cover during the 2018 SBO Program

Weather

Predominant weather conditions during the 2018 SBO Program were recorded as Partially Cloudy (during 60% of survey effort) followed by Overcast (19%) and Snow (8%; Figure 10). The remaining weather conditions recorded were Rain (5%), Fog (3%), Clear Skies (3%), and Snow/Fog (2%).

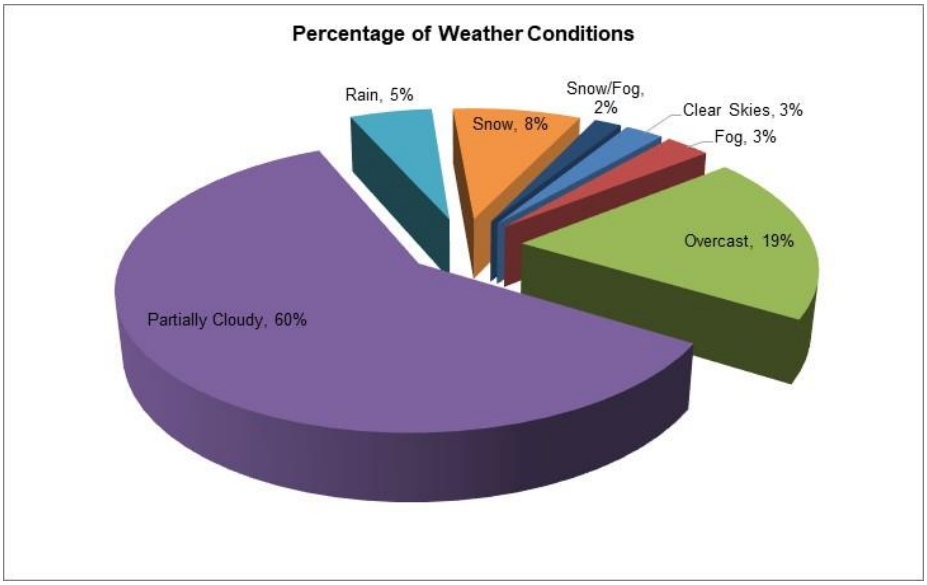


Figure 10: Weather Conditions during the 2018 SBO Program

Sea State

On a scale of 0 to 11, sea state ranged from 0 (0 m waves, Glassy) to 4 (1.2–2.4 m waves, Moderate Waves, Some Spray) throughout the 2018 SBO Program (Figure 11). The majority of sea state conditions were recorded as 0 (0 m waves, Glassy; for 32% of survey effort), followed by 0.5 (<0.1 m, Ripples; 30%) and 1 (0–0.1 m waves, Small Wavelets; 18%). The sea state 2 (0.1–0.5 m waves, Smooth Wavelets) accounted for 10% followed by 3 (0.5–1.2 m waves, Slight; Small White Caps) at 9% and 4 (1.2–2.4 m waves, Moderate Waves, Some Spray) at 1%.

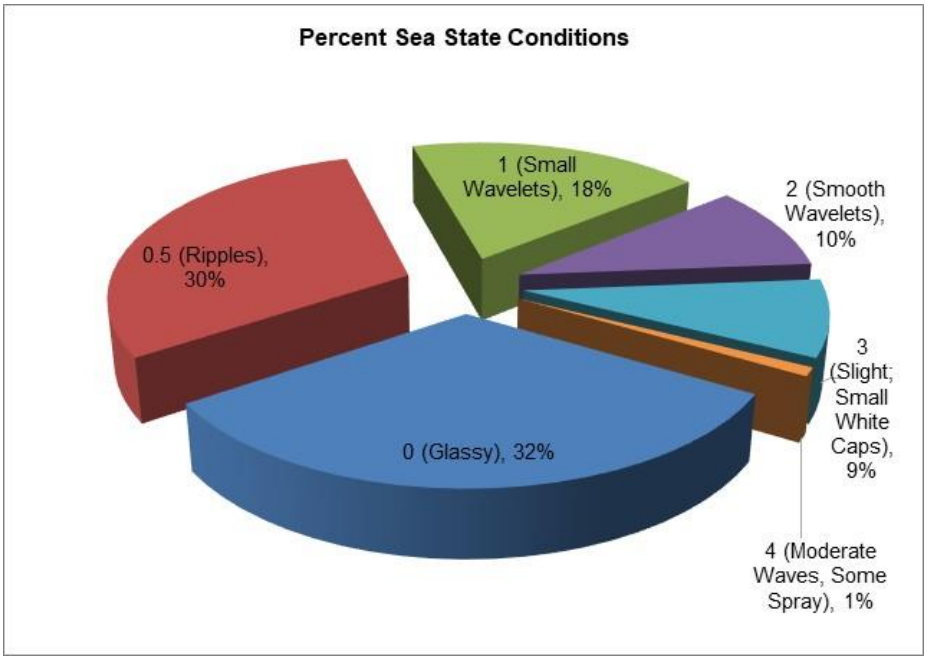


Figure 11: Sea State during the 2018 SBO Program

Wind Force

On a scale of 0 to 12, wind force ranged from 0 (<1 knot, Calm) to 7 (28+ knots, Near Gale) throughout the 2018 SBO Program (Figure 12). The majority of wind force conditions were recorded as 2 (4–6 knots, Light Breeze; for 30% of survey effort), followed by 3 (7–10 knots, Gentle Breeze; 23%) and 4 (11–16 knots, Moderate Breeze; 17%). The wind force 1 (1–3 knots, Light Air) accounted for 11% followed by 5 (17–21 knots, Fresh Breeze) at 9% and 6 (22–27 knots, Strong Breeze) at 7%.

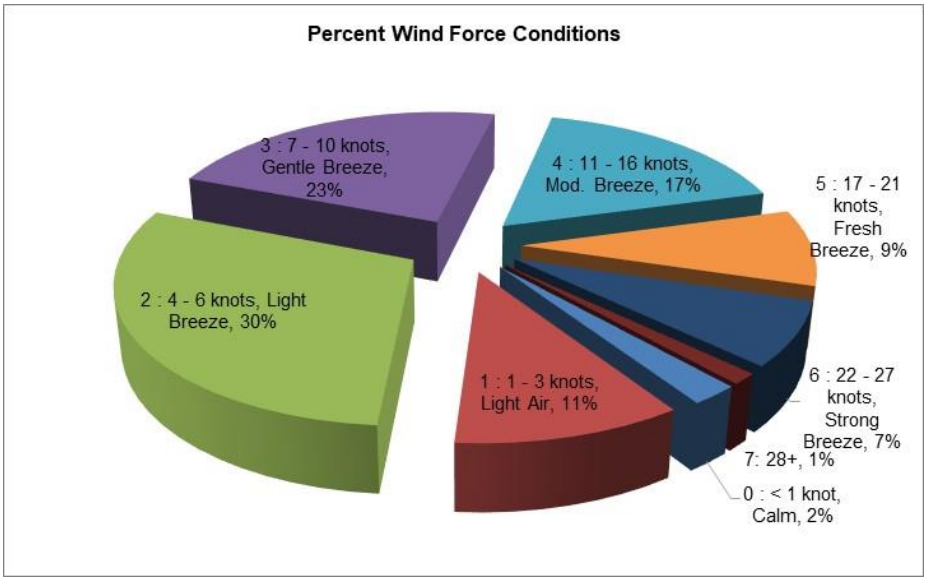


Figure 12: Beaufort Wind Force during the 2018 SBO Program

Visibility

Visibility during the 2018 SBO Program ranged from Low/Poor with 500–1000 m of visibility to Excellent with more than 10,000 m of visibility (Figure 13). Excellent conditions (>10,000 m of visibility) accounted for 38% of survey effort followed by High/Good conditions (2501–5000 m) with 25%. Very High/Very Good (5001–10,000 m) and Moderate (1001–2500 m) accounted for 16% and 13%, respectively. Periods of Low/Poor conditions (500-1000 m) accounted for only 8% of survey effort.

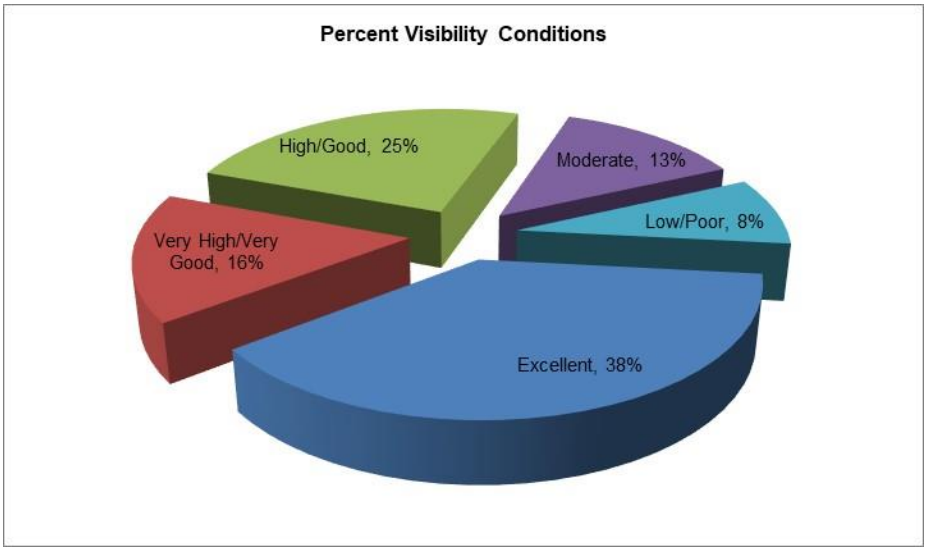


Figure 13: Visibility during the 2018 SBO Program

Sightability

Sightability is a qualitative measurement used by MWOs to estimate and describe the perceived ability to detect wildlife. Sightability included weather, sea state and visibility and was ranked as: Very High, High, Medium, Poor, Nil.

Sightability during the 2018 SBO Program ranged from Poor to Very High. Very High and High conditions were recorded the majority of the time accounting for 81% of survey effort (34% and 47%, respectively). During the remainder of the SBO Program Medium (11%), Poor (5%), and Low (2%) sightability conditions were recorded (Figure 14).

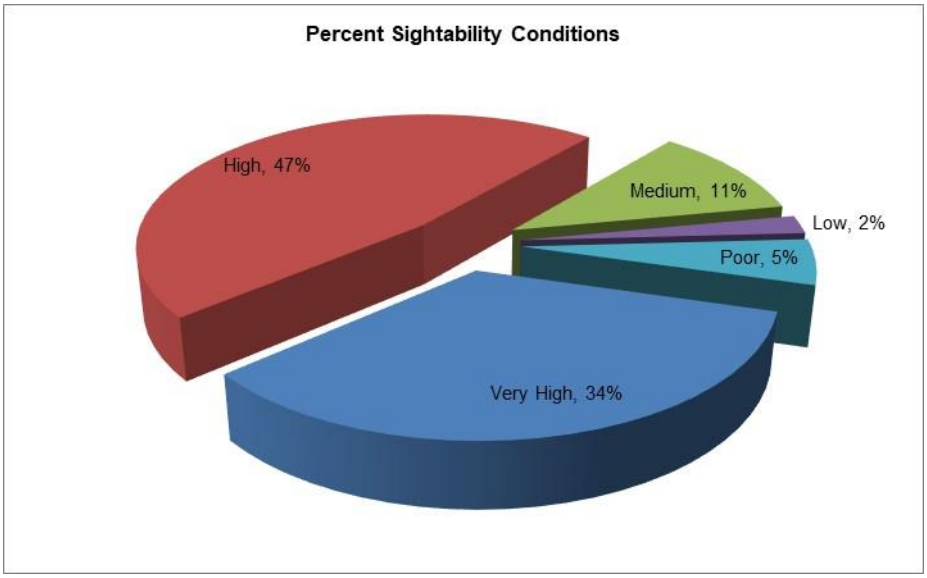


Figure 14: Sightability during the 2018 SBO Program

2.2.3 Marine Mammal Observations

Five different species of marine mammals were observed during the SBO Program; narwhal, ringed seal, harp seal, bearded seal, and polar bear. Unidentified whales and seals were also recorded during MWO watches. Table 1 summarizes the number of marine mammal sightings and individuals recorded for each species by survey period. A total of 552 sightings of 2,766 individual marine mammals were recorded during MWO watches.

During summer surveys, 269 sightings of 1,681 individual marine mammals were observed (Table 1). The most commonly identified species were ringed seal (194 sightings of 754 individuals), followed by harp seal (41 sightings of 292 individuals), narwhal (seven sightings of 19 individuals), and bearded seal (5 sightings of 5 individuals).

Similar numbers were observed during fall surveys, where 283 sightings of 1,085 individual marine mammals were observed (Table 1). The most commonly identified species were ringed seal (146 sightings of 315 individuals), followed by harp seal (64 sightings of 462 individuals), narwhal (34 sightings of 156 individuals), and two individual polar bears.

Table 1: Marine Mammal Observations during the Ship-based Observer Program, 2018

	Summer Surveys				Fall Surveys			
	In Water		On Ice		In Water		On Ice	
Species	Number of Sightings	Number of Animals	Number of Sightings	Number of Animals	Number of Sightings	Number of Animals	Number of Sightings	Number of Animals
Narwhal	7	19	0	0	34	156	0	0
Unidentified Whale	1	1	0	0	0	0	0	0
Ringed Seal	172	193	22	561	105	157	41	158
Harp Seal	40	291	1	1	59	456	5	6
Bearded Seal	2	2	3	3	0	0	0	0
Unidentified Seal	11	11	10	599	24	64	13	86
Polar Bear	0	0	0	0	0	0	2	2
Total	**233**	**517**	**36**	**1,164**	**222**	**833**	**60**	**252**

2.2.3.1 Location and Description of Marine Mammal Sightings

Narwhal

Narwhals were observed primarily in Eclipse Sound during both summer and fall surveys (Figures 15 and 16). Two narwhal sightings were observed in northern Milne Inlet during summer surveys. A total of 41 sightings of 175 individual narwhals were recorded during MWO watches (Table 1). Narwhal group sizes ranged from single animals to a group size of 16, with an average group size of 4.3.

Unidentified Whale

One unidentified whale was observed in Eclipse Sound, east of Pond Inlet, during summer surveys (Figure 15). It was observed as a single animal.

Ringed Seal

Ringed seals were observed throughout the survey area during both summer and fall surveys (Figures 17 and 18). A total of 340 sightings of 1069 individual ringed seals were recorded during MWO watches (Table 1). Ringed seals observed in the water were primarily observed as singles (251 out of 277 sightings). Group sizes ranged from single animals to a group size of 40, with an average group size of 1.3 for ringed seals observed in the water. Ringed seals on the ice were observed with group sizes that ranged from single animals to 160, with a median group size of 1.

Harp Seal

Harp seals were observed in Eclipse Sound and northern Milne Inlet during summer surveys and primarily in Eclipse Sound during fall surveys (Figures 17 and 18). A total of 105 sightings of 754 individual harp seals were recorded during MWO watches (Table 1). Almost half of all harp seals observed in the water were observed as singles (46 out of 99 sightings). Group sizes ranged from one to 100 individuals, with the average group size of 7.5 (for animals observed in water). Harp seals on the ice were observed in group sizes ranging from one to two individuals (average group size of 1.2 individuals).

Bearded Seal

Bearded seals were only observed during summer surveys in Eclipse Sound. A total of five sightings of five individual bearded seals were recorded during MWO watches (Table 1). All sightings were observed as singles, two in the water and three on the ice.

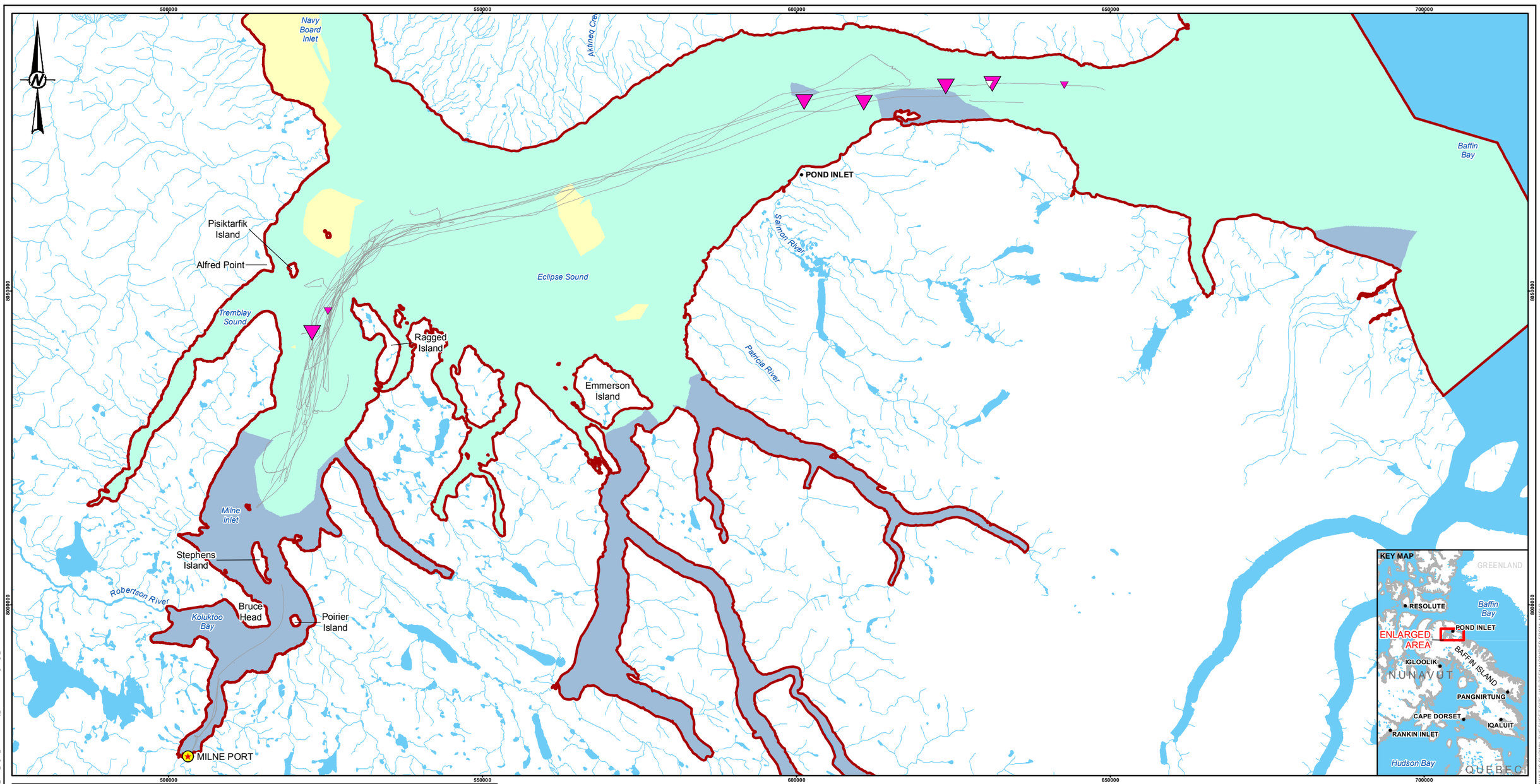
Unidentified Seal

Unidentified seals were observed in Eclipse Sound during summer surveys and in Eclipse Sound and northern Milne Inlet during fall surveys (Figures 17 and 18). A total of 58 sightings of 760 unidentified seals were recorded during MWO watches (Table 1). Unidentified seals in the water were primarily observed as singles (33 out of 35 sightings). Group sizes ranged from single animals to a group size of 40, with an average group size of 2.1 for seals observed in the water. Unidentified seals on the ice were observed with group sizes that ranged from single animals to a group size of 237, with an average group size of 29.8.

Polar Bear

Two polar bear sightings were made during fall surveys. One sighting was in Eclipse Sound, northwest of Pond Inlet (Figure 18). The polar bear was first observed on the ice and appeared to be feeding and responded to the vessel by diving into the water. The observer lost sight of the animal shortly after first observing it. It was observed again, 15 minutes later, moving repeatedly from the water back up on the ice.. The second polar bear sighting was NNE of Ragged Island in Eclipse Sound and remained on the ice as the ship passed.

It should be noted that sightings made during the CWS bird survey (taken during the same time period as the marine mammal surveys) included four sets of polar bear tracks not associated with the two recorded two polar bear sightings. One of these track sightings represented two polar bears, one adult and one cub.



LEGEND

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

NARWHAL

- 1
- 2 - 10

UNIDENTIFIED WHALE

- 1

- COMMUNITY
- MILNE PORT
- SURVEY TRACK (JULY 28 - AUGUST 7, 2018)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

SUMMER MEAN PERCENT ICE CONCENTRATION (JULY 29 TO AUGUST 7, 2018)

- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY, ACCESSED NOVEMBER 23, 2018.
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PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	TT
PREPARED	AA
REVIEWED	DC
APPROVED	PA

TITLE
DISTRIBUTION OF CETACEAN OBSERVATIONS DURING JULY 28 TO AUGUST 7, 2018

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	20000	0	15

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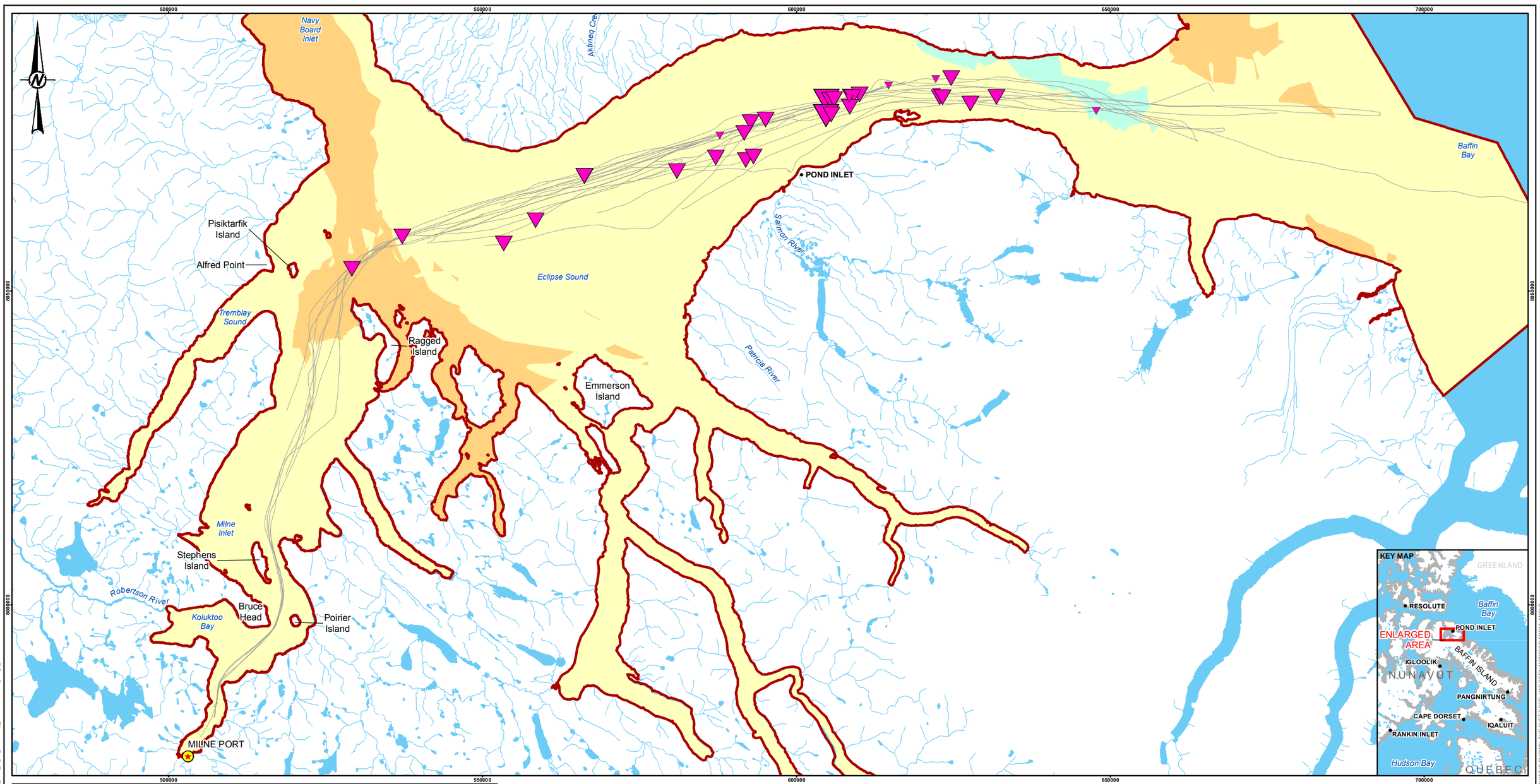

LEGEND

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

NARWHAL

- 1
- 2 - 10
- 10+

- COMMUNITY
- MILNE PORT
- SURVEY TRACK (SEPTEMBER 29 - OCTOBER 17, 2018)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

FALL MEAN PERCENT ICE CONCENTRATION (SEPTEMBER 28 TO OCTOBER 17, 2018)

- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018.
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PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	TT
PREPARED	AA
REVIEWED	DC
APPROVED	PA

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

TITLE
DISTRIBUTION OF CETACEAN OBSERVATIONS DURING SEPTEMBER 28 TO OCTOBER 17, 2018

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	20000	0	16

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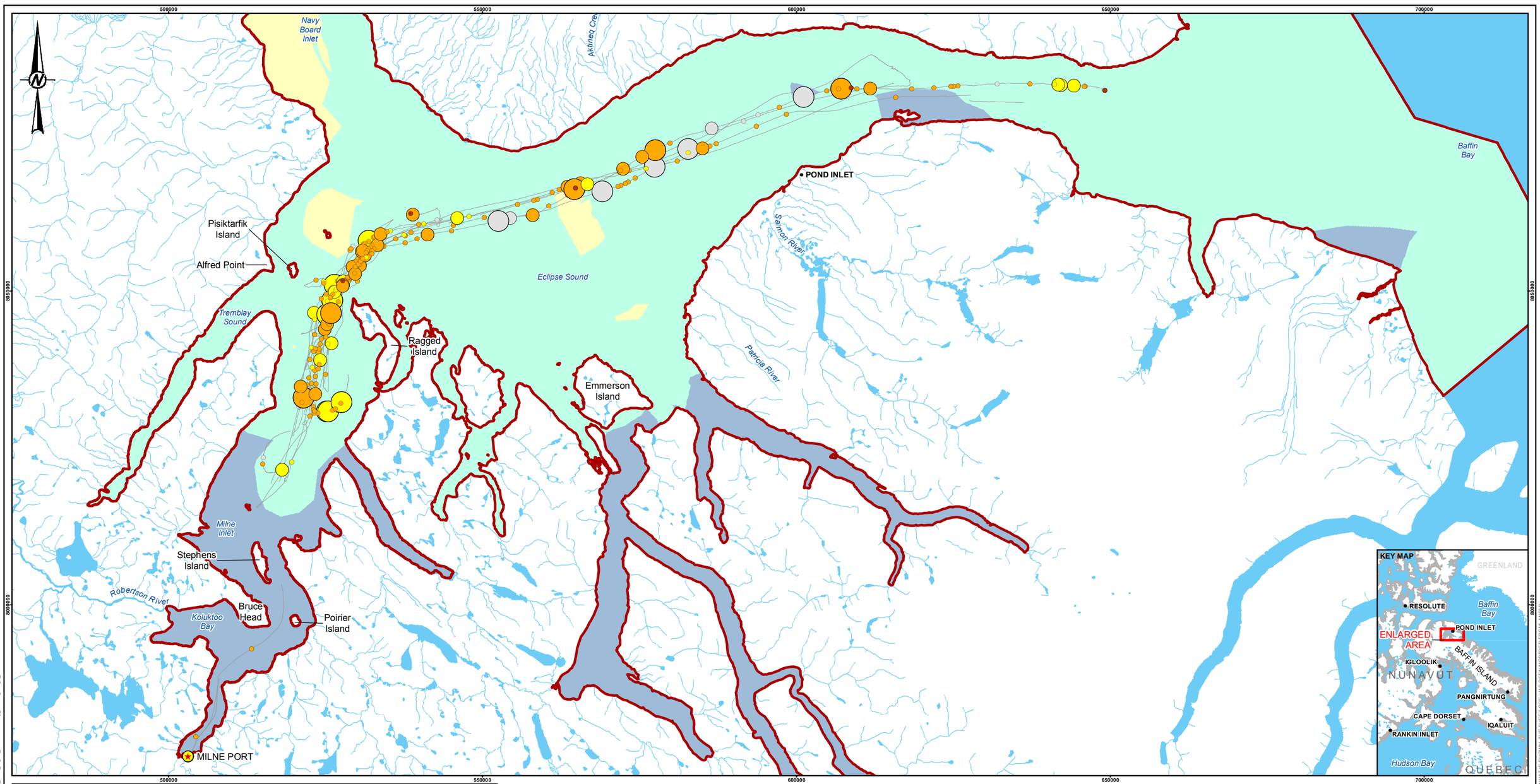

LEGEND

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BEARDED SEAL
- 1

HARP SEAL
- 1
- 2 - 10
- 10+

RINGED SEAL
- 1
- 2 - 10
- 10+

UNIDENTIFIED SEAL
- 1
- 2 - 10
- 10+

- COMMUNITY
- MILNE PORT
- SURVEY TRACK (JULY 28 - AUGUST 7, 2018)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

SUMMER MEAN PERCENT ICE CONCENTRATION (JULY 29 TO AUGUST 7, 2018)
- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY, ACCESSED NOVEMBER 23, 2018.
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YYYY-MM-DD	2019-02-14
DESIGNED	TT
PREPARED	AA
REVIEWED	DC
APPROVED	PA

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

TITLE
DISTRIBUTION OF PINNIPED OBSERVATIONS DURING JULY 28 TO AUGUST 7, 2018

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	20000	0	17

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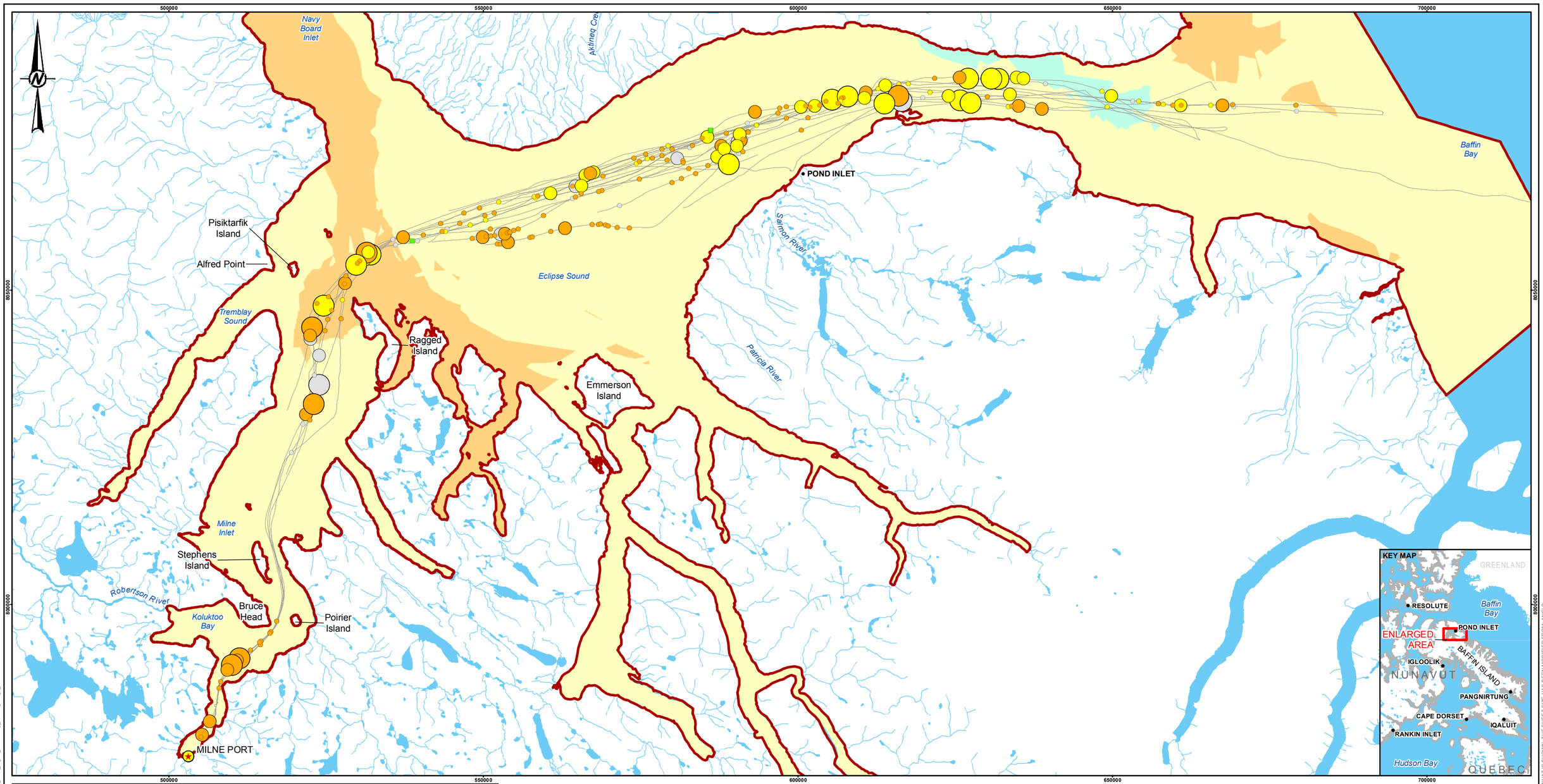


LEGEND

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

HARP SEAL
- 1
- 2 - 10
- 10+

POLAR BEAR
- 1

RINGED SEAL
- 1
- 2 - 10
- 10+

UNIDENTIFIED SEAL
- 1
- 2 - 10
- 10+

- COMMUNITY
- MILNE PORT
- SURVEY TRACK (SEPTEMBER 29 - OCTOBER 17, 2018)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

FALL MEAN PERCENT ICE CONCENTRATION (SEPTEMBER 28 TO OCTOBER 17, 2018)
- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED NOVEMBER 23, 2018.
GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-15
DESIGNED	TT
PREPARED	AA
REVIEWED	DC
APPROVED	PA

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

TITLE
DISTRIBUTION OF PINNIPED AND POLAR BEAR OBSERVATIONS DURING SEPTEMBER 28 TO OCTOBER 17, 2018

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	20000	0	18

2.2.3.2 Detection Rates of Marine Mammals During SBO Program

The total SPUE during scheduled marine mammal watch periods of the entire 2018 SBO Program was 0.18 sightings per km (551 sightings per 3153.9 km). During summer surveys, 269 sightings of marine mammals were made with a SPUE of 0.24 sightings per km. Sighting rates were lower during fall surveys with SPUE values of 0.14 sightings per km. Table 2 summarizes the detection rates recorded for each species by survey period.

Table 2: Detection Rates for Marine Mammals

	Summer Surveys		Fall Surveys	
Species	**Number of Sightings**	**Relative Detection Rate (sightings/km)**	**Number of Sightings**	**Relative Detection Rate (sightings/km)**
Narwhal	7	0.0063	34	0.0166
Unidentified Whale	1	0.0009	0	0.0000
Ringed Seal	194	0.1756	146	0.0713
Harp Seal	41	0.0371	64	0.0312
Bearded Seal	5	0.0045	0	0.0000
Unidentified Seal	21	0.0190	37	0.0181
Polar Bear	0	0.0000	2	0.001

2.2.3.3 Observed Ice Cover

Ice cover was recorded for environmental conditions as a percentage cover in the field of view. These environmental conditions were extrapolated to the sightings and as such, they don't directly relate to the ice cover at the sighting, but in the general vicinity of the sighting. Table 3 presents all ice cover extrapolated for each sighting during all scheduled marine mammal watches. Pinnipeds observed hauled-out on ice were calculated separately from pinnipeds observed in the water.

Table 3: Observed Ice Cover at Locations of Marine Mammal Sightings

	Narwhal	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Summer Survey							
In Water							
Mean Ice Cover (%)	29.7	80.0	36.9	40.8	30.0	20.5	–
Range (%)	3–80	80	0–95	3–90	20–40	1–45	–
# Sightings	7	1	172	40	2	11	–
On Ice							
Mean Ice Cover (%)	–	–	65.2	20.0	48.3	69.0	–
Range (%)	–	–	25–90	20	20–75	20–100	–
# Sightings	–	–	22	1	3	10	–
Fall Survey							
In Water							
Mean Ice Cover (%)	80.8	–	71.8	59.0	–	68.3	80.0
Range (%)	0–100	–	0–100	0–100	–	0–100	70-90
# Sightings	34	–	105	58	–	24	2
On Ice							
Mean Ice Cover (%)	–	–	72.5	84.0	–	84.7	–
Range (%)	–	–	0–100	60–100	–	0–100	–
# Sightings	–	–	41	5	–	13	–

Narwhal

Narwhals were observed in areas where ice cover averaged 29.7% (range 3% to 80%) during summer surveys and 80.8% (range: 0–100%) during fall surveys (Table 3).

Unidentified Whale

One unidentified whale was observed in an area where ice cover was recorded as 80% during a summer survey.

Ringed Seal

Ringed seals in the water were observed in areas where ice cover averaged 36.9% (range: 0–95%) during summer surveys and 71.8% (range: 0–100%) during fall surveys (Table 3). Ringed seals on ice were observed in areas where ice cover averaged 65.2% (range: 25–90%) during summer surveys and averaged 72.5% (range: 0–100%) during fall surveys.

Harp Seal

Harp seals in the water were observed in areas where ice cover averaged 40.8% (range: 3–90%) during summer surveys and 59.0% (range: 0–100%) during fall surveys (Table 3). Harp seals were not observed on ice very often. One harp seal was observed on ice during a summer survey in ice coverage of 20% and five harp seals were observed during fall surveys in ice coverage that averaged 84.0% (range: 60–100%).

Bearded Seal

Bearded seals were only observed during summer surveys. Ice coverage observed for bearded seals averaged 30.0% (range: 20–40%) in the water and 48.3% (range: 20–75%) on ice averaged (Table 3).

Unidentified Seal

Unidentified seals in the water were observed in areas where ice cover averaged 20.5% (range: 1–45%) during summer surveys and 68.3% (range: 0–100%) during fall surveys (Table 3). Unidentified seals on ice were observed in areas where ice cover averaged 69.0% (range: 20–100%) during summer surveys and 84.7% (range: 0–100%) during fall surveys.

Polar Bear

Two polar bears were observed during the fall survey, one in 70% ice cover and the second in 90% ice cover.

2.2.3.4 Closest Point of Approach (CPA) to Vessel

Distance of marine mammals to the ship was measured from the bridge. The initial distance at which a marine mammal was observed by the MWO was noted and if the animal was subsequently observed closer to the vessel, the closest distance of approach was identified (referred to as the “Closest Point of Approach” or CPA). Table 4 presents a summary of CPAs recorded for sightings during all scheduled marine mammal watches. CPAs for pinnipeds ‘on ice’ and ‘in water’ were calculated separately given differences in animal detectability and animal behaviours between the two environments (i.e., pinnipeds were more easily detected on ice than in water). As such, mean CPAs for pinnipeds on ice was generally greater than that for pinnipeds observed in water.

Table 4: Observed Closest Point of Approach of Marine Mammals to the Vessel

	Narwhal	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Summer Surveys							
In Water							
Mean CPA (m)	681.7	100.0	213.9	208.1	145.0	250.0	–
Range (m)	200–2000	100	10–1900	20–1000	90–200	50–1000	–
# Sightings	6	1	124	32	2	10	–
On Ice							
Mean CPA (m)	–	–	355.6	–	1275.0	675.5	–
Range (m)	–	–	100–1000	–	50–2500	50–3000	–
# Sightings	–	–	16	–	2	10	–
Fall Surveys							
In Water							
Mean CPA (m)	351.5	–	184.0	170.4	–	367.8	200
Range (m)	30–900	–	15–600	10–800	–	30–1500	200
# Sightings	31	–	88	51	–	23	2
On Ice							
Mean CPA (m)	–	–	323.2	270.0	–	574.6	–
Range (m)	–	–	50–700	100–350	–	270–1200	–
# Sightings	–	–	36	5	–	13	–

Narwhal

The closest point of approach (CPA) observed for narwhals ranged from 200 to 2000 m (mean CPA = 681.7 m) during summer surveys and ranged from 30 to 900 m (mean CPA = 351.5 m) during fall surveys (Table 4). Mean CPAs were almost twice as far during summer surveys compared with fall surveys, although the difference was not statistically significant (Mann-Whitney U = 107.5, p = 0.281). The low sample size during summer surveys, coupled with the high variance in CPA range, may have affected our ability to measure a statistically significant difference.

Unidentified Whale

One unidentified whale was observed with a mean CPA of 100 m during a summer survey.

Ringed Seal

The CPA observed for ringed seals in water ranged from 10 to 1,900 m (mean CPA = 213.9 m) during summer survey and ranged from 15 to 600 m (mean CPA = 184.0 m) during fall surveys (Table 4). Ringed seals observed on ice ranged from 100 to 1,000 m (mean CPA = 355.6 m) during summer surveys and ranged from 50 to 700 m (mean CPA = 323.2 m) during fall surveys.

On average, the CPAs for ringed seals in water during summer and fall surveys were similar (Mann-Whitney U = 6014, p = 0.102). Likewise, CPAs for ringed seals on ice were similar during summer and fall surveys (Mann-Whitney U = 258, p = 0.281).

Harp Seal

The CPA observed for harp seals in water ranged from 20 to 1,000 m (mean CPA = 208.1 m) during summer surveys and ranged from 10 to 800 m (mean CPA = 170.4 m) during fall surveys (Table 4). Harp seals were not observed on ice very often. Five harp seals were observed on ice during fall surveys at a mean CPA of 270.0 m (range: 100–350 m). On average, CPAs for harp seals in water during summer and fall surveys were similar (Mann-Whitney U = 807, p = 0.468).

Bearded Seal

Bearded seals were only observed during summer surveys. The CPA observed for bearded seals in water ranged from 90 to 200 m (mean CPA = 145.0 m) and on ice ranged from 50 to 2500 m (mean CPA = 1275.0 m) (Table 4).

Unidentified Seal

The CPA observed for unidentified seals in water ranged from 50 to 1,000 m (mean CPA = 250.0 m) during summer surveys and ranged from 30 to 1,500 m (mean CPA = 367.8 m) during fall surveys (Table 4). Unidentified seals observed on ice ranged from 50 m to 3,000 m (mean CPA = 675.5 m) during summer surveys and ranged from 270 to 1,200 m (mean CPA = 574.6 m) during fall surveys.

On average, CPAs for unidentified seals in water during summer and fall surveys were similar (Mann-Whitney U = 74, p = 0.056). Likewise, CPAs for unidentified seals on ice during summer and fall surveys were similar (Mann-Whitney U = 53.5, p = 0.248).

Polar Bear

Two polar bears were observed during the fall survey with a CPA of 200 m (Table 4). One polar bear was initially observed on the ice at a distance of 2,000 m and dove into the water as the vessel approached at approximately 8.5 knots. About 15 minutes later, the same polar bear was observed again swimming perpendicular to the ship's course at a distance of 200 m from the vessel. The second polar bear was first sighted 200 m from the ship which also was its closest distance to the ship.

2.2.3.5 Marine Mammal Movement

A movement category was assigned to each sighting to describe the general direction in which the animal appeared to be moving in relation to the vessel. Marine mammals were coded as “swimming towards”, “swimming away”, “swimming parallel”, “swimming perpendicular” (animal in front or behind a vessel moving perpendicularly to the vessel), “mix” (a combination of two or more movements), “none” (no movement observed), or “unknown”. Marine mammals coded as hauled-out (i.e., resting on ice or land) were not analyzed in this section. Table 5 presents movements recorded for recorded sightings (except unidentified whale, bearded seal, and polar bear, due to low sighting numbers) during scheduled marine mammal watches.

Table 5: Percentage of Movement Activities Observed for Marine Mammals

Species	Summer Surveys	n	Percent Movement (%)	Fall Surveys	n	Percent Movement (%)
Narwhal	Swim Perpendicular	3	42.9	Swim Away	25	75.8
	Swim Away	2	28.6	Swim Parallel	4	12.1
	Swim Parallel	1	14.3	Swim Perpendicular	2	6.1
	Unknown	1	14.3	Swim Towards	1	3.0
				Mix	1	3.0
Ringed Seal	Swim Away	121	70.3	Swim Away	33	32.4
	Swim Perpendicular	25	14.5	None	24	23.5
	Swim Parallel	10	5.8	Swim Perpendicular	18	17.6
	Swim Towards	9	5.2	Swim Parallel	13	12.7
	None	7	4.1	Unknown	10	9.8
				Swim Towards	3	2.9
				Mix	1	1.0
Harp Seal	Swim Away	24	60.0	Swim Away	37	64.9
	Swim Parallel	7	17.5	None	7	12.3
	Swim Perpendicular	7	17.5	Swim Parallel	5	8.8
	Swim Towards	1	2.5	Swim Perpendicular	4	7.0
	None	1	2.5	Unknown	3	5.3
				Mix	1	1.8
Unidentified Seal	Swim Away	5	45.5	Unknown	10	41.7
	Swim Perpendicular	2	18.2	Swim Away	5	20.8
	Unknown	2	18.2	None	5	20.8
	Swim Parallel	1	9.1	Swim Perpendicular	3	12.5
	Swim Towards	1	9.1	Swim Parallel	1	4.2

Narwhal

The most commonly observed movement exhibited by narwhals during summer surveys was swimming perpendicular to the vessel accounting for 42.9% of all movements, followed by Swim Away, Swim Parallel and Unknown (28.6 %, 14.3%, and 14.3%, respectively; Table 5). During fall surveys, the most commonly observed movement was swimming away from the vessel accounting for 75.8% of all movements, followed by Swim Parallel and Swim Perpendicular (12.1% and 6.1% respectively; Table 5). The remaining movements recorded were Swim Towards (3.0%) and Mix (3.0%).

Unidentified Whale

One unidentified whale was observed swimming away from the vessel.

Ringed Seal

Ringed seals were observed swimming away from the vessel 70.3% of the time during summer surveys. The remaining movements recorded were Swim Perpendicular, Swim Parallel, Swim Towards, and None (14.5%, 5.8%, 5.2%, and 4.1%, respectively; Table 5). During fall surveys, the most commonly observed movement was also swimming away from the vessel accounting for 32.4% of all movements, followed by None, Swim Perpendicular, and Swim Parallel (23.5%, 17.6% and 12.7% respectively; Table 5). The remaining movements recorded during fall surveys were Unknown, Swim Towards, and Mix (9.8%, 2.9%, and 1.0%, respectively).

Harp Seal

The most commonly observed movement exhibited by harp seals was swimming away from the vessel accounting for 60.0% during summer surveys and 64.9% during fall surveys (Table 5). The remaining movements exhibited by harp seal during summer surveys were Swim Parallel, Swim Perpendicular, Swim Towards, and None (17.5%, 17.5%, 2.5%, and 2.5%, respectively). During fall surveys, the remaining movements exhibited were None, Swim Parallel, Swim Perpendicular, Unknown, and Mix (12.3%, 8.8%, 7.0%, 5.3%, and 1.8%, respectively).

Bearded Seal

Two bearded seals were observed in water during the SBO program. One was observed swimming towards the vessel and one was not moving.

Unidentified Seal

Unidentified seals were observed swimming away from the vessel 45.5% of the time during summer surveys. The remaining movements recorded were Swim Perpendicular, Unknown, Swim Parallel, and Swim Towards (18.2%, 18.2%, 9.1%, and 9.1%, respectively; Table 5). During fall surveys, the most commonly observed movement was Unknown (generally meaning the animal was not seen long enough to accurately determine its movement) accounting for 41.7% of all movements, followed by Swim Away, None, Swim Perpendicular and Swim Parallel (20.8%, 20.8% 12.5%, and 4.2%, respectively; Table 5).

Polar Bear

Two polar bears were observed during the fall period. One bear was first observed on ice from 2,000 m and appeared to be feeding at a kill site. The bear dove in the water swimming perpendicularly away from the ship’s projected path. When the bear was re-sighted, there were small pockets of water on and between ice pans and the bear continued to move mostly perpendicularly away repeatedly rising up on the ice then back in the water. The second polar bear in the fall survey was a young bear sighted 200 m from the vessel which showed minimal response or movement relative to the ship.

2.2.3.6 Observed Behaviours of Marine Mammals

Primary and secondary behaviours were recorded for each marine mammal sighting. The primary behaviour was the first behaviour observed. A secondary behaviour was noted if the animal's behaviour changed during the sighting. Table 6 presents all primary and secondary behaviour recorded during all scheduled marine mammal watches (except unidentified whale and polar bear, due to low sighting numbers).

Table 6: Percentage of Primary and Secondary Behaviours Observed for Marine Mammals

Species	Primary Behaviour	n	Percent Behaviour (%)	Secondary Behaviour	n	Percent Behaviour (%)
Narwhal	Swimming	20	48.8	Diving	17	41.5
	Surfacing	18	43.9	Surfacing	14	34.1
	Resting	1	2.4	Swimming	9	22.0
	Diving	1	2.4	Unknown[1]	1	2.4
	Unknown[1]	1	2.4			
Ringed Seal	Swimming	168	49.6	Diving	142	41.9
	Looking	57	16.8	Looking	49	17.1
	Hauled-out	42	12.4	Swimming	58	14.5
	Resting	28	8.3	Surfacing	33	9.7
	Surfacing	27	8.0	Hauled-out	21	6.2
	Head Up Startled	8	2.4	Resting	20	5.9
	Diving	7	2.1	Head Up Startled	4	1.2
	Feeding	1	0.3	Porpoising	3	0.9
	Porpoising	1	0.3	Milling	2	0.6
				None observed	2	0.6
Harp Seal	Swimming	41	39.4	Swimming	24	23.1
	Looking	21	20.2	Looking	23	22.1
	Porpoising	14	13.5	Diving	22	21.2
	Surfacing	12	11.5	Surfacing	16	15.4
	Hauled-out	5	4.8	Head Up Startled	7	6.7
	Resting	4	3.8	Porpoising	6	5.8
	Head Up Startled	3	2.9	Resting	3	2.9
	Milling	2	1.9	Hauled-out	1	1.0
	Diving	2	1.9			
Bearded Seal	Resting	3	60.0	Resting	2	40.0
	Hauled-out	1	20.0	Hauled-out	2	40.0
	Swimming	1	20.0	Diving	1	20.0
Unidentified Seal	Hauled-out	15	26.3	Diving	20	36.1
	Swimming	11	19.3	Looking	12	21.1
	Resting	9	15.8	Swimming	9	15.8
	Looking	8	14.0	Hauled-out	6	10.5
	Surfacing	7	12.3	Resting	4	7.0
	Diving	5	8.8	Surfacing	4	7.0
	Head Up Startled	2	3.5			

[1]Unknown behaviour: recorded when MWOs cannot make a determination of behaviour, which may happen when multiple sightings occur.

Narwhal

The most commonly observed primary behaviours exhibited by narwhal were Swimming and Surfacing, accounting for 92.7% of all primary behaviours (48.8% and 43.9%, respectively; Table 6) followed by Resting, Diving, and Unknown (2.4% each). The most common observed secondary behaviour exhibited by narwhal was diving (41.5%), not surprisingly since most whales generally surface for short periods before diving. The remaining secondary behaviours recorded were Surfacing, Swimming, and Unknown (34.1%, 22.0%, and 2.4%, respectively).

Unidentified Whale

One unidentified whale was observed with Swimming as its primary behaviour. No secondary behaviour was recorded.

Ringed Seal

The three most commonly observed primary behaviours exhibited by ringed seal were Swimming (49.6%), Looking (16.8%), and Hauled-out (12.4%) accounting for a total of 78.8% of all primary behaviours (Table 6). The three most commonly observed secondary behaviours exhibited by ringed seal were Diving (42.5%), Looking (17.4%), and Swimming (14.7%) accounting for a total of 74.6% of all secondary behaviours (Table 6).

Harp Seal

Swimming and Looking were the two most commonly observed behaviours exhibited by harp seal accounting for a total of 59.6% of all primary behaviours and 46.0% of all secondary behaviours (Table 6). Other primary behaviours commonly exhibited by harp seal include Porpoising (13.5 %) and Surfacing (11.5). Other secondary behaviours commonly exhibited by harp seal include Diving (21.6%) and Surfacing (15.7%).

Bearded Seal

Resting and Hauled-out were the two most commonly observed behaviours exhibited by bearded seal accounting for 80.0% of all primary and secondary behaviours (Table 6). Swimming and Diving were the only other behaviours exhibited by bearded seal.

Unidentified Seal

The three most commonly observed primary behaviours exhibited by unidentified seals were Hauled-out (26.3%), Swimming (19.3%), and Resting (15.8%), accounting for a total of 61.4% of all primary behaviours (Table 6). The three most commonly observed secondary behaviours exhibited by unidentified seals were Diving (36.4%), Looking (21.8%), and Swimming (16.4%), accounting for 74.6% of all secondary behaviours (Table 6).

Polar Bear

Two polar bears were observed in the fall SBO program. One bear was first observed on ice from 2,000 m and appeared to be feeding at a kill site. The bear dove in the water swimming perpendicularly away from the ship's projected path. There were small pockets of water on and between ice pans and the bear continued to move mostly perpendicularly away repeatedly rising up on the ice then back in the water. The second polar bear in the fall survey was a young bear sighted 200 m from the vessel which showed minimal response or movement relative to the ship.

2.3 Discussion

Previous SBO programs were conducted differently than the 2018 SBO program. In previous years, MWOs surveyed the shipping route through the RSA during the open water season when ice cover was zero, or very low. In 2014 and 2015, the MWOs boarded the observation vessel at Pond Inlet and disembarked at Milne Port. In 2018, the MWOs boarded and disembarked the observation vessel in Milne Port. During the 2018 SBO Program, MWOs surveyed the shipping route through the RSA on the *Botnica*, during the shoulder seasons of the open-water season when ice was deteriorating in the summer (28 July to 7 August) and forming in fall (28 September to 17 October). Due to the different time frames, different survey platforms, and different environmental conditions between the programs it was not possible to directly compare the previous studies with the current study, although general observations were noted.

The main species observed during the three previous SBO programs (SEM 2016), as with the current 2018 SBO Program, were narwhals, ringed seals, and harp seals. Less observation effort during the previous SBO programs resulted in lower numbers of sightings compared to the 2018 program. In 2013, five narwhals, 43 ringed seals, 10–15 harp seals and one unidentified seal were observed (SEM 2016). In 2014, 7–9 narwhals, two ringed seals, and one unidentified seal were observed (SEM 2016). In 2015, 5–10 narwhals and one ringed seal were observed (SEM 2016). During the 2018 SBO Program, 175 narwhals, 1,069 ringed seals, 754 harp seals, 760 unidentified seals, five bearded seals, one unidentified whale and two polar bears were observed.

A summary of 2018 SBO Program findings, discussion of results and vessel interactions, and incidents of concern related to vessel activities, is provided below. In 2018, as in previous years, no marine mammal ship strikes or near misses occurred during observation periods on the *Botnica*. No ship strikes or near misses were reported for other Project-related vessels.

Narwhal

Available information on narwhals (COSEWIC 2004; DFO 2015; Elliott et al. 2015; Heide-Jørgensen et al. 2002; Laidre et al. 2004; Marcoux et al. 2009; Richard et al. 1994; Richard et al. 2010; Thomas et al. 2015a, 2016; Watt et al. 2012) indicate that the RSA is regularly used during summer and fall, although the distribution of narwhals varies throughout the season. During the 2018 summer surveys (late July to early August), narwhals were observed primarily in Eclipse Sound. During the same time period in 2015, narwhals were observed primarily in Milne Inlet, Tremblay Sound and Koluktoo Bay during an aerial survey monitoring program (Thomas et al. 2016), whereas during 2014 aerial surveys, narwhals had a similar distribution to what was observed in 2018 (Thomas et al. 2015a). Results from the 2017 Tremblay Sound tagging program show tagged narwhals during the first half of August concentrated in the Eclipse Sound, Milne Inlet, Tremblay Sound and Koluktoo Bay

(Golder 2018d). At this time of year, narwhals enter their summering habitat and presumed to be heading toward the Milne Inlet, Koluktoo Bay, and Tremblay Sound. Ice conditions appeared similar between years, with ice coverage ranging from 0–100% in the study area. During the 2018 fall surveys (early- to mid-October) narwhals were again observed primarily in Eclipse Sound. During aerial surveys conducted during the same time period in 2013 and 2014, narwhals were also observed in Eclipse Sound (Elliott et al. 2015; Thomas et al. 2015a). Results from the 2017 Tremblay Sound tagging program show tagged narwhals disperse into Eclipse Sound and areas surrounding Bylot Island during the first half of October (Golder 2018d). It is during this time that narwhals are assumed to be preparing to leave Eclipse Sound and heading toward their wintering habitat.

Previous studies have found average group sizes of 2.26 (range: 1–20; Thomas et al. 2016), 3.23 (range: 1–21; Thomas et al. 2015a), 3.5 (range: 1–25; Marcoux et al. 2009), 3.7 (range: 1–23; Golder et al. 2018), 3.7 (range: 1–19; Thomas et al. 2014), 4.0 (range: 1–45; Smith et al. 2017), 4.3 (range: 1–30; Smith et al. 2015) and 5.5 (range: 1–45; Smith et al. 2016). Observations in 2018 were consistent with past studies with an observed average group size of 4.3 (range: 1–16).

Narwhals were observed in average ice cover of 29.7% during summer surveys and 80.8% during fall surveys. Fall surveys had higher ice concentrations. It was, therefore, not surprising to observe narwhal in higher ice concentrations during fall surveys.

The CPA observed for narwhals ranged from 200 to 2,000 m (mean CPA = 681.7 m) during summer surveys and ranged from 30 to 900 m (mean CPA = 351.5 m) during fall surveys. The CPA observed for narwhals was not significantly different between the summer and fall surveys. However, the number of sightings were low for the summer surveys which may have affected our ability to detect a statistically significant difference. If narwhals were acclimating to vessels, we would have expected the CPA to be closer during the fall surveys. While this was observed, the difference was not statistically significant. It is also possible that a number of other factors influence the recorded CPA, notably ice conditions around the vessel.

Narwhal were observed swimming away from the vessel 28.6% of the time during summer surveys and 75.8% of the time during fall surveys. The higher percentage of swimming away from the vessel observed during the fall may be attributable to the higher ice concentrations observed in the fall resulting in more noise.

With respect to one sighting on October 17, the MWO on duty commented that narwhals were using the old trail that the vessel created the previous day. This was not surprising as narwhal normally use open leads as a way of passing through areas of heavy ice.

Ringed Seal

Population structures of ringed seal across the Canadian Arctic are poorly understood in general, and no investigations of population structure specific to Baffin Bay have been done. Aerial surveys of ringed seals in the RSA have been undertaken during the molting period (spring) when ringed seals are largely on the sea ice and easy to count (Thomas et al. 2015b; Yurkowski et al. 2018). Over four survey replicates, 1996 sightings of 2471 individual ringed seals were observed in the RSA (Thomas et al. 2015b), suggesting that ringed seals use the RSA extensively during the spring molt. Yurkowski et al. (2018) also noted several ringed seal hotspots throughout the RSA during the spring molt. The 2018 SBO Program confirmed the use of the RSA by ringed seals. Ringed seals were the most commonly recorded species during the 2018 SBO Program.

The CPA observed for ringed seals did not differ between the summer and fall surveys for either the seals in the water or the seals on the ice. Ringed seals on the ice were observed at greater CPA distances than seals in the water at least in part because they were more easily detected on ice at greater distance than in water. Pinnipeds are also more vulnerable on ice and, thus, more likely to react by diving into the water at closer distances. Ringed seals were observed swimming away from the vessel 70.3% of the time during summer surveys and 32.4% of the time during fall surveys.

Harp Seal

The lack of available information on harp seals in the RSA along with the documented presence of harp seals during the 2018 SBO Program suggests that additional information on this species may be needed. During the 2018 SBO Program, harp seals were more likely to be observed in the water than on ice. Ninety-nine harp seal sightings (747 individuals) were recorded in the water and six harp seal sightings (seven individuals) were recorded on ice. Harp seals were observed swimming away from the vessel 60.0% of the time during summer surveys and 64.9% of the time during fall surveys. Harp seal were not observed on ice frequently enough to enable a comparison between summer and fall surveys.

Bearded Seal

The lack of available information on bearded seals in the RSA along with the documented low numbers of bearded seal during the 2018 SBO Program suggests that additional information on this species may also be needed. During the 2018 SBO Program two sightings of individual bearded seals were recorded in the water and three sightings of individual bearded seals were recorded on ice during summer surveys. Bearded seals were not observed during fall surveys.

Polar Bear

During the 2018 SBO Program, no polar bears were observed during summer surveys and only two polar bears were observed during fall surveys. One polar bear was observed on the ice 2,000 m from the vessel at a kill site presumably feeding (although too far to confirm). It dove into the water as the vessel approached and was lost from sight. It was observed again 15 minutes later as the vessel passed within 200 m of the bear which was repeatedly going back up on the ice then down again into the water. The second polar bear was first sighted on the ice at a distance of 200 m from the vessel. This ultimately was its closest distance from the ship. The inclusion of four sets of polar bear tracks within the observational dataset for the CWS bird survey suggest more polar bears were in the area than were recorded in the marine mammal dataset (n=2).

3.0 SEABIRDS

Seabird surveys were completed according to the CWS/ECSAS protocols for moving platforms (Gjerdrum et al. 2012). The objective of the seabird survey was to document seabird species, abundance, and distribution. Similar to marine mammal surveying methodology, environmental variables such as weather, ice condition, sea state, visibility, and ship speed and direction were recorded. All observations were entered into an ECSAS database and format provided by CWS.

In addition to Inuit MWOs being trained in marine mammal survey techniques, they were also trained in the identification of seabird species and in seabird data entry protocol in order for them to also participate in the systematic seabird surveys. For both summer and fall survey periods, the Golder field biologist and site supervisor served as the principal observer and data recorder in the bird surveys.

3.1 Methods

3.1.1 Surveys from Moving Platforms

An ECSAS/CWS bird survey consists of a series of one minute “snapshot” counts of birds within an estimated 300m perpendicular distance to the ship’s port side (in the case of the survey vessel MSV *Botnica*) and extending forward of that perpendicular point an estimated 300m thus defining the functional survey box. Given the ship’s chosen typical travelling speed between 8.0 and 9.0 knots (approx. 16 to 18kph) it would travel approximately 300m in one minute thus defining the spatial extent of a survey box. Five back-to-back one minute snapshots were each called a transect. ECSAS/CWS protocol suggests that each series of transects should last for between one and two hours which in turn are referred to as a “survey”. The protocol considers a survey to be applicable regardless of whether birds are present or not. The seabird surveys conducted during the summer SBO attempted to provide consistent coverage throughout the day. During the fall SBO a two-hour survey each in the morning and afternoon were generally achieved. Weather, sea state, and other factors affected that schedule only to a limited extent.

According to the ECSAS/CWS protocol bird surveys are best completed when the platform is travelling at a minimum speed of 4 knots (7.4 km/h). Surveys can be done when the ship is travelling less than 4 knots, but birds are often attracted to slow moving or stationary vessels. If birds are clearly gathering around the vessel and settling on the water when the ship is moving slowly (i.e., less than 2 knots), surveys would cease. As stated earlier, vessel speeds were typically between 8.0 and 9.0 knots. Therefore, the potential problems of making repeat sightings of individual birds was considered nil.

During a 5-minute observation period, each 300 m wide rectangular area of ocean was covered on the port side from 270˚ to 0˚. (Figure 19). All birds observed on the water surface were continuously recorded throughout each 5-minute periods and their perpendicular distance from the observer estimated. ECSAS prescribes that counts be recorded in distance “bins” 0 to 50 m, 51 to 100 m, 101 to 200 m, and 201 to 300 m.

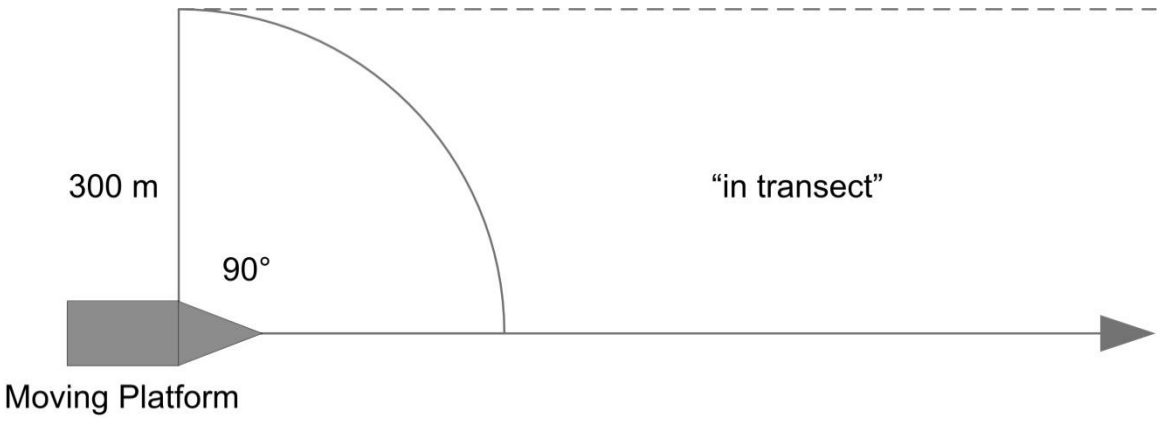


Figure 19: Moving Platform Sampling Area for Eastern Canada Seabirds at Sea Monitoring

3.1.2 Birds in Flight

More birds fly through a survey area than are present in that area at a single instant in time. Flying birds were recorded using a series of five instantaneous (one minute) snapshots. The distance covered during each snapshot would depend on the speed of the ship but as aforementioned, given the ship's chosen typical travelling speed between 8.0 and 9.0 knots (approx. 16 to 18kph), it would travel approximately 300 m in one minute (thus defining a survey box). According to protocol, during each snapshot, flying birds were recorded as in transect only if they were within 300 m to the side and 300 m ahead of the vessel (i.e., within the estimated box).

3.1.3 Lines of Flying Birds

Some bird species fly in long lines. At each snapshot, the number of birds in the flock was counted and the distance class assigned according to the location of the flock centre. All birds are recorded as in transect if the centre of the flock is within the 300 m transect.

It should be noted that only a cursory assessment of the bird data recorded within the SBO study are being used for the SBO program. It is recommended that the full database be provided to CWS/ECSAS as they will conduct a much more detailed analyses appropriate to their more exhaustive bird research program.

3.1.4 Surveys from Stationary Platform

Although bird surveys from the stationary vessel were planned, none were conducted in the end during either summer or fall. In general, such surveys would have been best completed from a position outdoors as close to the edge of the platform as permitted. This was considered a safety risk while aboard the Botnica given the prevalent temperature and weather conditions during the respective survey periods. A position near the edge can increase the detection rates of birds, especially for birds that use the waters at the base of the platform.

3.2 Results

Seabird monitoring was completed daily from July 29 to August 7, 2018 during the summer survey period and from October 4 to 17, 2018 during the fall survey period. Monitoring resulted in 102 5-minute observation periods during the summer surveys and 529 5-minute observation periods during the fall surveys.

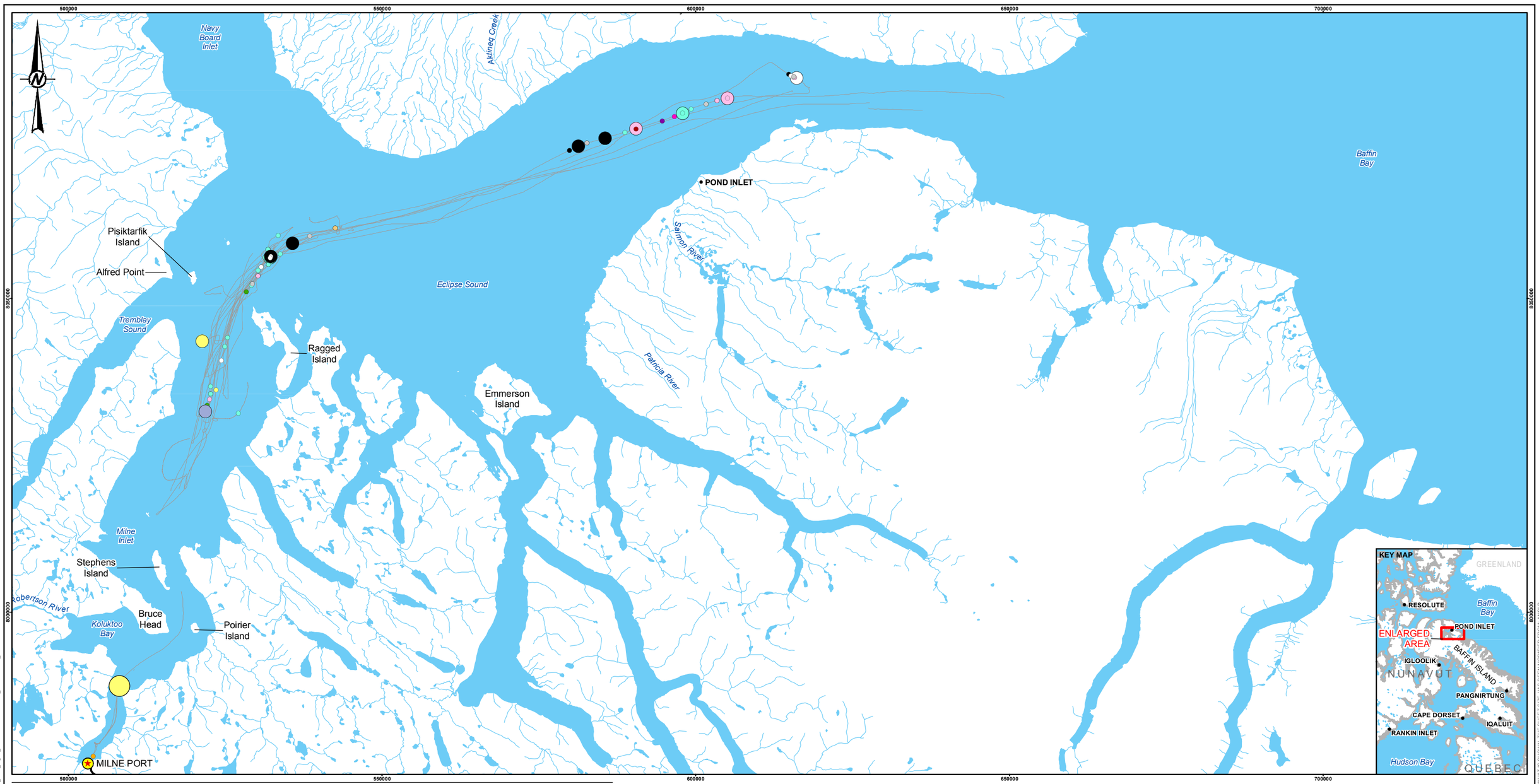
Thirteen identified species totalling 136 seabirds and 14 unidentified seabirds were observed during the summer surveys (Table 7). The most common identified species during summer surveys were northern fulmar (*Fulmarus glacialis*), king eider (*Somateria spectabilis*), black-legged kittiwake (*Rissa tridactyla*), and thick-billed murre (*Uria lomvia*) (Figure 20).

Five identified species totalling 704 seabirds and 15 unidentified seabirds were observed during the fall survey (Table 7). Glaucous gull (*Larus hyperboreus*), black-legged kittiwake, and northern fulmar were the most commonly observed species during fall surveys (Figure 21).

Table 7: Number of Individuals and Counts of Seabirds Observed during the 2018 Ship-based Observer

Common Name	Scientific Name	Number of Individuals	Number of Counts	Dates Observed
Summer Survey (July and August)				
Arctic tern	*Sterna paradisaea*	2	1	July 29
Black guillemot	*Cepphus grylle*	1	1	July 30
Black-legged kittiwake	*Rissa tridactyla*	19	5	July 30 and 31 August 1, 2, and 4
Unidentified gull		14	4	July 30 and 31 August 1 and 4
Glaucous gull	*Larus hyperboreus*	5	4	July 30 and 31 August 2 and 4
Great black-backed gull	*Larus marinus*	3	3	July 31 August 1 and 4
Herring gull	*Larus argentatus*	2	1	August 2
Iceland gull	*Larus glaucoides*	1	1	July 30
King eider	*Somateria spectabilis*	22	3	July 30 August 3 and 4
Long-tailed jaeger	*Stercorarius longicaudus*	3	2	August 2 and 4
Northern fulmar	*Fulmarus glacialis*	65	7	July 29–31 August 1, 2, 4, and 5
Parasitic jaeger	*Stercorarius parasiticus*	1	1	July 30
Thick-billed murre	*Uria lomvia*	11	4	July 30 and 31 August 2 and 4
Yellow-billed loon	*Gavia adamsii*	1	1	August 3
Fall Surveys (October)				
Black guillemot	*Cepphus grille*	42	3	October 9, 14, and 16
Black-legged kittiwake	*Rissa tridactyla*	170	60	October 4, 6–10, 12, and 14

Common Name	Scientific Name	Number of Individuals	Number of Counts	Dates Observed
Unidentified gull, tern, noddy, or skimmer		1	1	October 4
Unidentified gull	–	14	7	October 4, 6–10
Glaucous gull	*Larus hyperboreus*	437	153	October 4, 6–10, 12–17
Northern fulmar	*Fulmarus glacialis*	54	27	October 6, 7, 9, 10, and 14
Pomarine jaeger	*Stercorarius pomarinus*	1	1	October 10



LEGEND

SEABIRD SPECIES OBSERVATIONS (GROUP SIZE)

ARCTIC TERN
- 2 - 9

BLACK-LEGGED KITTIWAKE
- 1
- 2 - 9

BLACK GUILLEMOT
- 1

GENUS: GULLS(LARUS, XEMA, RISSA, PAGOPHILIA, RHODOSTETHIA)
- 1
- 2 - 9

GLAUCOUS CULL
- 1

HERRING GULL
- 1

ICELAND GULL
- 1

KING EIDER
- 1
- 2 - 9
- 10 +

LONG-TAILED JAEGER
- 1

NORTHERN FULMAR
- 1
- 2 - 9

PARASITIC JAEGER
- 1

THICK-BILLED MURRE
- 1
- 2 - 9

YELLOW-BILLED LOON
- 1

- COMMUNITY
- MILNE PORT
- MILNE INLET TOTE ROAD
- SURVEY TRACK (JULY 28 - AUGUST 7, 2018)
- WATERCOURSE
- WATERBODY

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT MAY 28, 2018 AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	LD
PREPARED	AA
REVIEWED	DC
APPROVED	PA

TITLE
DISTRIBUTION OF SEABIRD OBSERVATIONS, SUMMER 2018

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	20000	0	20

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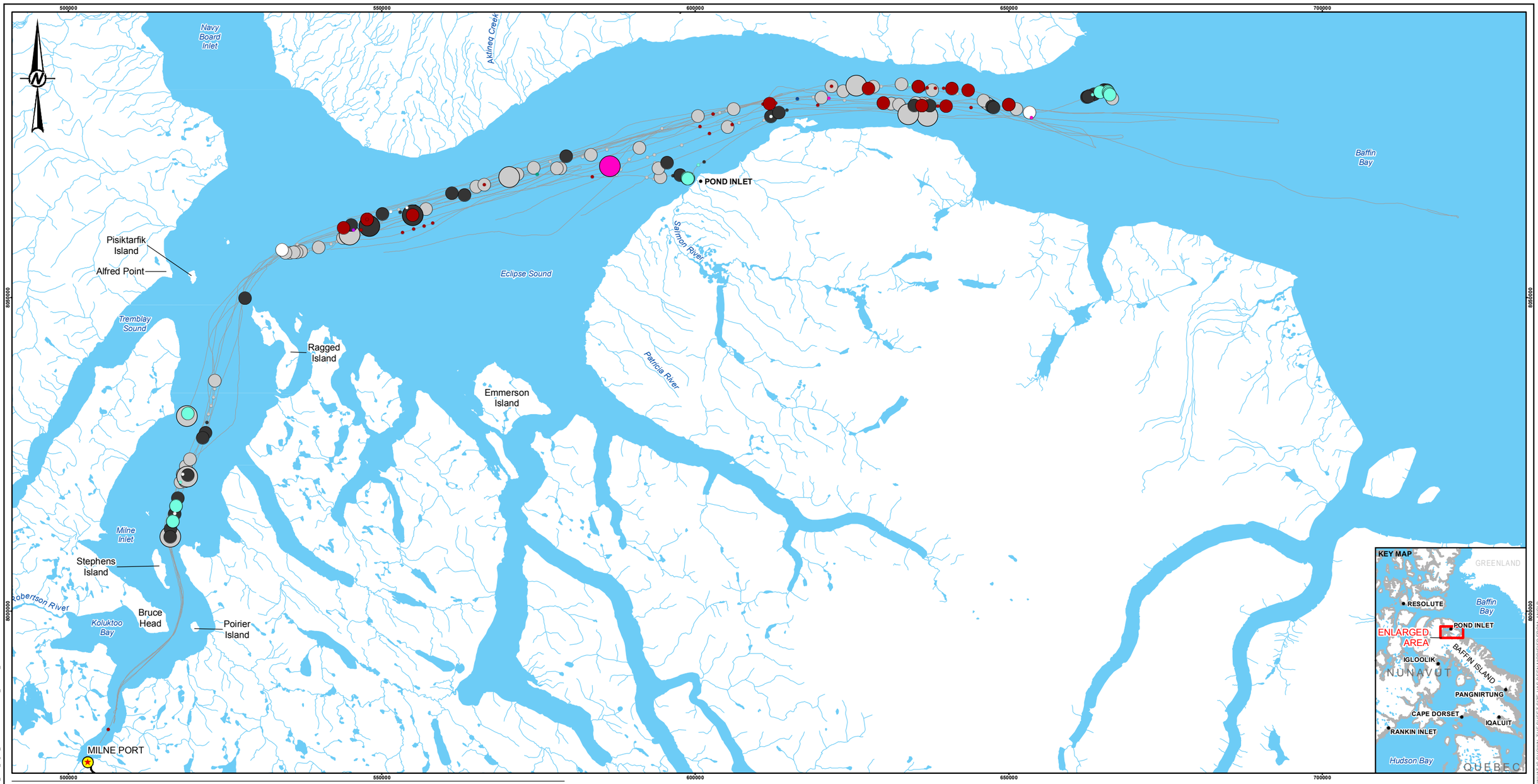

LEGEND

SEABIRD SPECIES OBSERVATIONS (GROUP SIZE)

BLACK-LEGGED KITTIWAKE
- 1
- 2-9
- 10 +

BLACK GUILLEMOT
- 1
- 10 +

COMMON RAVEN
- 1
- 2-9

FAMILY: GULLS, TERNS, NODDIES, AND SKIMMERS
- 1

GENUS: GULLS WHITE-WINGED (ICELAND OR GLAUCOUS)
- 1
- 2-9

GLAUCOUS GULL
- 1
- 2-9
- 10 +

NORTHERN FULMAR
- 1
- 2-9

POMARINE JAEGER
- 1

SNOWY OWL
- 1

- COMMUNITY
- MILNE PORT
- MILNE INLET TOTE ROAD
- SURVEY TRACK (SEPTEMBER 29 - OCTOBER 17, 2018)
- WATERCOURSE
- WATERBODY

0 10 20
1:600,000 KILOMETRES

REFERENCE(S)
MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT MAY 28, 2018 AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

CONSULTANT
GOLDER

YYYY-MM-DD	2019-02-14
DESIGNED	LD
PREPARED	AA
REVIEWED	DC
APPROVED	PA

PROJECT
MARY RIVER PROJECT - 2018 SHIP-BASED OBSERVER PROGRAM

TITLE
DISTRIBUTION OF SEABIRD OBSERVATIONS, FALL 2018

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	20000	0	21

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4.0 SUMMARY

The 2018 SBO Program was designed to monitor the occurrence and distribution of marine mammals along the Northern Shipping Route, and localized marine mammal responses to vessel traffic. The 2018 SBO Program addressed Project Certificate Terms and Conditions #106, #123 and #126. The revised monitoring approach applied in 2018 offered an improved platform for animal detection compared to the 2015 SBO Program. It also addressed safety concerns flagged during the previous SBO monitoring campaign related to ship-to-ship personnel transfer while at sea. Program modifications introduced in 2018 included:

- Collection of data during the shoulder shipping seasons
- Increased monitoring effort (28 days)
- Vessel embarking and disembarking at Milne Port, eliminating the risk of boarding at sea by MWOs

Marine mammal and seabird observations were recorded along the Northern Shipping Route in addition to mammal behavioural responses to vessel movements and CPA distances. A direct comparison of 2018 results could not be made to the previous SBO program because of differences in survey design, sighting conditions, and data collection procedures.

No ship strikes or near misses were observed between animals and the survey vessel, or with any other Project-related vessel.

Continuation of the SBO Program is recommended for 2019 in accordance with Project Certificate Terms and Conditions. Ongoing annual surveillance monitoring will allow for a comparison between monitoring years.

5.0 CLOSURE

We trust the information contained in this report is sufficient for your present needs. Should you have any questions, please do not hesitate to contact the undersigned.

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APPENDIX A

SBO Training Manual

GOLDER

REPORT

2018 Ship-Based Observer Program

Training Manual

1663724-069-R-Rev0

12 July 2018

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FIGURES

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APPENDIX A
Hard Copy Datasheets

1.0 INTRODUCTION

The Ship-based Observer (SBO) Program represents one of several programs that were developed in order to support the Mary River Project (the Project). The SBO Program is part of the Marine Environmental Effects Monitoring Program (MEEMP) for marine mammals and seabirds, in accordance with Project Certificate (PC) terms and conditions issued for the Project. This manual was developed by experienced marine wildlife observers (MWOs) to be able to train other biologists and non-biologists who may or may not have MWO experience to support the objectives of the MEEMP.

A MWO is a person with training in marine mammal and seabird survey techniques, including from a vessel platform. These techniques include spotting and identifying marine mammals and seabirds, estimating distances to sightings, determining relative location of sightings and their movement with respect to the vessel, and recording environmental variables. This training may also serve as a refresher course for experienced MWOs.

This SBO Program manual will cover:

- objectives of the SBO Program
- life at sea
- training goals
- marine mammal surveys
- seabird surveys

2.0 OBJECTIVES OF THE SHIP-BASED OBSERVER (SBO) PROGRAM

The main role of the MWO on a vessel is to continuously scan the water around the vessel and actively look for marine mammals and seabirds.

- To document all marine mammal and seabird observations while onboard the vessel.
- To document any marine mammal and seabird vessel interactions or incidents of concern related to vessel activities.

3.0 LIFE AT SEA

Working at sea for long periods of time is an exciting adventure, but it can also be challenging. Your experience on a vessel will depend a lot on your attitude and what you make of the experience. It is usually a great opportunity to explore areas not often seen by others, or to view a familiar area through a different point of view, and to develop relationships in the close community on board a vessel.

Since a ship is a confined environment with limited space shared by a number of people, some rules and procedures are often needed. The following section will introduce you to the conditions of working at sea.

3.1 What to Bring

Remember to bring copies of all your important documents and certificates. You are required to bring:

- Valid photo identification and other important documents and certificates.
- Important medication (i.e. Epipen, seasickness tablets etc.). If you take regular medications, bring enough to last the entire trip with enough to last an extra week, just in case.
- Towel.
- Personal toiletries.
- Outdoor clothing and footwear to wear on deck.
- Indoor footwear to wear in the vessel where you will spend most of your time.
- Flip-flops for wearing in the shower.
- Camera.
- Sunglasses (polarized are better), sunscreen.
- Water bottle (optional).
- Personal entertainment. Since entertainment can be limited, it is strongly recommended that you bring items such as books, music, cards, games or other hobbies to keep yourself busy during your spare time. This can go a long way towards keeping you happy during your stay.
- Don't count on cell phone service or internet. There will be a satellite phone to use for emergencies.

3.2 Vessel

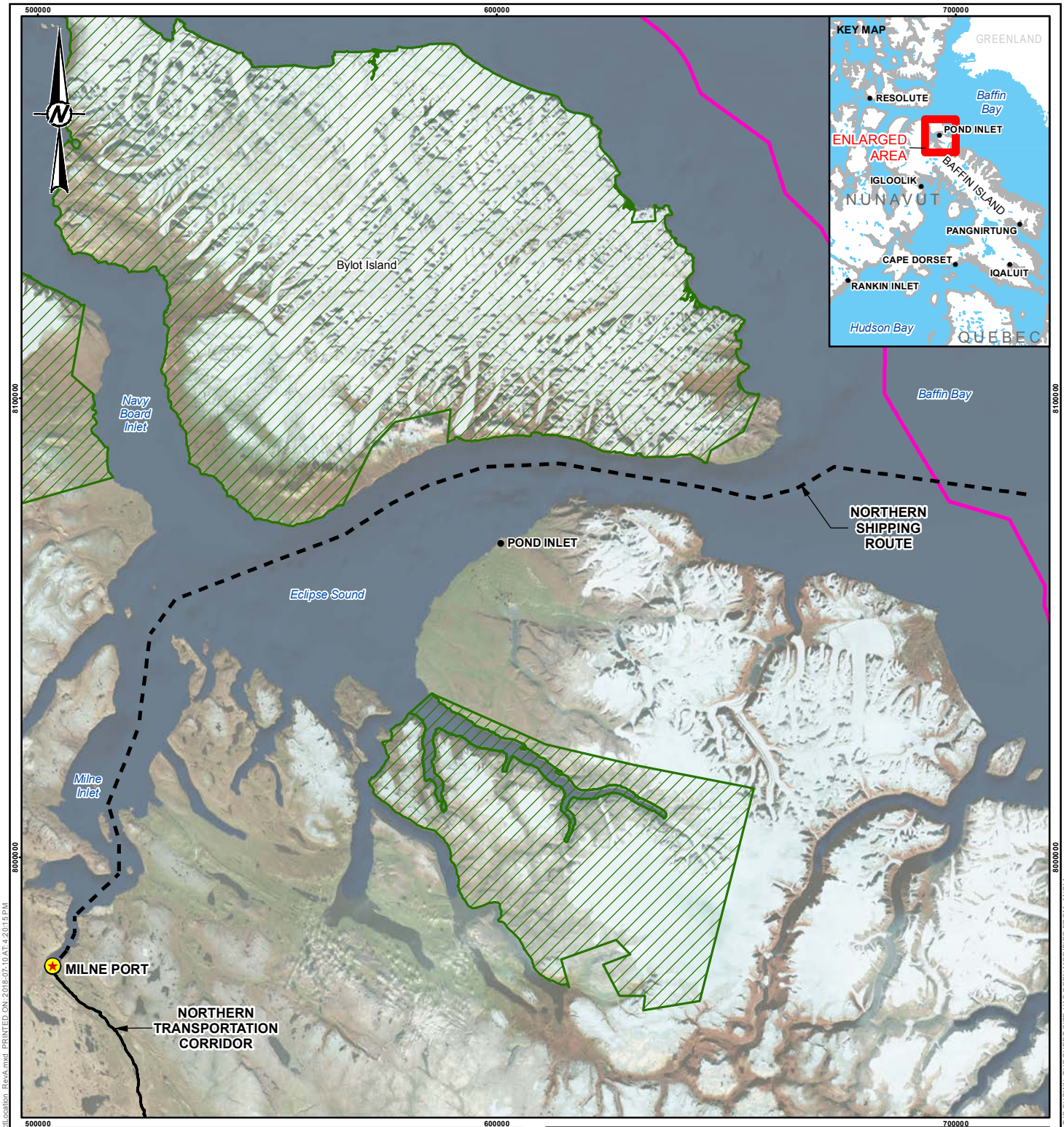
The MSV *Botnica* is a multipurpose offshore support vessel and icebreaker built by Finnyards in Rauma, Finland, in 1998 (Figure 1). The vessel was the newest and technically most advanced state-owned icebreaker of Finland until 2012, when it was sold to the Port of Tallinn (Estonia). The *Botnica* is approximately 96.70 m (317.3 ft) by 24 m (78.7 ft) and can accommodate up to 72 personnel.

The *Botnica* will act as an Ice Management Vessel (IMV), providing clear safe passage for Project Ore carriers through the Northern Shipping Route (Figure 2). MWOs will be stationed on the bridge of the *Botnica* while observing for marine mammals and seabirds.

Its crew are Transport Canada certified to meet government safety requirements. This includes:

- Transport Canada safety inspections
- marine safety equipment available onboard
- marine emergency procedures (e.g. man overboard), and evacuation procedures
- crew certified in vessel operation, Marine First Aid, and Marine Emergency Duties

Figure 1: MSV Botnica



LEGEND

- COMMUNITY
- PROJECT SITE
- NORTHERN SHIPPING ROUTE
- NORTHERN TRANSPORTATION CORRIDOR
- NUNAVUT SETTLEMENT AREA
- SIRMILIK NATIONAL PARK

0 25 50

1:1,200,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT

TITLE
PROJECT LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2018-07-10
DESIGNED	KZ
PREPARED	AA
REVIEWED	
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	20000	0	2

3.3 Health and Safety

Vessel specific health and safety to consider while onboard the vessel will be covered once you board the vessel. This will include:

- emergency equipment and supplies
- emergency drills (man overboard, spills, abandon ship)
- location of medic/nurse station
- restricted areas
- smoking areas and non-smoking areas
- drug and alcohol policies
- areas where specific personal protective equipment (PPE) is required
- how and when to use an immersion suit and SOLAS life vest (provided by the vessel)
- all survey crew will partake in a vessel safety orientation at the beginning of the survey

Additional health and safety requirements are covered in the SBO program-specific Health, Safety, and Environment (HSE) Plan which will be reviewed prior to the start of any SBO Program related work. A major component of the HSE Plan is the identification of potential health and safety hazards associated with the SBO Program including environmental conditions and MWO activities and the implementation of the controls necessary to minimize the risk to people. The program-specific HSE Plan is based on the assessment of previous worksites and similar activities, and is a dynamic documents that can be modified if things change during the SBO Program. The HSE plan will cover the following information:

- personnel contact information
- emergency contact information
- Safe Work Practices and Procedures
- toolbox meetings (to be completed at the start of every day)
- incident reporting

While working at sea there is the potential to become seasick. This can affect your ability to continue to observer for marine mammals and seabirds. It is recommended that if you are unsure about whether or not you will get seasick that you plan to bring enough seasickness meditation to last you the entire program.

4.0 TRAINING GOALS

From this manual; you will learn:

- For Marine Mammal Surveys:
  - field schedule and what is expected of you
  - position on the vessel while observing
  - observation techniques
  - how to use the equipment
  - how to estimate distances
  - how to record data
  - how to spot and identify marine mammal
- For Seabirds:
  - survey methods from a moving platform
  - survey methods from a stationary platform
  - how to record data

5.0 MARINE MAMMAL SURVEY

5.1 Field Schedule

Watch periods will consist of two hour observations periods (Table 1). After each two hour watch the MWO will take a break and the MWO will start his/her watch shift. Each MWO will conduct four watches each 24-hour period covering a total of 16 hours of active marine mammal observing (from 06:00 to 22:00 EST). The Golder crew lead will alternate between teams to mentor the MWOs during active watch periods, help with data recording, and to review data quality.

Table 1: Proposed MWO Schedule

24 Hour Clock (MDT)	12 Hour Clock (MDT)	Ship-base Observer		Golder Crew Lead
		MWO 1	MWO 2	
06:00-06:30	06:00-06:30	Watch 1		Toolbox Meeting Daily MWO set-up Seabird Survey 1
06:30-07:00	06:30-07:00	Watch 1		
07:00-07:30	07:00-07:30	Watch 1		
07:30-08:00	07:30-08:00	Watch 1	7:30 Breakfast	7:30 Breakfast
08:00-08:30	08:00-08:30	8:00 Breakfast	Watch 1	Toolbox Meeting Data Review Seabird Survey 2
08:30-09:00	08:30-09:00		Watch 1	

24 Hour Clock (MDT)	12 Hour Clock (MDT)	Ship-base Observer		Golder Crew Lead
		MWO 1	MWO 2	
09:00-09:30	09:00-09:30		Watch 1	
09:30-10:00	09:30-10:00		Watch 1	
10:00-10:30	10:00-10:30	Watch 2		Data Review
10:30-11:00	10:30-11:00	Watch 2		
11:00-11:30	11:00-11:30	Watch 2		
11:30-12:00	11:30-12:00	Watch 2	11:30 Lunch	11:30 Lunch
12:00-12:30	12:00-12:30	12:00 Lunch	Watch 2	Data Review Seabird Survey 3
12:30-13:00	12:30-1:00		Watch 2	
13:00-13:30	1:00-1:30		Watch 2	
13:30-14:00	1:30-2:00		Watch 2	
14:00-14:30	2:00-2:30	Watch 3		Data Review Sea Bird Survey 3
14:30-15:00	2:30-3:00	Watch 3		
15:00-15:30	3:00-3:30	Watch 3		
15:30-16:00	3:30-4:00	Watch 3		
16:00-16:30	4:00-4:30		Watch 3	Data Review Seabird Survey 4
16:30-17:00	4:30-5:00		Watch 3	
17:00-17:30	5:00-5:30		Watch 3	5:00 Dinner
17:30-18:00	5:30-6:00	5:30 Dinner	Watch 3	
18:00-18:30	6:00-6:30	Watch 4	6:00 Dinner	Data Review
18:30-19:00	6:30-7:00	Watch 4		
19:00-19:30	7:00-7:30	Watch 4		
19:30-20:00	7:30-8:00	Watch 4		Final Data Review Daily/Weekly Reporting

5.2 Observer Position

When one observer is present on the bridge the MWO is responsible for surveying the entire area around the vessel (360°) from the middle of the bridge. When the vessel is in-transit, the observer will scan from the bow (0°) to the stern (180°), focusing on the water ahead and to the side(s) of the moving vessel (from 120° to 240°, Figure 3). When the vessel is stationary, the MWO should change their searching area for marine mammals to cover the entire around the vessel (Figure 4). This may require the MWO to move from the starboard side to the port side of the vessel to cover all areas.

When two observers are on watch together, each focus their survey efforts to their side of the vessel with some overlap at the bow to ensure proper coverage where the two surveying areas meet. When the vessel is in-transit,

marine mammal observations will consists of scanning the water from the bow (0°) to the stern (180°), focusing on the water ahead and to the side(s) of the moving vessel (from 0° to 120° or 0° to 240° depending on the location of the MWO; Figure 5 and Figure 7). When the vessel is stationary, MWOs should change their searching area for marine mammals to cover the entire around the vessel (Figure 6).

The bridge on the *Botnica* offers good visibility all around the vessel.

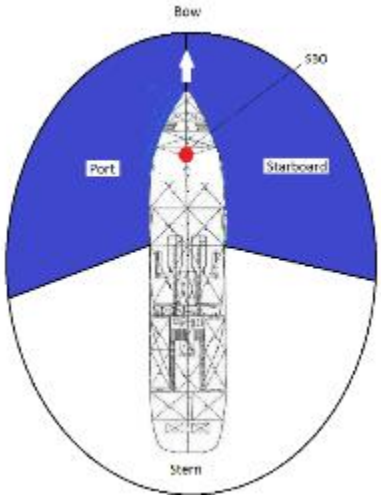


Figure 3: MWO location (one MWO) and Field of Observation when Vessel is Moving

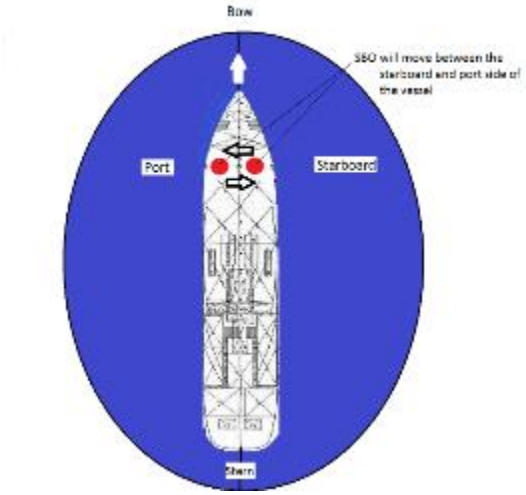


Figure 4: MWO location (one MWO) and Field of Observation when Vessel is Stationary

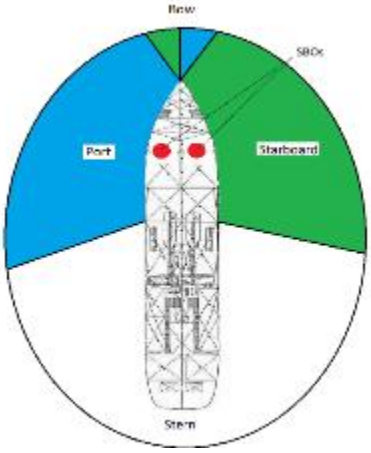


Figure 5: MWO locations (two MWOs) and Field of Observation when Vessel is Moving

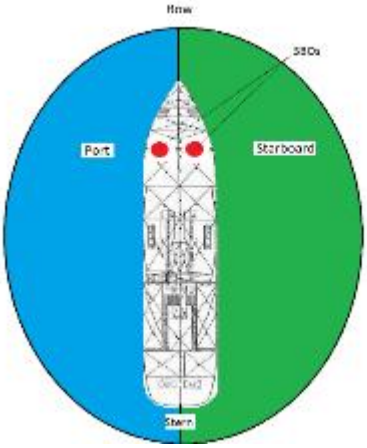


Figure 6: MWO location (two MWOs) and Field of Observation when Vessel is Stationary

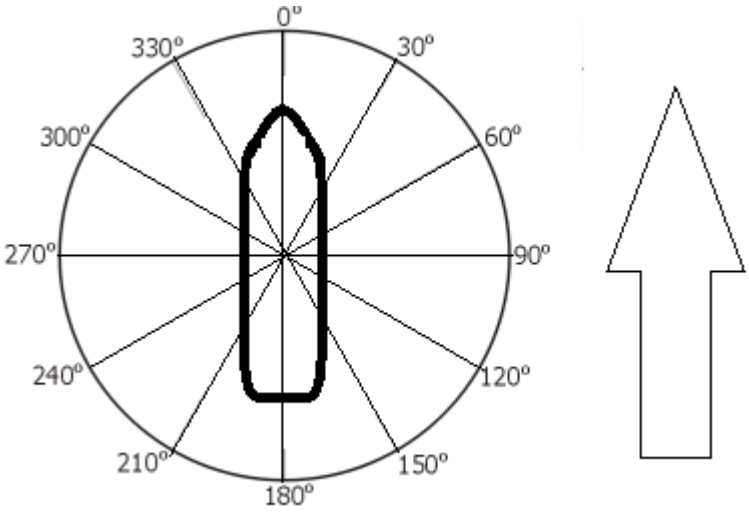


Figure 7: Degrees in Relation to the Vessel

5.3 Equipment

Binoculars

Typical binoculars increase objects 7 to 10 times (i.e. 7x or 10x).

Two types of binoculars are to be used:

- 7x 50 reticle binoculars (used when estimating distances)
- 25x to 40x Big-Eye Binoculars (for closer marine mammal observations at greater distances)

It suggested to regularly clean the binocular eye pieces with an alcohol based antiseptic cloth when sharing in between sharing binocular with other individuals. This prevents to spread of eye infections which are usually highly contagious. Additionally, if they come in contact with ocean water, rinse them with fresh water and let them dry. Use a soft cloth to clean the lenses as they are prone to scratches and some have protective coats that can wear out.

Reticle Binoculars

Reticle binoculars have a scale built inside the lenses called a reticle which is used to estimate distances of objects. This will be discussed in greater detail below.

Big-Eye Binoculars

Big-eye binoculars will be set up on a tripod somewhere in the middle of the bridge. They are used to identify sightings that are very far away. Don't used the big eyes to scan the water.

Laser Range Finder

Range finders are instruments that calculate distances with a laser when pointed at an object. They will be used during the training to practice your distance estimation abilities. Unfortunately, they are not very useful in the field during marine mammal surveys as they cannot distinguish between the ocean and a whale.

Laptop with Access database

Data will be entered on a laptop computer with an Access©-based database application. The database is programmed with data forms (drop-down menus) and data entry fields that are specific to the type of data we are collecting. The data that will be collected in the databased is discussed in more detail below.

Garmin GPS

The Garmin GPSs will be used to track the vessel during marine mammal surveys and record waypoints when:

- a sighting is made (marine mammal, other vessel)
- the start and end of a watch period
- the environmental variables change

The GPSs should be turned on at the start of the first watch. To turn on the GPS hold the “ON” button located on the top of the device. It may take a few minutes for the device to acquire satellites. The GPSs will be connected to external antennae in order for them to be able to acquire a signal. To take a waypoint press the “MARK” button. A waypoint number will come up on the screen which you will then record in the database.

The MWO should check the GPS regularly during his/her shift to ensure that it has not lost signal and is working properly.

Hard Copy Data Sheets

Printed forms of observation data will be available in paper form to be used when observing away from the data recording laptop, or as backup. These forms will collect the same type of data as the Access-based database application.

5.4 Observing Techniques

To ease the strain on the observers’ eyes, two types of scanning techniques are used to detect marine mammals: U and S scans (Figure 8). S scan method consist of scanning the water parallel to the horizon (in an s-shaped pattern) and U scans consist of scanning the water perpendicular to the horizon (shaped like the letter u). These scanning techniques should be used every 20 seconds to avoid observer fatigue. These are some helpful hints to implement in your active scanning routine:

- Continuously scan the water with the naked eye using the S and U techniques.

- Use binoculars only to focus in on possible sightings. Binoculars decrease your observing area by focusing your view on a small area so it is best not to use them to scan.
- Use big-eye binoculars for sightings at far distances. It can be difficult to focus the big-eye binoculars in rough sea conditions.
- Be ready to observe the next sighting, so keep your eyes moving and scanning the field of view as soon as possible after gathering all information about a sighting.
- Regularly change the distance of your view, do not just look at the horizon or just at the water close to the vessel.
- Watch for sighting cues (discussed in more detail below).

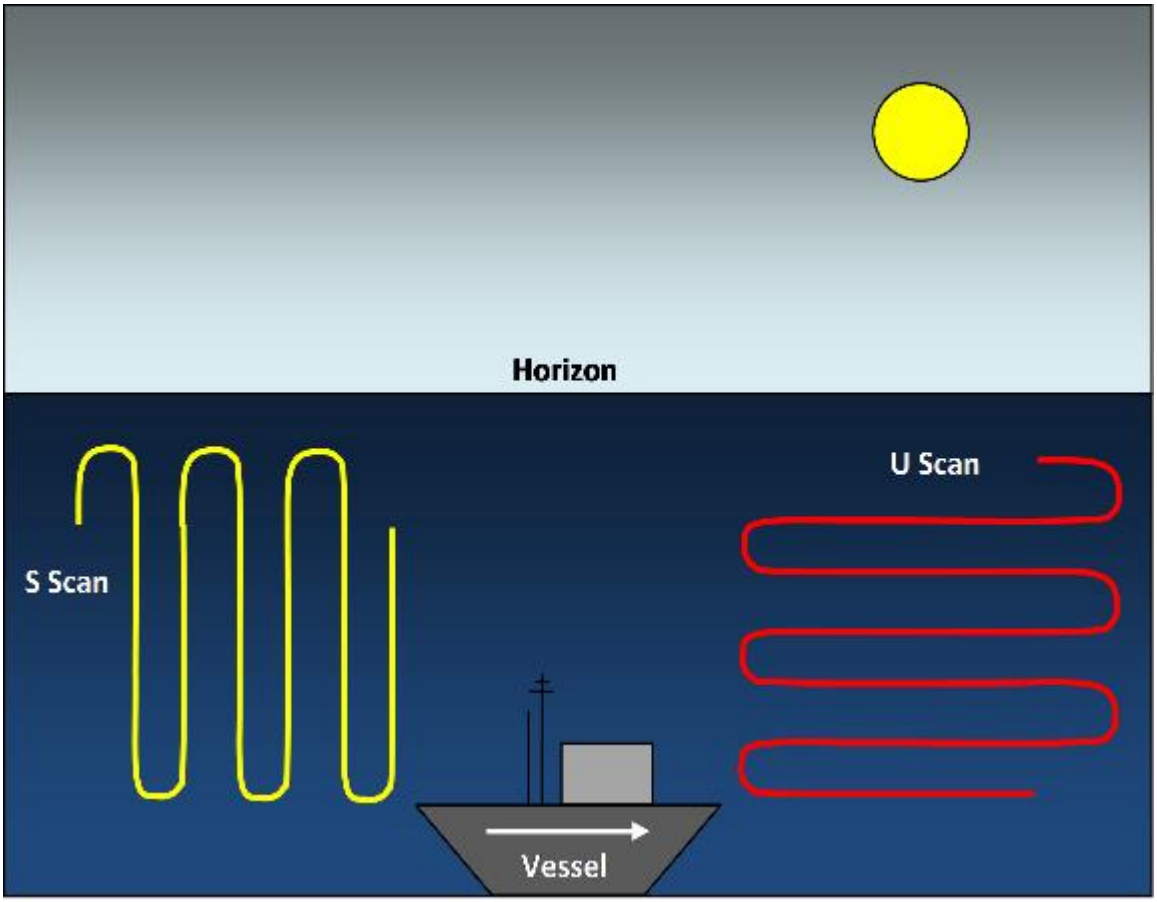


Figure 8: S and U Scanning Techniques to be used during Marine Mammal Observing

5.5 Estimating Distances

Accurately estimating distances is the most important MWO skill and is learned with regular practice. Some helpful resources when trying to estimate the distance to a sighting is:

- use the known distance to shore (from nautical maps, ship vessel radar, GPS plotters) as a reference

- ask others on the bridge – the crew is a great resource
- Practice in between sightings using the rangefinder on a non-moving object – usually limited to objects < 500 m.
- If available use the reticle binoculars.

Calculating distance using reticule binoculars

Reticular binoculars can be used to estimate the distance to a sighting if the following information is present/known:

- a horizon is present and is not obscured (by fog or land)
- the height above sea-level to the eye of the person sighting the marine mammal is known

It is useful to generate a distance table (see Table 2) prior to the start of a field program once the MWO have been identified (eye height is known) and the vessel platform has been decided (platform high above sea level).

Making a Distance Table

Estimating distances based on reticle readings depends on the distance to the horizon which is dependent on

- the height of the observer eye above sea level in metres
- radians per reticle mark for the type of binoculars you are using

The milliradians (mils) per reticle mark for Fujinon 7X50 reticle binoculars is 5 (Fujinon 2006). We use this number to produce a distance table for each project and each person (if the height of individuals differs significantly) using the following equation:

Distance = (eye height + height above sea level in meters) x 1000 / # of mils or milliradians

For the purposes of this manual we have assume that everyone is 1.8 m to eye level. We know that the height of the bridge is 20 m above sea level = total 21.8 m. With these assumptions we can generate the following table.

Table 2: Distance Table Example

Number of Reticles	# milliradians (mils)	Eye Height* + Height Above Sea Level	Distance in Meters to Sighting
1	5	21.8	4360
2	10	21.8	2180
3	15	21.8	1453
4	20	21.8	1090
5	25	21.8	872
6	30	21.8	727

Number of Reticles	# milliradians (mils)	Eye Height* + Height Above Sea Level	Distance in Meters to Sighting
7	35	21.8	623
8	40	21.8	545
9	45	21.8	484
10	50	21.8	436
11	55	21.8	396
12	60	21.8	363
13	65	21.8	335
14	70	21.8	311

Notes: Distance = (eye height + height above sea level in metres) x 1000 / # of mils (Fujinon 2006).
Assumptions: eye height = 1.8 m, height above sea level = 20 m (for MSV *Botnica*)
* Eye height will change with each individual
Each Reticle = 5 milliradians also called mils

How to use the Fujinon reticle binoculars:

1. make sure your binoculars are in focus
2. line up the top reticle line with the horizon
3. count from the horizon (top reticle) down, how many lines there are to the marine mammal
4. use the number of lines counted and the distance calculation table to find out the distance to the marine mammal

Example: Look at Figure 9 and estimate the distance to the marine mammal using Table 2 above.

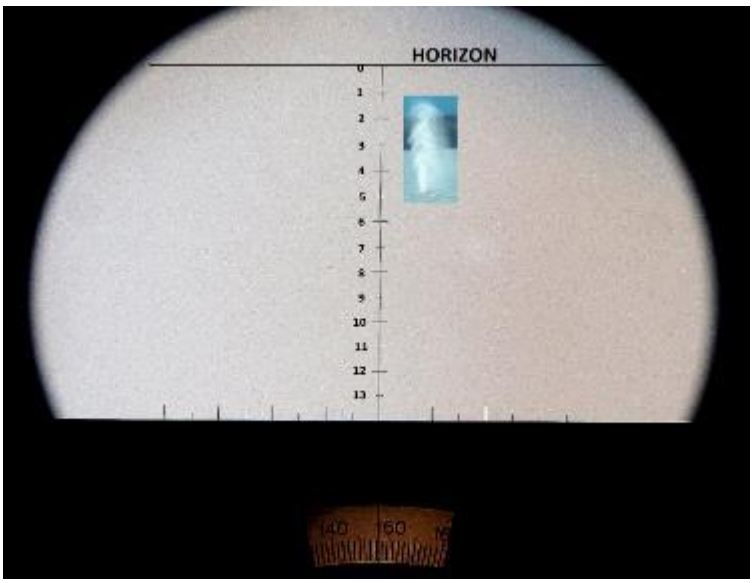


Figure 9: Calculate the Distance to the Marine Mammal

5.6 Detection Cues

Marine mammals spend most of their time underwater, therefore, MWOs only have the ability to spot them when they are at the surface which in most instances is for a very short period of time. Detection cues are useful to know as they can mark the presence of marine mammals even when they have not fully surfaced. Below is a list of detection cues that will be useful to know when performing MWO duties.

Splashes in the water

Splashes may be a sign that a marine mammal is present (Figure 10).

Figure 10: Splash

Footprints

Footprints are when the surface of the water looks disturbed and are made when a marine mammal has just been on or near the surface of the water (see Figure 11).

Figure 11: Footprint from Marine Mammal

Birds

Birds may be attracted to marine mammal when they are feeding. Keep an eye out for bird aggregations near the surface of the water and diving into the water (Figure 12).

Figure 12: Birds on the Water with Whale

Blows

Marine mammals breathe air and are forced to surface even if only for a short time. When whales surface, they often expel a watery mist from their blow holes. Blows vary in size and can be seen from very far distances. This is the one of the most common detection cues. During calm conditions, blows may also be heard.

Baleen whales (bowhead whales) and toothed whales (narwhals, belugas and killer whales) have different blows.

Toothed whale blow (Narwhals, Belugas and Killer Whales)

Because toothed whales have a single blow hole and because they are smaller animals than the baleen whales we might observe (bowhead whales), their blows are shorter and wider that baleen whale blows (Figure 13). Blows of toothed whales are not often seen from far distances, and at times, not seen at all.

Baleen whale blow (Bowheads)

Because baleen whales have two blowholes, their blows are wider apart and sometimes make a V-shaped or heart-shape (Figure 13). Baleen whale blows are also much higher than toothed whale blows at times, can be observed from greater than one kilometre away.


Figure 13: Toothed whale blow (left) versus baleen whale blow (right)

5.7 Species Identification

Identifying the species of marine mammal you have observed is a task that is learned through training and experience. If you are local to the area, you likely already know more that we do!

If you are unsure about what species you have spotted you can ask others on the bridge to help you identify the animal, including the other MWO is on the bridge and the Golder lead. It is also a good idea to take a photo as soon as you see the sighting. Photos can be useful to confirm species identification. Marine mammal cues can sometimes look different from an elevated surface like that of the bridge of a large vessel compared to from smaller vessels at the water surface. It may take a few sightings to get used to cues from a different platform. If you still do not know the species and the sighting has disappeared, then you would simply record the sighting as unidentified or identify the species and mark it as a possible species identification.

The common marine mammals in the area include:

- narwhal whales
- beluga whales
- killer whales
- bowhead whales
- ringed seals
- harp seals
- bearded seals
- walruses
- polar bears

Here are some helpful hints to distinguish between the common marine mammals you are likely to see in the area.

5.7.1 Whales

If you spot what you think is a whale the first questions to ask are:

- what is the shape of the blow?
- what is the size of the whale?
- what is the colour?
- do you see a tusk?

If it is a large whale with a V-shaped blow then it is likely a bowhead whale. If it smaller with a lower bushy blow and white then it is likely a beluga whale. If it is smaller with a lower bushy blow and dark then it is likely a narwhal whale. If it is smaller with a lower bushy blow and a large dorsal fin then it is likely a killer whale.

Narwhals

Adult male narwhals are easily recognizable by their long spiraled tusk that can extend up to nine feet. Narwhals do not have functional teeth inside the mouth, but males (and some females) continuously grow one of two upper jaw teeth through their lips. The narwhal is a relatively small whale (4.7 m) with a sleek grey and white spotted body. Their head is blunt lacking a beak, and they lack a dorsal fin. The pectoral flippers are small and rounded, and their fluke is noticeable convex at the terminal end. They occasionally lift their flukes while diving. Narwhals follow the receding Arctic ice in the summers deep into non-frozen pockets of bays and fjords, and migrate out to sea as winter ice grows. Light colored females and young adults can sometimes be mistaken for belugas, but generally a few individuals in a group of narwhals will display identifiable characteristics. Large congregations of hundreds of animals occur in the summer months.

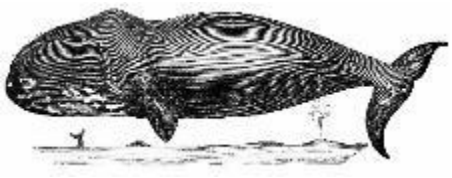
Beluga Whales

As the only marine mammal that is completely white, the beluga whale is easily recognizable. Its skin can at times have a yellowish-tint. Belugas have a relatively small body size (as with the narwhal) of between 2.7 to 4.2 m long. The head is blunt, containing a protruding melon. Their fins are small and they have narrow ridge instead of a dorsal fin. They rarely raise their flukes when diving. Belugas are very social, often found in groups or 5 to 15 individuals and even aggregations of thousands in some estuarine and bays. They display a strong site fidelity to their natal bays. They can sometimes be mistaken for young harp seals, ice or white birds.

Killer Whales

Killer whales will be the only whale you may see with a prominent dorsal fin. They are mid-sized whales (larger than narwhals and belugas) and can reach up to 9 m in length. Their other distinguishing feature is their dark black bodies with white eye and saddle patches. It should be easy to spot and identify killer whales if they surface during the program.

Bowheads



The Bowhead has black robust body, lacking a dorsal fin, a massive head, and a highly arched jaw line. Distinguishing features are a white lower chin patch and a hump anterior of the blowholes followed by a depression. The immense head is capable of breaking through ice 1.8 meters thick. Their blows are also V-shaped when seen from the front or from behind, and they often raise their fluke when diving. They are closely associated with sea ice and follow the receding ice in the northern hemisphere summers.

5.7.2 Seals and Walruses

Ringed Seals

Ringed seals are the smallest and most common species of seal in the Arctic. They are the most important prey species for polar bears. Ringed seals have plump bodies and small heads with short snouts. They are generally dark dorsally with irregular ring patterns and lighter on the ventral side. Pups are born white and shed this coat at 6 to 8 weeks of age after which they are uniformly dark until their first molt. Like the bearded seal, they are also closely associated with sea ice. Ringed seals are also often observed alone and do not often aggregate in large groups. Ringed seal molt in June and July when they haul-out on the sea ice.

Harp Seals

Harp seals are distinguishable from ringed seals in their horseshoe-shaped dark saddle patch on their backs. Pups are born with white fluffy coats until 3 to 4 weeks of age when the white coat is replaced with a silver coat with some scattered spot. Adult have robust bodies and small heads with broad flat narrow snouts. They have light gray coats with black faces and black saddle patch. Younger individual may appear spotted as their saddle patch develops with each moult. Aggregations are observed during breeding (February to March) and in spring when moulting. Groups may also form during feeding and migrating activities.

Bearded Seals

Bearded seals are one of the largest seals in the Arctic. Its distinguishing characteristic is a dense “beard” of whiskers on its upper lip. Its large body is offset by its small blunt head with large cheeks. The square fore flippers are small relative to the body making it appear more stocky and robust than other seals. Adults are gray or dark brown with some spots or rings visible. Pups are also brown to bluish. Bearded seals and generally associated with drifting sea ice in shallow-water areas. They are more commonly observe alone, however, aggregations may occur when drifting sea ice become concertation. During the months of April to August bearded seals will spend more time hauled out for molting.

Walruses

Walruses are easily distinguished from other seals by their large bodies and tusks. They have a thick bunch of whiskers on their cheeks. Adult males are usually much large than females. Skin colour varies and can appear pale beige to bright pink. Newborns have greyish-brown hair. In the summer, walruses haul-out on pebble and sandy beached in large aggregations to molt and rest.

5.7.3 Polar Bears

Polar bears are easily distinguishable from other marine mammals. On the ice, polar bears appear to have a yellow-tint. Keep in mind that you may observe a polar bear swimming in the ocean. Its pointed snout should allow you to distinguish it from seals.

5.8 Behaviours

Behaviours will need to be recognized and recorded during the proposed survey. The following is a list of behaviours you may see while observing marine mammals:

Breaching – When a whale leaps with its entire body out of the water and lands back down on the surface.

Flipper Slapping – When a marine mammal slaps its fore flipper against the surface of the water. Dolphins, whales, seals and sea lions all exhibit this type of behaviour.

Lobtailing – When a whale or dolphin slaps the water surface with its fluke[a], sometimes repeatedly

Diving – When a marine mammal dives beneath the surface. In whales, the differentiation between diving and fluking is that no flukes are observed during diving behaviours.

Fluking – When a whale shows its fluke as it dives beneath the water

[a] Tail

Spyhopping – When a whale raises its head vertically out of the water so that its eyes are clear of the surface

Blowing – When a whale releases air from its lungs at the surface of the water. Blows can be visible from far distances and are observed as clouds moist air at the surface of the water

Resting – When a marine mammal is on the surface but is neither swimming nor moving

Looking – When a marine mammal is in an upright position with its head out of the water (not traveling) and looks at a vessel. Whales are more likely to exhibit spyhopping than looking. Seals often will look in the direction of a vessel.

Feeding – When a marine mammal gathers or chases prey and eats.

Hauled-out – When a seal or walrus pulls their body out onto land or ice.

Swimming Towards Vessel – When a marine mammal is observed swimming towards the vessel.

Swimming Away from Vessel – When a marine mammal is observed swimming away from the vessel.

Milling – When a marine mammal swims slowly in a limited area with no particular travel direction and does not seem disturbed by anything. Swimming in circles is an example of milling.

Surfacing – When a marine mammal is observed coming to the surface of the water.

Fast Swimming – When a marine mammal is swimming rapidly through the water. Fast swimming is often associated with splashes in the water from the animal moving quickly through it.

Slow Swimming – When a marine mammal is swimming at a normal or slow pace.

5.9 Other Important Information to Record

Re-sightings – It is important not to double count marine mammal sightings. If you see a marine mammal multiple times it is ok to add each sighting into the database if you mark each duplicate as a re-sighting. This is provided as an option in the database for each sighting you record.

Bearing from bow – In order to record the location of marine mammal sightings we need each sighting to include a bear from bow. Figure 14 shows how to estimate the bearing from bow for a whale sighting.

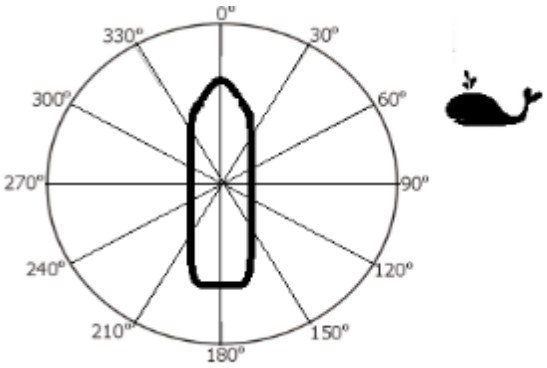


Figure 14: The Whale Sighting is Observed at Approximately 70 degrees

5.10 Environmental Variables

Environmental variables that are important to record during observation periods are:

- ice cover
- wind speed/direction
- sea state
- weather
- visibility
- sightability
- sun glare

Environmental variables are important to record because they can alter the ability to spot and identify marine mammals as well as influence the distribution of marine mammals. This information is used during reporting to analyse the MWO effort and marine mammal distribution.

Environmental variables should be recorded in several instances:

- at the beginning of each MWO watch
- if the environmental variables or vessel position changes during a watch; and
- at the time of a marine mammal observation.

The database is programmed in such a way that you will be prompted to record the important. If you are using hard copy forms, you will have to remind yourself to record the necessary information.

Ice Cover

There will likely be ice present during the program. As the presence of ice can affect the distribution of marine mammals it is an important condition to record. Ice cover will be recorded in a percentage cover of your field of view. Please not any additional comments you may have about the ice in the notes of the database.

Wind Speed

Wind is the major environmental condition affecting wave height and shape. In general, stronger winds produce larger and rougher waves. High winds causing rough sea conditions can make it very difficult to spot and identify marine mammals. The Beaufort wind force scale is an international scale that ranks wind speeds into 12 categories (0 to 11). Wind speed is recorded in knots and is usually monitored by a dedicated instrument on the vessel called an anemometer. When you get on board, ask a crew member where to obtain readings on wind speed and direction. Table 3 describes the main Beaufort wind force categories.

Table 3: Beaufort Scale for Wind Force

Wind Speed (knots)	Beaufort Wind Force	Description
<1	0	Calm
1–3	1	Light air
4–6	2	Light breeze
7-10	3	Gentle breeze
11-16	4	Moderate breeze
17-21	5	Fresh breeze
22-27	6	Strong Breeze
28- >64	7-12	Near gale to hurricane

You can also estimate wind speed based on the sea state observed. Table 4 describes the type of sea conditions that correspond to the Beaufort wind force categories.

Wind Direction

Direction of the wind is also noted in the database as North, East, South or West etc. If unsure, ask a crew member.

Sea State

Sea state greatly affects MWOs abilities to spot and identify marine mammals. Sea state is measured in wave height in metres. Wave height is measured from the bottom of a wave (trough) to the top (crest) of the adjacent wave (Figure 15).

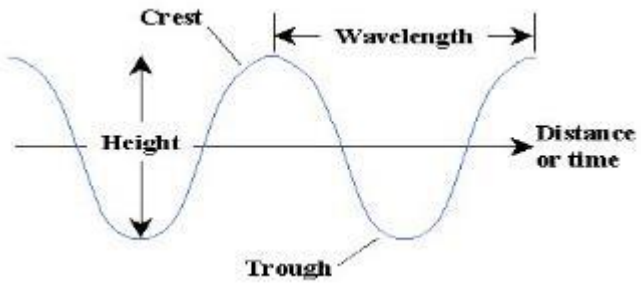


Figure 15: Wave Characteristics

Sea state is also measured in categories. It is broken into 11 categories, numbered 0 to 9 (Table 4). It is a good idea to carry a copy of the sea state table with you when you go on an MWO program and have it visible in an area where you are performing your duties. It is important to note that the sea state scale **does not** quite match the Beaufort wind force scale.

Table 4: Sea States Categories and Corresponding Descriptions in relation to Beaufort Wind Force

Wave Height (m)	Sea State	Description	Beaufort Wind Force	Picture of Sea Condition
0	0	Glassy	0	
<0.1	0.5	Ripples	1	

Wave Height (m)	Sea State	Description	Beaufort Wind Force	Picture of Sea Condition
0-0.1	1	Small wavelets	2	
0.1-0.5	2	Smooth wavelets	3	
0.5-1.2	3	Slight; small white caps	4	
1.2 - 2.4	4	Moderate waves, some spray	5	

Wave Height (m)	Sea State	Description	Beaufort Wind Force	Picture of Sea Condition
2.4 – 4	5	Rough, larger waves	6	
4 – 14 plus	6 – 9	Very rough to extremely high	7 - 12	 

Notes: Photos retrieved from http://thegiddyupplan.blogspot.ca/2011/03/noaa-beaufort-sea-state-images.html

Weather

Marine mammal observing is largely dependent on local weather conditions, as the ability to see a marine mammal is greatly reduced in conditions of high seas, heavy rain, fog, or presence of glare. Weather conditions are continuously recorded throughout a marine mammal survey in order to account for any changes in the ability to detect animals.

Visibility

Visibility' is the distance you are able to see from the vessel. In the database your options are >10,000 m which would be considered excellent visibility to 500 to 1000 m which is considered poor or low visibility.

Sightability

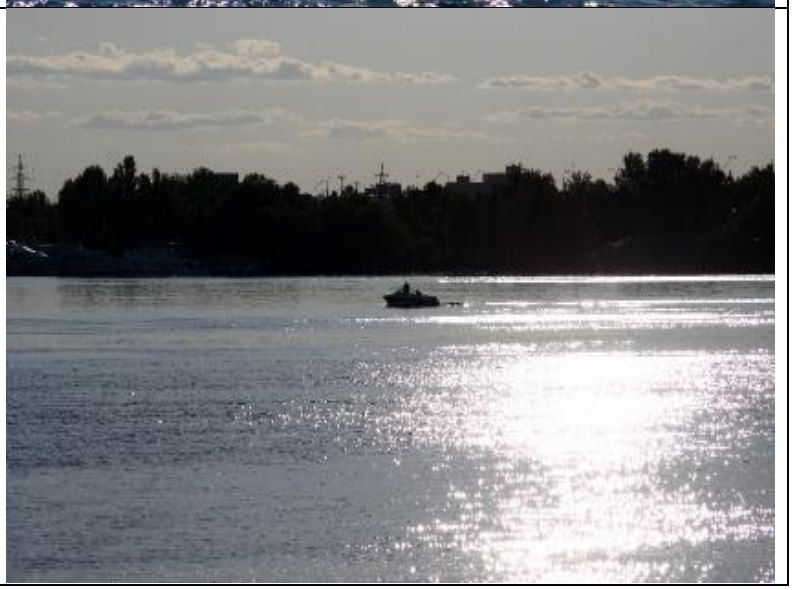
Sightability is based on a number of environmental variables (weather, glare, sea state etc.). This factor plays a major role in your ability to spot and accurately identify marine mammals, particularly at a distance. Visibility is recorded in metres.

Sun glare

Sun glare can also greatly affect a MWO's ability to spot and identify marine mammals. Sun glare is recorded in the environmental observation form. Table 5 outlines what each sun glare description represents. The percent the sun glare is taking up in your field of view (FOV) is also recorded, as well as the where the sun glare starts and ends in the FOV (the relative position of the glare is recorded either in degrees or in clock position).

Table 5: Sun Glare

Sun Glare Description	Picture of Description
No Glare	
Weak Glare	

Sun Glare Description	Picture of Description
Strong Glare	
Variable Glare	

5.11 Recording Data

One of the most important parts of your work will be to carefully enter information on all sightings/observations during your watch. This information is critical to the success of the SBO Program. A lot of time and mentorship will be spent on training to properly, efficiently and consistently record information.

To make data entry easier, all MWOs will use a specially designed electronic database on a laptop. Hard copy datasheets will also be available in case of technical issues with the laptops or database. These are provided in APPENDIX A.

The Access database will include:

- information on observer and watch/survey effort
- environmental variables that may affect marine mammal detection during the watch
- marine mammal sighting information

The forms include “drop-down” lists and pre-defined selections to make data recording faster and ensure data entry consistency for later analysis.

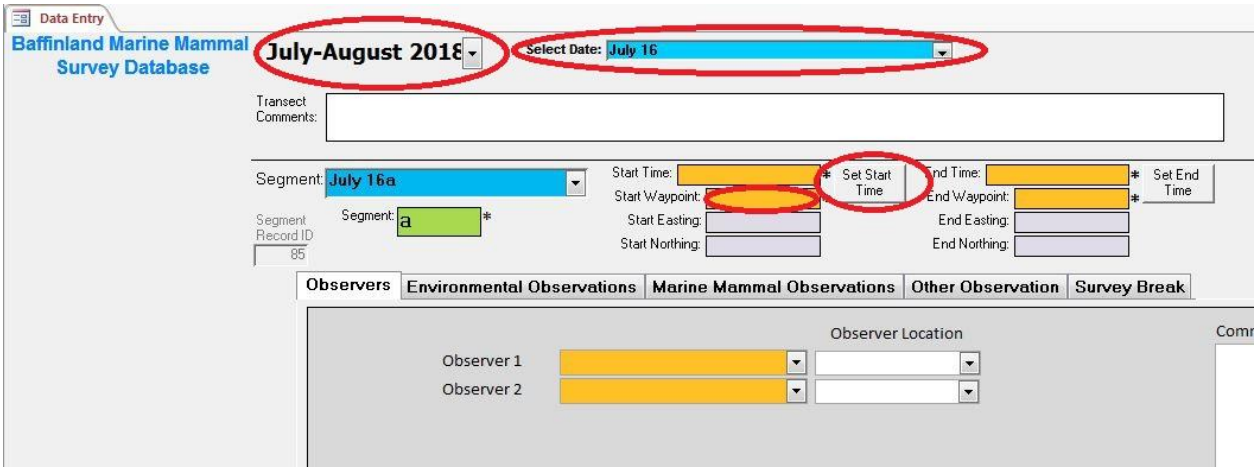
The most important thing is to ensure that all data fields have been entered when an observation is made.

The database automatically saves, so you do not have to worry about saving until the end of the day.

5.11.1 Observer Information

When the database opens the following screen will be visible. This is the first form you will fill out at the start of your watch. The first team on deck will fill out the following fields:

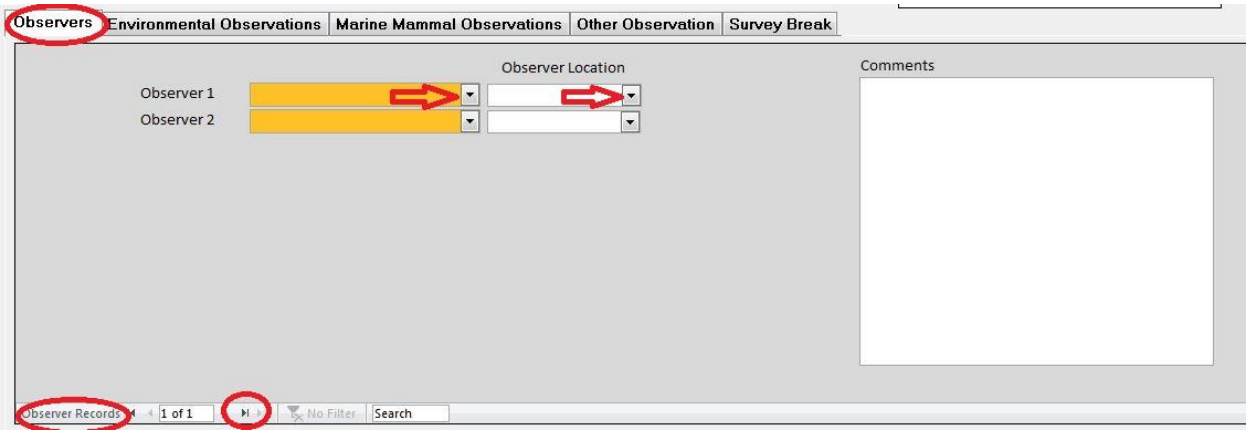
- select proper survey month
- select date
- set start time and take a starting waypoint with the Garmin GPS waypoint and enter the waypoint number



GPS tracks will be taken during all MWO activities to capture the survey effort. In addition, MWOs will take waypoints at the start and end of every day to mark when observations started and ended.

Go to Observer tab and:

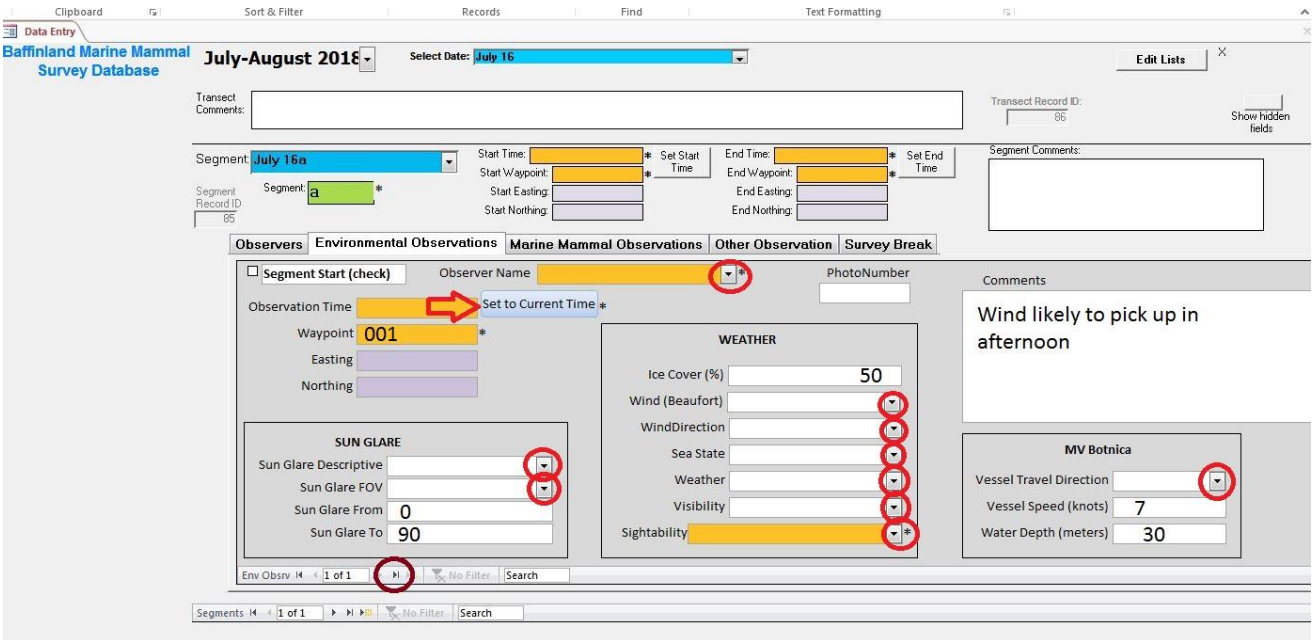
- Choose the location of your observation position (Starboard, Port or Middle of the Bridge).
- If only one observer is present chose – One MWO – Middle of Bridge for both observers
- A new record sheet should be filled out at the start of each WATCH. Get a new record by pressing the right arrow at the bottom on the screen.



5.11.2 Environmental Variables

Go to the environmental variables form. This form should be completed at the start of every day, every 30 minutes and when conditions change.

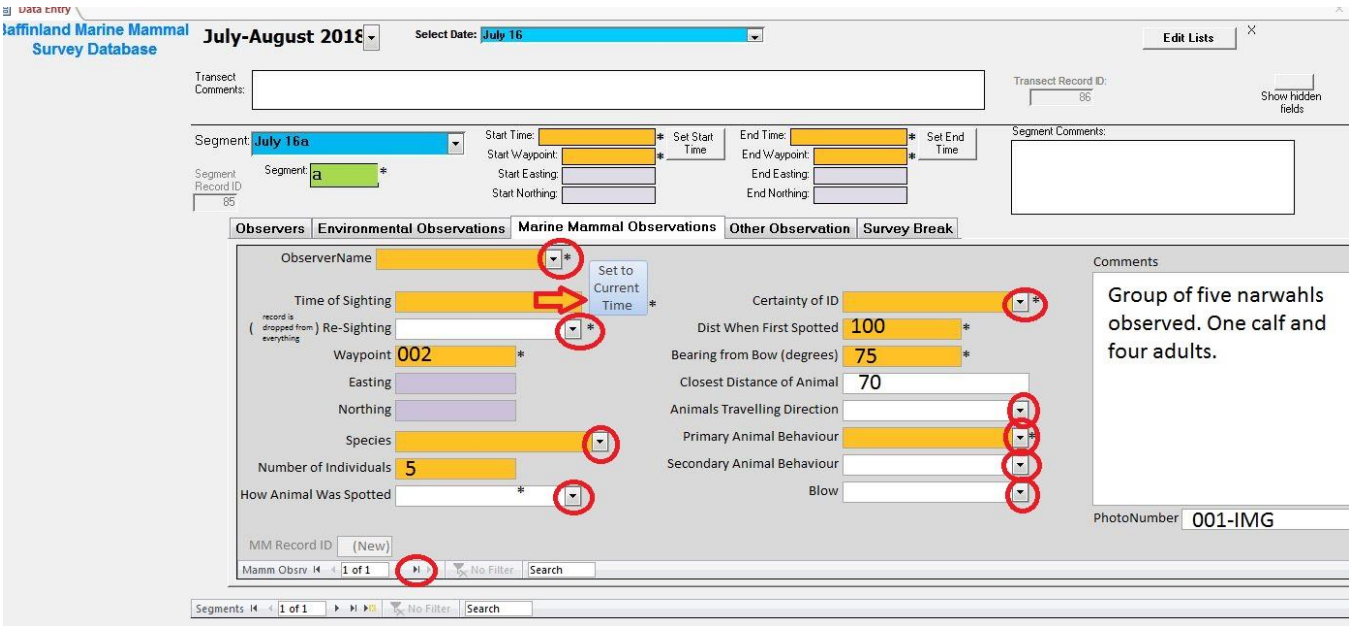
- Choose your MWO number or name.
- Set the time using the blue “set to Current Time” button.
- Enter a waypoint in the Garmin GPS and record the Waypoint number.
- Fill out the Sun Glare and Weather Boxes. Refer to Section 5.10 of this manual for details regarding these descriptions.
- Add a photo number if a photo was taken to capture the environmental variable (it is good practice to take at least one shot of each environmental variable in order to capture the interpretation of these factors in the field).
- A new environmental record sheet should be filled out at the start of each WATCH and when conditions change. Get a new record by pressing the right arrow at the bottom on the screen.



5.11.3 Marine Mammal Sightings

Once you see a marine mammal go to the marine mammal observations tab:

- Choose your MWO number or name
- Set the time using the blue “set to Current Time” button
- Choose if the animal is a re-sighting (i.e. has been observed previously)
- Enter a waypoint in the Garmin GPS and record the Waypoint number
- Enter species, number of individuals
- Certainty of ID
- Distance when first spotted (in m) – type it in
- Bearing from Bow (degrees) – type in
- Closest distance of animal (did the animal get closer to the vessel after if was first spotted?)
- Primary and secondary animal behaviours (these might be the same)
- If a blow was observed – add if it was high, medium or low
- If you get a chance, take a photo! – Add the photo number
- A new marine mammal sighting record sheet should be filled out every time you see an animal. Get a new record by pressing the right arrow at the bottom on the screen.

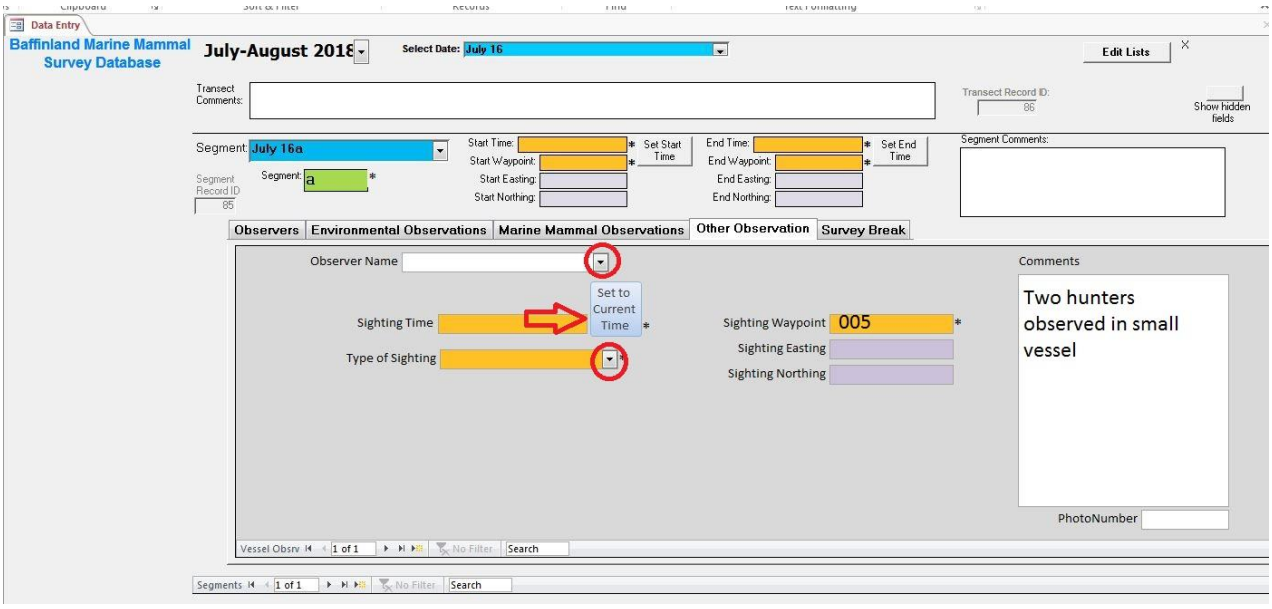


5.11.4 Survey Break

If you need to take a break from your post on the bridge at any point, please fill out the survey break form. This allows us to track the observer effort and to record when there is no one on the bridge recording marine mammals.

5.11.5 Other Observation

It is useful to gather other information in the area while conduction your MWO duties. This form includes information on other vessels in the area, hunting activities and allows the MWO to add any additional information they think would be useful.



6.0 SEABIRD SURVEY

Seabird surveys will be completed by the field lead according to the Canadian Wildlife Service's (CWS) Eastern Canada Seabirds at Sea (ECSAS) Protocols (Gjerdrum et al. 2012)[b]. During periods low marine mammal activity, WMOs will be trained and participate in seabird surveys. The objective of the seabird survey is to document seabird species abundance and distribution. Similar to the marine mammal surveys, the seabird surveys also record the distances to bird observations. A brief summary of the survey methodology is provided here. A full outline of the methodology is provided in Gjerdrum et al. (2012).

6.1 Surveys from Moving Platforms

A survey consists of a series of 5-minute observation periods, which are exclusively dedicated to detecting birds. The goal is to complete six to ten 5-minute observation periods during a dedicated seabird survey period, regardless of whether birds are present or not. Seabird surveys should be conducted throughout the day to provide consistent coverage (see Table 1). The transition between observation periods may take a minute or two depending on seabird activity, in order to record the vessel's position and any conditions that may have changed since the last 5-minute observation period. A series of surveys will not exceed a total of two hours to avoid observer fatigue.

Surveys are best completed when the platform is travelling at a minimum speed of 4 knots (7.4 km/h). Surveys can be done when the ship is travelling less than 4 knots, but birds are often attracted to slow moving or stationary vessels. If birds are clearly gathering around the vessel and settling on the water when the ship is moving at decreased speeds (i.e., less than 2 knots), surveys will cease.

During a 5-minute observation period, a 300 m wide rectangular area of ocean will be covered (from 0˚ to 90˚). All birds observed on the sea surface are continuously recorded throughout the 5-minute period and their perpendicular distance from the observer is estimated. Bird counts are associated with distance "bins" and include 0 to 50 m, 51 to 100 m, 101 to 200 m, and 201 to 300 m. The distance gauge using an ordinary ruler will be used to approximate distance categories.

6.1.1 Birds in Flight

More birds will fly through the survey area than were present in that area at a single instant in time. Flying birds are recorded using a series of instantaneous counts, or snapshots, at regular intervals along the transect and during the 5-minute survey period (Table 6). The time interval between snapshots depends on the speed of the ship and is chosen so that the ship moves roughly 300 m between snapshots. During each snapshot, flying birds are recorded as in transect only if they are within 300 m to the side and 300 m ahead of the vessel.

[bb] Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. 2012. Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 37 pp.

Table 6: Snapshot Interval Frequency

Platform Speed (knots)	Interval Between Counts (minutes)
0.1 to 4.5	2.5
4.6 to 5.5	2
5.6 to 8.5	1.5
8.6 to 12.5	1
12.6 to 19	0.5

6.1.1.1 Lines of Flying Birds

Some bird species fly in long lines. At the time of the snapshot, the number of birds in the flock is counted and the distance class is assigned according to the location of the flock centre. All birds are recorded as in transect if the centre of the flock is within the 300 m transect.

6.2 Surveys from Stationary Platforms

Survey from stationary ships or platforms will be completed using snapshots methods occurring at regular intervals throughout the day. Surveys are completed from a position outdoors whenever possible, as close to the edge of the platform as permitted. A position near the edge will increase the detection rates of birds, especially for birds that use the waters at the base of the platform. Surveys are completed by scanning a 180° arc, giving priority to birds within a 300 m semi-circle. The same distance bins are used as with Moving Platform methods (Section 6.1).

6.3 Data Quality Assurance/Quality Control and Back Up

At the end of each day, you should do a QA/QC on the data to verify that no records/fields are missing. Once completed, the database must be backed up on an external hard drive.

APPENDIX A

Hard Copy Datasheets

MARINE MAMMAL DESCRIPTIONS

Species
Ringed Seal
Bearded Seal
Harp Seal
Unidentified Seal
Bowhead Whale
Beluga Whale
Narwhal
Killer whale
Unidentified whale
Walrus
Polar Bear

Table A-1: Marine Mammal Sightings

Observer Name	Date of Sighting	Time of Sighting	Lat	Long	Re-Sighting? Yes/No	Species	Certainty of ID (Possible / Definite)	Number of Individuals	Sightings Cue	Distance (m)	Closest Distance to Vessel (m)	Bearing from Bow (degrees)	Travel Direction	Primary Behaviour	Secondary Behaviour	Travel Speed	Comments (Free Notes)

Table A-2: Environmental Conditions

Date	Time	Lat	Long	Observer(s) on Watch			Wind Speed (knots)	Wind Direction	Beaufort Sea State	Vessel Direction	Water Depth (m)	Precipitation	Glare Intensity	Glare FOV %	Glare From-To	Visibility (km)	Sightability	Ice Cover (%)	Comments

golder.com

Name: Jeff W. Higdon

Agency / Organization: Qikiqtani Inuit Association

Date of Comment Submission: 12 March, 2019

#	Document Name	Section Reference	Comment	Baffinland Response
1	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. v, Executive Summary	Re: birds, there were unidentified individuals, not species (i.e. individual birds that could not be identified to species). Based on details reported later in the report, they could be listed here as unidentifiable larids and terns.	Correct. The added specification was added in the Executive Summary.
2	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 1, S. 1.0 Introduction	The SMV Botnica has been described as an IMV here and in previous documentation, but recently (e.g., Phase 2 meeting in Ottawa) it has been described as an icebreaker. Is it an IMV or an icebreaker, as per the differences in activities as defined by Baffinland?	References to ice management vessel and icebreaking have been removed from the report to avoid confusion with terminology moving forward. The MSV *Botnica* is a class ICE-10 Icebreaker.
3	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 1, S. 1.0 Introduction	Is there really an "information gap" in the CWS ECSAS database? As written it suggests there are no data available for the region in the database, is this the case? It makes sense of course to use the same methodology to add to the database.	Yes, there is a gap in data collected using the CWS standardized methodology within the waters of the Local Study Area (LSA).

#	Document Name	Section Reference	Comment	Baffinland Response
4	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 3, S. 1.1 Project Background	In regards to past programs, it's most likely that people just weren't recording observations very well, e.g., complete lack of sightings recorded, not even gulls	The 2018 SBO Program was designed to ensure quality systematic observations through the training of the marine wildlife observers (MWOs) prior to boarding the vessel and the ongoing training and mentorship on the vessel.
5	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 4, S. 1.3 MMO Training and Crew	Can the two training manuals (Golder 2018a, b) be provided to the MEWG and/or appended to the report?	The Training Manual (Golder 2018b) will be included as an appendix to the report.
6	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 6, S. 2.1 Methods	Were U and S-scans used consistently, i.e., one, then the other, and repeat, or did different MMOs use methods as preferred? The Bruce Head training manual (s. 5.8 Observing Techniques, p. 21) provided direction on scanning techniques, was a similar process employed here? Having access to the training documents for the SBO program would help answer questions.	The choice of scanning method was left to the observers. The different systematic methodologies were introduced to the MWOs during training. As indicated in response to IR#5, the Training Manual (Golder 2018b) will be included as an appendix to the report.

#	Document Name	Section Reference	Comment	Baffinland Response
7	2018 Ship-Board Observer Program Report draft (file name “2018_SBO Report DRAFT FOR MEWG.pdf”)	Pg. 6, S. 2.1 Methods	Other species are also known to occur in the RSA, at least occasionally, e.g., sperm whales (and might be increasing in the north Baffin region).	Baffinland acknowledges there have been rare sightings of other species, such as sperm whales in Eclipse Sound in recent years. The methodology provides a list of the most likely species to be encountered.
8	2018 Ship-Board Observer Program Report draft (file name “2018_SBO Report DRAFT FOR MEWG.pdf”)	Pg. 9, S. 2.1 Methods	How was swim speed defined? What was considered "fast" versus "slow"? Having access to the training manual would help here.	It is a qualitative assessment of swim speed based on the MWOs judgement and knowledge of the animals. As indicated in response to IR#5, the Training Manual (Golder 2018b) will be included as an appendix to the report.
9	2018 Ship-Board Observer Program Report draft (file name “2018_SBO Report DRAFT FOR MEWG.pdf”)	Pg. 9, S. 2.1 Methods (and Results)	How often could reticle binoculars be used for distance determination? This should be reported in the Results for each species.	Distances cannot be calculated using reticle binoculars unless a horizon unobstructed by land is visible. Due to the high land features in the LSA there are few occasions that an unobstructed horizon is visible. As described in Section 2.1, the MWOs use the most accurate method to estimate the distance to animals and this methodology remained consistent throughout the survey.

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10	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 10, S. 2.1.1 Data Analysis	Unclear how ice cover percentage was determined, i.e., limited to observation area defined in Figure 4, p. 8 (S. 2.2.3.3 p. 26 indicates yes)? How often did estimates change? This will vary from survey to survey but summary statistics could be provided.	Ice cover percentage was limited to the observation area. Whenever there was a significant change in ice conditions a new estimate would have been recorded. Figure 9 summarizes the percent ice cover over the duration of the program. Figures 15 and 16 show the average ice conditions over the two phases of the program (summer and fall surveys).
11	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 11, S. 2.2.1 Survey Effort	Figure 6 - would be useful to have both shoulder seasons shown separately.	The vessel tracklines for each survey season are shown in different colours on Figure 6.
12	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 12, S. 2.2.2 Environmental Variables	Sea ice "normals" are usually defined by median conditions (vs average), see for example 30-year ice climatologies.	For the purpose of the SBO Program Report, average ice conditions suited the needs of the program. The recommendation is noted and will be considered for potential inclusion during future reporting.
13	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 12, S. 2.2.2 Environmental Variables	It would be useful to see weekly charts of ice type (no analysis necessary, CIS charts could be added as an Appendix).	Baffinland appreciates the recommendation from QIA related to including weekly ice charts and will be considered for potential inclusion during future reporting. Ice charts are available on several public accessed sites including the Government of Canada website. https://www.canada.ca/en/environment-climate-change/services/ice-

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				forecasts-observations/latest-conditions.html.
14	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 15-19, S. 2.2.2.1 Sighting Conditions	Any measures of variability among SBOs with respect to estimating ice cover, sea state, weather conditions, etc?	The MWOs calibrated their environmental condition reporting early at the start of the program through training on the vessel, as well as throughout the program through cross-checking.
15	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 17, S. 2.2.2.1 Sighting Conditions	Was wind force estimated only? No wind data collected?	Wind data was not directly collected. Beaufort sea state conditions provide the most relevant data to assess the detectability of marine mammals.
16	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 18, S. 2.2.2.1 Sighting Conditions	As noted above, an idea of observer variation wrt sightability would be useful.	The MWOs calibrated their environmental condition reporting, including assessment of sightability, early at the start of the program through training on the vessel, as well as throughout the program through cross-checking.

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17	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 18, S. 2.2.2.1 Sighting Conditions	It would also be useful to see more on the relationships between sightability variables (weather, sea state, visibility) and the index measure.	Baffinland deems that this goes beyond the required scope.
18	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 20, S. 2.2.3.1 Unidentified whale	Is any more information available, e.g. relative size? Was it possibly a bowhead, sperm whale, etc., or smaller like a narwhal?	Unfortunately, no.
19	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 20, S, 2.2.3.1 Location and Description of Marine Mammal Sightings	The report indicates that maximum ringed seal group sizes of 40 animals were observed in water, and 160 for seals observed on ice. QIA is very skeptical that these are accurate given what is known about ringed seal social behaviour. We've also consulted a number of marine mammal biologists with extensive ringed seal research experience, including in the north Baffin region, and they are equally skeptical that these observations are accurate. The report does not indicate how group size was defined. Was it defined as animals within 5 body lengths of one another, as typically done? A group of 40 seals in the water is far more likely to be misidentified harp seals (especially juveniles in the bedlamer pelage stage as they are less distinctive than adults).	Marine mammal sightings were recorded by trained Pond Inlet community residents. Given that seals contribute towards a large portion their harvest, it is expected that MMOs have knowledge of discriminating specific seal species over others, in other words, it is unlikely that they would mistake a ringed seal from a harp seal. Baffinland takes IQ input into the marine monitoring programs very seriously and thus the integration of Inuit sightings have been incorporated accordingly in the data presented in this SBO Program report. Group numbers of ringed seals reported are likely an artifact of a single observation of numerous individuals, or small groups of

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			Herds of harp seals in the 100s are not uncommon along the east coast of Baffin in spring and fall. Large numbers of ringed seals can be observed hauled out along sea ice cracks in spring, for example in DFO surveys along the western Hudson Bay coast, but using the 5 body length rule would result in a number of groups along that crack, not one single large group. Seal density is also lower in the Eclipse Sound area relative to nearshore western Hudson Bay. What were the ice conditions during the time of the observation of 160 hauled out seals? What was the observation distance for the purported group of 160 seals? It can be difficult to judge distance (i.e., number of body lengths) from a vessel, and what appears to be close groups may not be that close when viewed from above. This effect gets worse with distance from the observer. It is likely that these observations represent either an observation at a perspective that makes them look tightly grouped from a distance, a broader definition of what constitutes a group in terms of proximity, misidentified harp seals, or some combination thereof. Unless additional details to corroborate the sightings (e.g., photos or video) are available, these observations could be classed as unidentified pinnipeds, and all statistics recalculated accordingly. These observations are unrealistic given what is known about ringed seal behaviour, and call into question the more general	individuals, hauled out on large ice floes in close proximity, but not necessarily interacting with one another as a group. Group size is a collective of animals roughly uniformly distributed within one to five body lengths of one another. The 160 ringed seals were sighted at 400 m in 40% ice cover.

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			accuracy of the pinniped species identifications.	
20	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 21, S. 2.2.3.1 Location and Description of Marine Mammal Sightings	What was response distance for the polar bear that stopped foraging and left the ice? (also p. 37, etc.)	The polar bear was observed at an estimated distance of 2,000 m from the vessel.
21	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 26, S. 2.2.3.3 Observed Ice Cover	Table 3 should report median ice concentration instead of (or in addition to) mean.	For the purpose of the SBO Program Report, mean ice conditions suited the needs of the program. The recommendation is noted and will be considered for inclusion during future reporting efforts.
22	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 31, S. 2.3.3.5 Marine Mammal Movement	Add bearded seal to list of Table 5 exclusions due to low sighting numbers.	Acknowledged and included.

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23	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 31, S. 2.3.3.5 Marine Mammal Movement	Table 5 - having the sample size listed would be helpful (could be added after species name, n per season).	Sample size was added to Tables 5 and 6.
24	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 31, S. 2.3.3.5 Marine Mammal Movement	It would be helpful to have pie charts or similar for movement direction to improve comparisons for species (narwhal, ringed seal and harp seal) and season. The Table is sorted by percent movement, so categories shift in comparisons, figures would help via consistent colour patterns, position, etc. Text descriptions (with values, etc.) could be shortened to highlight key differences.	Baffinland appreciates the recommendation from QIA related to the use of pie charts and will consider for possible inclusion during future reporting efforts.
25	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 32, S. 2.3.3.5 Marine Mammal Movement	As noted above - what was distance when bear left the ice? At 2000 m?	The polar bear was first sighted at 2,000 m when it left the ice and lost from sight shortly after.
26	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 33, S. 2.2.3.6 Observed Behaviours	Table 6 - would again be useful to have sample size listed after each species name	Sample size was added to Table 6.

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27	2018 Ship-Board Observer Program Report draft (file name “2018_SBO Report DRAFT FOR MEWG.pdf”)	Pg. 33, S. 2.2.3.6 Observed Behaviours	Table 6 - why pool data from both seasons? Data shouldn’t be pooled without specifying why, for example test for differences between seasons for species with sufficient number of sightings (narwhal, ringed seal, harp seal) and report results. If no statistical basis, don’t pool.	Low sample size resulted in the need for pooling data. Multi-year comparisons may enable meaningful season comparisons during future reporting efforts.
28	2018 Ship-Board Observer Program Report draft (file name “2018_SBO Report DRAFT FOR MEWG.pdf”)	Pg. 33, S. 2.2.3.6 Observed Behaviours	Table 6 should include the percentage of primary behaviour determinations that were followed by no secondary behaviour (i.e., add "none"). The values in the secondary behaviour column add up to 100%, but presumably do not include 100% of the primary behaviour observations, unless all observations had two behaviour categories.	This information is now available through the addition of sample sizes (see IR #26 above).
29	2018 Ship-Board Observer Program Report draft (file name “2018_SBO Report DRAFT FOR MEWG.pdf”)	Pg. 35, S. 2.3 Discussion	Some observers boarded vessels in Quebec City in 2013, I think?	That is a misprint. The correct year intended in this sentence is 2018, not 2013. The correction was made to the report.
30	2018 Ship-Board Observer Program Report draft (file name “2018_SBO Report DRAFT FOR MEWG.pdf”)	Pg. 36, S. 2.3 Discussion	How was group size defined? Was it consistent across these various studies? How was it defined during this program (see previous comments re: unrealistic ringed seal group sizes)?	Group size is a collective of animals roughly uniformly distributed within one to five body lengths of one another.

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31	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 36, S. 2.3 Discussion	As previously noted, should report median ice cover instead of (or along with) average.	For the purpose of the SBO Program Report, mean ice conditions suited the needs of the program. The recommendation is noted and will be considered in future reporting.
32	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 36, S. 2.3 Discussion	In the fall surveys, is there a relationship between narwhal direction in relation to the vessel and vessel direction? If narwhal are starting to make migratory movements east through Eclipse Sound and Pond Inlet, they might be expected to be mostly moving in that direction.	This relationship was not specifically examined. Consideration will be given to assess whether this could be effectively integrated into future data acquisition protocols and analyses.
33	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 36, S. 2.3 Discussion	What were ice conditions like during the 17 October survey when a trail from the previous day was still visible? What were the ice conditions (concentration, stage, floe size, etc.) in which the trail passed through?	Ice conditions were 97% coverage at the time of the observation.
34	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 36, S. 2.3 Discussion	Tannis et al. (2015b, ringed seal aerial surveys in spring 2014) - I don't think this report was ever provided to the MEWG, please circulate.	This is a draft report. An update to the citation has been made to reflect this.

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35	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 40, S. 3.1.3 Lines of Flying Birds	A MEWG discussion on data use (e.g., additional analyses that could be conducted using more data than a "cursory assessment" as described here) could be beneficial, particularly with CWS/ECCC input.	This discussion is beyond the scope of the SBO Program Report. A discussion could be had at future MEWG in-person meeting to further elaborate potential next steps.
36	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 40, S. 3.2 Results	Why such a big discrepancy in effort between the two seasons? There are ca. 5X more observation periods in the fall.	The fall survey lasted over a longer period of time. Ship-based marine mammal surveys were conducted in the shoulder seasons from July 28 to August 7 and September 28 to October 17. There were also more MWOs onboard the MSV *Botnica* during the fall surveys compared to the summer surveys (four MWOS in the fall vs. three MWOs in the summer). Ideally, there would be equal effort in each of the two seasons, but varying degrees of effort can still enable the comparison of proportion changes.
37	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Pg. 40-41, S. 3.2 Results	Table 7 indicates that all unidentified birds in the summer were gulls, so text could specify that all were larids; fall could similarly say all larids or terns (also see comment on Executive Summary).	Agreed. The text has been revised to reflect this.

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Agency / Organization: DFO Science

Date of Comment Submission: April 3, 2019

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1	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page v	"Sightings of four sets of polar bear tracks were observed on the sea-ice including an adult with a cub", this demonstrates that Polar Bears are using the ice even when it is not land-fast ice. This reinforces the importance of ice and the potential for ecological impacts to ice-dependent species. Full consideration of all species dependent on ice should influence the decision to start or end the shipping season.	Comment noted. Polar bears are observed on the sea ice during periods when the ice is not land-fast ice. The sightings also indicate that polar bears are observed using the sea ice when the MSV *Botnica* is transiting in the Northern Shipping Corridor. No response required with regards to the Ship-based Observer (SBO) Program report.
2	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 3	Baffinland states that impacts of Narwhal ship strikes are not significant due to the fact that no Narwhal strikes were reported during the 2014 and 2015 monitoring seasons. Please note that the program did not occur in 2016 and 2017 due to safety concerns. However, these two years of monitoring only conducted 9 hours of survey time/year and saw few animals due to low survey time/effort. The impact of vessel strikes on these animals is likely underestimated based on the current level of marine mammal ship based observing effort and assessment.	The impact of narwhal ship strikes is accurately assessed considering past and current observations from observers during marine monitoring programs, but also considering vessel speed limitations (nine knots), vessel avoidance behaviour of narwhal and Inuit Qaujimajatuqangit (IQ). To date, no ship strikes have been reported or observed as a result of the Project.

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3	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 6	Ice-management vessels are 97 m long. Parks Canada is concerned that vessels under 100 m have not been included in the analysis for vessel effect to narwhal behaviour from the narwhal tagging studies. As a result, there is no data to show how much avoidance to expect from this survey method.	The current Ship-Based Observer (SBO) Program examines effects of vessel traffic including those of the MSV *Botnica* on narwhal through sighting rates, closest point of approach, marine mammal movement and behaviour. With regards to tagging studies, the 2017 Narwhal Tagging Study report only includes analyses for narwhal tagged in 2017. The MSV *Botnica* was not used in 2017. The reaction of tagged narwhal to the MSV *Botnica* during the 2018 monitoring season will be included as part of 2018 narwhal study reporting; results have yet to be finalized and distributed to the Marine Environmental Working Group (MEWG).
4	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 10	DFO Science questions why the ship-based marine mammal surveys were only conducted in the shoulder seasons from July 28 to August 7 and September 28 to October 17. Peak abundance of several marine mammal species, especially Narwhal, is from mid-August to mid-September not during the survey periods.	The MSV *Botnica* was deemed the safest and most appropriate platform to conduct the SBO program in 2018. The MSV *Botnica* only operates during the shoulder season. Previous programs completed during open-water conditions required observers to board ore carriers at sea, which was assessed as an unacceptable safety risk for Baffinland. The history of the SBO program is provided in Section 1.1 of the current report. Other marine monitoring programs (Bruce Head monitoring, tagging programs, aerial survey programs, acoustic monitoring programs) provide monitoring data during periods when the MSV *Botnica* is not in the Regional Study Area (RSA), including periods of peak abundance for several marine mammal species.
5	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Figure 15 and 17	DFO Science questions why the survey stopped in the middle of Milne Inlet instead of reaching Milne Port? In comparison, the fall survey (to October 17) reached Milne Port.	The icebreaker is present to escort other Project vessels safely through potential ice hazards along the Northern Shipping Route. Once escorted vessels reach open water, an escort is no longer required. The intent of this platform was not to perform systematic surveys of the entire Local Study Area (LSA) or RSA, but rather act as an opportunistic data collection platform.

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				No ice was present from the middle of Milne Inlet to the port during the early shoulder season. As such, the MSV *Botnica* spent little time transiting or escorting Project vessels in this region. During the fall survey, ice was present down to Milne Port which resulting in the MSV *Botnica* escorting Project vessels through this area.
6	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 20, Figures 15 and 17 with reference to Ringed Seals	DFO Science questions what defines a group size for Ringed Seals? Is it the number of observed seals per X km^2? If so, the proponent should clear identify and state this. DFO Science is surprised to see several groups of 10+ Ringed Seals together. It is surprising to see group sizes of 40 and 160 during the summer and fall surveys, respectively; particularly since these seals are mainly solitary animals during the open water period and when DFO performed aerial surveys in June 2016 and 2017, the largest group of Ringed Seals observed around a seal hole was seven. This is a time when they are known to haul-out in small groups, but are not in large groups during the fall. DFO Science is concerned that Ringed Seals may have been mistaken for Harp Seals.	Group numbers of ringed seals reported are likely an artifact of a single observation of numerous individuals, or small groups of individuals, hauled out on large ice floes in close proximity, but not necessarily interacting with one another as a group. Marine mammal sightings were recorded by trained Pond Inlet community residents. Given that seals contribute towards a large portion their harvest, it is expected that MMOs have knowledge of discriminating specific seal species over others, in other words, it is unlikely that they would mistake a ringed seal from a harp seal. Baffinland takes Inuit input into the marine monitoring programs very seriously and thus the integration of Inuit sightings have been incorporated accordingly in the data presented in this SBO Program report.
7	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 21 and 30	Condition 120 states that "The Proponent shall ensure that, subject to vessel and human safety considerations, all project shipping adhere to the following mitigation procedures while in the vicinity of marine mammals: a) **Wildlife will be given right of way,** b) Ships will when possible, maintain a straight course and constant speed,	When the polar bear was first sighted, it was at a distance of 2,000 m. The observer lost sight of the animal soon after first observing it after the animal went in the water. Thus, the ship did not need to alter course based on this initial observation. When the polar bear was re-sighted, it was to the side of the vessel and the vessel was already moving away from the bear. It is acknowledged that the text in the report could lead to a misinterpretation of the

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			avoiding erratic behavior; and, c) When marine mammals appear to be trapped or **disturbed by vessel movements**, the vessel will implement appropriate measures to mitigate disturbance **including stoppage of movement until wildlife have moved away from the immediate area**". Furthermore, the proponent includes in their Shipping and Marine Wildlife Management Plan Mitigations the following: 1) Maintain constant course and speed when possible, 2) Reduce vessel idling time at dock, 3) Vessel to be designed to limit noise output, 4) Shipboard Marine Wildlife Observers to be on select vessels to **monitor interactions with marine mammals** (Ringed Seal, Bearded Seal, Walrus, Beluga, Narwhal, Bowhead Whale, Polar Bear); and, 5) **Reduce vessel speed**. With the above as context, on Page 21, Golder states that a Polar Bear was observed to be feeding and responded to the vessel by diving into the water and was observed over the next 15 minutes to be moving repeatedly from the water to the ice as **the vessel closed the distance travelling forward**. On Page 30, it was also identified that a Polar Bear was at 2000 m when it first dove into the water and the vessel was moving at 8.5 knots. The Polar Bear was observed again 15 minutes later swimming perpendicular to the vessel 200 m from the vessel. A third example	interaction and the text was modified to clarify that both were independent observations of what was likely the same polar bear and not a continuous 15-minute observation of the animal as the vessel approached it (an initial observation at a distance of 2 km and a re-sighting at a distance of 200 m, 15 minutes after the initial observation was made and the bear was lost from sight).

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			was provided on Page 35. These observations are concerning since there is disagreement with the conditions and mitigation plan and the actions that were undertaken and described in the examples provided within the report.	
8	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 23, Figure 16:	The figure shows ice cover and Narwhal observations in the fall. Parks Canada questions if the 70-80% ice cover between Emerson Island and Navy Board Inlet suggests that landfast ice was starting to form during the fall when Baffinland was shipping. This brings up the question as to how Baffinland will determine start and end shipping dates based on ice.	Figure 16 shows mean ice concentration based on daily ice reports by Environment Canada for September 28 to October 17. A mean ice concentration of 70%-80% indicates that 20%-30% of this same area would typically be open water during the same period.
9	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 26:	The report states that 760 unidentified seals were most likely Ringed Seals; however they are all found to be in very large groups, this may indicate that they are Harp Seals.	Group numbers of ringed seals reported are likely an artifact of a single observation of numerous individuals, or small groups of individuals, hauled out on large ice floes in close proximity, but not necessarily interacting with one another as a group. Marine mammal sightings were recorded by trained Pond Inlet community residents. Given that seals contribute towards a large portion their harvest, it is expected that MMOs have knowledge of discriminating specific seal species over others, in other words, it is unlikely that they would mistake a ringed seal from a harp seal. Baffinland takes Inuit input into the marine monitoring programs very seriously and thus the integration of Inuit sightings have been incorporated accordingly in the data presented in this SBO Program report.

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10	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 31:	DFO Science suggests that the analysis and table regarding marine mammal movement characteristics relative to a vessel should be modified by changing the number of categories that were broken down to describe how a marine mammal was moving relative to the vessel. By describing so many different detailed movements by category, which essentially all describe movement away from a vessel, creates misleading results. For example, the following categories were used: 1) swim perpendicular, 2) swim away, 3) swim parallel, 4) swim towards, 5) a mix, or 6) none or unknown. DFO Science suggests considering simplifying this into 3 categories: 1) swim towards, 2) swim with (i.e., parallel) and 3) swim away. The purpose and objective of the analysis is to quantify the 'swimming away' variable. If an animal is swimming perpendicular to the ship and it is not towards it (one of the categories), it must be swimming away from it. So, the swimming perpendicular and swimming away categories should be amalgamated. For example, for Narwhal in Table 5, by combining these categories, the 'swim away' category should be 71.5% (42.9 + 28.6) in summer and 81.9% (75.8 + 6.1) in fall. This would considerably change some the conclusions described in the Discussion (page 36). Similarly, on Page 37 and 42, "swim perpendicular" could also be	Baffinland appreciates the recommendation from DFO Science related to changing the number of categories. Swim perpendicular is recorded for animals in front or behind a vessel and moving perpendicular to the vessel and not necessarily away or toward the vessel. It provides useful context. The conclusions would not considerably change as there were few narwhal observations in the summer surveys to drag conclusions from and the "swim away" category already accounted for 75.8% of observations in the fall surveys. In addition, it is expected that marine mammals will show localized avoidance from vessels and potentially "swim away" from vessels. The data collected will potentially allow seasonal and annual changes in movement patterns in relation to vessels.

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			considered as “swimming away”.	
11	2018 Ship-Board Observer Program Report draft (file name “2018_SBO Report DRAFT FOR MEWG.pdf”)	Page 33, Table 6:	Marine Mammal Behaviours are not broken down by open water vs ice observations or seasonally like other data within the report. Therefore, it is difficult to determine if changes in behaviour during ship interaction/sighting are the same in open water and ice conditions (i.e., Ringed Seals show change from hauling out at 12% to 6% and Harp Seals hauling out from 4% to 1%, while Bearded Seals increase hauling out from 40% to 60%).	Small sample sizes limited the ability to further break down the analysis. With regards to comparisons between open water and ice conditions, there is no relative response control available. The MSV *Botnica* has been procured by Baffinland for periods of the shipping season when the presence of ice may be expected (i.e. shoulder season). Ice management may occur intermittently at any point during the shoulder season and anywhere along the shipping corridor, where support from the MSV *Botnica* is required to allow for safe passage of ore carriers. The distribution of sea ice changes spatially and temporally along the Northern Shipping Route. As a result, changes in behaviour may be confounded by other natural factors.
12	2018 Ship-Board Observer Program Report draft (file name “2018_SBO Report DRAFT FOR MEWG.pdf”)	Page 31:	Parks Canada is concerned that results from the Percentage of Movement Activities are not thoroughly analysed for significant differences between summer and fall. As a result, it is difficult to determine if marine mammals were more sensitive to disturbance during different seasons/ice conditions. For example, on Page 36 Golder states that there is no significant difference between closest approach distances of	Sample sizes limited the ability to perform statistical comparison. The sample sizes (*n*-values) were added to Tables 5 and 6 of the report. Multi-year data will potentially enable an analysis of seasonal differences.

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			Narwhal and vessels between the summer and fall, but does not provide results on whether the change in Percentage of Swimming away from the vessel from 28.6% in summer and 75.8% in fall was a "significant difference" and how this relates to thresholds. Furthermore, Table 5 appears to show that Narwhal are more sensitive and swim away at higher instances in fall ice conditions while seals in ice display many different reactions in fall compared to in the summer, when most seals swim away. Parks Canada noticed that the category of "none" appears more often in fall which might suggest seals are either becoming habituated or displaying a freeze response when in ice conditions.	
13	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 36:	The program ran from July 28 to August 7 and September 28 to October 17 which was considered a fuller representation of the shipping season. During this time they saw 7 sightings of 15 individuals in summer, and 34 sightings of 156 Narwhal. Eclipse Sound is known to have 10,000-20,000 Narwhal in the area based on survey data. It appears that there were very few Narwhal in the area considering in 2016 they were seeing 156 Narwhal/hour at Bruce Head. Although the study design	The SBO program is not designed to calculate abundance estimates or to compare relative abundance estimates between programs, such as between the SBO and Bruce Head programs. A comparison of relative abundance from SBO programs will be performed in future years.

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			changed from year to year, a change in abundance should be acknowledged within the reports.	
14	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 41:	It is not clear exactly when ice-breaking occurred during the dates when the "ice management" vessel was active and the Marine Mammal Observers were taking observations. There is concern that ice breaking activities occurred daily? If this was not the case, then it would be useful to compare observations on days where the vessel was breaking ice to days when the vessel was in transit or following paths through previously broken ice.	The MSV *Botnica* has been procured by Baffinland for periods of the shipping season when the presence of ice may be expected (i.e. shoulder season). Ice management may occur intermittently at any point during the shoulder season and anywhere along the shipping corridor, where support from the MSV *Botnica* is required to allow for safe passage of roe carriers. Ice conditions for the 2018 season are presented in Figure 9. The recommendation is noted and the data recording protocol will be examined for upcoming seasons to assess how such information can be better collected by the marine wildlife observers on the vessel.
15	2018 Ship-Board Observer Program Report draft (file name "2018_SBO Report DRAFT FOR MEWG.pdf")	Page 45:	In the conclusions of the report, it is stated that there was an inability to compare data to previous work because of design changes. This is a concerning flaw in the monitoring program since the purpose of monitoring is to compare changes from the baseline, to an impact (i.e., Early Revenue Phase), and to changes in the impact (i.e., Phase II). This needs to be considered for	As identified in Section 1.1, the previous SBO programs (2013-2015) were terminated due to safety concerns. The 2018 SBO Program was redesigned to address these safety concerns and ensure a platform that would enable the comparison of multi-year data sets that is based on monitoring from an icebreaking vessel (e.g., MSV *Botnica*) during shoulder seasons.

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			all monitoring reports to be effective.	

Name: Parks Canada – Protected Areas Establishment and Conservation Branch (via Chantal Vis)

Agency / Organization: Parks Canada

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1.	*2018 Ship Based Observer Program*	1.1	Baffinland has previously stated that impacts to marine mammals from vessel strikes are negligible, however these statements are only based upon 18 hours of observations between 2014 & 2015. Marine Mammals Observers need to continue to be placed on multiple vessels throughout the season to observe marine mammal and ensure that the impacts from vessel strikes are not significant.	The impact of narwhal ship strikes is accurately assessed considering past and current observations from observers during marine monitoring programs, but also considering vessel speed limitations (nine knots), vessel avoidance behaviour of narwhal and Inuit Qaujimajatuqangit (IQ). To date, no ship strikes have been reported or observed as a result of the Project.
2.	*2018 Ship Based Observer Program*	2.2.3.1	Baffinland has suggested a setback distance for Polar Bears of 300m for the Phase 2 Proposal and their current mitigations for shipping impacts to all marine mammals include reducing speed and monitoring interactions with marine mammals. Condition 120 states that, "a) **Wildlife will be given right of way** b) Ships will when possible, maintain a straight course and constant speed, avoiding erratic behavior c) When marine mammals appear to be trapped or **disturbed by vessel movements**, the vessel will implement appropriate measures to mitigate disturbance, **including stoppage of movement until wildlife have moved away from the immediate area**." The Ship based observer program describes	All mitigations set by the project certificate and Baffinlands' Shipping and Marine Wildlife Management Plan were adhered to. While generally showing localized avoidance behaviour to vessels, some marine mammals will approach a vessel and, in many instances, the marine mammal will only surface (and thus be available to be observed) when they are at a close distance.

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			an interaction where a polar bear flees into the water at 2000m away after it was observed feeding on the ice. The icebreaker is described to continue to move forward at 8.5 knots towards the polar bear as the bear continues to move away as it repeatedly jumps between the ice and the water until the ice breaker comes within 200m of the bear. In addition, the vessel reports coming within 100m of a whale, 10m of a ringed seal, 20m of a harp seal and 30m of a narwhal. Why were the mitigations set by the project certificate or Baffinlands' Shipping and Marine Wildlife Management Plan not adhered to? Are Marine Mammal Observers recording vessels' compliance with these mitigations? Why was 300m selected as a setback distance given that this polar bear reacted so strongly at 2km away?	In the case of the polar bear, it was first sighted at a distance of 2,000 m. The observer lost sight of the animal soon after first observing it after the animal went in the water. Thus, the ship did not need to alter course based on this initial observation. When the polar bear was re-sighted, it was to the side of the vessel and the vessel was already moving away from the bear. It is acknowledged that the text in the report could lead to a misinterpretation of the interaction and the text was modified to clarify that both were independent observations of what was likely the same polar bear and not a continuous 15-minute observation of the animal as the vessel approached it (an initial observation at a distance of 2 km and a re-sighting at a distance of 200 m, 15 minutes after the initial observation was made and the bear was lost from sight).
3.	*2018 Ship Based Observer Program*	2.2.3.5	The Percentage of Movement Activities Observed for Marine Mammals (Table 5) are broken down for fall and summer behaviors, but are not analyzed for significant differences between the two seasons, making it difficult to determine if the marine mammals behaviors towards ships changed significantly in ice conditions.	Sample sizes limited the ability to perform statistical comparison. The sample sizes (*n*-values) were added to Tables 5 and 6 of the report. Multi-year data will potentially enable an analysis of seasonal differences.

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4.	*2018 Ship Based Observer Program*	2.2.3.5	No definitions are provided for the movement behaviors, especially for distinguishing between the animals moving perpendicular to the vessel versus moving towards or away from the vessel.	Movement behaviours are defined by their name. Swimming perpendicular is recorded for animals in front or behind a vessel moving perpendicularly to the vessel. This definition was added in brackets to Section 2.2.3.5 (Marine Mammal Movement).
5.	*2018 Ship Based Observer Program*	2.2.3.6	The Percentage of Primary and Secondary Behaviors Observed for Marine Mammals (Table 6) ought to be broken down seasonally or for open water vs ice conditions to determine if marine mammals' reactions were similar in open water and ice conditions or if their response to vessels changes based on the presence of ice.	Small sample sizes limited the ability to further break down the analysis. The sample sizes (*n*-values) were added to Table 6 of the report. With regards to comparisons between open water and ice conditions, there is no relative response control available. The MSV *Botnica* has been procured by Baffinland for periods of the shipping season when the presence of ice may be expected (i.e. shoulder season). Ice management may occur intermittently at any point during the shoulder season and anywhere along the shipping corridor, where support from the MSV *Botnica* is required to allow for safe passage of ore carriers. The distribution of sea ice changes spatially and temporally along the Northern Shipping Route. As a result, changes in behaviour may be confounded by other natural factors.

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6.	*2018 Ship Based Observer Program*	2.3	The lack of narwhal observations is not discussed in this report nor are the thresholds that Baffinland has established for determining impacts. All reports moving forwards should re-state the threshold that Baffinland has established for disturbance (FEIS, 2013) and results should be link back to these disturbance thresholds.	Early warning indicators and corresponding thresholds are currently being developed, in collaboration with the Marine Environmental Working Group (MEWG). Once these thresholds are established, results of monitoring programs will be assessed in relation to them.
7.	*2018 Ship Based Observer Program,*		Monitoring Programs for impacts to marine mammal should be integrated across the monitoring programs to provide a clear and comprehensive understanding of effects to marine mammals, similar to what Baffinland has provided for the Marine Environmental Effects Monitoring Report.	Comment noted.
8.	2018 Ship Based Observer Program	2.2.1 (figure 6)	Because the marine mammal observers are already on board, it would be useful for them to collect observations along the vessel's entire route – for baseline and comparative information.	Marine mammal observers did collect observations along the MSV Botnica's entire route (e.g transits) while in the study area.
9.	2018 Ship Based Observer Program	2.2.2 (figure 8)	Figure 8 shows ice on both shores of Navy Board Inlet and Eclipse Sound, would this not constitute landfast ice?	Figure 16 shows mean ice concentration based on daily ice reports by Environment Canada for September 28 to October 17. A mean ice concentration of 70%-80% indicates that 20%-30% of this same area would typically be open water during the same period.