TECHNICAL DATA REPORT

Mary River Project

2019 Ship-based Observer Program

Submitted to:

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Submitted by:

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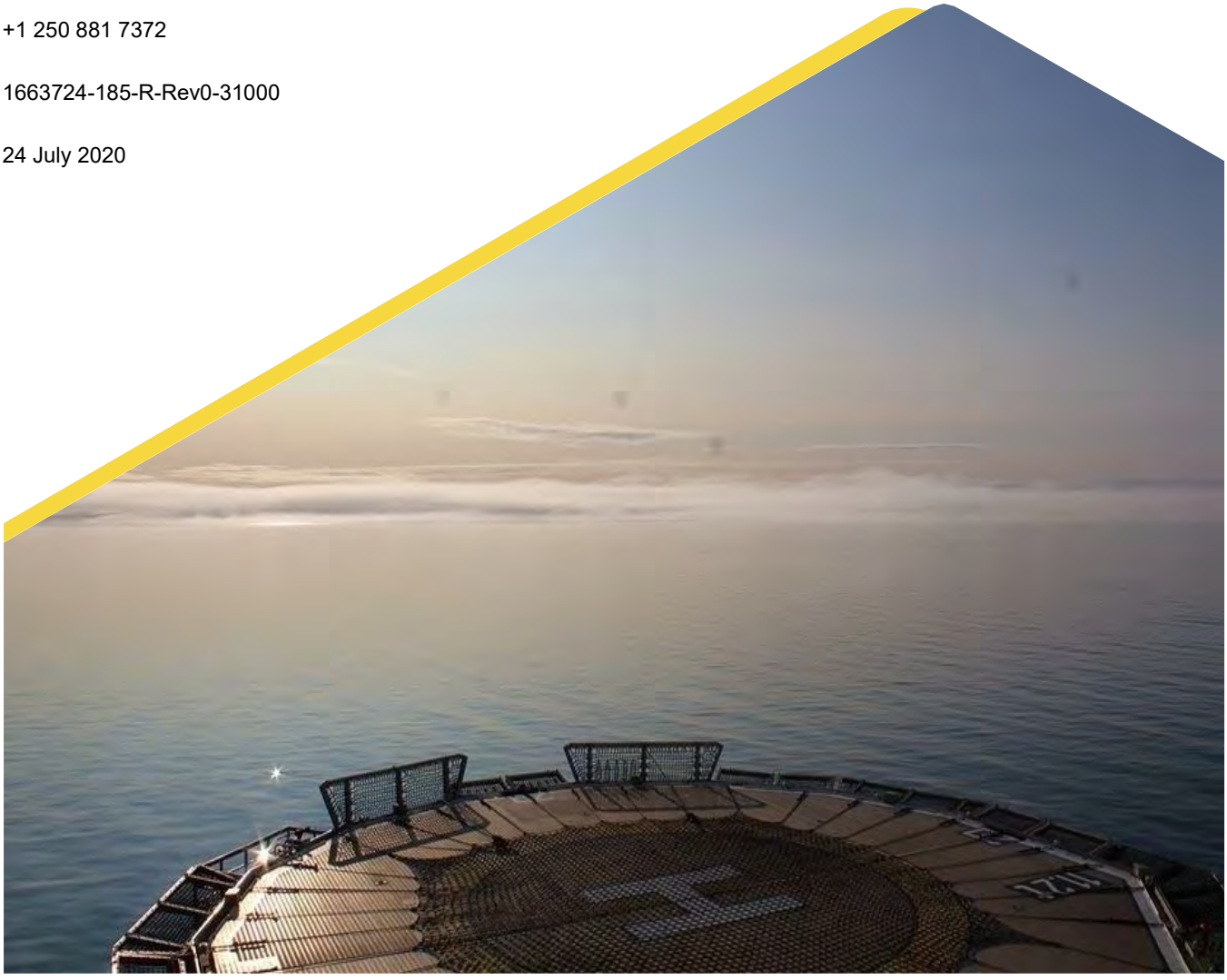

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Executive Summary

Golder Associates Ltd. (Golder), on behalf of Baffinland Iron Mines Corporation (Baffinland), conducted a Ship-based Observer (SBO) Program onboard the icebreaker MSV Botnica during the early summer (Leg 1: 19–29 July) and fall shoulder season (Leg 2: 5-28 October) of 2019. The SBO Program was designed to meet Conditions No. 106, 108, 121, 122, 123 and 126 of Project Certificate No. 005. The primary objective of the SBO Program was to monitor for potential ship strikes on marine mammals and seabirds in the Regional Study Area (RSA). The secondary objective of the SBO program was to collect data on the presence, relative abundance and distribution of marine mammals and seabirds within the boundaries of the RSA. Project shipping in 2019 began on 17 July 2019 and ended on 30 October 2019.

Data collection methodology for the 2019 SBO Program was similar to the 2018 SBO Program with slight adjustments in protocol to address recommendations provided by the Marine Environmental Working Group (MEWG). In addition to marine mammal observations, seabird sightings were recorded using the Canadian Wildlife Service's (CWS) Eastern Canada Seabirds at Sea (ECSAS) survey protocol.

Prior to the start of the 2019 SBO Program, several MWO candidates from Pond Inlet were trained in marine safety, marine wildlife identification and monitoring techniques, and data entry protocols. From 11–15 May 2019, nine Inuit MWOs traveled to Halifax, Nova Scotia and participated in the Transport Canada approved offshore safety training course "Proficiency in Personal Survival Techniques". Upon completion of this course, four of the MWO candidates were selected to participate in the 2019 MWO Program onboard the MSV Botnica. Golder provided a one-day MWO training session for all four MWOs prior to commencement of the program.

The MWOs were responsible for recording marine wildlife sightings from the bridge of the MSV Botnica during dedicated watch periods. Monitoring protocol differed for marine mammals and seabirds. Marine mammal sightings were recorded over a daily monitoring period extending up to 16 h on Leg 1 (early summer) and up to 10 h on Leg 2 (fall) depending on available daylight hours. Seabird sightings were recorded during dedicated seabird surveys conducted periodically throughout the day (lasting one to two hours each). The total daily watch period for seabirds was variable depending on sighting conditions, ranging from 0 to 6 h.

Marine Mammals

Total monitoring effort for marine mammals consisted of 268.7 h covering 3,089 km (Leg 1 and 2 combined). Total monitoring effort during Leg 1 was 100.4 h covering 1,119 km. Total monitoring effort during Leg 2 was 168.3 h covering 1,970 km. Although there were nearly twice as many observation days in Leg 2 compared to Leg 1 (24 vs. 11 days), this was not reflected in overall survey effort given the longer daylight hours during Leg 1 (mean daily effort= 11 h) compared to Leg 2 (mean daily effort = 7 h).

Seven different species of marine mammals were observed during the 2019 SBO Program: narwhal, beluga whale, bowhead whale, ringed seal, harp seal, bearded seal and polar bear. A total of 304 marine mammal sightings comprising 2,785 individuals were recorded. Killer whale and walrus were not recorded in the RSA during either survey leg in 2019; however, both species are known to occur in the region.

During early summer (Leg 1), a total of 152 marine mammal sightings comprising 2,453 individuals were recorded. Species identified included ringed seal (61 sightings of 722 individuals), narwhal (27 sightings of 385 individuals), harp seal (24 sightings of 136 individuals), bowhead whale (22 sightings of 24 individuals), bearded

seal (four sightings of four individuals), polar bear (two sightings of two individuals) and beluga (one sighting of one individual). There were also nine sightings of unconfirmed pinniped species (comprising 1,176 individuals) and two sightings of unconfirmed cetacean species (comprising three individuals).

During fall (Leg 2), a total of 152 marine mammal sightings comprising 332 individuals were recorded. Species identified included ringed seal (53 sightings of 58 individuals), narwhal (27 sightings of 103 individuals), harp seal (25 sightings of 117 individuals), bearded seal (one sighting of one individual) and bowhead whale (one sighting of one individual). There were also 44 sightings of unconfirmed pinniped species (49 individuals) and one sighting of an unconfirmed cetacean species (comprising three individuals).

The relative abundance of marine mammals in the RSA, expressed as the animal detection rate (no. of animals relative to survey effort in km), was 0.90 animals/km (0.10 sightings per km). More animals were observed during Leg 1 (2.19 animals/km) than during Leg 2 (0.17 animals/km). All marine mammal species, including narwhal, occurred in higher relative abundance in the RSA during Leg 1 than during Leg 2.The relative abundance of marine mammals in the RSA was similar in 2019 (0.90 individuals per km) to that reported in 2018 (0.88 individuals per km). Species observed in greater relative abundance in 2019 than 2018 included narwhal, beluga, and bowhead whale. For these species, the increase was reflective of more animals observed during Leg 1 (similar numbers were seen during Leg 2 in both years). Less ringed seal and harp seal were observed in 2019 compared to 2018, although this was likely associated with the large number of unconfirmed seal species recorded in 2019 (n=1,225) compared to 2018 (n=760). When considering all seal categories (confirmed and unconfirmed species), a similar number of seals was observed in both years.

The observed increase in narwhal relative abundance in 2019 may be reflective of abnormally low numbers of narwhal in the RSA in 2018, as reported by community members and as supported by low catch rates that year. Hunters found the opposite to be true in 2019 when narwhal were regularly observed throughout the RSA and in large groups. The increase in relative abundance observed in 2019 may have also been a result of new adaptive management measures implemented during the early 2019 shoulder season to specifically reduce icebreaker noise impacts on narwhal, such as the 40 km floe edge buffer zone and a reduced number of icebreaker transits per day in the RSA in heavy ice conditions.

Aerial clearance surveys were flown in the RSA at the end of the shipping season on 30-31 October 2019 to monitor the shipping corridor and adjacent areas for potential narwhal entrapment events following the completion of Baffinland's 2019 shipping operations in the RSA. A total of six narwhal sightings comprising 14 individuals were recorded during the 30 October survey. All animals were located east of Pond Inlet and near the entrance to Baffin Bay, with all animals travelling eastbound at the time of sighting. No narwhal sightings were recorded during the 31 October survey. Results of the end of season aerial clearance survey suggest that no entrapments occurred in 2019 as a result of Project icebreaking and shipping activities in the RSA.

Similar to previous years, no ship strikes on marine mammals (or near misses) were recorded during the active monitoring periods on the MSV Botnica during 2019. Overall, the distances maintained by marine mammals from the survey vessel in 2019 (i.e., Closest Point of Approach {CPA} results) lend confidence to existing environmental assessment predictions, in that marine mammals in the RSA are likely to demonstrate localized avoidance of Project vessels, and that vessel strikes on marine mammals are unlikely to occur based on current vessel speeds in the RSA (9 knot speed restriction).

Collectively, the 2019 SBO monitoring results support the impact predictions and significance determination in the FEIS Addendum for the Early Revenue Phase (ERP) in that the Project is unlikely to result in significant residual

adverse effects on marine mammals in the RSA, defined as effects that compromise the integrity of marine mammal populations in the region either through mortality (i.e., ship strikes) or via large-scale displacement or abandonment of the RSA.

Continuation of the SBO Program is recommended for 2020 in accordance with NIRB Project Certificate No. 005 Terms and Conditions. Ongoing annual monitoring will allow for additional data comparison between monitoring years, which may serve to identify whether any adaptive management measures to Project operations during the shoulder seasons are required.

Seabirds

Total monitoring effort for seabirds in 2019 was 103.2 h (Leg 1 and 2 combined), consisting of 231 5-min surveys during Leg 1 and 1,008 5-min surveys during Leg 2. A total of eleven species were identified during Leg 1 (157 confirmed sightings comprising 265 individuals), with fulmar and thick-billed murre being the most common species. A total of nine species were identified during Leg 2 (97 sightings comprising 396 individuals), with glaucous gull and northern fulmar being the most common species. Four ivory gulls, a federally *Endangered* species on Schedule 1 of the *Species at Risk Act* (SARA) (Government of Canada 2019), were observed during Leg 2; this species was not observed during the Leg 1 survey period, nor during either survey leg in 2018.

A similar number of species were observed during Leg 1 (early summer) surveys in 2018 and Leg 1 surveys in 2019 (13 and 11 species, respectively). More species were recorded during Leg 2 in 2019 than during Leg 2 in 2018 (9 vs. 5 species, respectively). This is likely in the range of natural variation for presence and abundance of species between years. During the Leg 1 surveys, no new species were reported in 2019 relative to 2018. During the Leg 2 surveys, two new species were identified in 2019 that were not observed in 2018: ivory gull and long-tailed duck. More seabirds were observed during Leg 1 in 2019 than in 2018 (265 vs. 136 individuals, respectively). The opposite trend was observed for Leg 2, with more seabirds observed during Leg 2 in 2018 than in 2019 (719 vs. 661 individuals, respectively).

The overall probability of detecting seabirds during moving platform surveys in 2019 was estimated to be 1.00 (95% Confidence Interval [CI]: 1.00 to 1.00). This was similar to the detection probability calculated by Bolduc and Fifield (2017) while completing moving transect surveys in the Gulf of St. Lawrence. Overall, seabird density in the RSA during 2019 was 0.66 birds/km^2 (95% CI: 0.45 to 0.96). Species-specific density estimates were only generated for northern fulmar as this was the only species with an adequate sample size for analysis (Buckland et al. 2001). Density estimates were not completed for other seabird species as the low sample sizes for these species would have yielded inaccurate results (Buckland et al. 2001). The probability of detection for northern fulmar in 2019 was estimated to be 0.55 (95% CI: 0.38 to 0.79). The density estimate for northern fulmar in 2019 was 0.99 birds/km^2 (95% CI: 0.52 to 1.87).

One seabird strike was recorded during 2019 (Leg 2). At 22:00 on 11 October, the bridge officer observed a long-tailed duck fly into the superstructure (support post) beneath the ship's helideck. The strike occurred in eastern Eclipse Sound near Pond Inlet (72 50.1 N, 78 00.1 W) while the vessel was holding station (stationary for the night). Conditions at the time were low visibility (dark, heavy snow), low wind and calm sea state. The specimen was a definitive basic (adult winter plumage) male. The specimen suffered a broken neck and died shortly thereafter. The bird strike event was reported to Baffinland's Environmental Coordinator on 12 October 2019.

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ᒎᓪᑐᒃᑯᑦ (Golder Associates Ltd.) (ᒎᓪᑐ), ᐱᔾᔪᑎᑉᓗᒋᑦ ᐹᕕᓐᓛᓐ ᓴᕕᙳᑦ ᐅᔭᕋᒃᑕᓇᐊᒃᑯᑦ (ᐹᕕᓐᓛᓐ), ᐅᒥᐊᕐᔪᐊᕐᒦᓐᓂᕐᓗᑎᒃ ᓯᑯᒥᑦ ᓯᕐᑯᑎᑎᓇᖃᑦᑕᖅᑐᖅ MSV Botnica-ᒥᑦ ᖃᐅᔨᓴᐃᓂᖃᓚᐅᖅᑐᑦ ᐊᐅᔭᖅᐸᓪᓕᐊᓕᕌᖅᑎᓪᓗᒍ (ᐃᖏᕐᕋᓂᖅ 1: ᓴᑉᑕᐱᑦ 19-ᒥᑦ 29-ᒧᑦ) ᐊᒻᒪᓗ ᐅᑭᐊᒃᖕᒃᑯᑦ (ᐃᖏᕐᕋᓂᖅ 2: ᐅᑭᐅᓖᑦ 5-ᒥᑦ 28-ᒧᑦ) 2019-ᒥᑦ. ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᖅ ᐋᖅᑭᐅᒪᔪᖅ ᑎᑭᐅᑎᓂᐊᕐᓗᒋᑦ ᖃᓄᐃᖓᔭᓇᐊᖃᕐᓂᐅᔪᑦ ᓈᓴᐅᑏᑦ 106, 108, 121, 122, 123 ᐊᒻᒪᓗ 126 ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑕᖅ ᓈᓴᐅᑎ 005-ᒦᑦᑐᑦ. ᐱᔾᔪᒃᓴᐅᑎᐅᓗᐊᖅᑐᖅ ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᖅ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒍ ᐅᒥᐊᕐᔪᐊᖅ ᐊᒃᑑᑎᓂᖃᖅᐸᑦ ᑕᓇᐅᕐᒥᐅᑕᓂᒃ ᐊᒻᒪᓗ ᑎᖕᒥᐊᓂᒃ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕙᐅᔪᒥᑦ. ᑐᒡᓕᐊ ᐱᔾᔪᑎ ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᑲᑎᖅᓱᐃᓗᓂ ᓈᓴᐅᑎᓂᒃ/ᑎᑎᖅᑲᓂᒃ ᑕᓇᐅᕐᒥᐅᑕᐃᑦ ᐊᒻᒪᓗ ᑎᖕᒥᐊᑦ ᐱᑕᖃᕐᓂᖏᑦ, ᐊᒥᓲᑎᒋᓂᖏᓐᓂᒃ ᐊᒻᒪᓗ ᓇᒧᙵᐅᓂᖏᓐᓂᒃ ᑭᒡᓕᒋᔭᐅᔪᒥᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕙᐅᔪᒥᑦ. ᐱᓕᕆᐊᕐᒧᑦ ᐅᒥᐊᕐᔪᐊᑦ 2019-ᒥᑦ ᐱᒋᐊᓚᐅᖅᑐᑦ ᓴᑉᑕᐱᑦ 17, 2019-ᒥᑦ ᐱᐊᓂᒃᓗᑎᒡᓗ ᐅᑭᐅᓖᑦ 30, 2019-ᒥᑦ.

ᓈᓴᐅᑎᓂᒃ/ᑎᑎᖅᑲᓂᒃ ᑲᑎᖅᓱᐃᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᔪᑦ 2019 ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐊᔾᔨᓪᓕᒋᓚᐅᖅᑕᖓ 2018 ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᐅᓚᐅᖅᑐᒥᑦ ᐋᖅᑭᒋᐊᖅᓯᒪᓂᖅᑖᕐᔪᒃᓗᑎᒃ ᐊᑐᓇᐊᓕᖕᒧᑦ ᐃᒪᓐᓈᖅᑑᑕᐅᔪᓄᑦ ᐱᔭᐅᔪᑦ ᑕᓇᐅᕐᒥᐅᑕᓕᓇᓂᕐᒧᑦ ᐱᓕᕆᐊᓕᖕᓂᑦ. ᐃᓚᒋᔭᐅᑉᓗᓂ ᑕᓇᐊᕐᒥᐅᑕᓂᒃ ᖃᐅᔨᔭᐅᔪᓄᑦ, ᑎᖕᒥᐊᑦ ᑕᑯᔭᐅᔪᑦ ᑎᑎᕋᐅᓯᐅᓚᐅᖅᑐᑦ ᐊᑐᖅᓗᒋᑦ ᑲᓇᑕᒥᑦ ᐆᒪᔪᓕᕆᔨᒃᑯᑦ ᑲᓇᙳᒥᑦ ᑲᓇᑕᒥᑦ ᑕᓇᐅᕐᒥᐅᑕᐃᑦ ᑎᖕᒥᐊᑦ ᖃᐅᔨᓴᐃᓂᖅ.

ᐱᒋᐊᕐᓂᐊᓵᖅᑎᓪᓗᒍ ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᖅ, ᖃᑉᓯᐊᕐᔪᐃᑦ ᖃᐅᔨᓴᐃᔨᐅᓂᐊᖅᑐᑦ (MWO) ᒥᑦᑎᒪᑕᓕᖕᒥᐅᑕᐃᑦ ᐊᔪᕈᓐᓃᖅᓴᖅᑕᐅᓚᐅᖅᑐᑦ ᑕᓇᐅᕐᒥᑦ ᐊᑦᑕᓇᖅᑐᖅᑕᐃᓕᓂᕐᒥᒃ, ᑕᓇᐅᕐᒥᐅᑕᓂᒃ ᓇᓗᓇᐃᒃᑯᑎᖅᑐᐃᓂᕐᒥᒃ ᐊᒻᒪᓗ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᔪᓂᒃ, ᐊᒻᒪᓗ ᓈᓴᐅᑎᓂᒃ/ᑎᑎᖅᑲᓂᒃ ᑎᑎᕋᐃᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᓂᒃ. ᓄᕐᕋᐃᑦ 11-ᒥᑦ 15-ᒧᑦ, 2019-ᒥᑦ, 9 ᐃᓄᐃᑦ ᖃᐅᔨᓴᐃᔩᑦ Hᐋᓕᕚᒃᓴ, ᓅᕙ ᓯᑰᓴᒨᒐᐅᓚᐅᖅᑐᑦ ᐊᔪᕈᓐᓃᖅᓴᖃᑕᐅᑉᓗᑎᒃ ᑲᓇᑕᒥᑦ ᐃᖏᕐᕋᔪᓕᕆᔨᒃᑯᑦ ᓈᒻᒪᒋᔭᖕᒑᓂᒃ ᐃᒪᕐᒥᑦ ᐊᑦᑕᓇᖅᑐᖅᙱᑦᑐᓕᕆᓂᕐᒧᑦ "ᐊᔪᙱᓐᓂᖃᕐᓂᖅ ᐋᓇᒃᑐᕈᓇᕐᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᑦ". ᐱᐊᓂᖓᑕ ᐃᓕᓐᓂᐊᕐᓂᑎᒃ, ᓯᑕᒪᓂᒃ ᖃᐅᔨᓴᐃᔨᐅᓂᐊᖅᑐᓂᒃ ᓂᕈᐊᓚᐅᖅᑐᑦ 2019 ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ MSV Botnica ᐅᒥᐊᕐᔪᐊᕐᒦᓐᓂᐊᖅᑐᓂᒃ. ᐱᒋᐊᕐᓂᐊᓵᖅᑎᓪᓗᒋᑦ ᒎᓪᑐᒃᑯᑦ ᐊᔪᕈᓐᓃᖅᓴᐃᓚᐅᖅᑐᑦ ᐊᑕᐅᓯᖅ ᐅᑉᓗᕐᒥᑦ ᓯᑕᒪᑦ ᖃᐅᔨᓴᐃᔨᓄᑦ.

ᖃᐅᔨᓴᐃᔩᑦ ᑎᑎᕋᐃᖃᑦᑕᓇᐊᖃᓚᐅᖅᑐᑦ ᑕᓇᐅᕐᒥᐅᑕᓂᒃ ᑕᑯᔭᐅᔪᓂᒃ ᐃᑳᕈᑎᖓᓃᓐᓗᑎᒃ MSV Botnica ᐅᒥᐊᕐᔪᐊᑉ. ᖃᐅᔨᓴᐃᓃᑦ ᐊᔾᔨᒌᓚᐅᖏᑦᑐᑦ ᑕᓇᐅᕐᒥᐅᑕᓄᑦ ᐊᒻᒪᓗ ᑎᖕᒥᐊᓄᑦ. ᑕᓇᐅᕐᒥᐅᑕᐃᑦ ᑕᑯᔭᐅᔪᑦ ᑎᑎᕋᐅᓯᐅᖃᑦᑕᓚᐅᖅᑐᑦ ᖃᐅᑕᒫᑦ ᖃᐅᔨᓴᐃᓐᓇᐅᑎᓪᓗᒍ 16 ᐃᑲᕐᕋᓄᑦ ᑎᑭᐅᑎᑉᓗᑎᒃ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ (ᐊᐅᔭᖅᐸᓪᓕᐊᓕᕌᖅᑎᓪᓗᒍ) ᖁᓕᓄᑦ ᐃᑲᕐᕋᓄᑦ ᐃᖏᕐᕋᓂᖅ 2-ᒥᑦ (ᐅᑭᐊᒃᖕᒃᑯᑦ) ᖃᐅᒪᑎᓪᓗᒍ. ᑕᓇᐅᕐᒥᐅᑕᐃᑦ ᑎᖕᒥᐊᑦ ᑕᑯᔭᐅᔪᑦ ᑎᑎᕋᐅᓯᐅᖃᑦᑕᓚᐅᖅᑐᑦ ᑎᖕᒥᐊᓂᒃ ᖃᐅᔨᓴᐃᓂᖃᖅᑎᓪᓗᒋᑦ ᖃᑯᑎᒃᑰᖃᑦᑕᖅᓱᓂ ᐅᑉᓗᕐᒥᑦ (ᐊᑕᐅᓯᕐᒥᑦ ᒪᕐᕉᙳᑦ ᐃᑲᕐᕋᓅᕙᒃᓱᑎᒃ). ᑲᑎᓪᓗᒋᑦ ᖃᐅᑕᒫᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᖅ ᑎᖕᒥᐊᓄᑦ ᐊᔾᔨᒌᖃᑦᑕᓚᐅᖏᑦᑐᑦ ᑕᑯᔪᓐᓇᕋᙶᑕ ᑭᓯᐊᓂᐅᓚᐅᕐᒪᑦ, 0-ᒥᑦ ᐊᕐᕕᓂᓕᖓᓄᑦ ᐃᑲᕐᕋᓅᖃᑦᑕᖅᓱᑎᒃ.

ᑕᓇᐅᕐᒥᐅᑕᐃᑦ ᓂᕐᔪᑏᑦ

ᑲᑎᓪᓗᒃᑖᖅᓱᒋᑦ ᖃᐅᔨᓴᐃᓂᐅᓚᐅᖅᑐᖅ ᑕᓇᐅᕐᒥᐅᑕᓂᒃ 268.7 ᐃᑲᕐᕋᐃᑦ 3,089 ᑭᓛᒥᑕᐅᑉᓗᑎᒃ (ᐃᖏᕐᕋᓂᖅ 1 ᐊᒻᒪᓗ 2 ᑲᑎᖕᓗᒋᒃ). ᑲᑎᓪᓗᒃᑖᖅᓱᒋᑦ ᖃᐅᔨᓴᐃᓂᐅᓚᐅᖅᑐᖅ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ 100.4 ᐃᑲᕐᕋᐅᓚᐅᖅᑐᑦ 1,119 ᑭᓛᒥᑕᐅᑉᓗᑎᒃ. ᑲᑎᓪᓗᒃᑖᖅᓱᒋᑦ ᖃᐅᔨᓴᐃᓂᐅᓚᐅᖅᑐᖅ ᐃᖏᕐᕋᓂᖅ 2-ᒥᑦ 168.3 ᐃᑲᕐᕋᐅᓚᐅᖅᑐᑦ 1,970 ᑭᓛᒥᑕᐅᑉᓗᑎᒃ. ᒪᕐᕈᐃᖅᑕᖅᓱᑎᒃ ᐊᒥᓲᓂᖅᓴᐅᓚᐅᖅᑎᓪᓗᒋᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐅᑉᓗᐃᑦ ᐃᖏᕐᕋᓂᖅ 2-ᒥᑦ ᐃᖏᕐᕋᓂᖅ 1-ᒥᐅᖔᓂᑦ (24 ᐅᑉᓗᐃᑦ ᐱᖃᑖ 11 ᐅᑉᓘᑉᓗᑎᒃ), ᑕᒪᓐᓇ ᑕᒃᑯᒃᓴᐅᓚᐅᖕᒋᑦᑐᖅ ᑕᒪᐃᓐᓃᖓᔪᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᖃᐅᒪᒃᖕᕐᓂᖅᓴᐅᖃᑦᑕᓚᐅᕐᒪᑦ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ (ᖃᐅᒪᓂᖃᕐᓂᖅ = 11 ᐃᑲᕐᕋᐃᑦ) ᐃᖏᕐᕋᓂᖅ 2-ᒥᓕ (ᖃᐅᒪᓂᖃᕐᓂᖅ = 7 ᐃᑲᕐᕋᐃᑦ).

7 ᐊᔾᔨᒌᙱᑦᑐᑦ ᑕᓇᐅᕐᒥᐅᑕᐃᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ 2019 ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ: ᑑᒡᓕᒃ, ᕿᓇᓗᒐᖅ, ᐊᕐᕕᖅ, ᓇᑦᑎᖅ, ᖃᐃᕈᓕᒃ, ᐅᒡᔪᒃ ᐊᒻᒪᓗ ᓇᓄᖅ. ᑲᑎᖕᓗᒋᑦ 304 ᑕᓇᐅᕐᒥᐅᑕᐃᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ 2,785-ᓂᒃ ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᒋᑦ ᑎᑎᕋᐅᓯᐅᑉᓗᑎᒃ. 2019-ᒥᑦ ᓇᓕᐊᖕᓂᑐᐃᓐᓇᖅ ᖃᐃᔾᔨᓴᐃᓂᕐᒥᑦ ᐋᕐᓗᐃᑦ ᐊᒻᒪᓗ ᐊᐃᕖᑦ ᑎᑎᕋᐅᓯᐅᓚᐅᖏᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕙᐅᔪᒥᑦ; ᑭᓯᐊᓂ ᑕᒪᕐᒥᒃ ᓂᕐᔪᑏᑦ ᖃᐅᔨᒪᔭᐅᔪᑦ ᑕᐃᒪᐅᖃᑦᑕᕐᒪᑕ ᑕᒫᓂ.

ᐊᐅᔭᖅᐸᓪᓕᐊᓕᕌᖅᑎᓪᓗᒍ (ᐃᖏᕐᕋᓂᖅ 1), ᑲᑎᖕᓗᒋᑦ 152 ᑕᓇᐅᕐᒥᐅᑕᐃᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ, 2,453-ᓂᒃ ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᒋᑦ ᑎᑎᕋᐅᓯᐅᑉᓗᑎᒃ. ᓂᕐᔪᑏᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ ᓇᑦᑎᖅ (61 ᑕᑯᔭᐅᔪᑦ 722 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᑎᒃ), ᑑᒡᓖᑦ (27 ᑕᑯᔭᐅᔪᑦ 385 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᑎᒃ), ᖃᐃᕈᓖᑦ (24 ᑕᑯᔭᐅᔪᑦ 136 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᑎᒃ), ᐊᕐᕖᑦ (22 ᑕᑯᔭᐅᔪᑦ 24 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᑎᒃ), ᐅᒡᔪᐃᑦ

(ᓯᑕᒪᑦ ᑕᑯᔭᐅᔪᑦ ᓯᑕᒪᑦ ᐊᑕᐅᓯᐅᖃᑦᑕᖅᔪᑎᒃ), ᓇᓄᐃᑦ (ᒪᕐᕆᒃ ᑕᑯᔭᐅᔪᑦ ᒪᕐᕆᒃ ᐊᑕᐅᓯᐅᖃᑦᑕᖅᔪᑎᒃ), ᐊᒻᒪᓗ ᕿᓇᓗᒐᐃᑦ (ᐊᑕᐅᓯᖅ ᑕᑯᔭᐅᔪᖅ ᐊᑕᐅᓲᖅᔪᒍ). 9-ᖑᓚᐅᕐᒥᔪᑦ ᑕᑯᔭᐅᔪᑦ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᙱᑦᑐᖅ ᐊᐃᕙᕐᓄᑦ ᐃᓚᒋᔭᐅᔪᑦ (1,176 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᔪᑎᒃ) ᐊᒻᒪᓗ ᒪᕐᕆᒃ ᑕᑯᔭᐅᔪᑦ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᙱᑦᑐᑦ ᕿᓇᓗᒐᐅᖕᒥᔪᑦ (ᐱᖕᒐᓱᑦ).

ᐅᑭᐊᒃᓵᕐᒥᑦ (ᐃᖏᕐᕋᓂᖅ 2), ᑲᑎᕐᔪᒋᑦ 152 ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ 332 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᔪᑎᒃ ᑎᑎᕋᐅᓯᐅᔪᑦ. ᓂᕐᔪᑏᑦ ᖃᐅᔨᔭᐅᔪᓂᑦ ᐃᓚᐅᔪᑦ ᓇᑦᑎᖅ (53 ᑕᑯᔭᐅᔪᑦ 58 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᔪᑎᒃ), ᑑᒐᓖᑦ (27 ᑕᑯᔭᐅᔪᑦ 103 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᔪᑎᒃ), ᖃᐃᕈᓖᑦ (25 ᑕᑯᔭᐅᔪᑦ 117 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᔪᑎᒃ), ᐅᒡᔪᐃᑦ (ᐊᑕᐅᓯᖅ ᑕᑯᔭᐅᔪᖅ ᐊᑕᐅᓲᖅᔪᒍ) ᐊᒻᒪᓗ ᐊᕐᕙᖅ (ᐊᑕᐅᓯᖅ ᑕᑯᔭᐅᔪᖅ ᐊᑕᐅᓲᖅᔪᒍ). 44-ᓂᒃ ᑕᑯᓚᐅᕐᒥᔪᑦ ᐊᐃᕙᕐᓄᑦ ᐃᓚᒋᔭᐅᔪᓂᒃ (49 ᐊᑕᐅᓯᐅᑉᓗᑎᒃ) ᐊᒻᒪᓗ ᐊᑕᐅᓯᖅ ᑕᑯᔭᐅᔪᖅ ᕿᓇᓗᒐᐅᖕᒥᔪᑦ (ᐱᖕᒐᓱᑦ).

ᐊᒥᓲᓂᖏᑦ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ, ᖃᐅᔨᔭᐅᔪᓂᑦ ᓂᕐᔪᑎᓄᑦ ᓈᓴᐅᑏᑦ (ᖃᑉᓯᐅᓂᖏᑦ ᓂᕐᔪᑏᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ ᑭᓛᒥᑕᓂᑦ), 0.90 ᓂᕐᔪᑏᑦ/ᑭᓛᒥᑕᓂᑦ (0.10 ᑕᑯᔭᐅᔪᑦ ᐊᑕᐅᓯᖅ ᑭᓛᒥᑕᒥᑦ). ᐊᒥᓲᓂᖅᓴᐃᑦ ᓂᕐᔪᑏᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ (2.19 ᓂᕐᔪᑏᑦ/ᑭᓛᒥᑕᓂᑦ) ᐃᖏᕐᕋᓂᖅ 2-ᒥᒡ (0.17 ᓂᕐᔪᑏᑦ/ᑭᓛᒥᑕᓂᑦ). ᑕᒪᓗᒃᑖᖅ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ, ᐃᓚᐅᑉᓗᑎᒃ ᑑᒐᓖᑦ, ᐊᒥᓲᓂᖅᓴᐅᖃᑦᑕᓚᐅᖅᑐᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ ᐃᖏᕐᕋᓂᖅ 2-ᒥᐅᖕᒐᓂᑦ. ᐊᒥᓲᓂᖏᑦ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ ᐊᔾᔨᑦᓕᒋᓚᐅᖅᑕᖕᒐ 2019-ᒥᑦ (2.19 ᓂᕐᔪᑏᑦ/ᑭᓛᒥᑕᓂᑦ) ᐅᓂᑉᖃᐅᑕᐅᓚᐅᖅᑐᒥᑦ 2018-ᒥᑦ (0.88 ᓂᕐᔪᑏᑦ/ᑭᓛᒥᑕᓂᑦ). ᓂᕐᔪᑏᑦ ᖃᐅᔨᔭᐅᔪᑦ ᐊᒥᓲᓂᖅᓴᐅᑉᓗᑎᒃ 2019-ᒥᑦ 2018-ᒥᐅᖕᒐᓂᑦ ᐃᓚᐅᔪᑦ ᑑᒐᓖᑦ, ᕿᓇᓗᒐᐃᑦ, ᐊᒻᒪᓗ ᐊᕐᕚᑦ. ᑖᑉᑯᓇᙵ ᓂᕐᔪᑎᓄᑦ, ᐊᒥᓱᙳᓇᐊᖅᓯᒪᓂᖅ ᑕᑯᒃᓴᐅᑎᑦᑎᓚᐅᖅᑐᖅ ᓂᕐᔪᑏᑦ ᐊᒥᓲᓂᖅᓴᐃᑦ ᑕᑯᔭᐅᔪᑦ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ (ᐊᔾᔨᑦᓚᖕᒐ ᖃᑉᓯᐅᓂᖏᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ ᐃᖏᕐᕋᓂᖅ 2-ᒥᑦ ᑕᒪᐃᓐᓂᑦ ᐅᑭᐅᕐᓂᑦ). ᐊᒥᓲᙱᓐᓂᖅᓴᐃᑦ ᓇᑦᑏᑦ ᐊᒻᒪᓗ ᖃᐃᕈᓖᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ 2018-ᒥᐅᖕᒐᓂᑦ, ᐱᔾᔪᑕᐅᓚᐅᖅᑐᒃᓴᐅᔪᖅ ᐊᒥᓯᑲᓪᓚᐃᑦ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᙱᑦᑐᑦ ᓇᑦᑏ5 ᑎᑎᕋᐅᓯᐅᓯᒪᔪᑦ 2019-ᒥᑦ (n=1,225) 2018-ᒥᐅᖕᒐᓂᑦ (n=760). ᐃᓱᒪᒋᑉᓗᒋᑦ ᖃᓄᐃᑦᑐᒃᑖᑦ ᓇᑦᑏᑦ (ᓇᓗᓇᐃᖅᑕᐅᔪᑦ ᐊᒻᒪᓗ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᙱᑦᑐᑦ ᓂᕐᔪᑏᑦ), ᐊᔾᔨᑦᓚᖏᑦ ᐊᒥᓲᓂᖏᑦ ᖃᐅᔨᔭᐅᓯᒪᔪᑦ ᑕᒪᐃᓐᓂᑦ ᐅᑭᐅᕐᓂᑦ.

ᐃᒥᓲᒍᓂᕐᓂᖏᑦ ᑑᒐᓖᑦ 2019-ᒥᑦ ᐱᔾᔪᑕᐅᑐᐃᓐᓇᕆᐊᓕᒃ ᐊᑦᑎᒃᓯᓯᒪᓗᐊᓚᐅᕐᓂᖏᑦ ᐊᒥᓲᓂᖏᑦ ᑑᒐᓖᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕙᔪᒥᑦ 2018-ᒥᑦ, ᐅᖃᐅᓯᐅᓂᖓᑦᑐᑦ ᓄᓇᓕᖕᒥᐅᓂᑦ ᐊᒻᒪᓗ ᑑᒐᓕᓗᐊᖃᑦᑕᙱᓯᒪᑉᓗᑎᒃ ᑕᐃᑲᓂ ᐅᑭᐅᕐᒥᑦ. ᒪᖃᐃᑏᑦ ᖃᐅᔨᓚᐅᖅᑐᑦ ᑕᐃᒪᓐᓇᐃᖏᓐᓂᖓᓄᑦ 2019-ᒥᑦ ᑑᒐᓖᑦ ᑕᑯᔭᐅᒐᔫᒃᔪᑎᒃ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ ᐊᒻᒪᓗ ᐊᒥᓱᒻᒪᕆᐅᖃᑦᑕᖅᔪᑎᒃ ᑲᑎᕐᒪᔪᑦ. ᐊᒥᓲᒍᕆᐊᕐᓂᖏᑦ ᖃᐅᔨᔭᐅᔪᑦ 2019-ᒥᑦ ᐱᔾᔪᑕᐅᑐᐃᓐᓇᕆᐊᖃᕐᒥᔪᑦ ᓄᑖᓂᒃ ᐊᑐᓕᕐᓂᖏᑦ ᐊᐅᓚᑦᑎᓂᕐᔫᖕᒐᔪᓂᒃ ᐱᒋᐊᓵᖅᑎᓪᓗᒍ 2019 ᓯᑯᒥᑦ ᓯᕐᑯᑉᑎᕆᔾᔪᑎᒥᑦ ᒥᒃᓴᒋᐊᖅᑎᑕᐅᓂᖓ ᓂᐱᖃᕐᓂᖓ, ᓃᕐᓗ 40 ᑭᓛᒥᓂᒃ ᓯᓈᓂᑦ ᐅᖓᓯᒃᑎᒋᓂᕐᒧᑦ ᑭᒡᓕᐅᔪᖅ ᐊᒻᒪᓗ ᐊᒥᓲᔪᖕᓅᕐᓂᖏᑦ ᓯᑯᒥᑦ ᓯᕐᑯᑉᑎᕆᔪᑦ ᐃᖏᕐᕋᔾᔪᖕᓂᖏᑦ ᐅᑉᓗᑕᒫᒃᑯᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ ᓯᑯᖃᓗᐊᖅᑎᓪᓗᒍ.

ᖃᖓᑕᔫᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᖅᑕᖃᓚᐅᖅᑐᖅ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ ᐃᓱᐊᓂ ᐅᒥᐊᕐᔪᐊᑦ ᑎᑭᖃᑦᑕᕐᓂᖏᓐᓂᑦ ᐅᑭᐅᖑᑦ 30-ᒥᑦ 31-ᒧᑦ, 2019-ᒥᑦ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒋᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐊᑉᕐᑯᑎᖏᑦ ᐊᒻᒪᓗ ᐊᑭᐊᓂᑦ ᐃᓂᐅᔪᑦ ᑑᒐᓖᑦ ᐊᔪᖅᓯᑦᑐᖃᖅᐸᑦ ᐱᐊᓂᒃᑎᓪᓗᒍ ᐹᕙᒫᓐᓇᑯᑦ ᐅᒥᐊᕐᔪᐊᓂᒃ ᑎᑭᑎᑦᑎᖃᑦᑕᕐᓂᖏᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ. ᑲᑎᕐᔪᒋᑦ ᐊᕐᕙᓃᑦ ᑑᒐᓖᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ 14 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᔪᑎᒃ ᑎᑎᕋᐅᓯᐅᑉᓗᑎᒃ ᐅᑭᐅᖑᑦ 30-ᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ. ᓂᕐᔪᑎᓗᒃᑖᑦ ᑲᓇᖕᓇᖕᒐᓃᓚᐅᖅᑐᑦ ᒥᑦᑎᒪᑕᓕᐅᑉ ᐊᒻᒪᓗ ᖃᓂᑕᖕᒐᓂᑦ ᕿᑭᖅᑖᓅᑉ ᐃᒪᖕᒐᓄᐊᕆᐊᕐᕙᐊᓂᑦ, ᓂᕐᔪᑎᓗᒃᑖᑦ ᑕᑯᔭᐅᔪᑦ ᑲᓇᖕᓇᒨᙱᒐᐅᑉᓗᑎᒃ. ᑑᒐᓖᑦ ᑕᑯᔭᐅᓂᖏᓐᓄᑦ ᑎᑎᕋᐅᓯᐅᓚᐅᖏᑦᑐᑦ ᐅᑭᐅᖑᑦ 31-ᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ. ᖃᓄᐃᖕᒐᓂᐅᔪᑦ ᐃᓱᐊᓂᑦ ᖃᖓᑕᔫᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᖃᐅᔨᓇᖅᑐᖃᓚᐅᖏᑦᑐᖅ ᐊᔪᖅᓯᓯᒪᔪᓂᒃ 2019-ᒥᑦ ᐱᓕᕆᐊᕐᒧᑦ ᐱᔪᓂᒃ ᓯᑯᒥᒃ ᓯᕐᑯᑉᑎᕆᔾᔪᑎᒧᑦ ᐊᒻᒪᓗ ᐅᒥᐊᕐᔪᐊᓕᕆᓂᕐᓂᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ.

ᐊᔾᔨᑦᓚᖕᒐᑎᑦᑐᑦ ᐅᑭᐅᓂᑦ ᐊᓂᒍᖅᑐᓂᑦ, ᐅᒥᐊᕐᔪᐊᕐᓂᑦ ᑐᓗᖅᓯᔪᖃᓚᐅᖏᑦᑐᖅ ᑕᕆᐅᕐᒥᐅᑕᓂᒃ (ᑐᓗᖅᑕᐅᖅᑲᔭᖅᑐᓂᒡ ᓘᓐᓅᑦ) ᑎᑎᕋᐅᓯᐅᔪᖃᓚᐅᖏᑦᑐᖅ ᖃᐅᔨᓴᐃᓂᖃᖅᑎᓪᓗᒋᑦ ᐅᒥᐊᕐᔪᐊᕐᒦᖕᔪᑎᒃ MSV Botnica 2019-ᒥᑦ. ᑕᒪᐃᓐᓅᖕᒐᔫᒃᑯᑦ, ᐅᖕᒐᓯᖕᓂᖃᐃᓐᓇᓚᐅᖅᑐᑦ ᑕᕆᐅᕐᒥᐅᑕᓄᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᖅ ᐅᒥᐊᕐᔪᐊᕐᒥᑦ 2019-ᒥᑦ (ᓃᕐᓗ, ᖃᓂᒡᒋᒃᑯᑦ ᑎᑭᐅᑎᓂᕐᒧᑦ ᖃᓄᐃᖕᒐᓂᐅᔪᑦ) ᓇᓗᓇᙱᑎᑦᑐᔪᖅ ᑕᐃᒪᐅᔪᒥᒃ ᐊᕝᕙᑎᓕᕆᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᓂᑦ, ᑕᕆᐅᕐᒥᐅᑕᓄᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ ᑕᒃᓴᐅᑎᑦᑎᔪᖕᓇᖅᑐᑦ ᖃᒡᓕᑦᑕᐃᓕᓂᖏᑦ ᐅᒥᐊᕐᔪᐊᓄᑦ, ᐊᒻᒪᓗ ᐅᒥᐊᕐᔪᐊᑦ ᑐᓗᖅᓯᔭᓇᐊᒃᓴᖏᓐᓂᒃ ᐱᑕᖃᙱᑦᑐᖅ ᒪᓕᒃᔪᒋᑦ ᒫᓇᐅᔪᖅ ᐅᒥᐊᕐᔪᐊᑦ ᓇᑭᖅᓴᕐᓂᖏᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ (9 ᓈᑦᓂᒃ (knot) ᓇᑭᖅᓴᕐᓂᕐᒧᑦ ᑭᒡᓕᐅᔪᖅ).

ᐊᑕᐅᑦᑎᒃᑯᑦ, 2019 ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᖃᓄᐃᖕᒐᓂᐅᔪᑦ ᐃᑲᔪᐃᔪᑦ ᐊᒃᑐᖅᓯᓂᕐᒧᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᓂᒃ ᐊᒻᒪᓗ ᐊᖏᔪᒥᒃ ᖃᐅᔨᓂᕐᒧᑦ FEIS-ᒥᑦ ᑎᑎᖅᑲᖅ ᐃᓚᒋᔭᐅᔪᒧᑦ ᑮᓇᐅᔭᓕᐅᖅᐸᓪᓕᐊᒋᐊᓖᕐᓂᕐᒥᑦ ᐱᓕᕆᐊᖅ ᐊᖏᔪᒥᒃ ᕿᒪᒃᑎᑦᑐᓂᒃ

ᖃᓄᐃᖅᑲᓕᖅᑎᑦᑎᓂᐊᕐᓂᖅᑲ ᑕᕆᐅᕐᒥᐅᑕᓄᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ, ᑐᑭᓕᐅᖅᓯᒪᔪᖅ ᖃᓄᐃᖅᑲᓕᖅᑎᑦᑎᓂᐅᔪᑦ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᐊᒥᓲᓂᖏᓐᓂᒃ ᑖᒥᓂ ᓇᓕᑐᐃᓐᓇᖅᑲᒍᑦ ᑐᕐᑯᑕᐅᓂᖏᑦᑎᒍᑦ (ᓲᕐᓗ, ᐅᒥᐊᕐᔪᐊᕐᒧᑦ ᑐᓗᖅᑕᐅᔪᑦ) ᐅᕝᕙᓘᓐᓃᑦ ᐊᒥᓯᑦ ᐊᓯᐊᓄᐊᕐᓂᖏᓐᓄᑦ ᕿᒪᐃᓂᖏᓐᓄᓪᓗᓐᓃᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ.

ᑲᔪᓯᑯᔭᐅᔪᖅ ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᖅ 2020-ᒧᑦ ᒪᓕᒡᓗᒋᑦ ᐊᕙᑎᓕᕆᔩᒃᑯᑦ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑕᖅᑲᑦ ᓈᓴᐅᑎ 005-ᖏᑦᑐᑦ ᑐᑭᐅᔪᑦ ᐊᒻᒪᓗ ᖃᓄᐃᖅᑲᔭᕆᐊᖃᕐᓂᐅᔪᑦ. ᐊᕐᕌᒍᑕᓖᑦ ᖃᐅᔨᓴᐃᖃᑦᑕᕐᓂᖅ ᐱᔾᔪᑎᖃᖅᑎᑦᑎᓂᐊᖅᑐᖅ ᓈᓴᐅᑎᒃᑲᓂᕐᓂᒃ/ᑎᑎᖅᑲᒃᑲᓂᕐᓂᒃ ᖃᓄᐃᓐᓂᖅᓵᐅᓂᖏᓐᓃᕐᓂᐊᕐᓗᒋᑦ ᐊᑯᓂᖏᓐᓂᒃ ᐅᑭᐅᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᓂᑦ, ᖃᐅᔮᔾᔪᑕᐅᔪᖕᓇᖅᑐᑦ ᐊᑐᓕᖅᑎᑦᑎᓂᕐᒨᖅᑲᔪᓂᒃ ᐱᓕᕆᐊᕐᒥᒃ ᐊᐅᓪᓛᖅᑎᑦᑎᓂᕐᓄᑦ ᐅᒥᐊᕐᔪᐊᓕᕆᓂᖃᕆᐊᖃᕋᔭᖅᐸᑕ.

ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᑎᖅᒥᐊᑦ

ᑲᑎᕝᓗᒋᑦ ᖃᐅᔨᓴᐃᓃᑦ ᑎᖅᒥᐊᓂᑦ 2019-ᒥᑦ 103.2 ᐃᑲᕐᕿᐅᓚᐅᖅᑐᑦ (ᐃᖏᕐᕋᓂᖅ 1 ᐊᒻᒪᓗ 2 ᑲᑎᕝᓗᒋᑦ), 231-ᓂᒃ 5-ᒥᓂᑦᓂᒃ ᖃᐅᔨᓴᐃᓂᖃᖅᓗᑎᒃ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ ᐊᒻᒪᓗ 1,008-ᓂᒃ 5-ᒥᓂᑦᓂᒃ ᖃᐅᔨᓴᐃᓂᖃᖅᓗᑎᒃ ᐃᖏᕐᕋᓂᖅ 2-ᒥᑦ. ᑲᑎᓗᒃᑖᖅᓗᒋᑦ 11 ᑎᖅᒥᐊᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ (157 ᓇᓗᓇᐃᖅᑕᐅᔪᑦ ᑕᑯᔭᐅᓂᖏᓐᓄᑦ 265 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᑎᒃ), ᓇᐅᔭᑦᔪᐊᕐᓚᐅᓪᓗ ᐱᑦᑎᐅᓛᓪᓗ ᐊᒥᓲᓛᖑᐸᓗᑎᒃ ᑎᖅᒥᐊᓂᑦ. ᑲᑎᕝᓗᒋᑦ 9 ᑎᖅᒥᐊᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ ᐃᖏᕐᕋᓂᖅ 2-ᒥᑦ (97 ᑕᑯᔭᐅᔪᑦ 396 ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᑎᒃ), ᓇᐅᔭᑦᔪᐊᑦ ᐊᒻᒪᓗ ᓇᐅᔭᑦᔪᐊᕐᓚᐃᑦ ᐊᒥᓲᓛᖑᐸᓗᑎᒃ. ᑎᓴᒪᑦ ᖁᕝᕗᐃᓐᓇᐃᑦ ᓇᐅᔭᑦᔪᐊᕐᓚᐃᑦ, ᑲᓇᑕᐅᑉ ᒐᕙᒪᒃᑯᖏᑦ *ᓄᖑᓕᖅᑐᑦᓂᕐᔪᑏᑦ* ᐃᓚᖏᔭᐅᔪᖅ 1-ᒥᑦ *ᓂᕐᔪᑏᑦ ᐅᓗᓇᐊᓇᖅᑐᒦᑦᑐᑦ ᐱᕐᔪᕐᒥᑦ* (ᑲᓇᑕᐅᑉ ᒐᕙᒪᒃᑯᖏᑦ 2019), ᑕᑯᔭᐅᓚᐅᖅᑐᑦ ᐃᖏᕐᕋᓂᖅ 2-ᒥᑦ; ᑕᑯᔭᐅᓚᐅᖏᑦᑐᑦ ᑖᒃᑯᐊ ᑎᖅᒥᐊᑦ ᐃᖏᕐᕋᓂᖅ 1 ᖃᐅᔨᓴᐃᓂᕐᒥᑦ, ᓇᓕᐊᖕᓂᑐᐃᓐᓇᕐᓗᓐᓃᑦ ᐃᖏᕐᕋᓃᖕᓂᑦ 2018-ᒥᑦ.

ᐊᔾᔨᑦᓚᖏᑦ ᐊᒥᓲᓂᖏᑦ ᑎᖅᒥᐊᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ (ᐊᐅᔭᖅᐸᓪᓕᐊᓕᕆᖅᑎᓪᓗᒍ) ᖃᐅᔨᓴᐃᓂᖅ 2018-ᒥᑦ ᐊᒻᒪᓗ ᐃᖏᕐᕋᓂᖅ 1-ᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ 2019-ᒥᑦ (13 ᐊᒻᒪᓗ 11 ᑎᖅᒥᐊᖑᓚᐅᖅᑐᑦ). ᐊᒥᓱᒃᑲᓃᑦ ᑎᖅᒥᐊᑦ ᑎᑎᕋᐅᓯᐅᓚᐅᖅᑐᑦ ᐃᖏᕐᕋᓂᖅ 2 2019-ᒥᑦ ᐊᒻᒪᓗ ᐃᖏᕐᕋᓂᖅ 2 2018-ᒥᑦ (9-ᖑᓚᐅᖅᑐᑦ 5-ᖑᓚᐅᖅᓗᑎᓪᓕ ᑎᖅᒥᐊᑦ). ᑕᐃᒪᓐᓇᐃᑦᑐᒃᓴᐅᔪᖅ ᐱᖁᓯᑎᓭᐅᔫᒃᑯᑦ ᐊᔾᔨᒌᙱᓐᓂᐅᔪᖅ ᑕᐃᒪᑕᖃᐅᕐᓂᖏᓐᓄᑦ ᐅᑯᓂᖏᓐᓂᑦ ᐅᑭᐅᓂᑦ. ᐃᖏᕐᕋᓂᖅ 1 ᖃᐅᔨᓴᐃᓂᕐᓂᑦ, ᓄᑖᓂᒃ ᑎᖅᒥᐊᓂᒃ ᖃᐅᔨᔪᖃᓚᐅᖏᑦᑐᖅ 2019-ᒥᑦ ᐊᔾᔨᒋᐸᓗᒍ 2018-ᒥᑦ. ᐃᖏᕐᕋᓂᖅ 2 ᖃᐅᔨᓴᐃᓂᕐᓂᑦ, ᒪᕐᕉᒃ ᓄᑖᒃ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᑎᖅᒥᐊᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ ᖃᐅᔨᔭᐅᓚᐅᖏᓐᓗᑎᓪᓕ 2018-ᒥᑦ: ᖁᕝᕗᐃᓐᓇᖅ ᓇᐅᔭᑦᔪᐊᕐᓚᒃ ᐊᒻᒪᓗ ᑕᑭᔪᒥᒃ ᐸᒥᐅᓕᒃ ᐊᒡᒋᐊᕐᔪᒃ. ᐊᒥᓲᓂᖅᓴᓂᒃ ᑕᕆᐅᕐᒥᐅᑕᓂᒃ ᑎᖅᒥᐊᓂᒃ ᑕᑯᓚᐅᖅᑐᑦ ᐃᖏᕐᕋᓂᖅ 1 2019-ᒥᑦ 2018-ᒥᐅᖅᑲᓂᑦ (265-ᓂᒃ ᐱᖃᑖᓂᓕ 136-ᓂᒃ ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᑎᒃ). ᐱᖃᑖᒨᖅᑳᓚᐅᖅᑐᓪᓕ ᖃᐅᔨᔭᐅᔪᑦ ᐃᖏᕐᕋᓂᖅ 2-ᒥᑦ, ᐊᒥᓲᓂᖅᓴᐃᑦ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᑎᖅᒥᐊᑦ ᖃᐅᔨᔭᐅᕙᓗᑎᒃ ᐃᖏᕐᕋᓂᖅ 2 2018-ᒥᑦ 2019-ᒥᐅᖅᑲᓂᑦ (719-ᓂᒃ ᐱᖃᑖᓂᓕ 661-ᓂᒃ ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓗᑎᒃ).

ᑕᒪᐃᓐᓅᖅᑲᔪᒃᑯᑦ ᖃᐅᔨᔭᐅᔪᖅᓇᕐᓂᖏᑦ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᑎᖅᒥᐊᑦ ᐊᐅᓛᖅᑐᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ 2019-ᒥᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓚᐅᖅᑐᖅ 1.00-ᒥᒃ (95% ᓇᓗᓇᙱᓐᓂᖅ ᐊᑯᓂᖅᑲᓂᑦ [CI]: 1.00-ᒥᑦ 1.00-ᒧᑦ). ᐊᔾᔨᑦᓕᒋᓚᐅᖅᑕᖅᑲ ᖃᐅᔨᔭᐅᔪᖅᓇᕐᓂᖏᓐᓄᑦ ᓈᓴᐅᓯᓇᔭᐅᔪᑦ Bodluc ᐊᒻᒪᓗ Fifield-ᒧᑦ (2017) ᐱᐊᓂᒃᐸᓪᓕᐊᑎᓗᒋᑦ ᓅᑕᐅᓂᖏᑦ ᑲᑎᓐᓂᐅᔪᓂᒃ ᖃᐅᔨᓴᐃᓃᑦ Gulf of St. Lawrence-ᒥᑦ. ᑕᒪᐃᓐᓅᖅᑲᔪᒃᑯᑦ, ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᑎᖅᒥᐊᑦ ᐱᑕᖃᐅᕐᓂᖏᑦ ᖃᓂᑦᑐᒥᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᒥᑦ 2019-ᒥᑦ 0.66 ᑎᖅᒥᐊᖑᓚᐅᖅᑐᑦ/ᑭᓛᒥᑕᓂᒃ^{2} (95%-ᖑᔪᖅ CI: 0.45-ᒥᑦ 0.96-ᒧᑦ). ᑎᖅᒥᐊᑦ ᐱᑕᖃᐅᕐᓂᖏᓐᓄᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ ᓇᐅᔭᑦᔪᐊᕐᓚᖅᓅᓚᐅᖅᑐᖅ ᑖᓐᓇ ᑎᖅᒥᐊᖅ ᐃᓱᐊᓚᐅᕐᒪᑦ ᐆᒃᑐᕋᐅᑎᒋᓂᐊᕐᓗᒍ ᐊᖏᓂᕆᔭᖅᑲ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ (Buckland et al. 2001). ᐱᑕᖃᐅᕐᓂᖏᓐᓄᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ ᐱᐊᓂᓚᐅᖏᑦᑐᑦ ᐊᓯᖏᓐᓄᑦ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᑎᖅᒥᐊᓄᑦ ᐆᒃᑐᕋᐅᑎᒋᓂᐊᕐᓗᒋᑦ ᐊᖏᓂᖏᑦ ᑎᖅᒥᐊᑦ ᓇᓚᐅᑦᑎᖏᓐᓂᖃᕐᓂᐊᓚᐅᕐᒪᑕ ᖃᓄᐃᖅᑲᓂᐅᔪᓂᒃ (Buckland et al. 2001). ᖃᐅᔨᔭᐅᔪᖅᓇᕐᓂᖏᓐᓄᑦ ᓇᐅᔭᑦᔪᐊᕐᓚᐃᑦ 2019-ᒥᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓚᐅᖅᑐᑦ 0.55-ᖑᓂᖏᓐᓄᑦ (95% CI: 0.38-ᒥᑦ 0.79-ᒧᑦ). ᐱᑕᖃᐅᕐᓂᖏᓐᓄᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ ᓇᐅᔭᑦᔪᐊᕐᓚᖅᓄᑦ 2019-ᒥᑦ 0.99-ᖑᓚᐅᖅᑐᑦ ᑎᖅᒥᐊᓄᑦ/ᑭᓛᒥᑕᓂᑦ^{2} (95% CI: 0.52-ᒥᑦ 1.87-ᒧᑦ).

ᐊᑕᐅᓯᕐᒥᒃ ᑕᕆᐅᕐᒥᐅᑕᖅ ᑎᖅᒥᐊᒥᕐᒥᑦ ᑐᓗᖅᑕᐅᔪᖃᕐᒪᑦ ᑎᑎᕋᐅᓯᐅᓚᐅᖅᑐᖅ 2019-ᒥᑦ (ᐃᖏᕐᕋᔭᖕᓂᖅ 2). ᓯᕿᙳᔭᖅ 22:00-ᒧᐊᖅᑎᓪᓗᒍ ᐅᑭᐅᕐᓂᑦ 11-ᒥᑦ, ᐃᑳᕈᑎᒧᑦ ᐱᓕᕆᔨᐅᔪᖅ ᖃᐅᔨᓚᐅᖅᑐᖅ ᑕᑭᔪᒥᒃ ᐸᒥᐅᓕᒃ ᐊᒡᒋᐊᕐᔪᒃ ᑎᖅᒥᑉᓗᓂ ᑐᓗᓚᐅᖅᑐᖅ ᐊᑖᓂᑦ ᐅᒥᐊᕐᔪᐊᑉ ᕿᓕᒥᒨᓕᕝᕕᖅᑲᓂᑦ. ᑐᓗᓚᐅᖅᑐᖅ ᑕᓯᐅᔭᖅ ᑲᓇᖅᓇᖅᑲᓂᑦ ᖃᓂᑕᖅᑲᓂᑦ ᒥᑦᑎᒪᑕᓕᐅᑉ (72 50.1 N, 78 00.1 W) ᐅᒥᐊᕐᔪᐊᖅ ᐅᓐᓄᖅᒧᑦ ᓄᖅᑲᖅᑲᑎᓪᓗᒍ. ᓯᓚ ᑕᑯᒃᓴᐅᑦᑎᐊᕐᓇᓚᐅᖏᑦᑐᖅ (ᑖᖅᓱᓂ, ᖃᓐᓂᖅᓱᓂ), ᐊᓄᓇᑭᕐᓱᓂ ᐊᒻᒪᓗ ᐅᖅᓯᐊᓚᐅᖅᑐᖅ ᑕᓄᐅᖅ. ᑎᖅᒥᐊᖅ ᐊᖑᓴᓪᓘᓚᐅᖅᑐᖅ. ᖁᖓᓯᓂᐊ ᓯᕐᑯᒥᕐᓱᓂ ᐊᑯᓂᐅᖏᑦᑐᕐᓗ ᑐᕐᑯᑉᓗᓂ. ᑎᖅᒥᐊᖅ ᑐᓗᖅᑐᖅ ᐅᖃᐅᓯᐅᓚᐅᖅᑐᖅ ᐹᕝᕕᓐᓃᓐᑯᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᑐᑭᒧᐊᒃᑎᑦᑎᔩᒧᑦ ᐅᑭᐅᓃᑦ 12, 2019-ᒥᑦ.

Study Limitations

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List of Acronyms and Abbreviations

AIC	Akaike's Information Criterion
Baffinland	Baffinland Iron Mines Corporation
CIS	Canadian Ice Service
CI	Confidence Interval
CPA	closest point of approach
CWS	Canadian Wildlife Service
ECSAS	Eastern Canada Seabirds at Sea
FEIS	Final Environmental Impact Statement
Golder	Golder Associates Ltd.
GPS	Global Positioning System
km	Kilometres
km^2	square kilometres
m	Metre
MHTO	Mittimatalik Hunters and Trappers Organization
MMP	Marine Monitoring Plan
Mtpa	million tonnes per annum
MWOs	Marine Wildlife Observers
n/a	not applicable
Project	Mary River Project
PC No. 005	Project Certificate Number 005
RSA	Regional Study Area
SBO	Ship-based Observer
SPUE	Sightings Per Unit Effort

1.0 INTRODUCTION

The Mary River Project (the Project) is an operating open-pit iron ore mine located in the Qikiqtani Region of North Baffin Island, Nunavut (Figure 1). Baffinland Iron Ore Corporation (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, 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 (the Project Certificate) 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, Baffinland 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 granted for 2018 and 2019. The Northern Shipping Route encompasses Milne Inlet, Eclipse Sound, Pond Inlet, and adjacent water bodies.

In accordance with existing Terms and Conditions of the Project Certificate, Baffinland is responsible for the establishment and implementation of a Marine Monitoring Plan (MMP), 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.

This report presents the results of the 2019 Ship-based Observer (SBO) Program conducted in the Regional Study Area (RSA) (Figure 2) established for the Northern Shipping Route. The 2019 SBO Program was one of several environmental effects monitoring (EEM) programs that collectively made up Baffinland's Marine Monitoring Plan (MMP) undertaken in support of the Project, in accordance with terms and conditions of Project Certificate No. 005.

The 2019 SBO Program took place onboard the icebreaker MSV Botnica during the early summer (Leg 1: 19–29 July) and fall shoulder season (Leg 2: 5-28 October). Marine Wildlife Observers (MWOs) stationed on the MSV Botnica were responsible for undertaking marine wildlife monitoring during icebreaker and ore carrier escort transits in the RSA. This included monitoring for potential ship strikes on marine mammals or seabirds during Project vessel transits along the Northern Shipping Route, as well as recording information on the presence, relative abundance and distribution of marine mammal species in this area relative to Project shipping operations. Seabird sightings were also recorded in accordance with the Eastern Canada Seabirds at Sea (ECSAS) monitoring protocol. The 2019 SBO Program represented the second consecutive year of ship-based marine wildlife monitoring on the MSV Botnica during the shoulder (early summer and fall) shipping seasons for the Project.

LEGEND

- PROJECT SITE
- COMMUNITY
- FUTURE SOUTH RAILWAY
- MILNE INLET TOTE ROAD
- NORTHERN SHIPPING ROUTE
- NUNAVUT SETTLEMENT AREA
- SOUTHERN 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 - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
PROJECT LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
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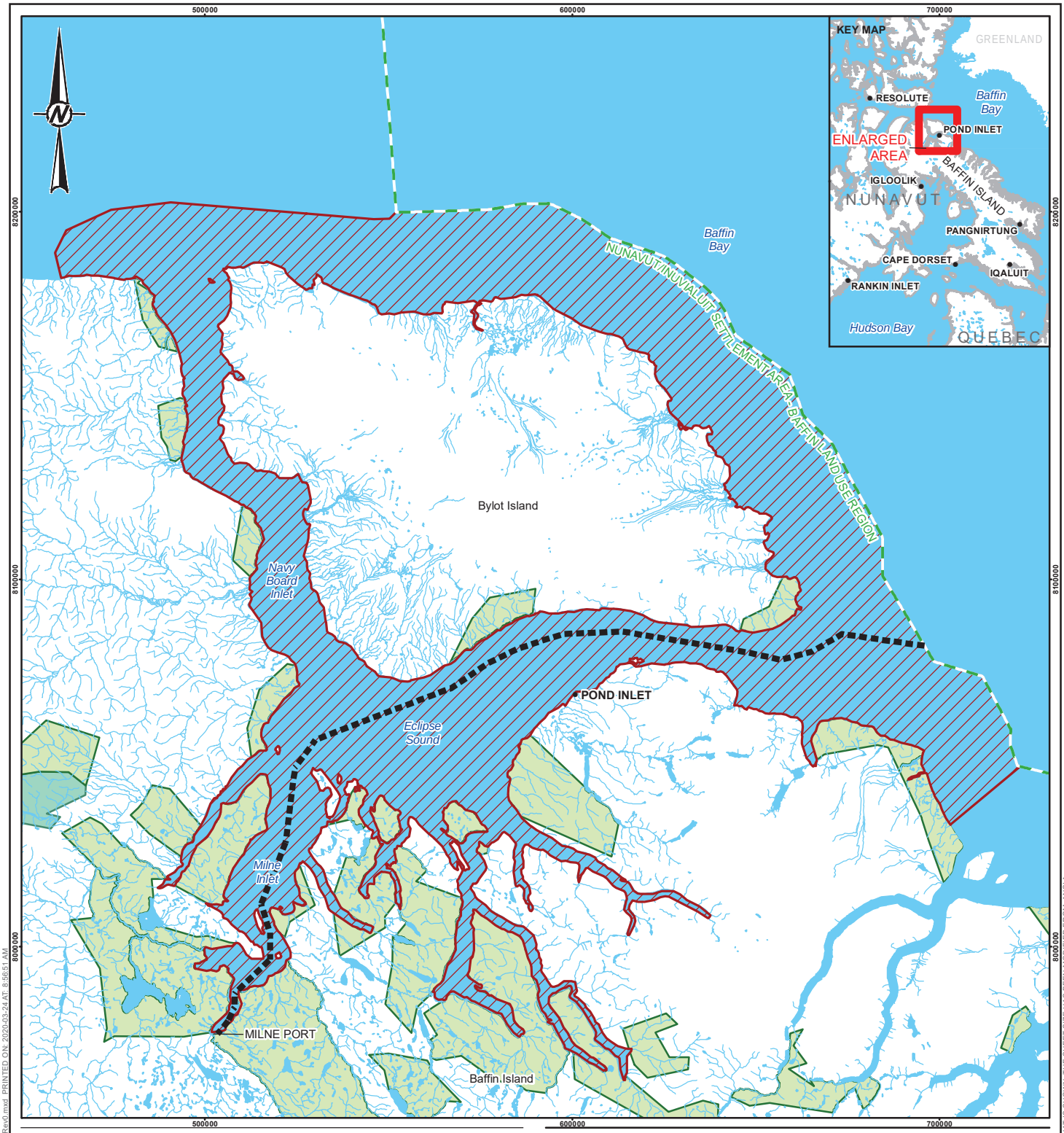

LEGEND

- 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)

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CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
MARINE MAMMAL REGIONAL STUDY AREA

CONSULTANT
GOLDER

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REVIEWED	KG
APPROVED	PR

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The 2019 SBO Program specifically addressed the following Project Certificate 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. 108 – “The Proponent shall ensure that data produced by the surveillance monitoring program is analysed rigorously by experienced analysts (in addition to being discussed as proposed in the FEIS) to maximize their effectiveness in providing baseline information, and for detecting potential effects of the project on marine mammals, seabirds and seaducks in the Regional Study Area. It is expected that data from the long-term monitoring program be treated with the same rigor.”
- Condition No. 121 – “The Proponent shall immediately report any accidental contact by project vessels with marine mammals or seabird colonies to Fisheries and Oceans Canada (DFO) and Environment Canada respectively, by notifying the appropriate regional office of the:
  - Date, time and location of the incident.
  - Species of marine mammal or seabird involved.
  - Circumstances of the incident.
  - Weather and sea conditions at the time.
  - Observed state of the marine mammal or sea bird colony after the incident.
  - Direction of travel of the marine mammal after the incident, to the extent that it can be determined.
- Condition No. 122 – “The Proponent shall summarize and report annually to the NIRB regarding accidental contact by project vessels with marine mammals or seabird colonies through the applicable monitoring report.”
- 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.”

1.1 Program Background

Baffinland first initiated the SBO Program in 2013 (SEM 2014) prior to development of the Project, concurrent with initial ship transport of fuel and supplies to Milne Port using vessels transiting between Quebec City and Milne Inlet. During the construction phase of the Project in 2014 and 2015, the SBO Program was implemented onboard fuel tanker and sealift vessels transiting along the Northern Shipping Route. Ship-based MWOs embarked the vessels at Pond Inlet and disembarked at Milne Port. Results for these programs are presented in SEM (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 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 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 associated with the MWOs boarding the vessel at-sea.

In 2018, the SBO Program was re-initiated onboard the MSV Botnica, an icebreaker retained by Baffinland to conduct ore carrier escort services in the RSA during the shipping shoulder seasons. Data collection methods and monitoring protocols were revised in 2018 to better address terms and objectives of the Project Certificate. In 2019, several further modifications to the monitoring protocol were incorporated based on recommendations provided by the Marine Environmental Working Group (MEWG). These modifications included the following components:

- Ice cover data was collected during active watch periods at two spatial scales:
  - Ice cover in the Near Field (within 100 m of the vessel) was recorded to estimate the proportion of time that the MSV Botnica was actively engaged in icebreaking relative to prevalent ice conditions.
  - Ice cover in the Far Field (beyond 100 m of the vessel, over the full extent of the MWO's view from the bridge) was recorded to assess marine mammal detectability as a function of ice cover.
- Median and mean ice conditions were used to define sea ice normal values.
- Weekly ice chart maps were produced for inclusion in the annual monitoring report.
- The relationship between sightability parameters and detection rates was evaluated.
- Seal group size was defined in the SBO training manual and data collection methods for seal group size were explained to Inuit researchers during the SBO training program.

1.2 Study Objectives

The primary objective of the SBO Program was to monitor for potential ship strikes on marine mammals and seabirds in the Regional Study Area (RSA) (Figure 2). The secondary objective of the SBO program was to collect observational data on the presence, relative abundance and distribution of marine mammals and seabirds within the boundaries of the RSA relative to Project vessel operations.

1.3 MWO Training

Prior to the start of the SBO Program, nine Inuit MWO candidates from Pond Inlet completed a three-day offshore 'Personal Survival Techniques' marine offshore safety certification program in Dartmouth, Nova Scotia. Golder subsequently provided a one-day MWO training session on 16 July 2019 for three of the MWO candidates which included detailed instruction on marine wildlife survey protocols and data collection techniques. The training session also provided an overall introduction to the SBO field program including survey and reporting objectives. The training session was conducted by a senior marine scientist from Golder with MWO certification and local marine mammal and seabird survey experience. Observer consistency was generally achieved by retaining the same trained MWOs for both survey legs, although one Inuit MWO from Leg 1 was unavailable for Leg 2 and was therefore replaced with a different Inuit MWO from Pond Inlet. A second one-day technical training session was provided to this candidate on 4 October 2019. MWO training manuals were provided to all MWO team members at the training session (Appendix A). During the training, participants gained practical experience using all monitoring equipment (e.g., reticle binoculars), as well as theoretical and practical instruction on data collection, and data entry/upload into field data sheets and an electronic sightings database. The MWO training session included the following components:

- Personal Survival Techniques course (STCW A-VI/1-1).
- Marine wildlife species identification, observation techniques, data entry and data QA/QC procedures. This included practical training using the digital sightings database, GPS units and binoculars (Golder 2019).
- Seabird identification and ECSAS sampling and data entry protocols (Gjerdrum et al. 2012) as provided by the Canadian Wildlife Service (CWS).

2.0 MARINE MAMMAL MONITORING

The 2019 SBO Program took place onboard the icebreaker MSV Botnica during the early summer (Leg 1: 19–29 July) and fall shoulder season (Leg 2: 5-28 October). Marine mammal monitoring methods are described in Section 2.1 with monitoring results presented in Section 2.2. The objective of the marine mammal monitoring surveys was to monitor for potential ship strikes on marine mammals in the RSA, and to document the presence, relative abundance and distribution of marine mammal species in the RSA relevant to shipping operations.

2.1 Survey Methods

The SBO survey team consisted of three Inuit MWOs and one Golder MWO lead. The MWOs were stationed on the bridge of MSV Botnica as this was the highest accessible and protected vantage point on the vessel. The height of the bridge of the MSV Botnica was 20 m above sea level. An estimated observer eye-height of 1.7 m was considered for all observers in reticle distance calculations. The bridge on the MSV Botnica offers good visibility all around the vessel. The MWOs were responsible for recording marine wildlife sightings from the bridge of the MSV Botnica during dedicated watch periods. Systematic data on marine wildlife sightings and environmental conditions were recorded by the MWOs and entered into an electronic database. Surveying was performed with the naked eye and using 10x42 and 7x50 binoculars. The MWOs were also responsible for photo-documentation of wildlife sightings and reporting observed ship strikes on marine mammals or seabirds, including near misses. At the beginning of each watch period, a Global Positioning System (GPS) track file was initiated to record the path and speed of the survey vessel and to record sighting locations. Database entries underwent daily quality assurance and quality control procedures by the Golder MWO lead.

Marine mammal sightings were recorded over a daily monitoring period extending up to 16 h on Leg 1 (from 10:00 to 02:00 EST) and up to 10 h on Leg 2 (from 08:00 to 18:00 EST) depending on available daylight hours. While the vessel was in transit, the focus of the survey was forward of the vessel, with the MWOs visually surveying from 240° to 120° relative to the centre or track line of the vessel (0°) (Figures 3 and 4). When the vessel was stationary, the MWOs walked around the bridge to visually survey on all sides (360°) of the vessel. The vessel was rarely stationary, representing only 3% of total survey effort on Leg 1 (2 h and 46 min) and 1% of total survey effort on Leg 2 (52 min).

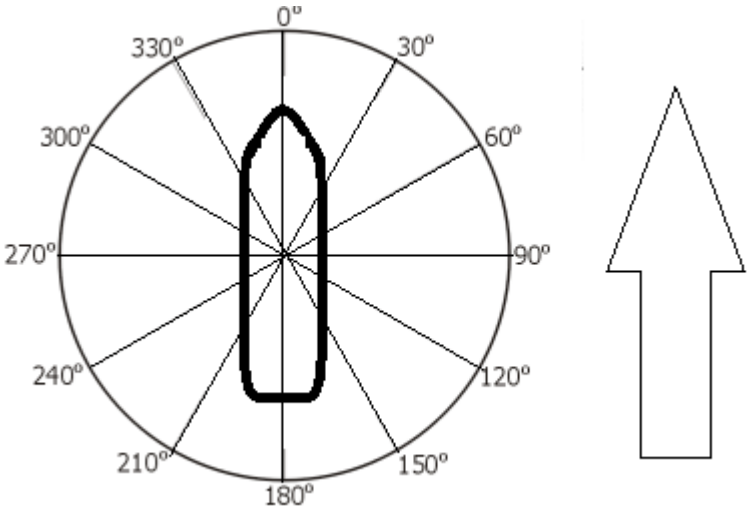


Figure 3: Bearing of Observations Relative to Vessel

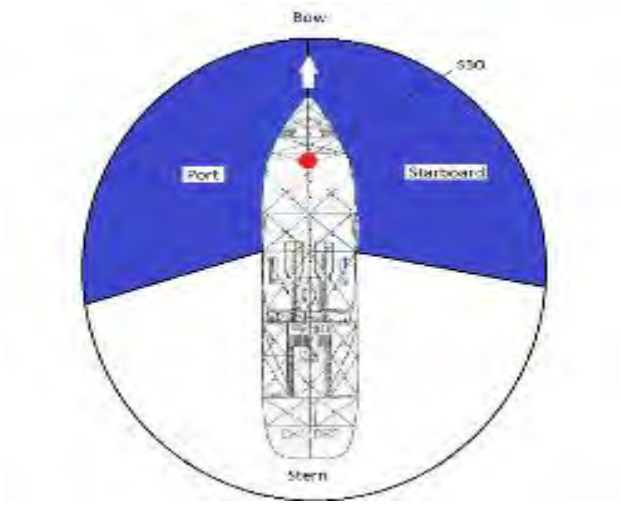


Figure 4: Approximate Field of View for Marine Wildlife Observers from the *Botnica* bridge.

When species identification was uncertain, animals were recorded as an unconfirmed species to the most recognizable level (e.g., unidentified pinniped or cetacean). Observations were entered into a computer database. In addition to species identifications, MWOs recorded the initial observed 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), bearing from vessel, and movement direction. The distances to the animals were often estimated with the naked eye because the horizon was rarely visible during the survey due to the high elevation of the terrain surrounding the Northern Shipping Route. When the horizon was visible, reticle binoculars were used to record estimated observation distances.

2.1.1 Data Analysis

This section describes the methods used for analyzing environmental conditions, observer effort and marine wildlife sightings.

Observational Effort

Observational effort was calculated relative to survey distance in linear kilometres using trackline GPS data extracting segments of effort using start and end times recorded during each MWO shift. The same start and end times were used to determine temporal survey effort. All data analyses were completed based on spatial survey effort (km) and not temporal effort.

Environmental Variables

Various environmental variables were systematically recorded during the active survey watch periods as these can influence an observer's ability to detect and identify marine mammals, in addition to potentially altering animal behaviour and distribution. Environmental variables were recorded at the beginning of each watch and whenever conditions noticeably changed during a watch. Environmental variables considered in the study included Near Field Ice Cover (ice cover within 100 m of the vessel, estimated by MWOs), Far Field Ice Cover (ice cover ≥ 100 m from vessel but within line of sight of the MWO), Sea State, Beaufort Wind Force, Weather (e.g., precipitation and cloud cover), Visibility, Sun Glare and Sightability (combination of Weather, Sun Glare, and Sea State). Relative representations of environmental conditions (e.g., Near Field and Far Field Ice Cover, Weather, Sea State, Visibility and Sightability) were calculated as percentages of observational effort and were entered into the sightings e-database.

Detection Rates

To compare results of the 2019 SBO Program with the 2018 SBO Program, animal detection rates were calculated and expressed as sightings per unit effort (SPUE; number of sightings/km) and number of animals/km (used as a proxy for relative abundance). Sightings were therefore expressed relative to spatial observational effort consistent with other similar studies and methods (Nichols et al. 2005). Detection rates were also analysed in relation to environmental conditions as these had the potential to influence detectability of marine mammals by the MWOs. For all analyses, pinnipeds that were observed hauled-out on ice were considered separately from pinnipeds observed in-water due to the differences in animal detectability between the two environments (i.e., pinnipeds are more easily detected on ice than in-water).

Closest Point of Approach

For each sighting, the Closest Point of Approach (CPA) was recorded (i.e., the closest distance observed between the animal and the vessel). Distances to sightings were estimated by the MWO either using the naked eye, reticle binoculars and through comparison with known distances to reference points including land masses (using on-board navigational equipment) or, for closer observations, the 97-m length of the MSV Botnica.

End of Season Aerial Surveys

Following completion of Project shipping operations in the RSA in 2019, aerial surveys were flown along the Northern Shipping Route and throughout the RSA to verify that no narwhal were entrapped during ice freeze-up. A twin otter aircraft was flown along planned survey routes over two consecutive days. The last Project vessel transited out of the RSA on 30 October. The aerial clearance surveys occurred on 30 and 31 October. Flight path planning was coordinated between Baffinland, Golder, DFO and the Mittimatalik Hunters and Trappers Organization (MHTO). The aerial survey team consisted of several Inuit MWOs from Pond Inlet and a Golder lead

MWO responsible for coordinating the survey and serving as primary data recorder on the aircraft. The Golder coordinator communicated with the pilots and recorded sightings data and locations relayed by the aerial survey MWOs. Members of the MHTO were also present onboard the aircraft and actively participated in the survey.

MWO Program Feedback

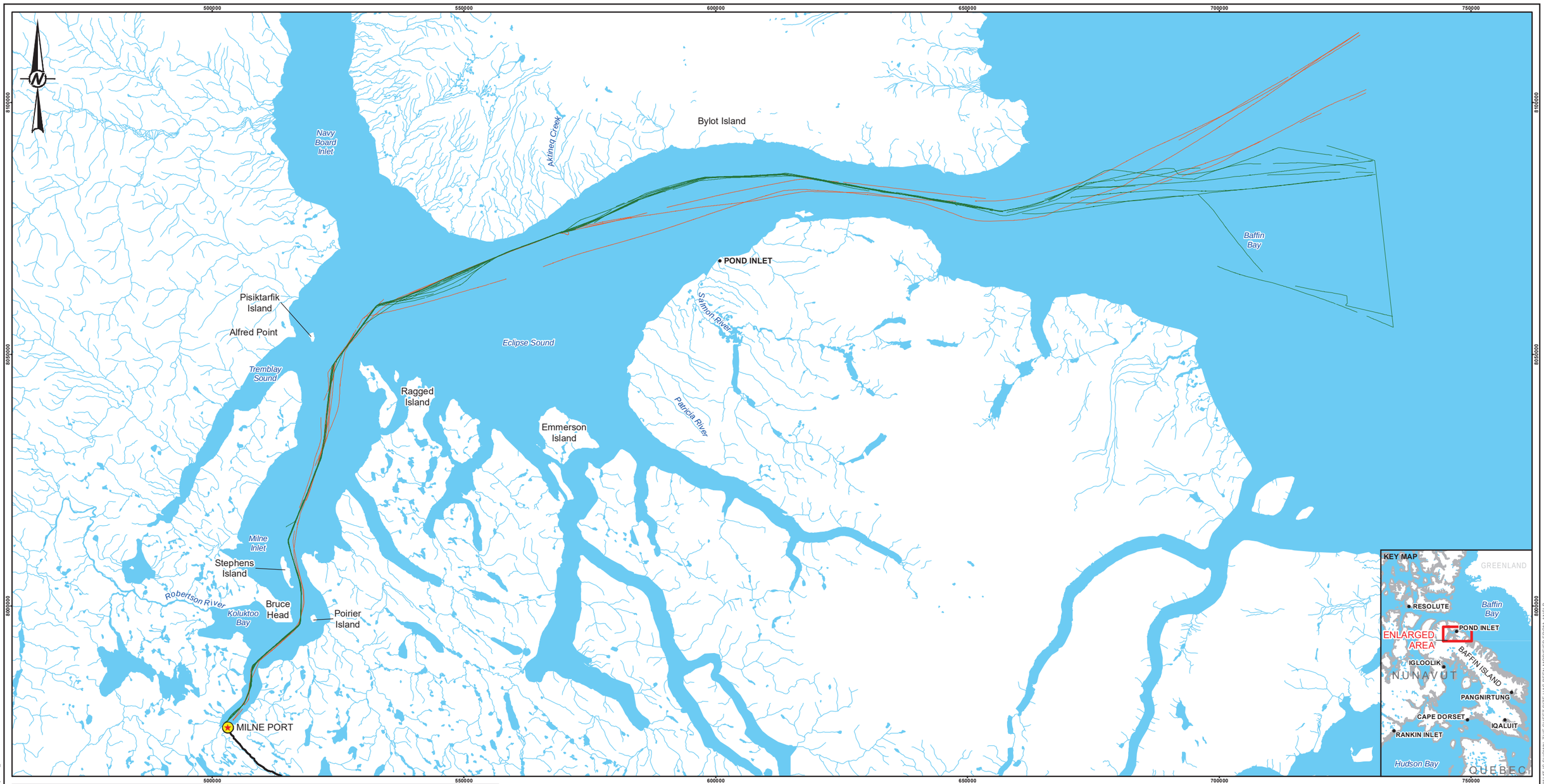
Upon completion of the SBO Program, MWOs that participated in Leg 1 and Leg 2 were asked to participate in an end-of-program interview comprising a list of questions that aimed to garner feedback on the program, observations made in the field, and recommendations to consider for future surveys. Questions were strictly qualitative and open-ended, and related to the following topics: program design, data analysis and interpretation, reporting and adaptive management. The full list of questions along with responses provided by the interview participants are presented in Appendix D.

2.2 Results

Leg 1 surveys were completed from 19–29 July and Leg 2 surveys were completed from 5–28 October.

2.2.1 Survey Effort

Total monitoring effort for both survey legs was 268.7 h covering 3,089 km (Figure 5). Total monitoring effort during Leg 1 was 100.4 h covering 1,119 km. Total monitoring effort during Leg 2 was 168.3 h travelling 1,970 km. Although there were nearly twice as many observation days in Leg 2 compared to Leg 1 (24 vs. 11 days), this was not reflected in overall survey effort given the longer daylight hours during Leg 1 (mean daily effort = 11 h) compared to Leg 2 (mean daily effort = 7 h).



LEGEND

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- MILNE PORT
- MILNE INLET TOTE ROAD
- WATERCOURSE
- SURVEY TRACK (JULY 19 - 29, 2018)
- SURVEY TRACK (OCTOBER 5 - 28, 2018)
- WATERBODY

0 25 50

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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 - 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

TITLE
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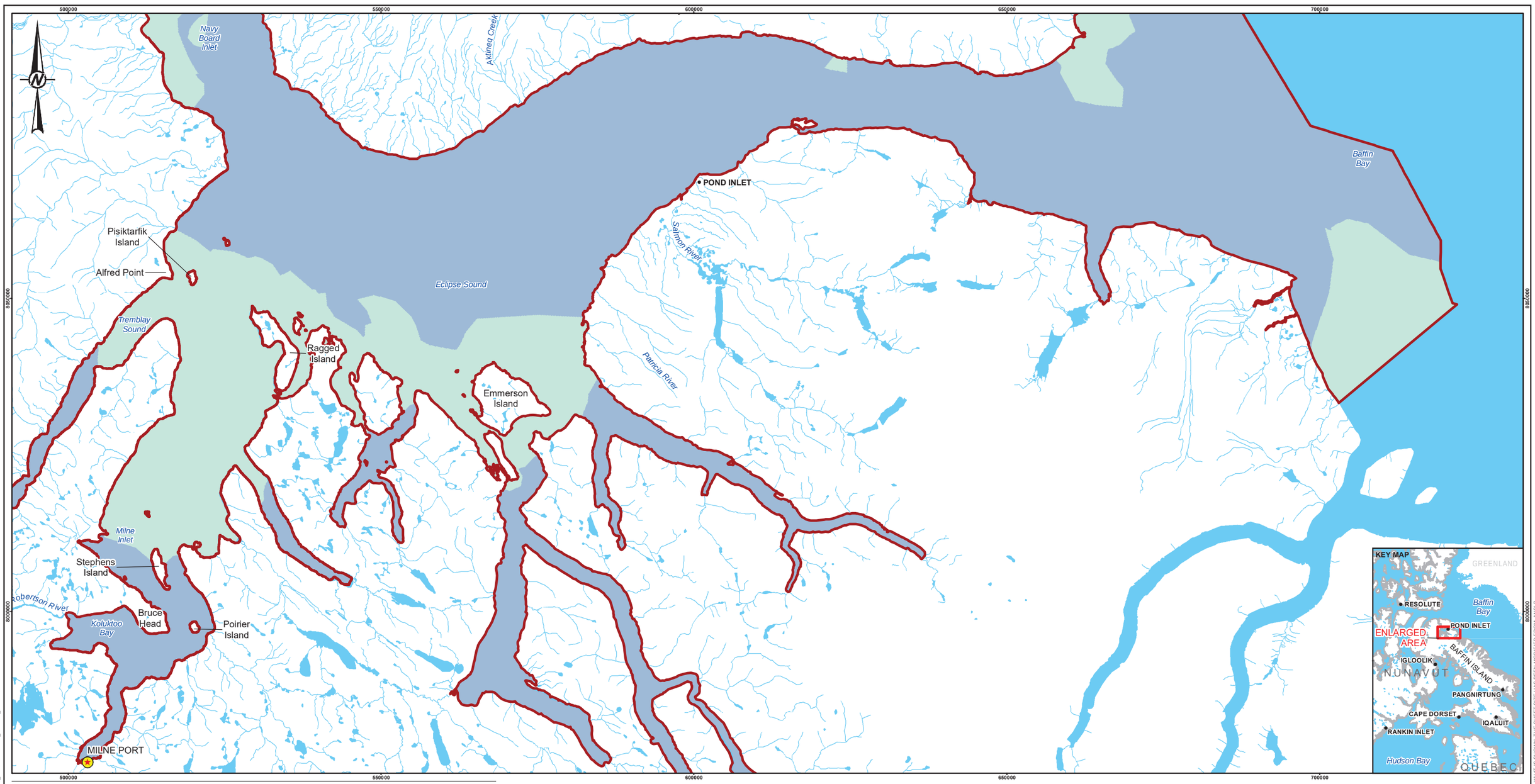
2.2.2 Survey Conditions

2.2.2.1 Ice Concentrations

In addition to recording percent and type of ice cover 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 (mean and median) ice cover (percent) encountered during each survey period. Figures 6 and 7 show mean ice cover during Leg 1 and Leg 2 surveys, respectively. Additional ice cover analyses were completed to show ice cover on the first and last days of the survey, weekly ice cover through the survey period and median ice cover (Appendix B). Overall, Leg 1 had more extensive ice coverage than Leg 2.



LEGEND

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

LEG 1 MEAN ICE CONCENTRATION (19-29 JULY 2019)

- 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 SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
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CLIENT
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CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT
MARY RIVER PROJECT - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
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PROJECT NO.	CONTROL	REV.	FIGURE
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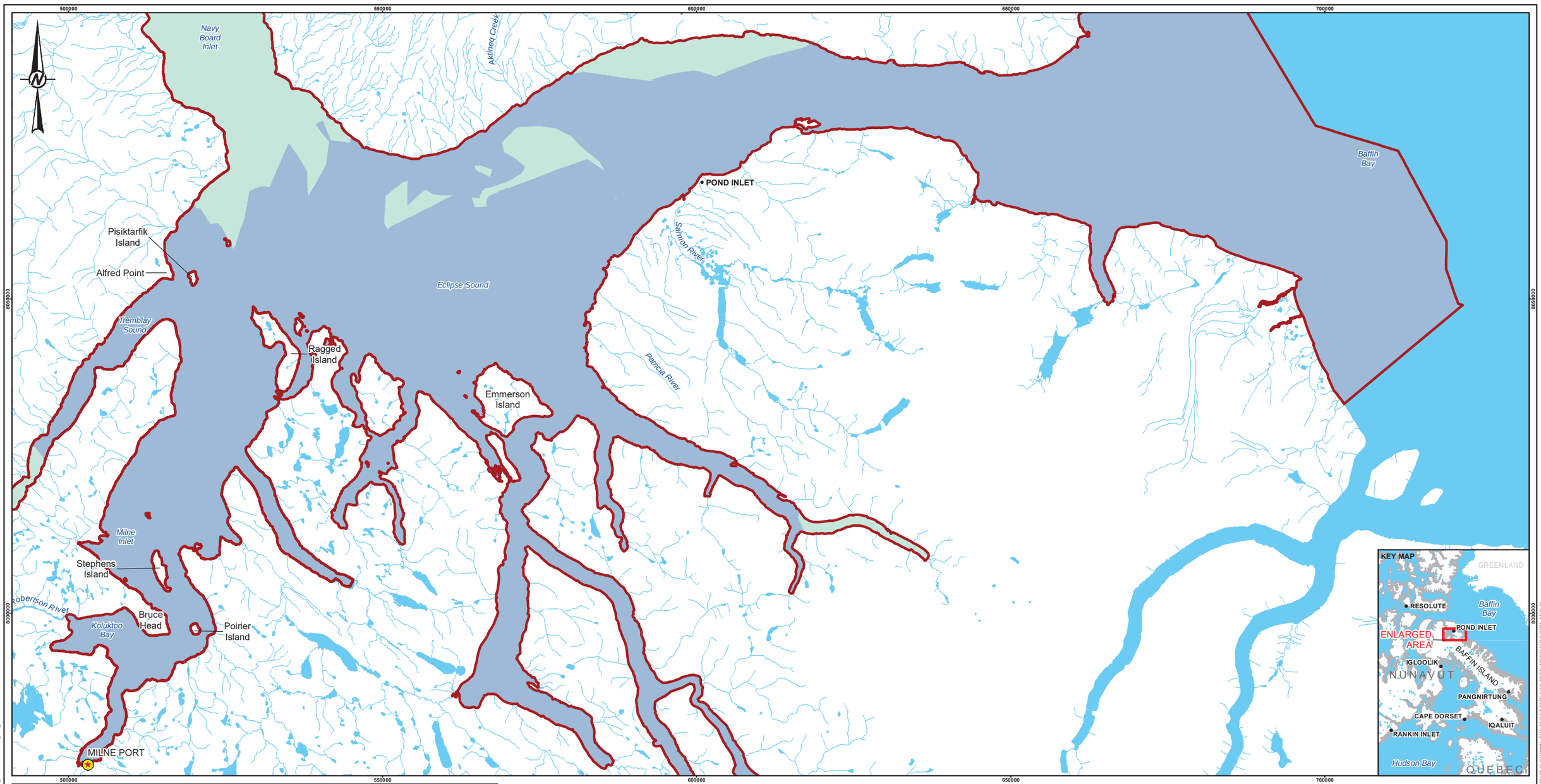

LEGEND

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

LEG 2 MEAN ICE CONCENTRATION (5-28 OCTOBER 2019)

- 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 SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
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CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

TITLE
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PROJECT NO.	CONTROL	REV.	FIGURE
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2.2.2.2 Sighting Conditions

MWOs recorded sighting conditions at the beginning of each watch period and anytime environmental variables changed. Sighting conditions were evaluated based on percent of geographic survey effort when each condition was observed. Animal detection rates were assessed in relation to Ice Cover, Sea State, Visibility and Sightability, as these variables have the greatest impact on the MWO's ability to detect marine mammals.

Ice Cover

Ice cover during the 2019 SBO Program was recorded at two spatial scales relative to the vessel: Near Field (≤100 m) and Far Field (>100 m from vessel but within sighting range of the observer). The majority of the survey during both Leg 1 and Leg 2 occurred in ice-free waters (0% ice cover), with ice conditions ranging from 0 to 100% coverage at both spatial ranges (Figures 8 and 9).

During Leg 1 (early summer), ice-free conditions accounted for 88% of total survey effort in the near field, and 82% of total survey effort in the far field (Figures 10 and 11). Heavy ice conditions (>80% ice cover) accounted for 2% of total survey effort in the near field, and 1% of total survey effort in the far field (Figures 10 and 11). During Leg 2 (fall), ice-free conditions accounted for 92% of total survey effort in the near field, and 88% of total survey effort in the far field (Figures 12 and 13). Heavy ice conditions (>80% ice cover) accounted for 1% of total survey effort in the near field, and 2% of total survey effort in the far field (Figures 12 and 13).

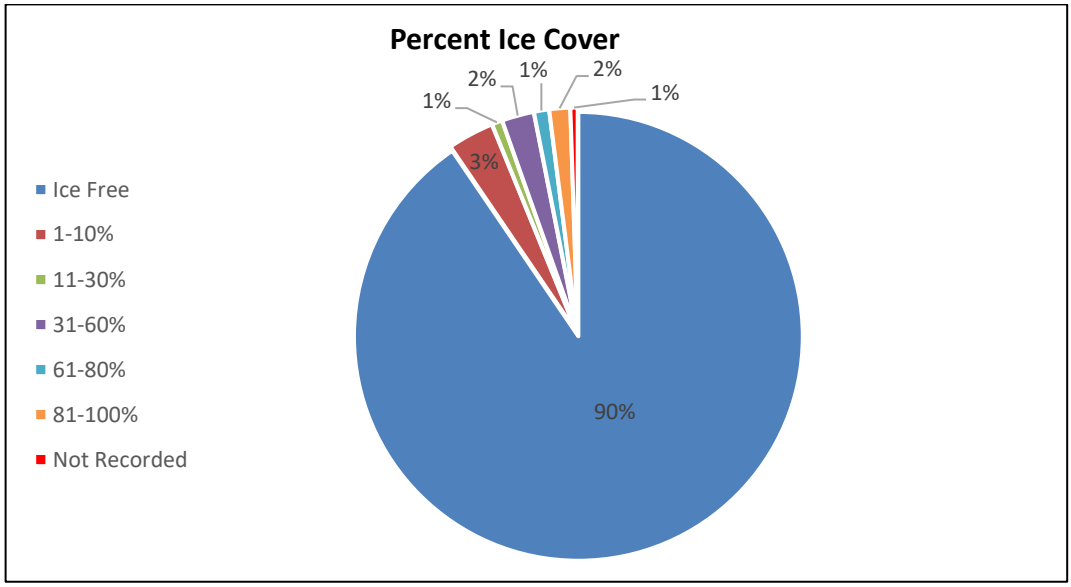


Figure 8: Proportional Breakdown of Ice Cover in Near Field (Leg 1 and 2 Combined)

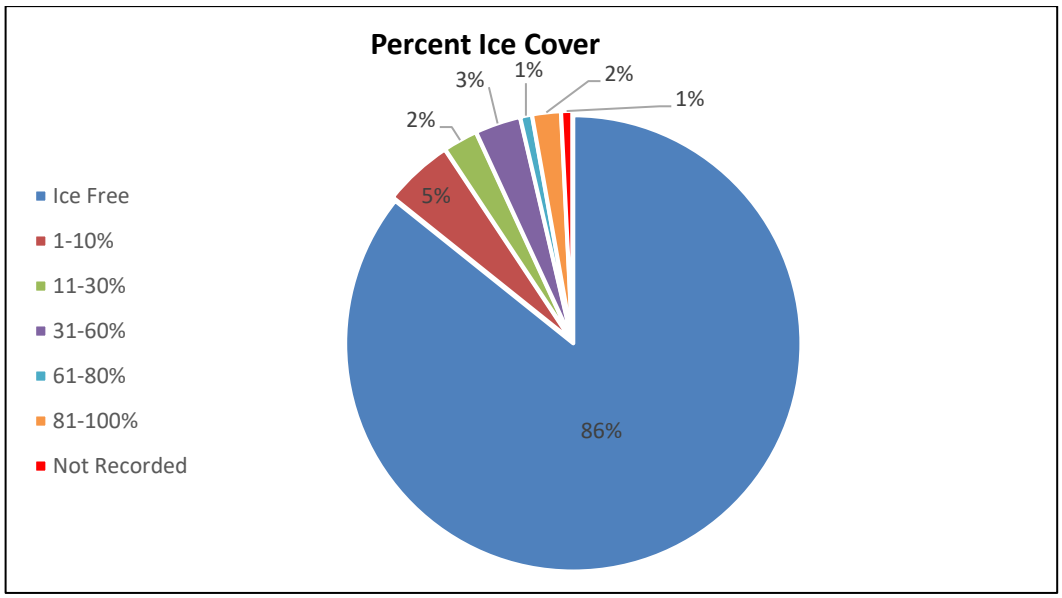


Figure 9: Proportional Breakdown of Ice Cover in Far Field (Leg 1 and 2 Combined)

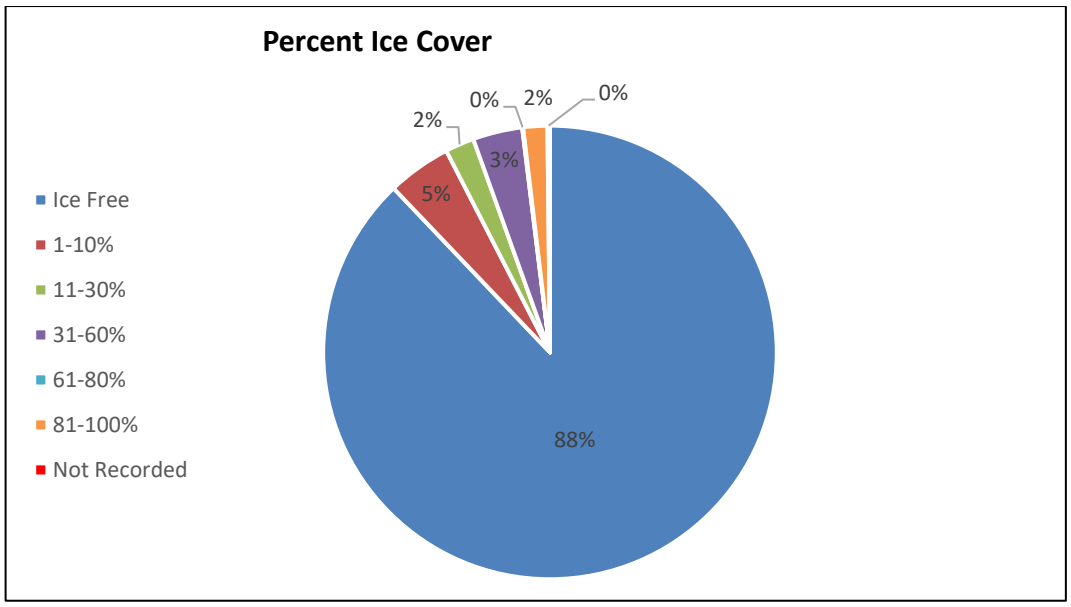


Figure 10: Proportional Breakdown of Ice Cover in Near Field during Leg 1 (Early Summer)

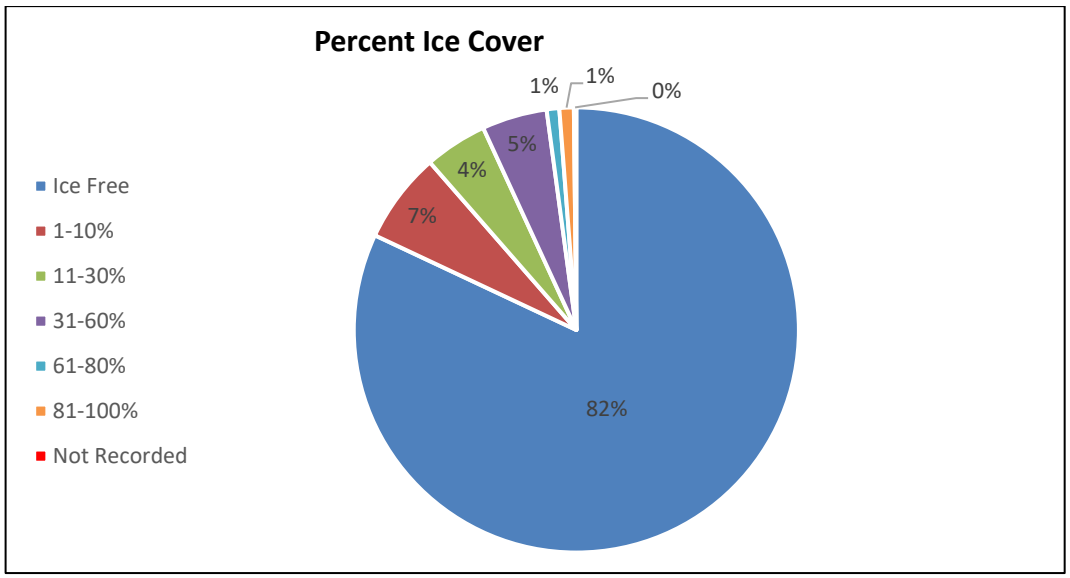


Figure 11: Proportional Breakdown of Ice Cover in Far Field during Leg 1 (Early Summer)

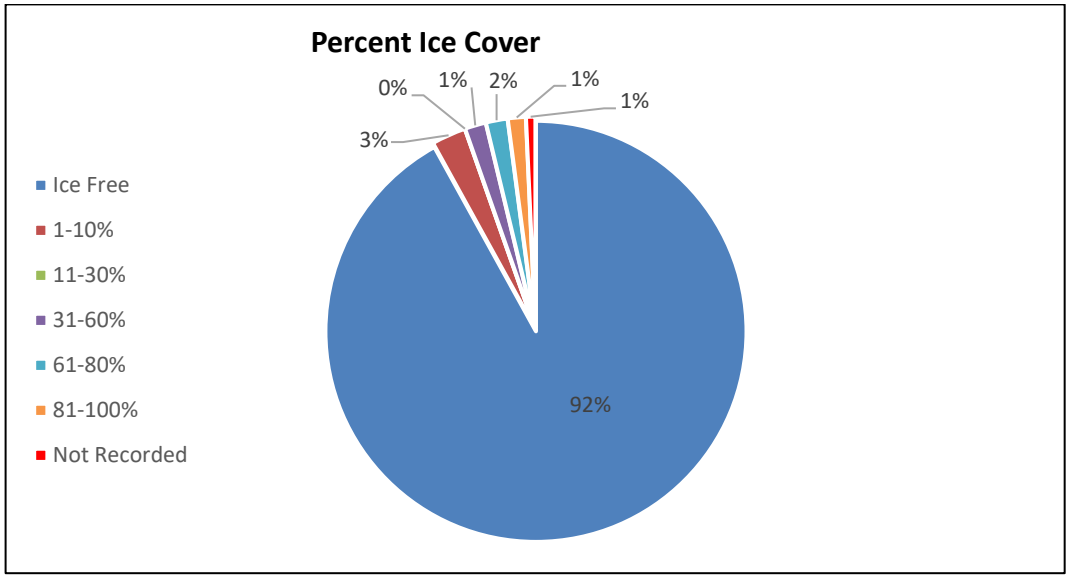


Figure 12: Proportional Breakdown of Ice Cover in Near Field during Leg 2 (Fall)

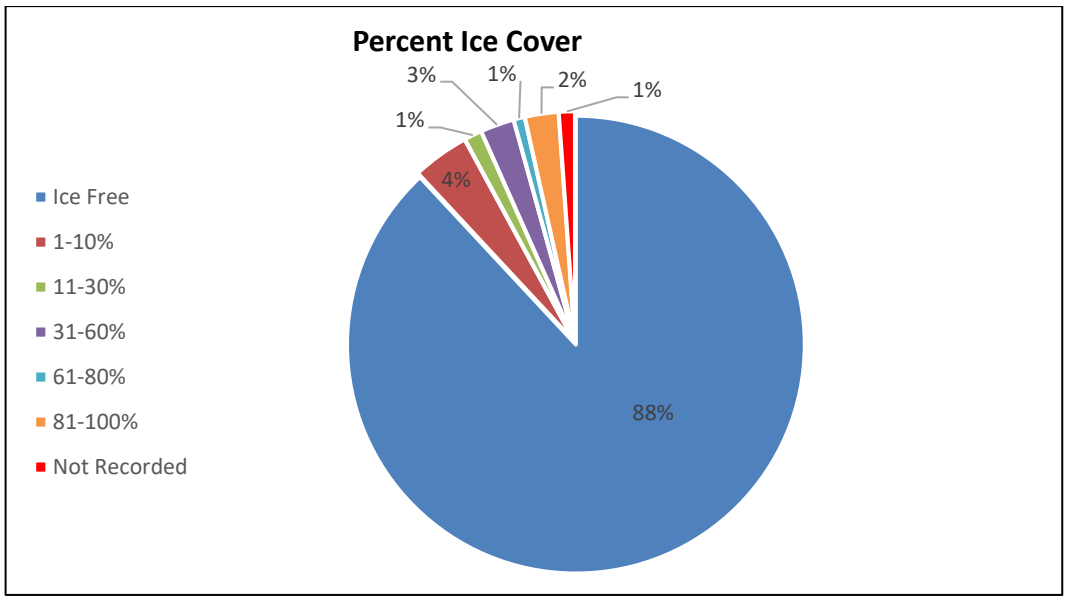


Figure 13: Proportional Breakdown of Ice Cover in Far Field during Leg 2 (Fall)

Sea State

Sea State recorded during Leg 1 and Leg 2 was limited to the following categories:

- 0 = 0 m waves, glassy
- 0.5 = ripples
- 1 = small wavelets
- 2 = smooth wavelets
- 3 = slight; small white caps
- 4 = moderate waves, some spray

Conditions above Sea State 4 were not recorded during on-effort periods by MWO during 2019 SBO Program. The majority of monitoring took place in Sea State 3 or less (72% of survey effort during Leg 1 and 70% of survey effort during Leg 2) (Figures 14 to 16). Table 4 in Section 5.10 of the SBO Training Manual (Appendix A) provides full descriptions of Sea State categories.

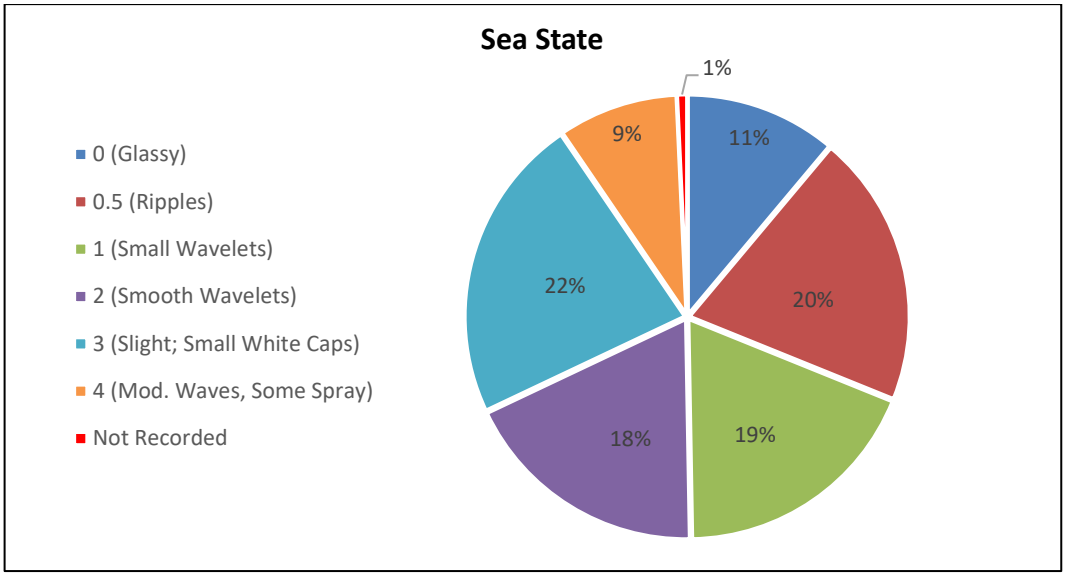


Figure 14: Proportional Breakdown of Sea State (Leg 1 and 2 Combined)

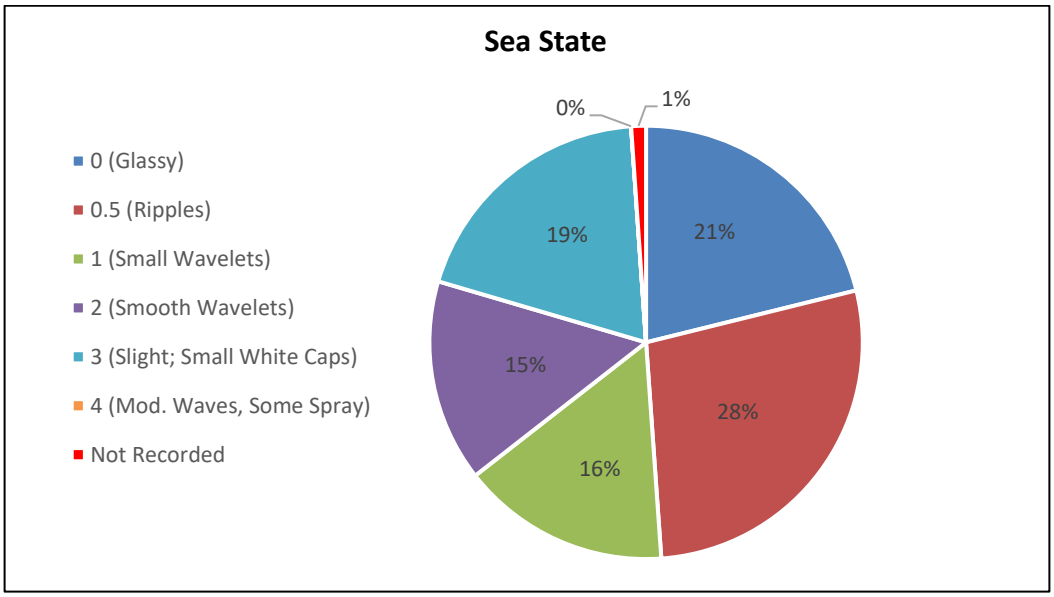


Figure 15: Proportional Breakdown of Sea State during Leg 1 (Early Summer)

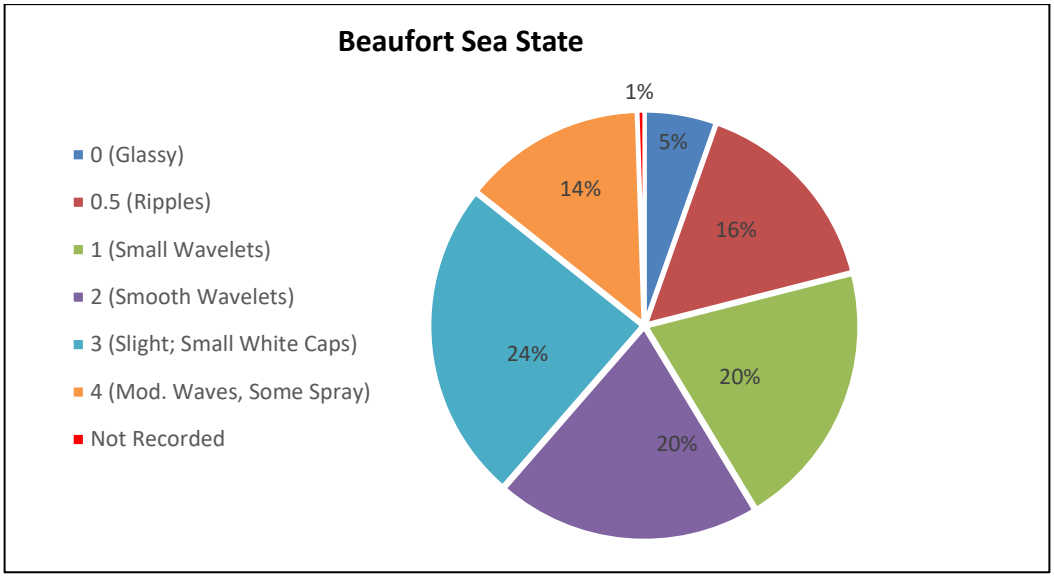


Figure 16: Proportional Breakdown of Sea State during Leg 2 (Fall)

Beaufort Wind Force

Beaufort Wind Force recorded during Leg 1 and Leg 2 ranged from 0 (<1 knot, Calm) to 7 (28+ knots, Near Gale) (Figure 17). The majority of monitoring took place in Beaufort Wind Force 3 (7–10 knots, Gentle Breeze) (25% of survey effort) followed by Beaufort Wind Force 2 (4–6 knots, Light Breeze) (23% of survey effort), Beaufort Wind Force 4 (11–16 knots, Moderate Breeze) (16% of survey effort), Beaufort Wind Force 1 (1-3 knots, Light Air) (15% of survey effort), Beaufort Wind Force 5 (17–21 knots, Fresh Breeze) (8% of survey effort), Beaufort Wind Force 0 (<1 knot, Calm) (7% survey effort), Beaufort Wind Force 6 (22-27 knots, Strong Breeze) (4% of survey effort) and Beaufort Wind Force 7 (28+ knots, Near Gale) (1% of survey effort). Conditions above Beaufort Wind Force 7 (i.e., Beaufort Wind Force categories 8 through 12) were not recorded during either leg of the 2019 SBO Program.

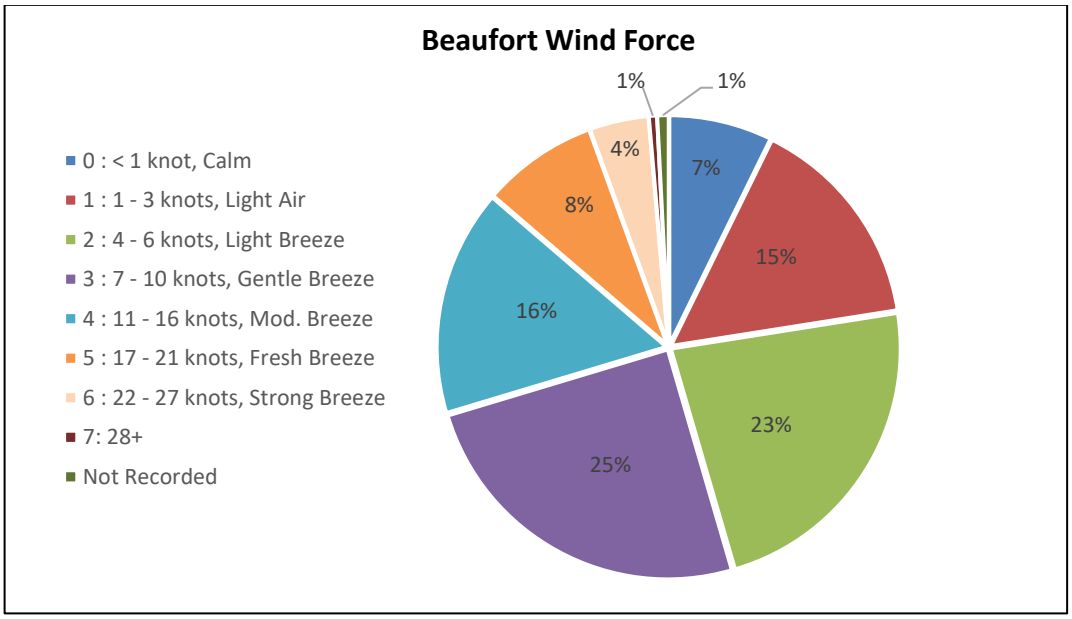


Figure 17: Proportional Breakdown of Beaufort Wind Force (Leg 1 and 2 Combined)

Visibility

Visibility recorded during the 2019 SBO Program ranged from poor (500–1,000 m) to excellent (>10 km) (Figure 18). Poor conditions accounted for 11% of observation effort while excellent conditions accounted for 49% of observation effort. Visibility was better during Leg 2 (84% of survey effort completed in good conditions or better, Figure 20) compared to Leg 1 (61% of survey effort completed in good conditions or better, Figure 19).

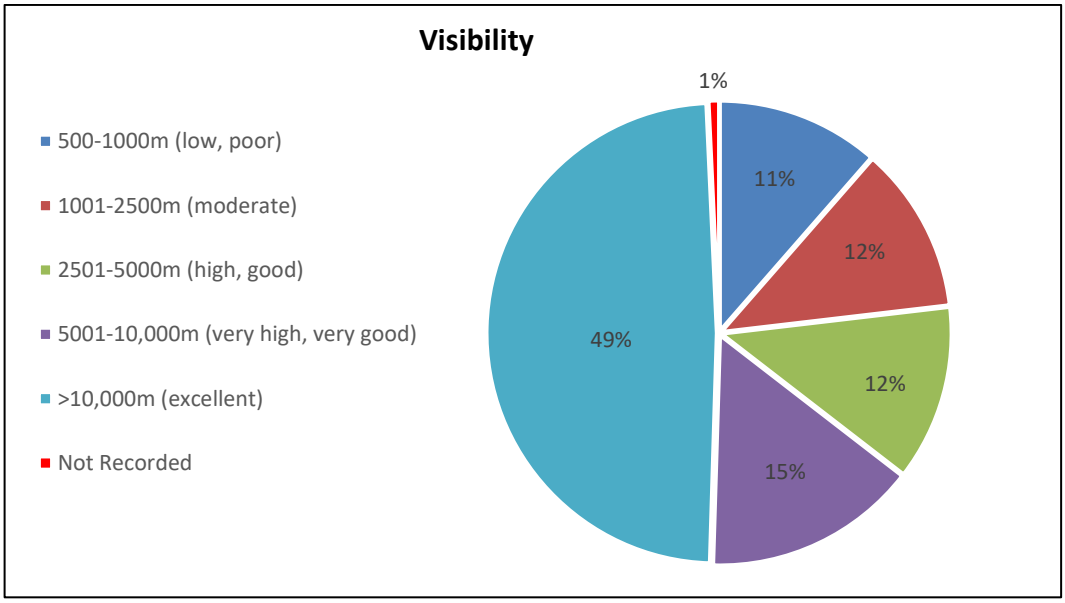


Figure 18: Proportional Breakdown of Visibility (Leg 1 and 2 Combined)

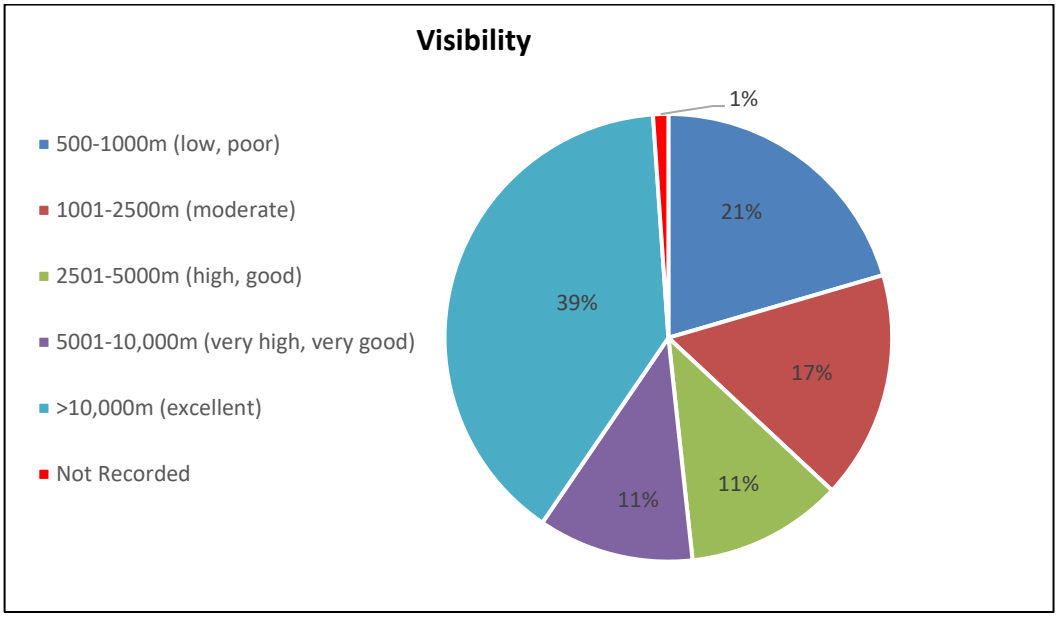


Figure 19: Proportional Breakdown of Visibility during Leg 1 (Early Summer)

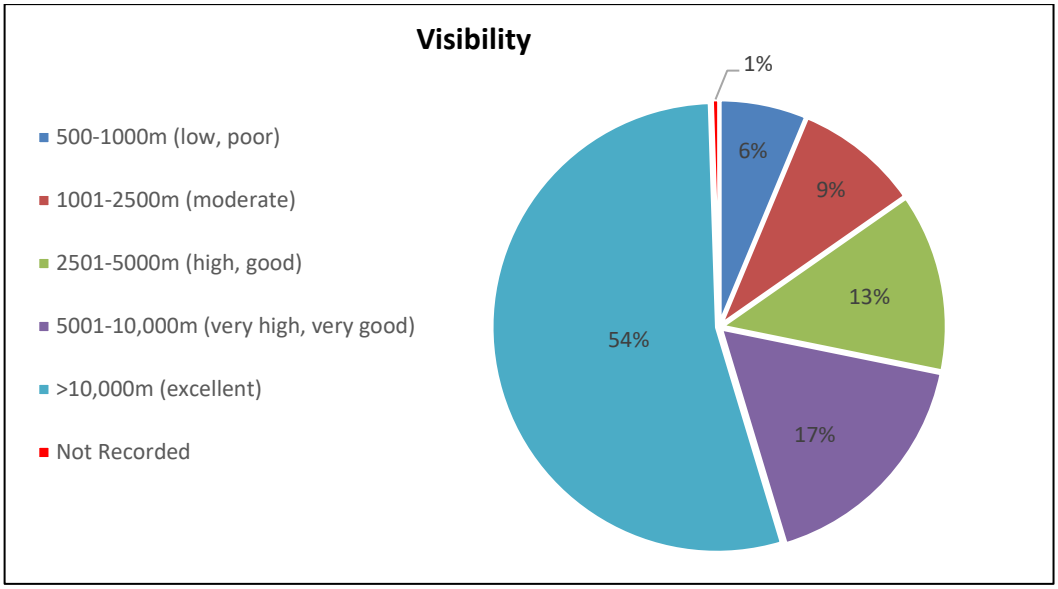


Figure 20: Proportional Breakdown of Visibility during Leg 2 (Fall)

Sightability

Sightability was a qualitative metric used by MWOs to estimate and describe the perceived ability of an observer to detect wildlife based on the combined influence of Weather, Sea State and Visibility. Sightability during the 2019 SBO Program ranged from poor to very high. Medium sightability conditions were available for the majority of observations (28% of observation effort). High and very high Sightability conditions were available for 37% of total observation effort (22% and 15% of observation effort, respectively). Low and poor Sightability conditions were present for 17% and 17% of total observation effort, respectively (Figure 21).

Overall, Sightability was better during Leg 2 surveys than Leg 1, with high and very high Sightability conditions representing 45% of total observation effort during Leg 2 (16% and 29%, respectively; Figure 22) compared to 31% during Leg 1 (25% and 6%, respectively; Figure 23). Medium Sightability conditions were more common during Leg 2 (44% of total survey effort) than during Leg 1 (20% of total survey effort). Low and poor Sightability conditions were more common during Leg 1 (33% of total survey effort) than Leg 2 (30% of total survey effort).

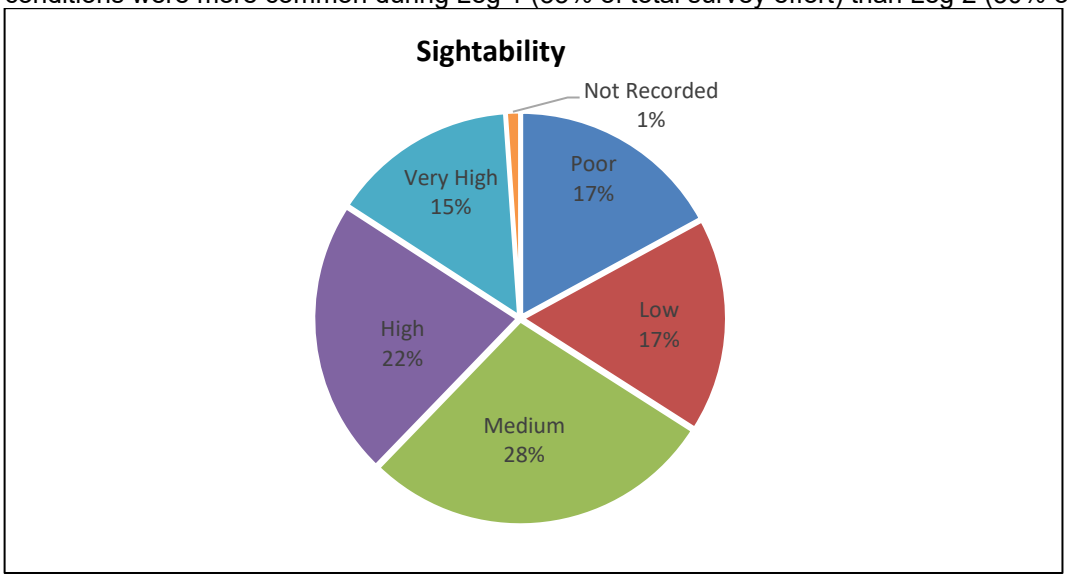


Figure 21: Proportional Breakdown of Sightability (Leg 1 and Leg 2 Combined)

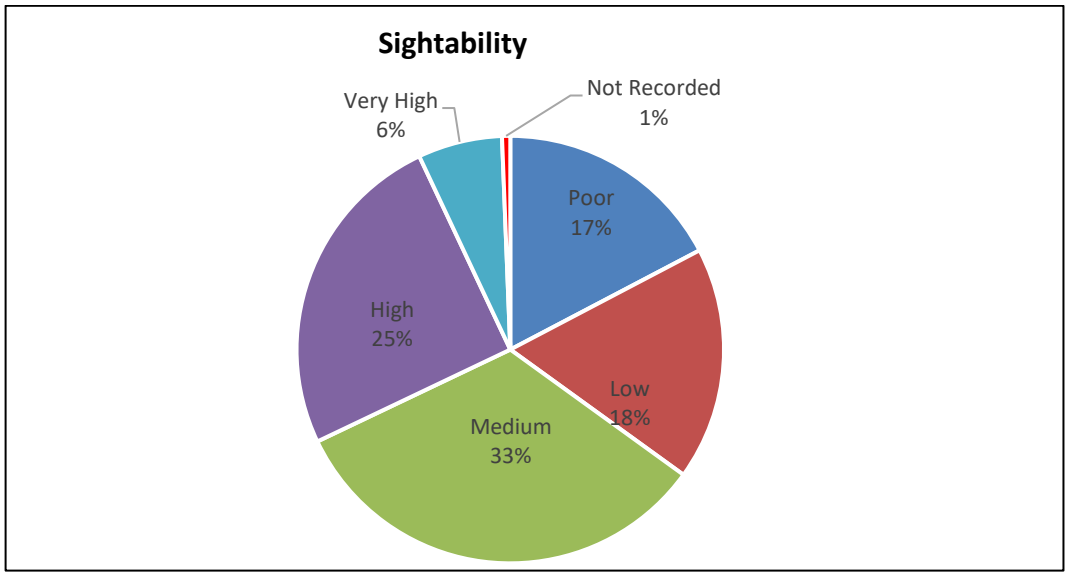


Figure 22: Proportional Breakdown of Sightability during Leg 1 (Early Summer)

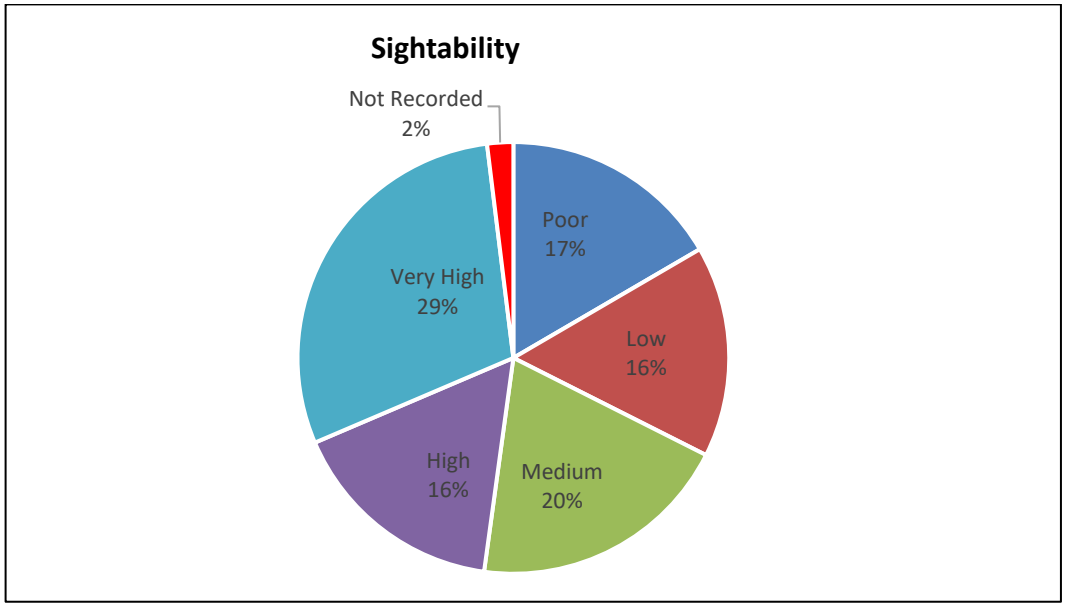


Figure 23: Proportional Breakdown of Sightability during Leg 2 (Fall)

Weather

Predominant weather conditions during the 2019 SBO Program were Partially Cloudy (35% of survey effort), Overcast (34% of survey effort), and Fog (11% of survey effort) (Figure 24).

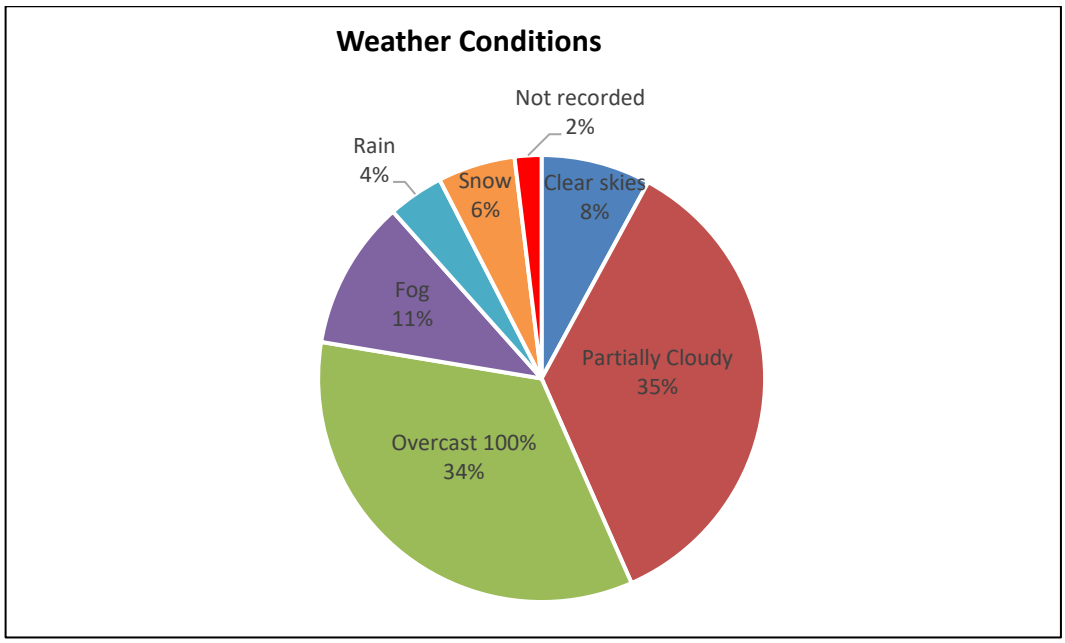


Figure 24: Proportional Breakdown of Weather (Leg 1 and 2 Combined)

2.2.3 Marine Mammal Observations

Seven different species of marine mammals were observed during the 2019 SBO Program: narwhal, beluga whale, bowhead whale, ringed seal, harp seal, bearded seal and polar bear. Killer whale and walrus were not recorded in the RSA during either survey leg in 2019; however, both species are known to occur in the region. A total of 304 marine mammal sightings comprising 2,785 individuals were recorded during both survey legs. Overall, an equal number of sightings were recorded during Leg 1 and Leg 2, though fewer individuals were present during Leg 2 (Table 1).

During Leg 1, a total of 152 marine mammal sightings comprising 2,453 individuals were recorded (Table 1). Species identified included ringed seal (61 sightings of 722 individuals), narwhal (27 sightings of 385 individuals), harp seal (24 sightings of 136 individuals), bowhead whale (22 sightings of 24 individuals), bearded seal (four sightings of four individuals), polar bear (two sightings of two individuals) and beluga (one sighting of one individual). There were also nine sightings of unconfirmed pinniped species (comprising 1,176 individuals) and two sightings of unconfirmed cetacean species (comprising three individuals).

During Leg 2, a total of 152 marine mammal sightings comprising 332 individuals were recorded (Table 1). Species identified included ringed seal (53 sightings of 58 individuals), narwhal (27 sightings of 103 individuals), harp seal (25 sightings of 117 individuals), bearded seal (one sighting of one individual) and bowhead whale (one sighting of one individual). There were also 44 sightings of unconfirmed pinniped species (49 individuals) and one sighting of an unconfirmed cetacean species (comprising three individuals). No polar bear or beluga were observed during the fall surveys.

Table 1. Marine Mammal Sightings Recorded During the 2019 Ship-based Observer Program

Species	Leg 1 - Early Summer (July 19-29)				Leg 2 - Fall (0ct 05-28)			
	In Water		On Ice		In Water		On Ice	
	No. of Sightings	No. of Animals	No. of Sightings	No. of Animals	No. of Sightings	No. of Animals	No. of Sightings	No. of Animals
Narwhal	27	385	0	0	27	103	0	0
Beluga	1	1	0	0	0	0	0	0
Bowhead	22	24	0	0	1	1	0	0
Unknown whale	2	3	0	0	1	3	0	0
Ringed seal	48	49	13	673	52	56	1	2
Harp seal	24	136	0	0	25	117	0	0
Bearded seal	1	1	3	3	1	1	0	0
Unknown seal	4	4	5	1,172	36	37	8	12
Polar bear	0	0	2	2	0	0	0	0
Total	**129**	**603**	**23**	**1,850**	**143**	**318**	**9**	**14**

2.2.3.1 Species-based Observations

Narwhal

A total of 54 narwhal sightings comprising 488 individuals were recorded in the RSA in 2019, with a higher number of animals observed during Leg 1 (n=385) than Leg 2 (n=103) (Table 1). Narwhal were observed as early as 19 July and as late as 28 October. During Leg 1, sightings were concentrated in eastern Eclipse Sound near Pond Inlet and near Bruce Head in southern Milne Inlet (Figure 25). During Leg 2, sightings were concentrated in Eclipse Sound near the southwest tip of Bylot Island and in Milne Inlet North near Ragged Island (Figure 26). Mean narwhal group size in 2019 was nine (ranging from 1 to 100 animals). No mothers with calves were identified during the 2019 SBO Program.

There were four sightings of dead narwhal on 13, 17, 18, and 19 October, during Fall surveys (Figure 27). On 13 October, the vessel was traveling westbound, near the entrance of Eclipse Sound, multiple birds consisting mostly of northern fulmar were observed feeding at the water surface. Multiple pieces of narwhal, which could be identified by the colouration of the skin, were soon observed floating past the vessel. It was speculated by the Inuit MWOs, based on the shape and size of the pieces and their rough edges (i.e. they were not cut by a hunter's knife) that these pieces of narwhal flesh could be the result of a killer whale predation event. On 17 October, an intact dead narwhal was observed and could also be identified by the skin colouration and shape of the pectoral fin pointing upward. On 18 October, while the vessel was traveling northbound and passing a small beach on the west side of Assomption Harbour just north of Milne Port, two narwhal carcasses were observed on the beach. On 19 October, when the vessel was traveling westbound east of Eclipse Sound in Baffin Bay, multiple northern fulmar were observed feeding at the surface of the water and a few large pieces of narwhal flesh were observed.

None of these observations of dead narwhal suggested they were the result of a ship strike. None of the Inuit MWOs raised a concern that the dead narwhal observations were the result of a ship strike or were struck and lost.

Beluga Whale

There was one sighting of a single beluga whale in Milne Inlet South during Leg 1, observed near the entrance to Koluktoo Bay (Table 1; Figure 25).

Bowhead Whale

A total of 23 sightings of 25 individual bowhead whales were recorded in the RSA during MWO watches in 2019 (Table 1). All of the bowhead sightings occurred during Leg 1 (Figure 25), with the exception of one solitary bowhead observed north of Ragged Island during Leg 2 (Figure 26). Bowhead sightings during Leg 1 were primarily concentrated in Eclipse Sound with several individuals also observed in Milne Inlet South and Milne Inlet North near Ragged Island (Figure 25). All sightings consisted of solitary animals except for two separate sightings of a pair of bowheads recorded during Leg 1.

Unconfirmed Cetacean Species

There were three sightings of unconfirmed cetacean species comprising six individuals (Table 1); two sightings during Leg 1 (Figure 25) and one sighting during Leg 2 (Figure 26). The first sighting (single individual) occurred in Eclipse Sound, east of Pond Inlet and Boleil Island. The second sighting (two individuals) occurred in western Eclipse Sound, south of Navy Board Inlet (Figure 25). The third sighting (three individuals) occurred in eastern Eclipse Sound, northeast of Pond Inlet and Boleil Island (Figure 26). The three whales were first detected through binoculars when they were approximately 5 km ahead of the vessel; three low puffy blows were visible but sea conditions (Beaufort Sea State 4) at the time prevented species confirmation although the nature of the blows and the lack of a distinct dorsal fin were suggestive of narwhal.

Ringed Seal

A total of 114 ringed seal sightings comprising 780 individuals were recorded in the RSA in 2019 (Table 1). During Leg 1, ringed seal were distributed along the entire shipping corridor, with multiple large group sightings (>10 animals) recorded in Milne Inlet North (Figure 28). During Leg 2, ringed seal were observed primarily in Eclipse Sound with only a few sightings recorded in Milne Inlet and Baffin Bay (Figure 29). In-water sightings consisted primarily of solitary animals (95 out of 100 sightings) resulting in an average group size of 1.05 for both legs combined. In-water average ringed seal group sizes were 1.02 and 1.08 for Legs 1 and 2, respectively. On-ice sightings consisted of solitary animals or in groups ranging in size from 2 to 300 animals. The large group sizes are possibly the result of multiple smaller groups observed at a distance in a general area.

Harp Seal

A total of 49 harp seal sightings comprising 253 individuals were recorded in the RSA in 2019 (Table 1). During both Leg 1 and Leg 2 surveys, harp seal were observed primarily in Eclipse Sound and eastward towards the entrance to Eclipse Sound (Tuqsukatta) (Figure 27 and Figure 29). All in-water sightings consisted of solitary animals or in groups ranging in size from two to 25 animals, with an average group size of 5.16 for both legs combined. In-water average harp seal group sizes were 5.67 and 4.68 during Legs 1 and 2, respectively. No harp seals were observed on ice during either survey leg.

Bearded Seal

A total of five bearded seal sightings (all solitary animals) were recorded in the RSA in 2019 (Table 1). Four of the sightings occurred during Leg 1, three of which were on-ice (Figure 28). The lone sighting recorded during Leg 2 consisted of a solitary animal observed in-water at the entrance to Baffin Bay (Figure 29).

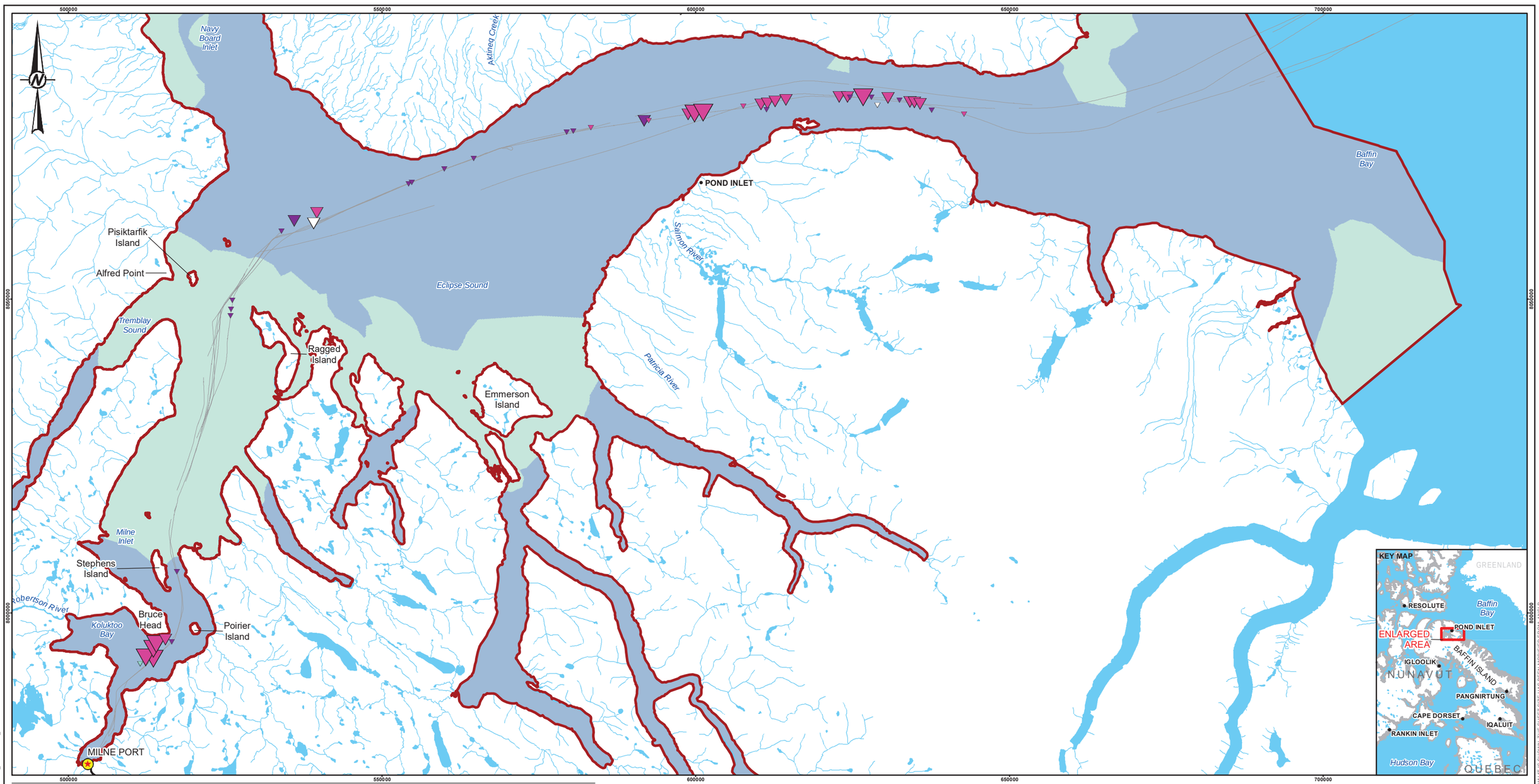
Unconfirmed Seal Species

A total of 53 sightings of unconfirmed seal species comprising 1,225 individuals were recorded during Leg 1 and Leg 2 (Table 1). The majority of these (n=40) were in-water sightings comprising of lone individuals (39 out of 40 sightings). The remainder of these sightings (n=13) were seals on ice, either solitary or in groups, ranging up to 560 animals. The MWOs noted that the three sightings associated with large group sizes were quite a distance away from the vessel (1,500 – 2,000 m) with animals clustered together on a large ice pan making it difficult to distinguish specific groups. Therefore, the best estimate of the number of animals on the ice pan was recorded.

Most of the unconfirmed seals observed during Leg 1 were recorded in Milne Inlet and western Eclipse Sound. Several sightings however occurred near Pond Inlet and near the entrance to Baffin Bay (Tuqsukatta) during Leg 1 (Figure 27). During Leg 2, most unconfirmed seal sightings occurred in Eclipse Sound and northern Milne Inlet with one sighting in southern Milne Inlet near Koluktoo Bay (Figure 29).

Polar Bear

Only two polar bear sightings were recorded in the RSA in 2019, both on the same day (20 July), with each sighting consisting of a solitary polar bear walking on the sea ice in Milne Inlet North (Table 1; Figure 27). The first polar bear was observed approximately 1 km from the icebreaker. The second polar bear was observed 12 min later, approximately 3 km from the vessel. There was also one incidental polar bear sighting made by the ship crew on 21 July at 02:00 when the MWOs were not on watch. The bear was observed in Milne Inlet North (near Ragged Island) where it was resting on the ice ahead of the vessel at an unknown distance before running away.



LEGEND

- COMMUNITY
- MILNE PORT

CETACEAN SPECIES OBSERVATIONS (GROUP SIZE)

BELUGA
- 1

BOWHEAD WHALE
- 1
- 2 - 10

NARWHAL
- 1
- 2 - 10
- 10+

UNIDENTIFIED WHALE
- 1
- 2 - 10

- MILNE INLET TOTE ROAD
- SURVEY TRACK (19-29 JULY 2019)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

LEG 1 MEAN ICE CONCENTRATION (19-29 JULY 2019)
- 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 SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. 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	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT
MARY RIVER PROJECT – 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
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PROJECT NO.	CONTROL	REV.	FIGURE
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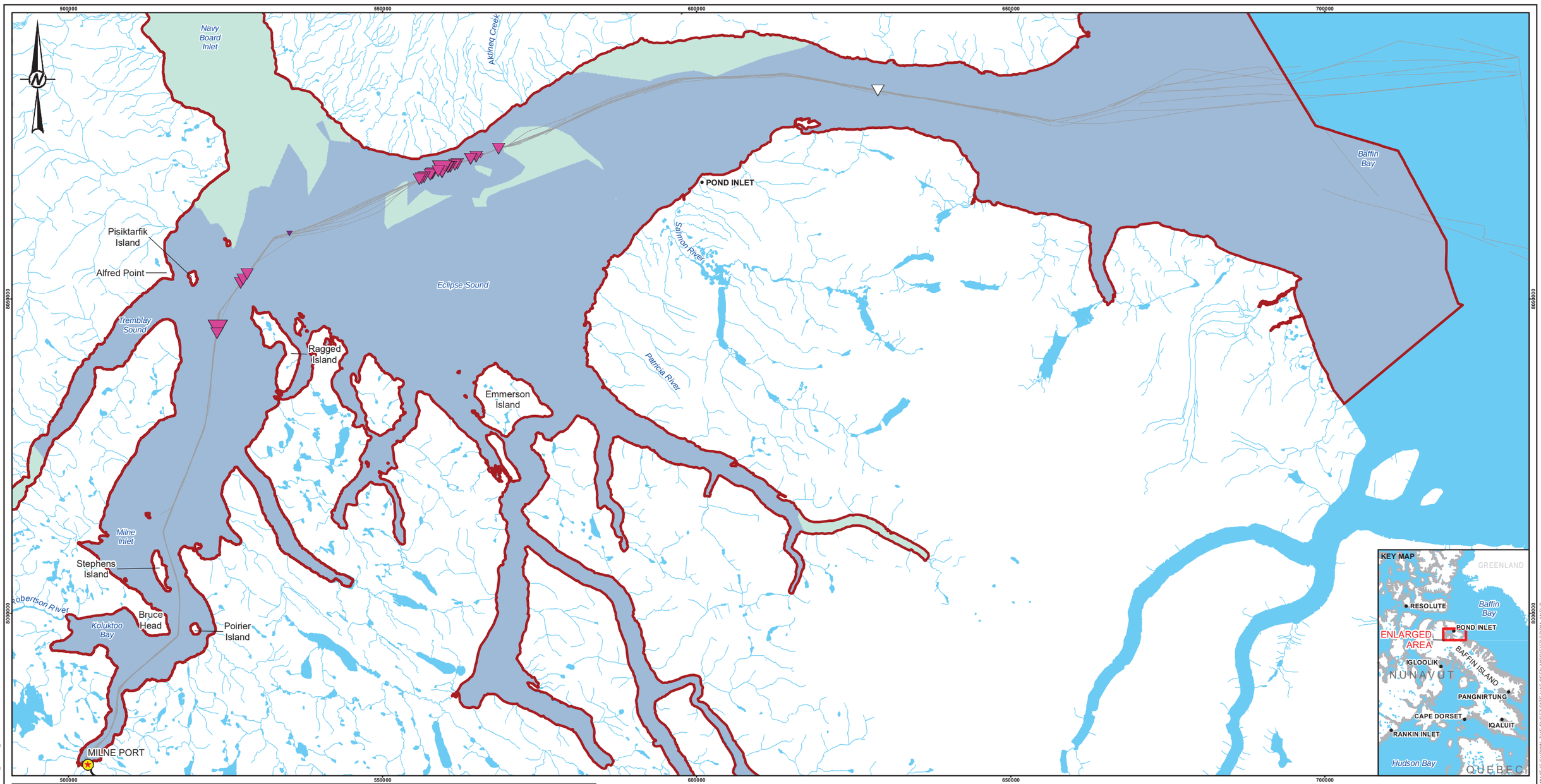

LEGEND

- COMMUNITY
- MILNE PORT

CETACEAN SPECIES OBSERVATIONS (GROUP SIZE)

BOWHEAD WHALE

- 1

NARWHAL

- 1
- 2 - 10
- 10+

UNIDENTIFIED WHALE

- 2 - 10

- MILNE INLET TOTE ROAD
- SURVEY TRACK (5-28 OCTOBER 2019)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

LEG 2 MEAN ICE CONCENTRATION (5-28 OCTOBER 2019)

- 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 SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. 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 – 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

TITLE
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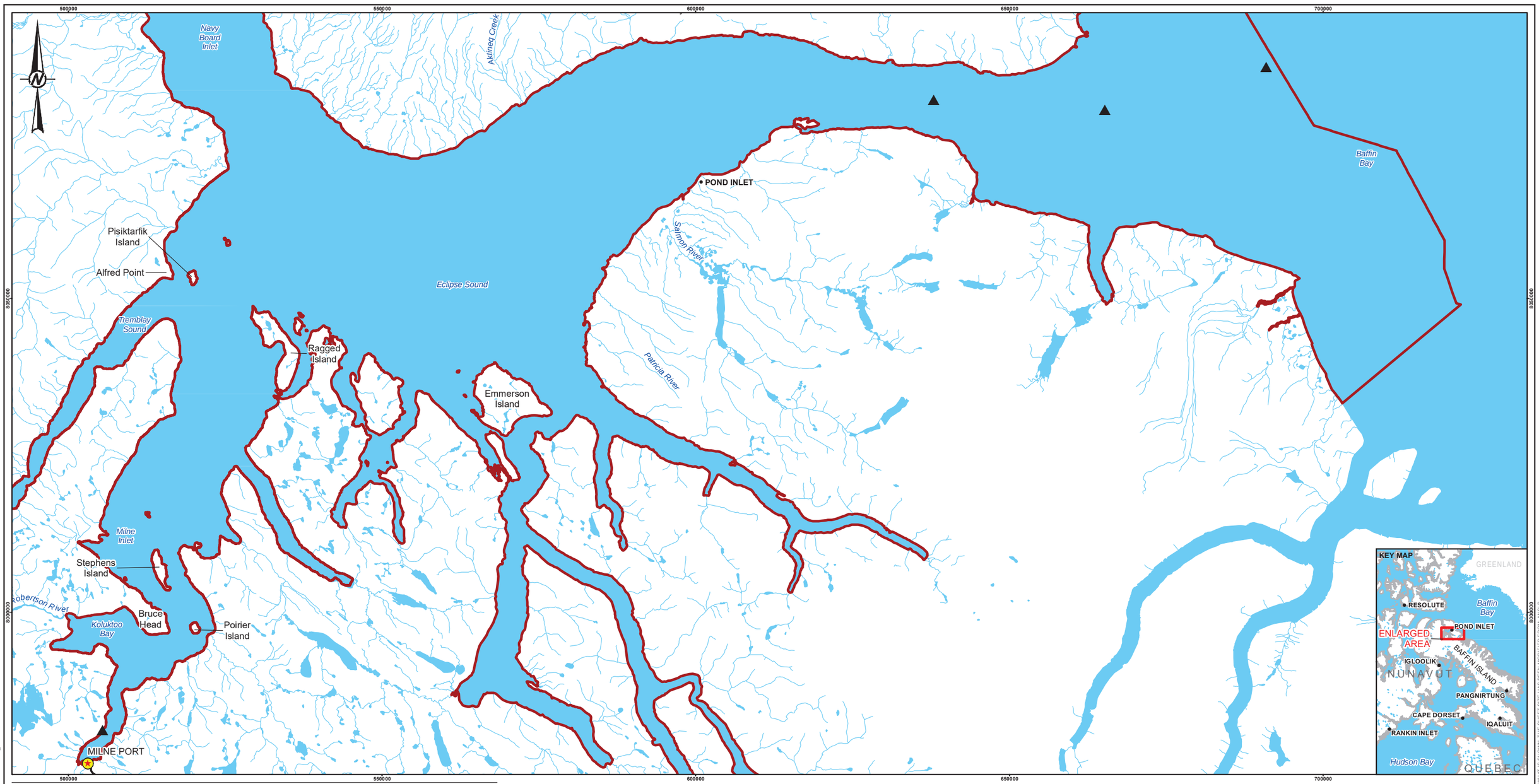

LEGEND

- COMMUNITY
- MILNE PORT

DEAD MARINE MAMMAL SPECIES OBSERVATIONS

- NARWHAL
- MILNE INLET TOTE ROAD
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- 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 – 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

TITLE
LOCATION OF DEAD NARWHAL OBSERVED DURING LEG 2 (5-28 OCTOBER 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
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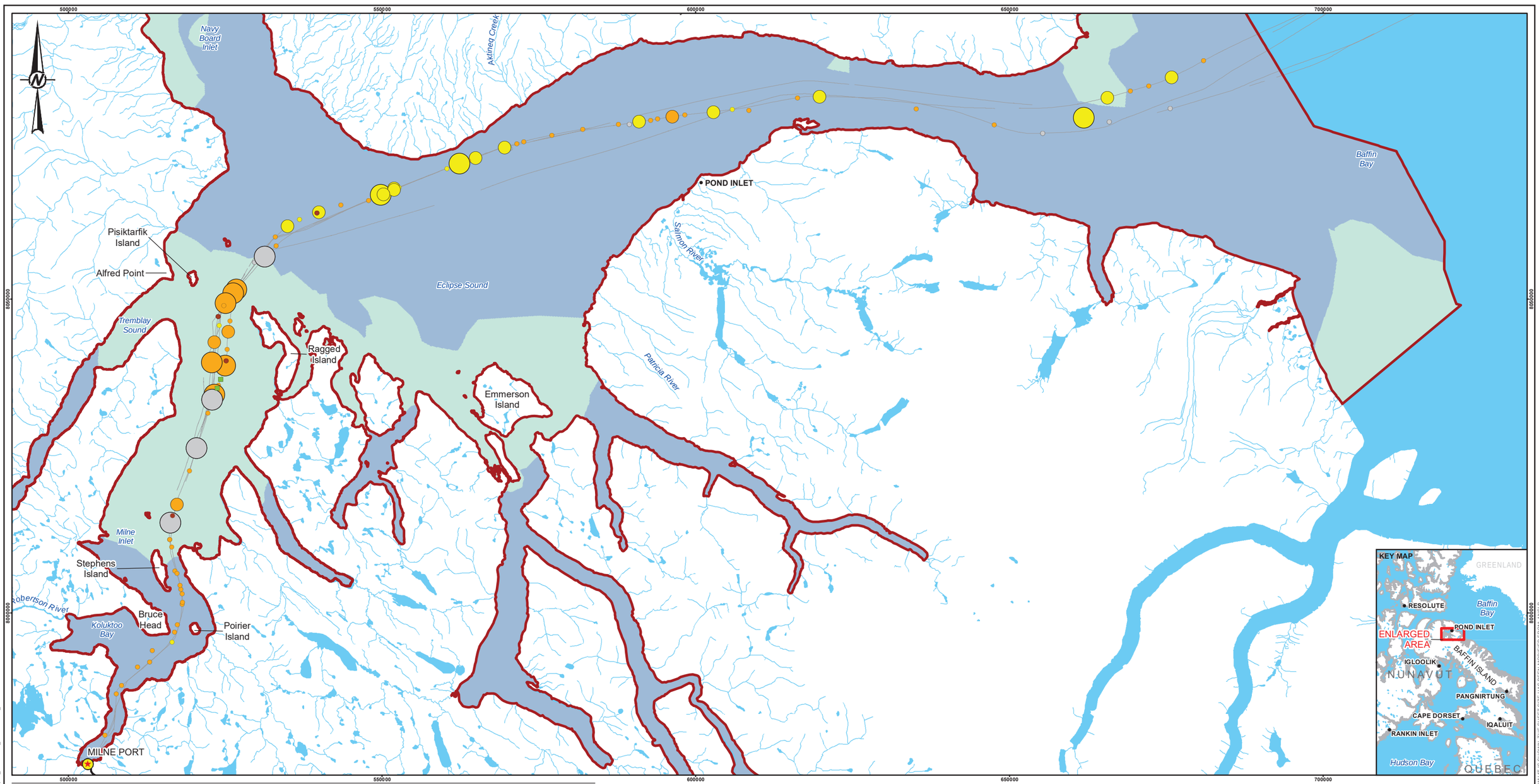

LEGEND

- COMMUNITY
- MILNE PORT

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BEARDED SEAL
- 1

HARP SEAL
- 1
- 2 - 10
- 10+

POLAR BEAR
- 1

RINGED SEAL
- 1
- 2 - 10
- 10+

UNIDENTIFIED SEAL
- 1
- 10+

- MILNE INLET TOTE ROAD
- SURVEY TRACK (19-29 JULY 2019)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

LEG 1 MEAN ICE CONCENTRATION (19-29 JULY 2019)
- 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 SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. 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	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT
MARY RIVER PROJECT – 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
LOCATION OF PINNIPED AND POLAR BEAR SIGHTINGS DURING LEG 1 (19-29 JULY 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	28

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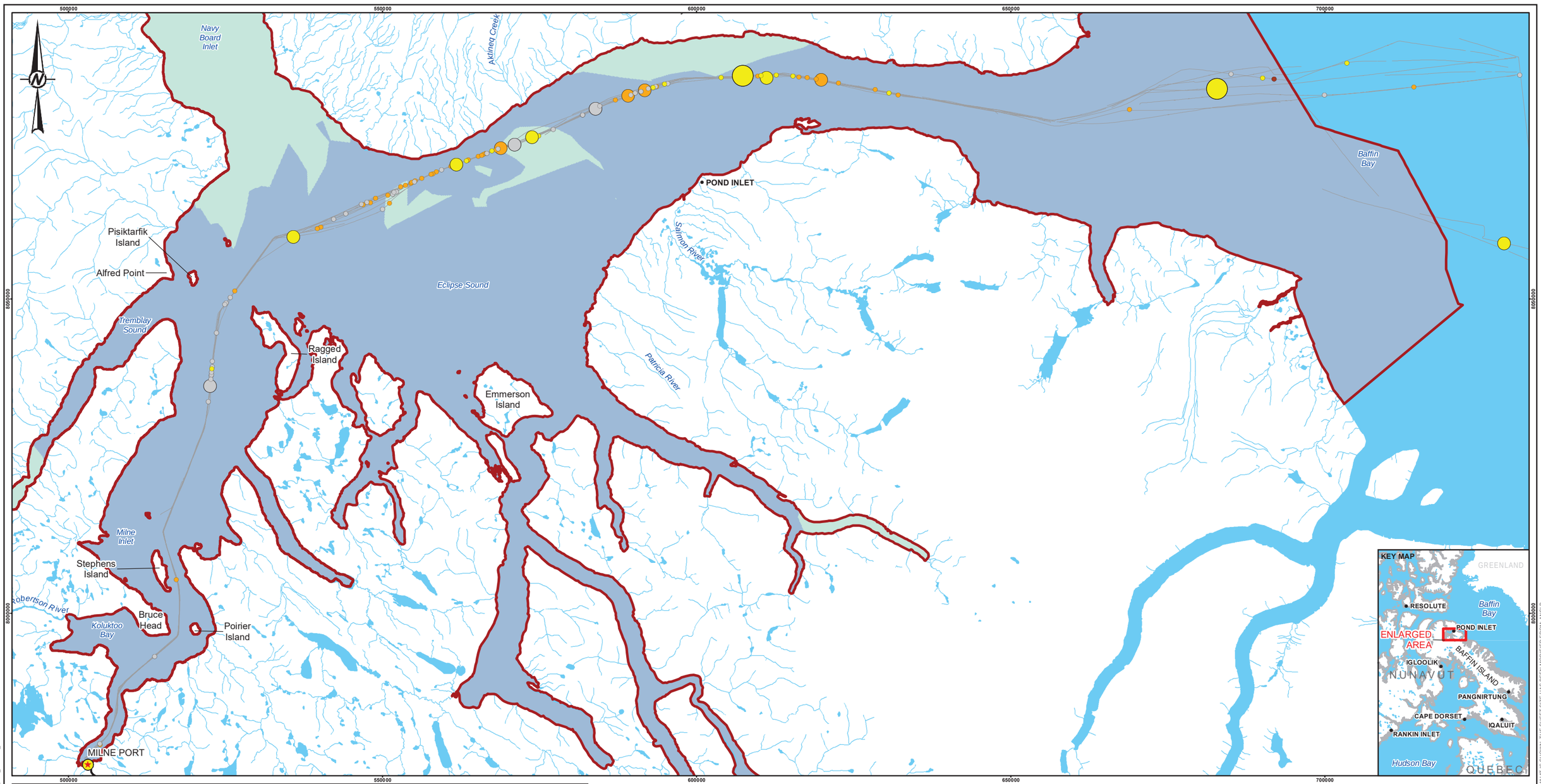

LEGEND

- COMMUNITY
- MILNE PORT

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BEARDED SEAL
- 1

HARP SEAL
- 1
- 2 - 10
- 10+

RINGED SEAL
- 1
- 2 - 10

UNIDENTIFIED SEAL
- 1
- 2 - 10

- MILNE INLET TOTE ROAD
- SURVEY TRACK (5-28 OCTOBER 2019)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

LEG 2 MEAN ICE CONCENTRATION (5-28 OCTOBER 2019)
- ICE FREE
- 0-10%
- 10-30%
- 40-60%
- 70-80%
- 90-100%

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 – 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

TITLE
LOCATION OF PINNIPED SIGHTINGS DURING LEG 2 (5-28 OCTOBER 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	29

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2.2.3.2 Relative Abundance of Marine Mammals in RSA

The relative abundance of marine mammals in the RSA, expressed as the animal detection rate (no. of animals relative to survey effort in km) in Table 2 below, was 0.90 animals/km (0.10 sightings per km). More animals were observed during Leg 1 (2.19 animals/km) than during Leg 2 (0.17 animals/km). Table 2 provides a summary of sighting rates and animal detection rates by species and between survey legs. All marine mammal species, including narwhal, occurred in higher relative abundance in the RSA in Leg 1 than in Leg 2.

Table 2: Sighting and Animal Detection Rate (Relative Abundance) of Marine Mammals in RSA

Species	Leg 1 (July 19-29)		Leg 2 (0ct 05-28)		Combined	
	No. of Sightings (No. of Individuals)	Sighting Rate (Animal Detection Rate)*	No. of Sightings (No. of Individuals)	Sighting Rate (Animal Detection Rate)*	No. of Sightings (No. of Individuals)	Sighting Rate (Animal Detection Rate)*
Narwhal	27 (385)	0.0241 (0.3441)	27 (103)	0.0137 (0.0523)	54 (488)	0.0175 (0.1580)
Beluga whale	1 (1)	0.0009 (0.0009)	0 (0)	0 (0)	1 (1)	0.0003 (0.0003)
Bowhead	22 (24)	0.0197 (0.0214)	1 (1)	0.0005 (0.0005)	23 (25)	0.0074 (0.0081)
Unknown whale	2 (3)	0.0018 (0.0027)	1 (3)	0.0005 (0.0015)	3 (6)	0.0010 (0.0019)
Ringed seal	61 (722)	0.0545 (0.6452)	53 (58)	0.0269 (0.0294)	114 (780)	0.0369 (0.2525)
Harp seal	24 (136)	0.0214 (0.1215)	25 (117)	0.0127 (0.0594)	49 (253)	0.0159 (0.0819)
Bearded seal	4 (4)	0.0036 (0.0036)	1 (1)	0.0005 (0.0005)	5 (5)	0.0016 (0.0016)
Unknown seal	9 (1,176)	0.0080 (1.0509)	44 (49)	0.0223 (0.0249)	53 (1,225)	0.0172 (0.3965)
Polar bear	2 (2)	0.0018 (0.0018)	0 (0)	0(0)	2 (2)	0.0006 (0.0006)
Total	152 (2,453)	0.1358 (2.1921)	253 (332)	0.0771 (0.1685)	304 (2,785)	0.0984 (0.9015)

Note: *sightings/km (individuals/km)

Comparison to 2013 – 2015 SBO Programs

The main species observed during SBO programs in 2013, 2014 and 2015, prior to the 2018 and 2019 SBO Programs, were narwhal, ringed seal, and harp seal (SEM 2016). Less observation effort during earlier SBO programs (5.5 hours in 2013 and 9 hours each in 2014 and 2015) resulted in lower numbers of sightings compared to the 2018 and 2019 programs. In 2013, five narwhals, 45 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) (Table 3).

Table 3: Number of Marine Mammal Observation in the RSA – A Comparison Between 2013, 2014 and 2015 SBO Programs

Species	2013	2014	2015
	No. of Individuals	No. of Individuals	No. of Individuals
Narwhal	5	7–9	5–10
Beluga whale	0	0	0
Bowhead whale	0	0	0
Unidentified Whale	0	0	0
Ringed Seal	45	2	1
Harp Seal	10–15	0	0
Bearded Seal	0	0	0
Unidentified Seal	1	1	0
Polar Bear	0	0	0
# Observation Hours	**5.5**	**9.0**	**9.0**
Total	**61 to 66**	**10 to 19**	**6 to 16**

Comparison to 2018 SBO Program

The relative abundance of marine mammals in the RSA was similar in 2019 (0.90 individuals per km) to that observed in 2018 (0.88 individuals per km) (Table 4). Species observed in greater relative abundance in 2019 included narwhal, beluga, and bowhead whale. For these species, the increase was reflective of more animals observed during Leg 1 (similar numbers were seen during Leg 2 in both years). Less ringed seal and harp seal were observed in 2019 compared to 2018, although this was likely associated with the large number of unconfirmed seal species recorded in 2019 (n=1,225) compared to 2018 (n=760) (Table 4). When considering all seal categories (confirmed and unconfirmed species), a similar number of seals were observed in both years.

The observed increase in narwhal relative abundance in 2019 may have been reflective of abnormally low numbers of narwhal in the RSA in 2018, as reported by community members and as supported by low catch rates that year. Hunters found the opposite to be true in 2019 when narwhal were regularly observed throughout the RSA and in large groups (R. Arnakallak, Pers. Comm. 2020). The increase in relative abundance observed in 2019 may have also been a result of new adaptive management measures implemented during the early 2019 shoulder season to specifically reduce icebreaker noise impacts on narwhal, such as the 40 km floe edge buffer zone and a reduced number of icebreaker transits per day in the RSA in heavy ice conditions.

Table 4: Relative Abundance of Marine Mammals in RSA – A Comparison Between 2018 and 2019 SBO Programs

Species	Combined 2018		Combined 2019	
	No. of Individuals	Relative Abundance*	No. of Individuals	Relative Abundance*
Narwhal	175	0.0555	488	0.1580
Beluga whale	0	0.0000	1	0.0003
Bowhead whale	0	0.0000	25	0.0081
Unidentified Whale	1	0.0003	6	0.0019
Ringed Seal	1,069	0.3389	780	0.2525
Harp Seal	754	0.2391	253	0.0819
Bearded Seal	5	0.0016	5	0.0016
Unidentified Seal	760	0.2410	1,225	0.3965
Polar Bear	2	0.0006	2	0.0006
Total	**2,766**	**0.8770**	**2,785**	**0.9015**

Note: *individuals/km (corrected for survey effort in km)

2.2.3.2.1 Ice Cover During Shoulder Seasons

Ice cover was recorded during the active MWO watch periods on the icebreaker as one of several environmental conditions. It was recorded as 'percent cover' at the following two spatial scales: Near Field (≤100 m of the ship) and Far Field (>100 m from the ship but within line of sight of the observer). Pinnipeds that were observed hauled-out on ice were considered separately from pinnipeds observed in-water.

Near Field Ice Cover

Ice cover conditions within 100 m of the ship (Near Field) were recorded during active MWO watches to estimate the proportion of time that the MSV Botnica engaged in icebreaking activities. Table 5 presents summary statistics for Near Field Ice Cover conditions present at the time of the recorded sightings. Sighting detection rates, corrected for effort (distance traveled), are presented for each ice cover category in Table 6 (for the most commonly observed species) and in Appendix C (for all observed species).

During Leg 1, all narwhal sightings occurred with open-water (0-20%) conditions in the near field (Table 5) with an overall sighting detection rate of 0.0257 sightings/km (Table 6). During fall, the majority of narwhal sightings occurred with high (61-80%) ice cover conditions in the near field (mean = 63.0%, range = 0-90%) (Table 5), corresponding with a sighting detection rate of 0.9462 sightings/km (Table 5).

A single beluga was observed during Leg 1 when open-water (0-20%) conditions were prevalent in the near field (Table 5).

During Leg 1, all bowhead whale sightings in the near field occurred either in open-water (0-20%) or in low (21-40%) ice cover conditions (mean = 4.1%; range = 0-40%) (Table 5), with sighting detection rate (0.0290 sightings/km) highest in low (21-40%) ice cover conditions (Table 6). The single bowhead sighting during Leg 2 occurred in open-water (0-20%) conditions (Table 6).

During Leg 1, in-water sightings of ringed seal occurred in a variety of ice cover conditions in the near field (mean = 5.2%, range = 0–100%) (Table 5), with the highest detection rate occurring in low (21-40%) ice cover conditions (0.0869 sightings/km) (Table 6). During Leg 2, most ringed seal in-water sightings occurred in moderate to high (41-100%) ice cover conditions in the near field (mean 39.6%, range: 0–100%) with the highest sighting detection rate occurring in high (61-80%) ice cover conditions (0.5478 sightings/km) (Table 6). On-ice sightings of ringed seal during Leg 1 occurred primarily in high and moderate (41-100%) ice cover conditions (mean = 61.5%, range = 30-90%), with the highest sighting detection rate occurring in heavy (81-100%) ice cover conditions (0.3135 sightings/km) (Table 6). During Leg 2, the single sighting of a lone ringed seal occurred in moderate (50%) ice conditions (Table 6).

During Leg 1, in-water sightings of harp seal occurred primarily in open-water (0-20%) conditions in the near field (all with ice free near field ice cover) with an overall detection rate of 0.0229 sightings/km (Table 6). During Leg 2, in-water sightings of harp seal occurred primarily in moderate to heavy (41-100%) ice cover conditions, with the highest detection rate (0.4505 animals/km) (Table 6) occurring in moderate (41-60%) ice conditions. No harp seals were observed on ice during either survey leg.

In-water sightings of bearded seal occurred only in open-water (0-20%) conditions in the near field during both Leg 1 and Leg 2 (Table 5). On-ice sightings of bearded seals during Leg 1 occurred primarily in moderate (41-60%) ice cover conditions (mean =56%, range 40-90%). No bearded seals were observed on ice during Leg 2.

Both polar bear sightings took place during Leg 1 in heavy (81-100%) ice cover conditions in the near field (Table 5).

Table 5: Near Field Ice Cover Recorded During Marine Mammal Sightings

	Narwhal	Beluga	Bowhead	Unconfirmed cetacean sp.	Ringed seal	Harp seal	Bearded seal	Unconfirmed seal sp.	Polar bear
Leg 1: Early Summer (July 19-29)									
In-water									
Mean Near Field Ice Cover (%)	0	0	4.1	0	5.2	0	0	0	n/a
Near Field Ice Cover Range (%)	0	0	0-40	0	0-100	0	0	0	n/a
# Sightings	27	1	22	2	48	24	1	4	0
On ice									
Mean Near Field Ice Cover (%)	n/a	n/a	n/a	n/a	61.5	n/a	56.7	37.5	90.0
Near Field Ice Cover Range (%)	n/a	n/a	n/a	n/a	30-90	n/a	40-90	10-90	90
# Sightings	n/a	n/a	n/a	n/a	13	0	3	5	2
Leg 2: Fall (0ct 05-28)									
In-water									
Mean Near Field Ice Cover (%)	63.3	n/a	0.0	0.0	39.6	18.4	0.0	30.8	n/a
Near Field Ice Cover Range (%)	0-90	n/a	0	0	0-100	0-90	0	0-100	n/a
# Sightings	27	0	1	1	52	25	1	36	0
On ice									
Mean Near Field Ice Cover (%)	n/a	n/a	n/a	n/a	50.0	n/a	n/a	23.8	n/a
Near Field Ice Cover Range (%)	n/a	n/a	n/a	n/a	50	n/a	n/a	0-80	n/a
# Sightings	n/a	n/a	n/a	n/a	1	0	0	8	0

Table 6: Sighting Detection Rates as a Function of Near Field Ice Cover

Ice Conditions	Leg 1: Early Summer (July 19-30)				Leg 2: Fall (0ct 05-28)			
	Narwhal	Bowhead whale	Ringed seal	Harp seal	Narwhal	Bowhead whale	Ringed seal	Harp seal
In-water Sightings								
0-20% (Open water)	**0.0257**	0.0200	0.0419	**0.0229**	0.0057	**0.0010**	0.0257	0.0171
21-40% (Low)	0.0000	**0.0290**	**0.0869**	0.0000	0.0000	0.0000	0.0000	0.0000
41-60% (Moderate)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4505	**0.4505**
61-80% (High)	0.0000	0.0000	0.0000	0.0000	**0.9462**	0.0000	**0.5478**	0.0996
81-100% (Heavy)	0.0000	0.0000	0.0522	0.0000	0.1090	0.0000	0.5450	0.0545
# Sightings	27	22	48	24	27	1	52	25
On ice Sightings								
0-20% (Open-water)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
21-40% (Low)	n/a	n/a	0.1448	0.0000	n/a	n/a	0.0000	0.0000
41-60% (Moderate)	n/a	n/a	0.1613	0.0000	n/a	n/a	**0.1126**	0.0000
61-80% (High)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
81-100% (Heavy)	n/a	n/a	**0.3135**	0.0000	n/a	n/a	0.0000	0.0000
# Sightings	n/a	n/a	13	0	n/a	n/a	1	0

Note: Bold indicates ice condition with highest detection rate

Far Field Ice Cover

To assess sighting detection rates as a function of ice cover over the wider extent of the observation area, data on far field ice cover were recorded, along with other environmental variables, during active MWO watches conducted during the Leg 1 and Leg 2 surveys. Table 7 presents summary statistics for Far Field Ice Cover conditions present at the time of the recorded sightings. Sighting detection rates, corrected for effort (distance traveled), are presented for each ice cover category in Table 8 (for the most commonly observed species) and in Appendix C (for all observed species).

During Leg 1, the majority of narwhal sightings occurred in open-water (0-20%) conditions in the far field (mean = 1.1%, range = 0-30%) (Table 7) with an overall detection rate of 0.0256 sightings/km (Table 8). During Leg 2, the majority of narwhal sightings occurred in moderate to heavy (41-100%) ice cover conditions in the far field (mean = 73.0%, range = 0-90%), with the highest detection rate (0.6520 sightings/km) occurring in heavy (81-100%) ice conditions (Table 8).

A single beluga was observed during Leg 1 when open water (0-20%) conditions were prevalent in the far field (Table 7).

During Leg 1, bowhead whale sightings occurred in ice conditions ranging from open-water (0-20%) to moderate in the far field (41-60%) (mean = 9.1%; range = 0-50%) (Table 7), with detection rate (0.1761 sightings/km) highest in moderate (41-60%) ice cover conditions (Table 8). The single bowhead sighting during Leg 2 occurred in open-water (0-20%) far field conditions.

During Leg 1, in-water sightings of ringed seal occurred in a variety of ice cover conditions in the far field (mean = 8.5%, range = 0–100%) (Table 7), with the highest detection rate occurring in low (21-40%) ice cover conditions (0.0878 sightings/km) (Table 8). During Leg 2, most ringed seal in-water sightings occurred in moderate to heavy (41-100%) ice cover conditions in the far field (mean 42.7%, range: 0–100%) (Table 7), with the highest detection rate occurring in heavy (81-100%) ice cover conditions (0.5834 sightings/km) (Table 8). On-ice sightings of ringed seal during Leg 1 occurred primarily in moderate (41-60%) ice cover conditions (mean = 63.1%, range = 30-90%) (Table 7), with the highest detection rate occurring in moderate (41-60%) ice cover conditions (0.3521 sightings/km) (Table 8). During Leg 2, the single on-ice sighting of a lone ringed seal occurred during moderate ice conditions (50%) in the far field.

During Leg 1, in-water sightings of harp seal occurred primarily in open-water (0-20%) conditions in the far field (mean = 1.3%, range = 0-10%) (Table 7), with an overall detection rate of 0.0236 sightings/km (Table 8). During Leg 2, in-water sightings of harp seal occurred primarily in low to moderate (21-60%) ice cover conditions in the far field (mean = 22.0%, range = 0–90%) (Table 7), with the highest detection rate occurring in moderate (41-60%) ice cover conditions (0.4711 sightings/km) (Table 8). No harp seals were observed on ice during either survey leg.

In-water sightings of bearded seal occurred only in open-water (0-20%) conditions in the far field during both Leg 1 and Leg 2 (Table 7). On-ice sightings of bearded seals during Leg 1 occurred primarily in high (61-80%) ice cover conditions in the far field (mean = 63%, range 40-90%) (Table 7). No bearded seals were observed on ice during Leg 2.

Both polar bear sightings took place during Leg 1 in heavy (81-100%) ice cover conditions in the far field (Table 7).

Table 7: Far Field Ice Cover Recorded During Marine Mammal Sightings

	Narwhal	Beluga	Bowhead	Unconfirmed cetacean sp.	Ringed seal	Harp seal	Bearded seal	Unconfirmed seal sp.	Polar bear
Leg 1: Early Summer (July 19-30)									
In-water									
Mean Far Field Ice Cover (%)	1.1	0.0	9.1	0.0	8.5	1.3	0.0	5.0	n/a
Far Field Ice Cover Range (%)	0-30	0	0-50	0	0-100	0-10	0	0-10	n/a
# Sightings	27	1	22	2	48	24	1	4	0
On ice									
Mean Far Field Ice Cover (%)	n/a	n/a	n/a	n/a	63.1	n/a	63.3	47.5	85.0
Far Field Ice Cover Range (%)	n/a	n/a	n/a	n/a	30-90	n/a	40-90	20-80	80-90
# Sightings	n/a	n/a	n/a	n/a	13	0	3	5	2
Leg 2: Fall (0ct 05-28)									
In-water									
Mean Far Field Ice Cover (%)	73.0	n/a	0.0	0.0	42.7	22.0	0.0	35.6	n/a
Far Field Ice Cover Range (%)	0-90	n/a	0	0	0-90	0-90	0	0-90	n/a
# Sightings	27	0	1	1	52	25	1	36	0
On ice									
Mean Far-field Ice Cover (%)	n/a	n/a	n/a	n/a	60.0	n/a	n/a	36.3	n/a
Far Field Ice Cover Range (%)	n/a	n/a	n/a	n/a	60	n/a	n/a	10-90	n/a
# Sightings	n/a	n/a	n/a	n/a	1	0	0	8	0

Table 8: Sighting Detection Rates as a Function of Far Field Ice Cover

Ice Conditions	Leg 1: Early Summer (July 19-30)				Leg 2: Fall (0ct 05-28)			
	Narwhal	Bowhead whale	Ringed seal	Harp seal	Narwhal	Bowhead whale	Ringed seal	Harp seal
In-water Sightings								
0-20% (Open water)	**0.0256**	0.0117	0.0384	**0.0236**	0.0016	**0.0005**	0.0138	0.0090
21-40% (Low)	0.0146	**0.0293**	**0.0878**	0.0000	0.2461	0.0000	0.0000	0.0820
41-60% (Moderate)	0.0000	0.1761	0.0400	0.0000	0.000	0.0000	0.4711	**0.4711**
61-80% (High)	0.0000	0.0000	0.0000	0.0000	0.1352	0.0000	0.3381	0.0676
81-100% (Heavy)	0.0000	0.0000	0.0855	0.0000	**0.6520**	0.0000	**0.5834**	0.0686
# Sightings	27	22	48	24	27	1	52	25
On ice Sightings								
0-20% (Open water)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
21-40% (Low)	n/a	n/a	0.0439	0.0000	n/a	n/a	0.0000	0.0000
41-60% (Moderate)	n/a	n/a	**0.3521**	0.0000	n/a	n/a	**0.1178**	0.0000
61-80% (High)	n/a	n/a	0.1951	0.0000	n/a	n/a	0.0000	0.0000
81-100% (Heavy)	n/a	n/a	0.3422	0.0000	n/a	n/a	0.0000	0.0000
# Sightings	n/a	n/a	13	0	n/a	n/a	1	0

Note: Bold indicates ice condition with highest detection rate

2.2.3.2.2 Sea State

Table 8 presents sightings detection rates for the most commonly observed marine mammal species in the RSA, broken down by Sea State category. Data for all species are presented in Appendix C.

The highest detections rates for narwhal occurred in Sea State 0 for both Leg 1 (0.0592 sightings/km) and Leg 2 surveys (0.2060 sightings/km) (Table 9). The single beluga whale sighting recorded during Leg 1 occurred in Sea State 0 (Table 9). No beluga whale were recorded during Leg 2. During Leg 1, sighting detection rate for bowhead whale was highest in Sea State 0 (0.0423 sightings/km) (Table 9). The single bowhead whale sighting during Leg 2 occurred in Sea State 3 (Table 9).

The highest detection rate for ringed seal in-water occurred in Sea State 0 for both Leg 1 (0.1564 sightings/km) and Leg 2 surveys (0.2182 sightings/km) (Table 9). The highest detection rate for ringed seal on ice also occurred in Sea State 0 during Leg 1 (0.0254 sighting/km) (Table 9). The single sighting of a ringed seal on ice during Leg 2 occurred in Sea State 0.5 (Table 9).

The highest detection rate for harp seal in-water occurred in Sea State 0 for the Leg 1 survey (0.0550 sightings/km) (Table 8), and in Sea State 0.5 for the Leg 2 survey (0.0116 sightings/km) (Table 8). No harp seals were observed on ice during either survey leg (Table 9).

There was a single sighting of a bearded seal in-water during each of the Leg 1 and Leg 2 surveys coinciding with Sea State 0 (0.0042 sightings/km) and Sea State 1 (0.0022 sightings/km), respectively (Appendix C). The highest detection rate for bearded seal on ice during Leg 1 occurred at Sea State 0 (0.0085 sightings/km) (Appendix C). There were no bearded seals detected on ice during Leg 2 (Table 9).

Two polar bear were observed on ice during Leg 1; one polar bear was observed in Sea State 0 and the other in Sea State 0.5 (Appendix C). No polar bear were observed during Leg 2.

Table 9: Sighting Detection Rates as a Function of Sea State

Sea State	Leg 1: Early Summer (July 19-30)				Leg 2: Fall (0ct 05-28)			
	Narwhal	Bowhead whale	Ringed seal	Harp seal	Narwhal	Bowhead whale	Ringed seal	Harp seal
In-water								
0 (Glassy)	**0.0592**	**0.0423**	**0.1564**	**0.0550**	**0.2060**	0.0000	**0.2182**	0.0364
0.5 (Ripples)	0.0193	0.0097	0.0258	0.0161	0.0236	0.0000	0.0708	**0.0371**
1 (small wavelets)	0.0287	0.0229	0.0115	0.0000	0.0045	0.0000	0.0112	0.0022
2 (smooth wavelets)	0.0000	0.0118	0.0059	0.0059	0.0022	0.0000	0.0045	0.0134
3 (Slight; Small white caps)	0.0092	0.0139	0.0000	0.0231	0.0000	**0.0022**	0.0112	0.0067
4 (Mod. Waves, some spray)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0044	0.0044
# Sightings	27	22	48	24	27	1	52	25
On ice								
0 (Glassy)	n/a	n/a	**0.0254**	0.0000	n/a	n/a	0.0000	0.0000
0.5 (Ripples)	n/a	n/a	0.0226	0.0000	n/a	n/a	**0.0034**	0.0000
1 (small wavelets)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
2 (smooth wavelets)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
3 (Slight; Small white caps)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
4 (Mod. Waves, some spray)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
# Sightings	n/a	n/a	13	0	n/a	n/a	1	0

Note: Bold indicates Sea State with highest detection rate

2.2.3.2.3 Visibility

Table 10 presents sightings detection rates for the most commonly observed marine mammal species in the RSA, broken down by Visibility category. Data for all species are presented in Appendix C.

The highest detection rates for narwhal during Leg 1 (0.0473 sightings/km) and Leg 2 (0.0258 sightings/km) occurred in good (2,501-5,000 m) and excellent (>10,000 m) Visibility conditions, respectively (Table 10). The

single beluga whale sighting recorded during Leg 1 occurred in excellent Visibility (>10,000 m) (Appendix C). No beluga whale were observed during Leg 2. During Leg 1, sighting detection rate for bowhead whale was highest in excellent Visibility conditions (0.0295 sightings/km) (Table 10). The single bowhead whale sighting during Leg 2 also occurred in excellent visibility (Table 10).

The highest detection rate for ringed seal in-water occurred in excellent visibility conditions for both Leg 1 (0.0863 sightings/km) and Leg 2 surveys (0.0392 sightings/km) (Table 10). The highest detection rate for ringed seal on ice also occurred in very good Visibility (5,001-10,000 m) during Leg 1 (0.0556 sighting/km) (Table 10). The single sighting of a ringed seal on ice during Leg 2 occurred in excellent visibility (Table 10).

The highest detection rate for harp seal in-water occurred in very good Visibility for the Leg 1 survey (0.0473 sightings/km) (Table 10), and in poor Visibility for the Leg 2 survey (0.0189 sightings/km) (Table 10). No harp seal were observed on ice during either survey leg (Table 10).

There was a single sighting of a bearded seal in-water during each of the Leg 1 and Leg 2 surveys coinciding with excellent Visibility (0.0023 sightings/km) and very good Visibility (0.0027 sightings/km), respectively (Appendix C). The highest detection rate for bearded seal on ice during Leg 1 occurred in very good Visibility (0.0159 sightings/km) (Appendix C). There were no bearded seals detected on ice during Leg 2.

Both polar bear sightings recorded during Leg 1 occurred in very good Visibility (0.0159 sightings/km, Appendix C). No polar bear were observed during Leg 2.

Table 10: Sighting Detection Rates as a Function of Visibility

Visibility	Leg 1: Early Summer (July 19-30)				Leg 2: Fall (0ct 05-28)			
	Narwhal	Bowhead whale	Ringed seal	Harp seal	Narwhal	Bowhead whale	Ringed seal	Harp seal
In-water								
500-1,000 m (Poor)	0.0044	0.0000	0.0044	0.0000	0.0000	0.0000	0.0189	**0.0189**
1,001-2,500 m (Moderate)	0.0054	0.0109	0.0163	0.0163	0.0000	0.0000	0.0000	0.0052
2,501-5,000 m (High, Good)	**0.0473**	**0.0473**	0.0158	**0.0473**	0.0000	0.0000	0.0173	0.0087
5,001-10,000 m (V. Good)	0.0009	0.0079	0.0318	0.0000	0.0000	0.0000	0.0133	0.0080
>10,000 m (Excellent)	0.0409	0.0295	**0.0863**	0.0340	**0.0258**	**0.0010**	**0.0392**	0.0163
# Sightings	27	22	48	24	27	1	52	25
On ice								
500-1,000 m (Poor)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
1,001-2,500 m (Moderate)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
2,501-5,000 m (High, Good)	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
5,001-10,000 m (V. Good)	n/a	n/a	**0.0556**	0.0000	n/a	n/a	0.0000	0.0000
>10,000 m (Excellent)	n/a	n/a	0.0136	0.0000	n/a	n/a	**0.0010**	0.0000
# Sightings	n/a	n/a	13	0	n/a	n/a	1	0

Note: Bold indicates visibility category with highest detection rate

2.2.3.2.4 Sightability

Table 11 presents sightings detection rates for the most commonly observed marine mammal species in the RSA, broken down by Sightability category. Data for all species are presented in Appendix C.

The highest detection rates for narwhal during Leg 1 (0.0516 sightings/km) and Leg 2 (0.1770 sightings/km) occurred in very high Sightability conditions (Table 11). The single beluga whale sighting recorded during Leg 1 also occurred in very high Sightability conditions (Appendix C). No beluga whale were observed during Leg 2. During Leg 1, sighting detection rate for bowhead whale was highest in high Sightability conditions (0.0394 sightings/km) (Table 11). The single bowhead whale sighting during Leg 2 also occurred in high Sightability conditions (Table 11).

The highest detection rate for ringed seal in-water occurred in very high Sightability conditions for both Leg 1 (0.1122 sightings/km) and Leg 2 surveys (0.2065 sightings/km) (Table 11). The highest detection rate for ringed seal on ice also occurred in high Sightability conditions during Leg 1 (0.0381 sighting/km) (Table 11). The single sighting of a ringed seal on ice during Leg 2 also occurred in high Sightability conditions (Table 11).

The highest detection rate for harp seal in-water during Leg 1 (0.0425 sightings/km) and Leg 2 (0.0369 sightings/km) occurred in very high Sightability conditions (Table 11). No harp seal were observed on ice during either survey leg (Table 11).

There was a single sighting of a bearded seal in-water during each of the Leg 1 and Leg 2 surveys coinciding with very high (0.0030 sightings/km) and high (0.0028 sightings/km) Sightability conditions, respectively (Appendix C). The highest detection rate for bearded seal on ice during Leg 1 occurred in very high Sightability conditions (0.0061 sightings/km) (Appendix C). There were no bearded seals detected on ice during Leg 2.

Both polar bear sightings recorded during Leg 1 occurred in periods of high Sightability (0.0109 sightings/km, Appendix C). No polar bear were observed during Leg 2.

Table 11: Sighting Detection Rates as a Function of Sightability

Sightability	Leg 1: Early Summer (July 19-30)				Leg 2: Fall (Oct 05-28)			
	Narwhal	Bowhead whale	Ringed seal	Harp seal	Narwhal	Bowhead whale	Ringed seal	Harp seal
In Water								
Poor	0.0054	0.0054	0.0108	0.0000	0.0052	0.0000	0.0052	0.0103
Low	0.0113	0.0056	0.0000	0.0226	0.0051	0.0000	0.0127	0.0025
Medium	0.0272	0.0181	0.0181	0.0226	0.0000	0.0000	0.0092	0.0057
High	0.0054	0.0163	0.0272	0.0054	0.0000	**0.0028**	0.0281	0.0337
Very High	**0.0516**	**0.0394**	**0.1122**	**0.0425**	**0.1770**	0.0000	**0.2065**	**0.0369**
# Sightings	27	22	48	24	27	1	52	25
On Ice								
Poor	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
Low	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
Medium	n/a	n/a	0.0000	0.0000	n/a	n/a	0.0000	0.0000
High	n/a	n/a	**0.0381**	0.0000	n/a	n/a	**0.0011**	0.0000
Very High	n/a	n/a	0.0182	0.0000	n/a	n/a	0.0000	0.0000
# Sightings	n/a	n/a	13	0	n/a	n/a	1	0

Note: Bold indicates sightability category with highest detection rate

2.2.3.3 Closest Point of Approach to Vessel

During each recorded marine mammal sighting, the distance between the detected marine mammal and the ship was estimated. The initial distance at which a marine mammal was observed by the MWO was noted and if the animal was subsequently observed again at a closer distance to the ship, the Closest Point of Approach (CPA) was updated. Table 11 presents a summary of CPAs recorded for sightings during all scheduled marine mammal watches in 2019. 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., as pinnipeds are more easily detected on ice than in-water).

Table 12: Closest Point of Approach (CPA) Distances Recorded during the 2019 SBO Program

	Narwhal	Beluga	Bowhead whale	Unconfirmed cetacean sp.	Ringed seal	Harp seal	Bearded seal	Unconfirmed seal sp.	Polar bear
Leg 1: Early Summer (July 19-29)									
In-water									
Mean CPA (m)	792.6	1000.0	729.5	550.0	223.8	330.8	600.0	237.5	n/a
Range (m)	200-2500	1000	200-1500	200-900	50-900	60-800	600	100-400	n/a
# Sightings	27	1	24	2	48	24	1	4	0
On ice									
Mean CPA (m)	n/a	n/a	n/a	n/a	830.8	n/a	233.3	1180.0	2000.0
Range (m)	n/a	n/a	n/a	n/a	100-2000	n/a	100-300	100-2000	1000-3000
# Sightings	0	0	0	0	13	0	3	5	2
Leg 2: Fall (0ct 05-28)									
In-water									
Mean CPA (m)	1175.9	n/a	3700.0	5000.0	415.8	315.4	800.0	824.7	n/a
Range (m)	250-2500	n/a	3700	5000	30-1500	10-900	800	10-5000	n/a
# Sightings	28	0	1	0	54	27	1	36	0
On ice									
Mean CPA (m)	n/a	n/a	n/a	n/a	400.0	n/a	n/a	5062.5	n/a
Range (m)	n/a	n/a	n/a	n/a	400	n/a	n/a	500-8000	n/a
# Sightings	0	0	0	0	1	0	0	8	0

Narwhal

The CPA for narwhal ranged from 200 to 2,500 m (mean = 792.6 m) during Leg 1, and from 250 to 2,500 m (mean = 1,175.9 m) during Leg 2 (Table 12).

Beluga Whale

The single observation of a beluga whale during early summer corresponded with a CPA of 1,000 m (Table 12).

Bowhead Whale

The CPA for bowhead whale during Leg 1 ranged from 200 to 1,500 m (mean = 729.5 m; Table 12). The single bowhead whale sighting during Leg 2 corresponded with a CPA of 3,700 m.

Ringed Seal

The CPA for ringed seal in-water ranged from 50 to 900 m (mean = 223.8 m) during Leg 1, and from 30 to 1,500 m (mean = 415.8 m) during Leg 2 (Table 12). The CPA for ringed seal on ice ranged from 100 to 2,000 m (mean = 830.8 m) during Leg 1. The only sighting of a pair of ringed seal on ice during Leg 2 corresponded with a CPA of 400 m.

Harp Seal

The CPA for harp seal in-water ranged from 60 to 800 m (mean = 330.8 m) during Leg 1, and from 10 to 900 m (mean = 315.4 m) during Leg 2 (Table 11). Harp seal were not observed on ice during either survey leg.

Bearded Seal

The single bearded seal in-water sighting during Leg 1 corresponded with a CPA of 600 m (Table 11) and the single bearded seal in-water sighting during Leg 2 corresponded with a CPA of 800 m (Table 12). The CPA for bearded seal on-ice ranged from 100 to 300 m during Leg 1 (mean = 233.3 m; Table 12). No on-ice sightings of bearded seal occurred during Leg 2.

Polar Bear

Two polar bears were observed during Leg 1; the first was observed on the ice with a CPA of 1,000 m and the second was observed on the ice with a CPA of 3,000 m (Table 12).

Overall, the 2019 CPA results support impact predictions that animals demonstrate localized avoidance of the ship. This provides further confidence that a vessel strike on a marine mammal is unlikely to occur based on current vessel speeds in the RSA (9 knot speed restriction). These results also further support impact predictions made in the FEIS Addendum for the Early Revenue Phase (ERP), that the Project was unlikely to result in significant residual adverse effects on narwhal in the RSA, defined as effects that compromise the integrity of the population either through mortality (i.e., ship strikes) or via large-scale displacement or abandonment of the RSA.

2.2.4 End of Shipping Season Aerial Clearance Surveys

Aerial surveys (i.e., clearance surveys) were flown in the RSA at the end of the shipping season on 30-31 October 2019. The purpose of the surveys was to monitor the shipping corridor and adjacent areas for potential narwhal entrapment events following the completion of Baffinland's 2019 shipping operations in the RSA and the completion of ship-based monitoring as part of the 2019 SBO Program.

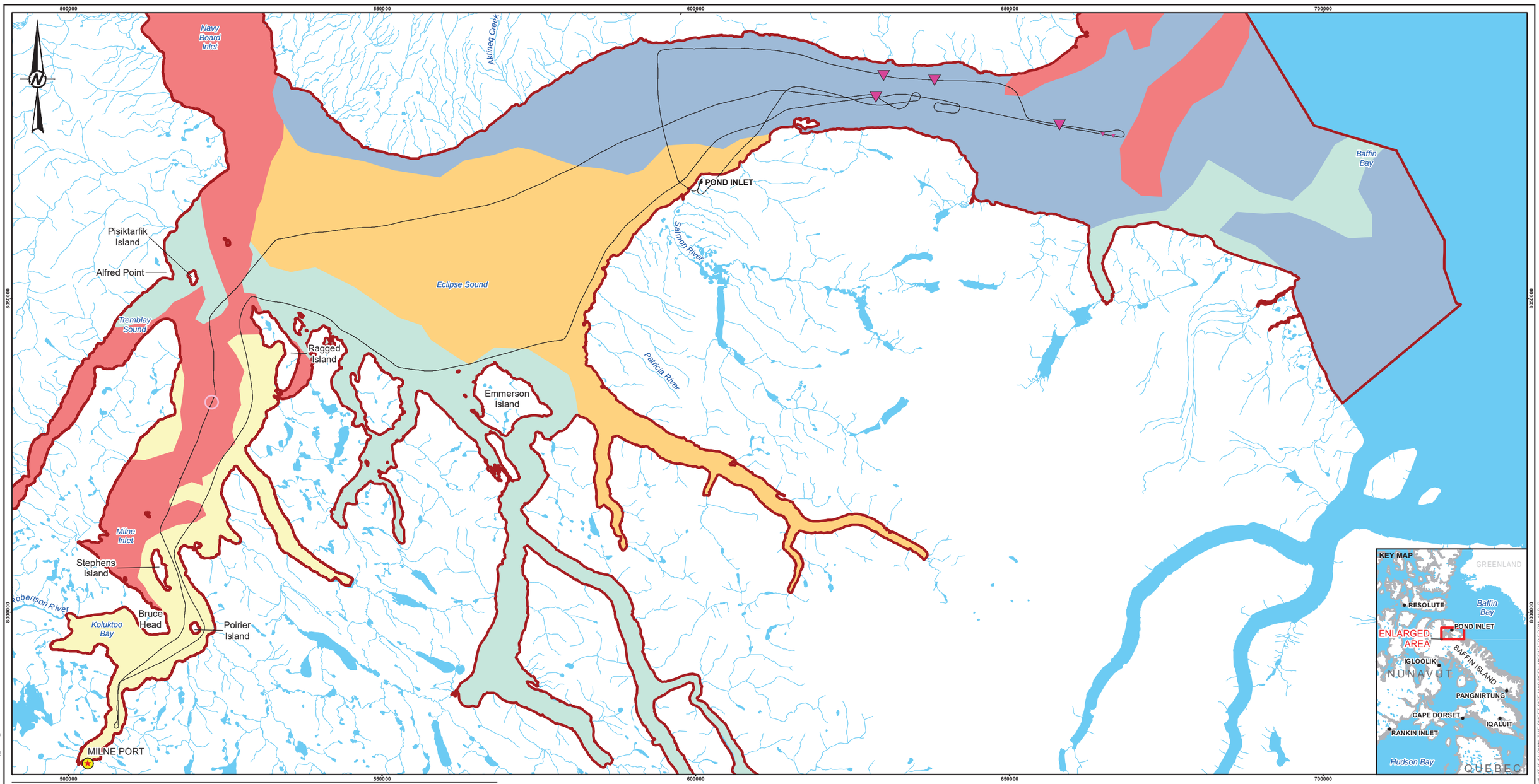
The first clearance survey was flown on 30 October, corresponding with the last icebreaker transit out of the RSA (while escorting a single ore carrier). At the time of the aerial survey, the icebreaker was located east of Pond Inlet transiting eastward toward Baffin Bay. Total aerial survey effort on 30 October consisted of 3 h and 19 min, covering 604.3 km (Figure 30). The aircraft flew the clearance survey at a speed of 100 knots and at an approximate altitude of 333 m (1,000 feet) along the full extent of the nominal shipping route from the entrance of the RSA to Milne Port. The aircraft then returned north tracking along the east shore of Milne Inlet, the south shores of Eclipse Sound West, Eclipse Sound East, and Pond Inlet returning to the entrance of the RSA. The

aircraft then returned westward following the south coast of Bylot Island to Sermilik Glacier, and then crossing southward across Eclipse Sound and returning to Pond Inlet (Figure 30). Historical entrapment areas in the RSA, including south of Bylot Island and north of Ragged Island, were covered during the survey. A total of six narwhal sightings comprising 14 individuals were recorded during the 30 October survey. All animals were located east of Pond Inlet and near the entrance to Baffin Bay, with all animals travelling eastbound at the time of sighting. The three most easterly sightings (n=7) were observed in the general vicinity of the icebreaker escort. One sighting of a potential narwhal footprint (depression left in water or thin ice following a dive) was also reported in Milne Inlet North between Athole Point and Eskimo Inlet. The aircraft circled over this area to confirm the sighting but no narwhal were observed.

The second clearance survey was flown on 31 October when all Project vessels were confirmed outside the RSA. Total aerial survey effort on 31 October consisted of 4 h and 32 min, covering 709 km (Figure 31). The aircraft flew the clearance survey at a speed of 100 knots and at an approximate altitude of 333 m (1,000 ft), transiting initially westward through central Eclipse Sound, then turning south in Milne Inlet North following the nominal shipping route to Milne Port. Upon arriving at Milne Port, the aircraft turned north to survey Koluktoo Bay, then transited eastward to the east side of Poirier Island before turning north and tracking along the eastern shore of Milne Inlet up to Ragged Island. The aircraft then crossed Milne Inlet and entered the north end of Tremblay Sound but had to abort this portion of the survey due to low cloud cover. The aircraft tracked back down the western shore of Milne Inlet to the south end of Stephens Island, returning north through central Milne Inlet following the nominal shipping to Eclipse Sound West, before proceeding into south Navy Board Inlet. Due to poor weather and low cloud cover in Navy Board Inlet, the plane turned back south into Eclipse sound and surveyed the areas north of Ragged Island and Curry Island before returning back to Pond Inlet via the south coast of Bylot Island (Figure 31). Historical entrapment areas in the RSA, including south of Bylot Island and north of Ragged Island, were covered during the survey.

No narwhal sightings were recorded during the 31 October survey. Two sightings of potential narwhal footprints were recorded, both in Eclipse Sound West, north of Ragged Island. The aircraft circled over this area repetitively to confirm the sighting but no narwhal were observed (Figure 31). Other marine mammals recorded on 31 October included eight sightings of unidentified seal species: three in western Eclipse Sound, four in central Milne Inlet near Stephens Island and one south of Ragged Island. There were also multiple holes observed in the sea ice in Milne Inlet that were consistent with breathing holes maintained by ringed seal (Figure 32).

Results of the end of season aerial clearance survey suggest that no entrapments occurred in 2019 as a result of icebreaking and Project shipping.



LEGEND

- POSSIBLE NARWHAL FOOTPRINTS

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

NARWHAL

- 1
- 2-9
- 10+

- COMMUNITY
- MILNE PORT
- CLEARANCE SURVEY AERIAL TRACK
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

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 SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. 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 - 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

TITLE
SURVEY EFFORT AND SIGHTING LOCATIONS - AERIAL CLEARANCE SURVEY (30 OCTOBER 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	A	30

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

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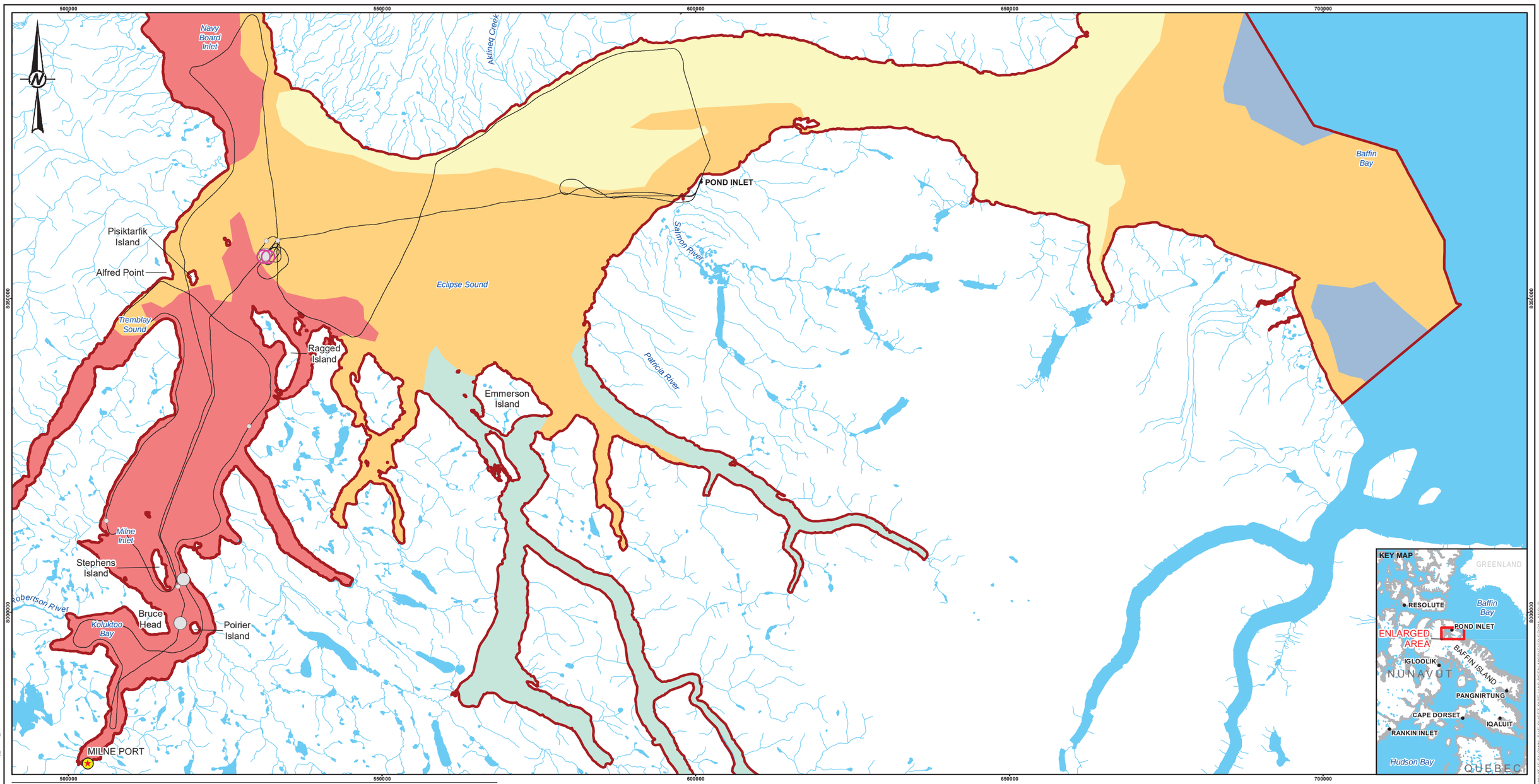

LEGEND

- NARWHAL FOOTPRINTS

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

UNIDENTIFIED SEAL

- 1
- 2-9

- COMMUNITY
- MILNE PORT
- CLEARANCE SURVEY AERIAL TRACK
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

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 SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. 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 - 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

TITLE
SURVEY EFFORT AND SIGHTING LOCATIONS - AERIAL CLEARANCE SURVEY (31 OCTOBER 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	31

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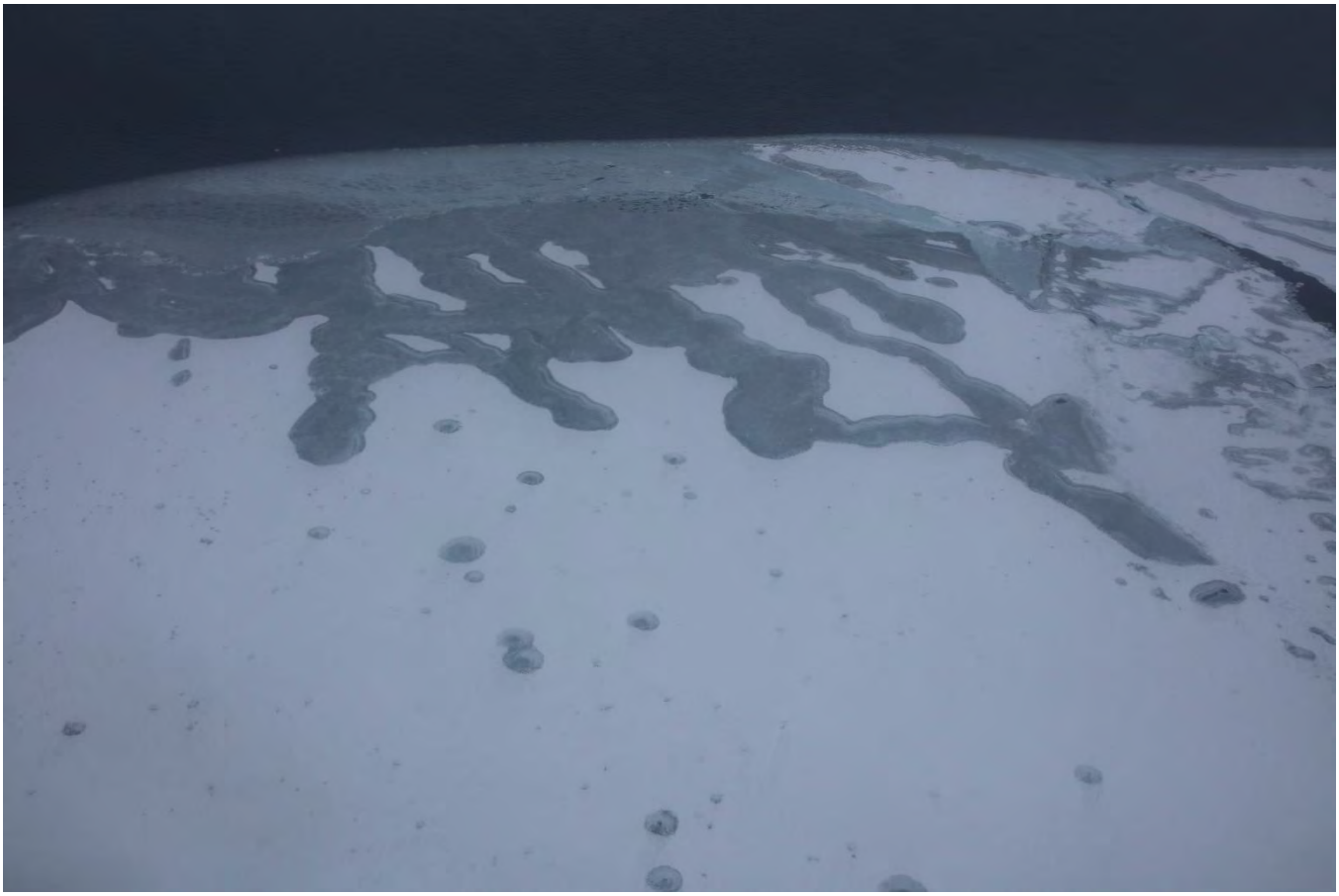


Figure 32: Ringed Seal Breathing Holes Observed in Sea Ice during Aerial Survey in Western Eclipse - 31 Oct 2019

2.2.5 MWO Program Feedback

Upon completion of the 2019 SBO Program, two of the four Inuit MWOs involved in the 2019 SBO Program participated in the end-of-program interview. The full list of questions along with responses provided by the interview participants are presented in Appendix D. Following is a summary of the feedback provided specific to this program.

When asked about which areas in the RSA are important to narwhal and other marine mammals, MWOs indicated that it depended on the season. MWOs indicated that in late spring, Navy Board Inlet and areas where there was still ice near the floe edge are important. It was noted that once the ice breaks up, narwhal can be seen throughout the RSA. In the summer, when the ice is gone in areas near Ragged Island, the waters near Bruce Head, Koluktoo Bay and Tremblay Sound were important feeding ground for narwhal mothers and calves. MWOs noted that in the fall, narwhal were typically scattered throughout the RSA, most commonly northeast of Ragged Island into Eclipse Sound.

When asked where the ice typically starts to form in Milne Inlet and Eclipse Sound, MWOs indicated that in Milne Inlet, ice freeze-up starts to occur near the mouth of the river near Milne Port and then expands outward. In Eclipse Sound, the ice initially forms in Navy Board Inlet and if waters remain calm in Eclipse Sound, water will

freeze the same throughout. When asked where the ice typically starts breaking up in Milne Inlet and Eclipse Sound during the early shoulder season, the MWOs indicated that ice break-up usually starts in the same area freeze-up occurs in Milne Inlet; near the outlet of Philipp's Creek at Milne Port, whereas in Eclipse Sound, ice break-up starts at the floe edge. The MWOs stated that marine wildlife generally began their in-migration into the RSA when ice break-up occurred at the floe edge east of Pond Inlet and at the top end of Navy Board Inlet.

The MWOs were asked whether marine mammals tended to swim toward or away from the icebreaker during active transits. The MWOs indicated that when the icebreaker is approaching and the whales are ahead, the animals swim away and once the ship has passed, the animals calm down though some still swim away. The MWOs also stated that some animals may be curious around the ship. The MWOs also indicated that they thought the icebreaker and other ships might scare narwhal away through use of their sonar. The MWOs did not notice narwhal swimming behind the ship's ice tracks in 2019.

The MWOs indicated that it was hard to tell whether marine mammals change their travel speed around ships. They noted that when the vessel was closer, marine mammals travel faster than when the vessel was further away, but that this response was variable and influenced by what behaviour the whales were engaged in prior to vessel exposure. When asked whether they noticed marine mammals coming close to the icebreaker or other ships relative to previous years, the MWOs indicated that this was not the case for the icebreaker but they have observed this around other Project vessels, such as ore carriers. Overall, it was suggested that marine mammals usually keep their distance from the icebreaker.

The MWOs indicated that the impacts of the icebreaker on marine mammal behaviour compared to ore carriers depended on whether there was ice or not and that if there was ice, they would say that the impacts are different, though it was difficult to confirm. The MWOs were not able to provide specific recommendations on how far the icebreaker should stay away from marine mammals on ice such as polar bear and seals, but indicated that they did not see many polar bears on ice during the shoulder season surveys. They also indicated that the effects seemed to be more related to vessel speed than the distance of approach.

The MWOs indicated that they recalled that in 2018 the icebreaker came close to a narwhal that dove under the bow of the ship. The MWOs indicated that seals move out of the way of the icebreaker and bowhead whale have not been observed near the icebreaker and when sighted, are normally off the sides of the ship and swim fast.

When asked if they saw anything unexpected during the 2019 SBO survey, the MWOs referred to the observation of a gyrfalcon that caught and ate a black-legged kittiwake on the helideck of the ship during the fall survey. MWOs also suggested that it was important to consider bowhead whales when evaluating impacts from shipping as bowhead were present in the RSA in the early summer.

3.0 SEABIRDS

Seabird monitoring methods are described in Section 3.1 with monitoring results presented in Section 3.2. Seabird surveys were completed in accordance with the CWS ECSAS survey protocol for moving platforms (Gjerdrum et al. 2012). The objective of the seabird monitoring surveys was to monitor for potential ship strikes on seabirds in the RSA, and to document the presence, relative abundance and distribution of seabird species in the RSA relevant to shipping operations. Similar to marine mammal surveying methods, 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 a format provided by CWS. Seabird sightings data were provided by Baffinland to the CWS for integration into a long-term seabird sightings database for the Arctic region. This data is used by the CWS to examine linkages between seabirds and marine habitats (OBIS 2019).

3.1 Survey Methods

For both Leg 1 and Leg 2 surveys, the Golder MWO lead served as the principal observer and primary data recorder for the seabird survey component of the 2019 SBO Program. Sightings data were collected from the bridge of MSV Botnica during dedicated survey periods that were scheduled intermittently throughout the day (lasting one to two hours each). The total daily watch period for seabirds was variable depending on sighting conditions, ranging from 0 to 6 h. Systematic data collection on marine wildlife sightings and environmental conditions were entered into an electronic database. Surveying was performed with the naked eye and using 10x42 and 7x50 binoculars. At the beginning of each watch period, a Global Positioning System (GPS) track file was initiated to record the path and speed of the survey vessel and to record sighting locations. Database entries underwent daily quality assurance and quality control procedures by the Golder MWO lead.

3.1.1 Surveys from Moving Platforms

An ECSAS bird survey consisted of a series of one minute “snapshot” counts of birds within an estimated 300 m perpendicular distance from the ship’s port side and extending forward of that perpendicular point an estimated 300 m thus defining the functional survey box. Given the ship’s typical travel speed of seven to nine knots (14 to 18 kilometres per hour [kph]), the ship travelled approximately 300 m in one minute thus defining the spatial extent of a survey box. A transect was defined as five, back-to-back, one-minute snapshots. ECSAS protocol suggests that each series of transects should be between one and two hours in duration (i.e., survey). The ECSAS protocol considered a survey to be applicable regardless of whether birds were present or not. The seabird surveys conducted during the SBO Summer surveys attempted to provide consistent coverage throughout the day. During the SBO Fall surveys, 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 protocol, bird surveys were best completed when the platform was travelling at a minimum speed of 4 knots (7.4 kph). Surveys could be done when the ship was travelling less than 4 knots, but birds are often attracted to slow moving or stationary vessels. If birds were clearly gathering around the vessel and settling on the water when the ship was moving slowly surveys were ceased. As vessel speeds were typically between seven and nine knots, the potential for making repeat sightings of individual birds was considered negligible.

During each five-minute observation period, a 300 m wide rectangular area of ocean from 270˚ to 0˚ was surveyed from the vessel's port side (Figure 33). All birds observed on the water surface were recorded throughout each five-minute period and their perpendicular distance from the observer estimated. ECSAS prescribed that counts be recorded in distance bins of 0 to 50 m, 51 to 100 m, 101 to 200 m, and 201 to 300 m.

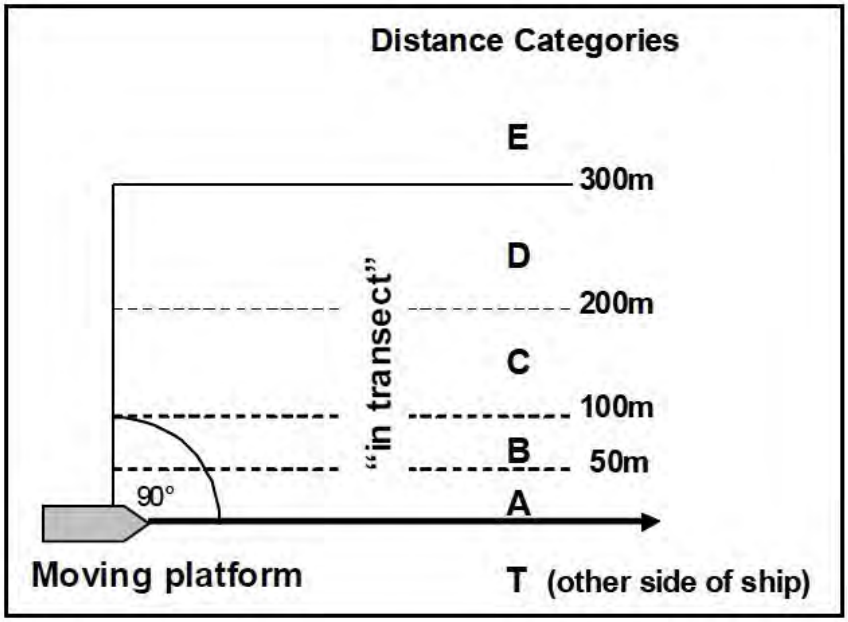


Figure 33: Moving Platform Sampling Area for Eastern Canada Seabirds at Sea Monitoring

3.1.1.1 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 (i.e., 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 18 kph), it would travel approximately 300 m in one minute (thus defining a survey box). According to ECSAS 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).

3.1.1.2 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 were recorded as in transect if the centre of the flock was within the 300 m transect.

3.1.2 Surveys from Stationary Platforms

No seabird surveys were performed while the MSV Botnica was stationary in 2019.

3.1.3 Data Analysis

3.1.3.1 Species Relative Abundance and Species Richness

Species relative abundance and species richness were calculated for both the early summer (Leg 1) and fall (Leg 2). Species abundance is the sum of all individuals observed per species per survey period. Species richness is the number of different species recorded during each survey period.

3.1.3.2 Species Density and Probability of Detection

Sightings data from a moving vessel are analogous to line-transect sampling and were used to estimate the density of seabirds. When distances to seabirds are recorded, the density estimate can be corrected for seabirds that are farther away from the ship and harder to detect (i.e., not observed or missed). This correction is employed through use of a distance-based detection function as outlined in Buckland et al. (2001). The analysis was focussed on estimating seabird density for 2019. Densities are presented without regard for environmental variables because preliminary review of data indicated that low sample sizes were going to be limiting (Buckland et al. 2001) and inclusion of additional model variables would decrease the precision of estimates.

Analysis of seabird data was performed using the Conventional Distance Sampling analysis engine of the Distance 7.3 software program (Thomas et. al. 2010). The initial step was to fit a detection distribution that corresponded to the sightings data. The hazard-rate, half-normal, and uniform key functions, all with cosine, simple polynomial, and hermite polynomial series expansions, were tested for fitting the data. The observation data were transformed into intervals for the fitting of the models. There was a possibility that seabirds actively avoid the ship during the moving platform surveys (e.g., birds may dive when they are close to the ship and resurface further from the ship where they are recorded by observers). To account for this, seabird observations from moving platform surveys that were recorded within 0 to 50 m and 51 to 100 m from observers were pooled together into one distance interval (i.e., 0 to 100 m) for the data analysis. Distance truncation of the data was performed to remove sightings past the survey area (i.e., 300 m perpendicular distance from observers), which served to remove outliers that would otherwise inflate density and abundance estimates (i.e., observation size-bias) as well as remove hard-to-fit portions of the dataset (e.g., obvious data heaping at certain distances).

The standard analysis method of transect surveys assumed that on average, over multiple replications of the survey, each point within the survey area had an equal likelihood of being sampled (uniform coverage probability). Because the locations of the transect lines were considered random with respect to the location of seabirds, the average density of seabirds was considered to be the same irrespective of distance from the transect line. Thus, any observed change in seabird sightings with increasing distance from the transect line was considered a change in the probability of detection, rather than a true change in bird density. The change in detection probability with respect to sighting distance from the transect line was measured to provide an estimate of the average probability of detection of a bird, which was, in turn, used to estimate the density of seabirds in the survey area. Sample size for modelling detection function should generally be at least 60 to 80 sightings, although for some purposes, as few as 40 sightings may be adequate (Buckland et al. 2001).

Models were selected using the minimum Akaike's Information Criterion (AIC) as well as consideration for fit near zero distance, where fit was most critical and not accounted for in AIC values (Buckland et. al. 2001). These detection functions assumed 100% detection on the trackline (g[0] = 1).

Observational data using distance analyses included on-transect sightings only. Re-sightings were not used for the estimation of any variables. When estimating detection functions and seabird densities data from both spring and fall survey period were combined so that adequate sample sizes could be obtained (Table 13). Sample size using combined spring and fall data was large enough to estimate species-level densities for northern fulmar only; all other species had inadequate sample size for this analysis.

Table 13: Seabird Sample Sizes Available for Density and Probability of Detection Analyses

Year	Sample Size for Calculating Detection Function and Density Estimates
2019 – All species	254[(a)]
2019 – Northern fulmar	82[(a)]

(a) Number of transects with species observed

3.2 Results

Only a cursory assessment of the seabird data recorded as part of the 2019 SBO Program is presented in this report. The complete 2019 seabird sightings database has been provided to CWS.

3.2.1 Species Relative Abundance

Total monitoring effort for seabirds in 2019 was 103.2 h (Leg 1 and 2 combined), consisting of 231 5-min surveys during Leg 1 and 1,008 5-min surveys during Leg 2. The discrepancy in the amount of effort between Legs 1 and 2 was due to a number of factors. Leg 2 survey duration was more than twice as long as Leg 1. There was an additional member on the observer team during Leg 2. This meant that more time could be spent on seabird observations. Less time was required during Leg 2 to liaise with vessel crew to coordinate survey planning and communicating mitigation requirements. A total of 11 species were identified during Leg 1 (157 confirmed sightings comprising 265 individuals), with northern fulmar and thick-billed murre being the most common species (Table 14; Figure 34). A total of nine species were identified during Leg 2 (97 sightings comprising 396 individuals), with glaucous gull and northern fulmar being the most common species (Table 14; Figure 35). Four ivory gulls, a federally *Endangered* species on Schedule 1 of the *Species at Risk Act* (SARA) (Government of Canada 2019), were observed during Leg 2; this species was not observed during the Leg 1 survey period, nor during either survey leg in 2018. Three of the ivory gull sightings occurred in western Eclipse Sound near Ragged Island while the fourth sighting occurred in eastern Eclipse Sound (Figure 35).

Table 14: Seabird Sightings Recorded during the 2019 Ship-based Observer Program

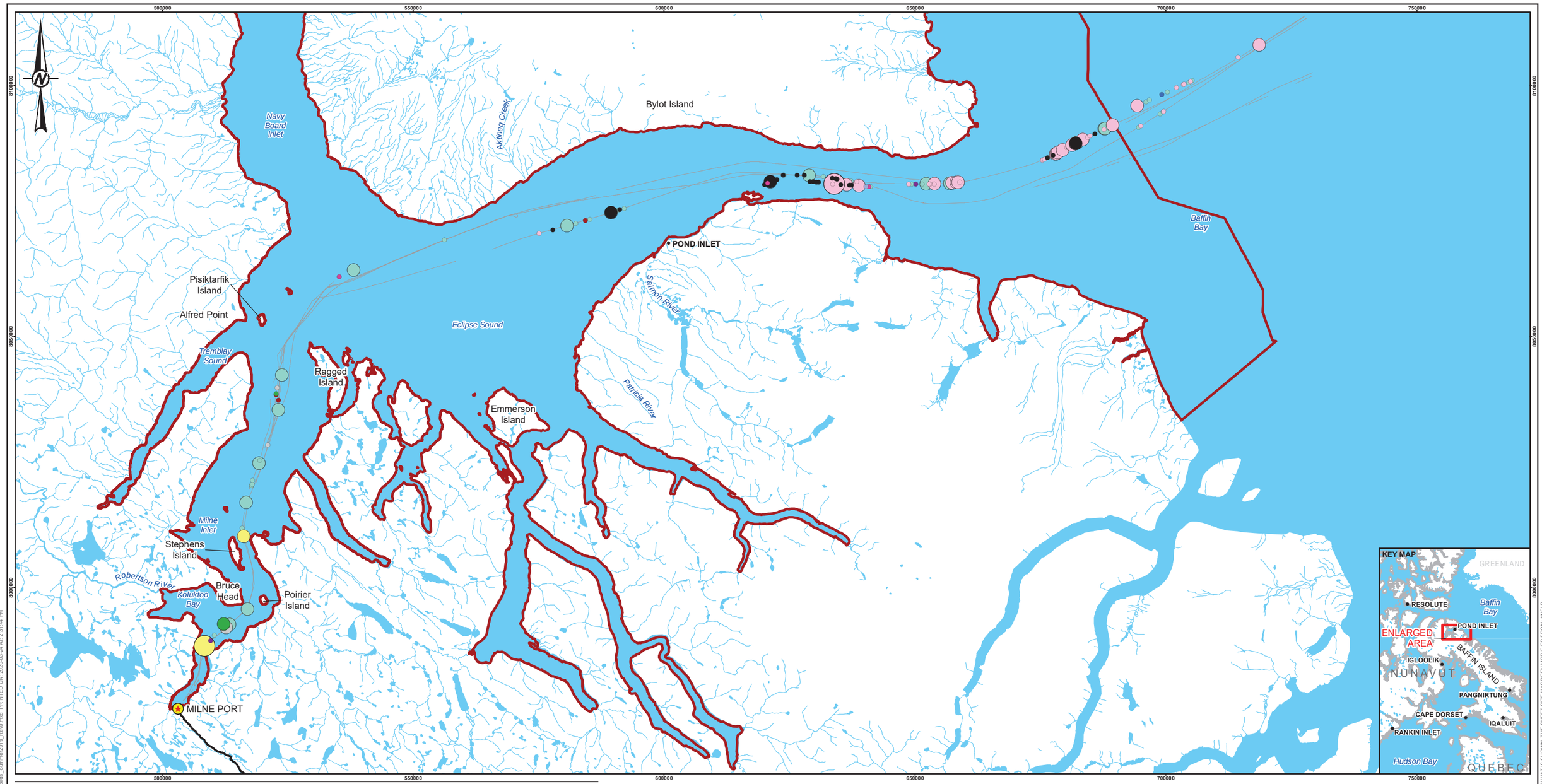
Common Name	Scientific Name	No. of Individuals	No. of Sightings	No. of Transects
Leg 1: Early Summer (21-29 July 2019)				
Arctic tern	*Sterna paradisaea*	1	1	1
Black guillemot	*Cepphus grille*	3	3	3
Black-legged kittiwake	*Rissa tridactyla*	33	26	26
Dovekie	*Alle alle*	1	1	1
Glaucous gull	*Larus hyperboreus*	6	4	4
Iceland gull	*Larus glaucoides*	2	2	2
King eider	*Somateria spectabilis*	27	2	2
Long-tailed jaeger	*Stercorarius longicaudus*	10	3	3
Northern fulmar	*Fulmarus glacialis*	87	61	61
Parasitic jaeger	*Stercorarius parasiticus*	3	3	3
Thick-billed murre	*Uria lomvia*	92	51	51
	Subtotal	*265*	*157*	*157*
Leg 2: Fall (6-28 October 2019)				
Black guillemot	*Cepphus grille*	17	16	10
Black-legged kittiwake	*Rissa tridactyla*	36	33	19
Glaucous gull	*Larus hyperboreus*	167	140	33
Iceland gull	*Larus glaucoides*	1	1	1
Ivory gull	***Pagophila eburnean***	**4**	**4**	**4**
King eider	*Somateria spectabilis*	8	3	1
Long-tailed duck	*Clangula hyemalis*	1	1	1
Northern fulmar	*Fulmarus glacialis*	162	141	26
Thick-billed murre	*Uria lomvia*	6	3	2
	Subtotal	*402*	*342*	*97*
	Total	**667**	**499**	**254**

Bolded species = federally-listed species (Schedule 1 Endangered, SARA 2019)

Comparison to 2018 SBO Program

A similar number of species were observed during Leg 1 (early summer) surveys in 2018 and Leg 1 surveys in 2019 (13 and 11 species, respectively). More species were recorded during Leg 2 in 2019 than during Leg 2 in 2018 (10 vs. 5 species, respectively). This is likely in the range of natural variation for presence and abundance of species between years. During the Leg 1 surveys, no new species were reported in 2019 relative to 2018. During the Leg 2 surveys, two new species were identified in 2019 that were not observed in 2018: ivory gull and long-tailed duck. More seabirds were observed during Leg 1 in 2019 than in 2018 (265 vs. 136 individuals, respectively). The opposite trend was observed for Leg 2, with more seabirds observed during Leg 2 in 2018 than in 2019 (719 vs. 661 individuals, respectively).

Glaucous gull and northern fulmar were the two most abundant species observed in 2018 and 2019. Black-legged kittiwake were much more commonly observed in 2018 than in 2019 (189 individuals in 2018 vs. 66 individuals in 2019). Thick-billed murre were more commonly observed during Leg 1 in 2019 compared to 2018 (92 individuals in 2019 vs. 11 individuals in 2018); however, the number of thick-billed murre recorded during Leg 2 was similarly low in both survey years (11 individuals in 2018 and 3 individuals in 2019).



LEGEND

- COMMUNITY
- MILNE PORT

SEABIRD SPECIES OBSERVATIONS (GROUP SIZE)

ARCTIC TERN
- 1

BLACK GUILLEMOT
- 1

BLACK-LEGGED KITTIWAKE
- 1
- 2 - 10

DOVEKIE
- 1

ICELAND GULL
- 1

GLAUCUS GULL
- 1
- 2 - 10

KING EIDER
- 2 - 10
- 10+

LONG-TAILED JAEGER
- 1
- 2 - 10

NORTHERN FULMAR
- 1
- 2 - 10

PARASITIC JAEGER
- 1

THICK-BILLED MURRE
- 1
- 2 - 10
- 10+

- MILNE INLET TOTE ROAD
- SURVEY TRACK (19-29 JULY 2019)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

0 25 50
1:750,000 KILOMETRES

REFERENCE(S)
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PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT
MARY RIVER PROJECT – 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
LOCATION OF SEABIRD SIGHTINGS DURING LEG 1 (19-29 JULY 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	34

PATH: I:\2016\1663724\Mapping\MXD\31000_SBO2019\1663724_31000_Fig34_SBO_Seabirds_Summer2019_Rev0.mxd PRINTED ON: 2020-03-24 AT: 2:31:44 PM

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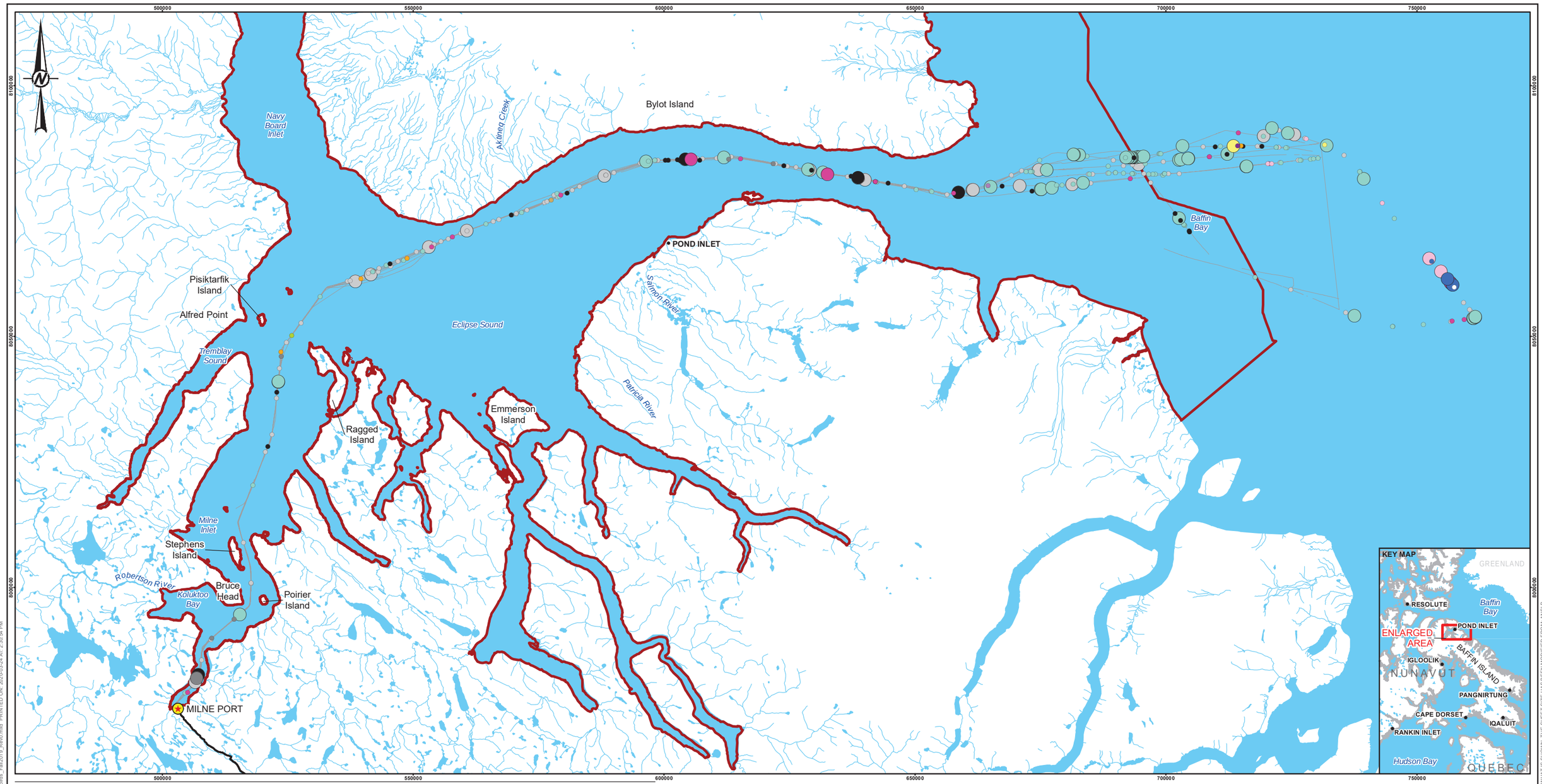

LEGEND

- COMMUNITY
- MILNE PORT

SEABIRD SPECIES OBSERVATIONS (GROUP SIZE)

BLACK GUILLEMOT
- 1
- 2 - 10

BLACK-LEGGED KITTIWAKE
- 1
- 2 - 10

COMMON RAVEN
- 1
- 2 - 10

DOVEKIE
- 1
- 2 - 10

GENUS: JAEGERS
- 1

GLAUCUS GULL
- 1
- 2 - 10

GYRFALCON
- 1

ICELAND GULL
- 1

IVORY GULL
- 1

KING EIDER
- 1
- 2 - 10

LONG-TAILED DUCK
- 1

NORTHERN FULMAR
- 1
- 2 - 10

SNOWY OWL
- 1

THICK-BILLED MURRE
- 1
- 2 - 10

- MILNE INLET TOTE ROAD
- SURVEY TRACK (5-28 OCTOBER 2019)
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

0 25 50
1:750,000 KILOMETRES

REFERENCE(S)
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	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT
MARY RIVER PROJECT – 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
LOCATION OF SEABIRD SIGHTINGS DURING LEG 2 (5-28 OCTOBER 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	35

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3.2.2 Density Estimates and Probability of Detection

For the initial step in determining density, the detection distribution with the best fit to the sightings data was determined. The uniform distribution model with a cosine expansion had the lowest AIC score. Having the lowest AIC score of all detection distributions evaluated meant it was the most appropriate analysis method to use. Based on this detection function, the overall probability of detecting seabirds during moving platform surveys in 2019 was estimated to be 1.00 (95% Confidence Interval [CI]: 1.00 to 1.00). This was similar to the detection probability calculated by Bolduc and Fifield (2017) while completing moving transect surveys in the Gulf of St. Lawrence and its estuary (i.e., a detection probability of 0.92). Overall, seabird density in the RSA during 2019 was 0.66 birds/km^2 (95% CI: 0.45 to 0.96) (Table 15).

Species-specific density estimates were only generated for northern fulmar (Table 15) as this was the only species with an adequate sample size for analysis (Buckland et al. 2001). The half-normal model with a cosine expansion had the lowest AIC score for northern fulmar. Based on this detection function, the overall probability of detecting northern fulmars in 2019 was estimated to be 0.55 (95% CI: 0.38 to 0.79). The density estimate for northern fulmar in 2019 was 0.99 birds/km^2 (95% CI: 0.52 to 1.87) (Table 15).

Table 15: Density Estimates and 95% Confidence Intervals for 2019 Seabird Surveys in the RSA

Species	Model, AIC Score	Sample Size (number of transects with species observations)	Density Estimate (individuals/km^2)	95% Confidence Interval (individuals/km^2)
All seabirds	Uniform, 469.97	254	0.66	0.45 to 0.96
Northern fulmar	Half-normal, 188.18	87	0.99	0.52 to 1.87

km^2 = square kilometres; AIC = Akaike's Information Criteria.

3.2.3 Ship Strike Events

A single seabird strike was recorded during the 2019 SBO Program (Leg 2). At 22:00 on 11 October, the bridge officer observed a long-tailed duck (*Clangula hyemalis*) fly into the superstructure (support post) beneath the ship's helideck. The strike occurred in eastern Eclipse Sound near Pond Inlet (72 50.1 N, 78 00.1 W) while the vessel was holding station (stationary) for the night. Conditions at the time were low visibility (dark, heavy snow), low wind and calm sea state. The specimen was a definitive basic (adult winter plumage) male (Figure 36). The specimen suffered a broken neck and died shortly thereafter. The bird strike event was reported to Baffinland's Environmental Coordinator on 12 October 2019. No other seabird strikes were recorded in 2019.

Figure 36: Long-tailed duck mortality following collision with vessel on 11 October 2019

4.0 SUMMARY

The 2019 SBO Program was conducted onboard the icebreaker MSV Botnica during the early summer (Leg 1: 19–29 July) and fall shoulder seasons (Leg 2: 5-28 October) of 2019. The SBO Program was designed to meet Conditions No. 106, 108, 121, 122, 123 and 126 of Project Certificate No. 005. The primary objective of the SBO Program was to monitor for potential ship strikes (and near misses) on marine mammals and seabirds in the Regional Study Area (RSA). The secondary objective of the SBO program was to collect data on the presence, relative abundance and distribution of marine mammals and seabirds within the boundaries of the RSA.

Data collection methodology for the 2019 SBO Program was similar to the 2018 SBO Program with slight adjustments in protocol to address recommendations provided by the MEWG. In addition to marine mammal observations, seabird sightings were recorded using the Canadian Wildlife Service's (CWS) Eastern Canada Seabirds at Sea (ECSAS) survey protocol. Marine mammal sightings were recorded over a daily monitoring period extending up to 16 h on Leg 1 (early summer) and up to 10 h on Leg 2 (fall) depending on available daylight hours. Seabird sightings were recorded during dedicated seabird surveys conducted periodically throughout the day (lasting one to two hours each). The total daily watch period for seabirds was variable depending on sighting conditions, ranging from 0 to 6 h.

Marine Mammals

Total monitoring effort for marine mammals consisted of 268.7 h covering 3,089 km (Leg 1 and 2 combined). Total monitoring effort during Leg 1 was 100.4 h covering 1,119 km. Total monitoring effort during Leg 2 was 168.3 h covering 1,970 km. Although there were nearly twice as many observation days in Leg 2 compared to Leg 1 (24 vs. 11 days), this was not reflected in overall survey effort given the longer daylight hours during Leg 1 (mean daily effort= 11 h) compared to Leg 2 (mean daily effort = 7 h).

Seven different species of marine mammals were observed during the 2019 SBO Program: narwhal, beluga whale, bowhead whale, ringed seal, harp seal, bearded seal and polar bear. A total of 304 marine mammal sightings comprising 2,785 individuals were recorded. Killer whale and walrus were not recorded in the RSA during either survey leg in 2019; however both species are known to occur in the region.

The relative abundance of marine mammals in the RSA, expressed as the animal detection rate (no. of animals relative to survey effort in km), was 0.90 animals/km (0.10 sightings per km). More animals were observed during Leg 1 (2.19 animals/km) than during Leg 2 (0.17 animals/km). All marine mammal species, including narwhal, occurred in higher relative abundance in the RSA in Leg 1 than in Leg 2.

The relative abundance of marine mammals in the RSA was similar in 2019 (0.90 individuals per km) to that reported in 2018 (0.88 individuals per km). Species observed in greater relative abundance in 2019 than 2018 included narwhal, beluga, and bowhead whale. For these species, the increase was reflective of more animals observed during Leg 1 (similar numbers were seen during Leg 2 in both years). Less ringed seal and harp seal were observed in 2019 compared to 2018, although this was likely associated with the large number of unconfirmed seal species recorded in 2019 (n=1,225) compared to 2018 (n=760). When considering all seal categories (confirmed and unconfirmed species), a similar number of seals was observed in both years.

The observed increase in narwhal relative abundance in 2019 may be reflective of abnormally low numbers of narwhal in the RSA in 2018, as reported by community members and as supported by low catch rates that year. Hunters found the opposite to be true in 2019 when narwhal were regularly observed throughout the RSA and in large groups. The increase in relative abundance observed in 2019 may have also been a result of new adaptive

management measures implemented during the early 2019 shoulder season to specifically reduce icebreaker noise impacts on narwhal, such as the 40 km floe edge buffer zone and a reduced number of icebreaker transits per day in the RSA in heavy ice conditions.

Aerial clearance surveys were flown in the RSA at the end of the shipping season on 30-31 October 2019 to monitor the shipping corridor and adjacent areas for potential narwhal entrapment events following the completion of Baffinland's 2019 shipping operations in the RSA. A total of six narwhal sightings comprising 14 individuals were recorded during the 30 October survey. All animals were located east of Pond Inlet and near the entrance to Baffin Bay, with all animals travelling eastbound at the time of sighting. No narwhal sightings were recorded during the 31 October survey. Results of the end of season aerial clearance survey suggest that no entrapments occurred in 2019 as a result of Project icebreaking and shipping activities in the RSA. Given ice conditions during the two surveys (consisting of many areas free of ice), the location of confirmed narwhal observations (east of Pond Inlet traveling east) and input from community members participating in the clearance aerial surveys, concern regarding the risk of entrapment of animals was low.

Similar to previous years, no ship strikes on marine mammals (or near misses) were recorded during the active monitoring periods on the MSV Botnica during 2019. Overall, the distances maintained by marine mammals from the survey vessel in 2019 (i.e., CPA results) lend confidence to existing environmental assessment predictions, in that marine mammals in the RSA are likely to demonstrate localized avoidance of Project vessels, and that vessel strikes on marine mammals are unlikely to occur based on current vessel speeds in the RSA (9 knot speed restriction).

Collectively, the 2019 SBO monitoring results support the impact predictions and significance determination in the FEIS Addendum for the Early Revenue Phase (ERP) in that the Project is unlikely to result in significant residual adverse effects on marine mammals in the RSA, defined as effects that compromise the integrity of marine mammal populations in the region either through mortality (i.e., ship strikes) or via large-scale displacement or abandonment of the RSA.

Continuation of the SBO Program is recommended for 2020 in accordance with NIRB Project Certificate No. 005 Terms and Conditions. Ongoing annual monitoring will allow for additional data comparison between monitoring years, which will serve to identify whether any additional adaptive management measures during the shoulder seasons are required.

Seabirds

Total monitoring effort for seabirds in 2019 was 103.2 h (Leg 1 and 2 combined), consisting of 231 5-min surveys during Leg 1 and 1,008 5-min surveys during Leg 2. A total of eleven species were identified during Leg 1 (157 confirmed sightings comprising 265 individuals), with fulmar and thick-billed murre being the most common species. A total of nine species were identified during Leg 2 (97 sightings comprising 396 individuals), with glaucous gull and northern fulmar being the most common species. Four ivory gulls, a federally *Endangered* species on Schedule 1 of the *Species at Risk Act* (SARA) (Government of Canada 2019), were observed during Leg 2; this species was not observed during the Leg 1 survey period, nor during either survey leg in 2018.

A similar number of species were observed during Leg 1 (early summer) surveys in 2018 and Leg 1 surveys in 2019 (13 and 11 species, respectively). More species were recorded during Leg 2 in 2019 than during Leg 2 in 2018 (9 vs. 5 species, respectively). This is likely in the range of natural variation for presence and abundance of species between years. During the Leg 1 surveys, no new species were reported in 2019 relative to 2018. During the Leg 2 surveys, two new species were identified in 2019 that were not observed in 2018: ivory gull and long-

tailed duck. More seabirds were observed during Leg 1 in 2019 than in 2018 (265 vs. 136 individuals, respectively). The opposite trend was observed for Leg 2, with more seabirds observed during Leg 2 in 2018 than in 2019 (719 vs. 661 individuals, respectively).

The overall probability of detecting seabirds during moving platform surveys in 2019 was estimated to be 1.00 (95% Confidence Interval [CI]: 1.00 to 1.00). This was similar to the detection probability calculated by Bolduc and Fifield (2017) while completing moving transect surveys in the Gulf of St. Lawrence. Overall, seabird density in the RSA during 2019 was 0.66 birds/km^2 (95% CI: 0.45 to 0.96). Species-specific density estimates were only generated for northern fulmar as this was the only species with an adequate sample size for analysis (Buckland et al. 2001). Density estimates were not completed for other seabird species as the low sample sizes for these species would have yielded inaccurate results (Buckland et al. 2001). The probability of detection for northern fulmar in 2019 was estimated to be 0.55 (95% CI: 0.38 to 0.79). The density estimate for northern fulmar in 2019 was 0.99 birds/km^2 (95% CI: 0.52 to 1.87).

A single seabird strike was recorded during the 2019 SBO Program (Leg 2). At 22:00 on 11 October, the bridge officer observed a long-tailed duck fly into the superstructure (support post) beneath the ship's helideck. The strike occurred in eastern Eclipse Sound near Pond Inlet (72 50.1 N, 78 00.1 W) while the vessel was holding station (stationary) for the night. Conditions at the time were low visibility (dark, heavy snow), low wind and calm sea state. The specimen was a definitive basic (adult winter plumage) male. The specimen suffered a broken neck and died shortly thereafter. The bird strike event was reported to Baffinland's Environmental Coordinator on 12 October 2019. No other seabird strikes were recorded in 2019.

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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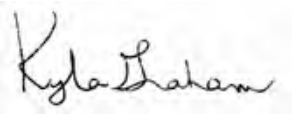

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APPENDIX A

SBO Training Manual

GOLDER

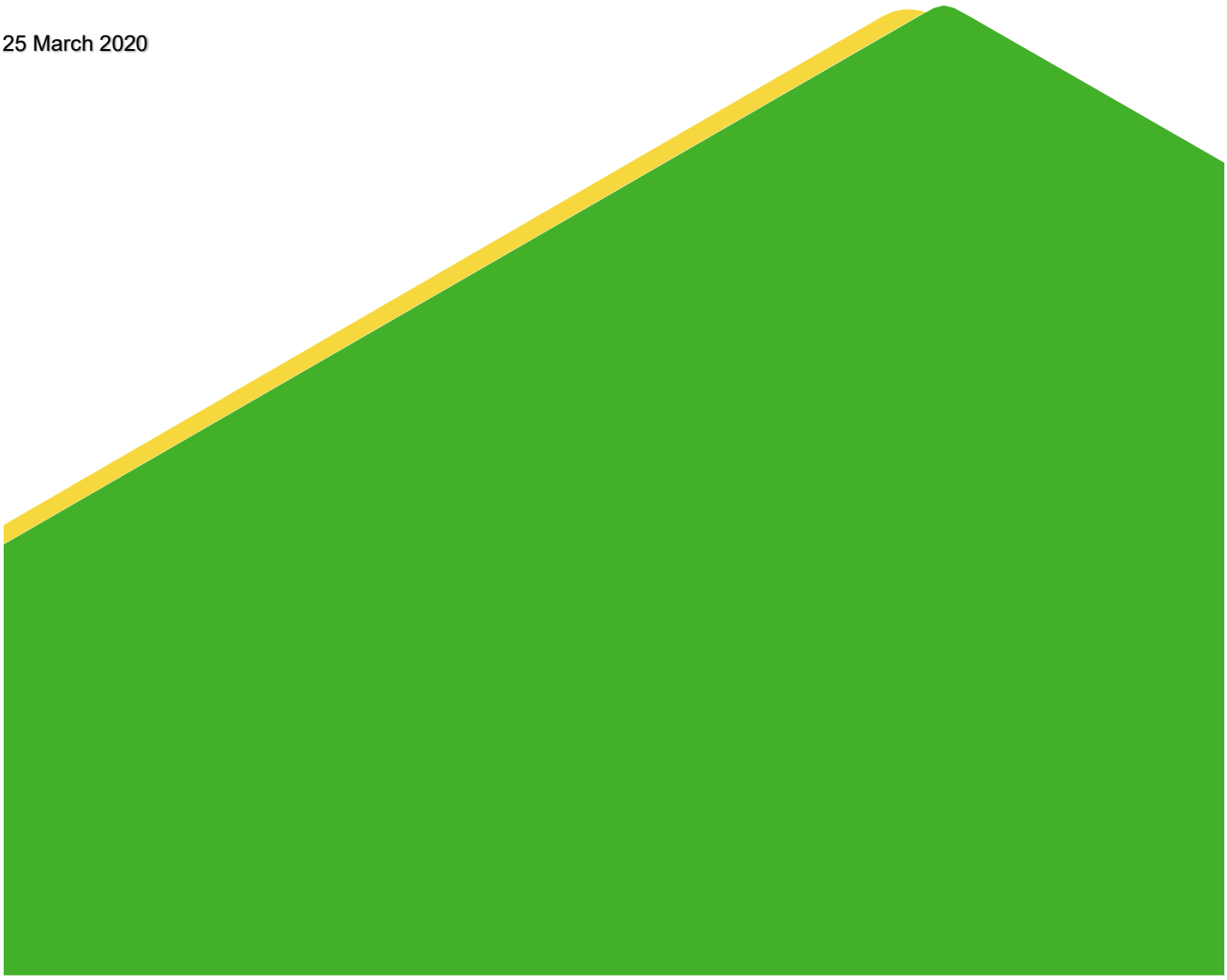
REPORT

2019 Ship-Based Observer Program

Training Manual

1663724-158-R-RevC

25 March 2020



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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 Mammals component of the Marine Monitoring Plan (MMP), 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.

An 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 several 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 certificate
- 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
- 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

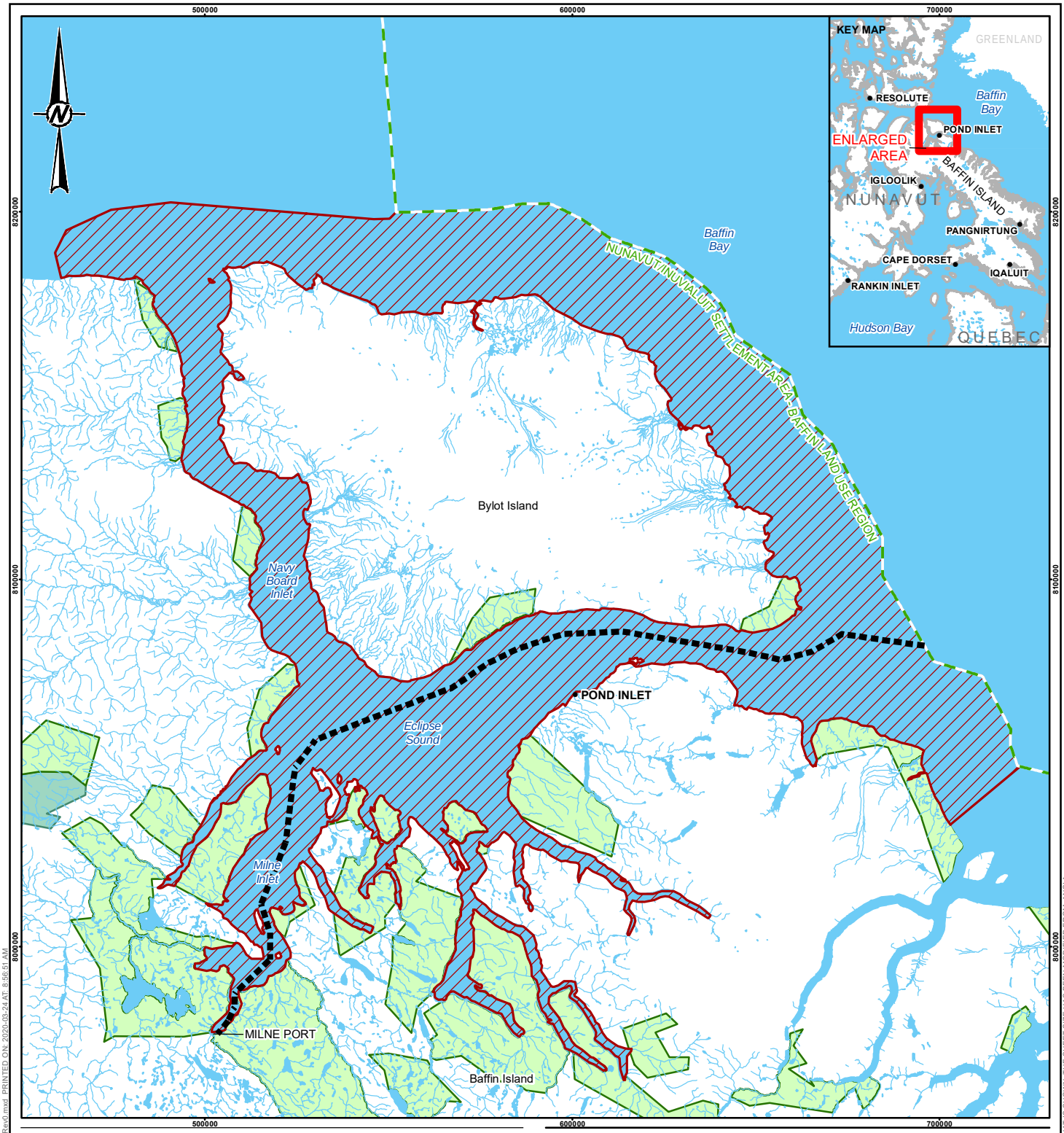
The MSV *Botnica* is a multipurpose offshore support vessel and icebreaker built by Finnyards in Rauma, Finland, in 1998 (Figure 1). The vessel was the newest and technically most advanced state-owned icebreaker of Finland until 2012, when it was sold to the Port of Tallinn (Estonia). The *Botnica* is 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
- 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 – 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
MARINE MAMMAL REGIONAL STUDY AREA

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

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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 document 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 observe for marine mammals and seabirds. It is recommended that if you are unsure about whether 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 a 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 on watch will take a break and the next MWO will start his/her watch shift. One MWO will be on watch at a time with one of the other three MWOs rotating in every two hours while the rest are on breaks. At times when there are many sightings or MWOs are feeling fatigued and unable to observe and collect data accurately then two MWOs will conduct watches together. 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	MWO 3	
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	7:30 Breakfast
08:00-08:30	08:00-08:30	8:00 Breakfast	Watch 1		Data Review Seabird Survey 2
08:30-09:00	08:30-09:00		Watch 1		
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 1	Data Review
10:30-11:00	10:30-11:00			Watch 1	
11:00-11:30	11:00-11:30			Watch 1	
11:30-12:00	11:30-12:00	11:30 Lunch	11:30 Lunch	Watch 1	11:30 Lunch
12:00-12:30	12:00-12:30	Watch 2		12:00 Lunch	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 2		Data Review Sea Bird Survey 4
14:30-15:00	2:30-3:00		Watch 2		
15:00-15:30	3:00-3:30		Watch 2		
15:30-16:00	3:30-4:00		Watch 2		
16:00-16:30	4:00-4:30			Watch 2	Data Review Seabird Survey 5
16:30-17:00	4:30-5:00			Watch 2	
17:00-17:30	5:00-5:30			Watch 2	5:00 Dinner
17:30-18:00	5:30-6:00	5:30 Dinner	5:30 Dinner	Watch 2	
18:00-18:30	6:00-6:30	Watch 3		6:00 Dinner	Data Review
18:30-19:00	6:30-7:00	Watch 3			
19:00-19:30	7:00-7:30	Watch 3			
19:30-20:00	7:30-8:00	Watch 3			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 area 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 consist 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.

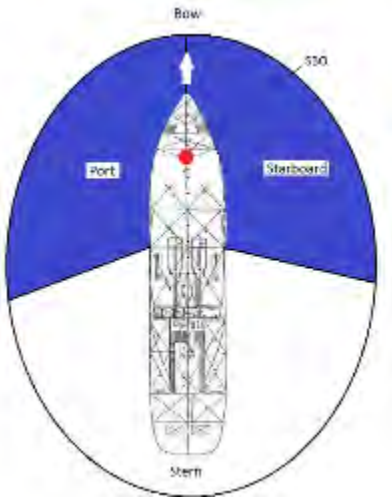


Figure 3: MWO location (one MWO) and Field of Observation when Vessel is Moving

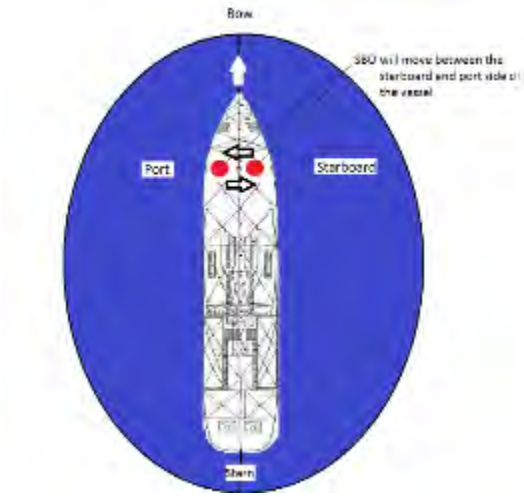


Figure 4: MWO location (one MWO) and Field of Observation when Vessel is Stationary

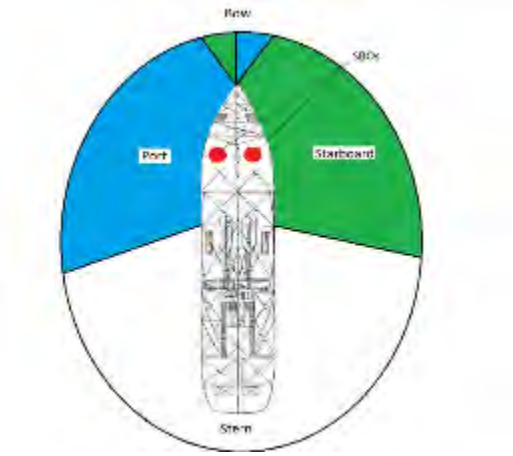


Figure 5: MWO locations (two MWOs) and Field of Observation when Vessel is Moving

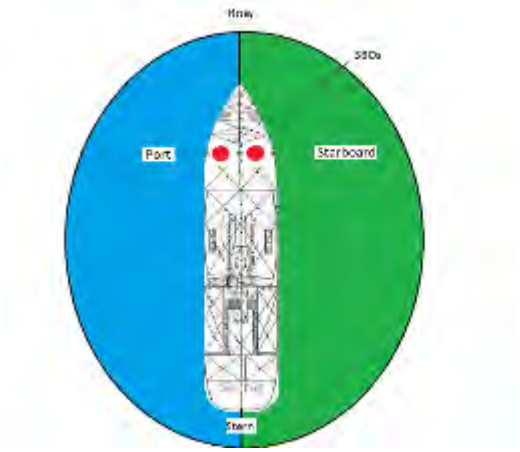


Figure 6: MWO location (two MWOs) and Field of Observation when Vessel is Stationary

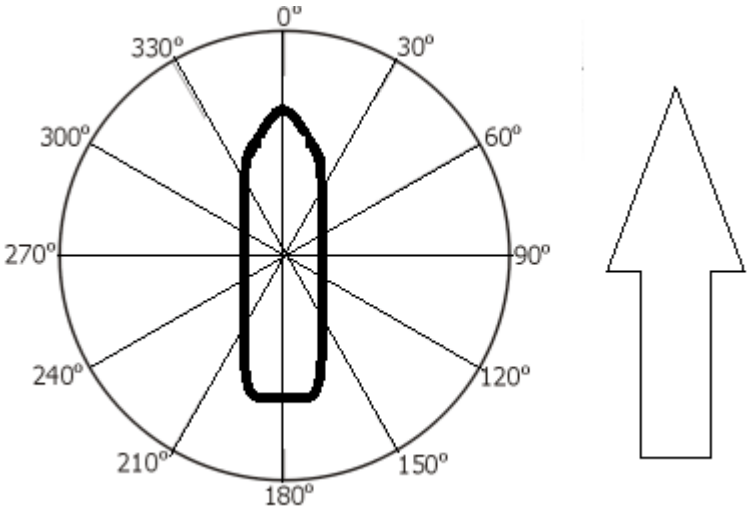


Figure 7: Degrees in Relation to the Vessel

5.3 Equipment

Binoculars

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

Three types of binoculars are to be used:

- 7x50 reticle binoculars (typically used when estimating distances)
- 8x42 and 10x42 (for higher magnification of marine mammal observations, i.e. for identification purposes)

It is suggested to regularly clean the binocular eye pieces with an alcohol based antiseptic cloth when sharing binoculars with other individuals. This prevents the spread of eye infections which are usually highly contagious. Don't use the antiseptic cloth to clean lenses. If the binoculars 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.

8x42 Binoculars

8 and 10x42 binoculars will also be used. They will have slightly greater magnification to use for identification.

Laptop with Access Database

Data will be entered on a laptop computer using the *MS Access*© 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 database is discussed in more detail below.

Bad Elf GPS

The Bad Elf GPS will be used to track the vessel during marine mammal surveys and record waypoints when:

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

The GPS's should be turned on at the start of the first watch. To turn on the GPS hold the "ON" button located on the top left of the device. It may take a few minutes for the device to acquire satellites. The GPS's have built in antennae to acquire a signal.

The GPS being used for the marine mammal survey data should be set to log GPS track data continuously. To turn on logging, press and hold the GPS button for 3 seconds and when it has started logging the LCD display will show a blinking icon along the bottom of the display. The MWO should check the GPS regularly during his/her shift to ensure that it has not lost signal and is working properly.

****IMPORTANT****

- Make sure to download the GPS tracks daily so we don't lose data when the GPS starts writing over older tracks.
- Every time you turn the GPS on and off again make sure to RESTART LOGGING.

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 higher magnification binoculars for sightings at far distances. It can be more difficult to focus binoculars with higher magnification in rough sea conditions.
- Be ready to observe the next sighting; 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).

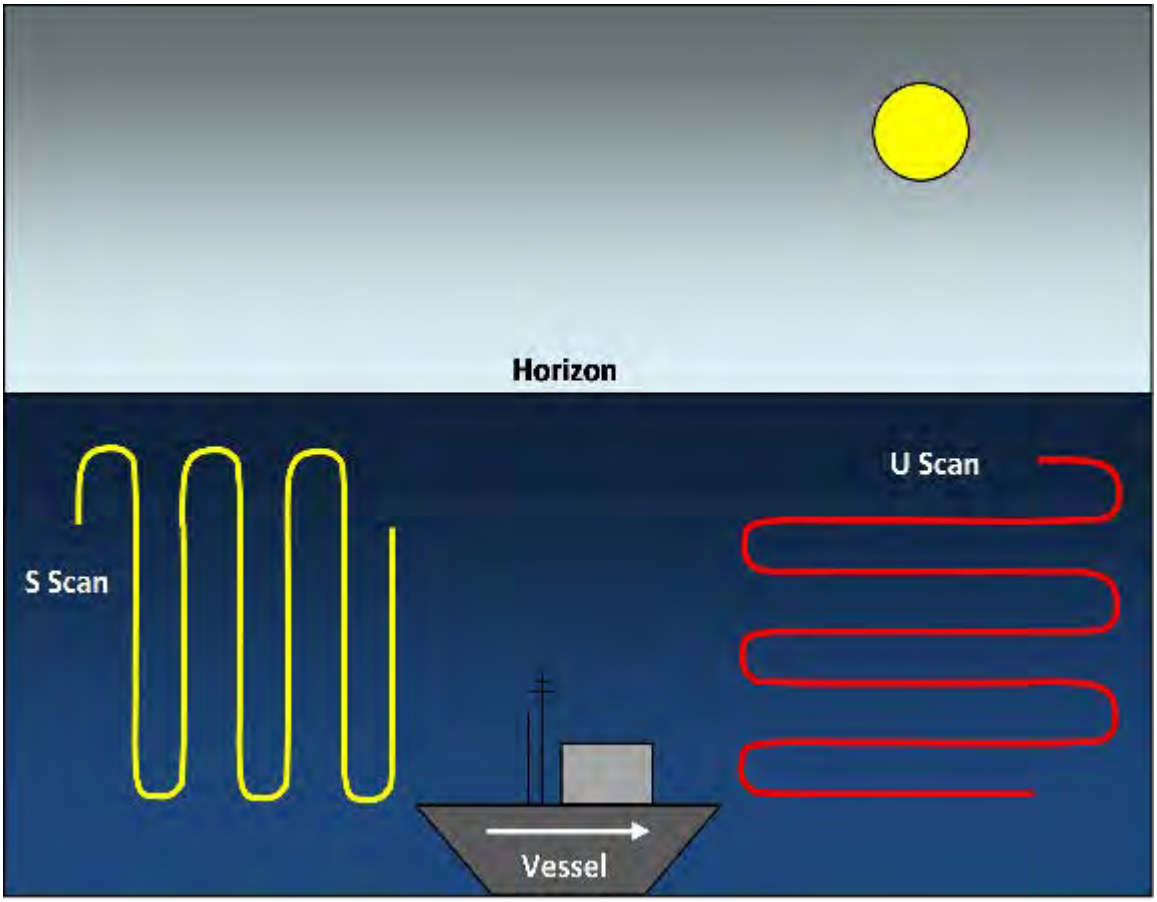


Figure 8: S and U Scanning Techniques to be used during Marine Mammal Observing

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 and can see the horizon, use the reticle binoculars.

Calculating Distance Using Reticle Binoculars

Reticle 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 Metres 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
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.

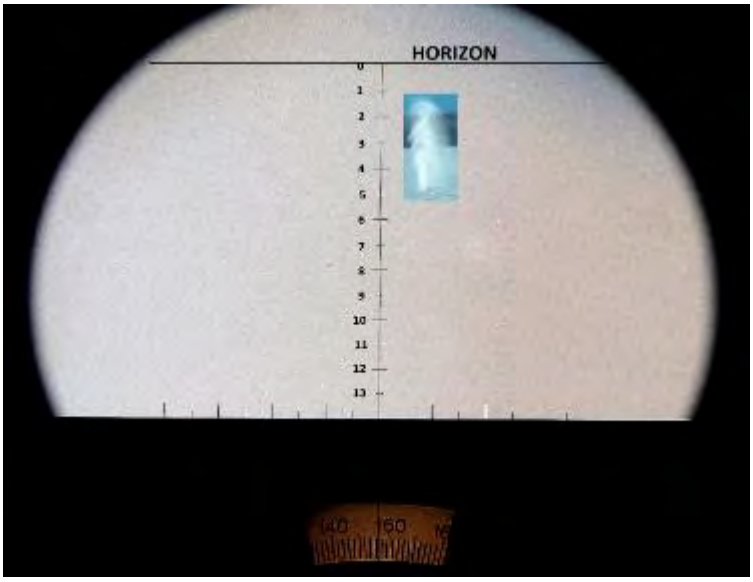


Figure 9: Calculate the Distance to the Marine Mammal

5.6 Detection Cues

Marine mammals spend most of their time underwater, therefore, MWOs can only spot them when they are at the surface which in most instances is for a very short amount 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 occur when a marine mammal has just been on or near the surface of the water the surface and the surface looks disturbed and different from the surrounding water (see Figure 11).

Figure 11: Footprint from Marine Mammal

Birds

Birds may be attracted to marine mammals 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 requiring them to surface between dives, even if 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)

Toothed whales have only one single blow hole and, because they are smaller animals than the baleen whales we might observe, e.g. 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 (bowhead whales)

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

Figure 13: Baleen whale blow (left) versus toothed whale blow (right)

5.7 Species Identification

Identifying the species of a 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 than 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 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 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
- beluga whale
- killer whale
- bowhead whale
- ringed seal
- harp seal
- bearded seal
- walrus
- polar bear

Here are some helpful hints to distinguish between the common marine mammals you will likely 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?

Here are some quick tips:

- 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 body then it is likely a **beluga whale**.
- If it is smaller with a lower bushy blow and a dark body, then it is likely a **narwhal.**
- If it is smaller with a lower bushy blow and a large dorsal fin, then it is likely a **killer whale.**

Narwhal

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 noticeably 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 Whale

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 a 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 Whale

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.

Bowhead Whale

The Bowhead has a 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 can break 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 Seal

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 moult in June and July when they haul-out on the sea ice.

Harp Seal

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 spots. Adult have robust bodies and small heads with broad flat narrow snouts. They have light gray coats with black faces and a black saddle patch. Younger individuals 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 Seal

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 stockier and more robust than other seals. Adults are gray or dark brown with some spots or rings visible. Pups are also brown to bluish. Bearded seals are generally associated with drifting sea ice in shallow-water areas. They are more commonly observed alone, however, aggregations may occur when drifting sea ice becomes concentrated. During the months of April to August bearded seals will spend more time hauled out for molting.

Walrus

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 moult and rest.

5.7.3 Polar Bear

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 onto 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. A whale can dive with or without lifting its fluke.

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

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

[a] Tail

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.

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.

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

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-medium Swimming – When a marine mammal is swimming at a normal or slow pace. Definite heading, barely visible trail or small amount of white water.

5.9 Other Important Information to Record

Re-sightings – It is important not to double count marine mammal sightings. If you see the same animal or group of marine mammals 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 bearing from bow. Figure 14 shows how to estimate the bearing from bow for a whale sighting.

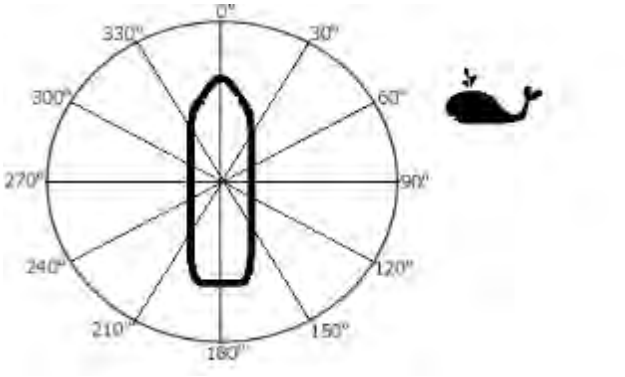


Figure 14: The Whale Sighting is Observed at Approximately 70 degrees

5.10 Environmental Variables

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

- Ice Cover
- Wind Force
- Wind Direction
- Beaufort 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 information. 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 as a percentage cover in the immediate vicinity of the vessel (within 100 m, Near Field Ice Cover) and a percentage cover of your field of view (Far Field Ice Cover) and Please note any additional comments you may have about the ice in the notes section of the database.

Wind Force

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.

Beaufort 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).

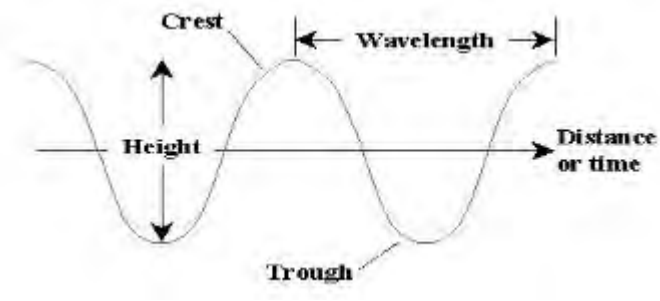
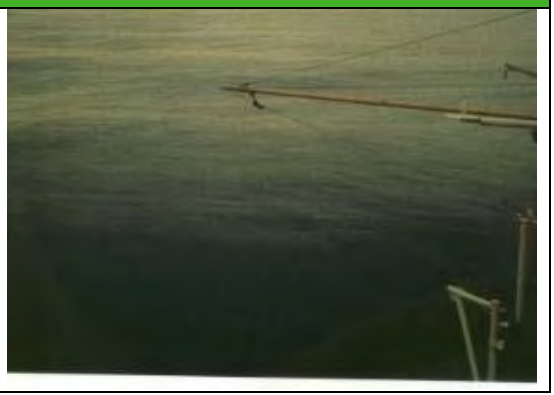
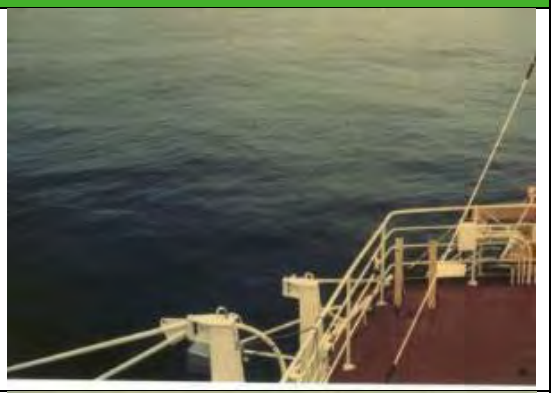
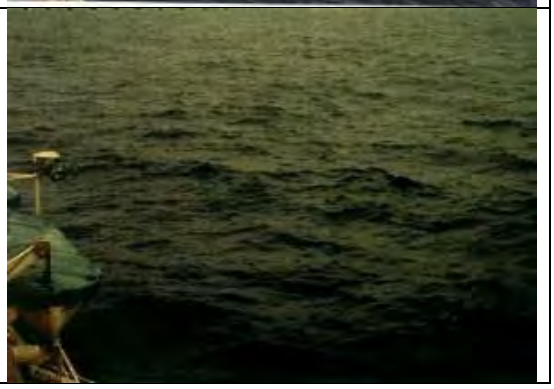


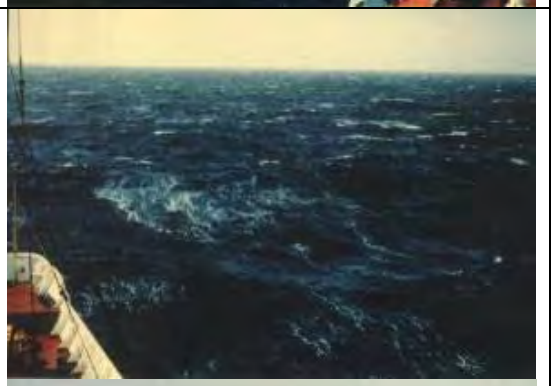
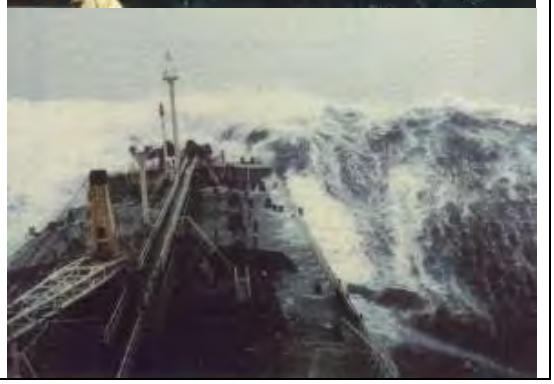
Figure 15: Wave Characteristics

Beaufort 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 Beaufort 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 Beaufort Sea State scale **does not** quite match the Beaufort Wind Force scale.

Table 4: Beaufort Sea State 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	

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

Wave Height (m)	Sea State	Description	Beaufort Wind Force	Picture of Sea Condition
1.2 - 2.4	4	Moderate waves, some spray	5	
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 can see from the vessel. In the database your options are >10,000 m which would be considered excellent visibility down to 500 to 1000 m which is considered poor or low visibility.

Sightability

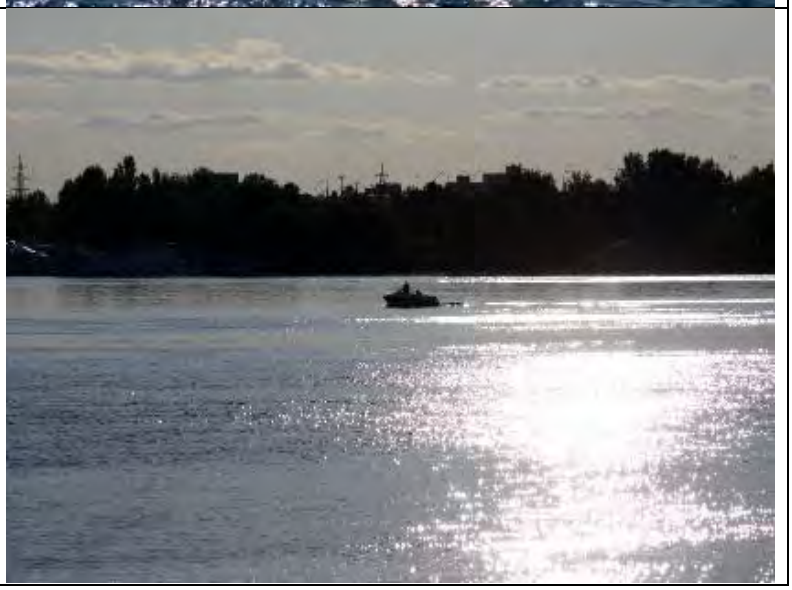
Sightability is based on several environmental variables (weather, glare, sea state etc.). This factor plays a major role in your ability to spot and accurately identify marine mammals, particularly at a distance. Sightability can be Poor, Low, Medium, High and Very High.

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	

Sun Glare Description	Picture of Description
Weak Glare	
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 watch will fill out the following fields (Red circles highlight these fields in Figure 16):

- Select Survey name, e.g., Summer 2019 or Fall 2019.
- Select date from the drop down menu. Keep in mind the database uses UTC time and with daylight savings time UTC time is four hours ahead of Nunavut time so, for example, 4 pm Nunavut 8 pm UTC.
- Set start time. Ensure the Bad Elf GPS is logging tracks continuously. If you’re using a Garmin GPS (backup GPS) take a starting waypoint and enter the waypoint number in the database.

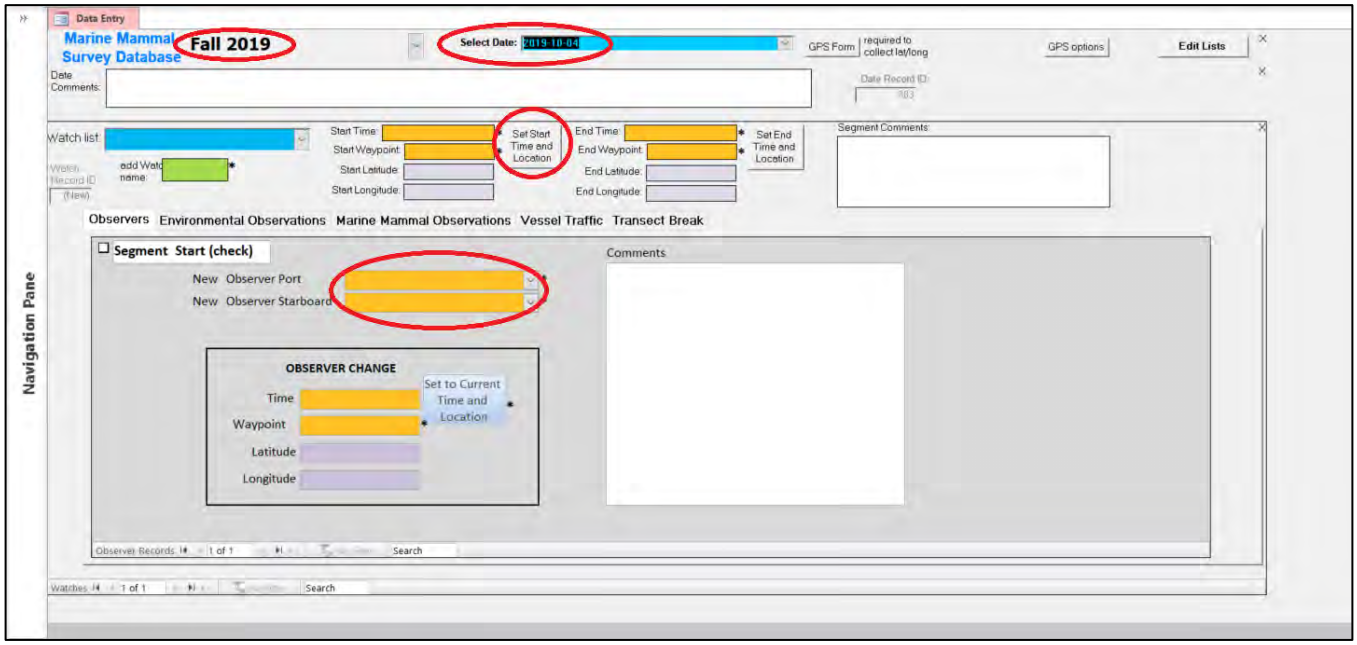


Figure 16: Starting a New Record in the Marine Mammal Database

GPS tracks will be taken during all MWO activities to capture the survey effort. In addition, if using the backup Garmin GPS, 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, circled in red in observer tab in above figure).
- If only one observer is present chose – enter your name in both New Observer Port and New Observer Starboard.
- 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.

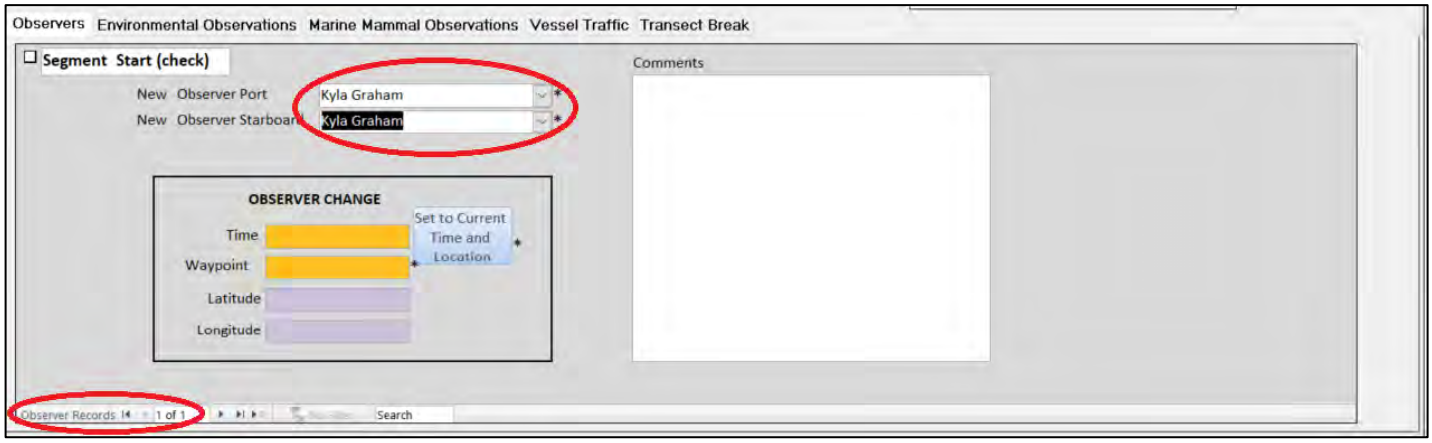


Figure 17: Entering Observer Information in the Marine Mammal Database

5.11.2 Environmental Observations

Go to the Environmental Observations 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.
- If using a Garmin GPS enter a waypoint and record the Waypoint number.
- Fill out the Sun Glare, Weather- Ice and MSV *Botnica* 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).
    - During the summer survey transits, the vessel will be passing near or over AMAR (Autonomous Multi-channel Acoustic Recorder) underwater bouys which were deployed to record source noise levels of the icebreaker. For these 2019 summer surveys we will be taking a photo of the environmental conditions near the vessel especially directly ahead where the vessel is traveling through the ice/water. You will need to keep track of when the vessel is passing within a couple kilometers of the AMAR locations.
- The MSV *Botnica*’s activities will be recorded including vessel activity, travel direction, speed and water depth. For vessel activity we’ll be recording whether the *Botnica* is transiting in open water, icebreaking, transiting through a previous icebreaker path or stationery. It is important to update environmental observations when the vessel transitions from one type of activity to another.
- 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.

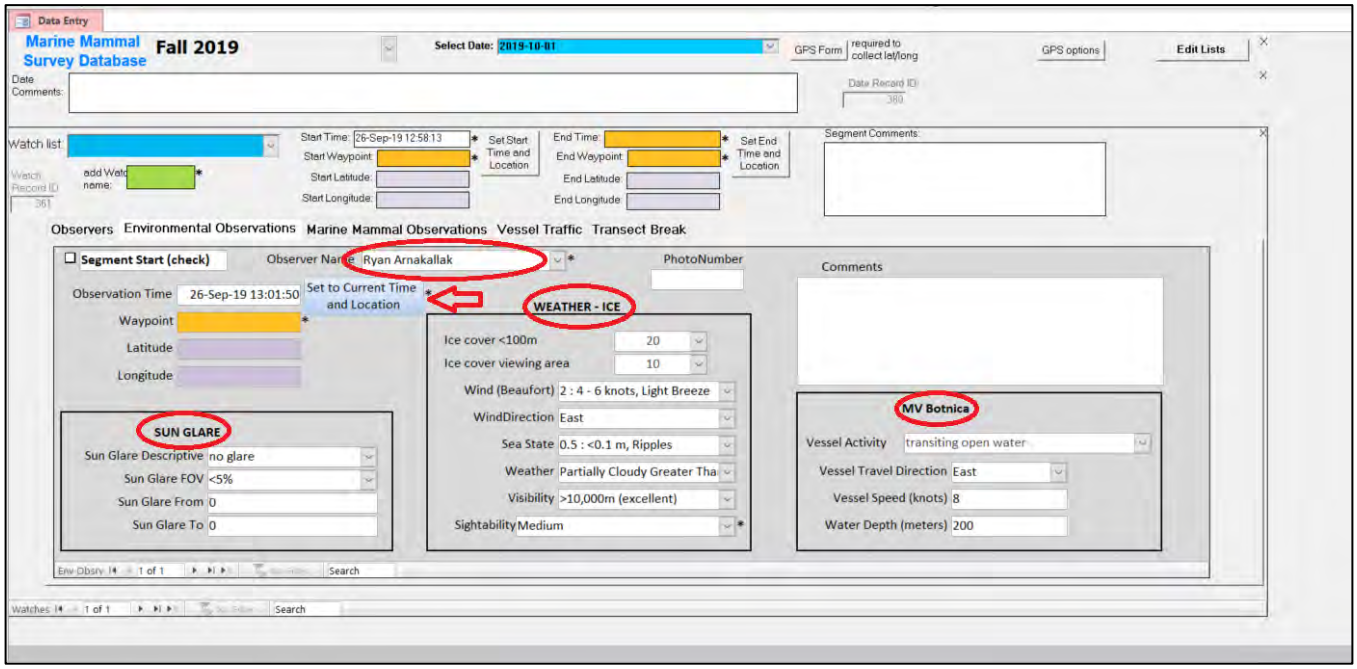


Figure 18: Entering Environmental Data in the Marine Mammal Database

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).
- If using the Garmin GPS enter a waypoint and record the Waypoint number.
- Enter species, number of individuals.
  - Pinniped sub-group numbers and sizes – If you observe many seals in close proximity to each other but not necessarily in the same group, i.e. further than 5 body lengths away from each other, make sure you record the number of sub-groups and their respective group sizes if you’re recording it as one sighting, i.e. would be difficult to enter as many separate sightings.
- 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 it 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.
- If you are in a situation where there are many seals in multiple groups, make a note of the number of sub-groups you observe and how many are in the sub-groups, in the Comments section on the right of the screen.
- A new marine mammal sighting record sheet should be filled out every time you have a new sighting. Get a new record by pressing the right arrow at the bottom on the screen.

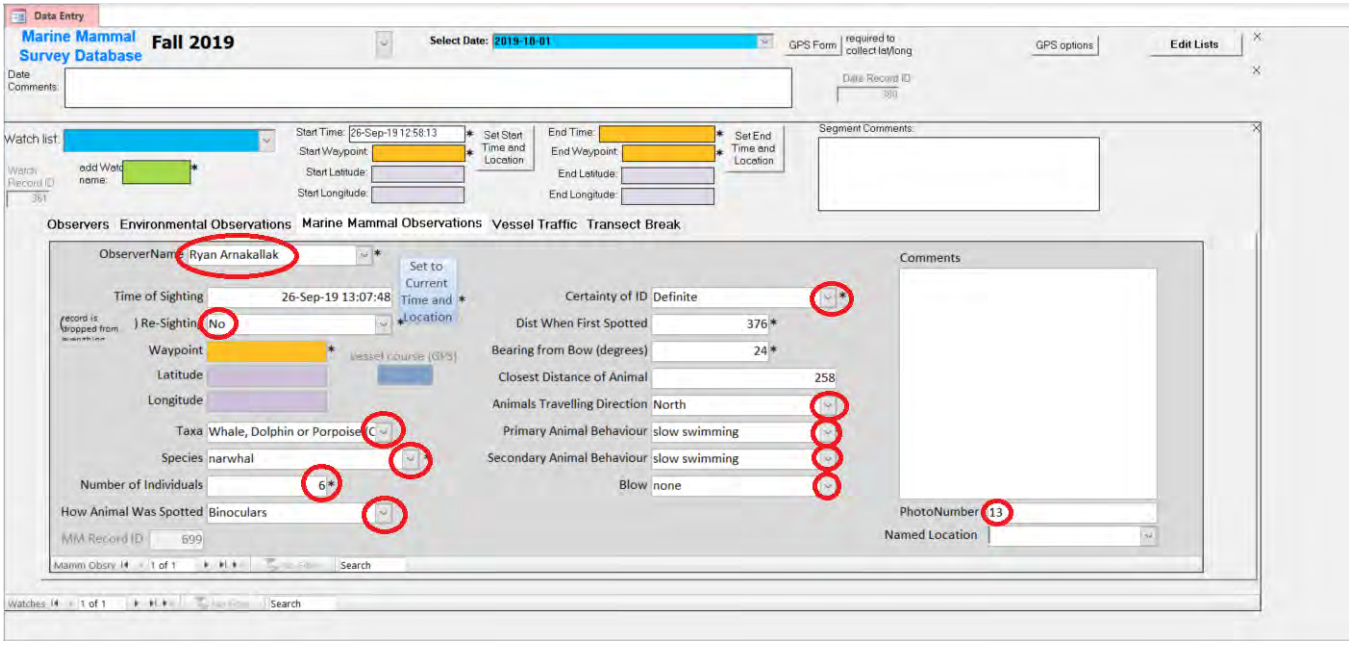


Figure 19: Entering Marine Mammal Observations in the Marine Mammal Database

5.11.4 Transect Break

If you need to take a break during your watch 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 observing for marine mammals.

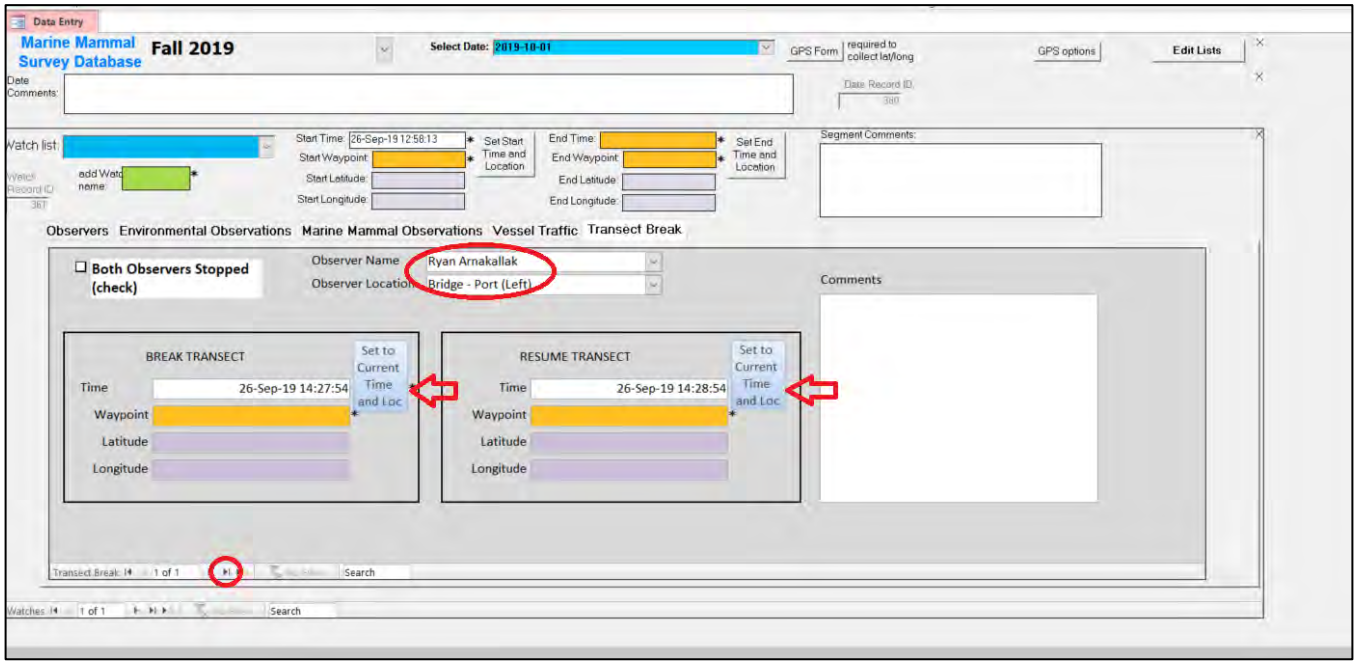


Figure 20: Entering a Transect Break in the Marine Mammal Database

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, MWO's 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.

[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.

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.

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

Table A-1: Marine Mammal Sightings

Observer Name	Date of Sighting	Time of Sighting	Re-Sighting? Yes/No	Lat	Long	Taxa (seal, whale, dolphin, etc.)	Species	# of Individuals	Sighting Cue	Certainty of ID (Possible / Definite)	Distance (m)	Bearing from Bow (degrees)	Closest Distance to Vessel (m)	Travel Direction	Primary Behaviour	Secondary Behaviour	Comments (Free Notes)

Table A-2: Environmental Conditions

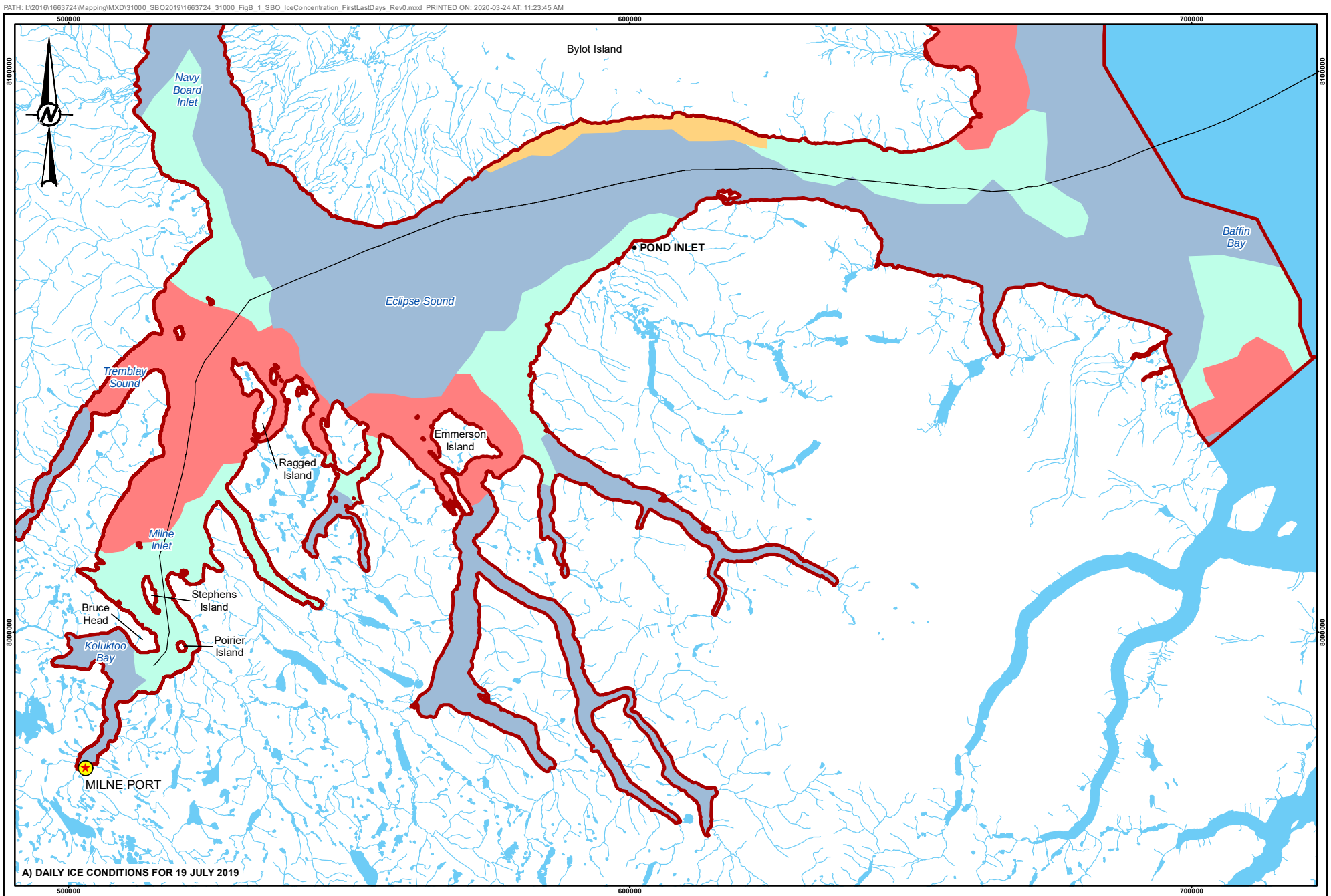
Date	Time	Lat	Long	Observer(s) on Watch			Glare Intensity (descriptive)	Glare FOV %	Glare From-To	Ice Cover (<100 m, %)	Ice Cover (viewing area, %)	Wind Speed (BF)	Wind Direction	Beaufort Sea State	Weather	Visibility	Sightability	Vessel Activity	Vessel Travel Direction	Vessel Speed (kts)	Water Depth (m)	Comments (free notes)

golder.com

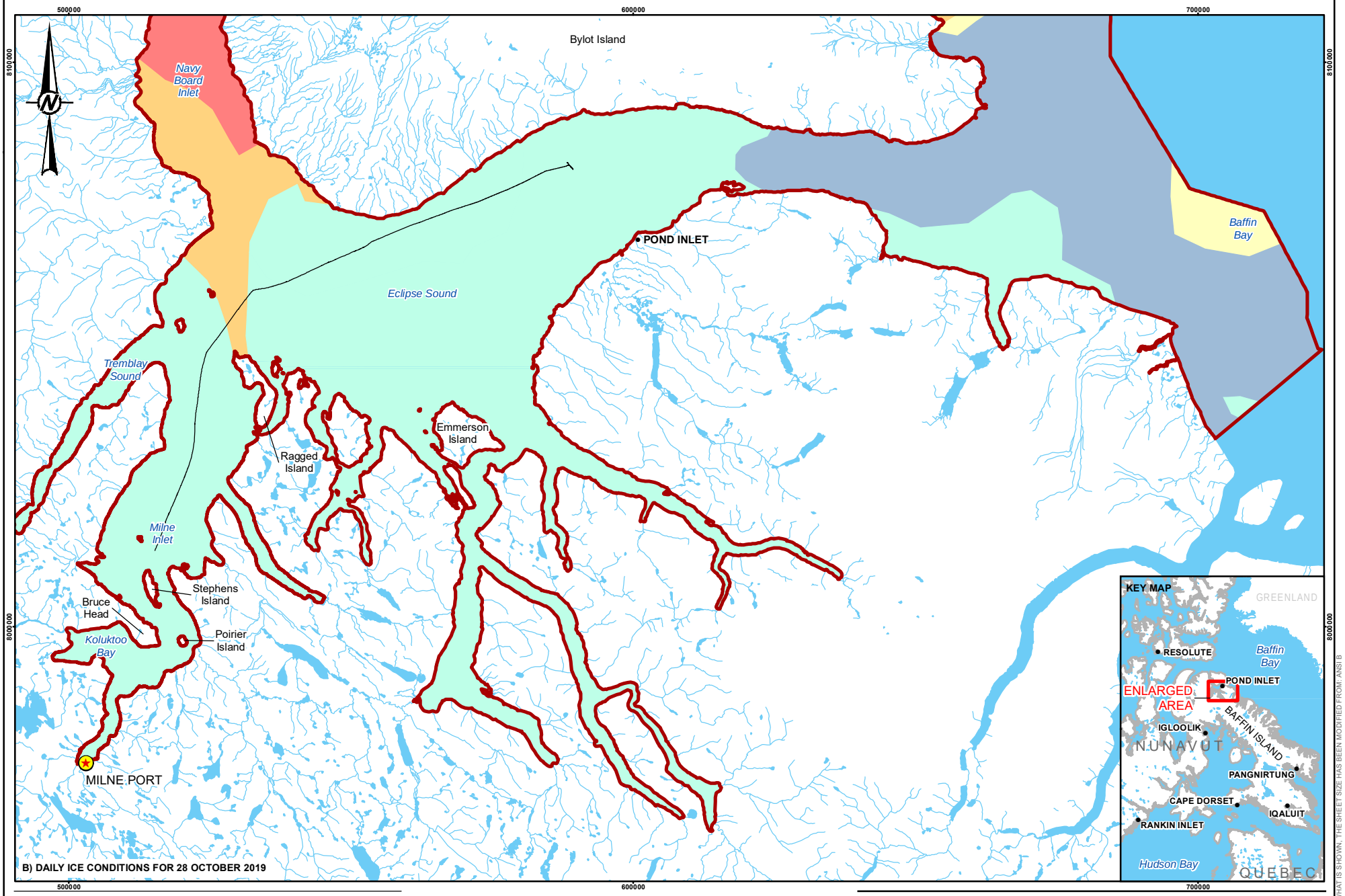
APPENDIX B

Ice Charts

PATH: I:\2016\1663724\Mapping\MXD\31000_SBO2019\1663724_31000_FigB_1_SBO_IceConcentration_FirstLastDays_Rev0.mxd PRINTED ON: 2020-03-24 AT: 11:23:45 AM



A) DAILY ICE CONDITIONS FOR 19 JULY 2019



B) DAILY ICE CONDITIONS FOR 28 OCTOBER 2019

LEGEND

- COMMUNITY
- MILNE PORT
- BOTNICA VESSEL TRACK
- WATERCOURSE
- MARINE MAMMAL REGIONAL STUDY AREA
- WATERBODY

ICE CONCENTRATION

- < 1/10
- 1-3/10
- 4-6/10
- 7-8/10
- 9-10/10

0 25 50

1:900,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, 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 - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
DAILY ICE CONDITIONS ON 19 JULY 2019 AND 28 OCTOBER 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	B-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm
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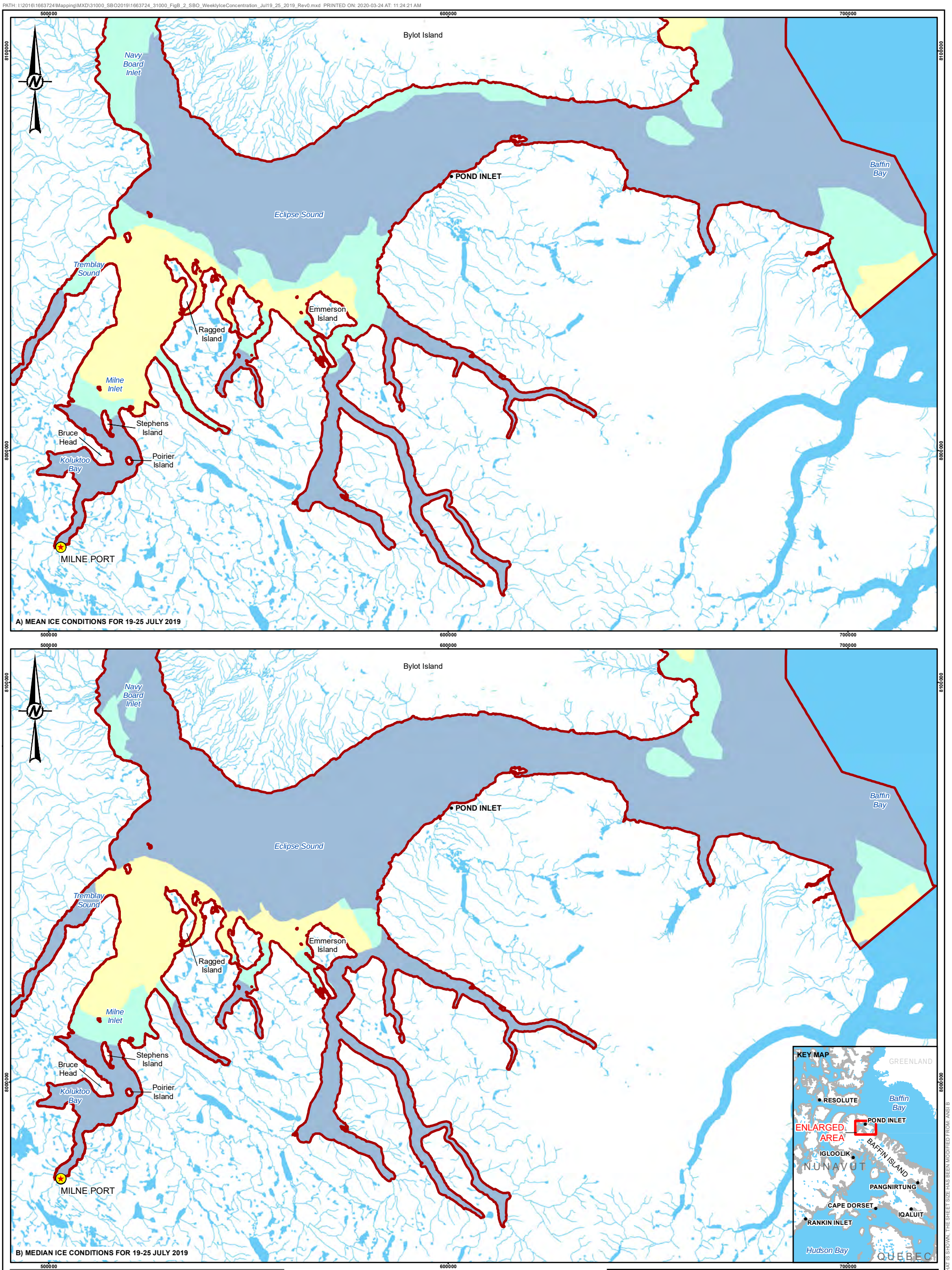
PATH: I:\2016\1663724\Mapping\MXD\31000_SBO2019\1663724_31000_FigB_2_SBO_WeeklyIceConcentration_Jul19_25_2019_Rev0.mxd PRINTED ON: 2020-03-24 AT: 11:24:21 AM



LEGEND

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

ICE CONCENTRATION (19-25 JULY 2019)

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

0 25 50

1:900,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, 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 - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
MEAN AND MEDIAN ICE CONDITIONS FOR 19-25 JULY 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	B-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0

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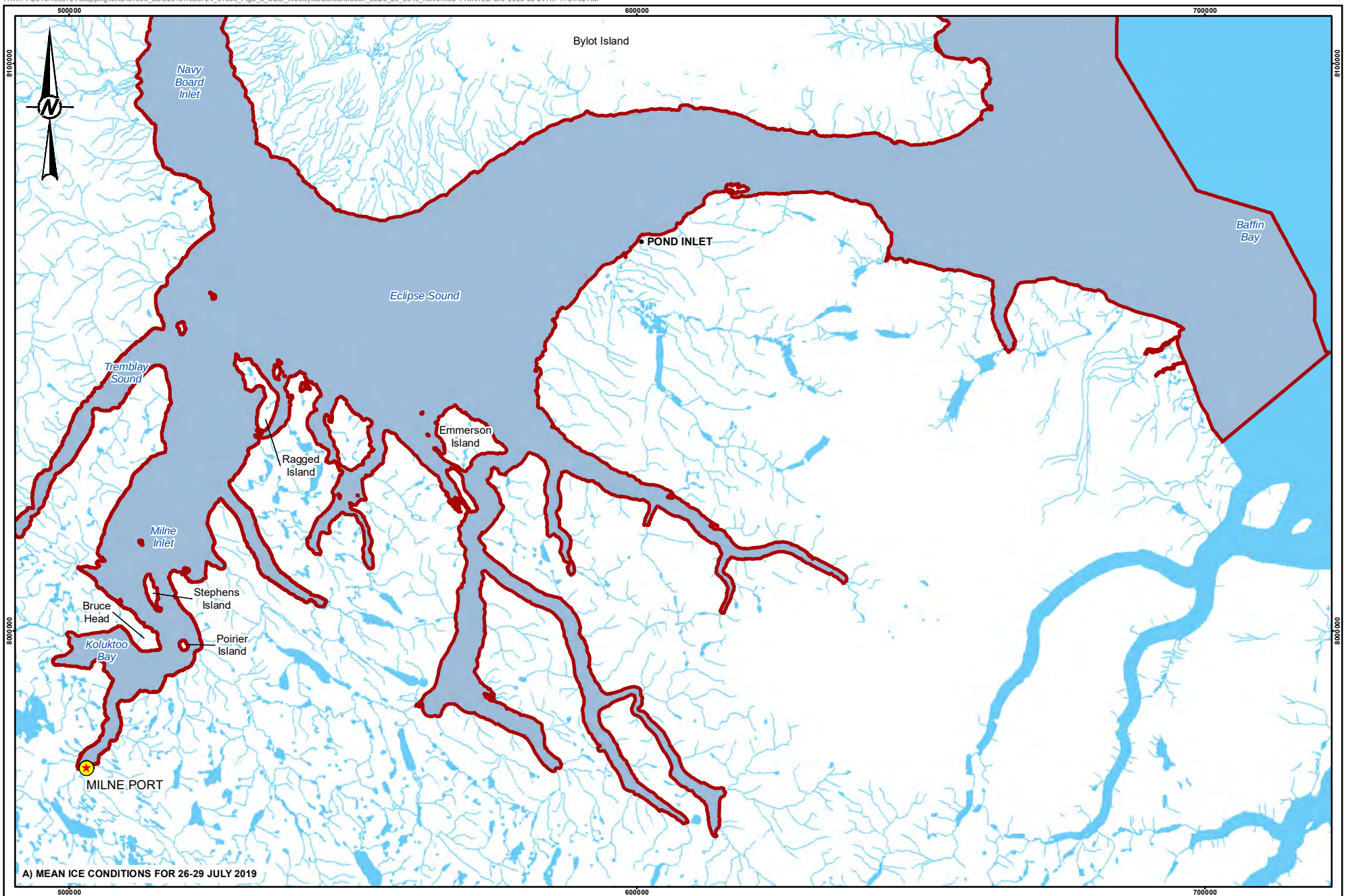

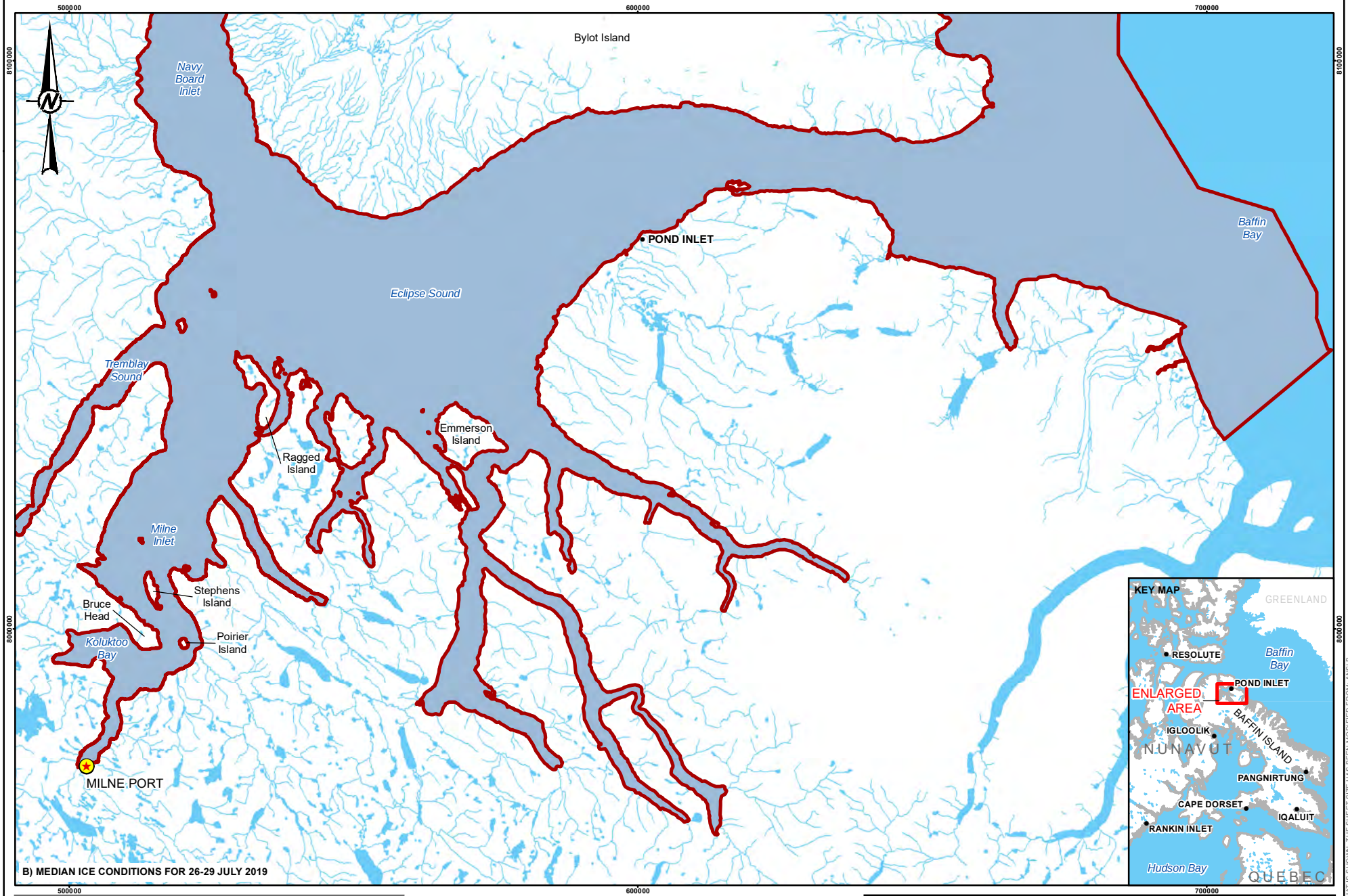

LEGEND

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

ICE CONCENTRATION (26-29 JULY 2019)

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

0 25 50

1:900,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, 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 - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
MEAN AND MEDIAN ICE CONDITIONS FOR 26-29 JULY 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	B-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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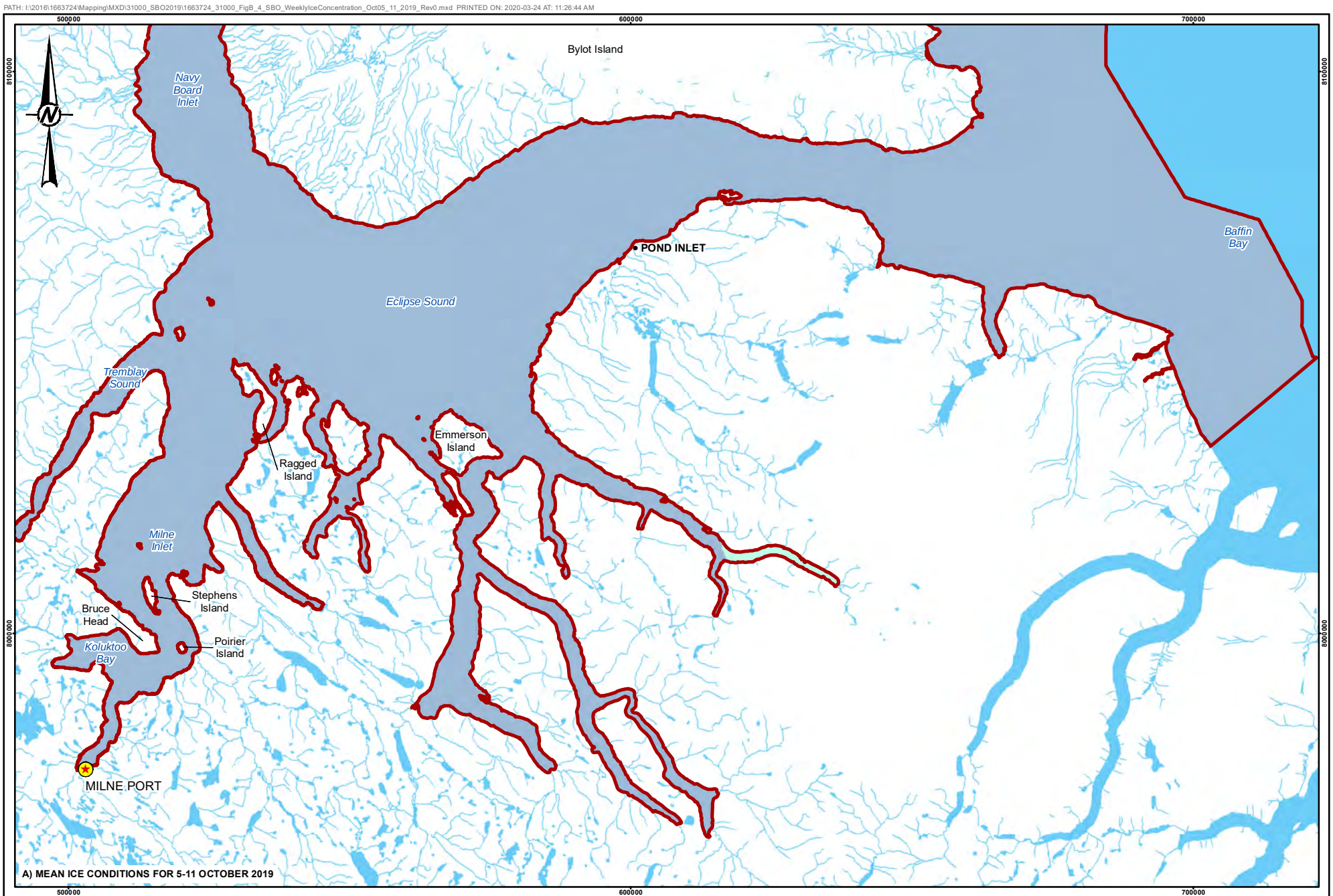
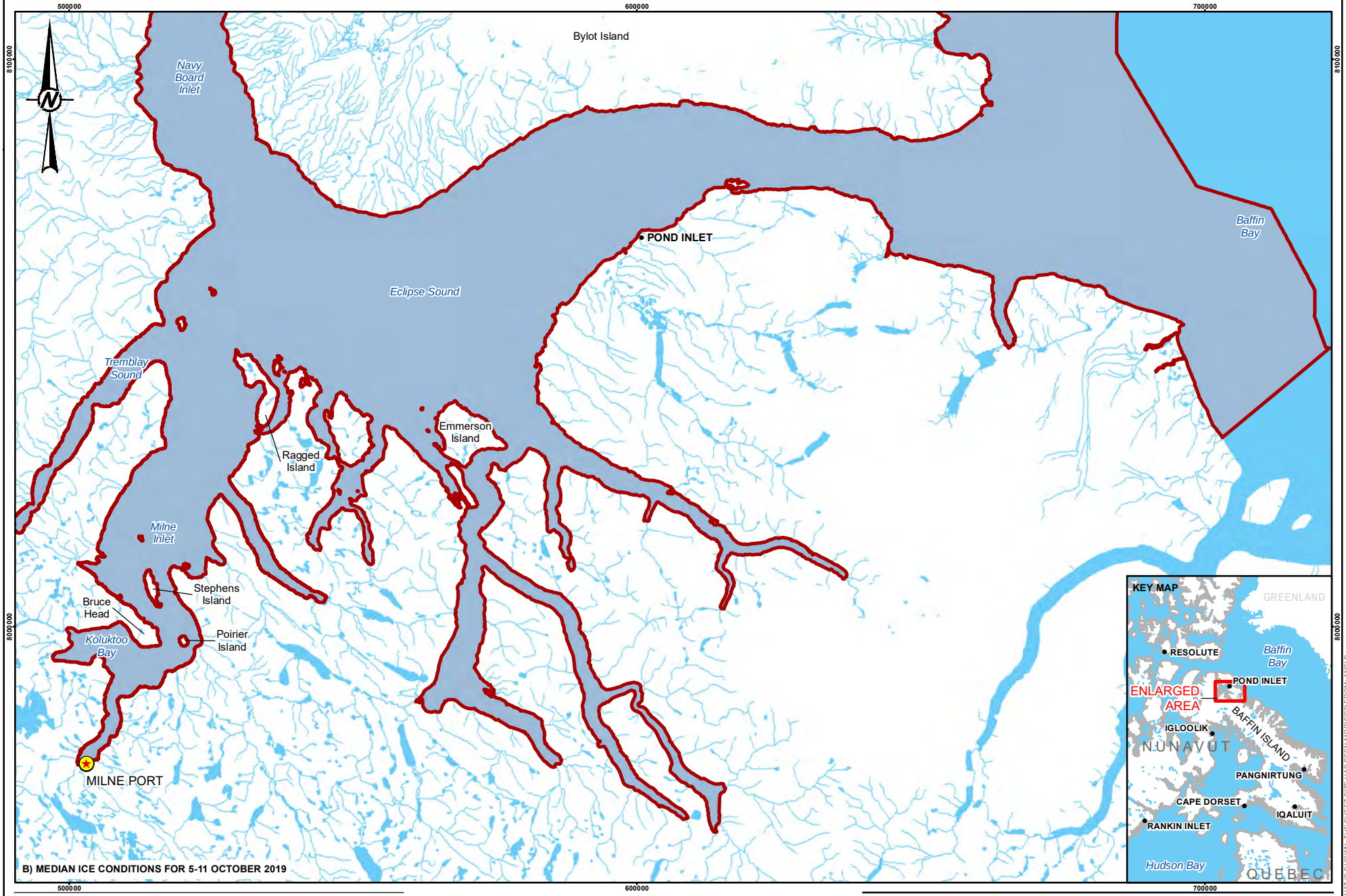


A) MEAN ICE CONDITIONS FOR 5-11 OCTOBER 2019



B) MEDIAN ICE CONDITIONS FOR 5-11 OCTOBER 2019

LEGEND

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

ICE CONCENTRATION (5-11 OCTOBER 2019)

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

0 25 50

1:900,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, 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 - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
MEAN AND MEDIAN ICE CONDITIONS FOR 5-11 OCTOBER 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

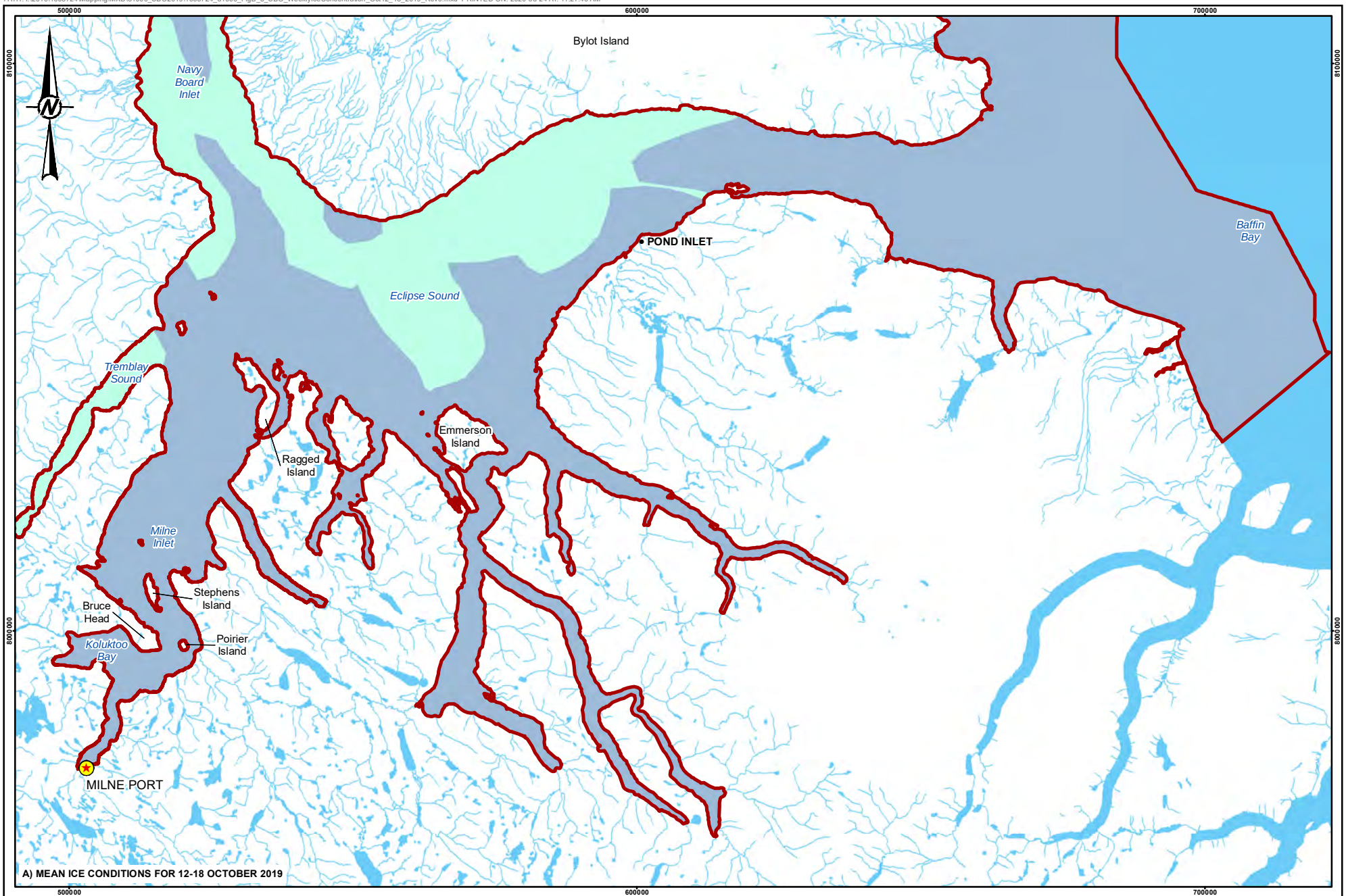
PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	B-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

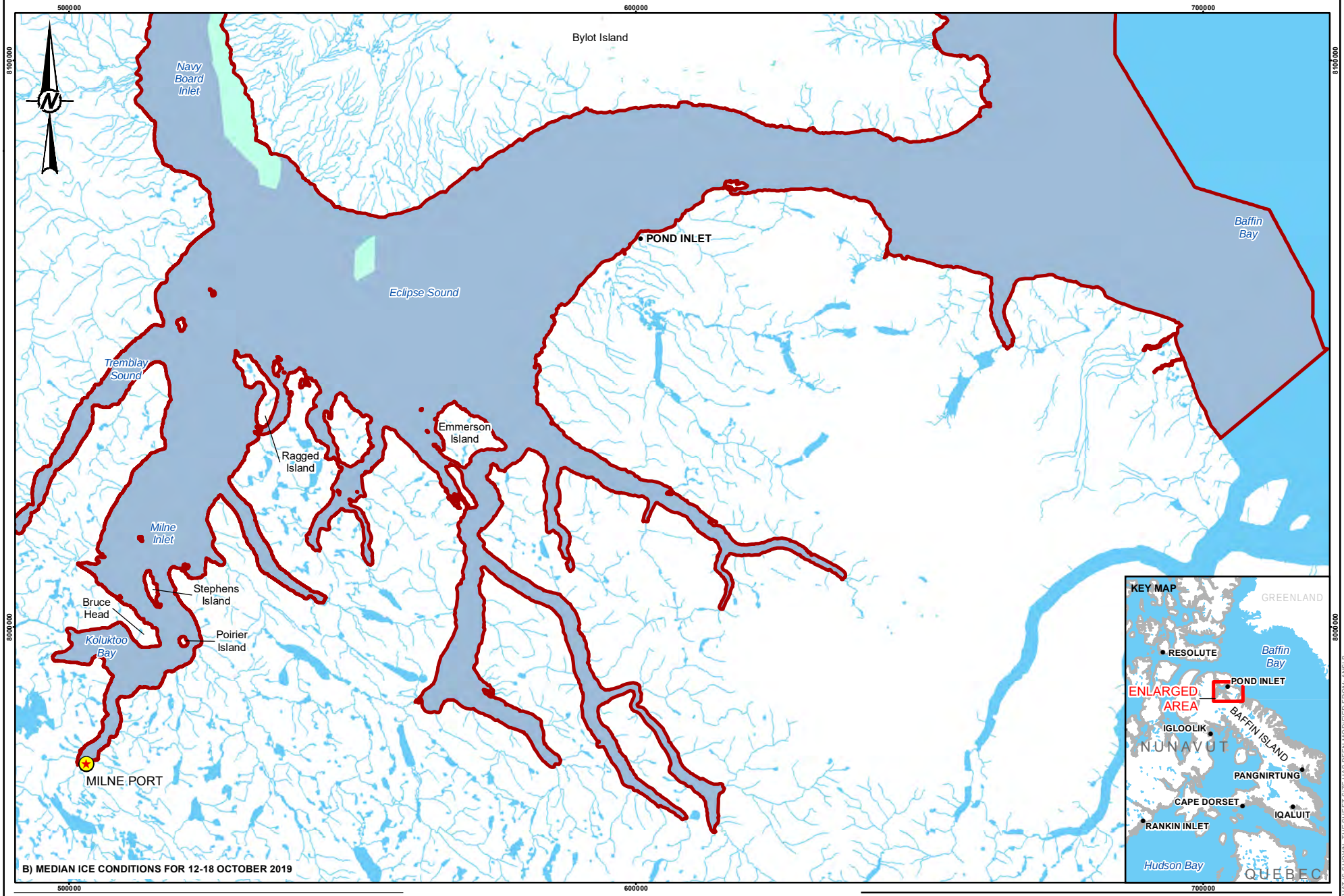
25mm

0

PATH: I:\2016\1663724\Mapping\MXD\31000_SBO2019\1663724_31000_FigB_5_SBO_WeeklyIceConcentration_Oct12_18_2019_Rev0.mxd PRINTED ON: 2020-03-24 AT: 11:27:40 AM



A) MEAN ICE CONDITIONS FOR 12-18 OCTOBER 2019



B) MEDIAN ICE CONDITIONS FOR 12-18 OCTOBER 2019

LEGEND

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

ICE CONCENTRATION (12-18 OCTOBER 2019)

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

0 25 50

1:900,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, 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 - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
MEAN AND MEDIAN ICE CONDITIONS FOR 12-18 OCTOBER 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

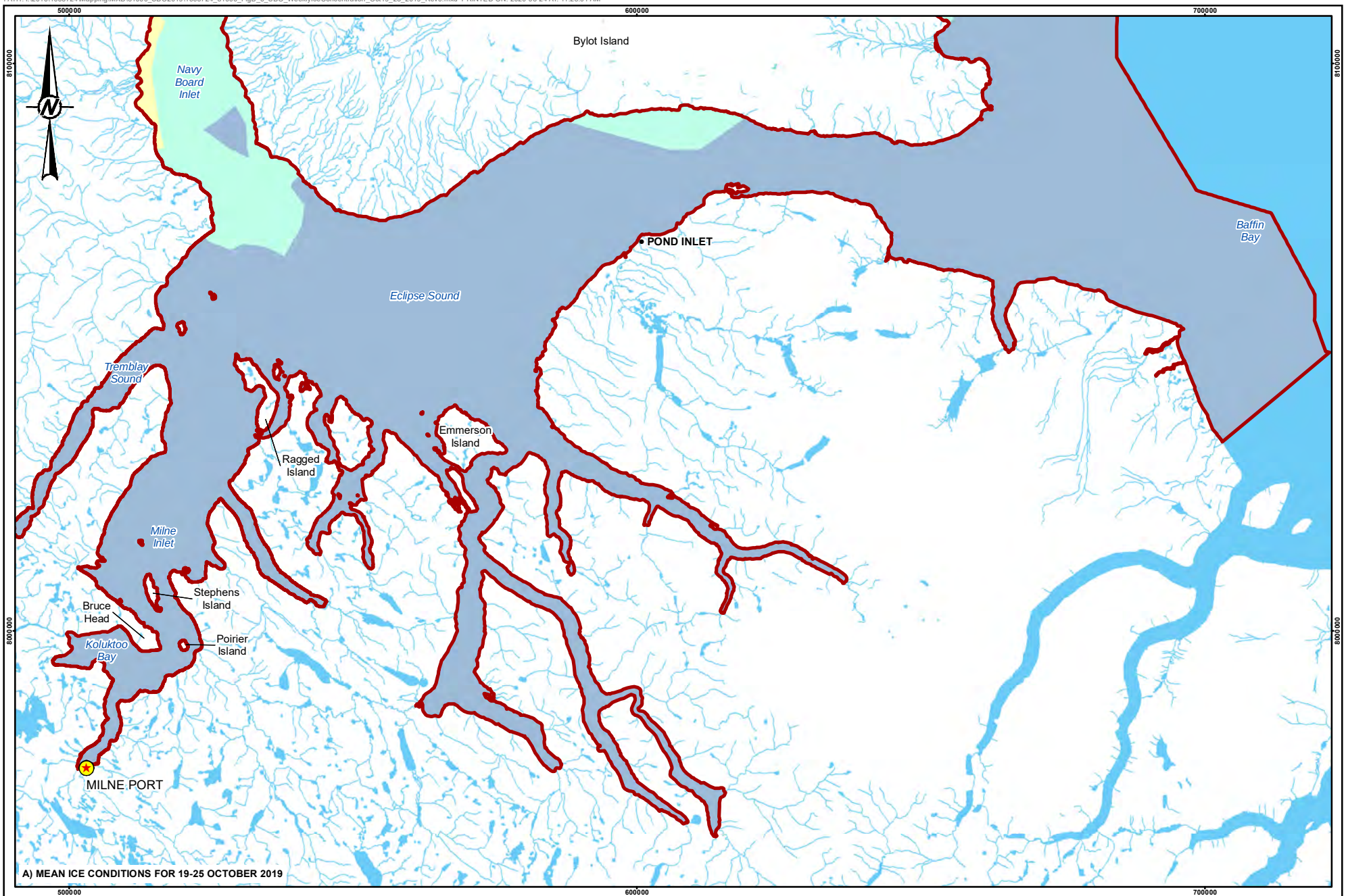
PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	B-5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

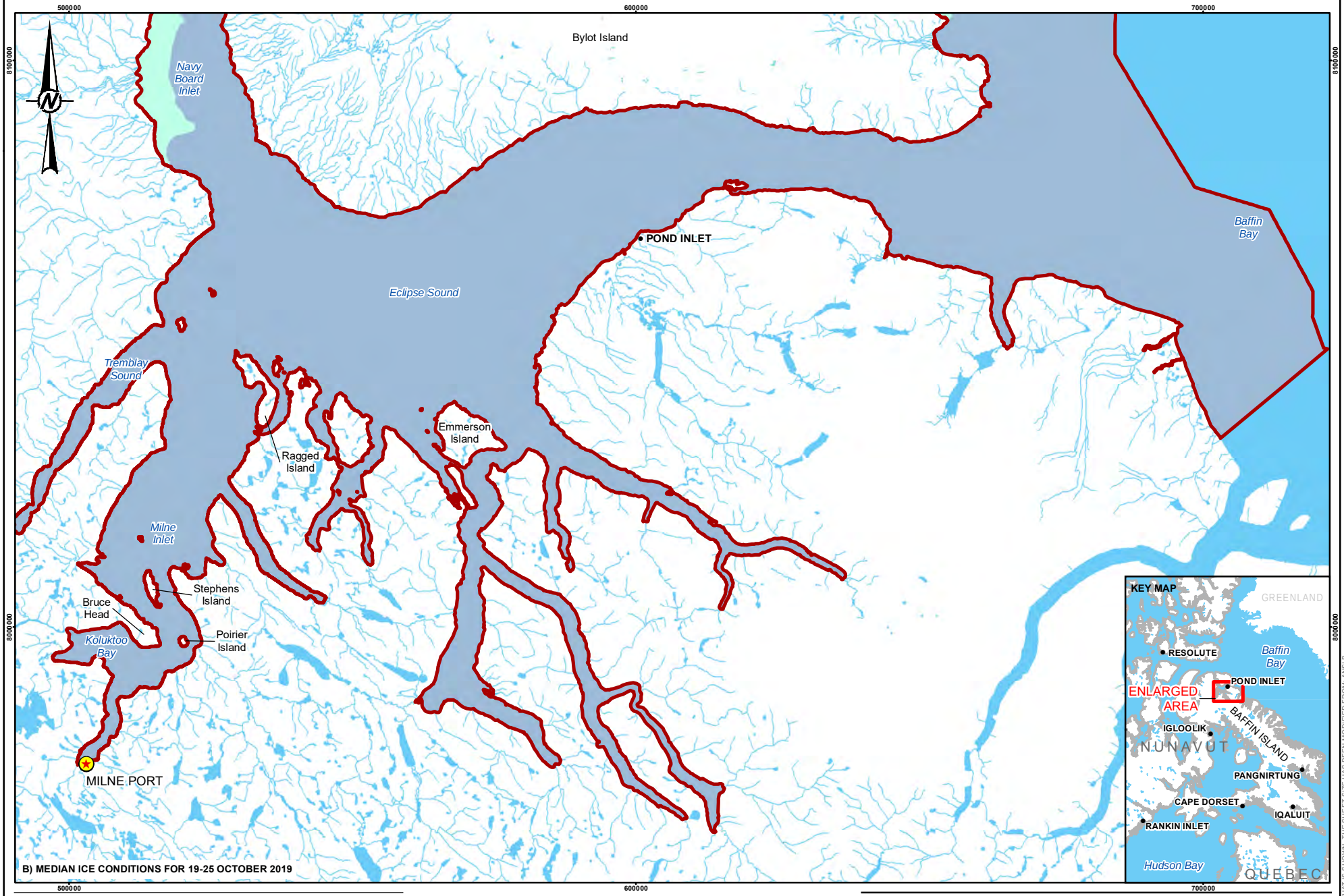
25mm

0

PATH: I:\2016\1663724\Mapping\MXD\31000_SBO2019\1663724_31000_FigB_6_SBO_WeeklyIceConcentration_Oct19_25_2019_Rev0.mxd PRINTED ON: 2020-03-24 AT: 11:28:01 AM



A) MEAN ICE CONDITIONS FOR 19-25 OCTOBER 2019



B) MEDIAN ICE CONDITIONS FOR 19-25 OCTOBER 2019

LEGEND

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

ICE CONCENTRATION (19-25 OCTOBER 2019)

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

0 25 50

1:900,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. PROJECTION: UTM ZONE 17 DATUM: NAD 83

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BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
MEAN AND MEDIAN ICE CONDITIONS FOR 19-25 OCTOBER 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	B-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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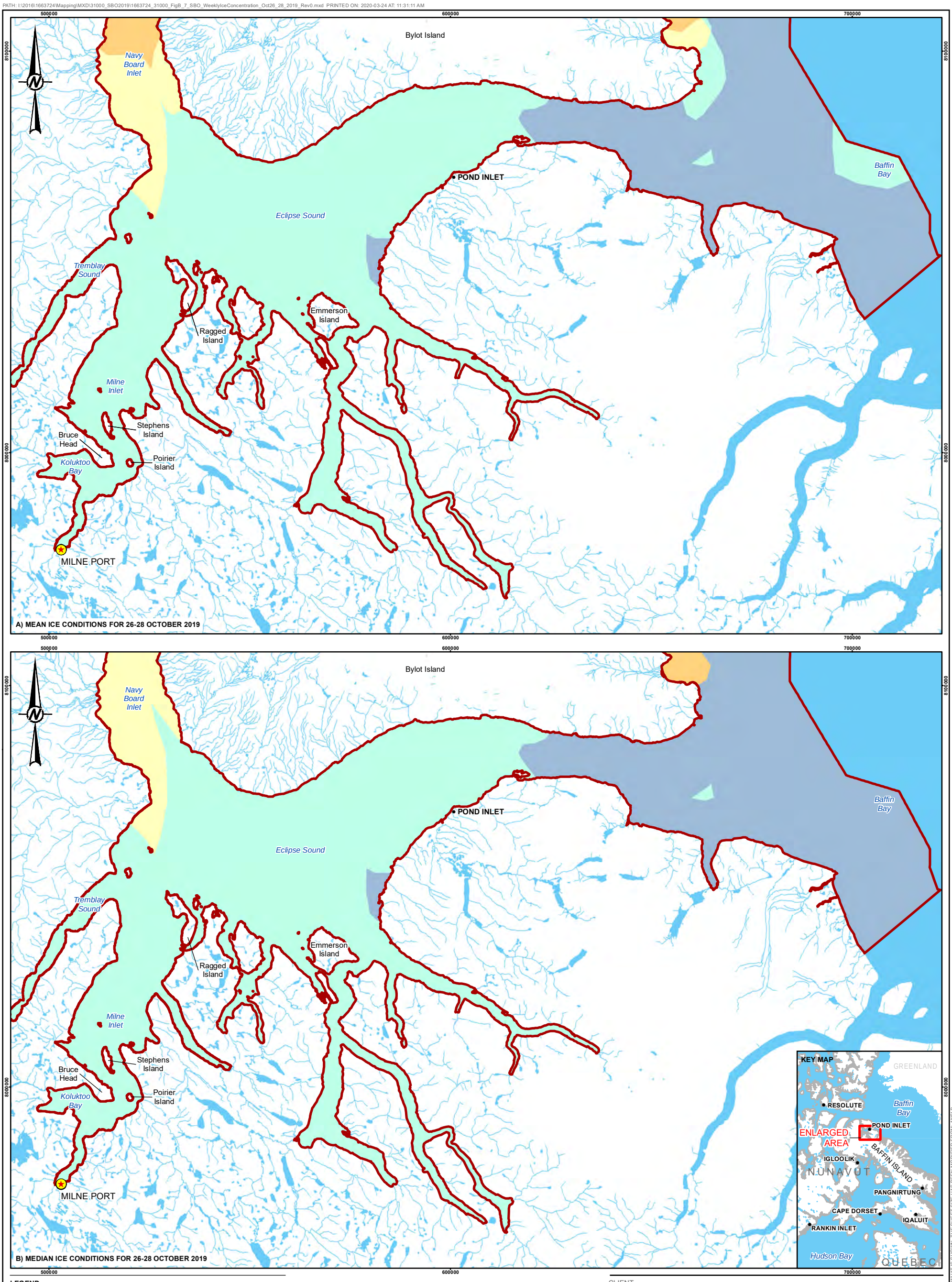
PATH: I:\2016\1663724\Mapping\MXD\31000_SBO2019\1663724_31000_FigB_7_SBO_WeeklyIceConcentration_Oct26_28_2019_Rev0.mxd PRINTED ON: 2020-03-24 AT: 11:31:11 AM



LEGEND

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

ICE CONCENTRATION (26-28 OCTOBER 2019)

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

0 25 50

1:900,000 KILOMETRES

REFERENCE(S)

ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. GEOGRAPHIC NAMES, 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 - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
MEAN AND MEDIAN ICE CONDITIONS FOR 26-28 OCTOBER 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	B-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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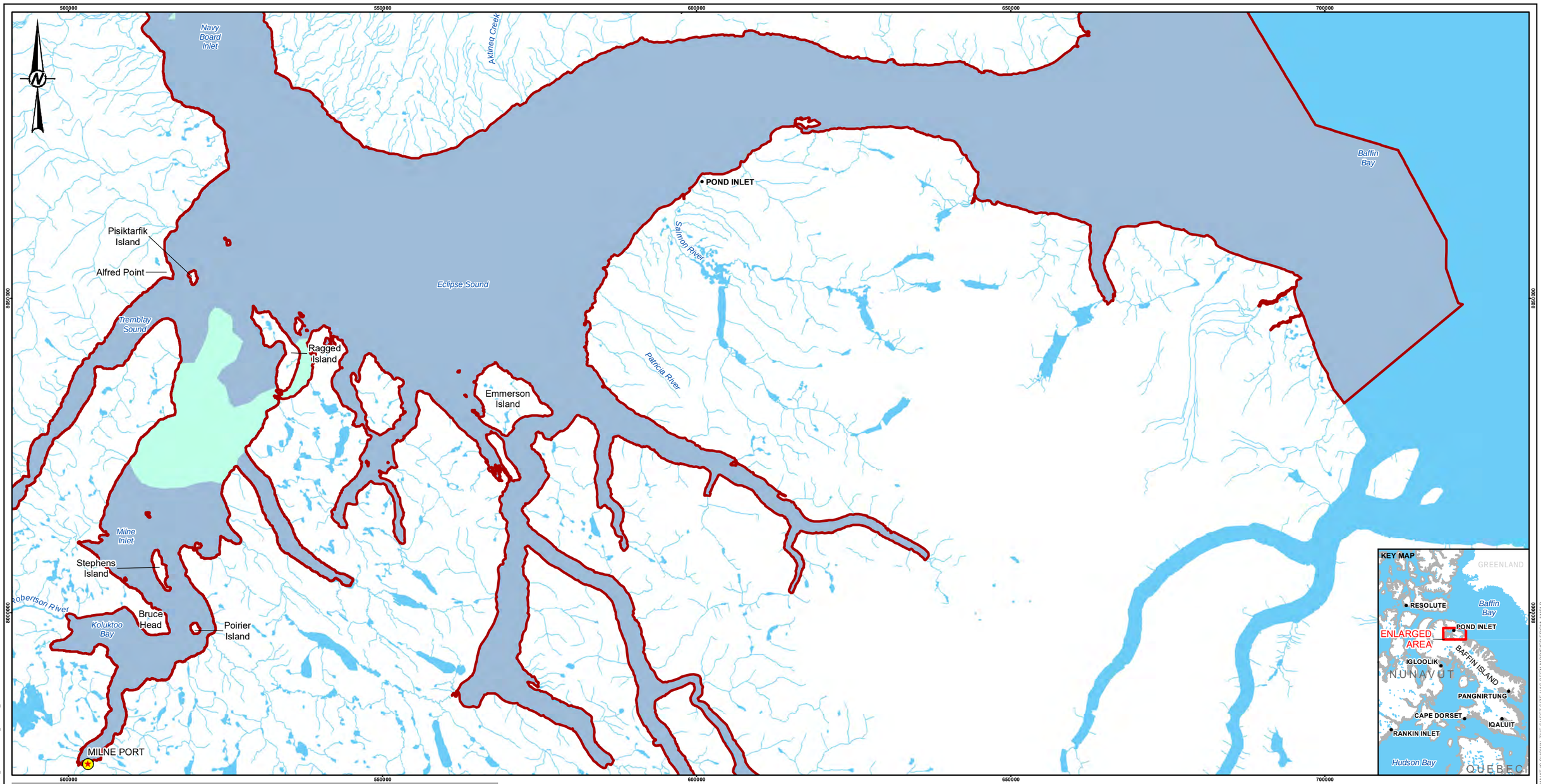

LEGEND

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

LEG 1 MEDIAN ICE CONCENTRATION (19-29 JULY 2019)

- 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 SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. 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	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

PROJECT
MARY RIVER PROJECT - 2019 SHIP-BASED OBSERVER PROGRAM

TITLE
MEDIAN OF PERCENT OF ICE CONCENTRATION FOR THE NORTHERN SHIPPING ROUTE – LEG 1 (19-29 JULY 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	B-8

PATH: I:\2016\1663724\Mapping\MXD\31000_SBO\2019\1663724_31000_FigB_8_SBO_Median_IceConcentration_Summer_Rev0.mxd PRINTED ON: 2020-03-24 AT: 11:33:32 AM
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
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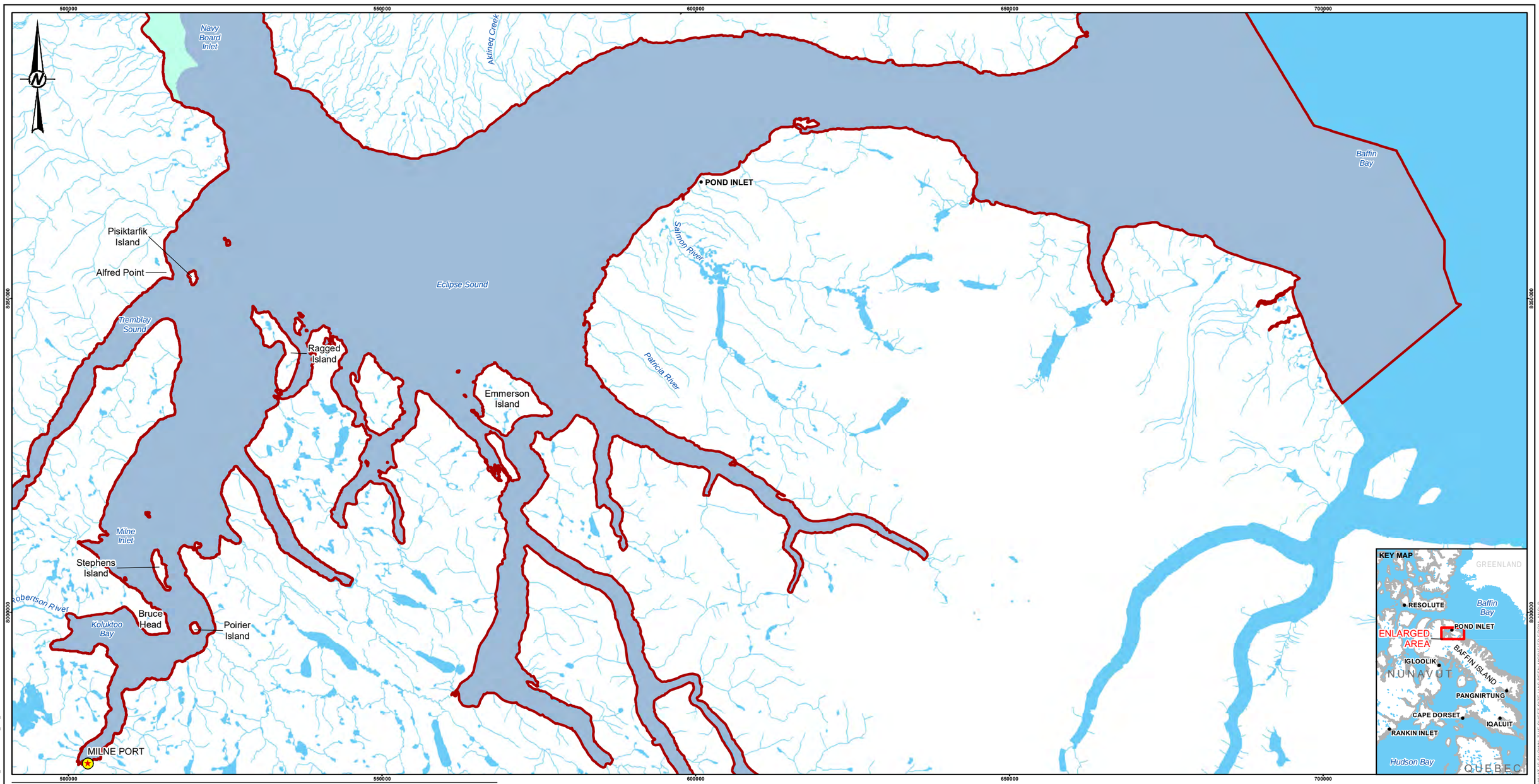

LEGEND

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

LEG 2 MEDIAN ICE CONCENTRATION (5-28 OCTOBER 2019)

- 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 SEPTEMBER 19, 2019 AND DECEMBER 13, 2019. 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 - 2019 SHIP-BASED OBSERVER PROGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-24
DESIGNED	KG
PREPARED	AA
REVIEWED	KG
APPROVED	PR

TITLE
MEDIAN OF PERCENT OF ICE CONCENTRATION FOR THE NORTHERN SHIPPING ROUTE – LEG 2 (5-28 OCTOBER 2019)

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	31000	0	B-9

PATH: I:\2016\1663724\Mapping\MXD\31000_SBO\2019\1663724_31000_FigB_9_SBO_Median_IceConcentration_Fall_Rev0.mxd PRINTED ON: 2020-03-24 AT: 11:33:03 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

APPENDIX C

Marine Mammal Detection Rate Tables

Table 1: Marine Mammal Detection Rates By Near Field Ice Cover Percentage During Summer Surveys

Sighting/km by Near Ice Cover Percentage (Survey Effort)	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Summer Surveys									
In Water									
0-20% (1,050 km)	0.0257	0.0010	0.0200	0.0019	0.0419	0.0229	0.0010	0.0038	0.0000
21-40% (34.5 km)	0.0000	0.0000	0.0290	0.0000	0.0869	0.0000	0.0000	0.0000	0.0000
41-60% (12.4 km)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
61-80% (0.79 km)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
81-100% (19.14 km)	0.0000	0.0000	0.0000	0.0000	0.0522	0.0000	0.0000	0.0000	0.0000
# Sightings	27	1	22	2	48	24	1	4	0
On Ice									
0-20% (1,050 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0019	0.0000
21-40% (34.5 km)	n/a	n/a	n/a	n/a	0.1448	0.0000	0.0579	0.0290	0.0000
41-60% (12.4 km)	n/a	n/a	n/a	n/a	0.1613	0.0000	0.0000	0.0000	0.0000
61-80% (0.79 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
81-100% (19.14 km)	n/a	n/a	n/a	n/a	0.3135	0.0000	0.0522	0.0522	0.1045
# Sightings	n/a	n/a	n/a	n/a	13	0	3	5	2

Table 2: Marine Mammal Detection Rates By Near Field Ice Cover Percentage During Fall Surveys

Sighting/km by Near Ice Cover Percentage (Survey Effort)	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Fall Surveys									
In Water									
0-20% (1,903 km)	0.0057	0.0000	0.0010	0.0010	0.0257	0.0171	0.0010	0.0200	0.0000
21-40% (0 km)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
41-60% (8.9 km)	0.0000	0.0000	0.0000	0.0000	0.4505	0.4505	0.0000	0.7883	0.0000
61-80% (20.1 km)	0.9462	0.0000	0.0000	0.0000	0.5478	0.0996	0.0000	0.0498	0.0000
81-100% (18.4 km)	0.1090	0.0000	0.0000	0.0000	0.5450	0.1090	0.0000	0.3815	0.0000
# Sightings	27	0	1	1	52	25	1	36	0
On Ice									
0-20% (1,903 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0048	0.0000
21-40% (0 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
41-60% (8.9 km)	n/a	n/a	n/a	n/a	0.1126	0.0000	0.0000	0.2252	0.0000
61-80% (20.1 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0498	0.0000
81-100% (18.4 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
# Sightings	n/a	n/a	n/a	n/a	1	0	0	8	0

Table 3: Marine Mammal Detection Rates and Observed Far Field Ice Cover During Summer Surveys

	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Summer Survey									
In Water									
0-20% (1,015 km)*	0.0256	0.0010	0.0117	0.0020	0.0384	0.0236	0.0010	0.0039	0.0000
21-40% (68.4 km)	0.0146	0.0000	0.0293	0.0000	0.0878	0.0000	0.0000	0.0000	0.0000
41-60% (11.4 km)	0.0000	0.0000	0.1761	0.0000	0.0400	0.0000	0.0000	0.0000	0.0000
61-80% (10.3 km)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
81-100% (11.7 km)	0.0000	0.0000	0.0000	0.0000	0.0855	0.0000	0.0000	0.0000	0.0000
# Sightings	27	1	22	2	48	24	1	4	0
On Ice									
0-20% (1,015 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0010	0.0000
21-40% (68.4 km)	n/a	n/a	n/a	n/a	0.0439	0.0000	0.0146	0.0146	0.0000
41-60% (11.4 km)	n/a	n/a	n/a	n/a	0.3521	0.0000	0.0880	0.0880	0.0000
61-80% (10.3 km)	n/a	n/a	n/a	n/a	0.1951	0.0000	0.0000	0.0976	0.0976
81-100% (11.7 km)	n/a	n/a	n/a	n/a	0.0036	0.0000	0.0855	0.0000	0.0005
# Sightings	n/a	n/a	n/a	n/a	13	0	3	5	2

*kilometers of observation effort/category

Table 4: Marine Mammal Detection Rates and Observed Far Ice Cover During Fall Surveys

	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Fall Survey									
In Water									
0-20% (1879.1 km)	0.0016	0.0000	0.0005	0.0005	0.0138	0.0090	0.0005	0.0096	0.0000
21-40% (12.2 km)	0.2461	0.0000	0.0000	0.0000	0.0000	0.0820	0.0000	0.2461	0.0000
41-60% (8.49 km)	0.4711	0.0000	0.0000	0.0000	0.4711	0.4711	0.0000	0.8245	0.0000
61-80% (14.8 km)	0.1352	0.0000	0.0000	0.0000	0.3381	0.0676	0.0000	0.0000	0.0000
81-100% (29.14 km)	0.6520	0.0000	0.0000	0.0000	0.5834	0.0686	0.0000	0.2745	0.0000
# Sightings	27	0	1	1	52	25	1	36	0
On Ice									
0-20% (1879.1 km)	n/a	n/a	n/a	n/a	0.1178	0.0000	0.0000	0.0021	0.0000
21-40% (12.2 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0820	0.0000
41-60% (8.49 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.2356	0.0000
61-80% (14.8 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
81-100% (29.14 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0343	0.0000
# Sightings	n/a	n/a	n/a	n/a	1	0	0	8	0

Table 5: Marine Mammal Detection Rates and Beaufort Sea State During Summer Surveys

	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Summer Surveys									
In Water									
0 (Glassy, 236.6 km)	0.0592	0.0042	0.0423	0.0042	0.1564	0.0550	0.0042	0.0085	0.0000
0.5 (Ripples, 310.3 km)	0.0193	0.0000	0.0097	0.0032	0.0258	0.0161	0.0000	0.0032	0.0000
1 (small wavelets, 174.4 km)	0.0287	0.0000	0.0229	0.0000	0.0115	0.0000	0.0000	0.0000	0.0000
2 (smooth wavelets, 168.9 km)	0.0000	0.0000	0.0118	0.0000	0.0059	0.0059	0.0000	0.0059	0.0000
3 (Slight; Small white caps, 216.5 km)	0.0092	0.0000	0.0139	0.0000	0.0000	0.0231	0.0000	0.0000	0.0000
4 (Mod. Waves, some spray, 0.0 km)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	0.0000	0.0000
# Sightings	27	1	22	2	48	24	1	4	0
On Ice									
0 (Glassy, 236.6 km)	n/a	n/a	n/a	n/a	0.0254	0.0000	0.0085	0.0085	0.0042
0.5 (Ripples, 310.3 km)	n/a	n/a	n/a	n/a	0.0226	0.0000	0.0032	0.0064	0.0032
1 (small wavelets, 174.4 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
2 (smooth wavelets, 168.9 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
3 (Slight; Small white caps, 216.5 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
4 (Mod. Waves, some spray, 0.0 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
# Sightings	n/a	n/a	n/a	n/a	13	0	3	5	2

Table 6: Marine Mammal Detection Rates and Beaufort Sea State During Fall Surveys

	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Fall Surveys									
In Water									
0 (Glassy, 82.5 km)*	0.2060	0.0000	0.0000	0.0000	0.2182	0.0364	0.0000	0.0970	0.0000
0.5 (Ripples, 296.4 km)	0.0236	0.0000	0.0000	0.0000	0.0708	0.0371	0.0000	0.0641	0.0000
1 (small wavelets, 447.8 km)	0.0045	0.0000	0.0000	0.0000	0.0112	0.0022	0.0022	0.0045	0.0000
2 (smooth wavelets, 449.3 km)	0.0022	0.0000	0.0000	0.0000	0.0045	0.0134	0.0000	0.0067	0.0000
3 (Slight; Small white caps, 447.2 km)	0.0000	0.0000	0.0022	0.0022	0.0112	0.0067	0.0000	0.0045	0.0000
4 (Mod. Waves, some spray, 227.2 km)	0.0000	0.0000	0.0000	0.0000	0.0044	0.0044	0.0000	0.0088	0.0000
# Sightings	27	0	1	2	48	25	1	36	0
On Ice									
0 (Glassy, 82.5 km)*	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0121	0.0000
0.5 (Ripples, 296.4 km)	n/a	n/a	n/a	n/a	0.0034	0.0000	0.0000	0.0101	0.0000
1 (small wavelets, 447.8 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
2 (smooth wavelets, 449.3 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0089	0.0000
3 (Slight; Small white caps, 447.2 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
4 (Mod. Waves, some spray, 227.2 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
# Sightings	n/a	n/a	n/a	n/a	1	0	0	8	0

Table 7: Marine Mammal Detection Rates and Visibility During Summer Surveys

	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Summer Survey									
In Water									
500-1000m (Low, Poor, 229.2 km)	0.0023	0.0000	0.0000	0.0000	0.0023	0.0000	0.0000	0.0023	0.0000
1001-2500m (Moderate, 184.2 km)	0.0023	0.0000	0.0045	0.0000	0.0068	0.0068	0.0000	0.0045	0.0000
2501-5000m (High, Good, 126.8 km)	0.0136	0.0000	0.0136	0.0000	0.0045	0.0136	0.0000	0.0000	0.0000
5001-10,000m (V. High, V. Good, 125.9 km)	0.0023	0.0000	0.0023	0.0000	0.0091	0.0000	0.0000	0.0000	0.0000
>10,000m (excellent, 440.6 km)	0.0409	0.0023	0.0295	0.0045	0.0863	0.0340	0.0023	0.0023	0.0000
# Sightings	27	1	22	2	48	24	1	4	0
On Ice									
500-1000m (Low, Poor, 229.2 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
1001-2500m (Moderate, 184.2 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0023	0.0000
2501-5000m (High, Good, 126.8 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
5001-10,000m (V. High, V. Good, 125.9 km)	n/a	n/a	n/a	n/a	0.0159	0.0000	0.0045	0.0045	0.0045
>10,000m (excellent, 440.6 km)	n/a	n/a	n/a	n/a	0.0136	0.0000	0.0023	0.0023	0.0000
# Sightings	n/a	n/a	n/a	n/a	13	0	3	5	2

Table 8: Marine Mammal Detection Rates and Visibility During Fall Surveys

	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Fall Survey									
In Water									
500-1000m (Low, Poor, 105.7 km)	0.0000	0.0000	0.0000	0.0000	0.0189	0.0189	0.0000	0.0095	0.0000
1001-2500m (Moderate, 193.0 km)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0052	0.0000	0.0000	0.0000
2501-5000m (High, Good, 231.2 km)	0.0000	0.0000	0.0000	0.0000	0.0173	0.0087	0.0000	0.0130	0.0000
5001-10,000m (V. High, V. Good, 375.8 km)	0.0000	0.0000	0.0000	0.0000	0.0133	0.0080	0.0027	0.0053	0.0000
>10,000m (excellent, 1044.8 km)	0.0258	0.0000	0.0010	0.0010	0.0392	0.0163	0.0000	0.0287	0.0000
# Sightings	27	0	1	1	52	25	1	36	0
On Ice									
500-1000m (Low, Poor, 105.7 km*)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
1001-2500m (Moderate, 193.0 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
2501-5000m (High, Good, 231.2 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
5001-10,000m (V. High, V. Good, 375.8 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
>10,000m (excellent, 1044.8 km)	n/a	n/a	n/a	n/a	0.0010	0.0000	0.0000	0.0077	0.0000
# Sightings	n/a	n/a	n/a	n/a	1	0	0	8	0

Table 9: Marine Mammal Detection Rates and Sightability During Summer Surveys

	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Summer Survey									
In Water									
Poor (183.6 km)	0.0054	0.0000	0.0054	0.0000	0.0108	0.0000	0.0000	0.0054	0.0000
Low (177.2 km)	0.0113	0.0000	0.0056	0.0000	0.0000	0.0226	0.0000	0.0000	0.0000
Medium (220.9 km)	0.0272	0.0000	0.0181	0.0000	0.0181	0.0226	0.0000	0.0091	0.0000
High (183.6 km)	0.0054	0.0000	0.0163	0.0000	0.0272	0.0054	0.0000	0.0000	0.0000
Very High (329.7 km)	0.0516	0.0030	0.0394	0.0061	0.1122	0.0425	0.0030	0.0030	0.0000
# Sightings	27	1	22	2	48	24	1	4	0
On Ice									
Poor (183.6 km)*	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
Low (177.2 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
Medium (220.9 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0045	0.0000
High (183.6 km)	n/a	n/a	n/a	n/a	0.0381	0.0000	0.0054	0.0054	0.0109
Very High (329.7 km)	n/a	n/a	n/a	n/a	0.0182	0.0000	0.0061	0.0061	0.0000
# Sightings	n/a	n/a	n/a	n/a	13	0	3	5	2

Table 10: Marine Mammal Detection Rates and Sightability During Fall Surveys

	Narwhal	Beluga whale	Bowhead whale	Unidentified Whale	Ringed Seal	Harp Seal	Bearded Seal	Unidentified Seal	Polar Bear
Fall Survey									
In Water									
Poor (194.1 km)	0.0052	0.0000	0.0000	0.0000	0.0052	0.0103	0.0000	0.0103	0.0000
Low (393.9 km)	0.0051	0.0000	0.0000	0.0000	0.0127	0.0025	0.0000	0.0051	0.0000
Medium (870.3 km)	0.0000	0.0000	0.0000	0.0011	0.0092	0.0057	0.0000	0.0080	0.0000
High (356.0 km)	0.0000	0.0000	0.0028	0.0000	0.0281	0.0337	0.0028	0.0534	0.0000
Very High (135.6 km)	0.1770	0.0000	0.0000	0.0000	0.2065	0.0369	0.0000	0.0443	0.0000
# Sightings	27	0	1	2	52	25	1	36	0
On Ice									
Poor (194.1 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
Low (393.9 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0000	0.0000
Medium (870.3 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0046	0.0000
High (356.0 km)	n/a	n/a	n/a	n/a	0.0028	0.0000	0.0000	0.0084	0.0000
Very High (135.6 km)	n/a	n/a	n/a	n/a	0.0000	0.0000	0.0000	0.0074	0.0000
# Sightings	n/a	n/a	n/a	n/a	1	0	0	5	0

APPENDIX D

MWO Completed Post-Season Questionnaire

GOLDER

Program Design

1. What was your personal experience with the SBO program? Explain what you did or did not like about it?
    - Okay, need better equipment.
    - Access database – little fixes needed.
    - Ship was good.

2. What did you think of the Personal Survival techniques training held in Halifax?
    - Good but quick.
    - Enjoyable.

3. Would you like to see SBO program continue in the future?
    - Yes.

4. What do you think about the number of observers present on the icebreaker during the program??
    - 3 was a good number of observers.

5. What did you learn working with the biologists on the SBO Program?
    - Not much.

6. What do you think you taught the biologists working on the SBO Program?
    - Some local species ID.

7. What areas do you think are most important for narwhal? For other marine mammals? Why?
    - Depends on season.
    - Late spring – when there's still ice near the floe edge; once ice is broken they're everywhere, up Navy Board Inlet.
    - Summer – when ice is gone, near Ragged Island and Koluktoo Bay, Ragged Island to Bruce Head (go into Tremblay – feeding ground for mothers and calves – then down to south and sometimes north)
    - Fall – scattered around, most commonly past Ragged Island and in Eclipse Sound.

Data Analysis

1. Where does the ice typically start to form in Milne Inlet and Eclipse Sound?
    - Milne Inlet – near the mouth of river and then expands out (at port).
    - Eclipse Sound – from Navy Board Inlet first, when calm freezes the same throughout Eclipse.

2. Where does the ice typically start breaking up in Milne Inlet and Eclipse Sound?
    - Milne Inlet – at the river
    - Eclipse Sound – floe edge

3. Do you notice marine mammals in or around the ice breakup? Where?
    - Once ice starts to break up the whales and all wildlife start to come in.
    - Floe edge first in both Navy Board Inlet and Eclipse Sound.

4. Did you notice any narwhals swimming behind the ships where we left an ice track?
    - No.
    - Easier to tell when there's 24 hours of daylight, i.e. better to tell in summer.

5. Do marine mammals swim toward or away from the icebreaker?
    - When ship first comes in and whales are in front, they swim away.
    - Once the ship passes, they calm down.
    - Some will still try to swim away, others may be curious.
    - Even ships know they're scaring narwhal away because of their sonar.

6. Do they change their speed of their travel?
    - Hard to tell.
    - If close, faster.
    - If far, slower.
    - Depends on what they're doing.

7. Do they dive more or less around the ships?
    - Hard to tell because of how many there are.

8. Did you notice marine mammals coming close to the icebreaker or other ships?
    - No for the icebreaker.
    - Somewhat around other ships.
    - Usually try to keep their distance.
    - Near Bruce Head in spring – observed whales and when the icebreaker started to pass them the narwhal were gone.

9. At what distance from the icebreaker do marine mammals not change their behaviour?
    - Don't know.
    - At Bruce Head, once an ore carrier approaches they start to go away and then come back after it's passed.
    - Haven't observed icebreaker and narwhal from Bruce Head.

10. Do you think the icebreaker has a different impact on marine mammals than the ore carriers?
    - Depends on if there's ice or not.
    - If there's ice – yes, but hard to tell.

11. How far do you think the icebreaker should stay from marine mammals on ice, like polar bears and seals?
    - Don't know – haven't seen many polar bears with ice.
    - Seals – some are curious and will approach the ship.
    - Not as much about distance, more about the speed of the ship.

12. Do you expect any marine mammals, bowheads or seals present when ice is around to get hit by the vessel. Would any whales or seal possibly get hit by the icebreaker or an ore carrier, in your opinion?
    - Last year during the spring they nearly hit a narwhal – the narwhal went under the bow of the ship and was not observed again.
    - Seals move out of the way.
    - Bowheads have not been observed near the ship, normally off the sides of the ship and swim fast.

13. Did you see anything during the program that you did not expect to see?
    - Gyrfalcon catching and eating the kittiwake.
    - Last year – couldn't pass an ice pan, it was too thick and couldn't move.

Reporting

1. What do you think is the best way to describe the studies that were undertaken for the SBO program?
    - Don't know.

2. What is the best way to communicate results to the residents of Pond Inlet?
    - Meeting – more people would be interested in going to the meeting.
    - If a report is available, i.e. online, people would also look at it.

3. What do you think people are most interested in hearing about?
    - How the animals are affected by the icebreaking and shipping in general.

Adaptive Management

1. Has your opinion of the impact of shipping activities on marine mammals changed since you participated in the program?
    - Easier to understand how they're impacted because of the shipping because of this program.

2. Do you have any suggestions to improve how we are monitoring for shipping effects on narwhal?
    - Would also be good to consider bowheads as well – they're here as well in the summer and could be impacted.

APPENDIX E

Response to MEWG Comments

Baffinland

Name: Jeff W. Higdon, D. Bruce Stewart

Agency / Organization: Qikiqtani Inuit Association

Date of Comment Submission: 01 May 2020 (due 30 April 2020)

#	Document Name	Section Reference	Comment	Baffinland Response
2019 Program Questionnaire -SBO 1	2019 Ship-based Observer Program (2019_SBO Report Draft for MEWG Review_1.pdf)	General	How do the results from this program, subject to the numerous issues identified in this review, inform adaptive management and mitigation? Issues identified include the following: - uncertainty in species identification - uncertainty in numbers, group sizes - lack of info on methodology needed to repeat/ interpret/ compare the observational data - lack of data on species' responses at varying distances	The primary objective of the SBO program is to monitor for potential ship strikes and, secondarily, to collect opportunistic data on occurrence and distribution of marine mammals in the RSA. The SBO program is not structured as a systematic abundance estimation or behavioural effects study, nor does it offer an opportunity to undertake these types of studies. Baffinland has other monitoring programs designed for this purpose, such as the marine mammal aerial survey program, the narwhal tagging program and the Bruce Head shore-based monitoring program. If ship strikes on marine mammals were to have been recorded during the SBO program, or evidence of near-miss events, then additional adaptive management procedures would be explored such as further ship speed reductions. Given no such

#	Document Name	Section Reference	Comment	Baffinland Response
				sightings have been recorded to date, no additional mitigation measures are considered warranted at this time related to ship strikes. One of the long-term objectives of the SBO program is transition the study into an independent community-based monitoring program where trained Inuit researchers act as marine wildlife observers (MWOs) and are fully responsible for data collection and reporting. The Inuit MWOs are local hunters and are very knowledgeable of local species identification. The training program includes theoretical training on data recording protocol and additional support in the field. It is possible that a large number of small groups of seals in the distance are counted as a single large group by observers so that the MWOs can focus return their attention on the upcoming waters for any risk of potential ship strikes and that a greater effort is allocated on recording the total number of animals of each species observed at the expense of correctly recording individual group sizes. This concern was noted by the QIA on the 2018 SBO report and, as such, was emphasized during the 2019 SBO training program. It will continue to be emphasized in future SBO programs.

#	Document Name	Section Reference	Comment	Baffinland Response
2	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	General - Seal group sizes (with numerous sections for reference, including the Executive Summary, p. ii-iii; 1.3 MWO Training, p. 6; 2.2.3 Marine Mammal Observations, p. 25; 2.2.3.1 Species-Based Observations, p. 26-27; 2.3.3.2 Relative Abundance of Marine Mammals in RSA, p. 32; 2.2.3.3 Closest Point of Approach to Vessel, p. 44; Appendix A, Training Manual, 5.11.3 Marine Mammal Sightings, p. 36 [pdf page 118 of 150])	We identified significant concerns with the rigour and quality of the seal observation data collected in 2018, and these concerns, while acknowledged here, remain after reviewing the 2019 draft report. There were 61 ringed seal sightings, of 722 individuals, in Leg 1, for an average group size of ca. 12 individuals. These group sizes are not biologically realistic (the reported average group for ringed seals is ca. double that of harp seals, which contrasts with the general understanding [extensively documented] regarding the ecology of these species). There were 53 sightings of 58 individual ringed seals in Leg 2, and these numbers are biologically reasonable. For “Unidentified pinnipeds”, there were 9 sightings of 1,176 individuals in Leg 1, for an average group size ca. 131. These observations were of seals hauled out on ice, and therefore very likely represent multiple groups of ringed seals (and not harp seals, which aren’t typically observed hauled out in large groups on ice in the north Baffin region - and note that no hauled out harp seals were recorded during the 2019 SBO program). In	The SBO program is designed with the goal of ultimately developing this into a community-based monitoring program where trained Inuit researchers act as marine wildlife observers (MWOs) and are responsible for observations and data recording. The Inuit MWOs are local hunters and are very knowledgeable of local species identification. The training program includes theoretical training on data recording protocol and additional support in the field. It is possible that a large number of small groups of seals in the distance are counted as a single large group by observers so that the MWOs can focus return their attention on the upcoming waters for any risk of potential ship strikes and that a greater effort is allocated on recording the total number of animals of each species observed at the expense of correctly recording individual group sizes. This concern was noted by the QIA on the 2018 SBO report and, as such, was emphasized during the 2019 SBO training program. It will continue to be emphasized in future SBO programs. Through the training and during the SBO program MWOs have been and will continue to be encouraged to take photos whenever possible to assist with

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			contrast, there were 44 sightings of 49 individual unidentified seals in Leg 2, which results in mean group sizes that are typical, and expected, for ringed seals. The Leg 2 pinniped group sizes seem more reasonable based on known ecology and biology of these pinnipeds, so it is important to have a strong understanding of these differences and why they occurred. Two of the 3 observers from Leg 1 were on Leg 2 (s. 1.3), so observer differences are unlikely to explain the seal group size discrepancy. What factors explain this difference? More in-water observations due to less ice cover in Leg 2? Closer observations? Something else? For on ice (i.e., hauled out) animals), there were 13 observations of 673 ringed seals in Leg 1, plus 5 observations of 1,172 unidentified seals. Most (if not all) seals hauled out on ice are likely ringed seals, and the average group sizes make little ecological or biological sense. The Leg 1 ringed seal group sizes included multiple large (10+) groups, and the Leg 2 reported group sizes on-ice of up to 300 seals (s. 2.2.3.1). These observations provide	identification of species and group sizes. Comments specific to the training manual are beyond the scope of comments to the SBO program draft report, but advice will be taken into consideration in the development of training manuals future years. The recommendations made by the QIA to remove calculations of relative abundance are noted. In future years, this analysis will not be conducted, and this component will be removed from the monitoring program objectives.

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			clear evidence of the importance of early ice formation for seals, but again, are not realistic. In total (both legs), there were 53 sightings of 1,225 individual unconfirmed seal species, including 40 sightings of individuals in the water and 13 on ice, with group size up to 560 animals. These on ice group sizes are clearly not accurate. Issues with these data are acknowledged in the draft report, as s. 2.2.3.1 (p. 26-27) noted that "[t]he MWOs noted that the three sightings associated with large group sizes were quite a distance away from the vessel (1,500-2,000 m) with animals clustered together on a large ice pan making it difficult to distinguish specific groups. Therefore, the best estimate of the number of animals was used." Are photographs of these groups available? These data should be excluded due to unreliability, as the animals were clearly too far to accurately determine group sizes. This is not a "best estimate". The SBO report should present observations by distance category to determine the extent of this issue.	

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			The calculations of relative abundance are highly questionable given the group size estimation issues. Table 2 (s.2.3.3.2, p. 32) should be broken down by distance class given the issues noted. Are unreliable observations of seals made at 1.5 km or more away from the vessel included? Given the issues noted, they should not be included. Table 11 (s. 2.2.3.3, p. 44) indicates that seal detections were made on ice at distances of up to 2000 m, with both ringed and unidentified seals - what makes groups identifiable to species in some cases but not others? Different observers? Different visibility conditions? It is important that MEWG members see a detailed summary, including data summarized by distance classes. Relative abundance should be recalculated using truncated distance data to address data quality issues. The relative abundance data are highly uncertain since we don't have information on the distribution of sightings by distance, and unreliable due to the inclusion of questionable seal group size observations. The number of sightings of both identified (i.e., to species) and	

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			unidentified seals should be summarized by distance. The instructions (Appendix A, Training Manual, 5.11.3 Marine Mammal Sightings, p. 36 [pdf page 118 of 150]) for multiple pinniped sub-groups are not clear. If you are recording “the number of sub-groups and their respective group sizes”, isn't that the same as entering many separate sightings? If each sub-group has a respective group size recorded, how it is recorded as one sighting? The following page (p. 37) slightly clarifies the instructions with respect to multiple seal groups, specifying that a note should be added to the Comments section in the database on “the number of sub-groups you observe and how many are in the sub-groups”. If this info is included in the Comments, it should be possible to expand the data to treat these sub-groups as actual separate groups (which they are, if > 5 body lengths separate them), rather than analyze data that clearly don't distinguish group size accurately. It would be useful to see photos of what the observers are seeing for seals to get a better understanding of where these unrealistic	

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			group size estimates are coming from.	
3	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	General - Methods (numerous sections including 2.1 Survey Methods, p. 7; Appendix A, Training Manual, s. 5.2 Observer Position, p. 8, pdf page 90 of 150)	Regarding observer position on the bridge of the *Botnica*, more details on the observation platform are needed. For example, how high are the observers above the water line? This information, i.e., observer eye height, is needed as part of the analyses of the seabird data following CWS protocols for distance sampling methods. Did all observers have observer-specific distance gauges? Can the entire 90-degree arc on one side of the vessel be observed from the bridge? Re: "When the vessel was stationary, the MWOs attempted to visually survey on all sides (360°) of the vessel, although the design of the bridge made this somewhat impractical." Define "somewhat". How much could be observed? Some of this information is included in the Training Manual, but should be added to the main text to increase clarity. For example, the Training Manual notes that "[t]he bridge on the *Botnica* offers good visibility all around the vessel." This would be useful to mention in the main report. Similarly,	The text has been revised to include: "The height of the bridge of the MSV Botnica is 20 m above sea level. An estimated observer eye-height of 1.7 m was considered for all observers in reticle distance calculations. The bridge on the MSV Botnica offers good visibility all around the vessel". The bridge provides a suitable 90-degrees arc on either side to complete the seabird counts in accordance with ECSAS protocols. The text was modified to indicate: "When the vessel was stationary, the MWOs walked around the bridge to visually survey on all sides (360°) of the vessel." The original statement referred to the fact that MWOs could not see 360° around the vessel from a single location, as is the case for all bridge. The observers could, however, survey 360° by simply walking to different positions on the bridge.

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			the Training Manual reports the bridge height, which should also be in the main report.	
4	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	General - Distance estimation (numerous sections including 2.1 Survey Methods, p. 8; 2.2.3.3 Closest Point of Approach to Vessel, p. 44; 3.1 Survey Methods, p. 53; 3.1.3.2 Species Density and Probability of Detection, p. 54)	1. More information is needed on how distances were measured and/or estimated. In s. 2.1 (Survey Methods, p. 8), the draft report states that "distances to the animals were often estimated with the naked eye because the horizon was rarely visible…". What training was done for distance estimation? How was accuracy of the different observers tested and accounted for? What proportion of observations were estimated? 2. Narwhal detections were reported at up to 5000 m (and bowhead up to 2,700 m, etc.) (e.g., see s. 2.2.3.3, p. 44). How are these extreme distances being measured and how accurate can we expect them to be?	1. When possible, distances were measured using reticulated binoculars. Distances cannot be calculated using reticle binoculars unless a horizon unobstructed by land is visible. Due to the high land features in the survey area, there were few occasions when an unobstructed horizon was visible and therefore distances to observations were mostly estimated by eye. When possible, distance estimation was compared to distances to known objects, i.e. other vessels on the ship's radar or GPS plotter. Additionally, distance estimates to sightings were often compared between observers, especially to those with extensive field survey experience from vessel platforms. Twelve percent of marine mammal sightings were observed using reticulated binoculars. 2. The observation identified as narwhal at 5,000 m was reported incorrectly. The detection was initially recorded as possible narwhal (based on the size and shape of the blows and the lack of tall dorsal fin to indicate killer whale) but was subsequently re-assigned as

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				unidentified cetacean sighting due to the distance to the observation and subsequent low confidence in ID. Table 12 in S. 2.2.3.3 of the report has been updated to reflect this. This unidentified cetacean sighting was one of the observations for which distance could be measured using reticulated binoculars given the horizon over open water was visible (looking east toward Baffin Bay). The bowhead whale was detected by eye and estimated to be 3,700 m away by an experienced Golder field team lead (30+ year experience of ship-based marine mammal and seabird surveys) because no unobstructed horizon was visible.
			3. Section 3.1 (Survey Methods, p. 53) states that "perpendicular distance from the observer [was] estimated." Were all distances estimated? Were any measured (reticle binoculars, observer-specific distance gauges)? How was observer accuracy and precision in distance estimation assessed and measured?	3. As noted above, 12% of marine mammal sightings were observed using reticulated binoculars while the remaining were observed with naked eye or non-reticulated binoculars therefore distance was estimated by eye or in reference to distances to known objects. Additionally, distance estimates to sightings were often compared between observers, especially to those with extensive field survey experience from vessel platforms.
			4. Section 3.1.3.2 (Species Density and Probability of Detection, p. 54) states that "[w]hen distances to seabirds are measured…", when the report previously said distances were estimated.	

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			Which is it? What proportion of distances were measured, and how?	4. The text has been modified to indicate: “When distances to seabirds are recorded…”.
5	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	General - Environmental data (including 2.1.1 Data Analysis, p. 8-9; 2.2.2.2 Sighting Conditions, p. 15; 3.1 Survey Methods, p. 53; Appendix A, Training Manual, 5.10 Environmental Variables, p. 26, pdf 108 of 150)	1. Were environmental variables recorded at the end of each watch as well, or only at the start or when conditions changed? Section 2.1.1 (p. 8-9) states that data were collected at the start of each watch or when conditions changed. Section 2.2.2.2 (p. 15) says condition data were collected at both the start and end of each watch. 2. For the Near Field and Far Field Ice Cover variables, was 100 m measured or estimated? If the former, how? If the latter, what data on observer accuracy of distance estimation are available? 3. Were sea ice data (sea ice forms, sea ice concentration) collected using the codes in the Eastern Canada Seabirds at Sea (ECSAS) manual? The	1. Environmental variables were recorded at the start and end of each watch and whenever environmental (or vessel activity) variables changed. However, the environmental data at the end of a watch are not included in any analyses as it is not associated with any following observation period or sightings. To avoid potential confusion, the text in Section 2.2.2.2 of the report has been updated to “at the beginning of each watch period and anytime environmental variables changed”. 2. The 100 m distance for the Near Field ice cover observations was estimated. Given that the Botnica is 97 m in length, the MWOs could use the length of the ship as an relative reference to measure 100 m. This variable was used as indication of ice coverage in the vicinity (near field) of the vessel rather than in the entire field of view. The accuracy of this estimation was not tested, nor does it need to be tested for the use of this information. 3. Sea ice data was collected using information provided by the MSV Botnica’s ice captain, captain and vessel

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			draft report does not provide any indication as to whether environmental data were collected based on the CWS protocol for seabird observations, e.g., the ECSAS ice type codes.	crew. Proportion of ice was an estimated percentage of ice coverage within the near and far fields.
6	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	General - Closest point of approach and behavioural data (multiple sections including 2.1.1 Data Analysis, p. 9; 2.2.3.1 Species-based observations, p. 26-27; 2.2.3.3 Closest Point of Approach to Vessel, p. 44; Polar Bear, p. 45; 2.2.5 MWO Program Feedback, p. 50; Appendix A, Training Manual, s. 5.8 Behaviours, p. 22-25 (pdf pages 104-107); Appendix A, Training Manual, 5.11.3 Marine Mammal Sightings, p. 36 (pdf page 118 of 150))	The draft report has numerous data gaps and deficiencies with respect to how data are reported and analyzed for both marine mammal behavioural observations and closest point of approach (CPA). No behavioural data are reported at all, and the CPA data are deficient. 1. For CPA, what proportion of estimates were done with the naked eye (i.e., estimated), with reticle binoculars, and with known distances to reference points? 2. In s. 2.2.3.1, why are no behavioural response data reported? For example, data on the distances at which hauled out seals entered the water or showed vigilance behaviour? For the polar bear observations, what primary and secondary behaviours were recorded? Given that none of these data are included, how does this report contribute to monitoring FEIS predictions?	1. Twelve percent of marine mammal sightings were observed using reticulated binoculars while the remaining were observed with naked eye. 2. As part of their marine wildlife observer training, MWOs were asked to record data regarding observed behaviour, but the SBO Program is not designed as a survey platform to analyse primary and secondary behaviour. As such, they were not included in the report. The SBO Program is strictly designed to monitor against FEIS predictions regarding potential. As reported in Section 2.2.3.1, both on-effort polar bear observations consisted of polar bears walking on ice. The polar bear observed by the vessel crew (when the MWOs were off effort) was of a single bear first resting on ice and then running across the ice. 3. Assessing localized avoidance and/or attraction is not an objective of the SBO

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			3. It is important that MEWG members see data on the initial distance of sightings compared to the CPA distance, as these data provide information on vessel avoidance and/or attraction. 4. The mean CPA distances for narwhal and ringed seal were significantly larger during Leg 2 compared to Leg 1. What are the potential reasons for this difference? Are there any differences when empty vessels are transiting to port versus when loaded vessels are transiting from port? 5. What were the behavioural reactions of the polar bears observed? What was the initial sighting distance compared to CPA distance? The lack of reporting on behavioural data is a significant deficiency in this draft.	Program as the survey design (i.e. not before- or after-impact control variable) is not compatible with collection of this information. Presenting initial distances to sightings will be considered in future SBO programs. 4. Given that sighting distances were approximations, statistical conclusions regarding CPA from leg 1 and leg 2 have been removed from the report (in response to DFO/CPA comment #5). The primary objective of the SBO program is to monitor for potential ship strikes and, secondarily, to collect opportunistic data on occurrence and distribution of marine mammals in the RSA. The program is not structured as a systematic behaviour effects survey. 5. As reported in Section 2.2.3.1, both on-effort polar bear observations consisted of polar bears walking on ice. The polar bear observed by the vessel crew (when the MWOs were off effort) was of a single bear first resting on ice and then running across the ice. The primary objective of the SBO program is to monitor for potential ship strikes and, secondarily, to collect opportunistic data on occurrence and distribution of marine mammals in the

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			6. Section 2.2.5 (MWO Program Feedback, p. 50) summarizes observations from the observers. It notes that "[t]he MWOs indicated that it was hard to tell whether marine mammals change their travel speed around ships. They noted that when the vessel was closer, marine mammals travel faster than when the vessel was further away, but that this response was variable and influenced by what behaviour the whales were engaged in prior to vessel exposure." These behavioural observations need to be analyzed and reported. At present we have a partial SBO report only. How did behaviour prior to vessel exposure influence response? How was exposure defined? What behaviours? Furthermore, "[t]he MWOs indicated that the impacts of the icebreaker on marine mammal behaviour compared to ore carriers depended on whether there was ice or not and that if there was ice, they would say that the impacts are	RSA. The program is not structured as a systematic behaviour effects survey. Baffinland has other monitoring programs designed for this purpose, such as the marine mammal aerial survey program, the narwhal tagging program and the Bruce Head shore-based monitoring program. 6-7. The primary objective of the SBO program is to monitor for potential ship strikes and, secondarily, to collect opportunistic data on occurrence and distribution of marine mammals in the RSA. The program is not structured as a systematic behaviour effects survey. The SBO program is not designed or assessing the behaviour of marine mammals around project vessels before, during and after exposure as there is no control.

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			different, though it was difficult to confirm." How is it different, and why? Better planning is needed to identify questions, properly train and equip personnel, gather the necessary data, analyze the results, and present them coherently with methodological descriptions that facilitate repeatable, comparable studies over the long term. Behavioural data are needed, and should be analyzed with ice condition data. 7. Observers "also indicated that the effects seemed to be more related to vessel speed than the distance of approach." Observations should be analyzed with data on both vessel speed and distance. 8. The draft report summary (s. 4.0, p. 61) states that "distances maintained by marine mammals from the survey vessel in 2019 (i.e., CPA results) lend confidence to existing environmental assessment predictions...". We cannot have confidence in this statement without seeing the data, and CPA results need to be comprehensively summarized in this report. 9. The Training Manual (s. 5.8 Behaviours, p. 22-25 [pdf pages 104-107]) lists a	8. Summary data for CPA is presented in Table 12 of the Final Report, in section 2.2.3.3. The results simply indicate that marine mammals are not generally found in the near vicinity of the vessel, hence suggesting localized avoidance. 9 and 10. As part of their marine wildlife observer training, MWOs were asked to record data regarding observed behaviour, but the

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			number of behaviours that observers should record, but the only one with any data reported on is hauling-out, and that is only because the in-water and on-ice observations are considered separately. All behavioural observations should be summarized. 10. The instructions in the Training Manual (Appendix A, Training Manual, 5.11.3 Marine Mammal Sightings, p. 36 [pdf page 118 of 150]) specify that distance of initial sighting, distance of closest approach, and primary and secondary animal behaviours are to be recorded. Why aren't these data analyzed and presented?	SBO Program is not designed as a survey platform to analyse primary and secondary behaviour. As such, they were not included in the report. The SBO Program is strictly designed to monitor against FEIS predictions regarding potential ship strikes.
7	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Executive Summary, p. ii	If Project shipping started on 17 July, why did the SBO program not start until 19 July?	The first vessels (including the MSV Botnica) entered the RSA on the evening of 17 July. The MSV Botnica was then stationed at Milne Port on 18 July 18 (per the 24-hour transit restriction mitigation), during which time the MWOs boarded the vessel. Boarding of the vessel prior to arrival at Milne Port is not possible given that a safe means for boarding at sea has not been identified.
8	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Study Limitations, p. vi	"Electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore no party can rely solely on the electronic	Should the QIA require hard copies of the final reports, the reports can be sent to the QIA office at their request.

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			media versions of this document." If this is the case, why aren't we receiving hard copies for review if we can't rely solely on the pdf, especially considering that the pdf file is secured to prevent modification?	
9	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	1.0 INTRODUCTION, p. 4 (also see 3.2.3 Ship Strike Events, p. 59)	Re: PCC 21 - was the Long-tailed Duck (LTDU) mortality reported to ECCC? Did Baffinland's Environmental Coordinator immediately report the LTDU mortality? What was done with the carcass?	The long-tailed duck mortality was reported by the MWO team to Baffinland Environmental coordinator on 12 October 2019. The long-tailed duck mortality was then reported to ECCC via the CWS office, as well as reported to the QIA and MHTO. The carcass was disposed of at sea by the ship crew.
10	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.0 MARINE MAMMAL MONITORING, p. 7	This section says that Leg 1 was from 19-29 July. The presentation shown at the February MEWG meeting said the *Botnica* stopped escorting vessels on 26 July. Why the discrepancy?	The MSV Botnica escorts Project vessels for as long as ice conditions require it. The 26 July was the last day the MSV Botnica was required for ice management and escorting vessels through the RSA. The MSV Botnica was then used opportunistically for work retrieving a fish camera trap during which the MWO team remained onboard and conducted marine mammal and seabird observations whenever possible. The MSV Botnica completed this work and returned to Milne Port on 29 July when the MWOs left the vessel.

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11	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.2.2.1 Ice Concentrations, p. 12	More information is needed on how mean and median ice concentrations were calculated. For weekly ice cover, how was the start and end of each week defined? Was survey day 1 the start, regardless of day of week? Some of this information is available in the Appendix, but having it in the main report would improve clarity. How were missing data (i.e., days when charts were not available) considered in the calculations?	For weekly ice cover survey, day 1 was the start of the week regardless of the day of the week and including dates within the survey period only. Weekly mean/medians were calculated for Leg 1 for Week 1 (19–25 July), Week 2 (26–29 July), and for Leg 2 for Week 1 (5–11 October), Week 2 (12–18 October), Week 3 (19–25 October) and Week 4 (26–28 October). These date ranges are indicated on the corresponding ice cover data maps. There were no days with missing ice charts for mean and median ice cover calculations.
12	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Beaufort Sea State, p. 18	"Conditions above Beaufort Sea State 4... were not recorded…". Unclear - conditions were not encountered? Or no data were collected in these situations?	The text has been updated to clarify that: "Conditions above Sea State 4 were not recorded during on-effort periods by MWO during 2019 SBO Program.
13	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Sightability, p. 22 (also section 2.2.3.2.4 Sightability, p. 42)	1. What data were collected on observer variation in their qualitative estimates of sightability? How was this variation controlled for in the data analysis?	1. The MWOs calibrated their environmental reporting, including assessment of sightability, early at the start of the program through training on the vessel, as well as throughout the program by cross-referencing sightability measures with each other and Golder program leads. The variability in observer variation was not controlled in the data analysis. The primary objective of the SBO

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			2. Summary data should be presented that shows how the different variables (weather, Beaufort Sea State, visibility) contribute to the overall sightability determination, and how this varies by observer. Comparisons of sightability within a leg, between legs, etc. depend on a clear understanding of how sightability scores vary with conditions, observer, etc.	program is to monitor for potential ship strikes and, secondarily, to collect opportunistic data on occurrence and distribution of marine mammals in the RSA. 2. Baffinland responded to a similar comment provided by QIA on the 2018 report ("It would also be useful to see more on the relationships between sightability variables (weather, sea state, visibility) and the index measure"). Though Golder deemed it was beyond the scope of the SBO program, the SBO program report for 2019 presented extensive tables summarizing the detection rates of marine mammals given the environmental conditions encountered during the SBO program including Near and Far Field Ice Cover, Sea State, Visibility and Sightability. Sightability remains a qualitative measure based on the observer's assessment of overall sighting conditions.
14	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.2.3.1 Species-based observations, p. 26-27	The ringed seal section references Figure 27, but no seal sightings are displayed there. It shows locations of dead narwhal - is this described in text? A word search for "dead" only finds the two uses in the figure title and legend.	There was an error in the figure reporting. Figure 27 (Leg 1 polar bear and pinniped sightings) and Figure 28 (Leg 2 pinniped sightings) are now both in the report. A paragraph in Section 2.2.3.1 has been added to provide additional context regarding these

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			These observations should be described. Were animals floating? On ice? Evidence for harvest (e.g., maqtaq removed)? Struck/lost? Why are Leg 2 pinniped sightings not mapped? Figure 28 shows Leg 1 only.	observations. Three of the observations were floating and the fourth was on the beach. Additional details were not provided in the report as none of the Inuit MWOs or Golder MWOs observed that the dead narwhal could have been the result of a ship strike or struck/lost.
15	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.2.3.2.1 Ice Cover During Shoulder Seasons	"Environmental conditions were extrapolated to the time of the most recent sightings and, as such, may not have accurately reflected the ice cover condition at the exact time of the sighting, but rather in the general vicinity of the sighting." This isn't clear. Do the ice conditions reported with a sighting not necessarily correspond with those at the sighting location? If so, how do we interpret the results? Are the ice observations taken at intervals? If so, at what frequency (separation in time/ distance), as this might help define the resultant uncertainty.	Environmental observation conditions, including ice cover, were recorded at the start of MWO watches, every 30 minutes and any time environmental conditions changed during MWO watches. When marine mammal sightings occurred, the last recorded environment conditions are associated with this sighting. The statement has been removed from the report to avoid confusion.
16	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.2.3.2.1 Ice Cover During Shoulder Seasons, p. 34-39	These sections aren't clear as to what is being described. Are the sightings reported in the "Near Field Ice Cover" sub-section only those made within 100 m from the observers? Were those	As described in each section for Near and Far Field Ice cover (see Section 2.3.2.1), Near Field Ice cover data was collected to provide an estimate of the proportion of time that the MSV Botnica was engaged in icebreaking

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			reported in the "Far Field ice Cover" sub-section only those made > 100 m from the observers? Some sentences seem to suggest this is the case former, others (e.g., beluga) do not. It would be more useful to present a summary of both near and far-field ice conditions for the various sightings, which would provide greater information on ice extent near vessels and marine mammal habitat use during the shoulder seasons. In addition, why was such a narrow band used for "Near field" with everything else as "Far field", given the size and noise output of these vessels?	activities, i.e. higher percentage of ice cover indicative of times when the Botnica was icebreaking, and Far Field Ice cover data was collected to provide information on ice cover over the wider extent of the observation area, i.e. a potential variable in the sightability of marine mammals. We acknowledge the text was confusing and it has been updated to reflect that all sightings rates were assessed in relation to both near and far field ice cover and not only in relation to whether they were within 100 m of the vessel (Near Field) or farther than 100m of the vessel (Far Field).
17	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.2.3.2.2 Beaufort Sea State, p. 39	What is Beaufort Sea State (BSS) 0.5? The World Meteorological Organization (WMO) sea state code uses 0 for calm (glassy) and 1 for calm (rippled). There is no 0.5 code. What is the source for the codes and descriptions in Table 8? Appendix A (Training Manual, Table 3, p. 27 (pdf page 109 of 150)) shows a Beaufort Sea State table with no 0.5 code, while Table 4 in Appendix has 0.5. We have never seen a BSS of 0.5 used in practice, what is the justification for this?	This has been updated in the report and will be updated in future training manuals. A scale for Sea State (analogous to Beaufort sea state) was used which additionally distinguished glassy, rippled or small wavelet sea states (SS 0, 0.5 and 1 respectively). All Sea State references have been corrected to not read as Beaufort Sea State, but Sea State only.

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18	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Bearded Seal, p. 45	This section says “ringed seal” in addition to bearded seal. Typo?	The typo has been corrected.
19	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.2.4 End of Shipping Season Aerial Clearance Surveys, p. 45	On 30 October, the *Botnica* transited out while escorting an ore carrier - why was SBO program suspended prior to this date?	Following a safety review of the program in 2017, it was identified that the only safe place for MWOs to onboard and disembark the vessels was at Milne Port. This means that the first and last transit of each shipping season does not have any SBO coverage.
20	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.2.4 End of Shipping Season Aerial Clearance Surveys, p. 46	“Results of the end of season aerial clearance survey suggest that no entrapments occurred in 2019 as a result of icebreaking and Project shipping.” What information on the progression of past entrapment events is available to support this statement? We do not consider two days of surveys to be sufficient to have confidence in this statement.	This statement is supported by the ice conditions at the time of the program, the location of marine mammal sightings, input from community members (including the MHTO) participating in the survey and the fact that, following the end of the shipping season, no entrapment events were identified. If an entrapment event were to occur later in the season, it would be very difficult to correlate this to shipping activities.
21	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.2.4 End of Shipping Season Aerial Clearance Surveys, p. 46-48	Figure 5 is cited for the 31 October survey but does not show this information. The 31 October track line isn't shown on any map figure that I saw. In the Table of Contents, Figure 31 is titled “Flight Path and Observations During the 31 October Clearance Aerial Survey”, on p. 48, but this	Figures 29 and 30 have been updated with the correct figures showing flight tracks for 30 and 31 October, respectively.

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			figure is missing and has been replaced by the figure on Ringed seal breathing holes, which is listed in the Table as Figure 32 on p. 49.	
22	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	2.2.5 MWO Program Feedback, p. 50	Why did only 2 of the 4 local observers participate in the end-of-program interview?	All observers were invited to participate. This was conducted as a paid, but voluntary option for MWOs. It is not a requirement of their employment with the program.
23	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	3.1.3.2 Species Density and Probability of Detection, p. 54	"Densities are presented without regard for environmental variables because preliminary review of data indicated that low samples sizes were going to be limiting…". What about a combined analysis with 2018 data? Sample size would be greatly increased. Re: "... obvious data heaping at certain distances)", what distances? More details on how and why data were excluded is needed.	Combining data from previous years would add an element of temporal variance that cannot be controlled. The analysis excluded seabird observations beyond 300 metres. There was not data heaping in the data collected for this program. The statement is a general statement used to describe how and why data is processed for seabird analyses.
24	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	3.1.3.2 Species Density and Probability of Detection, p. 55	"When estimating detection functions and seabird densities data from both spring and fall survey period were combined so that adequate sample sizes could be obtained (Table 12). Sample size using combined spring and fall data was large enough to estimate species-level densities for northern fulmar only; all other species	This was a mistake and should read northern fulmar. The text has been updated in the report. Please note that 82 transects was also a typo and should read 87, as per Table 15. This has been updated.

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			had inadequate sample size for this analysis." If Northern Fulmar (NOFU) was the only species for which species-specific density estimates were calculated, why does Table 12 list sample size for Glaucous Gull (GLGU) and not NOFU? Is the shown sample size (n = 87 transects with sightings) for NOFU or GLGU?	
25	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	3.2 Results, p. 55	"Only a cursory assessment of the seabird data recorded as part of the 2019 SBO Program is presented in this report. The complete 2019 seabird sightings database has been provided to CWS." A cursory assessment is not sufficient and does not provide the information needed to inform adaptive management and mitigation. The Canadian Wildlife Service will not be providing the necessary analyses, and this is the Proponent's responsibility. When can the MEWG expect a detailed analysis of the seabird data?	The following was stated by ECCC at the February MEWG Meeting. "We are seeing the same species in these monitoring programs, where they are, the timing of where they are. With this type of information being collected year over year, you are able to better understand what the trends are and how the Project may be affecting the environment. Especially with all the regional monitoring being undertaken, you are able to make more informed decisions in terms of management. This type of monitoring also allows researchers such as ECCC to be able to integrate these multiple sources of information and then know whether or not additional management measures need to be undertaken." At present, Baffinland has not identified any additional mitigation measures that need to be undertaken, however Baffinland will

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				continue to work closely with ECCC and CWS to seek further guidance on this.
26	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	3.2.1 Species Relative Abundance, p. 55	"... 231 5-min surveys during Leg 1 and 1,008 5-min surveys during Leg 2." Why is there such a discrepancy in the number of surveys conducted, with over 4X times as many in Leg 2 as Leg 1?	The following text has been added: "The discrepancy in the amount of effort between Legs 1 and 2 was due to a number of factors. Leg 2 survey duration was more than twice as long as Leg 1. There was an additional member on the observer team during Leg 2. This meant that more time could be spent on seabird observations. Additionally, less time was required during Leg 2 to liaise with vessel crew to coordinate survey planning and communicating mitigation requirements."
27	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	3.2.1 Species Relative Abundance, p. 55-56	Does Table 13 show all sightings or only those within the 300 m distance that was used for density estimates? The number of transects with observations should be reported for all species, either in Table 13 or elsewhere (e.g., a data appendix).	Only sightings within 300 m of observers were recorded as per the ECSAS methodology and, therefore, used in the analysis. The number of transects with observations for each species was added to Table 14.
28	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	3.2.2 Density Estimates and Probability of Detection, p. 59	The detection probability from Bolduc and Fifield (2017) should be reported to allow a direct comparison without having to find the other source.	This has been added into the report.
29	2019 Ship-based Observer Program (2019_SBO Report_Draft for	3.2.2 Density Estimates and Probability of Detection, p. 59	How is the density of "all seabirds" lower than that for Northern Fulmar (NOFU) only? Is it "all species excluding NOFU", or are	The density of all seabirds is lower than northern fulmar because the probability of detection for northern fulmar is lower than was

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	MEWG Review_1.pdf)	(and Executive Summary)	there analysis errors? If NOFU are excluded from the "all seabirds" calculation this needs to be clearly stated.	predicted for all seabirds (i.e., 0.55 versus 1.00, respectively). The lower probability of detection for northern fulmar increases uncertainty in the density estimate.
30	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	4.0 SUMMARY, p. 61	"The SBO Program was designed to meet Conditions No. 106, 108, 121, 122, 123, and 126…". How well did the program address these conditions?	106: Shipboard observers were employed and provided required training as part of their employment. Observations were performed from inside the bridge of the vessel. 108: The data produced by the SBO program was analysed by experienced biologists employed by Golder Associates Ltd. The biologist responsible for analysisng the data was also on the vessel leading the team of SBOs collecting the data. The report is also subject to review by the MEWG, who participate in the group on the basis of their technical expertise. 121: The long-tailed duck mortality was reported by the MWO team to Baffinland Environmental coordinator on 12 October 2019. The long-tailed duck mortality was then reported to ECCC via the CWS office, as well as reported to the QIA and MHTO. 122: See Baffinland 2019 Annual Report to the NIRB.

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				123: Marine mammal observers are positioned on a vessel that remains in the RSA for a longer period than other project vessel, while reducing risks associated with safe onboarding of the observers. The presence on the MSV Botnica also positions the MWOs on the first vessel on any convoy. This would ensure that MWOs could observe and report any potential collisions with marine mammals. 126: Nine Inuit trainees from Pond Inlet participated in a Transport Canada approved offshore safety training course in Halifax, NS, from 11–15 May 2019 for the 2019 SBO Program; four Inuit researchers were selected from this pool of trainees to participate in the 2019 SBO Program. Two of these observers were returning observers from the 2018 SBO program.
31	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	4.0 SUMMARY, p. 61	"Data collection methodology for the 2019 SBO Program was similar to the 2018 SBO Program with slight adjustments in protocol to address recommendations provided by the MEWG." What adjustments were made? Are they summarized in this document?	Yes, the adjustments made from 2018 to 2019 are listed in Section 1.1 Program Background and include the following: -Ice cover data was collected during active watch periods at two spatial scales: Ice cover in the Near Field and Ice cover in the Far Field -Median and mean ice conditions were used to define sea ice normal values.

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				-Weekly ice chart maps were produced for inclusion in the annual monitoring report. -The relationship between sightability parameters and detection rates was evaluated. -Seal group size was defined in the SBO training manual and data collection methods for seal group size were explained to Inuit researchers during the SBO training program and field program.
32	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	4.0 SUMMARY, p. 61	"The increase in relative abundance observed in 2019 may have also been a result of new adaptive management measures implemented during the early 2019 shoulder season to specifically reduce icebreaker noise impacts on narwhal…". We are glad to see acknowledgement of the Project's potential effect on narwhal distribution and relative abundance in 2018. It is important going forward that vessel presence and proximity relative to the Pond Inlet ice edge be carefully monitored to assess potential future effects on narwhal distribution and abundance and inform adaptive management including the establishment of EWIs and thresholds.	No response requested.

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33	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix A, Training Manual, s. 2.0 OBJECTIVES, p. 1 (pdf 83 of 150)	Documenting marine mammal and seabird interactions should include documenting responses to vessel presence (i.e., behaviour) - see other comments on this issue. Recording numbers and locations isn't documenting interactions, and interactions means more than just ship strikes or near misses. Similarly, behavioural impacts on marine mammals or seabirds are “incidents of concern”.	See previous responses.
34	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix A, Training Manual, s. 5.1 Field Schedule, p. 6 (pdf page 88 of 150)	What is the procedure for getting a second observer on deck if there are many sightings? How quickly can a second observer get in position?	The primary objective of the SBO program is to monitor for potential ship strikes and, secondarily, to collect opportunistic data on occurrence and distribution of marine mammals in the RSA. It is possible that in period with many sightings, some sightings could be missed. The MSV Botnica is an opportunistic platform for data collection on marine mammal presence and distribution, unlike a systematic distance sampling survey. A Golder lead is present on the bridge throughout the day and available to step in and assist when there are multiple sightings or call other MWOs to the bridge to assist, if needed.

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35	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix A, Training Manual, 5.2 Observer Position, p. 8 (pdf page 90 of 150)	"When two observers are on watch together, each focus their survey efforts to their side of the vessel with some overlap at the bow…". The report makes no mention of how this was considered for data analysis (i.e., single versus two observers on watch, how this influences detectability, etc.).	During the 2019 SBO Program, all watches were conducted by one observer at a time. As such, the analyses did not need to consider changes in detectability for one vs. two observers.
36	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix A, Training Manual, s. 5.5, p. 13 (pdf 95 of 150)	Four different resources for estimating distance are listed - how often did the observers use these resources? For example, how often did crew members assist? How much practice and training (with rangefinders, reticle binoculars, etc.) was conducted?	The choice of method used to estimate distance was left to the observers. As noted earlier, 12% of observations were recorded with reticulated binoculars when the horizon over open water was visible. Data on which of the other resources were used was not recorded.
37	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix A, Training Manual, s. 5.5, p. 13-14	For observers of average height, reticle binoculars are of little use at distances under 300 m given the height of the bridge (see Table 2, Appendix A, distance table example). An accurate measure of 300 m (and lesser distances) is critical for the seabird survey protocol. How were distances under 300 m determined? All estimated?	All seabird survey distances were estimated by eye and the primary seabird observer was very experienced at vessel-based marine mammal and seabird surveys. As such, the seabird observer frequently attempted to calibrate distance estimates to known reference points at varying distances throughout the SBO program.
38	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix A, Training Manual, s. 5.7 Species Identification, p.	"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."	Through the training and during the SBO program MWOs have been and will continue to be encouraged to take photos whenever possible to assist with

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		18 (pdf 100 of 150)	How often did observers take photographs? It would be useful to see photos of the seal observations with large (and questionable) group size estimates. What camera models are used? Do they have image stabilizing lenses, and what lens sizes?	identification of species and group sizes. In 2019, the MWOs were confident with their species identification and did not take photos of large seal groups. The camera provided to the observers was a Canon EOS 5DS R DSLR camera with a Canon 100-400 mm lens.
39	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix A, Training Manual, 5.10 Environmental Variables	The training manual states that "[e]nvironmental variables should be recorded... if the environmental variables or vessel position changes during a watch…". Isn't the vessel position constantly changing while en route?	The text is referring to vessel activity and this will be updated in future versions of the manual. The vessel may either be enroute while escorting a vessel or stationary while waiting for a vessel to meet up with the MSV Botnica for escort.
40	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix A, Training Manual, s. 5.11.2 Environmental Observations, p. 35 (pdf page 117 of 150)	"... it is good practice to take at least one shot [photo] of each environmental variable…". Agreed. How often was this done?	This was left at the discretion of the MWOs.
41	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix D - MWO Completed Post-Season Questionnaire (p. 3, pdf page 149 of 150)	The main report said 2 of 4 observers completed questionnaires. Are both merged here, or is only one provided?	The end-of-season feedback from the MWOs was done as a group discussion. Responses for both were recorded collectively.

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42	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix D - MWO Completed Post-Season Questionnaire (p. 3, pdf page 149 of 150)	Re: the question "What did you learn working with the biologists on the SBO Program?", the observer's response was "Not much". The question "What do you think you taught the biologists working on the SBO Program?" was answered "Some local species ID". The observer's perspective here suggests this was largely a one-way transfer, what can Golder/Baffinland do to improve knowledge transfer?	MWOs hired from Pond Inlet were provided two different training sessions, the first of which included a trip to Dartmouth Nova Scotia and resulting in the achievement of a Personal Survival Techniques – STCW Basic Training Level 1 Certificate. Secondary training regarding data collection and species identification was provided as part of the program (see training manual). Additional discussions will be had prior to future SBO programs to determine optimal ways to maximize knowledge transfer.
43	2019 Ship-based Observer Program (2019_SBO Report_Draft for MEWG Review_1.pdf)	Appendix D - MWO Completed Post-Season Questionnaire (p. 3, pdf page 149 of 150)	"Last year - couldn't pass an ice pan, it was too thick and couldn't move." What information on the ice conditions at this time can be provided? What situations led to difficulty for the *Botnica*? Were ore carriers in convoy at the time, and if so, why were they present in ice conditions that the icebreaker was unable to manage?	This information is not available. Ice conditions from 2018 were presented in the 2018 Annual Report to the NIRB and in the 2018 SBO Program Report.

Baffinland

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Agency / Organization: DFO/PCA

Date of Comment Submission: Thursday, April 30th, 2020

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1	2019 Ship-based Observer Program	2.1	Would it be possible to add detail about the height of the bridge where the observations were performed?	The text has been revised to include: "The height of the bridge of the MSV Botnica is 20 m above sea level".
2	2019 Ship-based Observer Program	2.1	Were the observers able to see the other ships that the MSV Botnica was escorting? Would they be able to make observations in relation to the other ships?	While the bridge of the MSV Botnica offers good visibility all around the vessel, most marine wildlife observer (MWO) detection effort is focused ahead of the vessel. This allows the MWO to assess any potential upcoming risk of ship strike with marine mammals for all vessels in the convoy. If an animal is observered by a MWO on the MSV Botnica, the animal is tracked and any observations regarding interactions with escorted vessels noted. If there was a risk of potential interaction with an escorted vessel, the bridge of that vessel would be notified by the MSV Botnica.
3	2019 Ship-based Observer Program	2.2.2.1 and 2.2.2.2	Would it be possible to install a camera that would take photographs of the ice in front of the MSV Botnica? It would help to document and describe the ice conditions during ice breaking.	As has been previously shared with DFO, this was completed in 2019. In future years, Baffinland may again decide to place a dedicated ice analyst and/or camera on the front of the vessel to capture ice conditions.

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				Ice conditions around the MSV Botnica were also recorded by MWOs, both in terms of Near Field (<100 m) and Far Field (>100 m) Ice Cover.
4	2019 Ship-based Observer Program	2.2.3.1	Observers observed 1,225 seals (unidentified species) in group of up to 560 individuals. They also noted that seals were clustered on large ice pan. This information is interesting because it confirms that seals use the ice for habitat until the ice is completely gone. The ice concentration ranged from 0 to 30% during the observation period.	No response requested.
5	2019 Ship-based Observer Program	2.2.3.3	BIM states the closest point of approach (CPA) for sighted marine mammals. When there was enough data, BIM statistically assess if there is a difference in CPA between Leg 1 and Leg 2. We would recommend to refrain from making statistical conclusions on the CPA since these distance were an approximation and might be a biased overestimate.	It is agreed that the distances are approximation, as are all distances of moving marine mammals reported by observers on a moving platform, and that the reported values may be overestimates as the animal could have approached closer when underwater and not visible to the MWO. The intent of the statistical analysis was to provide a method to objectively compare CPA values. Statistical analyses of the CPA have been removed from this report and will not be included in future reporting.
6	2019 Ship-based Observer Program	4.0 Summary-Marine Mammals	How do the observations of 2018 and 2019 compare to the original SBO Program in 2013 2014 and 2015? It was mentioned that low number of marine mammals were observed in 2014 and 2015. What about 2013? Were the methods comparable?	The 2018 SBO Program was redesigned to allow for a comparison of multi-year data sets based on monitoring conducted off the MSV Botnica during shoulder seasons. A comparative analysis between data collected in 2018 and 2019 is provided for in the report. Comparisons to previous SBO Programs would not be representative. The reasons for this are provided in Section 1.1.

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7	2019 Ship-based Observer Program	4.0 Summary-Marine Mammals	It is stated that no ship strikes were recorded. However, could it be clarified that this only applies to the Botnica and that it was not possible to determine if ship strike occurred on the other project related vessels.	No marine mammal ship strikes were recorded by observers on the MSV Botnica. As part of the Standing Instructions to Masters that is issued to all ship owners/operators prior to the start of the shipping season, all ship strikes on marine wildlife species are to be reported to Baffinland. To date, no vessel operators have reported any ship strikes occurring on marine mammals.
8	2019 Ship-based Observer Program	4.0 Summary-Marine Mammals	It is mentioned that: "*marine mammals in the RSA are likely to demonstrate localized avoidance of Project vessels*". In addition, it is mentioned that: "*that the Project is unlikely to result in significant residual adverse effects on marine mammals in the RSA, defined as effects that compromise the integrity of marine mammal populations in the region either through mortality (i.e., ship strikes) or via large-scale displacement or abandonment of the RSA*". It would be important to point out that these results demonstration some level of disturbance by project vessels on marine mammals and that more work is required to investigate the long term consequences of the project on the marine mammal populations.	This is indicated in the final paragraph of the Marine Mammals section of the Summary (see Section 4.0). "Continuation of the SBO Program is recommended for 2020 in accordance with NIRB Project Certificate No. 005 Terms and Conditions. Ongoing annual monitoring will allow for additional data comparison between monitoring years, which will serve to identify whether any additional adaptive management measures during the shoulder seasons are required."

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9	2019 Ship-based Observer Program	Bottom of pdf page 4 and top of pdf page 5.	PC: The report appears to only compare 2019 results to 2018 results and, from that, draws the conclusion that 2019 monitoring results support impact predictions etc. and that the Project is unlikely to result in significant adverse residual effects on marine mammals in the RSA. BIM does note the history of this monitoring program stopping and restarting (e.g.: Section 1.1). For the sake of comprehensive monitoring, BIM should make a comment regarding the ability of limitations in comparing 2019 data to all earlier data collected during any time the SBO program existed and to also try to conduct some kind of analysis using their entire suite of SBO data while acknowledging the limitations due to changes in methodology and an interrupted data set.	The 2018 SBO Program was redesigned to allow for a comparison of multi-year data sets based on monitoring conducted off the MSV Botnica during shoulder seasons. A comparative analysis between data collected in 2018 and 2019 is provided for in the report. Comparisons to previous SBO Programs would not be representative. The reasons for this are provided in Section 1.1.
10	Ship-based Observer Program	Last paragraph pdf page 4/150 and on pdf page 74/150 in the second full paragraph	PC: Regarding BIM's conclusions, no significant adverse effects as noted in the comment above. BIM notes that the SBO results "lend confidence to existing EA predictions" - however, there is no discussion about the extent and methodology of how the SBO results are incorporated into overall results so as to "lend confidence". It is worth reiterating some sort of general comment about the need for clarity on BIM's overall monitoring framework, as discussed in the marine monitoring section of CSAS Report #3.	The results simply indicate that marine mammals are not generally found in the near vicinity of the vessel, hence suggesting localized avoidance. A Technical Memorandum entitled “Summary of Results for the 2019 Marine Mammal Monitoring Programs” was submitted in May 2020 and incorporated a summary of the overall results of the marine mammal monitoring programs. Baffinland also suggests DFO review Baffinland’s 2019 Annual Report to the NIRB where this information is provided.

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