Final Project Report to NWMB – September 2019

1. NWRT Project Number: 3-18-09

2. Project Title: Northern Hudson Bay narwhal population aerial survey

3. Project Leader: Cortney Watt, Fisheries and Oceans Canada, 501 University Crescent, Cortney.Watt@dfo-mpo.gc.ca, 204-983-5053

4. Summary:

The Northern Hudson Bay (NHB) narwhal population is an isolated narwhal population with a distinct geographic distribution compared to other Canadian and Greenland populations, and can be distinguished from them by genetic and contaminant profiles. There is a subsistence hunt for narwhals from the NHB population by Inuit from Naujaat and other communities in the Kivalliq and Qikiqtaaluk regions of Nunavut. Aerial surveys were flown to estimate the NHB narwhal population abundance in the early 1980s, 2000, and 2011. However, there was a large difference between the estimated abundance in 2000 and 2011 (5053 and 12,485, respectively), and survey coverage was incomplete in 2011. Attempts to survey the NHB population in 2015 were unsuccessful due to bad weather, and so a new population abundance estimate of NHB narwhals is overdue. Therefore, another aerial survey was flown in August 2018 near the community of Naujaat, Nunavut to update the abundance estimate for Northern Hudson Bay narwhal.

5. Project Objectives:

The specific objectives of the proposed project, as outlined in the original proposal to NWMB, were to:

1) Estimate NHB narwhal abundance by conducting aerial visual and photographic surveys of their summering distribution

2) Determine trends in population abundance of NHB narwhals by incorporating this most recent survey abundance estimate into previous abundance estimates (1990s-2000s) and harvest removals

3) Update sustainable removal levels using total allowable harvest (TAH) calculation and population trajectory models

6. Materials and Methods:

The northern Hudson Bay aerial survey was flown from August 2-14, 2018. The survey consisted of four primary strata: (1) Repulse Bay, (2) North Bays (Lyon Inlet), (3) Roes Welcome Sound, and (4) Wager Bay (Figure 1). The survey design was replicated from the 2011 survey, with modifications recommended by the Arviq HTO which included increased effort in Wager Bay. Repulse Bay had to be sectioned into three substrata to accommodate for the operational restrictions of the plane (i.e., combination of fuel capacity, environmental conditions, and target altitude and speed). In total, 66 transects were flown in all four strata. The survey covered a total area of 22,729 km^2. Surveys were flown in a DeHavilland Twin Otter (DH-6) equipped with four bubble windows and an optical glass covered camera hatch

at the rear underbelly of the plane. A Global Positioning System unit (Bad Elf GPS pro+) was used to log the position, altitude, speed and heading of the aircraft every second. Two synced iPads running Foreflight (a navigation app) were also connected to the Bluetooth GPS and used by the survey coordinator and pilots to input/edit waypoints for each stratum, provide navigation and basemaps, and record daily flight tracks. A double platform approach was used for all visual surveys (Buckland et al. 2001). Visual surveys were flown at a target altitude of 1000 ft. (305 m) and a target speed of 100 knots (185 km/h). Two primary observers (front left and right) and two secondary observers (rear left and right) were seated at bubble windows. To ensure sightings were independent, the observers were visually and acoustically isolated from one another. Black curtains were hung to provide visual isolation between primary and secondary observers, and headsets, along with aircraft noise provided auditory isolation. The survey coordinator was positioned mid-plane, and their role was to communicate with pilots during flight, notify observers when off/on transect and operate cameras.

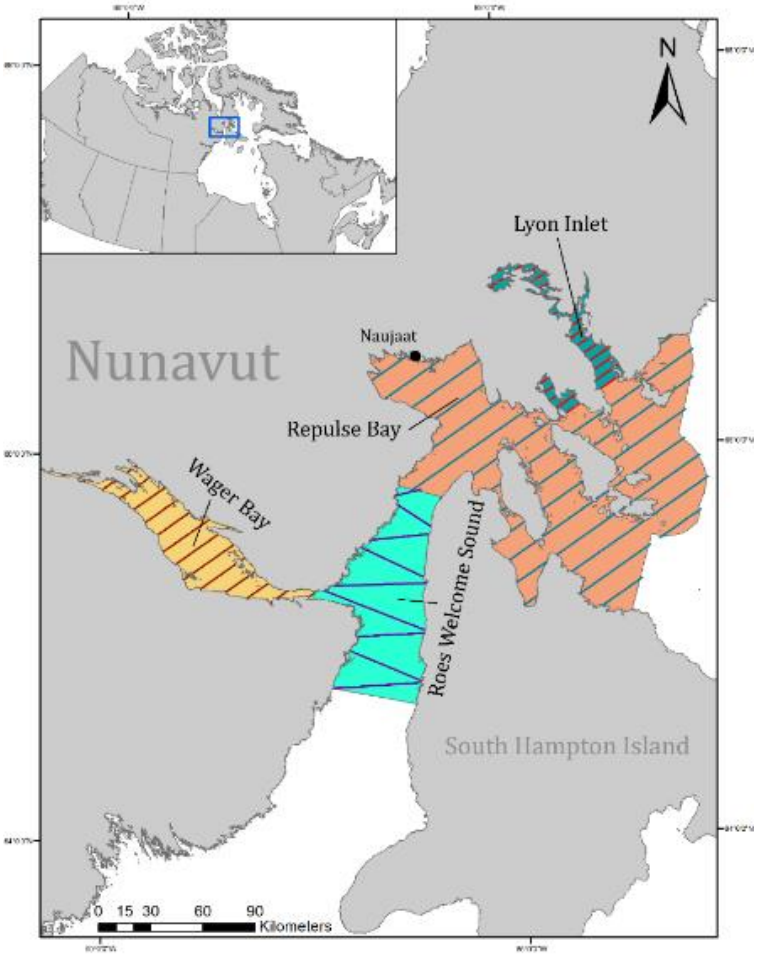

Figure 1. Study area for the 2018 Northern Hudson Bay aerial survey. Survey consisted of four main strata: Repulse Bay (orange), North Bays (Lyon Inlet, blue), Wager Bay (yellow) and Roes Welcome Sound (turquoise).

Speaking into a Sony PCM-D50 audio recorder, observers recorded all whale sightings, including species and the number of individuals in the group. Observers were instructed to focus their attention on the area closest to the track line and to use their peripheral vision for sightings farther afield. Using a Peco DCC1 Digital Compass/Clinometer, the perpendicular declination angle to the center of each group was measured when it was abeam of the observer (Figure 2). A 'group' was defined as animals within one body length of each other and behaving cohesively. When time permitted, observers were asked to give additional details on the sightings, such as the presence of calves, behaviour and direction of travel. The two primary observers were responsible for recording all changes in environmental conditions throughout the surveys: ice concentrations (in tenths), sea state (Beaufort scale), fog (% of field of view) and glare (% of forward field of view), and cloud cover (percentage). These environmental conditions were stated at the start of each transect and re-stated at any time a change was observed throughout the survey. A photographic survey was conducted simultaneously with the visual survey. The photographic survey was achieved using a Nikon D850 camera equipped with a 35 mm lens, mounted at the rear of the aircraft, directed straight down, with the longest side perpendicular to the track line. Photographs were geotagged via Bluetooth GPS receiver uplink (Bad Elf GPS Pro+ linked to Foolography Unleashed D200+ Bluetooth Module). Each camera was also connected to a laptop computer, to remotely control camera settings and to transfer raw (NEF) and internally processed (JPG) file formats to the computer's hard drive. Photographs were captured at a continuous 3 sec interval to achieve 20% overlap. In addition to the metadata (.exif) recorded to each photograph, the transect number, and start/stop times (standardized to +0 UTC) was recorded to facilitate post-processing.

7. Results:

On August 2nd, the survey crew flew to the North Bays stratum and 18 transects were completed (Figure 2). Narwhal and beluga were sighted on four separate transects. The survey team then flew back to Naujaat to refuel and continued on to Roes Welcome Sound (Figure 2). All nine zig-zag transects were completed and three narwhals were observed on one transect on the right side of the plane. On August 6th, the plane headed to Wager Bay, where 16 transects were surveyed (Figure 3). Narwhals were spotted on most transects from both sides of the plane, and at times belugas were also seen within the same group or nearby. Many seals were sighted, as well as one bowhead and two polar bears swimming in the bay. Then, after refueling, the plane started the Repulse Bay stratum (Figure 3). Most of the narwhals were seen around White Island, including many polar bears both sighted on land and swimming off the island. All 10 transects from south to north were completed.

Weather and mechanical plane issues caused the survey to be grounded for a few days, but on August 11th and 15th the survey crew completed the Repulse Bay stratum.

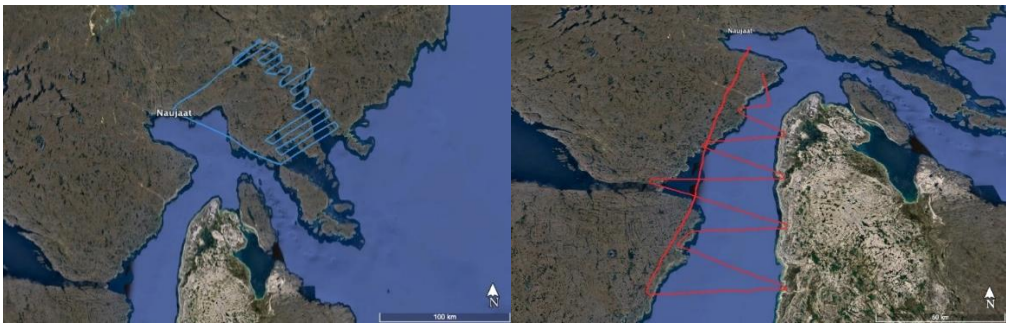

Figure 2. Survey track and 18 parallel transects completed in North Bays (Lyon Inlet) strata both August 2 and 14, 2018 (left) and nine zig-zag transects completed in Roes Welcome Sound strata August 2, 2018 (right).

Figure 3. Survey track completed in Wager Bay (left) and Repulse Bay (right) on August 6, 2018.

Photos were also taken throughout the survey using a Nikon D850 camera equipped with a 35 mm lens, mounted at the rear of the aircraft, directed straight down. Photographic coverage of the Northern Hudson Bay study area was approximately 65,000 m^2 (Figure 4).

Figure 4. Photo of narwhals (left) and beluga whales (right) taken at 1000 ft.

8. Discussion/Management Implications:

The Northern Hudson Bay narwhal population has not been surveyed since 2011 and a new survey abundance is needed to update advice regarding sustainable harvest levels. When limited information is known about a population, science has typically advised on sustainable harvest advice using the Potential Biological Removal method (PBR; Wade 1998). One advantage of PBR is that it only requires a single survey abundance estimate to calculate a PBR level. However, this has limitations and may be subjective. For instance, if multiple survey estimates are available it is difficult to decide which survey provides the best estimate, especially given that survey estimates on different days within a season can change significantly (Gosselin et al. 2017). Variability in survey estimates results in PBR estimates that will fluctuate much more than would be expected given the dynamics of narwhal populations. A new abundance estimate provided by the survey flown in 2018 will allow science to provide model-based sustainable harvest advice following the precautionary principle, and will provide resource users and managers a table of probabilities for different harvest scenarios, which can be discussed and implemented based on levels of risk all co-management partners are comfortable with.

9. Report by Inuit Participants:

Although our Inuit collaborators on this project did not provide a formal report, input through this collaboration is regularly requested and received though on-going discussions before the field work, communications while in the field, and through follow up discussions, and phone and email communication after the field work. Reports from our Inuit partners are vital to the success of the survey and help determine the total area covered, as well as on the ground decisions about weather and where to focus efforts. Every survey day Hugh Haqpi or David Ammaq flew with the DFO crew on the survey to share observations, offer guidance, and contribute to the data collection. Their input and assistance was a key aspect to the success of this survey.

10. Reporting to Communities/resource users:

The schedule of consultations with Arviq HTO has been almost completed as anticipated and a summary report and updates were sent as posters and through email to the Arviq HTO following completion of the survey. However, an in-person presentation of results has been pushed until 2020 since the abundance estimate will not be finalized and presented to the National Marine Mammal Peer Review until February 2020. Once it has been approved at the national level, an in person consultation will be scheduled with the Arviq HTO.

Consultation	Date	Type	Status/Changes
Before Research	February-June 2018	Email correspondence proposing project, requesting support and answering questions	Completed
During Research	Aug 2018	In person meetings with HTO manager to update on field research activities	Completed

After field work	October 2018	Summary reports/updates sent in the form of posters to the HTO and community of Naujaat.	Completed
After approval of abundance estimate	April 2020	In person consultation will follow when the abundance estimate is approved.	Not completed: in person presentation of results and consultation will follow approval of the abundance estimate.

11. References

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L., and Thomas, L. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, USA, Oxford.

Gosselin, J.-F., Hammill, M.O., and Mosnier, A. 2017. Indices of abundance of beluga (*Delphinapterus leucas*) in James Bay and eastern Hudson Bay in summer 2015. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/067. iv + 25 p.

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