

Final Project Report to NWMB – September 2019

1. **NWRT Project Number:** 3-18-01
2. **Project Title:** Eclipse Sound killer whale diet and impact on narwhals
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4. **Summary:**

Killer whale (*Orcinus orca*) occurrence in the eastern Canadian Arctic is restricted to the relatively ice-free summer season, when they prey on narwhal, beluga, bowhead whales, and seals. Recent increases in the number of killer whale sightings in the eastern Canadian Arctic, likely associated with decreasing summer sea-ice cover, have raised concerns regarding the effects of killer whales on other marine mammal populations.

The increasing presence of killer whales in the Eclipse Sound region, most recently in 2017, has raised concerns among Inuit regarding the number of narwhals killed by killer whales, and the overall impact on the Baffin Bay narwhal population and Eclipse Sound stock. The summer of 2018 provided a unique opportunity for the detailed study of killer whale predation on narwhals, as narwhal research, in particular, satellite tagging to document movements, was being conducted simultaneously in the same area (Ecosystem Approach to Tremblay Sound = EATS project).

We based our field work in Milne Inlet/Eclipse Sound region during August and September 2018. We used satellite telemetry to better understand killer whale movement and distribution, and killer whale-narwhal interactions (*e.g.*, how does killer whale presence influence narwhal behavior?). We collected tissue biopsies for stable isotope and fatty acid analyses to better understand diet and feeding ecology, and to better understand how eastern Canadian Arctic killer whales are genetically related to other populations in the North Atlantic. Finally, we photographed whales to estimate abundance from photo identified individuals.

In summary, we satellite tagged one killer whale (along with four narwhals in collaboration with the other DFO-NWMB funded project in the region). We also collected 18 killer whale skin and blubber biopsies and 1000s of photos.

5. **Project Objectives:**

The main purpose of this research is to assess killer whale impacts on narwhals in the Eclipse Sound area, including direct impacts (*e.g.*, how many narwhals do killer whales eat/kill in Eclipse sound) and indirect impacts (*e.g.*, changes in narwhal behavior and/or distribution) using:

- 1) high resolution satellite tag data from killer whales and narwhals to understand interactions between the two species, and how killer whale presence impacts narwhal behavior, movements, and distribution.
- 2) bioenergetics models to estimate daily caloric requirements of killer whales. These estimates will be used along with the proportion of narwhals consumed by killer whales (determined from carcasses) and the number of killer whales in the region (determined from photo ID) to estimate mortality levels of Eclipse Sound narwhals due to killer whale predation.

6. Materials and Methods:

Research methods did not change substantially from the project proposal. Fieldwork was completed between August 7th and September 17th, 2018, and consisted of day trips from DFO's Ecosystem Approach to Tremblay Sound camp in Tremblay Sound, or from the community of Pond Inlet, using one of several small aluminum boats. Materials and methods for specific tasks are detailed below.

Satellite telemetry: Killer whales were slowly approached by boat to within 10 m before attempting satellite transmitter deployment. A crossbow was used to surface-mount (by means of two 6 cm metal barbs) a satellite transmitter onto the base of the killer whale's dorsal fin. The satellite transmitters were programmed to transmit locations up to 300 times daily, and depth at 2-minute intervals.

Tissue biopsy: Tissue biopsies (skin and blubber) were collected from killer whales using crossbow bolts equipped with tubular sterile stainless steel biopsy tips (25 mm long x 6 mm diameter). Biopsies were held in a small cooler containing instant ice-packs on-board the research vessel, and then transferred to an electric freezer upon return to camp. Samples were transported to Fisheries and Oceans Canada Freshwater Institute in Winnipeg using a cryo-shipper, where they were stored at -80°C.

Photography: Photographic identification uses natural pigmentation variation, along with scarring and/or nicks on the trailing edge of the dorsal fin, to identify individual killer whales. Whales were photographed using two Canon EOS-1DX 18.0 megapixel camera bodies equipped with a 24-70 mm or 70-200 mm with 2.0x extender. Images suitable for individual identification were added to the Orcas of the Canadian Arctic photographic identification database and compared to images previously collected to identify re-sighted and newly identified individuals.

Acoustics: A portable hydrophone was used to record underwater noise, with the intention of capturing killer whale vocalizations. Underwater noise was only recorded when the research vessel was stopped with the motor turned off to prevent background noise interference.

Prey consumption and bioenergetics: The population's energetic requirements will be calculated as the product of the population's size (estimated using a photographic capture-mark-recapture approach), published daily energetic requirements, and an estimate of seasonal occupancy of the area. The total number of narwhals potentially taken by killer whales seasonally will be calculated by dividing the population's seasonal energetic requirements by a narwhal's energetic content.

7. Results:

Killer whales were encountered on five occasions between August 27th and September 11th, 2018 (Figure 1). In total, 18 biopsies and several thousand photographs were collected, and one Wildlife Computers SPLASH10-F-333 tag was deployed onto the dorsal fin of an adult male killer whale.

Killer whale tissue biopsies have been subsampled for stable isotope, fatty acid, contaminant, and genetic analyses. These analyses have been completed and results are being written up into manuscripts that will be submitted to peer-reviewed journals (in progress).

Preliminary analysis of photographs revealed that many individuals sighted in 2018 had been previously sighted, in some cases on multiple occasions, in the northern Baffin Island region (Figure 2).

The tagged killer whale (Figure 3) remained in the Eclipse Sound area for several days, moving into inlets in southern Eclipse Sound, before travelling north through Navy Board Inlet into Lancaster Sound (Figure 1). The whale then travelled east, into Baffin Bay, and along the eastern Coast of Baffin Island and into Buchan Gulf (Figure 1).

During the ten-day deployment, the killer whale's maximum-recorded depth was 352m, although a comparison with bathymetry indicated that none of the animal's dives were to the seafloor (Figure 4). Deep dives (>50m) occurred almost exclusively at night.

Unfortunately, none of the tagged narwhals overlapped in space and/or time with the tagged killer whale, and an analysis of narwhal behavior in response to killer whale presence was therefore not possible. No killer whale vocalizations were recorded.

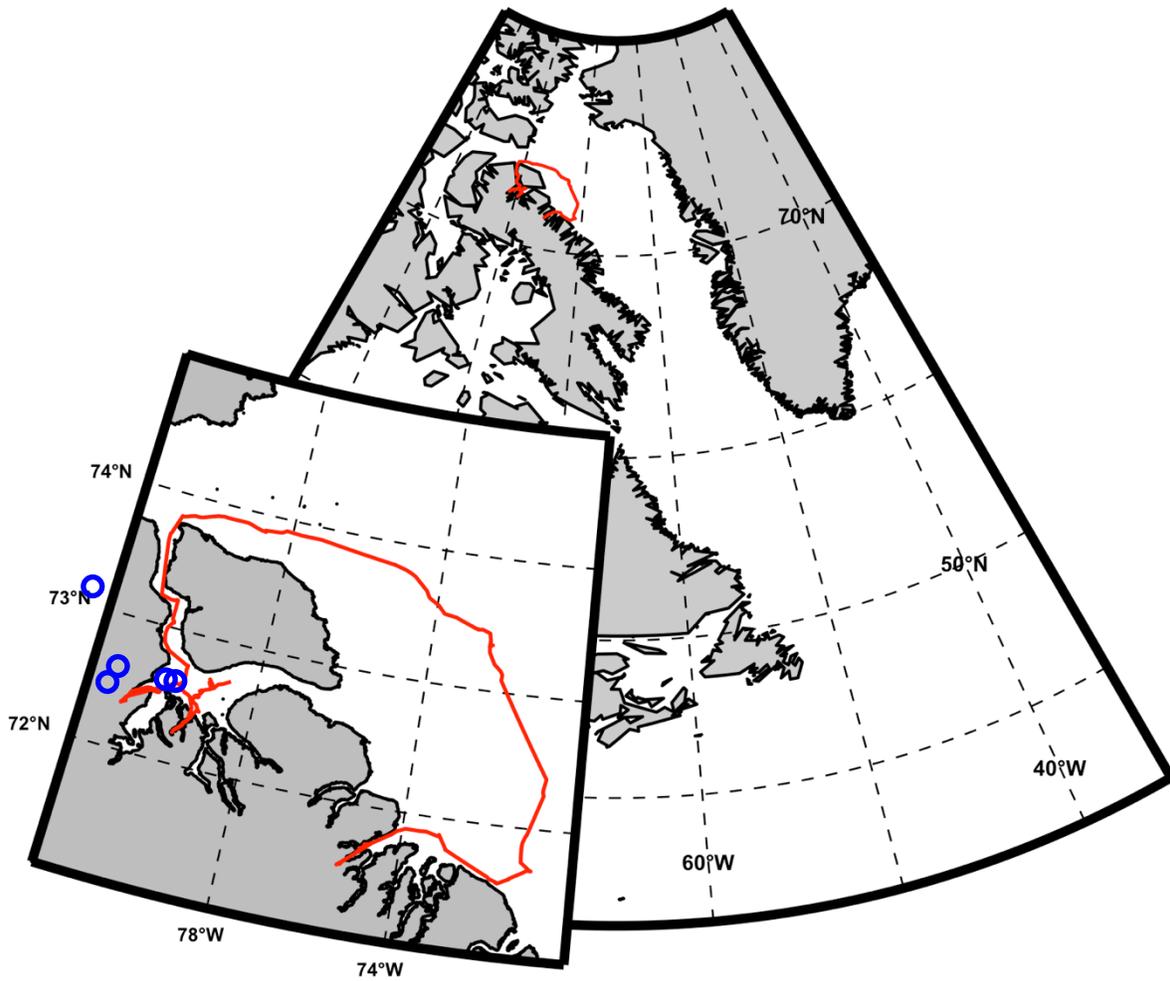


Figure 1. Killer whale movement based on FastLoc GPS locations from September 8th to 18th, 2018 (red track) and locations of five killer whale encounters (blue circles).



Figure 2. Adult male killer whale that had been previously sighted in Admiralty Inlet, Nunavut on August 15th 2009 (left), and during our 2018 field work in Eclipse Sound/Milne Inlet on September 8th, 2018 (right). Note the new notch on the trailing edge of the dorsal fin and new markings on the saddle patch.



Figure 3. Satellite transmitter deployed onto dorsal fin (circle) of adult male killer whale in Eclipse Sound on September 8th, 2018.

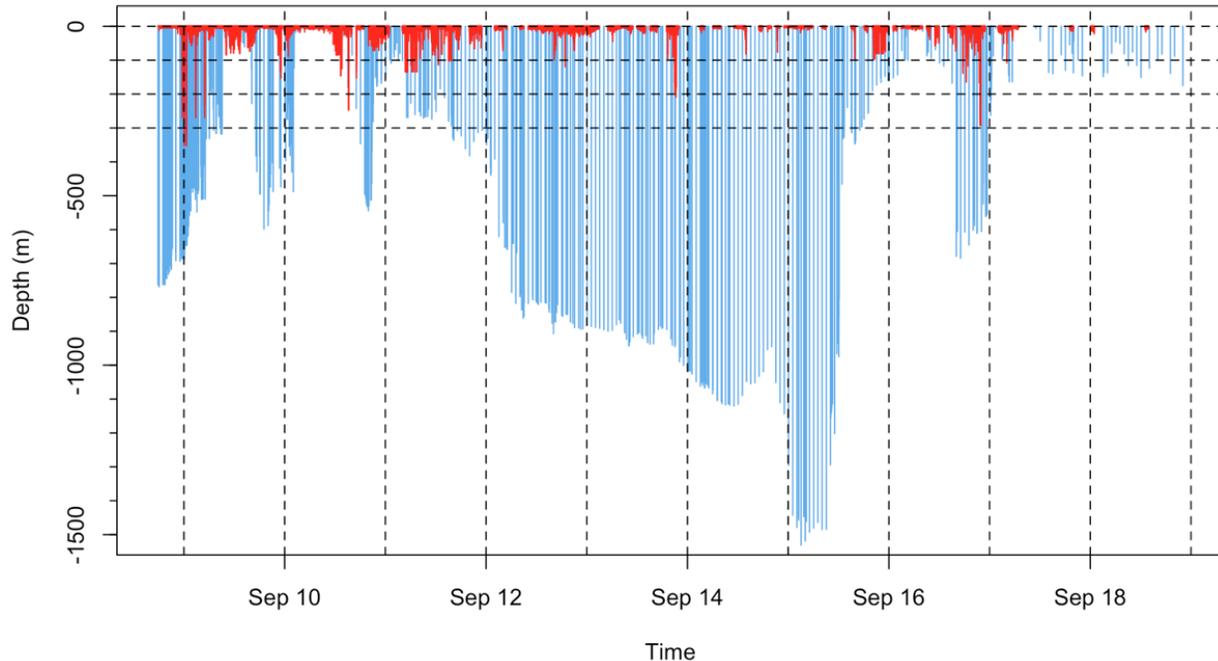


Figure 4. Dive profile (red) of the adult male killer whale that was satellite tagged in Eclipse Sound/Milne Inlet from September 8 to 18, 2018. ARGOS-predicted and FastLoc GPS bathymetric profiles are shown in light and dark blue, respectively.

8. Discussion/Management Implications:

2018 was one of our most successful field seasons working on killer whales.

Although we were unable to complete our telemetry study of killer whale impacts on narwhal movements and habitat use, we were able to better understand killer whale movements and potential foraging behavior in the Eclipse Sound area. The type of satellite tag we deployed allowed for the first characterization of killer whale dive behavior in the Canadian Arctic. Although the whale apparently did not dive to the sea floor, the fact that it undertook deep dives suggests it may have been foraging on fishes undergoing a diurnal vertical migration, or on narwhals that are in turn feeding on said fishes. Greenland sharks are a deep-water fish that may make up killer whale diet, and the killer whale dive patterns would be consistent with stable isotope values that have indicated Greenland shark as a potential prey. Additional work is needed to understand how killer whales and narwhals interact in Eclipse Sound, but also how killer whales interact with other potential prey such as Greenland sharks.

Our limited demographic understanding of eastern Canadian Arctic killer whales makes it difficult to quantify their ecosystem influence. Data from long-term photo-identification studies are therefore essential for calculating reliable estimates of killer whale abundance in the ECA. 2018 represented over ten years of collecting killer whale photographs in the Baffin Island region, providing a sufficient base of identified individuals to estimate abundance using capture mark recapture models based on the proportion of resighted animals. Although still not finalized, initial model estimates put the number of killer whales that seasonally visit the Baffin region at about

100. Efforts to estimate the caloric requirements of this number of killer whales during their residence of Eclipse Sound waters is ongoing to understand their potential narwhal consumption while they occur seasonally in the region. Accounting for the effects of increased killer whale occurrence and predation on local marine mammal populations of cultural and economic importance is necessary for effective killer whale prey stock management.

The preliminary findings from analysis of killer whale photographs from 2018 suggest that we have photographed a significant proportion of the population, making it feasible to obtain a population estimate. In addition, the developing photographic identification catalogue of Baffin killer whales will eventually allow us to describe important life-history information such as the proportion of calves in the population, calf survival and adult survival.

9. Report by Inuit participants:

Inuit participants have not provided a formal report. However, input from our Inuit partners is regularly requested and received through on-going discussions while in the field, communications during field work planning, and through follow-up discussions after completion of the field work.

In all communities in which we work, but in Pond Inlet in particular, Inuit involvement has been instrumental to our success in locating killer whales. Our boat captains and research assistants are in regular contact with hunters who are distributed throughout our study area, and these hunters almost always locate killer whales before we do. They have always been quick to contact us over radio to let us know exact locations and times of killer whale sightings, which sometimes is the only reason we have been able to locate and work with killer whales.

Nunavut beneficiaries hired as field assistants received training using crossbows to collect and process tissue biopsies, and to deploy satellite transmitters. They, along with the local boat captains we worked with, expressed interest in independently leading local field work on killer whales in the future. In 2020 we will be proceeding with a locally-led killer whale field research team for the second time in the eastern Canadian Arctic (the first being Pangnirtung in 2013).

10. Reporting to Communities/Resource Users:

The schedule for consultation and reporting of results has been completed as anticipated. Mittimatalik HTO Board members expressed considerable interest in our results, and supported our continued research in 2019.

Schedule of Consultations with Mittimatalik HTO

Consultation	Date	Type	Status/Changes
Before Research	Dec 2017	Email correspondence proposing project and requesting support. This was followed up with an in-person meeting.	Completed
During Research	Aug 2018	Communication with HTO before and during field	Completed

		research to provide updates on progress.	
Completion of Research	Mar-Apr 2018	In-person meeting to discuss findings from previous field season and to propose work for the coming year.	Completed