

Final Project Report to NWMB – September 2020

1. **NWRT Project Number:** 3-19-03
2. **Project Title:** Killer whale impact on local marine mammal stocks in Eclipse Sound
3. **Project Leader:**
Steve Ferguson
Fisheries and Oceans Canada
501 University Crescent, Winnipeg Manitoba
Email: Steve.Ferguson@dfo-mpo.gc.ca
Phone: (204) 983-5057
4. **Summary:** Killer whales are influential predators in marine ecosystems worldwide. Recent increases in the frequency of killer whale sightings in the eastern Canadian Arctic, presumably associated with diminishing sea-ice cover, have raised questions concerning their influence on the Canadian Arctic marine ecosystem. Preliminary photo-identification studies have indicated 100+ killer whales are seasonal visitors to the Tallurutiup Imanga / Lancaster Sound region. Increased occurrence could result in greater predation on culturally, economically, and ecologically valuable prey (e.g., narwhal, beluga) which could threaten their sustainable use as food sources available to northern communities. To assess the degree to which Canadian Arctic killer whales threaten marine mammal prey populations, we need information on their abundance and ecology (e.g., movement, seasonality, prey preferences). The objectives of this research were to better understand how killer whales influence northern ecosystems using bioenergetic modeling and to investigate population structure using genetic/genomic techniques. Fieldwork was based in Pond Inlet in September-August 2019. We collected tissue biopsies ($n = 11$) for stable isotope, fatty acid, contaminant, and genetic analyses to better understand feeding ecology and how Canadian Arctic killer whales are related to other populations in the North Atlantic. Furthermore, we collected 1000s of photographs that will be used to estimate the population's size. This is done in a capture-recapture framework using a photo identification catalogue assembled from images collected over the past decade.
5. **Project Objectives:**
[5.1] Objective: Investigate killer whale diet using microchemical analyses of biopsied skin and blubber. Biopsies collected in 2019 ($n = 11$) will supplement those collected during previous research programs and archived at Fisheries and Oceans Canada in Winnipeg. These samples will be used to assess the diet of Canadian Arctic killer whales and to identify overwintering areas. This project is led by Dr. Cory Matthews (DFO Research Scientist) with analyses planned for 2020.

[5.2] Objective: Investigative killer whale distribution, movement, and seasonality using satellite telemetry and multi-sensory tags. No satellite-tracking devices were deployed in 2019. This study will await additional tagging in the future.

[5.3] Objective: Estimate killer whale population size using capture-mark-recapture analyses of photographically identifiable individuals. Several thousand photographs were collected during 2019 fieldwork. These data will contribute to an ongoing project led by Kyle Lefort (MSc student at University of Manitoba). A peer-reviewed academic article was published on this topic in early 2020 (Lefort et al. 2020a)

[5.4] Objectives [5.1], [5.2], and [5.3] will be used to develop a bioenergetics model to estimate the population's energetic requirements and seasonal narwhal consumption. This model will be used to estimate the influence of killer whale predation on local narwhal stocks in the Canadian Arctic during the ice-free period, and thus Inuit food security. These data will contribute to an ongoing project led by Kyle Lefort (MSc student at University of Manitoba). A peer-reviewed academic article was published on this topic in early 2020 (Lefort et al. 2020a).

[5.5] Objective: Investigate killer whale population structure using genetic analysis of tissue biopsies collected from free-ranging animals and tooth samples collected from stranded animals. Tissue biopsies collected in 2019 ($n = 11$) will supplement samples archived at Fisheries and Oceans Canada. These data will contribute to an ongoing project led by Kyle Lefort (MSc thesis published on myspace University of Manitoba). Plans are to publish a peer-reviewed academic article on this topic in 2020.

- 6. Materials and Methods:** Research methods are identical to those detailed in the project proposal. Fieldwork was completed between August 15th and September 2nd, 2019. From Pond Inlet, one Nunavut beneficiary received training on safely approaching killer whales via boat for biopsy collection, while three additional beneficiaries hired as field assistants received training using crossbows to collect and process tissue biopsies from free-ranging killer whales.
- 7. Results:** Killer whales were encountered on six occasions between August 16th and September 2nd, 2019. In total, eleven killer whale tissue biopsies and several thousand photographs were collected. Killer whale tissue biopsies were subsampled and included in ongoing stable isotope, fatty acid, contaminant, and genetic studies. Preliminary analyses of photographs indicate none of the individuals photographed in 2019 had been previously photographed in this area. Photographs revealed the presence of barnacles on killer whale dorsal fins, which suggests residency in warmer waters. These findings are detailed in Matthews et al. (2020). A review paper on Canadian Arctic killer whales (Lefort et al. 2020b) was also published following the 2019 field season.

- 8. Discussion/Management Implications:** Our limited understanding of Canadian Arctic killer whales makes it difficult to quantify their ecosystem influence. Data from the long-term photo-identification program are therefore essential for calculating reliable estimates of killer whale abundance. Our models suggest 163 ± 27 killer whales occupy this area seasonally -- the number of narwhal consumed by this population of killer whales is discussed in Lefort et al. (2020a). Stable isotope, fatty acid, contaminant, and genetic studies are ongoing. 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 developing photographic identification catalog 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 written report. However, input from 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:

Schedule of consultations with Mittimatalik HTO.

Consultation	Date	Type	Status/Changes
Before Research	March 2019	Community meeting proposing project and requesting support.	Completed
During Research	Aug-Sept 2019	Communication with HTO before and during field research to provide updates on progress.	Completed
Completion of Research	Winter 2020	Community meeting to discuss findings and to	Pending (delayed due to COVID-19)

		propose work for the coming year(s).	
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11. References

- Lefort, K.J., Garroway, C.J., and Ferguson, S.H. 2020a. Killer whale abundance and predicted narwhal consumption in the Canadian Arctic. *Glob. Change Biol.*
- Lefort, K.J., Matthews, C.J.D., Higdon, J.W., Petersen, S.D., Westdal, K.H., Garroway, C.J., et al. 2020b. A review of Canadian Arctic killer whale (*Orcinus orca*) ecology. *Can. J. Zool.* 98(4): 245–253. doi:10.1139/cjz-2019-0207.
- Matthews, C.J.D., Ghazal, M., Lefort, K.J., Inuarak, E. 2020b. Epizotic barnacles on Arctic killer whales indicate residency in warm waters. *Mar. Mamm. Sci.* 1–5. doi:10.1111/mms.12674.