Nunavut Wildlife Management Board Interim Project Report – September 2022

1. **NWRT Project Number:** 3-21-04

2. **Project Title:** Population structure and ecology of killer whales (*Orcinus orca*) in the eastern Canadian Arctic

3. **Project Leader:**

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4. **Summary:**

Killer whales (*Orcinus orca*) move into sounds and inlets in the eastern Canadian Arctic (ECA) during summer, where they prey on narwhal, beluga, and bowhead whales, as well as seals. There is growing concern among Inuit communities that increasing killer whale presence in the Arctic (concurrent with sea ice declines) may have adverse impacts on their marine mammal prey.

In summer 2021, we will continue with core research methods including satellite telemetry, tissue biopsy, and photo-identification. We have recently compiled results of this work conducted over previous years to better understand how killer whales and prey interact (satellite telemetry), estimate killer whale population abundance (mark-recapture analysis of photo-ID'ed whales) and potential consumption of narwhals (bioenergetics modeling), decipher population structure (genetics analysis of biopsies), and characterize diet and distribution (stable isotopes analysis).

Expanded project goals in 2021 include recording killer whale calls using hydrophones and observing and recording behavior using drones. This work will allow us to study interactions between Arctic killer whales and their prey with greater detail than we have previously. Ultimately, characterization of killer whale calls and behavior (e.g., hunting) will provide baseline information with which to develop acoustic monitoring of killer whale behavior and impacts on prey populations throughout the Arctic.

5. **Project Objectives:**

Our killer whale research in the Eastern Canadian Arctic has been ongoing since 2005, and is broadly focused on killer whale abundance, population structure, and ecology (distribution, movements, and diet) to better understand their influence on Arctic marine ecosystems. Our proposed research objectives in 2021 include a continuation of core work (e.g., satellite telemetry) in addition to new initiatives (bioacoustics and drone work):

1. continue to develop independent, community-based field research teams (currently operating in Pond Inlet and Pangnirtung, NU);
2. determine summer distribution in the Arctic and winter distribution in the greater North Atlantic (photo-ID and satellite telemetry);

3. assess the existence of ecotypes with distinct diets (stable isotope and fatty acid analyses of skin and blubber) and concurrent genetic, morphological (photo-ID, drone footage), and cultural (bioacoustics) differences;
4. determine temporal and spatial overlaps with whale prey species, including foraging and hunting strategies (bioacoustics, drone focal follows, satellite telemetry);
5. determine stock structure and relatedness to other North Atlantic populations (bioacoustics, photo-ID, genetics);
6. update population abundance estimates and individual reproductive histories (mark recapture analysis of photo-ID'ed individuals).

6. Materials and Methods:

Our planned research program in 2021 will incorporate core field work (satellite tagging, biopsy, and photo-identification), along with new methods (acoustic and drone recordings) to allow for more detailed study of killer whale behavior.

[1] Satellite tag deployment: Killer whales will be slowly approached by boat to within 10 m. Limpet model satellite tags (Wildlife Computers) will be deployed onto the dorsal fin using crossbows. Tags will be surface-mounted using 6-cm metal darts that will anchor the tag below the skin into the cartilage upon contact. Deployed tags will transmit location and dive data up to 300 times daily, as the whale surfaces, to satellites that store data on the ARGOS system. Transmitters affixed to killer whales using this technique typically last several weeks, but have remained on individuals for up to ~120 days. Telemetry data acquired from satellite tags will be fed through state space models to better characterize killer whale movements in the Eclipse Sound area (i.e., foraging), and tags that transmit long enough will provide data on killer whale movements and distribution into the winter season.

[2] Biopsy: Skin biopsies will be collected using a Dan Inject CO2 gun to fire biopsy darts fitted with a 25 mm long x 6 mm diameter sterile stainless steel biopsy tip. The core of skin and blubber will be removed from the biopsy tip using sterile forceps, wrapped tightly in foil, and frozen until genetics and chemical analyses (stable isotopes, fatty acids, trace elements, and contaminants) are completed at Fisheries and Oceans Canada or commercial labs. Genetics analyses (e.g., whole-genome) will provide information on group and population structure of ECA killer whales, while the suite of microchemistry analyses will provide information on both distribution and diet.

[3] Photography: Encountered killer whales will be photographed using digital SLR cameras. Individual killer whales have unique natural features (dorsal fin shape, size, and scarring, and saddle patch and eye-patch shape) that can be used to identify them. Photo-identification has been used to understand killer whale movements and distribution, social structure, and population size. Estimates of killer whale abundance will be updated using statistical models that compare the rates of newly identified and re-sighted whales.

[4] Acoustic recordings: Killer whale calls will be recorded using dip hydrophones from the research boat, as well as 3-5 passive acoustic monitors moored at the bottom of Milne Inlet and Tremblay Sound. Acoustic recordings will be analysed using a combination of automated and manual detection using acoustics software (JASCO and Raven Pro). Killer whale calls have not been studied in the eastern

Canadian Arctic before, and the first step will be to build a call repertoire that will be compared to existing killer whale calls, particularly those from other populations in the North Atlantic, to assess unique attributes of killer whales in the ECA.

[5] Behavioral observations: Killer whale behavior will be recorded using drone-based aerial cameras and quantified using animal-borne tags fitted with accelerometers. Killer whale behaviors will be evaluated and quantitatively analysed with other covariates (e.g., killer whale call type, presence of prey such as narwhals) using mixed effects models to better understand correlations between behavior and call type. Quantifying these relationships will be the first step to using passive acoustic recorders to monitor killer whale presence and activity (e.g., predation) in the ECA.

7. Project Schedule:

Output or Step	**Start Date**	**End Date**	**Status/Changes**
Ongoing HTO consultation	09/01/2021	N/A	Completed.
HTO contracts and local participant hiring; field work preparation	30/06/2021	N/A	Completed.
HTO meeting to review field workplans	31/07/2021 (virtual?)	Aug/2021	Meetings were held with Enookie Inuarak and his field team; the HTO was largely inaccessible due to COVID-related closures
Conduct field work	01/08/2021	30/09/2021	Completed.
Present results to Mittimatalik HTO/Pond Inlet residents	31/03/2022	N/A	Ongoing; however, there will not be research results to report from summer 2021, as killer whales were not encountered.
NWMB Interim Report	15 Dec 2021	15 Dec 2021	Completed.
NWMB Interim Financial Report	15 Dec 2021	15 Dec 2021	Completed.
NWMB Final Project Report	30 Sep 2022	-	Completed (this report).

8. Preliminary Results/Discussion:

Unfortunately, COVID restrictions prevented DFO researchers from joining the local research team in Pond Inlet during summer 2021. As a result, plans to carry out bioacoustics recordings using hydrophones and behavior observations using drones were cancelled, as the local research team does not have experience using these instruments. Moreover, the Mittimatalik HTO and community of Pond Inlet restricted use of hydrophones in the Eclipse Sound region during summer 2021.

The local research team, led by Enookie Inuarak, conducted field work in August and September, 2021. They searched for killer whales from a single research vessel over a period of several weeks, during which they set up a satellite camp in an area where killer whales are usually sited. Unfortunately, killer whales were not encountered or even sighted by the research team over that period, and so plans to deploy satellite tags, collect biopsies, and take photographs for photo identification were not completed as planned. While killer whales have been sighted regularly and consistently in the Eclipse

Sound area over the past several years, sightings of killer whales for longer than normal lengths of time in other areas like Cumberland Sound during summer 2021 may indicate distribution/movement behavior were different this year. While scientific research objectives were unfortunately not completed, project goals to involve Inuit in DFO research projects and train local teams to collect scientific data were successful. This is particularly true because Enookie Inuarak, who has been involved with the killer whale research project for close to a decade, is now independently training members of his research team on satellite deployment and biopsy techniques.

9. Reporting to Communities/Resource Users:

Consultation	Date	Type	Status/Changes
Before Research	January to August 2021	Multiple email and phone call attempts to communicate with the Mittimatalik HTO; emails, phone calls, and frequent texts with local project lead Enookie Inuarak.	Completed.
During Research	August to October 2021	Frequent email, phone calls, and texts with Enookie Inuarak to update on field work situation.	Completed.
Post Research	October 2021 to present	Emails and phone calls with HTO/As. In-person visits tentatively scheduled for Feb 2021, with community approval RE COVID guidelines.	Completed. February meetings were postponed and held in May 2022 (in-person in Pond Inlet with the Mittimatalik HTO).