The Department of Fisheries and Oceans seeks to continue research monitoring the marine ecosystem of Tremblay Sound. This field program consists of passive acoustic monitoring, monitoring of narwhal using drones, remote tagging of narwhal and killer whales, and photo identification of killer whales. The program will take place between mid-July to September, with the potential for some spring work at the floe edge near Pond Inlet. Overall, this study will develop and apply methods to monitor the behaviour, distribution, and abundance of narwhals and killer whales in order to provide advice for sustainable harvest of narwhal as well as investigate the impact of shipping and predation of killer whales.

Research Questions:

1. What are the fine scale movements of whales in the Eclipse Sound area, and how do these movements relate to ecological and environmental drivers such as prey availability, shipping traffic and oceanographic parameters?

2. What are the temporal and spatial patterns of underwater sound in Tallurutiup Imanga National Marine Conservation Area and the proportions of biological, geological (wind & ice) and anthropogenic noise?

3. What is the population size and structure of killer whales in the Eastern Canadian Arctic and what is their ecology (distribution, movement, diet)?

4. What is the fine-scale behaviour of killer whales and how do they interact with their prey species and influence the Arctic marine ecosystem?

Short Term Project Objectives:

1. Pilot remote tagging program for narwhals
2. Establish baseline data of environmental noise, shipping noise, and vocalizations of narwhal while in their critical summer habitat in Tremblay Sound and other areas.
3. Determine temporal and spatial overlap of killer whales with whale prey species, including foraging and hunting strategies.
4. Update killer whale population estimates and individual reproductive histories.

Long Term Project Objectives:

1. Use co-knowledge production to modify techniques for narwhal remote tagging. Additionally, work with the Inuit Advisory Committee (IMAQ) of the TI NMCA to develop acoustic monitoring tools that are meaningful to Inuit and correspond to their research priorities.
2. Examine changes in proportions of environmental noise, shipping noise, and vocalizations of narwhal while in their critical summer habitat in Tremblay Sound with increasing shipping activity and tourist vessels.
3. Continuation of core work involving satellite telemetry for killer whales and continuing to develop independent, community-based field research teams.

4. Assess population structure and abundance of killer whales in the Arctic, as well as relatedness to North Atlantic populations.
5. Determine summer distribution of killer whales in the Arctic and winter distribution in the greater North Atlantic.
6. Examine cumulative effects of killer whale predation and potential impacts of shipping on narwhal.

Rationale:

Killer whale presence and distribution in the Eastern Canadian Arctic is increasing and there is growing concern among Inuit communities that this increase will negatively impact their marine mammal prey. Killer whales prey on belugas, narwhals, bowhead whales, and various seal species, which are of cultural, ecological, and economic importance. As killer whale abundance increases, there is a need to understand their impact on the Arctic ecosystem. Satellite tagging, photo-identification, biopsies, acoustic recordings, and behavioural observations, will provide information on killer whale abundance, population structure, distribution, and movement, all of which will help to better understand their potential influence on prey species. This project proposes to continue core field work (satellite tagging, biopsy, and photo-identification) as well as add new methods (acoustic and drone recordings) to study killer whale behaviour in more detail and better understand their impact on marine mammals harvested by Inuit. Research on killer whales in the area will help in developing a management plan for killer whales, as well as possible changes to existing management plans for prey species.

Narwhals are facing a threefold increase in shipping traffic in Eclipse Sound. This area is rich in marine biodiversity and is important for Inuit culture and harvesting. Currently, the Baffinland Mary River Project is proposing to double the extraction of iron ore and associated shipping in 2024. In addition, shipping related to tourism has increased in the area. In recent years, especially during the summer of 2018, Inuit hunters observed a lower number of narwhals in the Eclipse Sound area. Shipping and ice breaking can disturb narwhals, decrease their ability to forage, navigate and communicate, and ultimately impact population numbers. There is a need to monitor noise levels in Tallurutiup Imanga National Marine Conservation Area as well as estimating narwhal presence and numbers in relation to shipping activity. Using acoustics and satellite data from narwhals and killer whales will provide a more comprehensive understanding of the cumulative impacts of orca predation and vessel traffic on narwhal. This project proposes to continue passive acoustic monitoring to document noise level in this environment as well as detect the presence of narwhal in relation to shipping activity. In addition, we are proposing to pilot remote tagging of narwhal to study their movement and diving pattern in the summer.

The use of remote satellite tags on narwhals is a less invasive method than traditional live-capture and tagging of narwhals. This method has been used to successfully tag killer whales in Eclipse Sound since 2013. We hope this program will develop into a community-based initiative in future years. Data from the satellite tags provides information on narwhal movement and distribution. More specifically, for Eclipse Sound narwhal this data will contribute to understanding of movement between different management units. Satellite tags also provide data on diving behaviour that allows correction of aerial survey abundance estimates, accounting for narwhals that are underwater during a survey.

Progress to Date:

Previous DFO programs have included narwhal tagging (2016-2018), drone monitoring (2019), acoustic monitoring (2017-2020), remote cameras (2019) and killer whale satellite tagging, photo ID, and biopsy (2018-2019). This previous data will be analyzed in addition to future data to investigate the abundance, distribution, and timing of narwhal movements in the Eclipse Sound area, as well as the population size, structure, distribution, movement, and fine-scale behaviour of killer whales in the Eastern Canadian Arctic. Photo ID of killer whales has shown that 160 (+/- 30) killer whales occur seasonally in the region. Previous research has also shown that killer whale presence can affect distribution and movement of prey species.

Several Inuit participants have been employed in the past by DFO in similar programs (e.g. Eclipse Sound narwhal tagging in 2016, Ecosystem Approach to Tremblay Sound project in 2017-2019, remote tagging of killer since 2013). Locally hired project participants have been previously trained in the deployment of field equipment (moorings) as well as the usage of data collection methods (drones, narwhal observations). This training has led to significant engagement and leadership from Inuit researchers, made possible largely due to multi-year participation by researchers. Continued training and engagement is important for the development of future research and monitoring programs that we anticipate would be fully community-based projects.

Methodology:

In order to deploy acoustic equipment and remote tags on narwhal and killer whales, we will have a field team of up to ten people, including three Inuit researchers. The team based at boat accessible camps at different locations in Pond Inlet, Eclipse Sound and adjacent fjords depending on narwhal and killer whale aggregations. Researchers will mainly use the Tremblay Sound camp or Inuit hunting camps of collaborator and partners in the area. Environmental impacts from the field camp are expected to be minimal and will be mitigated using best management practices.

When stationed at Tremblay Sound, as done in previous years, participants will dig trenches to buried disposed of organic waste and grey water away from water sources. Burnable garbage will be burned to remove attractants. Food will be stored to prevent wildlife attractants. Firearms and bear deterrents including air horns are located at camp to prevent polar bear conflicts. Inuit researchers and trained staff will perform camp watches if needed to ensure the safety of the research team and animals. Chemicals and containers will be stored, handled and disposed of in accordance with labels, MSDS, and regulations. DFO staff will receive WHIMIS training prior to field seasons and complete DFO OSH camp safety protocols and check lists. Camp will be kept orderly and clean to avoid any spills or accidents. Waste, fuelling and storage will adhere to Tallurutiup Imanga National Conservation Area's best management practices. When working from Inuit hunting camp researchers will mitigate impacts using the practices used by Inuit for their camps. All non-burnable will be transported back to Pond Inlet for disposal.

1) ACOUSTICS

Sampling methods: We are aiming at deploying five passive acoustic recorders (hydrophones) in total. Each recorder will be part of a small mooring with a rock anchor at the bottom. We will deploy three of them in Tremblay Sound at the same locations they were previously deployed at during the Ecosystem Approach to Tremblay Sound project (2017-2019). The data from these three hydrophones will add to the long-term monitoring of narwhals in Tremblay Sound. Shipping traffic is minimal in this sound and therefore provides a long-term baseline data set of a quiet, undisturbed area. The two other passive acoustic recorders will be deployed in Milne Inlet where there is shipping related to the Baffinland Mary River mine. Passive acoustic recorders will be programmed to record for one year and will be retrieved in the summer of 2022. This data will be used to measure noise level related to shipping as well as investigate the presence of narwhals in areas with different noise levels.

2) REMOTE TAGGING

Sampling methods: A tagging team will camp in an area of high narwhal density (e.g. Tremblay Sound). Once narwhals are sighted, the tagging team will set out by boat and wait for narwhals come close to the boat. When narwhals are in close proximity, narwhal will be remotely tagged with a towable satellite tag (i.e. tethered tag on a leader line: Figure 2). Tags will be attached via a single point anchor system similar to a Domeier or Wilton design (Figure 3). Depending on distance to the narwhal and preference of the crew, a jab-stick, harpoon or crossbow (preferably jab-stick) will be used to attach the anchor. Narwhals will not be actively pursued during this procedure and should only feel the momentary jab from tag anchor insertion. DFO is proposing a maximum of 25 narwhal tagged with this method, however the final number will be confirmed with the Mittimatalik HTA.

Killer whales will be slowly approached by boat, in the Eclipse Sound area, to within 10m and Limpet model satellite tags (Wildlife Computers) will be deployed onto the dorsal fin with 6-cm metal darts that will anchor below the skin into the cartilage, using crossbows. Tags will transmit location and dive data up to 300 times daily, when the whale surfaces, to satellites that store data on the ARGOS system. DFO is proposing a maximum of 20 killer whales tagged with this method, however the final number will be confirmed with the Mittimatalik HTA.

Figure 2. Satellite tag with dive data for pilot remote tag deployment (Wildlife Computer SPLASH10-F-333).

Figure 3. Tag Attachments (anchors) for pilot remote tag deployment

3) BIOPSIES

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.

4) DRONES
Killer whale behavior will be recorded using drone-based aerial cameras and quantified using animal-borne tags fitted with accelerometers.

5) INUIT QAUJIMAJATUQANGIT
Development of remote tagging techniques and methods has been led by the Western Arctic Beluga research group. This work has been a celebrated example of knowledge integration between scientists and local knowledge holders. Should this project be funded and supported, we are excited to re-engage local experts from the north Baffin region to work together on modifying techniques for narwhal remote tagging. We are also planning to work with the Inuit Advisory Committee (IMAQ) of the TI NMCA to develop acoustic monitoring tools that are meaningful to Inuit and correspond to their research priorities.

6) ANIMAL CARE
Impacts to narwhals and killer whales are expected to be minimal due to the remote nature of tagging. Killer whales will be pursued in order to tag the faster moving whales, this may temporally increase stress to animals, however DFO marine experts will be examining the whales behaviour to assess if/when the boat should stop pursuing the animals. Narwhal will not be pursued with a boat, rather the boat will wait for narwhal to travel close to the boat. Tags will use a single dermal anchor point in the cartilage or blubber tissues of the animals. Anchors are pre-sterilized prior to fieldwork by gas (Ethylene Oxide) and sealed in a sterile pack until use Tagging will be done by trained DFO staff and Inuit researchers. Other research participants will assist in taking notes, photos and other tasks. Safety training and a crew orientation will be conducted on arrival to camp. This training will be given by project leads and biologists (Marcoux and Mathews). A missed attempt may cause a scrape or small puncture wound to the animal. In the case of a missed attachment, the arrow will be replaced with a sterile replacement. Arrow tips (stainless steel mm sharpened puncture tool with 6.5cm penetration depth) are sterilized in 10% Povidone-iodine soaked for minimum 20mins. All tagging procedures will be sent to the Freshwater Institute Animal Care Committee for approval before the field seasons.

Data management:

Data will be managed using DFO's data protocols and stored at the Freshwater Institute in Winnipeg, MB.

Research outputs:

Graduate students are specifically examining the acoustic environment and killer whale aspects of the research program. This research will be used for a Master and PhD thesis and associated publications, and conference presentations. Interim and finals results of these and the program as a whole will be shared with Inuit communities. Funding may also allow students to leave translated research posters in Pond Inlet for community members.