1. **NWRT Project Number:** 3-21-10
2. **Project Title:** A team-based approach to investigate and increase the understanding of Char and Cod declines in adjacent waters to Kugluktuk, NU.
3. **Project Leader:** Tracey Loewen, Freshwater Institute, 501 University Cres, Wpg, MB R3T2N6; Email: tracey.loewen@dfo-mpo.gc.ca and Telephone: 431-277-4308.
4. **Summary:** Kugluktuk Angoniatit Association Hunters and Trappers Organization (HTO) has identified priority concerns on declines in fish numbers and climate change impacts on subsistence fisheries within the Coronation Gulf (i.e., waters where the community of Kugluktuk spend time accessing country foods). A team-based approach was formed between the HTO, University of Waterloo and Fisheries and Oceans Canada to start examining issues on two targeted subsistence fisheries: 1. Chars (Arctic Char and Dolly Varden Char) and 2. Cods (Greenland Cod and Arctic Cod). Each subsistence fishery has long-standing use and both groups of species are considered culturally important by the community of Kugluktuk. For chars, the HTO specifically wanted to know where they were moving to overwinter and spawn within the Coppermine River, they expressed concerns over low water levels causing chars increased difficulty in migrating into freshwater, and where char accessed food resources in the marine environment. For cods and other marine fish, they wanted to know why they were harder to capture and why they were capturing more unusual fish such as wolffish. Collectively, the team developed a multi-faceted approach to answer these questions through the use of telemetry studies (fish movement), environmental sampling (water collection and temperature monitoring), genomics (understand the char run throughout the season and species identification), traditional knowledge (what is known about the fish from community members), and marine fish surveys (understand species biodiversity in the region and increase our understanding of marine fish life histories). Underpinning all these research efforts has been a highly successful community fish collection program. The community fish collection program samples are used to support all facets of our research programing (i.e., telemetry, otolith isotope and trace elements, genomics, marine fish). For 2021-2022 fiscal year we requested funds from NWRT to support the community fish collection program within Kugluktuk, NU.

5. **Project Objectives:** The main purpose of the overall study, which this community sampling program supports, is to increase our understanding of chars and cods in the Coronation Gulf region. Results will be used to support the management of the subsistence harvested fish by the community of Kugluktuk, NU. The project objectives have not changed since the NWRT application submission.

Specific Research Questions Pursued, Partially Through Samples Collected From the Community: 1.) Where do chars overwinter and spawn within the Coppermine River?
2.) Do chars congregate in feeding areas in the marine environment or do they disperse randomly?
3.) What species of char exists in the Coppermine River and how does this relate to migration timing in the run?
4.) What do we know about marine species (focused on cods) in Coronation Gulf?
5.) Which species have seen an increase in occurrence in recent years and what do we know about these fish (i.e., wolffish)?

Specific Research Objectives:

1.) To examine fish movement in freshwater and marine environments throughout the seasons through the use of otolith element and isotope analysis and acoustic-telemetry studies.
2.) To determine and identify char species in association with the timing of fish migrations up theCoppermine River using genomics, morphometric, meristic, and local knowledge.
3.) To identify and examine marine fish species life-history, feeding ecology, and biodiversity within Coronation Gulf.

6. **Materials and Methods:** Materials and methods for our research generally are consistent with the original proposal, but have evolved to respond to changes in field conditions, preliminary results, and community priorities. One update is the installation of summer and winter moorings that are designed to monitor the upper (1-3m) and lower (benthic near bottom) areas of the water column. These moorings will collect oceanographic data in areas where we know char gather/exist in summer and winter months. Three moorings were set out this summer and will be put out again under the ice (December or January). The design of setting the moorings under the ice was configured by Erik Hitkolok. The moorings will target the freshwater layer of water just under the ice (1-3m) from river outflows into the coastal marine area and benthic bottom water conditions.

Due to covid-19 restrictions, only one member of our science team (Rosie Smith) went to the community of Kugluktuk for the complete summer field season (2021). To undertake all aspects of the research, community members were hired, trained, and co-led to work with Rosie Smith. Eric Hitkolok had a lead role in providing programming assistance and still continues to lead aspects of work within the community for our programs. Rosie also trained and worked with other community members to complete programing including hiring and training individuals to collect tissues, otoliths and other information from char heads. This was done so the char heads could be left within the community.

7. **Results:**

Fish Tagging & Oceanographic Moorings: A total of >50 acoustic listening receivers were set out in the marine and freshwater environment in Coronation Gulf and some adjacent rivers draining into the region (i.e. Coppermine River). Receivers were successfully retrieved and re-set in the Coppermine River proper with the use of PCSP helicopter access (Figure 1). A total of 60 Char and 28 Greenland Cods were successfully tagged over the course of the summer field season. Surgeries were successful with no mortalities and fish detections occurring in the acoustic array. Data is presently being downloaded and analyzed for the 2022 summer field season. A total of 3 oceanographic moorings were set in the marine/coastal environment that examined upper and lower water column characteristics. The summer moorings will be retrieved in October before freeze-up. The moorings will be set out under the ice in December or January, dependent on ice conditions. Updates for the fish tagging program include all relevant data to the fall of 2022.

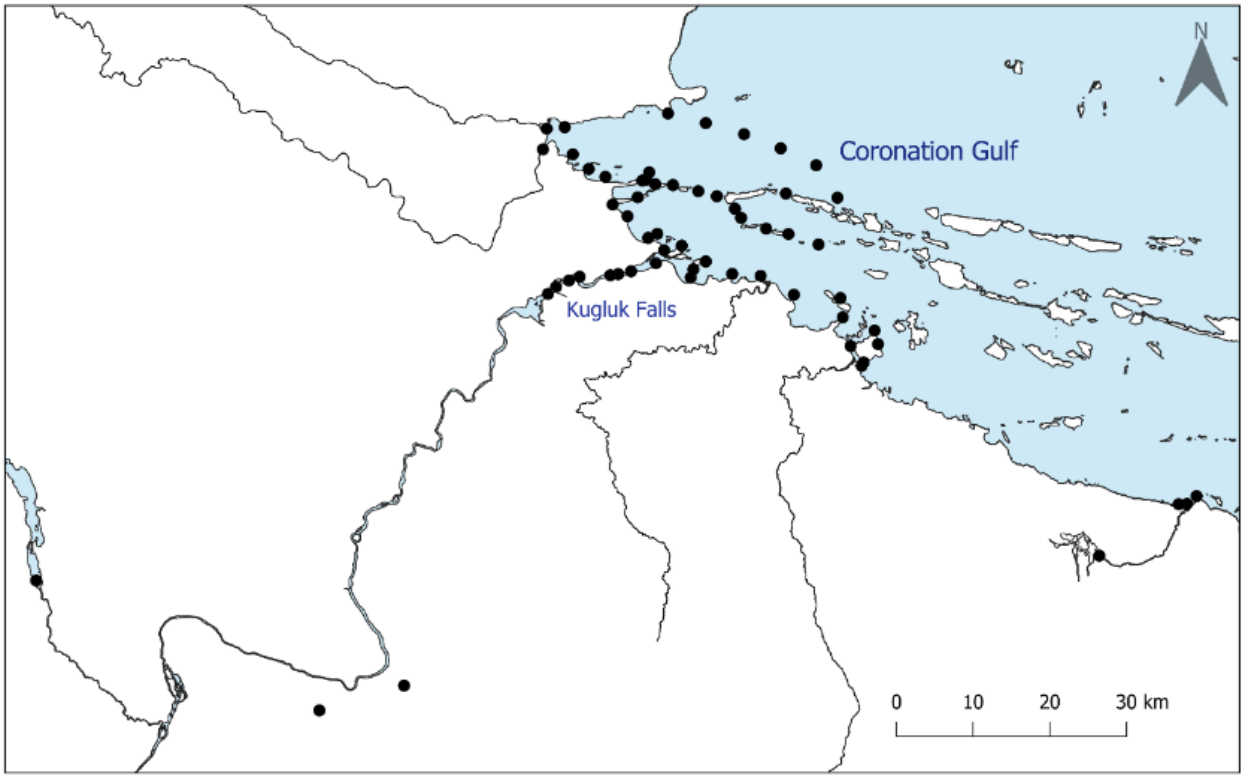

Figure 1: Acoustic listening receiver network that was installed in the 2022 summer field season.

Research on Char otolith elements and isotopes is also being pursued to assist with understanding fish movements and natal origins. To date (fall 2022), 1465 samples have been collected from char heads (all years of sample collection) and 595 char have been aged so far. The oldest char is 15 years and the youngest captured was 3 years. Otolith isotope and element analysis is ongoing and not available for presentation for this report.

Community Monitoring: A total of 350 Char heads, and numerous other whole fish were collected as part of the community monitoring program including Saffron Cods, Greenland Cods, whitefish, flatfish, and any other fish that the HTO deemed of interest to the community for collection. As the program continues, awareness of the program within the community is increasing. Char heads are being processed in Kugluktuk with Rosie Smith and community members that were trained to collect tissues, otoliths and samples. The summer fish collections have been sent to the Freshwater Institute for further processing. The fish have been processed for biological data collection. The 2022 summer field season updates will be included in our funding report for 2022-2023 fiscal year.

Bering Wolffish is one species we are collecting as part of community programming. Presently, we are examining biological characteristics, age, sex, maturity, stomach contents/isotopes/ecology, and parasitology. To date (all years of collection) we have fully sampled 8 fish and data will be presented to the Kugluktuk HTO in Feb. 2022. To date, the lifespan of wolfish is known to be 6-7 years of age, with a sex ratio of 5 males: 2 females that have been in a non-reproductive condition with round weights ranging from 652-1930 g and a length of 446-660 mm. All fish have been processed for biological data collection.

Char morphometry, genomics and IK work is presently ongoing and will be completed in the next 12 months. Delays during covid for genomics work was common – the same laboratory supplies to do this work are used in covid testing and there were shortages thus causing the delays. Preliminary results (all years of collection) suggest a high prevalence of Dolly Varden within the char populations (morphometry and genomics) in the region but more work is being done to verify and quantify this finding. To date, genomics for 227 fish have been examined from the Coppermine River. In addition, 44 Tree River and 79 reference Arctic Char and Dolly Varden samples have been analyzed. For morphometrics a total of 735 char have been examined to date (Kugluktuk and other regions of Canada). A total of >150 char were examined for meristics. IK interviews on char physical appearance and changes within the Coppermine River over time were completed in May. All IK interviews are being finalized in the present day.

Oceanographic data is presently being collected in association to summer and overwintering habitat use by chars and cods within the coastal marine environment. Data has been collected and will be presented in future reports. Eric H. was successful at deploying and retrieving the measuring instruments through summer/fall and winter seasons when the instrument could be deployed.

Coastal Cods research is currently being done to examine climate change impacts to Greenland Cods in the marine coastal environment. The research conducted has shown that larval hatch size of Greenland Cods is directly related to overall total length archived as adults. Over the last 13 years – larval hatch size of Greenland Cod has decreased and thus the adult size of Greenland Cod has also declined over time. Work is presently being done to compare these results to climate change variables. The research paper and presentation of these findings have been discussed with Amanda Dumond at the Kugluktuk HTO and will be presented to the HTO board during the next consultation meeting.

8. **Discussion/Management Implications:** The Kugluktuk HTO has discussed a high priority to sustain the long-term viability of subsistence harvesting of both chars and cods near Kugluktuk, NU. The research undertaken will help to address the management of both fisheries through increased monitoring and understanding of habitat use (marine and/or freshwater), assistance to predict and manage the effects of climate change, human disturbance, and management of subsistence fisheries for food security. Our research suggests that two species of chars inhabit the river systems in Coronation Gulf. A stronger understanding of Dolly Varden and Arctic Char habitat use and presence in overwintering areas will help to support the management of char fisheries in the region.

Dolly Varden Char have been listed as a species of special concern by COSEWIC. Our research (genomics, morphology, and local knowledge studies) will help to confirm the identification and verify the first presence of Dolly Varden Char in Nunavut waters. Our research will feed into Dolly Varden Char designatable unit calculations, overall population numbers for the species, and potentially modify the species distribution map for Canada.

9. Report by Inuit participants: Amanda Dumond has been a strong participant and organizer of the community collection program. Amanda has indicated that the community collection report is collecting fish species seen within the community fisher's nets. She wanted to manage and monitor when and how many fish are collected from each fisher. She has indicated it is challenging to ship the fish due to the large workload that the HTO has on various programs and thus we have hired Eric H. to assist with this task so that the HTO freezer is not overwhelmed

and at capacity constantly. There are competing interests for Amanda's time presently. Amanda has had the opportunity to read this final report and provide comment/change to the document.

Eric H. is currently in the field completing fall work with Rosie Smith – he is not able to provide a written update on the program. In future years, I will ask Eric for a verbal report during the summer field season that we can include in the final project report.

10. Reporting to the communities/resource users: Dr. H. Swanson met with the Kugluktuk HTO board on December 1, 2021 regarding the Chars and Cods program. A letter of support for the NWRT 2022-23 application was provided. A second meeting with the Kugluktuk HTO board was postponed due to covid related issues. Amanda Dumond suggested that the summer time period was not suitable for meeting with the board and alternative dates for consulting with the HTO are being discussed presently.

The HTO is generally positive about the progress made and were particularly interested in: the high proportion of fish that are genotyping out to be Dolly Varden Char, the otolith microchemistry work (both the approach, and temperature reconstruct), and the wolffish. The HTO is interested in taking a broad approach to the community collection program with some focus on char, whitefish, cod, and wolffish.