Monitoring and Research Results 2016-2020

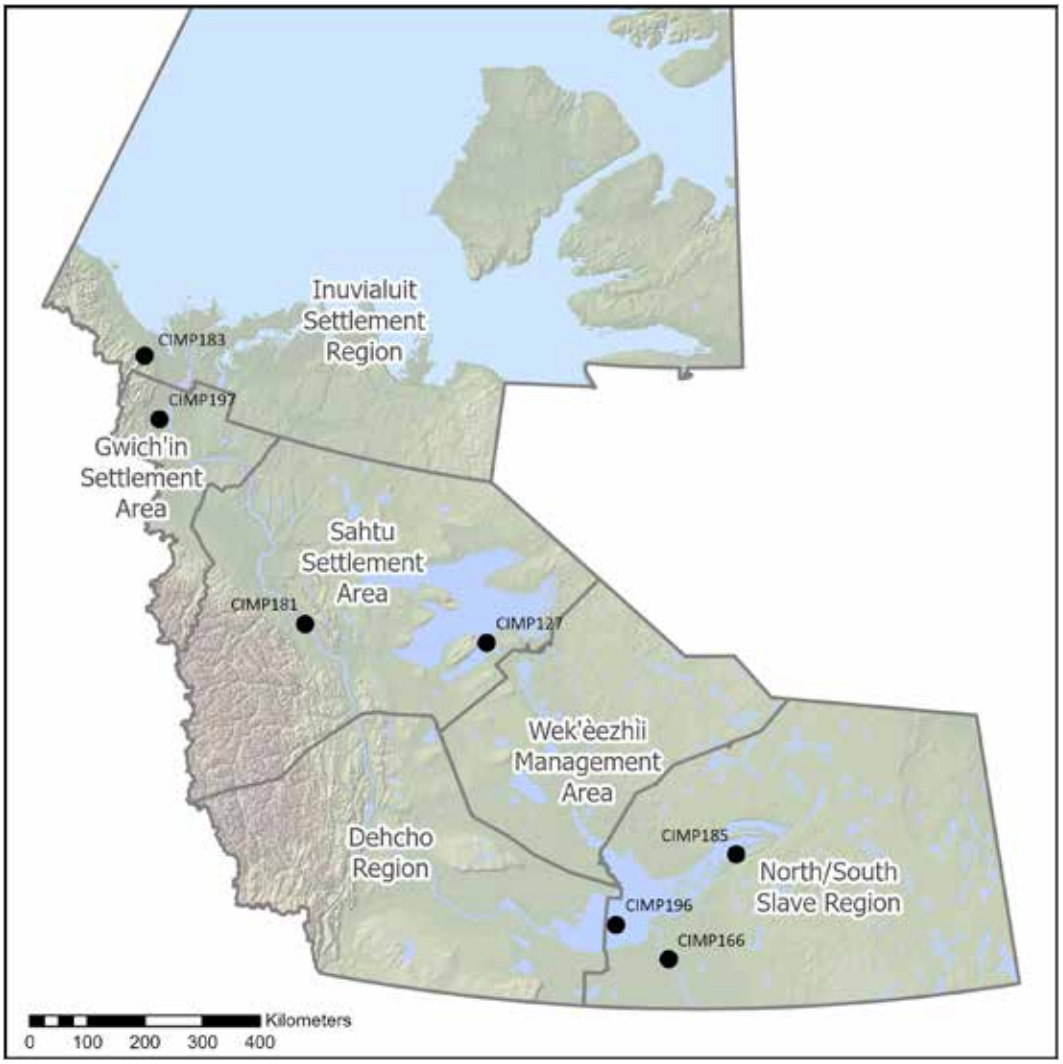
(Released December 2022)

NWT Cumulative Impact Monitoring Program (NWT CIMP)

FISH

Government of
Northwest Territories

NWT CIMP-funded fish projects in the NWT 2016-2020



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December 2022

About the Northwest Territories Cumulative Impact Monitoring Program (NWT CIMP)

The Northwest Territories Cumulative Impact Monitoring Program (NWT CIMP) is a source of environmental monitoring and research in the NWT. The program coordinates, conducts and funds the collection, analysis and reporting of information related to environmental conditions. Its main purpose is to better support resource management decision-making and the wise use of our resources by furthering our understanding of cumulative impacts and environmental trends. Based on the priorities of environmental regulators, co-management boards, and Indigenous governments and Indigenous organizations, the program has focused on caribou, water, and fish since 2011.

NWT CIMP strives to place research and monitoring results in the hands of those who need it to make decisions. As such, we are focused on reporting back to communities and to environmental regulators who can use the information to manage the land and water. This booklet of caribou monitoring, and research is one way in which the program shares results. Other means include community presentations by researchers, regional results workshops, peer-reviewed publications, and online through the NWT Discovery Portal.

NWT CIMP annually funds approximately 30 projects, providing $1.7 million to research and monitoring of cumulative impacts in the Northwest Territories. This publication provides high level summaries of the results from the boreal and barren ground caribou research and monitoring projects that were funded in 2016-2020 (see map on facing page).

For more information on the program, visit **www.nwtcimp.ca**. For NWT CIMP project results, visit **nwtdiscoveryportal.enr.gov.nt.ca** or email the principal investigator directly.

Contents

CIMP183

Years funded: 2

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Recommended Reading:

For additional information on this project please visit nwtdiscoveryportal.enr.gov.nt.ca and search "CIMP183".

Inuvialuit monitoring and management of the Big Fish River

Purpose

This project focused on addressing priorities of the Aklavik Hunters and Trappers Committee about the management and monitoring of Big Fish River Dolly Varden char. Elders and youth participated in a harvest monitoring program to build capacity and develop Inuvialuit and local knowledge indicators for co-management decision-making.

Key Findings

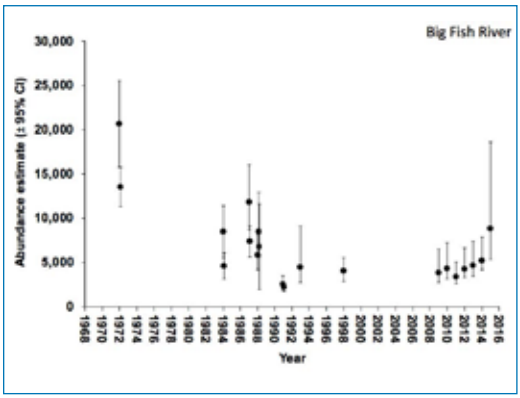
- Inuvialuit observations on Dolly Varden char and habitat were used to develop traditional and local knowledge indicators for co-management decision-making and allow a more balanced approach to annual harvest level recommendations.
- Inuvialuit observations on environmental change were documented and will be used to inform future long-term monitoring.
- Water quality results provided information on may potential impacts affecting Big Fish River Dolly Varden char habitat.

How does this project help in understanding cumulative impacts?

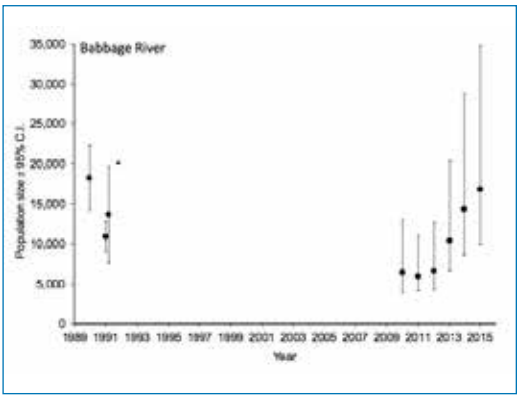
The indicators focused on char health such as general condition, presence of scarring and presence of parasites. Decision thresholds were developed for each indicator that categorized current status. The development of these indicators resulted in a more balanced approach to decision-making, equally incorporating both scientific data and Inuvialuit knowledge. The documentation of water quality at various sites along the Big Fish River and its tributaries (important Dolly Varden char habitat) will assist with future monitoring and cumulative effects assessments.

Tawna Brown Photography, www.nwtarts.com

Map of area with water quality monitoring sites from 2014 marked in blue, sites from 2016 marked in red and places of importance marked in white.



Big Fish River char population abundance estimates, 1972-2015 (DFO data presented by Colin Gallagher to the West Side Working Group).



Babbage River char population abundance estimates, 1972-2015 (DFO data presented by Colin Gallagher to the West Side Working Group).

CIMP197

Years funded: 4

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Recommended Reading:
For additional information on this project please visit nwtdiscoveryportal.enr.gov.nt.ca and search "CIMP197" or read the 29th issue of the NWT Environmental Research Bulletin (NERB), available online at www.nwtcimp.ca.

How does proximity to roadways impact water quality and invertebrates in Arctic lakes?

Purpose

Freshwater ecosystems are an important part of the northern environment. Northern communities depend on lakes for drinking water and food. Climate change is expected to continue to cause warming of lakes and the loss of permafrost, so it is important to understand how these changes might affect these important resources.

This project surveyed lakes in the Gwich'in Settlement Area and Inuvialuit Settlement Region for fish, aquatic invertebrates and water quality over three years. The project examined how water quality affected the abundance and diversity of these aquatic organisms in each lake. This information helped to predict how these aquatic organisms might respond to water quality and temperature changes.

Key Findings

- Water quality changes caused by permafrost thaw may lead to increases in the total abundance of waterfleas, but small decreases in the diversity of aquatic invertebrates.
- Indirect climate change effects on water quality, such as increased nutrients, seem more important for fish communities than the direct effect of increasing water temperatures.
- Warming water temperatures may allow lakes to support more types and higher numbers of fish, but changes in water quality due to permafrost thaw might act in the opposite direction, lowering the number and variety of fish that lakes can support.

Lake Whitefish caught in the Inuvialuit Settlement Region. (Credit: D. Gray)

How does this project help to understand cumulative impacts?

Project results suggested that fish diversity and abundance in northern lakes might be sensitive to changes in water quality, caused by climate change and permafrost thaw. However, predicting how fish communities may change is difficult because increases in water temperature and water quality changes may act in opposing directions. Their food, macroinvertebrates and zooplankton, might also change in response.

The baseline datasets developed through this project for water quality, invertebrates, and fish in lakes along the Fort McPherson-Inuvik-Tuktoyaktuk transportation corridor are a valuable tool and were provided to decision-makers, including the Gwich'in Land and Water Board and the Fisheries Joint Management Committee.

CIMP127

Years funded: 10

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Recommended Reading:
For additional information on this project please visit nwtdiscoveryportal.enr.gov.nt.ca and search "CIMP127".

Monitoring for impacts of harvest and climate change on the Great Bear Lake aquatic system

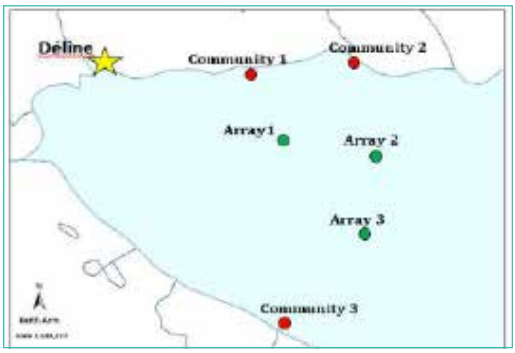
Purpose

This project began out of ongoing community concerns in Dél̨ı̨nę over the sustainability of fish resources in Great Bear Lake (GBL) and the potential changes in water quality due to climate change. In partnership, the Dél̨ı̨nę Got'ine Government and the Sahtú Renewable Resources Board (SRRB) standardized and collected baseline information for GBL on water quality, zooplankton, forage fish and harvested fish. Fisheries and Oceans Canada and the SRRB will use this information in fisheries management decisions.

Key Findings

- GBL shows signs of warming more during the open water season than it has historically.
- Although lake warming may benefit some fish species, the warming will likely result in reduced suitable habitat for cold-adapted fishes such as Cisco and Lake Trout. These species currently use the majority of the lake and were found to be associated with survey sites that had colder temperatures.
- Levels of contaminants in sediments, including mercury, were relatively low. However, some contaminants show an increasing trend over the last century, most likely related to climate change. Climate Change can increase long range atmospheric transport and have complex impacts on the local movement and bio-availability of contaminants.
- Although GBL has few species, results show a tremendous degree of intraspecific variation (differences that occur within a species). At least 4 types of Lake Trout, 3 types of Lake Whitefish and 2 types of Cisco were documented during this project.
- Although there are early signals of ecosystem change based on water temperature and sediment coring data, preliminary results of an updated ecosystem model for GBL indicated that it remains in a relatively stable state. This is in comparison to other large lakes in Canada such as Lake Superior and Lake Ontario.

Bobby Modeste and Louise Chavarie sampling Lake Trout at Russel Bay in Great Bear Lake. (Credit: C. Gallagher)



Map of fixed community-based monitoring sites. Offshore sampling sites and logger arrays are shown in green (Array 1-3); inshore benthic sampling sites are shown in red (Community 1-3).

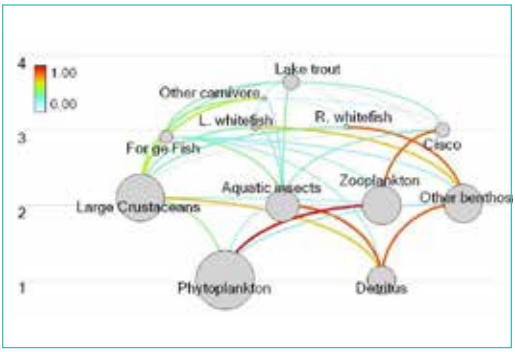


Diagram of Great Bear Lake flow web showing relative biomass and flows between functional groups at various trophic levels. Legend explains the percentage of dietary flows. For example, a strong red line is showing that 100% of dietary flows originated from that particular functional group.

How does this project help to understand cumulative impacts?

Information on trends in biological traits (e.g., age, length), relative abundance, and knowledge of intraspecific diversity of fish species will contribute to recommendations regarding fisheries management, including total allowable harvest levels for GBL.

CIMP154

Years funded: 7

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Recommended Reading:
For additional information on this project please visit nwtdiscoveryportal.enr.gov.nt.ca and search "CIMP154" or read the 10th issue of the NWT Environmental Research Bulletin (NERB), available online at www.nwtcimp.ca.

Understanding fish mercury concentration in Dehcho lakes

Purpose

This long-term project has been researching fish mercury concentrations in the Dehcho since 2013 and is expected to continue until at least 2025. Between 2016 to 2020 this project investigated why fish mercury concentrations are lower on the Horn Plateau lakes (Willow, Big Island, Mustard) than in Mackenzie Lowland lakes (Ekali, Sanguez, Kakisa, Trout) of the Dehcho Region. Fish, invertebrates, water and sediment were collected from each of the four lakes. In some traditional Dehcho fishing lakes, mercury levels are high enough to require consumption advisories for some fish species. By understanding the dominant drivers of fish mercury in the Dehcho region, information is used to better predict how climate change and potential future resource development may affect fish mercury.

Dehcho lakes were sampled for water, sediments, fish and small organisms living in the water (benthic invertebrates) and sediments (zooplankton). The project determined fish mercury levels as well as fish age, size, position in the food chain and food source. The project also determined mercury levels in benthic invertebrates and water. Water chemistry was also measured.

Key Findings

- Mercury levels in Lake Whitefish were generally below subsistence consumption advice and commercial sale guidelines.
- Of the eight lakes studied, Kakisa, Trout and Mustard have the lowest fish mercury levels, and Sanguez and McGill have the highest fish mercury levels.
- Mercury levels in some fish, and the rate of mercury biomagnification through the food web, can be predicted from water chemistry measurements; however, the best predictors were different for different types of fish.

Clockwise from top left: Elsie Lacorne, Shelley Lundvall, Heidi Swanson, Steven Nadlii, Joe Lacorne and Brian Branfireun. (Credit: H. Swanson)

How does this project help to understand cumulative impacts?

Project results showed that it is possible that some fish mercury levels may be predicted from simpler measurements of water chemistry. The information on fish mercury levels can help people make decisions about how often to eat fish. The results are informing discussions on management strategies that could reduce mercury levels in fish, such as fish-downs, where harvesting a certain number or type of fish could lead to faster growth and lower mercury levels, as well as public health advisories.

CIMP166

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Recommended Reading:
For additional information on this project please visit nwtdiscoveryportal.enr.gov.nt.ca and search "CIMP166" or read the 13th issue of the NWT Environmental Research Bulletin (NERB), available online at www.nwtcimp.ca.

Geospatial models and isotope tracers to identify key fish and animal habitats along the Slave River

Purpose

Community members continue to voice concerns about the health of ecosystems due to potential impacts of upstream development and climate change. In this project, a method called Stable Isotope Analysis was used to understand fish habitat use and how habitat may be related to the gradual build-up of mercury in fish over time.

The project collected insects and small fish from three locations: the Slave River Delta, the Slave River at Fort Smith, and Great Slave Lake. The project also collected large fish in the Slave River Delta and the Slave River at Fort Smith. They were classified as resident (remain near the location they were caught year-round) or migrant (migrate to the Slave River from Great Slave Lake) based on carbon and sulphur isotopes in their flesh. The project looked at differences in nitrogen isotopes in aquatic invertebrates, small and large fish to understand how mercury increases with each step in the food chain.

Key Findings

- The large majority of aquatic invertebrates and small fish were residents of where they were caught.
- The majority of large fish were shown to migrate between Great Slave Lake and the Slave River. There were few fish that spent their entire life in the river.
- As expected, mercury concentrations increased with each step in the food chain. This process is known as biomagnification. Large river resident fish (particularly pickerel and Northern Pike) tended to have higher mercury concentrations than large fish from the lake (inconnu) and are still within safe consumption guidelines.
- More work is needed to understand why there are higher levels of mercury in the large river fish. Scientists guess that it could be due to greater use of energy and consumption of food to maintain their position in the fast-flowing Slave River.

Victor Mandeville collecting insect samples for isotope analyses. (Credit: T. Jardine)

Shawn McKay with Tim Jardine in the Slave River Delta. (Credit: M. Carr)

How does this project help to understand cumulative impacts?

Stable Isotope Analysis helped to: 1) determine whether fish caught in the Delta and at Fort Smith are resident or migratory; 2) understand which areas the different fish species use to feed; 3) determine which fish species have greater mercury concentrations (pickerel and Northern Pike) and should be monitored to ensure they are safe to eat.

This information can be used to guide how fish are managed in the Slave River Delta region and contribute to making informed fish consumption recommendations.

CIMP132

Years funded: 10

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Recommended Reading:
For additional information on this project please visit nwtdiscoveryportal.enr.gov.nt.ca and search "CIMP132".

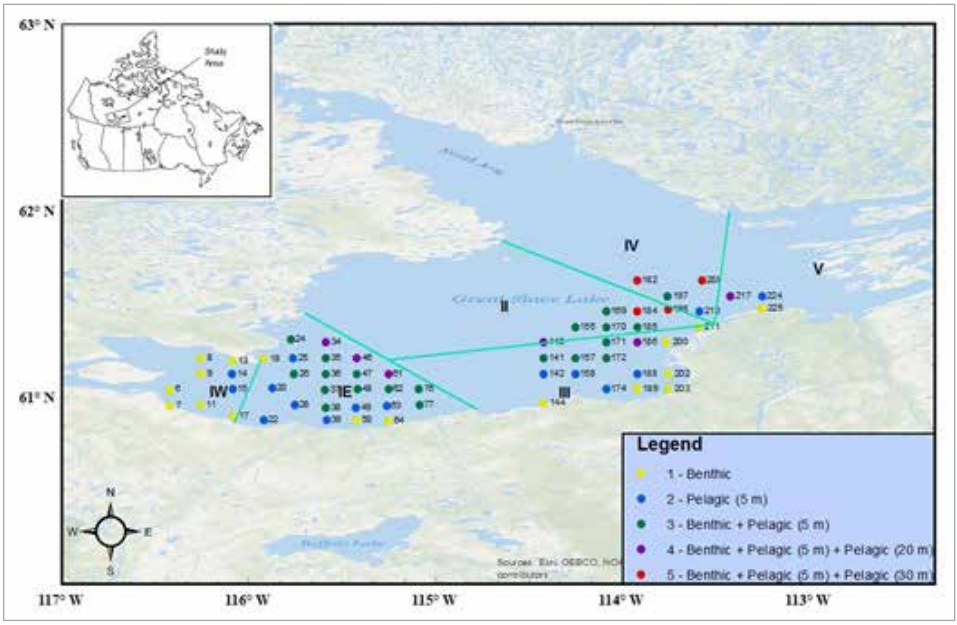
Monitoring, modeling and prediction of Great Slave Lake productivity and food-web dynamics

Purpose

The purpose of this long-term project is to better understand Great Slave Lake (GSL) and its fisheries by monitoring fish populations and associated environmental variables such as zooplankton, temperature and turbidity. This information, including Traditional Knowledge helps Fisheries and Oceans Canada to manage the GSL commercial fishery. The project applied standardized sampling protocols and established baseline indicators to conduct integrated fisheries ecosystem surveys in the southern part of GSL. This project has conducted monitoring on GSL since 2011 and is expected to continue until at least 2023.

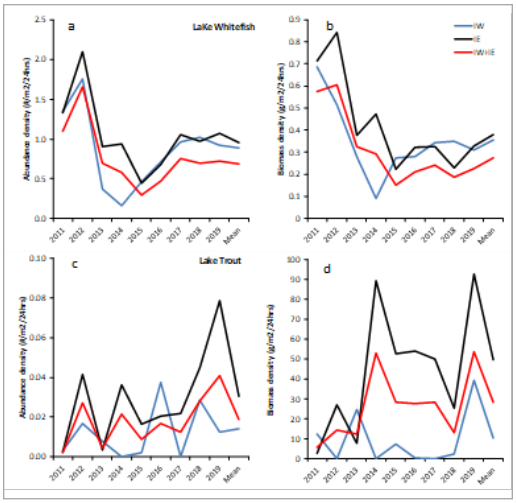
Key Findings

- Three aquatic environmental variables — depth, turbidity, and temperature — have been identified to differentiate spatial fish habitats in the main basin of GSL, using data collected between 2011-2019.
- Combined with temporal trends in limnology parameters, water temperature is an important indicator in GSL, showing a non-continuous depth-specific thermal pattern between the surface and bottom environments. In addition, turbidity and pH had significant depth-related differences.
- Three dominant fish species — Lake Whitefish, Lake Herring (Cisco), and Burbot — are widespread and highly abundant. These species influence the diversity and stability of the fish community.
- Lake Whitefish has dominated GSL fisheries since the beginning of commercial harvest, and we have seen a gradual decrease in abundance in the western basin since 2012. Abundance of Lake Trout were still relatively low compared to historical records, and appear to be slowly increasing between 2011 - 2019.
- Decline of Lake Whitefish abundance is partially a result of a shift in fishery targets and disproportionate harvests by management area.



Sampling grids for integrated fisheries ecosystem study in the southern part of Great Slave Lake, 2017-2019.

(Credit: X. Zhu, DFO)



Inter-annual variation of abundance (a, c) and biomass (b, d) of Lake Whitefish and Lake Trout from fishery-independent surveys in Great Slave Lake, summers of 2011-2019.

How does this project help to understand cumulative impacts?

Project results provide important information and knowledge to better understand water quality, the quality and quantity of fish habitat and fish species abundance for fisheries management decisions. This project provides a unique platform for DFO scientists to incorporate northern expertise into long-term monitoring programs on GSL, as it was the northern field crews, captains and coordinators that made this project possible.

CIMP181

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[2] Gwich'in Renewable Resources Board
[3] Sahtú Renewable Resources Board

Recommended Reading:
For additional information on this project please visit nwtdiscoveryportal.enr.gov.nt.ca and search "CIMP181".

Developing environmental DNA as a tool to monitor fish distributions in the NWT

Purpose

Fish presence and distribution data is a significant gap for NWT water bodies. This information would be useful for both developers and northern regulators. The purpose of this project was to develop an environmental DNA (eDNA) protocol to detect fish species such as salmon and Dolly Varden in remote northern areas using a community-based monitoring approach for data collection. Environmental DNA is genetic material shed from organisms into the aquatic environment. It can be collected and used to detect the presence of fish in a lake or stream without actually seeing them.

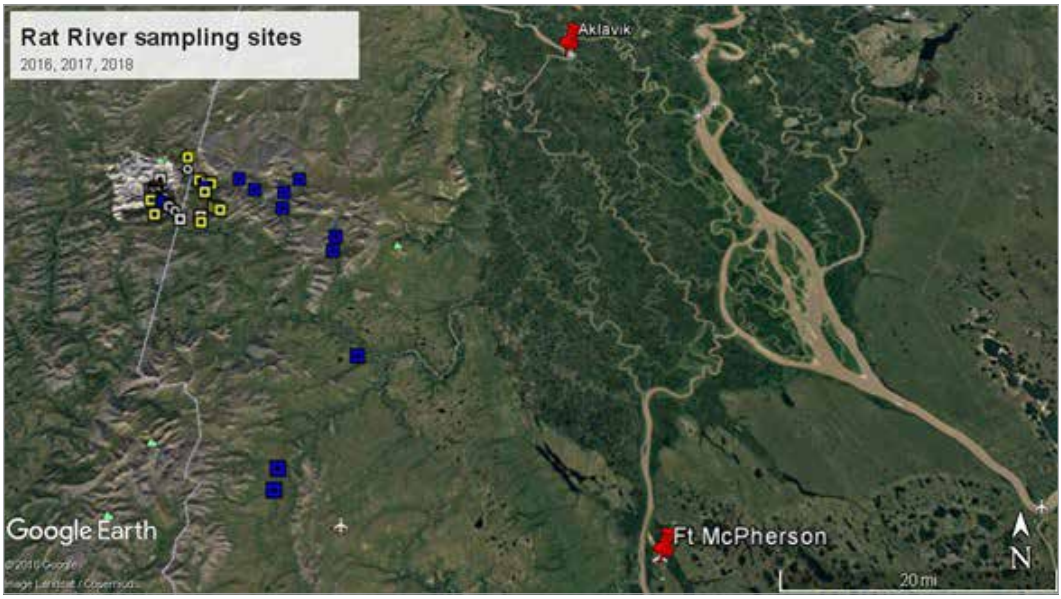
Samples were collected from rivers in the Gwich'in and Sahtú Settlement Areas, with help from community members from Norman Wells and Aklavik. Samples were sent to a genetics lab where single-species and multispecies eDNA detection techniques were developed.

Key Findings

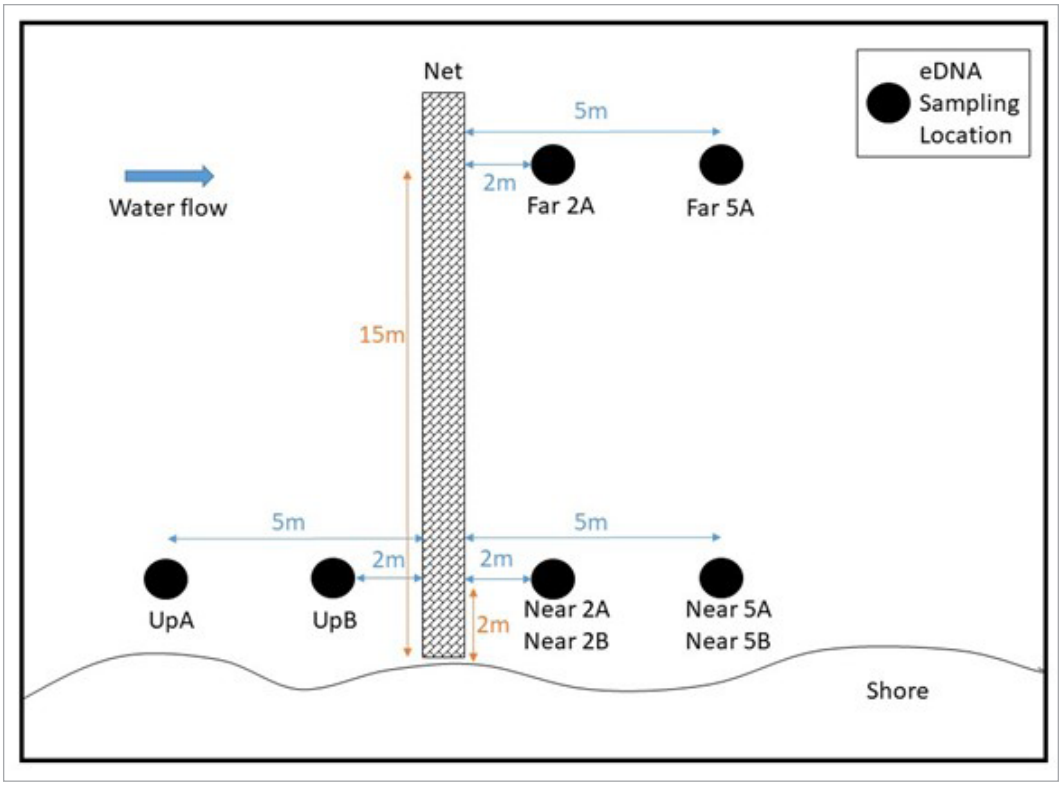
- Field protocols were developed to allow community-based monitors to successfully capture eDNA both in small streams and the Mackenzie River.
- Preliminary results indicate that eDNA methods are effective for detecting the presence of fish such as Dolly Varden, pink salmon and chum salmon in northern streams.
- The use of eDNA is being expanded to detect different northern fish species.

How does this project help to understand cumulative impacts?

Based on project results, a set of guidelines was developed for stream-based and community-based eDNA sampling to maximize the probability of detections and minimize contamination. This is despite the difference in sampling environments among streams and technical skill level among samplers. Together, these results advanced the reliable collection and analyses of eDNA samples collected. Additionally, this project specifically addressed and provided guidance regarding the use of eDNA as a tool to address concerns from northern decision-makers, using a community-based approach.



Locations of eDNA sampling in Rat River and tributaries, August 31, 2018 (blue squares), as well as in 2016 (white symbols; circles represent paired electrofishing/eDNA sampling and squares represent sites with eDNA sampling only) and 2017 (yellow squares).



The eDNA sampling locations in proximity to a subsistence net for community-based sampling. Sampling site UpA is located 5m upstream of the net and UpB is located 2m upstream of the net, 2m from shore. Duplicate samples (A and B) were collected at the sampling locations downstream of the net, 2m from shore (Near2 and Near5). The Far sampling sites were located 15m from shore and 2m (Far 2A) or 5m (Far 5A) downstream from the subsistence net.

CIMP196

Years funded: 1

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Recommended Reading:
For additional information on this project please visit nwtdiscoveryportal.enr.gov.nt.ca and search "CIMP196" or read the 23rd issue of the NWT Environmental Research Bulletin (NERB), available online at www.nwtcimp.ca.

Genetic stock identification and mixed-stock fishery analysis of Inconnu in Great Slave Lake

Purpose

The purpose of this project was to establish baseline genetic data for inconnu stocks in Great Slave Lake where inconnu are harvested in subsistence and commercial fisheries. The majority of commercial fisheries occur in Buffalo River inconnu habitat areas.

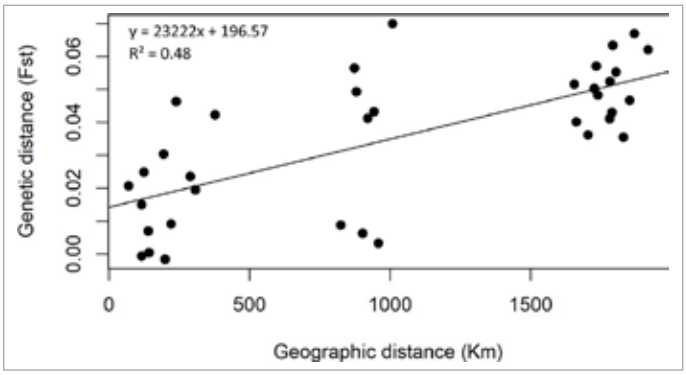
Information about Inconnu spawning locations, behavior, and movement in the Buffalo River was gathered by conducting interviews with Elders and land-users from the K'atl'odeeche First Nation. Samples were taken from locations in Yellowknife Bay and Buffalo, Yates, Slave, Taltson and Marian rivers in consultation with the local communities, fishers and information gathered from traditional studies. Genetic samples, including archived samples from the lower Mackenzie River, were collected and analyzed to see how genetically different Inconnu populations are within Great Slave Lake.

Key Findings

- Inconnu sampled in the Marian, Slave and Mackenzie rivers were genetically distinct.
- The greatest genetic difference between populations was observed between Marian Lake and Slave River samples.
- There may be two or more Inconnu populations that use the mouth of the Buffalo River.

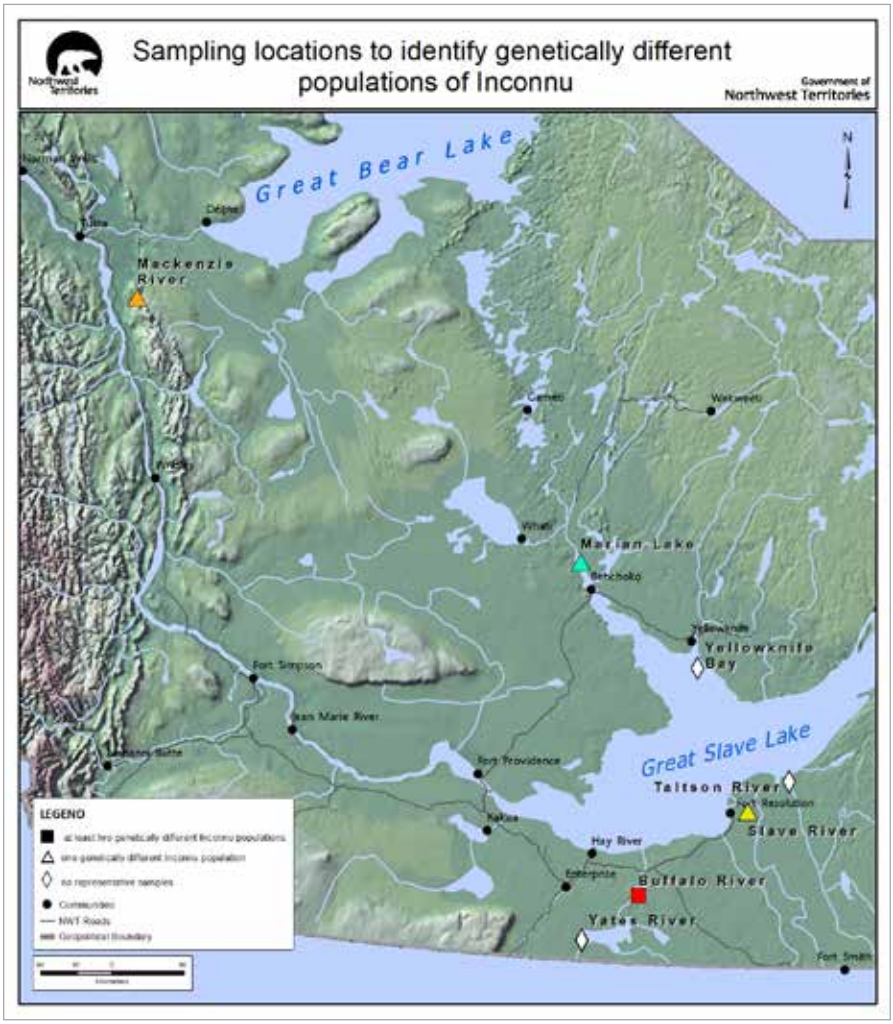
How does this project help to understand cumulative impacts?

Project results will have a direct impact on present and future fisheries management decisions (e.g., management of closed fisheries areas and seasons in Great Slave Lake). The project also helps in establishing genetic analysis as an enhanced analytical tool to understand the Inconnu stocks composition in Great Slave Lake.



Isolation by distance using of the pairwise genetic differentiation and geographic distance (km) of sampling locations within the NWT.

Peter Sabourin (K'atl'odeeche First Nation) and Lauren Wiens (Fisheries and Oceans Canada) sampling Inconnu at the mouth of Buffalo River. (Credit: D. Bugghins; K'atl'odeeche First Nation)



Sampling locations. Each colour represents a genetically different population of Inconnu sampled. Representative samples were not obtained from Yellowknife Bay or the Yates and Taltson Rivers. These sites are identified with the white diamonds.

(GNWT)

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For monitoring results:
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