



Government of
Northwest Territories

NWT Cumulative Impact Monitoring Program

2019/20 ANNUAL REPORT



To watch and understand the land so that it can be used respectfully forever.

NWT CIMP vision

Cumulative impacts are changes in the environment caused by human activities and natural processes that add up across the landscape over time. Monitoring cumulative impacts in the NWT is important because, over time, the results of many individual resource management decisions can lead to changes that may not have been expected.

Cumulative impact monitoring is a statutory requirement in the NWT, and a key feature of the Gwich'in, Sahtù and Tłıchǫ land claim agreements, as well as Part 6 of the *Mackenzie Valley Resource Management Act* (MVRMA).

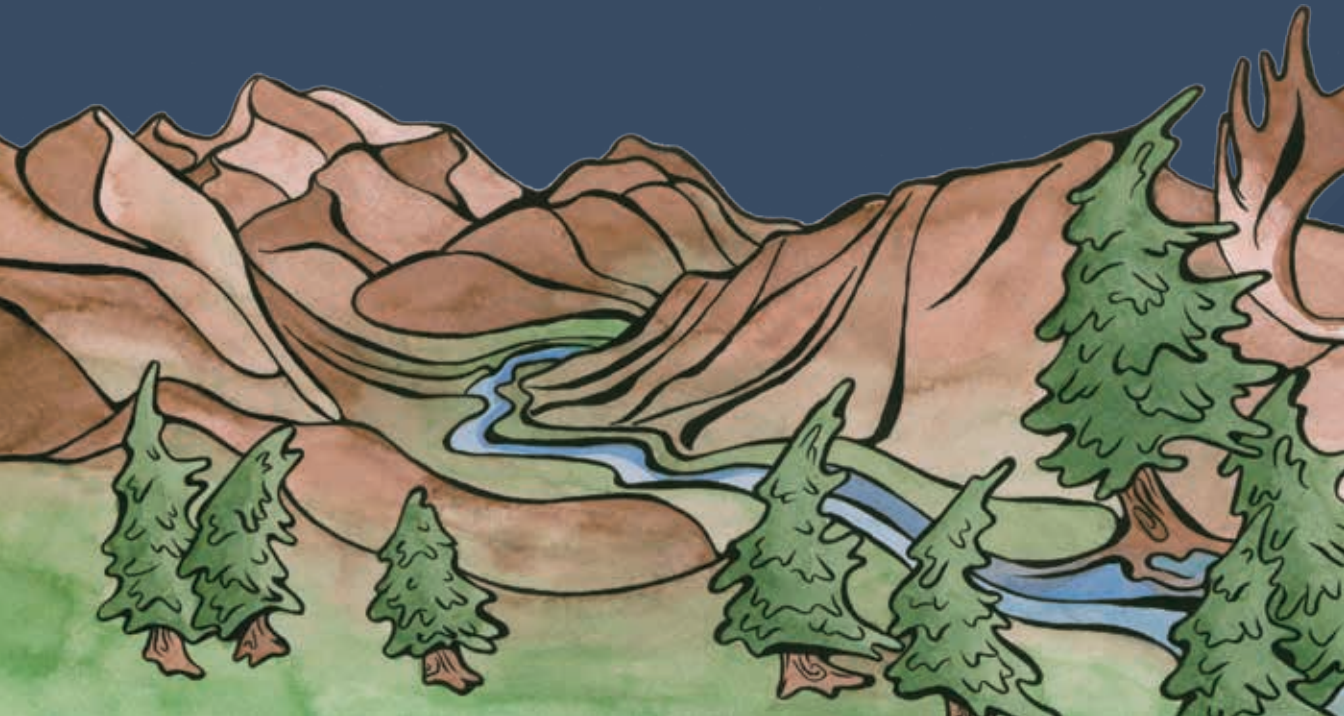


TABLE OF CONTENTS

Program at a Glance..... 2

Progress on our Action Plan..... 3

1. Working with Partners to Understand Key Monitoring
and Research Priorities..... 4

2. Coordinating, Conducting and Funding Monitoring,
Research and Analysis..... 7

3. Communicating Results to Decision-Makers and the Public 8

4. NWT Environmental Audit..... 14

5. Highlighted Project Summaries..... 16

6. List of 2019-20 NWT CIMP Projects..... 25



PROGRAM AT A GLANCE

The Northwest Territories Cumulative Impact Monitoring Program (NWT CIMP) is an environmental monitoring and research program within the Government of the Northwest Territories' Department of Environment and Natural Resources.

While many organizations monitor the NWT environment, NWT CIMP is mandated to understand cumulative impacts and environmental trends. NWT CIMP achieves this by conducting and funding the collection, analysis and reporting of environmental information within the NWT. Funding is available through an annual call for proposals.

NWT CIMP is focused on cumulative impacts related to three valued components that decision-makers agree are of critical importance to the people of the NWT: caribou, water and fish.

The goal of the program is to provide information to NWT regulators and the public that contributes to wise resource management decisions. NWT CIMP considers all sources of knowledge, including traditional knowledge, local knowledge (LK) and science, as sources of monitoring information.

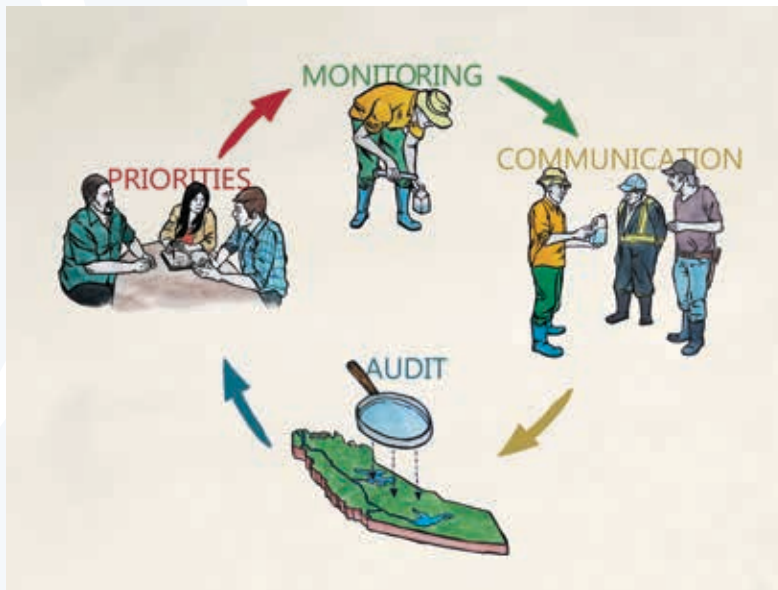
The program promotes community-based monitoring and capacity building associated with cumulative impact monitoring.

Monitoring results are available at **nwtdiscoveryportal.enr.gov.nt.ca**

PROGRESS ON OUR ACTION PLAN

NWT CIMP is guided by a five-year (2016-2020) Action Plan that includes four key activity areas:

1. Working with partners to understand key monitoring and research priorities.
2. Coordinating, conducting and funding environmental monitoring, research and analysis.
3. Communicating results to decision-makers and the public.
4. Coordinating the NWT Environmental Audit.



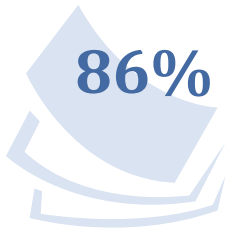
In 2019/20, the program made progress on all main activities in the Action Plan. Please read the following pages to learn more. Additional program information, including a copy of the current Action Plan, is available at www.nwtcimp.ca.

A new five-year (2021-2025) Action Plan is being developed.

1. WORKING WITH PARTNERS TO UNDERSTAND KEY MONITORING AND RESEARCH PRIORITIES

MONITORING PRIORITIES

In 2019/20, NWT CIMP continued to work with partners to confirm and refine its monitoring and research priorities for caribou, water and fish to ensure they continue to meet the needs of northern regulatory decision-makers. NWT CIMP also provided updates to regulatory boards on progress related to their research and monitoring priorities.



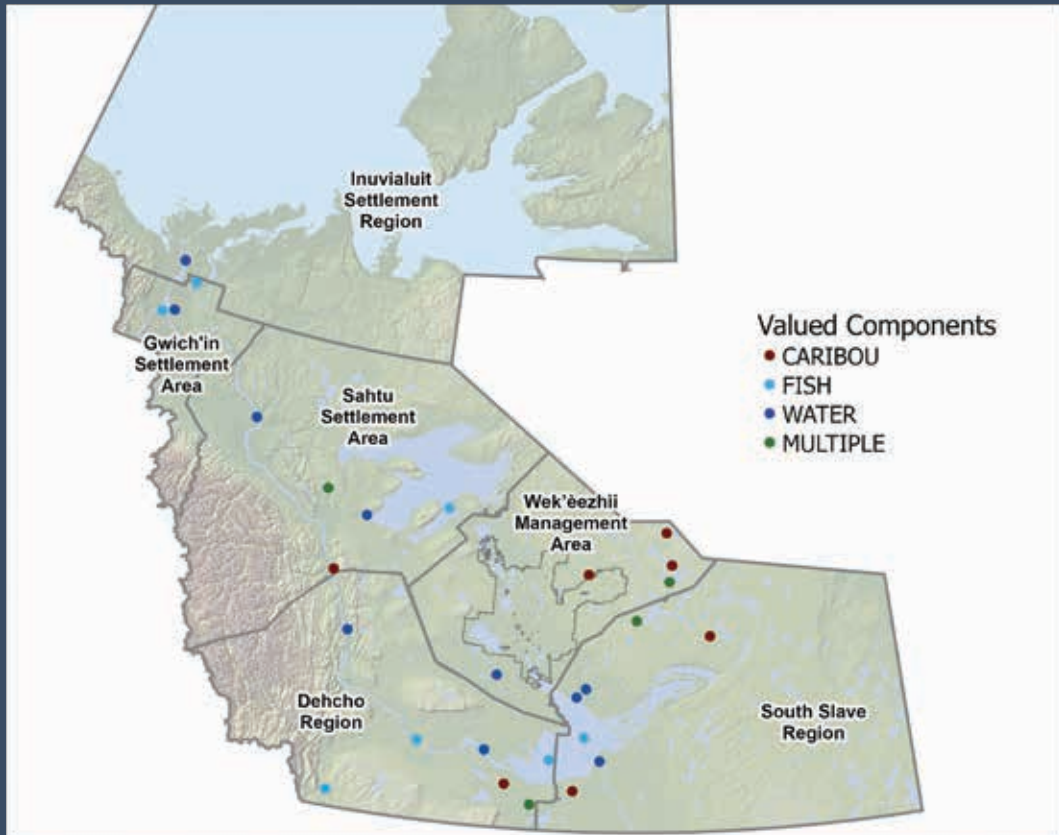
**Projects identified as being able to contribute
to a future decision-making process**

NWT CIMP STEERING COMMITTEE

NWT CIMP continued to engage and support its Steering Committee, including representatives of eight regional Indigenous governments, the Government of the Northwest Territories, and several co-management boards. The Steering Committee met three times in 2019/20 to provide guidance on the overall program and 14 new project funding proposals. The Committee also reviewed new project funding proposals and participated in the annual results workshop in Tulita.



NWT CIMP Steering Committee and Indigenous Government Representatives, March 2020.



Map of 2019/20 NWT CIMP projects.

2. COORDINATING, CONDUCTING AND FUNDING MONITORING, RESEARCH AND ANALYSIS

In 2019/20, the program generated a significant amount of new knowledge about caribou, water and fish. The knowledge generated focused on furthering our understanding of cumulative impacts and environmental trends in the NWT.

See Section 5 for highlighted projects that finished in 2019/20.

28 projects were supported across the NWT



Projects focused on caribou



Projects focused on fish



Projects focused on water



Projects focused on other topics related to caribou, fish or water



Projects that included TK collection/analysis



Funding distributed by NWT CIMP



Leveraged partner funding

SUPPORTING INDIGENOUS COMMUNITIES

This year, 17 projects were developed directly in response to community concerns, with 8 of these being completed in 2019/20. CIMP127 and CIMP193 are highlighted in Section 5 as examples of projects that were initiated based on a community concern.

A complete list of all projects funded by NWT CIMP is available at www.nwtcimp.ca

3. COMMUNICATING RESULTS TO DECISION-MAKERS AND THE PUBLIC

One of the goals of NWT CIMP is to ensure environmental monitoring data for the NWT, including all NWT CIMP-funded project results, are easily accessible to communities and decision-makers.

331 Total number of items posted to the NWT Discovery Portal in 2019-20

147 Reports, presentations and posters



184 Data files



NWT CIMP-funded researchers engaged with **28** NWT communities to discuss project results.



NWT CIMP hosted a regional results workshop in Tulita in December 2019.

SUPPORTING DECISIONS ABOUT THE ENVIRONMENT

NWT CIMP is focused on providing information to regulators and the public that supports effective environmental decision-making. Project leads are required to contact local decision-makers as part of the funding application process to ensure projects meet their needs. Several examples of projects that can contribute to northern environmental decision making are below.

CIMP # (report page #)	Environmental Decision
CIMP127 (page 20)	Fisheries and Ocean Canada fisheries management decisions for Great Bear Lake.
CIMP132 (page 21)	Fisheries and Ocean Canada fisheries management decisions for Great Slave Lake.
CIMP164 (page 23)	GNWT Department of Infrastructure regulatory decisions and maintenance planning along the Inuvik-to-Tuktoyaktuk and Dempster Highways.
CIMP192 (page 18)	Giant Mine Remediation Team water quality decisions for Giant Mine remediation water license.
CIMP202 (page 17)	GNWT Department of Environment and Natural Resources boreal caribou range planning, fire management decisions, and the Tłıchʔ All-Season Road habitat offset planning.

More information on each project is provided in Section 5.

COMMUNICATION WITH COMMUNITIES AND THE PUBLIC

One of NWT CIMP's key activities is to encourage two-way communication about monitoring and research projects directly with communities. All NWT CIMP project leads are required to engage with local communities or Indigenous governments and organizations prior to and during their project and to report their results directly to local communities or Indigenous governments and organizations.



Participants engage in a break-out group discussion at the Sahtú Research Results Workshop in Tulita.

NWT CIMP hosts an annual, regional workshop to facilitate the sharing of project results and ideas. This workshop is an opportunity to bring together community members, regulators, government and researchers to discuss results and provide feedback, and encourages the development of partnerships.

In December 2019, NWT CIMP, the Sahtú Renewable Resources Board and the Living on the Land Forum co-hosted a two-day workshop in Tulita that focused on projects conducted in the Sahtú. A workshop summary report will be posted on www.nwtcimp.ca when available.



Participants listen at the Sahtú Research Results Workshop in Tulita.

COMMUNICATION PRODUCTS

NWT CIMP project results must be of high quality and publicly accessible. That is why the program encourages the publication of project results in both peer-reviewed journals and plain language summaries. In 2019/20, the program generated nine peer-reviewed publications, two plain-language summaries and 31 reports.

ONLINE INFORMATION SOURCES

All information and knowledge generated by NWT CIMP is publicly available.

Northern Environmental Research Bulletins

Program staff work with project leads to develop and publish plain language summaries of their projects. An archive of Bulletins is available at **www.nwtcimp.ca**.

Inventory of Landscape Change Web Viewer

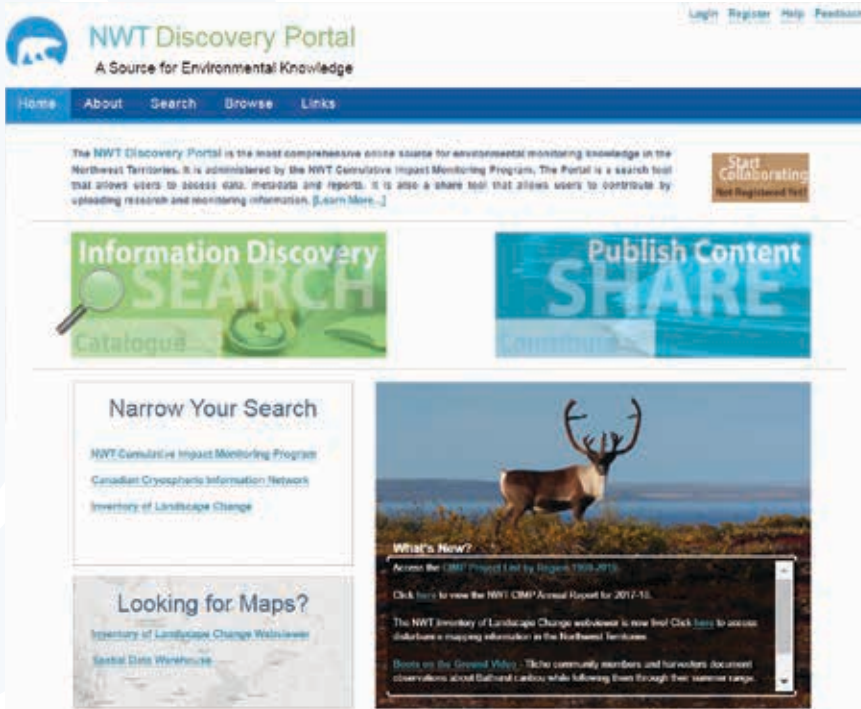
Comprehensive maps of human and natural disturbance for the NWT, such as roads and forest fires, are available online through the Inventory of Landscape Change (ILC) Web Viewer at **www.nwtcimp.ca**. This web viewer is a powerful tool that can be used to explore cumulative impacts by layering disturbance maps. The human disturbance layers on the ILC are updated annually, and are available for download.

NWT Discovery Portal

The NWT Discovery Portal is the most comprehensive online source for environmental monitoring knowledge in the NWT. There is a wide range of information to meet the needs of various audiences, including scientific journal articles, plain language presentations, raw data and maps:

nwtdiscoveryportal.enr.gov.nt.ca

The easiest way to find NWT CIMP project results is to consult the list of funded projects from 1999 to 2020 on the NWT Discovery Portal main page and then conduct a search using the NWT CIMP project number (e.g. CIMP164).

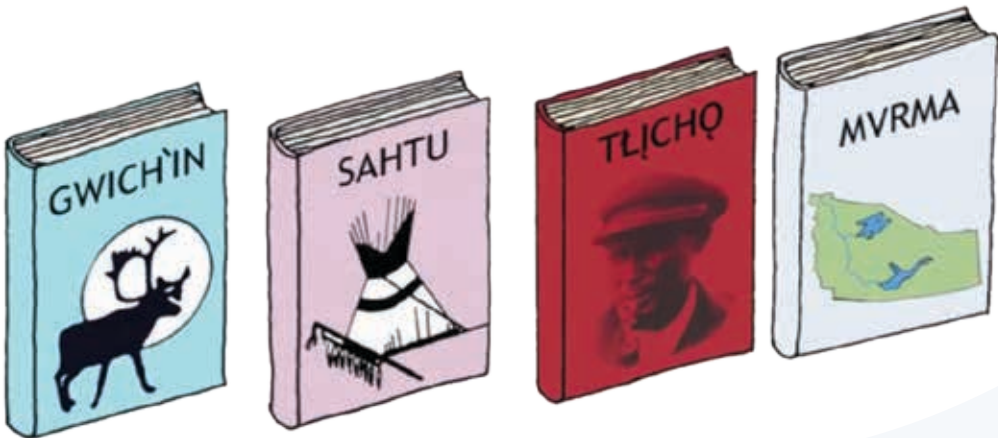


4. NWT ENVIRONMENTAL AUDIT

The NWT Environmental Audit is an independent review to assess the effectiveness of the regulatory regime in the Mackenzie Valley, as well as the quality of environmental information and processes related to monitoring cumulative impacts. It is meant to check how well our regulatory system is working to protect the environment.

The Audit is an obligation of the Sahtú, Gwich'in and Tłıchǫ land claim agreements and a legislated requirement of the MVRMA. The Audit highlights both successes and challenges. A key purpose of the Audit is to consider the challenges and provide useful recommendations that will improve how the environment is managed.

The MVRMA requires an Environmental Audit to be completed at least every five years by an independent consultant.



2020 NWT ENVIRONMENTAL AUDIT

The 2020 NWT Environmental Audit was conducted by a group of independent consultants guided by a steering committee of Indigenous, territorial and federal government representatives.

In 2019/20, the Audit Team collected information using various means, including:

- an extensive document review
- surveys and interviews with participants in NWT regulatory processes
- an online public survey
- open houses in seven communities

NWT CIMP supported the completion of the 2020 Audit by supporting the steering committee and facilitating community open houses.

This Audit focused on water quality and quantity information used to make decisions, as directed by the steering committee.

The 2020 NWT Environmental Audit will be released in the fall of 2020.

For more information visit this website:

www.enr.gov.nt.ca/en/services/nwt-environmental-audit

5. HIGHLIGHTED PROJECT SUMMARIES

Thirteen (13) projects were completed in 2019/20; the results of nine of these projects have been highlighted below. Detailed project results can be found by searching for the NWT CIMP project number (e.g. CIMP127) on the NWT Discovery Portal (nwtdiscoveryportal.enr.gov.nt.ca).

CARIBOU FOCUSED PROJECTS

Vegetation productivity and phenology across the Bathurst caribou range (CIMP187)

Ryan Danby, Queen's University (ryan.danby@queensu.ca)

One reason that has been suggested for the rapid decline of the Bathurst barren-ground caribou herd is a change in vegetation to more shrub cover due to climate change. This idea was tested by monitoring the abundance of shrubs across the herd's range, both through the use of satellite imagery, and through the field collection of shrub stems.

Results indicate that the abundance of shrubs and timing of growth has changed across a significant portion of the summer and fall range of the Bathurst caribou since the year 2000. Below the treeline, vegetation changes in the caribou range vary greatly and are closely linked to recent forest fires. Above the treeline, nearly half of the caribou calving and summer ranges saw increases in the abundance of shrubs. Recent changes in the herd's range may be due to changes in vegetation, which may be the result of climate warming. Further work is being done to test these linkages.

This project provides a valuable benchmark against which future monitoring can be evaluated and the spatial database generated from this project can be used by environmental regulators and Indigenous governments and organizations. Results from this project will inform future updates of the Bathurst Caribou Range Plan.

Boreal caribou habitat selection analysis and mapping to support range planning in the NWT (CIMP202)

James Hodson, ENR (james_hodson@gov.nt.ca)

This study sought to better understand how land cover type, wildfires and human disturbance features influence where boreal caribou prefer to be on the landscape. Boreal caribou were found to select recent (less than 10 years old) and older (greater than 30 years old) burned areas during the snow-free seasons, and then increasingly avoided burned areas less than or equal to 40 years old from early to late-winter. Caribou avoided areas close to major roads and other disturbances, and avoided areas with high densities of linear disturbances during snow-free seasons. This suggests that range plans should try to maintain areas for boreal caribou that include a mix of recent fires to meet their requirements in the snow-free season, and areas without recent fires (>60 years old) which are preferred winter habitat.

Maps of predictive habitat selection generated by this project are being used by ENR in boreal caribou range planning, to identify Values at Risk for boreal caribou for use in fire management decisions, and in the habitat offset plan being developed for the Tłıchǫ All-Season Road.



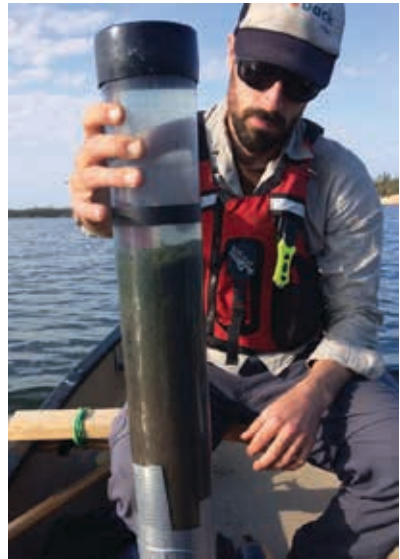
WATER FOCUSED PROJECTS

A multidisciplinary investigation of recovery in Yellowknife area lakes from 50 years of arsenic pollution: What are the factors inhibiting recovery and the biological consequences? (CIMP192)

Mike Palmer, Carleton University (mpalmer@auroracollege.nt.ca)

This project investigated the movement and location of arsenic in a small watershed that was heavily impacted by legacy mining emissions from 1948-1999, to help understand the timing and relative importance of arsenic fluxes across the landscape. A model was developed of the changes in arsenic, iron, and sulphur under the ice in Lower Martin Lake, a shallow subarctic lake impacted by 60 years of arsenic emissions. The model includes measurements of arsenic fluctuations between sediments and overlying water, in and out of the lake, and the terrestrial loading of arsenic being washed into the lake from the surrounding catchment. Results reveal the importance of understanding the influence of winter conditions on lake water quality, as large fluxes of arsenic may be due to the movement of arsenic from sediments to overlying waters under ice.

This project is providing important information on the upstream loading of arsenic to the Giant mine site, with data from this project being integrated into the Giant Mine water quality model used by the Giant Mine Remediation Team and the Mackenzie Valley Land and Water Board. It has also been provided to the Office of the Chief Public Health Officer and integrated into the public health advisory regarding arsenic in local lakes.



Michael Gilday holding a sediment core sample. (Credit: M. Palmer)

Understanding changes in aquatic ecosystem health and water quality in the Fort Good Hope – Ramparts Area (CIMP193)

Kirsty Gurney, Environment and Climate Change Canada (kirsty.gurney@canada.ca)

This project began in response to questions from community members in Fort Good Hope about local water quality. The subsequent development of project goals occurred in partnership with decision-makers, the Fort Good Hope Renewable Resource Council and Yamoga Land Corporation, to ensure results met their needs.

This project developed and implemented long-term, community-based monitoring of freshwater ecosystems in the Ts'udé Niljné Tuyeta Protected Area, near Fort Good Hope. Preliminary results suggest that the wetlands studied are characterized by clean water and are both physically and biologically diverse. However, both the physical and biological characteristics of these ecosystems are likely to be impacted by increases in forest fire frequency.

Ongoing work with partners in Fort Good Hope continues to focus on training Indigenous Guardians and monitoring the health of freshwater ecosystems as it relates to environmental change.

FISH FOCUSED PROJECTS

Combining biological, limnological and palaeolimnological data to study past, present and future impacts of climate change on the Great Bear Lake ecosystem (CIMP127)

Kim Howland, Department of Fisheries and Oceans (kimberly.howland@dfo-mpo.gc.ca)

This project arose out of ongoing community concerns in Délı̨ne over the sustainability of fish resources in Great Bear Lake and the potential changes in water quality due to climate change. The project supported a partnership between Délı̨ne and the Sahtú Renewable Resource Board, to collect water quality samples, local observations, and lake-bottom sediment samples.

Results show that lake warming is a leading stressor, with evidence of shifts in plankton production over the past century. While overall contaminant levels remain low in sediment cores and most fish, there is evidence of increasing trends for some substances (e.g. mercury in sediment cores) that are consistent with warming and increased lake productivity. These results show the importance of age, growth, food web level and habitat use on mercury accumulation, with older, slower growing, benthic trout reaching levels that occasionally exceed consumption guidelines.

Information generated by this project will aid in the determination of sustainable harvest levels for Great Bear Lake.

Comprehensive Assessment of Biological Adaptability of Great Slave Lake Fisheries Ecosystem to Anthropogenic and Natural Disturbances (CIMP132)

Xinhua Zhu, Department of Fisheries and Oceans (Xinhua.Zhu@dfo-mpo.gc.ca)

This project investigated the impact of ongoing changes to the aquatic ecosystem in Great Slave Lake (GSL). Results suggest that GSL is experiencing several changes from both natural and human disturbances. These changes include annual variations in the depth and thickness of the summer thermocline, variable river-lake exchanges on nutrient availability and changes in fish populations. In particular, a gradual decrease in lake whitefish abundance in the western basin has been observed since 2012. Also, the abundance of lake trout appears to be slowly increasing over time.

Results of this project will be used by the Department of Fisheries and Oceans to inform fisheries management decisions such as the maximum sustainable yield and total allowable catch for GSL fisheries.



Spawning lake whitefish. (Credit: P. Vecsei)

How will fish communities in Gwich'in and Inuvialuit lakes respond to climate change? (CIMP197)

Derek Gray, Wilfrid Laurier University (dgray@wlu.ca)

This project examined how fish and invertebrates in lakes of the Gwich'in Settlement Area and Inuvialuit Settlement Region may respond to water quality changes associated with climate change.

It was found that water quality changes associated with permafrost thaw, may lead to changes in the abundance and diversity of zooplankton and benthic invertebrates. Additionally, warming lake temperatures and associated changes in water quality due to climate change effects may be beneficial for some types of fish (e.g. lake whitefish), but detrimental to others (e.g. cisco).

Overall, the results of this project suggest that fish and invertebrate communities in Arctic lakes could change significantly due to the impacts of climate change and permafrost thaw. The baseline datasets developed through this project for water quality, invertebrates, and fish in lakes along the Fort McPherson-Inuvik-Tuktoyaktuk transportation corridor is a valuable tool and has been provided to decision-makers (e.g. the Gwich'in Land and Water Board, the Fisheries Joint Management Committee).



Lake whitefish caught in the ISR. (Credit: D. Gray)

PROJECTS EXAMINING TOPICS RELATED TO CARIBOU, WATER OR FISH

Tracking landscape change and cumulative environmental impacts using remote sensing (CIMP164)

Steve Kokelj (steve_kokelj@gov.nt.ca)

This project used new remote sensing techniques to identify areas where there has been permafrost disturbance and to monitor the resulting landscape change. A combination of fieldwork, satellite imagery and aerial photographs were used to produce datasets of landscape change. These datasets were then used to produce disturbance maps and spatial models of landscape susceptibility to climate change.

Project results will be a key data layer to understanding cumulative impacts in the NWT in areas being affected by climate change and have had a direct influence on infrastructure planning in the NWT. For example, these results informed regulatory decisions and mitigation planning along the Inuvik-to-Tuktoyaktuk and Dempster Highways. These results continue to influence environmental management decisions along both highways.

Community-Based TK Monitoring – Monitoring for Better Decision-Making Phase 3 (CIMP185)

Glen Guthrie, Łutselk'e Dene First Nation (lkdfnlands@gmail.com)

This project was the third phase of research exploring the challenges of including traditional knowledge (TK) in resource management decisions. A central theme was the challenge in developing monitoring programs that draw from both qualitative and quantitative research methods (for example, local values and knowledge versus objective, science-based information needs). The objective of this phase was to develop guidance on how community-based monitoring (CBM) programs can be used to document TK for use in decision-making.

Tools were developed to provide advice and guidance on how CBM can mobilize TK for its consideration in resource management decisions that affect traditional territories and practices. Guidance documents and tools developed as part of this project are still in review and will be posted on **nwtdiscoveryportal.enr.gov.nt.ca** when available. NWT CIMP will work to incorporate and promote the guidance and tools developed as appropriate, in partnership with the Łutselk'e Dene First Nation.

6. LIST OF 2019-20 NWT CIMP PROJECTS

CIMP#	Project Type	VC	Project Title	Lead Organization	Funding Year
CIMP94	TK	Caribou	Tłıchq Ekwo Nàowo: “Boots on the Ground” Bathurst Caribou monitoring program	Tłıchq Government	11 of 13
CIMP127	Science	Fish	Long-term monitoring of Great Bear Lake fisheries and the aquatic ecosystem	Department of Fisheries and Oceans	9 of 9
CIMP132	Science	Fish	Integrated Eco-monitoring and assessment of cumulative impacts of Great Slave Lake fisheries	Department of Fisheries and Oceans	9 of 9
CIMP141	Science	Caribou	Data and knowledge integration for improved monitoring of cumulative impacts of mining development and climate change on the Bathurst caribou (DAICI)	Natural Resources Canada	8 of 9



CIMP#	Project Type	VC	Project Title	Lead Organization	Funding Year
CIMP154	Science	Fish	Understanding fish mercury concentrations in Dehcho lakes	University of Waterloo	7 of 8
CIMP161	Science	Water	Legacy arsenic pollution in Yellowknife Bay sediments: An assessment of its long-term fate under a changing climate	Environment and Climate Change Canada	2 of 2
CIMP164	Science	Other	Tracking landscape change and cumulative environmental impacts using remote sensing	GNWT - NWT Geological Survey	6 of 6
CIMP174	Science	Water	Impact of wildfire on northern stream ecosystems	Brock University	4 of 4
CIMP185	TK	Other	Community-Based TK Monitoring – Monitoring for Better Decision-Making Phase 3	łutselk'e Dene First Nation	3 of 3
CIMP187	Science	Caribou	Vegetation productivity and phenology across the Bathurst caribou range	Queen's University	3 of 3



Anna Coles with NWT CIMP collecting a water sample.

CIMP#	Project Type	VC	Project Title	Lead Organization	Funding Year
CIMP191	TK	Caribou	Watching the land: Knowing the cumulative impacts of change	Kátl'odeeche First Nation	2 of 3
CIMP192	Science	Water	A multidisciplinary investigation of recovery in Yellowknife area lakes from 50 years of arsenic pollution: What are the factors inhibiting recovery and the biological consequences?	Carleton University	3 of 3
CIMP193	Science	Water	Understanding changes in aquatic ecosystem health and water quality in the Sahtú region	Environment and Climate Change Canada	3 of 3
CIMP194	Science	Caribou	Recovery of boreal caribou habitat after forest fires	Deninu K'úé First Nation	2 of 3
CIMP195	Science	Fish	Community-based monitoring of whitefish in the lower Mackenzie River watershed	Simon Fraser University	3 of 5
CIMP197	Science	Fish	How will fish communities in Gwich'in and Inuvialuit lakes respond to climate change?	Wilfrid Laurier University	3 of 3
CIMP198	TK	Water	Sahtú Benígodi: Traditional Knowledge of Great Bear Lake and its Watershed	Tsá Tué Biosphere Reserve	2 of 2
CIMP199	Science	Water	An integrated monitoring program for a boreal forest watershed with discontinuous permafrost responding to climate warming and increasing anthropogenic pressures	Université de Montréal	2 of 3

CIMP#	Project Type	VC	Project Title	Lead Organization	Funding Year
CIMP200	Science	Water	Changes in Water Within the Mackenzie Delta/Beaufort Region as Indicators of Aquatic Health	Wilfrid Laurier University	2 of 3
CIMP201	TK	Other	Yellowknives Dene Cumulative Impact and Monitoring Framework	Yellowknives Dene First Nation	2 of 3
CIMP202	Science	Caribou	Boreal caribou habitat selection analysis and mapping to support range planning in the Dehcho, South Slave and North Slave regions	GNWT - ENR	2 of 2
CIMP203	TK	Fish	Traditional Knowledge Study on Fish within the Acho Dene First Nation Traditional Territory	Acho Dene Koe First Nation	1 of 1
CIMP204	Science	Water	Fate of heavy metals in sewage disposal facilities and cumulative impacts on downstream aquatic systems	Dalhousie University	1 of 3
CIMP205	Science	Caribou	Identifying habitats that influence body condition and fitness of adult female boreal caribou in the southern Northwest Territories	GNWT - ENR	1 of 3
CIMP206	Science	Fish	Ecological monitoring of lake trout in Great Slave Lake	Department of Fisheries and Oceans	1 of 2
CIMP208	Science	Caribou	Assessing the disturbance responses of barren-ground caribou to industrial infrastructure	University of Northern British Columbia	1 of 2

CIMP#	Project Type	VC	Project Title	Lead Organization	Funding Year
CIMP209	Science	Water	Nutrient and contaminant status in the wetlands of the Slave River Delta	University of Saskatchewan	1 of 3
CIMP210	Science	Water	Development of a Biological Monitoring Program to Detect Change in Stream Health Along the Dempster-Inuvik-Tuktoyaktuk-Corridor	Wilfrid Laurier University	1 of 3



CONTACT INFORMATION

For program information: **www.nwtcimp.ca**

For monitoring results: **nwtdiscoveryportal.enr.gov.nt.ca**

For more information, please email us at: **nwtcimp@gov.nt.ca**

Illustration Credit: Trey Madsen

