



## **Northwest Territories Environmental Research and Monitoring Results Workshop**



**Summary Report**

**Yellowknife, NT**

**December 5-6<sup>th</sup>, 2018**

## Contents

Executive Summary.....	3
1. Background .....	5
2. Presentations .....	6
Day 1 .....	6
Day 2 .....	14
3. Break out Group Discussions .....	17
a) What could be done to make research, monitoring and reporting more useful?	
b) Are there different ways to better include Traditional Knowledge (TK) in research/monitoring	
c) What are opportunities for better coordination?	
Appendix A: Agenda.....	27
Appendix B: Attendee List.....	32
Appendix C: Evaluation Questionnaires.....	36
Appendix D: Project Abstracts .....	43

## Executive Summary

The Northwest Territories Environmental Monitoring Results Workshop was held at the Explorer Hotel in Yellowknife, Northwest Territories on December 5-6<sup>th</sup>, 2018. The event was co-hosted by the Government of the Northwest Territories' NWT Cumulative Impact Monitoring Program (NWT CIMP) and the Yellowknives Dene First Nation.

The objectives of the workshop were to:

1. Bring together NWT researchers, northern decision-makers and communities to share results of environmental research and monitoring related to wildlife, fish and water; and
2. Provide a forum for discussion between researchers, communities and northern decision-makers. Feedback from these discussions will be used to improve presented projects.

The workshop featured research and monitoring projects conducted across the NWT, with a focus on NWT CIMP-supported projects centered on water, fish and caribou. In all, 14 presentations were given by researchers and resource staff. In addition, a panel consisting of the NWT CIMP Steering Committee representatives shared their involvement and perspectives on the program. Small, interactive break-out groups were held to generate discussion and feedback on NWT CIMP plans for the next 5 years.

In all 88 people participated in the workshop, which was facilitated by local consultant Roxane Poulin. NWT CIMP provided funding for NWT community representatives to attend the workshop to promote information sharing with communities and decision-makers. Regional Indigenous organizations with input by NWT CIMP Steering Committee representatives identified attendees and administered their travel arrangements.

**The main purpose of this Summary Report is to provide a tool for community members, researchers and decision-makers who attended the workshop to communicate its results and discussions.**

The break-out group discussions were well-attended and provided, valuable input for planning the next five years of NWT CIMP. Participants were able to share their own experiences and perspectives on the program and develop some specific recommendations for how it can be improved in the coming years. These recommendations are detailed in the report that follows.

While a range of valuable questions and comments were shared over the course of two days, there were a few comment themes that ran through the discussions at the workshop. These included:

- With the guidance of the Steering Committee and feedback from partners, NWT CIMP has been successful in moving the program in the direction it needs to go. There was lots of positive feedback on improvements participants have seen over the past few years and many of the recommendations for the next five years focussed on continued improvement in the same areas.
- Though some progress has been made, participants continue to feel that NWT CIMP research needs to be communicated more effectively, both to communities and to decision-makers. This requires commitment, but also training, tools and resources. The importance of communicating with community members in plain language before, during, and after a project was emphasized.
- Communities are playing a much more active and meaningful role in research and monitoring, but there is still much room for improvement. Communities need to be involved in everything from defining research questions and planning projects, to monitoring and analysis activities, to interpreting and communicating results. This will make research and monitoring more relevant and build local capacity.
- Understanding of how to properly integrate Traditional Knowledge and work with Traditional Knowledge holders is still evolving. There is an increased focus on incorporating Traditional Knowledge in all projects and in supporting stand-alone Traditional Knowledge projects. However, how to best gather, use and communicate TK alongside scientific methods is something researchers and NWT CIMP continue to grapple with.
- Participants from communities frequently raise the importance of finding meaningful ways to involve youth and Elders in research and monitoring activities.
- Effective data collection, management, sharing and analysis continue to be challenges for researchers in the North. Participants expressed that addressing gaps and weaknesses in this area would greatly improve the value NWT CIMP research and monitoring to decision-making.

Participants were asked to evaluate the quality and relevance of the workshop by filling out a short survey each day. The majority of the feedback was positive and indicated that expectations for the workshop were met. Presenter scores for quality and relevance scores for presenters ranged from 72% to 89%. This information is shared with presenters to help improve their future communications with communities and decision-makers.



## 1. Background

The NWT Environmental Monitoring Results Workshop was held at the Explorer Hotel in Yellowknife, NT on December 5-6<sup>th</sup>, 2018. The event was co-hosted by the Government of the Northwest Territories' NWT Cumulative Impact Monitoring Program (NWT CIMP) and the Yellowknives Dene First Nation.

This was the eighth annual NWT environmental monitoring results workshop supported by NWT CIMP. Of these workshops, three have been held at the territorial level and five at the regional level. All workshop abstracts and summary reports are available at <https://www.enr.gov.nt.ca/en/services/cumulative-impact-monitoring-program-nwt-cimp/resources-nwt-cimp>.

NWT CIMP-funded results workshops are held annually in the NWT to provide environmental research and monitoring results to key audiences (Indigenous and public governments, community members, researchers, regulatory authorities and non-governmental organizations) and to provide information for informed decision-making. These workshops provide opportunities to network, to strengthen ties between communities, monitoring and decision-making, and to understand cumulative impacts in regions of the NWT. Regional workshops are supported to encourage participants to transmit information about NWT CIMP and the projects it supports back into their communities.

The 2018/19 workshop examined research conducted in various NWT regions and focused primarily on past and current NWT CIMP-supported projects centered on water, fish and caribou. Fourteen presentations were given by researchers and resource staff. A panel consisting of the NWT CIMP Steering Committee representatives shared their involvement and perspectives on the program. Small, interactive break-out groups were held to generate discussion and feedback on NWT CIMP plans for the next 5 years.

The objectives of the workshop were to:

1. Bring together NWT researchers, northern decision-makers and communities to share results of environmental research and monitoring related to wildlife, fish and water; and
2. Provide a forum for discussion between researchers, communities and northern decision-makers. Feedback from these discussions will be used to improve related presented projects.

In all, 88 people participated in the workshop, which was facilitated by local consultant Roxane Poulin. NWT CIMP provided funding for NWT community representatives to attend the workshop to promote information sharing with communities and decision-makers. Regional Indigenous organizations with input by NWT CIMP Steering Committee representatives identified attendees and administered their travel arrangements.

Each day, participants were asked to fill out an evaluation form to give feedback on the presenters, the usefulness of the material, the balance between presentations, questions and discussion, and how well the workshop objectives were met. Please see Appendix C for the sample evaluation forms.

## 2. Presentations

A total of 14 presentations were given over the two-day workshop. Each workshop participant was provided with an abstract (see Appendix D) for each presentation. The presentations are also available on the NWT Discovery Portal at <http://nwtdiscoveryportal.enr.gov.nt.ca>. In the text below, a direct link is provided beneath the title of each presentation, followed by a summary of any discussion following the presentation.

### Day 1

#### Wednesday December 5<sup>th</sup>, 2018

##### **Presentation #1 - *About the NWT Cumulative Impact Monitoring Program (NWT CIMP): Impact on Resource Decision-Making***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/1%20-%20Kanigan%20-%20NWT%20CIMP.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/1%20-%20Kanigan%20-%20NWT%20CIMP.pdf)

Julian Kanigan, NWT CIMP (GNWT - Environment and Natural Resources)

No time for discussion.

##### **Presentation #2 - *Assessing Regulators' Information Needs to make Decisions regarding Cumulative Effects under the MVRMA***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/2%20-%20Noble%20-%20Assessing%20Regulators%20Needs.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/2%20-%20Noble%20-%20Assessing%20Regulators%20Needs.pdf)

Bram Noble, University of Saskatchewan

##### Summary of Discussion

- During the study, interviewees were looking for a particular definition of cumulative effects. For the purpose of this study, the definition was the one used by many international organizations: cumulative impacts are impacts of projects in combination with their individual components in conjunction with other projects and natural disturbances.

### **Presentation #3 - *Community-Based TK Monitoring – Monitoring for Better Decision-Making Phase 3***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/3%20-%20Keats%20-%20TK%20CBM%20Phase%203.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/3%20-%20Keats%20-%20TK%20CBM%20Phase%203.pdf)

Gloria Enzoe, Lutsel K'e Dene First Nation and Beth Keats, Trailmark Systems Inc.

***“Community-based monitoring  
belongs to us, it’s our daily lives.”***

Gloria Enzoe



#### **Summary of Discussion:**

- **Question:** Who is responsible for interpreting the results coming out of these programs?

**Answer (Beth):** This needs to be a discussion that takes place at the beginning of a project. The community should be the first interpreter of their results and needs to have/maintain control over how those results are analyzed and interpreted. **(Gloria):** The information is being collected for different reasons when done by the community as opposed to when it is collected by other parties. We gather information to watch for our safety and our health. It is the community and it is the people in the community. It happens because we are watching our own territory, our own life. If we are watching animals move, it’s because we eat those animals. It is for us. At the same time, it is our tool to help us in processes like this.

### **Presentation #4 - *Overview of ENR’s Climate Change Hazard Mapping Initiative***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/4%20-%20Griffith%20-%20Hazard%20Mapping%20Program.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/4%20-%20Griffith%20-%20Hazard%20Mapping%20Program.pdf)

Fritz Griffith, GNWT- ENR – Environmental Stewardship and Climate Change Division



### Summary of Discussion:

- *Question:* How did you use Traditional Knowledge in developing your hazard maps?  
*Answer:* TK is certainly planned to be part of the development of hazard maps (although we are still not sure exactly how we will do that) and we're in the early stages of development. It would be great to hear how TK can be incorporated
- *Question:* Is anyone using the map to estimate the value of infrastructure that could be impacted to determine how big of a problem it is?  
*Answer:* Definitely a major issue and while I don't know the answer, these maps can be useful in determining that. Not sure of dollar figures. Heard from a lot of people in communities saying that it is a big problem. These hazard maps can help to adapt to that.
- *Question:* Has there been much discussion in how you would integrate the 2030 climate change framework into the regulatory decision-making process?  
*Answer:* ENR contact Michele Culhane would be the best one to answer that question. [michele\\_culhane@gov.nt.ca](mailto:michele_culhane@gov.nt.ca) or (867) 767-9236 ext. 53193

### **Presentation #5 - *Implementing collaborative cross-NWT water quality monitoring to address the needs of water partners, focusing on cumulative impacts and community concerns***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/5%20-%20Somers%20-%20Water%20CBM.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/5%20-%20Somers%20-%20Water%20CBM.pdf)

Gila Somers, GNWT -ENR - Water Management and Monitoring Division

### Summary of Discussion:

- *Question:* Is there a means to address community concerns that come up partway through the season? What if things change part way through?  
*Answer:* Part of the next phase is to ensure there is capacity at the community level to help allow this to take place if needed. We'll provide them with what they need, and they will have the freedom and flexibility to engage people when events are happening.



## **Presentation #6 - *Understanding fish mercury concentrations in Dehcho lakes***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/6%20-%20Swanson%20-%20Fish%20mercury%20in%20Dehcho%20lakes.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/6%20-%20Swanson%20-%20Fish%20mercury%20in%20Dehcho%20lakes.pdf)

Heidi Swanson, University of Waterloo



### Summary of Discussion:

- *Question:* Is any part of the fish more affected by the mercury retention?  
*Answer:* Mercury builds up in protein, which means that the highest levels are in the flesh, with lower levels in the guts and stomach. We noted that smoking the fish can reduce mercury levels.
- *Question:* Do you have an understanding of how the fish migrate in and out of the lakes? Do you look at sediments? Can the fish absorb the mercury from the environment or do they only get the mercury by eating other fish?  
*Answer:* In these lakes fish don't migrate, but migrations can really affect mercury levels when it occurs. For example, fish that migrate from freshwater to sea have less mercury because sea has less mercury and the fish grow faster. Also:
  - Yes, we do measure mercury in sediment which is low; and
  - The take up of mercury through the skin is only 2-3%, so most is taken up from their food.
- *Question:* What are the implications for trout in Great Bear Lake, a low-producing lake?  
*Answer:* Fish grow very slowly in Great Bear Lake because of the cold temperatures, so the mercury is higher than in faster growing fish. The levels of omega 3 acids and selenium are increasing and are very beneficial to eat. If more algae grows in the system, the fish could grow faster and it may reduce mercury levels. Permafrost change could be an impact as well.

**Presentation #7 – *How will fish communities in Gwich'in lakes respond to climate change?***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/7%20-%20Gray%20-%20Gwichin%20fish%20response%20to%20climate%20change.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/7%20-%20Gray%20-%20Gwichin%20fish%20response%20to%20climate%20change.pdf)

Derek Gray, Wilfrid Laurier University

**Summary of Discussion:**

- *Question:* You were explaining the chemicals you found in the fish. Is the first chemical in the list the largest and they graduate down?  
*Answer:* Most of the measurements were about the water quality not about what was in the fish. The variables listed were more about what influences the fish. Some analysis in mercury in fish involved Heidi - were able to make posters.
- *Question:* Is this a recent thing in the last 50 years or so or would the fish have always had those chemicals in them?  
*Answer (Heidi):* Yes, fish from 50 years ago would have had some of the metals in them as a result of the surrounding rocks. For example, Cynabar (Alaska) has naturally high mercury, other rocks have high copper. Some levels of metal have increased - it depends on if the chemical moves through air, water, or as particles. First, we have to understand how the metal gets into the fish and then can work back.
- *Question:* Do you check the rivers as well or just the lakes? There used to be a lot of herring in Fort Good Hope but now there is nothing.  
*Answer:* This study just looked at lakes. Initially we didn't realize how many people eat the fish from rivers. There is another study on the Peel and Mackenzie Rivers looking at habitat, although it's not collecting fish.

**Presentation #8 – *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?***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/8%20-%20Palmer%20-%20Arsenic%20mobility.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/8%20-%20Palmer%20-%20Arsenic%20mobility.pdf)

Mike Palmer, Carleton University

No time for discussion.

## Panel discussion: Meet your NWT CIMP Steering Committee



*Representatives of the NWT CIMP Steering Committee listen to Joline Huskey (Tłıchʔ Government) share perspectives and experiences of the program.*

The NWT CIMP Steering Committee (SC) shared their perspectives and experiences on the program. Panel participants included (from left to right in above photo):

- Joline Huskey (Tłıchʔ Government)
- Brett Wheler (Mackenzie Valley Environmental Impact Review Board)
- Dennis Arey (Inuvialuit Game Council)
- Nicole Hardisty (Dehcho First Nations)
- Dwayne Semple (Gwich'in Tribal Council)
- Garfield Giff (Aurora Research Institute - ARI)
- Stephanie Poole (Akaitcho Territory Government)
- Julian Kanigan (Government of the Northwest Territories)
- Tim Heron (NWT Metis Nation)
- Cindy Gilday (Sahtu Secretariat Incorporated)
- Leon Andrew and Dakota Erutse (Sahtu Secretariat Incorporated alternates)

*Regrets were extended from Kim Murray (Mackenzie Valley Land and Water Board) and Ellen Lea (Fisheries & Oceans Canada).*

### **Overview of the NWT Steering Committee (provided by Tim):**

The SC is a partner to the program and helps insure the program meets its goals as stated in the *Mackenzie Valley Resource Management Act*. Currently, the program Valued Components are caribou, fish, and water.

There have been many changes in the way NWT CIMP and the role of the Steering Committee over time. Initially, the emphasis was on conducting science-based monitoring projects. Now NWT CIMP, through the Steering Committee is more proactive in guiding the direction of the program and the research it funds to ensure that it is answering community concerns. There is also more emphasis on funding Traditional Knowledge projects. The public is also more involved now than in the past, for example by providing input to the key areas to monitor. So overall, the program is doing a better job listening to the people of the territory.

- **Question: Why do you enjoy being on the Steering Committee? What motivates you?**

Garfield – Being on the Steering Committee is an opportunity to be involved personally with what research is taking place in the NWT and to ensure the results are given back to the community. It's also a chance for ARI to relay community wants/needs.

Stephanie – It's an honour to serve members of the Akaitcho Territory Government. As observers on the Steering Committee, it is important to learn how the co-management system works and functions to be able to make decisions while negotiating the Treaty.

Dakota – NWT CIMP is a strong linkage between research and decision-making in the NWT. It ensures that Indigenous people of the North have influence on the research taking place.

Cindy – Back in 2014, most of the project applicants were from government or academic institutes. We were not getting any of the research money, but still had to be involved. Back then there were no Traditional Knowledge projects, but that has changed. Fracking was a big issue at the time. NWT CIMP and the Northern Contaminants Program held a joint meeting in Tulita and anyone doing research in the Sahtu came. Shortly after, the Sahtu established a regional Research and Monitoring Forum and now researchers have to present their ideas to the forum.

- **Question: Any other changes that people have seen?**

Joline – When industry first came North, it was a challenge to build trust. Little information was provided about environmental impacts and no plain language material was provided. Elders told industry what changes would happen (e.g. noise disturbance to caribou). By having Indigenous representatives on the Steering Committee now, the Elders appear to be more willing to share their Traditional Knowledge with researchers. NWT CIMP representatives act as a middle person and can explain both sides.

Leon – Changes are happening on the land so we must work together. The Steering Committee gives insight into what our future holds; gathering the information is important.

- **Question: What are the opportunities in the future (i.e. 3-5 years)? Challenges?**

Tim – We need to develop our own definition of cumulative impacts and not use one from someone else's point of view. This should be done sooner than 3-5 years.

Dennis – Indigenous people should decide what to study. Indigenous people are the 'eyes and ears' of the land.

Tim – We need to get more youth involved in monitoring and reporting. It's important to increase youth capacity and interest in order to take our places.

Garfield – More community groups should be conducting research and have easier access to funding.

Stephanie – It would be good to see management of cumulative impacts coming out of the co-management regime (e.g. stopping the development of the Slave Geological Province all-weather road given the significant cumulative impacts this would cause).

Brett – We need to continue to strengthen relationships and develop strategic questions to inform decision-making. We need to do regional scale assessments; tools are needed to bridge information between decisions and how to manage development. It is challenging to assess cumulative impacts when only assessing a single project at a time.

Dwayne – Global warming is happening quickly so we need to adapt to changes and use mitigations to lessen impacts.

Nicole – We need to include youth and get more information into schools.

Cindy – NWT CIMP staff are good at listening to the Steering Committee. Devolution was supposed to allow us to make better decisions for the North so we must continue to be involved. The MVRMA regime was thought up by the old valley chiefs; we need to keep their goal going. A challenge to the GNWT is collecting baseline data for the Mackenzie Valley Highway. This project will have big impacts to everyone: locals, communities, research, governments.

Tim – Social impacts should start being considered, not just environmental impacts.

Julian – As a Steering committee we have focused around areas of infrastructure, so now we need to consider new projects when considering future research needs. In 3-5 years, addressing long-term data needs should be started. We are currently looking into options for collecting long-term baseline data. An opportunity is partnering with Indigenous Guardians program and providing support.

*No further questions from the room for the panel.*

## Day 2

**Thursday December 6<sup>th</sup>, 2018**

### **Presentation #9- *Impacts of wildfire extent and severity on caribou habitat: from woodland to barren ground***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/9%20-%20Day%20-%20wildfire%20impacts%20on%20caribou.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/9%20-%20Day%20-%20wildfire%20impacts%20on%20caribou.pdf)

Nicola Day, Wilfrid Laurier University

#### Summary of Discussion:

- *Question:* Did you use Traditional Knowledge in your studies? As an old firefighter, when fire happens, we know there is going to be change in the following years in the caribou range because of habitat change. Are you using this study as a model to look at the impacts to caribou not just development?

*Answer:* At this point, Traditional Knowledge has not been used explicitly, but we have had a lot of casual conversations with people. Project lead Jennifer Baltzer has been in communication with Aalice Legat and the Wek'èezhì Renewable Resources Board (next presentation) in relation to TK efforts. In the future, we will look at that a bit more.

### **Presentation #10 - *When do caribou return? Impacts of wildfires on Tòdzì and ?ekwò***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/10%20-%20Todzi%20and%20state%20of%20habitat.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/10%20-%20Todzi%20and%20state%20of%20habitat.pdf)

Jody Pellsissey, Wek'èezhì Renewable Resources Board and Aalice Legat, Tlìchq Government

#### Summary of Discussion:

- *Question:* Has this project and the previous project (Baltzer/Day) worked together?  
*Answer:* (Alice) – In the past yes, and will likely pick up again and have discussed writing papers. Traditional Knowledge and science work compliment each other.

- *Question:* Can you elaborate on the verification process?

*Answer* (Alice): We do it in different ways but the one that works the best is often to pick up those people who didn't participate in the research and use different translators. We don't use translators in the work that I do because Elders select the people and they don't have those quick words so they explain it and you get a lot of information. Then we go to another group of people within the same knowledge

system and often the information grows. You miss a lot going from the language to English. The researchers also go back and ask what the Elders and Harvesters meant. They continually talk to the people and clarify.

- *Question:* Simply, when do caribou return?

*Answer:* The simple answer is that we don't have a direct answer to that question; however, the reason that question is in the title is because it was translated that way.

**Presentation #11 - *Tłichǫ Ekwo Nàowo: "Boots on the Ground" Bathurst Caribou monitoring program***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/11%20-%20Jacobsen%20-%20Boots%20on%20the%20Ground%20-%20videos%20removed.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/11%20-%20Jacobsen%20-%20Boots%20on%20the%20Ground%20-%20videos%20removed.pdf)

Petter Jacobsen, Joe Zoe, Russell Drybones, Tyanna Steinwand (Tłichǫ Government)



**Summary of Discussion:**

- *Question:* Do you bring drums and sing songs to the caribou? Do predators ever bother your camp?

*Answer:* Yes, we do sing songs and do something traditional while on the land, but we didn't bring a drum. Last year, a grizzly bear took down the kitchen tent. We just scare away a predator if needed, we don't shoot them.

**Presentation #12 - *Multiscale assessment of forest-tundra dynamics on the range of the Bathurst Caribou herd***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/12%20-%20Danby%20-%20Forest%20tundra%20dynamics%20on%20Bathurst%20herd.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/12%20-%20Danby%20-%20Forest%20tundra%20dynamics%20on%20Bathurst%20herd.pdf)

Ryan Danby, Queen's University



### Summary of Discussion:

- *Question:* How do you remove the effect of fire from your analysis?  
*Answer:* We masked out (removed) the areas where fires have burned in the last 50 years, so they just appear as white on the map. However, it is clear that fire has a substantial affect on the greening and browning trajectories - much more so than just climate.

### **Presentation #13 – *Using the past to inform the future: A paleological perspective of the impacts of drought and fire vegetation***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/13%20-%20Moser%20-%20Impacts%20of%20Climate%20Change%20and%20wildfires.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/13%20-%20Moser%20-%20Impacts%20of%20Climate%20Change%20and%20wildfires.pdf)

Katrina Moser, University of Western Ontario

### Summary of Discussion:

- *Question:* Due to fire decline, have you given any thought to pollen analysis and changes to vegetation as well?  
*Answer:* Yes, Mike Pisaric (Brock University) is looking at the pollen and yes that is being worked on and is a great addition to the charcoal record.
- *Question:* Can you get a gauge of fire severity?  
*Answer:* Unfortunately, we cannot get that information through the charcoal record.

### **Presentation #14 – *Building a cumulative impact monitoring network: Standardizing the reporting, archiving and dissemination of permafrost ground temperature and geohazard information***

[http://sdw.enr.gov.nt.ca/nwtdp\\_upload/14%20-%20Kokelj%20-%20Permafrost.pdf](http://sdw.enr.gov.nt.ca/nwtdp_upload/14%20-%20Kokelj%20-%20Permafrost.pdf)

Steve Kokelj , GNWT – NWT Geological Survey

***“Permafrost can be thought of as the glue that keeps the land together.”***

Steve Kokelj



No time for discussion.

### 3. Break out Group Discussions

#### **The NWT CIMP Action Plan – *Have your say!***

Workshop participants were split into 6 small break-out groups to discuss NWT CIMP plans for the next 5 years. Participants were grouped based on the type of relationship they had with NWT CIMP: 3 community groups; 1 government group; 1 academic; and 1 regulatory/co-management group. Each group discussed four pre-set questions, documented discussion on flipcharts and had one or two members of the group report out on key points in plenary.

#### **Discussion group questions:**

1. What would you say are the best features/characteristics of NWT CIMP right now? Put another way, what works well and why?
2. What have been the main improvements you have seen to NWT CIMP over the past five years? Why have these made a difference and to whom?
3. How could the program be even better? What specific improvements would you like to see and what impact would they have?
4. How would you define success for NWT CIMP over the next five years?

#### **Discussion Notes:**

***Question #1 – What would you say are the best features/characteristics of NWT CIMP right now? Put another way, what works well and why?***

#### **Community Groups (3 groups combined)**

- Provides a large diversity of projects with various focuses
  - with diversity, there is opportunity to learn and share among people and among various areas
- Independence of the program: perception of bias?
- Improved recognition and support to Traditional Knowledge (TK)
  - More TK projects funded
  - TK included in a meaningful way (not just stories)
  - Including TK is more relevant now
- Serves as a tool for environmental monitoring purposes
- Commitment to Indigenous governments and organizations capacity funding
- Monitoring Blueprints – give a good sense of direction
- Deals well with lead researcher – follow-up from program staff is good
- Involvement/partnerships with communities and researches (feeling included)
- Brings together different perspectives
- Involves researchers and communities at the start of planning a project
- Community-driven (creates participation)

- Works together equally
- Good NWT representation on Steering Committee
- Good two-way communication
  - workshops, videos, handouts are helpful – need different languages
- Studying the effects of climate change
- Visual reporting (videos, maps) are helpful and show relevance
- Youth and Elder involvement
- Monitoring environmental changes
- Creates opportunities for information sharing

### **Regulatory Group**

- Good staff (responsive, patient & helpful...in relation to funded projects)
- Priorities are correct (focus is helpful, known gaps)
- Plain language reporting on projects
- Community engagement (hands-on and included in design)



### **Academic Group**

- NWT CIMP recognizes and provides funds for the collection of baseline data, which is vital for understanding change
- NWT CIMP funding makes/helps with accountability to communities
- The Results Workshop is a forum for sharing results, meeting and networking with other researchers and with communities and boards, and hearing from the communities
- NWT CIMP assists with the effective resource allocation
- NWT CIMP can help projects to progress by helping to connect people and building teams which helps the researchers to pursue larger funding goals
- NWT CIMP requires metadata (this was seen as a positive)

- One researcher asked if NWT CIMP can track how recipients' other funding prospects improve because they have successfully applied for and received NWT CIMP

### **Government Group**

- Including youth
- Including Traditional Knowledge (*Encourages TK research and the use of TK in scientific projects*)
- Is directly addressing community issues/needs
- Having themes (*VCs/blueprints*) helps to focus the research being conducted
- Funding TK projects. (*i.e. the program encourages and funds TK-only research projects*)
- The program is good at leveraging money/funds
- The program is good at bringing more researchers to the North
- The Steering Committee seems responsive and adaptive to community input, as a result the program feels very bottom driven
- Prioritizing baseline data collection helps fill and identify some data gaps.
- The program enables a coordinated approach to data collection
- Facilitates researchers and community people getting to know each other better and create better knowledge transfer
- Results, data, and reports are available and accessible
- The annual workshop is good for making connections

***Question #2: What have been the main improvements you have seen to NWT CIMP over the past five years? Why have these made a difference and to whom?***

### **Community Groups (3 groups combined)**

- Returning results to the community
- Integration and approach to TK
  - Creating a separate proposal for TK projects
  - Seeing more TK included, more TK projects
  - Need more one-on-one discussions
- Nature of proposal evaluation (re: TK)
- Capacity funding for Indigenous governments and organizations
- Knowledge management and communication
  - Plain language summaries, videos, inventory of landscape change
- Seeing more representation of Indigenous people
- Seeing more collaboration and knowledge sharing
- More community-driven
- Seeing more pre-engagement between researcher and communities
- Increased information sharing with communities

- Increased communication tools (websites, workshops etc.)
- Increased attention to the ownership, control, access and possession of information
- More beneficial to regulatory boards, communities, governments, industry
- Increase of Indigenous organizations getting involved in the leadership of projects
- Increased Indigenous participation in results workshops (information goes back to the regions)



### **Regulatory Group**

- Good at making connections (academics, communities, etc.) and reporting back to support relationships
- Linkage to decision-making at various levels has improved
- Good progress on TK and science working together
  - TK and science projects help address similar questions and complement each other
- Good TK projects and results (i.e. Boots on the Ground)
- 
- Multi-year funding for projects
  - Easier to plan as \$ is predictable
  - Research questions are more ambitious which provides more information for decision-making
  - Flexibility – allows time to develop projects collaboratively and adjust program design if needed
  - Time for verification, cycle of learning and more refined questions
- Leverages outside support (e.g. Sharing of equipment, personnel, etc.)
- Better reporting
- Good monitoring priorities and better coordination with fewer one-off projects
- Building good knowledge
- More community-driven (increasing level of involvement, notification, engagement and participation)
- Useful workshops both at a regional and territorial level (need to communicate to those not in attendance)

- Improved data management through NWT Discovery Portal (yet sometimes hard to find, navigate and identify relevance)

### **Academic Group**

*\*Note: Only one researcher in the group has had multiple years of experience with NWT CIMP. The other researchers were in their first or second year of funding and felt that they could not answer these questions. \**

- NWT CIMP has an established process, and funding control is deliberately vested in a Steering Committee
- The NWT CIMP Steering Committee is young and diverse
- NWT CIMP has required research to focus on issues of emerging northern importance

### **Government Group**

- Having a dedicated TK proposal guideline
- Improved accessibility of data and reports
- Better respect for community knowledge, including increased sensitivity by researchers
- Improvement in relationships between communities and researchers
- Increased reporting back to communities
  - Improved communication methods, such as plain language material
- There is a greater understanding and appreciation of different perspectives from all parties
- More strict funding requirements (e.g. no funding to industry) means more money is available for community-led research
- Blueprints help to frame the research interest
- Better (i.e. more even) distribution of research across the territory
- Has been good at promoting community empowerment and involvement in decision making

***Question #3: How could the program be even better? What specific improvements would you like to see and what impact would they have?***

### **Community Groups (3 groups combined)**

- Further guidance on proposal development and examples of success proposals
- Funding Indigenous governments directly
- Have a Social Science advisor / staff member
- More funding into the program
- Include indexing on NWT Discovery Portal
- Develop a common reporting template for all research in the north

- Increased interregional, intercommunity communication
- Training and mentoring of youth to become leads of projects
- More linkage to previous research/programs (e.g. West Kitikmeot Slave Study)
- Provide help with access to past data
- Increase the balance between Traditional Knowledge and science
- Increase on-the-land experiences and mentoring (needs appropriate funding)
- Increase Elder participation/knowledge
- Increase collaboration and be pro-active to monitoring needs
- Don't be too limiting as to what should be monitored
- Help with proposal writing, especially with TK projects
  - Help by appropriate CIMP staff member to increase capacity-building
- Continue to improve, increase communication
  - plain language
  - Not just online
  - Make more information available in different Aboriginal language
  - Opportunities for dialogue and exchange
  - Glossary of terminology
  - Translators for Elders who attend meetings
  - Use radio and social media
- Make funding application easier (e.g. more plain language, provide a training session)
- When presenting results, more detail should be provided on the methodology used (i.e. 'show your work')
- Increase funding for training for community members based on recommendations from workshops
- Gather and distribute a list of recommendations from the research results (maximize value and impact on decision-making)
- More emphasis on approving funding for boreal forest research (needs more attention)
- Information sharing – data should be shared in useable formats (maps, GIS)

### **Regulatory Group**

- Clear plain language communication of results to different audiences (increases the value and meaning to users). Could the reporting template be better?
- Liaison/interpreter – go beyond researchers reporting back and plan communication at the start
- Priorities and monitoring blueprints are good but high-level
- Collectively, we should guide specific research questions (would help link the research back to the resource management system, co-management and decision-making)
- Identify and work on bridges between data/information and management (e.g. for land use plan reviews, can CIMP info inform the process?)
- Be responsive to new environmental changes/issues and new types of development



- Better and specific communication of the information needs from communities and decision-makers

### **Academic Group**

- Community-level research coordination support could lead to better efficiencies and interpersonal engagement
  - Especially when field and community access by researchers is limited
  - Look into creative ways to build relationships
  - One way could be to create opportunities to host researchers and support internships in the North
- Refine connections between researchers and communities
  - One way could be to liaise between Indigenous Government Organizations/Settlement areas and identify opportunities for getting on the planning agendas
  - Increase awareness of when on-the-land camps are happening and opportunities for researchers to participate
  - Could take people to spots on the landscape and talk about a specific thing (e.g. fire, tree line change)
    - Build relationships and make connections
- Provide training opportunities to help researchers better communicate with communities
  - Consider creating an opportunity during the workshop to have researchers explain what they do and ask communities how it could be helpful to the questions they have and want answered
  - Consider including some training in the Results Workshop agenda to help researchers better communicate their findings effectively to communities
  - Look at ways to bring people with various skills together to create educational/training opportunities for young people



## **Government Group**

- Need a better understanding of how the data/knowledge is used in decision making
  - Maybe this could be summarized by a 5-year audit report, but it would be difficult
- Need to increase awareness of the availability of results
  - Perhaps the results could be sent directly to regulatory bodies on a regular basis
- There is a need to improve the way the flow of information to decision makers
- There is a need to do more to synthesize research results to increase their value (e.g. taking the results/data of all projects and synthesizing this information / undertaking a CE assessment). But whose responsibility should this be? This needs to be identified.
  - The department of Environment and Natural Resources may have a role in synthesizing (as in summarizing) and ensuring Divisions are aware of relevant research results
- Part of the synthesis needed is to identify the monitoring information being collected by the federal government/GNWT/others and where the gaps are (e.g. water quality data/info)
- Identify the opportunities for even greater collaboration for monitoring information being collected by the federal government/GNWT/others
- We need a better understanding of the strengths and limitation of TK and scientific knowledge
  - Often, they are asking and answering different questions
  - You don't always need both - don't try to always push them together. Rather see what purpose each serves and how they can complement and complete each other.
- Simplify the application and reporting process to make it easier for community groups and others to apply for NWT CIMP funding. Right now, it is still a very onerous process.



***Question #4: How would you define success for NWT CIMP over the next five years?***

**Community Groups (3 groups combined)**

- Dialogue about cumulative effects among CIMP, the boards, government agencies and Indigenous governments/organizations
- Better understanding of how decision-making works with research from CIMP
  - Research results are integrated into management decisions
  - Researcher understand how project results are used in management decisions
- Community 'satisfaction' (via feedback through the Steering Committee, general Assemblies)
- More successful and funded TK projects
- NWT CIMP providing assistance in proposal writing and planning of projects
- Interest and support for NWT CIMP projects by Elders, hunters, harvesters and young people
- GNWT recognizing and addressing capacity issues
- Independent review of proposals
- A TK expert in each region
- More monitoring being done by the communities
- More defined trends impacts can be more clearly communicated
- More sharing of data
- More knowledge co-production
- Innovation in integrated science/TK/social science research
- More community capacity-building
- A long-term plan in place for collected data (to avoid repetition or loss)
- Looking to other countries for data on related topics
- Clearer methodologies for community-based research
- Focus on invasive species that affect the environment



### **Regulatory Group**

- Discovery Portal is restructured to make more user-friendly and to make more information available
- Through the public registry, access TK and science information (including standardized data) that is linked to the Portal
- Ability to report/demonstrate how CIMP overall has informed decision-making
  - Individual projects are being coordinated/connected
- Results and information are being disseminated to decision-makers and public (timely, ongoing to inform actions now)
- Results made available and accessible to all users
- NWT CIMP research is answering more specific community questions
- Comprehensive involvement is needed for full project cycle
- Seeing more TK-driven projects (ownership, verification, questions)

### **Academic Group**

- NWT CIMP is presenting synthesis of data through CEA or bringing people together to look at specific question and having a working meeting (picture a bunch of people talking science and working on different laptops) at local and NWT Wide workshops
- A strong relationship between management boards and NWT CIMP so that results are applicable to decision-makers
- More long-term projects with comparable data are presented at the Workshop
- NWT CIMP has a book of standards published
- Data is shared through a public site
- Expanded recommendations for data sharing platforms/sites with guidelines and training for data management
- There is a more even distribution of funding among applicant types

### **Government Group**

- Focus on determining whether priorities identified in the Blueprints have been addressed
  - This could be done in a similar way as the questions and answers presented in Gila's presentation
- NWT CIMP research results inform decision-making at all levels
- Compiled results of NWT CIMP work can be used to show trends
- Development of a GNWT/NWT coordinated approach to cumulative effects management

**Mahsi Cho - Thank you!**

## Appendix A: Agenda



# NWT Environmental Research and Monitoring Results Workshop Agenda

*December 5-6<sup>th</sup>, 2018*

*Katimavik Rooms B&C, Explorer Hotel, 4825-49<sup>th</sup> Avenue, Yellowknife, NT*

\*\*\*\*\*

*The Government of the Northwest Territories (GNWT)'s **NWT Cumulative Impact Monitoring Program** (NWT CIMP) and Yellowknives Dene First Nation are co-hosting a NWT-wide Environmental Research and Monitoring Results workshop.*

### OBJECTIVES:

The two objectives of the workshop are to:

- Bring together researchers, northern decision-makers and communities to **share results** of territory-wide environmental research and monitoring related to caribou, water and fish; and provide a **forum for discussion** between researchers, communities and northern decision-makers. Feedback from these discussions will help to inform the 5-year NWT CIMP Action Plan.

### INFORMATION:

Copies of abstracts and presentations will be provided and made available on the NWT Discovery Portal at [www.nwtdiscoveryportal.enr.gov.nt.ca](http://www.nwtdiscoveryportal.enr.gov.nt.ca)

For additional details, contact Meredith Seabrook at 867-767-9233 ext. 53086 or [nwtcimp@gov.nt.ca](mailto:nwtcimp@gov.nt.ca)

## NWT Environmental Research and Monitoring Results Workshop

### *Wednesday, December 5<sup>th</sup> - DAY 1*

Time	Activity	Lead
8:30 am	Arrival, Coffee and Mingling Registration	
9:00	Welcome, Opening Prayer and Introductions <ul style="list-style-type: none"> <li>Objectives and Agenda review</li> </ul>	Facilitator – Roxane Poulin
9:10 – 9:50	<b><i>Cumulative Impacts and Decision-Making</i></b> <ul style="list-style-type: none"> <li><b>Presentation #1</b> – <i>About the NWT Cumulative Impact Monitoring Program (NWT CIMP): Impact on Resource Decision-Making</i></li> <li><b>Presentation #2</b> – <i>Assessing Regulators' Information Needs to make Decisions regarding Cumulative Effects under the MVRMA</i></li> <li><b>Presentation #3</b> : <i>Community-Based TK Monitoring – Monitoring for Better Decision-Making Phase 3</i></li> </ul>	Julian Kanigan (GNWT-CIMP)
9:55 – 10:15		Bram Noble (University of Saskatchewan)
10:20 – 10:40		Gloria Enzoe (Lutsel K'e Dene First Nation) and Beth Keats (Trailmark Systems Inc.)
10:45 – 11:00	<b>BREAK</b>	
11:00 – 11:20	<ul style="list-style-type: none"> <li><b>Presentation #4</b> – <i>Overview of ENR's Climate Change Hazard Mapping Initiative</i></li> </ul> <b><i>Water and Fish</i></b> <ul style="list-style-type: none"> <li><b>Presentation #5</b> – <i>Implementing collaborative cross-NWT water quality monitoring to address the needs of water partners, focusing on cumulative impacts and community concerns</i></li> </ul>	Fritz Griffith (GNWT ENR – Environmental Stewardship and Climate Change Division)
11:25 – 11:50		Gila Somers (GNWT ENR - Water Management and Monitoring Division)

11:50 – 1:15pm	<b>LUNCH</b> (not provided)	
1:15– 1:35  1:50 – 2:10  2:15 – 2:30	<ul style="list-style-type: none"> <li>• <b>Presentation #6:</b> <i>Understanding fish mercury concentrations in Dehcho lakes</i></li> <li>• <b>Presentation #7</b> – <i>How will fish communities in Gwich'in lakes respond to climate change?</i></li> <li>• <b>Presentation #8</b> – <i>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?</i></li> </ul>	Heidi Swanson (University of Waterloo)  Derek Gray (Wilfrid Laurier University)  Mike Palmer (Carleton University)
2:40 pm	<b>BREAK</b>	
3:00 pm	<b><u>Meet your NWT CIMP Steering Committee</u></b> <ul style="list-style-type: none"> <li>• Introductions and perspectives</li> </ul>	Facilitator (with NWT CIMP Steering Committee members & observers)
3:45 pm	<b>Wrap up</b>	Facilitator



## NWT Environmental Research and Monitoring Results Workshop

### Thursday, December 6<sup>th</sup> - DAY 2

Time	Activity	Lead
8:30 am	Arrival, Coffee and Mingling	
9:00	Welcome and Opening Comments <ul style="list-style-type: none"> <li>Highlights from Day 1</li> <li>Review of Agenda</li> </ul>	Facilitator
9:10 – 9:30	<b>Caribou, Climate Change and Planning for the Next 5 Years:</b> <ul style="list-style-type: none"> <li><b>Presentation #9</b> - <i>Impacts of wildfire extent and severity on caribou habitat: from woodland to barren ground</i></li> <li><b>Presentation #10</b> - <i>When do caribou return?: Impacts of wildfires on Ṯoḏẕi and ʔekw̱ò</i></li> <li><b>Presentation #11</b> - <i>Ṯf̱icẖò Ekwo Nàowò: “Boots on the Ground” Bathurst Caribou monitoring program</i></li> </ul>	Nicola Day (Wilfrid Laurier University)
9:30 – 9:50		Jody Pellissey (Wek’èezhìi. Renewable Resources Board), Allice Legat (Ṯf̱icẖò Government)
9:50 – 10:30		Petter Jacobsen, Joe Zoe, Russell Drybones, Tyanna Steinwand (Ṯf̱icẖò Government)
10:30 – 10:45	<b>BREAK</b>	
10:45 – 11:05	<ul style="list-style-type: none"> <li><b>Presentation #12</b> – <i>Multiscale assessment of forest-tundra dynamics on the range of the Bathurst Caribou herd</i></li> <li><b>Presentation #13</b> – <i>Using the past to inform the future: A paleological perspective of the impacts of drought and fire vegetation</i></li> </ul>	Ryan Danby (Queen’s University)
11:05 – 11:30		Katrina Moser (University of Western Ontario)

11:30 – 11:50	<ul style="list-style-type: none"> <li><b>Presentation #14</b> – <i>Building a cumulative impact monitoring network: Standardizing the reporting, archiving and dissemination of permafrost ground temperature and geohazard information</i></li> </ul>	Steve Kokelj (GNWT – NWT Geological Survey)
11:50 am – 1:15pm	<b>LUNCH</b> (not provided)	
1:20 pm	<p><b><u>The NWT CIMP Action Plan – Have your say!</u></b></p> <ol style="list-style-type: none"> <li>Discuss NWT CIMP plans for the next 5 years in small break-out groups</li> </ol> <p>Discussion groups questions :</p> <ol style="list-style-type: none"> <li>What would you say are the best features/characteristics of NWT CIMP right now? Put another way, what works well and why?</li> <li>What have been the main improvements you have seen to NWT CIMP over the past five years? Why have these made a difference and to whom?</li> <li>How could the program be even better? What specific improvements would you like to see and what impact would they have?</li> <li>How would you define success for NWT CIMP over the next five years?</li> </ol>	
2:30 – 2:45 pm	<b>BREAK</b>	
2:45 – 3:30 pm	<p><b><u>The NWT CIMP Action Plan – Have your say!</u></b> (continued)</p> <ol style="list-style-type: none"> <li>Debrief from break-out groups</li> </ol>	Facilitator
3:30 pm	<b>Next steps, Wrap up, Closing Comments and Closing Prayer</b>	Facilitator
4:00 pm	<b>Adjourn</b>	

**Mahsi Cho**  
**Thank you for participating!**

## Appendix B: Attendee List

Last Name	First Name	Email	Organization
Andrew	Frederick		Tulita RRC
Andrew	Leon	srrb.leonandrew@gmail.com	Sahtu Secretariat Inc.
Arey	Dennis	dennisarey@yahoo.ca	Inuvialuit Game Council (CIMP SC)
Armstrong	Brittany	brittany.armstrong@canada.ca	Environment & Climate Change Canada
Bird	Brad	brad.bird@nwtmetis.ca	Northwest Territory Metis Nation
Boxwell	Janet	jboxwell@grrb.nt.ca	Gwich'in Renewable Resources Board
Brekke	Lorraine	Lorraine_Brekke@gov.nt.ca	NWT CIMP (GNWT- ENR)
Camsell-Blondin	Violet	violetcamsellblondin@tliche.com	Tliche Government
Canadien	Priscilla	<a href="mailto:rm@dehgahgotie.ca">rm@dehgahgotie.ca</a>	Dehcho First Nations
Cazon	Dieter	<a href="mailto:resources@liidliikue.com">resources@liidliikue.com</a>	Dehcho First Nations
Chapman	Monique	<a href="mailto:Monique_chapman@gov.nt.ca">Monique_chapman@gov.nt.ca</a>	GNWT ENR -(Climate Change)
Chenemu	Ambe	ambechenemu@tliche.com	Tliche Government
Coyle	Matt	Matthew_Coyle@gov.nt.ca	GNWT ENR - Forest Management
Danby	Ryan	Ryan.Danby@queensu.ca	Queen's University
Day	Nicola	nday@wlu.ca	Wilfrid Laurier University
Deneron	Joanne	jdeneron@reviewboard.ca	MV Environmental Impact Review Board
Dixon	Heather	<a href="mailto:hdixon@wlu.ca">hdixon@wlu.ca</a>	Wilfrid Laurier University
Drybones	Russell	<a href="mailto:russell66@live.ca">russell66@live.ca</a>	Tliche Government
Drygeese	Dayna	-	Yellowknives Dene First Nation
Edmondson	Jim	edmondsonjim@hotmail.com	MV Environmental Impact Review Board

Ensom	Tim	enso5730@mylaurier.ca	Wilfrid Laurier University
Enzoe	Gloria	gloriaenzoe@hotmail.com	Lutsel K'e Dene First Nation
Erutse	Dakota	erutse@sdmclca.org	Sahtu Secretariat Inc. (CIMP SC)
Firth	Wilbert	GeorginaVN@tgcouncil.ca	Gwich'in Tribal Council (Tetlit RRC)
Fitzgerald	Jane	Jane_Fitzgerald@gov.nt.ca	NWT CIMP (GNWT- ENR)
Gah	Evelyn	Evelyn_Gah@gov.nt.ca	GNWT ENR (Conservation Planning)
Gau	Rob	Rob_Gau@gov.nt.ca	GNWT ENR - Wildlife
Giff	Garfield	Garfield.Giff@auroracollege.nt.ca	Aurora Research Institute (CIMP SC)
Gilday	Cindy	cindygilday@hotmail.com	Sahtu Secretariat Inc. (CIMP SC)
Gray	Derek	dgray@wlu.ca	Wilfrid Laurier University
Griffith	Fritz	Fritz_Griffith@gov.nt.ca	GNWT - ENR (Climate Change)
Guile	Aimee	aguile@wrrb.ca	Wek'èezhii Renewable Resources Board
Handley	Joe	<a href="mailto:jhandley@reviewboard.ca">jhandley@reviewboard.ca</a>	MV Environmental Impact Review Board
Hanna	Bruce	Bruce_Hanna@gov.nt.ca	GNWT ENR - Knowledge Agenda
Harding	Melanie	exec_director@sahtulanduseplan.org	Sahtu Land Use Planning Board
Hardisty	Nicole	nicole_hardisty@dehcho.org	Dehcho First Nations (CIMP SC)
Heron	Tim	tim.heron@nwtmetis.ca	Northwest Territory Metis Nation (CIMP SC)
Heron	Chris	chris.heron@nwtmetis.ca	Northwest Territory Metis Nation
Huskey	Joline	jolinehuskey@tliche.com	Tliche Government - (CIMP SC)
Huskey	Peter	<a href="mailto:huskeyboy2003@yahoo.ca">huskeyboy2003@yahoo.ca</a>	Tliche Government
Jacobsen	Petter	petterjacobsen@gmail.com	Tliche Government
Kanigan	Julian	Julian_Kanigan@gov.nt.ca	NWT CIMP (GNWT - SC)

Kay	Johnny	<a href="mailto:kjohnny95@yahoo.ca">kjohnny95@yahoo.ca</a>	Gwich'in Tribal Council (Tetlit RRC)
Keats	Beth	beth.keats@trailmarksys.com	Trailmark
King	Trudy	trudy.king@nwtmetis.ca	Northwest Territory Metis Nation
Kokelj	Steve	Steve_Kokelj@gov.nt.ca	GNWT - NWT Geological Survey
Krutko	David	dkrutko@reviewboard.ca	MV Environmental Impact Review Board
Legat	Alice	alegat@gagos.ca	Tlicho Government
Lord	Sarah	slord@grrb.nt.ca	Gwich'in Renewable Resources Board
Low	Mike	jmichaellow@gmail.com	Dehcho First Nations - AAROM
MacDonald	Colin	<a href="mailto:northern@granite.mb.ca">northern@granite.mb.ca</a>	Sahtu Renewable Resources Board
MacLellan	Melissa	melissa@nsma.net	North Slave Metis Alliance
Meinert	Laura	lmeinert@wrrb.ca	Wek'èezhii Renewable Resources Board
Menard	Kaitlyn	Kaitlyn_Menard@gov.nt.ca	GNWT - HSS
Mennell	Robin	robin.mennell@queensu.ca	Queen's University
Moser	Katrina	kmoser@uwo.ca	University of Western Ontario
Munkittrick	Kelly	<a href="mailto:kmunkittrick@wlu.ca">kmunkittrick@wlu.ca</a>	Wilfrid Laurier University
Munroe	Sunny	smunroe@reviewboard.ca	MV Environmental Impact Review Board
Nitzia	Charlie Jim		Tlicho Government
Noble	Bram	b.noble@usask.ca	University of Saskatchewan
Norrish	Shalyn	snorrish@wrrb.ca	Wek'èezhii Renewable Resources Board
Ouellette	DonnaMarie	DonnaMarie_Ouellette@gov.nt.ca	NWT CIMP (GNWT- ENR)
Pain	Bill	Bill_Pain@gov.nt.ca	GNWT ENR -Waters
Palmer	Mike	michael.palmer@carleton.ca	Presenter - Queen's University

Pellissey	Jody	jpellissey@wrrb.ca	Wek'èezhii Renewable Resources Board
Pellissey	Sharon	<a href="mailto:pkfnlands@outlook.com">pkfnlands@outlook.com</a>	Dehcho First Nations
Pike	Emma	<a href="mailto:emma.pike@canada.ca">emma.pike@canada.ca</a>	Crown-Indigenous Relations and Northern Affairs Canada
Pink	Melissa	<a href="mailto:melissa_pink@gov.nt.ca">melissa_pink@gov.nt.ca</a>	GNWT - Lands
Poole	Stephanie	screeningofficer@eastarm.com	Akai'tcho Territory Government (CIMP SC)
Poulin	Roxane	roxanepoulin@gmail.com	Facilitator
Rabisca	Camilla		Sahtu Renewable Resources Board
Ross	Richard Jr.	richard_ross@gov.nt.ca	Gwich'in Tribal Council (Inuvik RRC)
Seabrook	Meredith	Meredith_Seabrook@gov.nt.ca	NWT CIMP (GNWT- ENR)
Seale	Lorraine	<a href="mailto:Lorraine_Seale@gov.nt.ca">Lorraine_Seale@gov.nt.ca</a>	GNWT - Lands
Semple	Dwayne	Dwayne.Semple@gwichintribal.ca	Gwich'in Tribal Council (CIMP SC)
Smith	Lisa	Lisa_Smith@gov.nt.ca	GNWT ENR - Forest Management
Somers	Gila	Gila_Somers@gov.nt.ca	GNWT - ENR (Waters)
Steinwand	Tyanna	<a href="mailto:tyannasteinwand@tlcho.com">tyannasteinwand@tlcho.com</a>	Tlcho Government
Swanson	Heidi	heidi.swanson@uwaterloo.ca	University of Waterloo
Tobin	Orla	orla.tobin@canada.ca	Environment & Climate Change Canada
Torng	Allan	Allan_Torng@gov.nt.ca	GNWT - HSS
Wheler	Brett	bwheler@reviewboard.ca	MV Environmental Impact Review Board (CIMP SC)
Whitford	Tony	<a href="mailto:tonywhitford@theedge.ca">tonywhitford@theedge.ca</a>	North Slave Metis Alliance
Zantoko	Zat	Lubaki_Zantoko@gov.nt.ca	NWT CIMP (GNWT- ENR)
Zoe	Joe		Tlcho Government
Zoe	Louis (& Therese)		Tlcho Government

## Appendix C: Evaluation Questionnaires

### NWT Environmental Research and Monitoring Results Workshop

#### Participant Evaluation Tool – Day 1 (Wednesday, December 5<sup>th</sup>)

*The sponsoring organizations are interested in participant feedback on the format and content of this workshop. After each presentation and activity, you will be asked to take a moment to provide your feedback in real time as the workshop unfolds. At the end of the day each day, please hand in or place your evaluation sheet in the box provided.*

**Please identify what type of organization to represent:**

☐ Federal/Territorial government      ☐ Indigenous government/organization

☐ Co-management Board      ☐ Researcher/Academic

☐ Other (specify): \_\_\_\_\_

- 1. Please rate each of the presentations using the scale provided based on the quality of the presentation and its relevance to you as a participant in this workshop.**

**Presentation #1: Julian Kanigan (GNWT-CIMP) - About the NWT Cumulative Impact Monitoring Program (NWT CIMP): Impact on Resource Decision-Making**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #2: Bram Noble (UoS) - Assessing Regulators' Information Needs to make Decisions regarding Cumulative Effects under the MVRMA**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant



**Presentation #3: Gloria Enzoe (LKDFN) & Beth Keats (Trailmark) - Community-Based TK Monitoring – Monitoring for Better Decision-Making Phase 3**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #4: Fritz Griffith (GNWT-ENR) - Overview of ENR's Climate Change Hazard Mapping Initiative**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #5: Gila Somers (GNWT-ENR) – Implementing collaborative cross-NWT water quality monitoring to address the needs of water partners, focusing on cumulative impacts and community concerns**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #6: Heidi Swanson (UoW) - Understanding fish mercury concentrations in Dehcho lakes**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #7: Derek Gray (WLU) - How will fish communities in Gwich'in lakes respond to climate change?**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #8: Mike Palmer (CU) - The mobility of arsenic in a small subarctic shield watershed impacted by mining pollution: What does this mean for the long-term fate of arsenic in the Yellowknife area?**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**2. Were the research results presented today useful to you?**

1	2	3	4	5
Not useful		Somewhat useful		Very useful

**3. Was meeting the NWT CIMP Steering Committee representatives and their perspectives useful to you?**

1	2	3	4	5
Not useful		Somewhat useful		Very useful

**4. Please rate the quality of the meeting facilitation today.**

1	2	3	4	5
Poor quality		Adequate quality		Excellent quality

5. Please rate how well the workshop fulfilled its objectives today.

*Bring together researchers, decision-makers and communities to share results of current NWT environmental monitoring and research related to water, fish and wildlife in the NWT.*

1	2	3	4	5
Did not meet		Partially met		Fully met

*Provide a forum for discussion between researchers, communities and regional decision makers. Feedback to be used to improve future NWT CIMP projects and workshops.*

1	2	3	4	5
Did not meet		Partially met		Fully met

**We welcome any additional comments or suggestions:**

**Mashi Cho - Thank you for your participation and input!**

## **NWT Environmental Research and Monitoring Results Workshop**

### **Participant Evaluation Tool – Day 2 (Thursday, December 6<sup>th</sup>)**

*The sponsoring organizations are interested in participant feedback on the format and content of this workshop. After each presentation and activity, you will be asked to take a moment to provide your feedback in real time as the workshop unfolds. At the end of the day each day, please place your evaluation sheet in the box provided.*

**Please identify what type of organization to represent:**

☐ Federal/Territorial government      ☐ Indigenous government/organization

☐ Co-management Board      ☐ Researcher/Academic

☐ Other (specify): \_\_\_\_\_

**1. Please rate each of the presentations using the scale provided based on the quality of the presentation and its relevance to you as a participant in this workshop.**

**Presentation #9: Nicola Day (WLU) - Impacts of wildfire extent and severity on caribou habitat: from woodland to barren ground**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #10: Jody Pellissey (WRRB) - When do caribou return? : Impacts of wildfires on Ṯoḏẕi and ʔekw̱ə**

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #11: Petter Jacobsen, Joe Zoe, Russell Drybones & Tyanna Steinwand (TG), - *Tłíchô Ekwo Nàowo: “We Watch Everything”: a Boots-on-the-Ground Approach to Caribou Monitoring***

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #12: Ryan Danby (Queen’s Uni) - *Multiscale assessment of forest-tundra dynamics on the range of the Bathurst Caribou herd***

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #13: Katrina Moser (UoWO) - *Using the past to inform the future: A paleological perspective of the impacts of drought and fire vegetation***

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**Presentation #14: Steve Kokelj (GNWT-NTGO) – *Building a cumulative impact monitoring network: Standardizing the reporting, archiving and dissemination of permafrost ground temperature and geohazard information***

1	2	3	4	5
Poor quality		Average quality		Excellent quality
1	2	3	4	5
Not relevant		Somewhat relevant		Highly relevant

**2. Were the research results presented today useful to you?**

1	2	3	4	5
Not useful		Somewhat useful		Very useful

**3. How did you find the balance between presentations and time for questions and discussion (break-out groups) today?**

Too much presentation time	Good balance	Too much discussion time
----------------------------	--------------	--------------------------

**4. Was the NWT CIMP Action Plan break-out group discussion useful to you?**

1	2	3	4	5
Not useful		Somewhat useful		Very useful

**5. Please rate the quality of the meeting facilitation today.**

1	2	3	4	5
Poor quality		Adequate quality		Excellent quality

**6. Please rate how well the workshop fulfilled its objectives today.**

***Bring together researchers, decision-makers and communities to share results of current NWT environmental monitoring and research related to water, fish and wildlife in the NWT.***

1	2	3	4	5
Did not meet		Partially met		Fully met

***Provide a forum for discussion between researchers, communities and regional decision makers. Feedback to be used to improve future NWT CIMP projects and workshops.***

1	2	3	4	5
Did not meet		Partially met		Fully met

**We welcome any additional comments or suggestions:**

**Mahsi Cho - Thank you for your participation and input!**

## Appendix D: Project Abstracts



# NWT Environmental Research and Monitoring Results Workshop

December 5<sup>th</sup> – 6<sup>th</sup>, 2018



## Abstract Volume



**Cover Photograph**

Mega slump located in the Stony Creek watershed west of Fort McPherson, NWT;  
Steve Kokelj

**Compiled by M. Seabrook**

***Recommended Citation:***

Seabrook, M. (compiler), 2018. NWT Environmental Research and Monitoring Results Workshop:  
Abstracts; Northwest Territories Cumulative Impact Monitoring Program, Yellowknife, NT. NWT CIMP  
Abstract Volume 2018



## **Table of Contents (Ordered by Author - \*denotes presenter)**

Recent Changes in Vegetation Productivity Across the Bathurst Caribou Range as Measured from Satellite Imagery and Field Sampling .....	48
Danby*, R. <sup>1,2</sup> , Dearborn, K. <sup>1,3</sup> , King, G. <sup>4</sup> , Bonta, C. <sup>1</sup> , Grishaber, E. <sup>2</sup> , Koop, J. <sup>4</sup> , Lebre, D. <sup>2</sup> , and Mennell, R. <sup>1</sup>	
48	
Impacts of Wildfire Extent and Severity on Caribou Habitat: from woodland to barren ground .....	49
Day*, N. <sup>1</sup> , Cumming, S. <sup>2</sup> , Degré-Timmons, G. <sup>1</sup> , Johnstone, J. <sup>3</sup> , Greuel, R. <sup>3</sup> , Mack, M. <sup>4</sup> , McIntire, E. <sup>5</sup> , Reid, K. <sup>1</sup> , Schmiegelow, F. <sup>6</sup> , Turetsky, M. <sup>7</sup> , Walker, X. <sup>4</sup> , and White, A. <sup>1</sup> , Baltzer, J. <sup>1</sup>	
49	
How will fish in Gwich'in and Inuvialuit lakes respond to climate change? .....	50
Gray, D.K. <sup>1</sup> , Murdoch, A. <sup>2</sup> , Vucic, J. <sup>1</sup> , Cohen, R. <sup>1</sup> , Shuvo, A. <sup>2</sup> , Sharma, S. <sup>2</sup>	
50	
Overview of ENR's Climate Change Hazard Mapping Initiative .....	51
Griffith*, F.	
51	
"We Watch Everything" - a Boots on the Ground Approach to Caribou Monitoring.....	52
Jacobsen*, P. Steinwand*, T. Zoe*, J. Drybones*, R.	
52	
NWT Cumulative Impact Monitoring Program (NWT CIMP): Impact on Resource Decision-Making .....	53
Kanigan*, J.	
53	
Community-Based TK Monitoring – Monitoring for Better Decision-Making: Phase 3.....	54
Keats*, B. <sup>1</sup> , Enzo*, G. <sup>2</sup>	
54	
Building a cumulative impact monitoring network: Standardizing the reporting, archiving and dissemination of permafrost ground temperature and geohazard information .....	55
Kokelj*, SV.	
55	
Tqdzi, Habitat, and Health .....	55
Legat, A. <sup>1</sup> , Nitsiza, C. <sup>2</sup> , Pellissey*, J. <sup>3</sup>	
55	
Using the past to inform the future: A paleoecological perspective of the impacts of drought and fire on lakes and forests. ....	57
Moser*, K.A. <sup>1</sup> , Pisaric, M.F.J. <sup>2</sup> , Turner, K.W. <sup>2</sup> , Ceci, M. <sup>2</sup> , Garner, C. <sup>2</sup> , Harris, D. <sup>2</sup> Martin, J-P. <sup>2</sup> , Prince, T. <sup>2</sup> , Sia, M. <sup>1</sup> and Viscek, J. <sup>2</sup>	
57	
Assessing Regulators' Information Needs to make Decisions regarding Cumulative Effects under the MVRMA.....	58
Noble*, B. <sup>1</sup> , Hanna, K. <sup>2</sup> , Arnold, L. <sup>2</sup> , Wong, L. <sup>1</sup>	
58	
The mobility of arsenic in a small subarctic shield watershed impacted by mining pollution: What does this mean for the long-term fate of arsenic in the Yellowknife area?.....	59

Palmer*, M.J. <sup>1</sup> , Lines, W. <sup>2</sup> , Chételat, J. <sup>3</sup> , Richardson, M. <sup>1</sup> , Jamieson, H.E. <sup>4</sup> , Spence, C. <sup>3</sup> , and Connon, R. <sup>5</sup>	59
NWT-Wide Community-Based Water Quality Monitoring (CBM) Program .....	61
Somers*, G.	61
An investigation of variable fish mercury concentrations in Dehcho lakes.....	62
Swanson*, H.K. <sup>1</sup> , Low, G. <sup>2</sup> , Branfireun, B. <sup>3</sup> , Baker, L. <sup>1</sup> , Low, M. <sup>2</sup> , Ng, K. <sup>3</sup>	62

## **Recent Changes in Vegetation Productivity Across the Bathurst Caribou Range as Measured from Satellite Imagery and Field Sampling**

Danby\*, R.<sup>1,2</sup>, Dearborn, K.<sup>1,3</sup>, King, G.<sup>4</sup>, Bonta, C.<sup>1</sup>, Grishaber, E.<sup>2</sup>, Koop, J.<sup>4</sup>, Lebre, D.<sup>2</sup>, and Mennell, R.<sup>1</sup>

(1) Department of Geography & Planning, Queen's University, Kingston ON

(2) School of Environmental Studies, Queen's University, Kingston ON

(3) Department of Biology, Wilfrid Laurier University, Waterloo ON

(4) Department of Science, University of Alberta – Augustana Faculty, Camrose AB

[ryan.danby@queensu.ca](mailto:ryan.danby@queensu.ca)

The productivity of tundra and boreal forest vegetation has undergone rapid change in recent decades. Increases in vegetation productivity (“greening”) are occurring mainly on the tundra and have frequently been attributed to an increase in shrubs, while decreases (“browning”) are often attributed to drought-related plant stress and have been observed primarily in the boreal forest. The purpose of this project is to map and analyze these types of changes across the entire range of the Bathurst caribou herd, and to identify linkages between these changes and significant shifts in herd distribution and habitat use during the same period.

We used MODIS data from NASA's Terra and Aqua satellites to monitor changes in vegetation productivity since year 2000; a period that coincides with a massive decline in the herd's size. Areas that have experienced forest fires in the last 50 years were removed from the analysis in an attempt to identify areas where climate may be the primary driver of change. We found substantially more greening than browning trends after the effect of fire had been removed. Specifically, significant greening occurred in 16% of the annual range (approximately 23,000 km<sup>2</sup>), while significant browning occurred in only 1% of the range. The herd's calving grounds experienced less significant change, with 10% (approximately 1800 km<sup>2</sup>) greening and less than 1% browning, while late summer range experienced the most change.

In 2018 we conducted five weeks of fieldwork near treeline in the vicinity of MacKay Lake in the middle of the herd's range. We visited 10 sites that have undergone significant greening according to the satellite imagery, and 10 sites that have not changed. At each site we obtained stem samples from 60 shrubs. These samples are currently being processed in the lab so that annual rings can be counted and measured. This will allow us to determine the extent to which changes indicated from the satellite imagery are related to shrub establishment and mortality or changes in growth.

## **Impacts of Wildfire Extent and Severity on Caribou Habitat: from woodland to barren ground**

Day\*, N<sup>1</sup>, Cumming, S<sup>2</sup>, Degré-Timmons, G<sup>1</sup>, Johnstone, J<sup>3</sup>, Greuel, R<sup>3</sup>, Mack, M<sup>4</sup>, McIntire, E<sup>5</sup>, Reid, K<sup>1</sup>, Schmiegelow, F<sup>6</sup>, Turetsky, M<sup>7</sup>, Walker, X<sup>4</sup>, and White, A<sup>1</sup>, Baltzer, J<sup>1</sup>

- (1) Wilfrid Laurier University, Waterloo, ON
- (2) Université Laval, Quebec City, QC
- (3) University of Saskatchewan, Saskatoon, SK
- (4) Northern Arizona University, Flagstaff, Arizona
- (5) Canadian Forest Service, Pacific Forestry Centre, Victoria, BC
- (6) University of Alberta at Yukon College, Whitehorse, YT
- (7) University of Guelph, Guelph, ON

[nday@wlu.ca](mailto:nday@wlu.ca)

One of the reasons caribou may avoid recently burned forests is thought to be due to lack of food. Ground-dwelling lichens are an important food source for both barren ground and boreal caribou and these are easily killed by wildfires. Understanding how quickly habitat and food resources recover after wildfires will help us better understand caribou distribution. A priority action identified in the GNWT document “Caribou Forever” is to “manage habitat in relation to forest fires and land use activities”, which recognises the importance of fire and vegetation dynamics for caribou habitat. This is not as simple as we might expect because burned forests don’t necessarily come back as they were before the fire. For example, black spruce forests with lots of lichens sometimes regenerate to deciduous forest where lichen does not grow, or to tundra-like vegetation. Knowing the conditions where forests regenerate away from lichen-favourable habitat helps us better understand how future fires may impact caribou distributions. This is particularly important now because even though fires are natural events in boreal forests, fire activity is expected to increase in the NWT, becoming more frequent and more severe. Accordingly, the impact of fire on caribou habitat remains a central outstanding research question, which is the focus of the research program we will talk about today.

The purpose of this presentation is to provide an overview of the progress made toward understanding lichen recovery after fires in different forest types. We will report on a network of 460 permanent sample plots established throughout Dehcho and Tłı̨cho lands that burned at different times, including prior to 1965 when NWT fire records began through to 2014. The goal of the plots in the 2014 fires was to improve our understanding of vegetation changes following the largest fire season on record in the NWT. The purpose of the plots in older burns is to improve our understanding of rates of caribou lichen recovery post fire. The results from this

four-year project have direct implications for forest and wildlife management in the face of changing boreal fire regimes.

## **How will fish in Gwich'in and Inuvialuit lakes respond to climate change?**

Gray, D.K.<sup>1</sup>, Murdoch, A.<sup>2</sup>, Vucic, J.<sup>1</sup>, Cohen, R.<sup>1</sup>, Shuvo, A.<sup>2</sup>, Sharma, S.<sup>2</sup>

(1) Department of Biology, Wilfrid Laurier University

(2) Department of Biology, York University

[dgray@wlu.ca](mailto:dgray@wlu.ca)

The aim of this project is to collect baseline data on water quality and fish communities in small-to medium-sized lakes located along the Dempster and Inuvik-Tuktoyaktuk highways. Using this baseline data along with climate-change models, we will try to predict how water quality and fish communities may change in response to a warming climate.

In the first two years of this project we have conducted fish and water quality surveys on 36 lakes. For each lake, we measured water quality parameters such as pH, dissolved oxygen, conductivity, turbidity (cloudiness), and nutrient levels (phosphorus and nitrogen). In addition, we made maps of the bottom of each lake (bathymetric maps) using depth sounders and computer software. Fish communities were surveyed using gill nets following a standardized protocol. Captured fish were measured for length and weight, and if a specimen was deceased, a tissue sample was taken for the measurement of mercury levels.

Out of the 36 lakes visited, 25 contained fish. The most common fish species in these lakes included Whitefish, Northern Pike (Jackfish), and Cisco. Our analyses showed that we could predict fish presence or absence in these lakes based on mean water depth, July water temperatures, dissolved organic materials present in the water, and conductivity. Mean depth, lake surface area, dissolved oxygen levels, conductivity, and July water temperatures were important for determining the types of fish present and their abundances. Our dataset is not yet big enough to attempt forecasting changes in fish communities; however, lake temperatures, conductivity, dissolved organic materials, and dissolved oxygen levels are expected to change as the climate warms, suggesting that there could be shifts in fish communities in response to the changing environment.



## **Overview of ENR's Climate Change Hazard Mapping Initiative**

Griffith\*, F.

Environmental Stewardship and Climate Change Division, Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT

[Fritz\\_Griffith@gov.nt.ca](mailto:Fritz_Griffith@gov.nt.ca)

The temperature in Canada's north is changing much faster than the global average, with winter temperatures expected to increase by 12°C by the 2090's. Impacts are already affecting people's health and safety, as well as infrastructure. Observed impacts include thawing permafrost, increases in drought and forest fires, flooding, changing ice conditions, and coastal erosion.

Recognizing that climate change represents serious and urgent challenges for the NWT, the GNWT released the 2030 NWT Climate Change Strategic Framework (Strategic Framework) on May 1, 2018. This document outlines how the territory plans to respond to challenges and opportunities associated with a changing climate, moving towards an economy that is less dependent on fossil fuels and doing its part to contribute to national and international efforts to address climate change. The 2019-2023 draft Action Plan is the implementation piece of the Strategic Framework that will address the concerns and interests of NWT residents with a long-term, comprehensive and coordinated response to climate change. It is the first of two five-year action plans to implement the Strategic Framework.

The Climate Change Hazard Mapping Program is an example of an initiative under the Strategic Framework. The purpose of this initiative is to develop climate change hazard maps and supporting resources to assist communities or other departments and organizations in their climate change adaptation efforts. As an example, vertical ground movement maps have been developed as a pilot test for a few communities. Precise measurements of ground elevation in and around communities are recorded by satellites over numerous years, and these changes in ground elevation over time are displayed on maps. Vertical ground movement maps can show areas where the ground is rising or falling, due to geological processes such as freeze-thaw cycles and permafrost melting. These maps can identify areas where shifting ground due to these processes may be a concern. Beneficial use of these maps include identifying areas where current or planned community infrastructure may be in jeopardy, helping to inform waste management plans, or monitoring certain features at mine sites associated with closure and reclamation requirements.

## **“We Watch Everything” - a Boots on the Ground Approach to Caribou Monitoring**

Jacobsen\*, P. Steinwand\*, T. Zoe\*, J. Drybones\*, R.

Tłıchq Government

[petterfjacobsen@gmail.com](mailto:petterfjacobsen@gmail.com)

Boots on the ground is a caribou monitoring program based on the traditional knowledge (TK) of Tłıchq and Inuit harvesters and elders. The program is a collaboration between the Tłıchq Government, Government of Northwest Territories-Environment and Natural Resources (GNWT-ENR), Dominion Diamond Mines ULC (DD), and the Wek'èezhii Renewable Resource Board (WRRB). The objectives are to monitor the conditions of Bathurst caribou herd on the summer range focusing on key indicators: (1) habitat; (2) caribou; (3) predators, and (4) industrial development. Boots on the Ground has developed the methodologies “We Watch Everything” and “Do as Hunters Do”. These methods are based on Tłıchq and Inuit traditional methods for monitoring our land and combines observations of biological nature with cultural knowledge of indigenous harvesters. “We Watch Everything” use indigenous ontology, language and perspectives on nature as the pillars of the framework. The “Do as Hunters Do” field data collection process unfolds through a set of techniques and concepts that are specifically related to the landscapes of Contwoyto Lake, as using hunting locations for observations and traditional hunting techniques for caribou monitoring. In addition, the use of participatory anthropological methods documents the harvesters’ qualitative descriptions, which allows us to further understand the interconnected elements of barren ground caribou habitat.

For three years, the program has monitored cow- calf ratio and health conditions of Bathurst caribou and their habitat. Overall, Bathurst caribou on the summer range displayed signs of being healthy, although a number of injuries are observed each year. The program examined the cumulative effects of industrial development, predators and climate change. Several signs of climate change were identified, as earlier spring melt, disappearance of summer snow, and appearance of a new predator specie, the bald eagle, on the post-calving and summer range. Increasing temperatures and the melting of summer snow altered caribou behaviour and exposed them to additional risks. Instead of moving to sun-shaded high hills with snow, herds tend to move in large circles to create wind, and seek to lakeshores and water to cool down their body temperatures. Industrial developments, roads, and human disturbance built on *tataa* (caribou land crossings), or on important corridors, forces caribou to select alternate terrain for migration. Local wolves are aware of and use the industrial and natural land features to their advantage in

the hunt. In recent years, caribou remained on the barrenlands for most of the year; a shift in range that provides a steady supply of prey for local wolf populations. Parallel, the decrease of harvesters from the landscape around Contwoyto Lake has profound impacts on predator/prey relationships between caribou, wolves, and humans. Using our traditional knowledge framework, our monitoring attested how change on caribou's summer range takes many forms, some of which would not be recognizable without a holistic approach, and based on these results, specific management recommendations regarding caribou habitat are developed.

## **NWT Cumulative Impact Monitoring Program (NWT CIMP): Impact on Resource Decision-Making**

Kanigan\*, J.

NWT Cumulative Impact Monitoring Program, Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT

[Julian\\_Kanigan@gov.nt.ca](mailto:Julian_Kanigan@gov.nt.ca)

NWT CIMP is a monitoring and research program that is administered by the Government of the Northwest Territories, Department of Environment and Natural Resources. It has an annual budget of approximately \$1.5 million and a staff of 6. It produces some of the best, most credible science and traditional knowledge in the territory.

The purpose of the program is to support environmental decision-making by generating baseline, cumulative impact and environmental trend information. As you know, many other agencies share responsibility for environmental monitoring in the NWT. It is NWT CIMP's role to fill information gaps that prevent an understanding of cumulative impacts.

NWT CIMP is part of the Mackenzie Valley co-management system, being an obligation of settled land claims in the Northwest Territories and Part 6 of the Mackenzie Valley Resource Management Act. NWT CIMP operates in the Inuvialuit Settlement Region through a memorandum of understanding with the Inuvialuit Regional Corporation.

The program is advised by a Steering Committee of regional Indigenous governments and organizations. Land and Water Boards and the Review Board provide advice to this committee as observers. ENR and the Steering Committee endorsed the current 5-year Action Plan in 2016 and it is focused on meeting the needs of co-management boards.

NWT CIMP has three key activity areas related to monitoring and research:

- 1) The program works with key decision-makers, the Steering Committee and others to determine monitoring priorities
- 2) NWT CIMP staff coordinate monitoring, research and analysis. We also provide funding to others to conduct relevant research and monitoring. Approximately 30 projects are funded per year, and about 10 of those are in their final year
- 3) NWT CIMP staff communicate results to decision-makers and communities

The program currently has three priority valued components that were chosen by a broad group of decision-makers in 2011 and reconfirmed by the Steering Committee in the new action plan. These priorities are caribou, water and fish.

The focus of this presentation will be to give participants a better understanding of NWT CIMP information and its use in decision-making. It will focus on topics that co-management boards have identified as a high priority, with specific examples of how projects have been or could be used in board decisions.

### **Community-Based TK Monitoring – Monitoring for Better Decision-Making: Phase 3**

Keats\*, B.<sup>1</sup>, Enzoe, G\*.<sup>2</sup>

(1) Trailmark (2) Łutsel K'e Wildlife, Lands, and Environment Division

[beth.keats@trailmarksys.com](mailto:beth.keats@trailmarksys.com)

[gloriaenzoe@hotmail.com](mailto:gloriaenzoe@hotmail.com)

This research asks, what is Traditional Knowledge (TK) Community-based monitoring (CBM) according to Łutsel K'e Dene First Nation, and how does it serve as a pathway for meaningful inclusion of Indigenous knowledge into resource management decisions? We explore this question through 1) assessing how Łutsel K'e's CBM programs currently include TK, 2) identifying challenges and recommendations, and 3) conducting a review of relevant literature and speaking with other indigenous CBM program organizers and participants in the North. This research looks to the experiences of indigenous monitoring practitioners and managers to understand how CBM works to support the transfer of local traditional knowledge in community-level land governance and decision-making, as well as provide outputs to external, typically science-based third parties and governments. This research will produce a CBM toolkit for Łutsel K'e and other indigenous communities, and contribute to supporting the improvement

of CBM methodology and strategy for better inclusion of indigenous knowledge in resource decisions.

This program builds off of the NWT CIMP 185 Project *Community-Based TK Monitoring – Monitoring for Better Decision-Making: Phase 1 & 2* which explored the legacy of challenges surrounding the integration and consideration of Indigenous traditional knowledge in living systems management and major project environmental assessments in the Northwest Territories and beyond. *Phase 1 & 2* yielded recommendations for decision-makers and TK researchers alike to improve the inclusion of TK in resource management and understanding cumulative effects.

### **Building a cumulative impact monitoring network: Standardizing the reporting, archiving and dissemination of permafrost ground temperature and geohazard information**

**Kokelj\*, SV.**

NWT Geological Survey, Government of the Northwest Territories, Yellowknife, NT

[Steve.Kokelj@gov.nt.ca](mailto:Steve.Kokelj@gov.nt.ca)

Permafrost is the product of cold climate and affects terrain across the entire Northwest Territories. It consists of frozen earth materials and can be thought of as the cement that holds northern landscapes together. The state of permafrost is linked with climate and rapid warming throughout the NWT is causing permafrost to thaw. Permafrost thaw is affecting northern ecosystems and it is the main driver of changes to northern aquatic ecosystems. Permafrost also provides the foundation for our communities, including building and roads. As climate warms and permafrost thaw increases it becomes critical to organize permafrost monitoring information and mapping to track change and inform decision making. This presentation discusses the need for ongoing efforts to organize and compile information on the permafrost temperatures, ground ice conditions and maps that track landscape change.

### **Ṯodzi, Habitat, and Health**

Legat, A.<sup>1</sup>, Nitsiza, C.<sup>2</sup>, Pellissey\*, J.<sup>3</sup>

(1) Gagos Social Analysts, Inc. for Wek'èezhìi Renewable Resources Board

(2) Community Researcher, Community of Whatì and Land Protection, TG  
(3) Wek'èezhì Renewable Resources Board

[alegat@gagos.ca](mailto:alegat@gagos.ca)

In Canada, *Tòdzì* (boreal caribou) are listed as 'threatened' under the federal *Species at Risk Act*. They have a similar status in the Northwest Territories. Scientific and Indigenous research clearly shows that habitat loss, degradation, and fragmentation are the main causes of *tòdzì* population decline. In the NWT, increasing forest fires, industrial development and associated infrastructure contribute to an increased loss of habitat. Across Canada, Indigenous people consider all *tòdzì* habitat to be at risk.

As early as 1996, Tìchq elders associated with the Whaèhdò Náowo Program recommended that the Tìchq do research on forest fires in the boreal forest and document Tìchq knowledge on *tòdzì*. These elders thought this necessary because of their observations of flora and habitat change associated with industrial developments, and climate change impacts such as more frequent and intense forest fires. For the Tìchq elders and harvesters, in depth knowledge of these habitat changes is essential to understanding how to maintain the relationship with *tòdzì* while harvesting and using them. To gain Tìchq knowledge, harvesters observe the relationships between all beings in the environment.

The original goal of the community of Whatì and the Wek'èezhì Renewable Resources Board's project was to take a first step towards compiling Tìchq elders' and harvesters' knowledge of *tòdzì* and their habitat before and after a forest fire. Our research question was 'when do *tòdzì* return to a place after a forest fire?'. However, the goal and research question morphed as the research team listened to the elders. The elders focused us to: i) observe and document their knowledge of habitat-types key to *tòdzì*'s ability to thrive within their range; and ii) document how to watch the land to determine the likelihood of animal occurrence and health.

Their goal is to watch all the *tòdzì* land and share key details of the relationship between *tòdzì* character and their range. Harvesters and elders who know *tòdzì* understand their character and behaviour just as they understand the traits of all that dwell within Wek'èezhì. They also understand when their land and the beings it contains, change. They know by observing, experiencing, harvesting, and using *tòdzì* because *tòdzì* were, and continue to be, an important being with which the Tìchq thrive – both intellectually and physically.

The purpose of this presentation is to address the Tìchq elder's knowledge that decision-makers must understand and recognize that *tòdzì* need 100% of their habitat within their range to maintain a healthy population. Any management plan must be respectful of the relationships between *tòdzì* and all that is part of their range, including Tìchq Dene. From a Tìchq perspective, one cannot consider the state of *tòdzì* without considering other species that inhabit the area.

## **Using the past to inform the future: A paleoecological perspective of the impacts of drought and fire on lakes and forests.**

Moser\*, K.A.<sup>1</sup>, Pisaric, M.F.J.<sup>2</sup>, Turner, K.W.<sup>2</sup>, Ceci, M.<sup>2</sup>, Garner, C.<sup>2</sup>, Harris, D.<sup>2</sup>, Martin, J-P.<sup>2</sup>, Prince, T.<sup>2</sup>, Sia, M.<sup>1</sup> and Viscek, J.<sup>2</sup>

(1) Dept. of Geography, The University of Western Ontario, London, Ontario

(2) Dept. of Geography, Brock University, St. Catharines, Ontario

[kmoser@uwo.ca](mailto:kmoser@uwo.ca)

Arctic and sub-Arctic terrestrial and aquatic ecosystems are being affected by numerous ecological stressors. Climate change is prominent amongst these. A warming climate during the 20<sup>th</sup> century, which has occurred at rates and magnitudes in the North that exceed those in most other parts of the world, has led to cascading impacts. In Arctic and sub-Arctic regions of Canada, widespread climate warming is thought to be affecting disturbance regimes including those related to wildfire and drought. The 2014 fire season in the Northwest Territories (NWT) was notably severe with ~390 reported fires burning nearly 3.5 million hectares of forest cover. Warm and dry conditions also caused low lake levels and reduced stream flow. The main purpose of our research is to use paleorecords to study the cumulative impacts of warming temperatures, low moisture availability and wildfire on forest and aquatic ecosystems in the southern NWT.

Our first objective is to use tree ring and lake sediment isotope records to reconstruct stream flow and moisture availability (precipitation-evaporation), respectively. Our second objective is to determine the duration, intensity and frequency of fire during the past several 100s to 1000s of years. Our third objective is to determine the magnitude and direction of change in aquatic ecosystems in response to warming temperatures, drier conditions and fires. We will consider changes in aquatic communities (invertebrate in stream and algal in lakes), overall primary production and lake levels. A comparison of sites recently affected to those unaffected by wildfire provides an understanding of the connections between wildfire, community composition, and lake primary production in the context of climate warming.

Tree ring measurements from moisture-stressed sites in the Snare River catchment provide a record of stream flow for the last several centuries. The return period of the drought-like conditions of 2014 was estimated at ~100-200 years. We measured charcoal accumulation in lake sediments and determined that over the last 2000 years fire frequency decreased or remained stable. Findings also showed marked spatial variability in the number of fire events, which



ranged from <5 to 13 over 2000 years. Benthic invertebrates in streams were collected following protocols of the Canadian Aquatic Biomonitoring Network (CABIN) to determine aquatic ecosystem health of recently burned compared to unburned sites. Increases in particulate organic matter resulting from fires led to structural differences in invertebrate communities, including higher richness and abundance of primary consumers and their predators. It is, however, unknown whether these observed changes persist, which would require continued long-term monitoring. In lakes we measured sedimentary chlorophyll *a* and its derivatives to determine a record of overall algal production. Algal production changed little in response to fire, but increased steadily beginning at the turn of the century. These increases are linked to warming temperatures. Analysis of depth measurements, catchment properties and isotope tracers indicate that shallow lakes with small catchments are the most responsive to warming. Results presented here are preliminary and we are continuing to determine the cumulative impacts of multiple stressors on ecosystems in the southern NWT.

## **Assessing Regulators' Information Needs to make Decisions regarding Cumulative Effects under the MVRMA**

Noble\*, B.<sup>1</sup>, Hanna, K.<sup>2</sup>, Arnold, L.<sup>2</sup>, Wong, L.<sup>1</sup>

(1) Department of Geography & Planning, University of Saskatchewan

(2) Center for Environmental Assessment Research, University of British Columbia

[b.noble@usask.ca](mailto:b.noble@usask.ca)

There is an expectation that cumulative impacts to freshwater resources are not only monitored but also managed. The recent NWT Environmental Audit and CIMP's Action Plan identified the need to understand the cumulative impact priorities of decision makers and make sure that monitoring programs can deliver meaningful information to regulators. This project was initiated to understand regulators' information needs for making decisions about cumulative impacts to freshwater resources when assessing the impacts of development proposals under the MVRMA, and to identify some of the issues and challenges to be addressed to help improve practice.

Our project consisted of two parts. First, we examined how cumulative effects information about freshwater resources is used in environmental assessment decision making processes and the challenges to the effective use of information at the project scale. Results indicate some uncertainty about who is responsible for providing and interpreting cumulative effects information such that it is meaningful to decision makers, and limitations in the ability to make decisions about individual projects and impact management strategies based on cumulative

effects information. Second, we examined the monitoring data that are collected across a suite of Type A water licenses, and from a sample of government programs, to determine whether existing data support cumulative effects understanding. Our analysis focused on the consistency of monitoring parameters, the compatibility of monitoring and reporting methods, whether the indicators monitored are capable of detecting cumulative change, and the accessibility and usability of monitoring data. Results indicate that monitoring is routinely prescribed and based on the needs of the specific water license, but there is considerable variability across water licenses, both in terms of what is monitored and how, and concerns about the usability and accessibility of monitoring data to support better understanding of cumulative effects.

Overall, our project identified a number of constraints – but also opportunities – for advancing monitoring programs to better support cumulative effects information needs when making project decisions. Our results reinforce the need for regional approaches and improvements in monitoring to track cumulative effects, and the need to ensure the data generated is useful to and applied within project-based decision-making. A strong foundation for cumulative effects decision making exists, and the challenges (and solutions) may be more about coordination, knowledge, and governance than science.

### **The mobility of arsenic in a small subarctic shield watershed impacted by mining pollution: What does this mean for the long-term fate of arsenic in the Yellowknife area?**

Palmer\*, M.J.<sup>1</sup>, Lines, W.<sup>2</sup>, Chételat, J.<sup>3</sup>, Richardson, M.<sup>1</sup>, Jamieson, H.E.<sup>4</sup>, Spence, C.<sup>3</sup>, and Connon, R.<sup>5</sup>

<sup>1</sup>Carleton University, Ottawa, ON

<sup>2</sup>Yellowknives Dene First Nation, Ndilo, NT

<sup>3</sup>Environment and Climate Change Canada, Ottawa, ON

<sup>4</sup>Queen's University, Kingston, ON

<sup>5</sup>GNWT-ENR, Yellowknife, NT

[michael.palmer@carleton.ca](mailto:michael.palmer@carleton.ca)

The early years of historical mining activities in the Yellowknife region resulted in the release of large amounts of arsenic, antimony, and metals to the surrounding area. Sixty years after the bulk of these emissions were deposited large amounts of arsenic and antimony remain in lake sediments and soils in the region, and surface waters of many small lakes continue to exhibit

elevated concentrations of these metalloids. Understanding the chemical recovery of small lakes from mining pollution in the region requires the consideration of processes occurring within lakes and their surrounding catchment. Studies that integrate these processes provide important information on the long-term fate of arsenic in impacted subarctic environments.

This presentation will draw on results from year-round sampling in the watershed of a small shallow lake (1.1 km<sup>2</sup> and < 3 m maximum depth) to discuss the various pools and fluxes of arsenic in a subarctic environment impacted by 50 years of mining pollution. Inputs and outputs of arsenic from the lake were measured by combining bi-weekly chemical sampling and continuous flow measurements at the lake inflow and outflow. The flux of arsenic between lake sediments and the overlying water column was measured using a combination of porewater extraction techniques and experimental field incubations of lake sediments. The contribution of arsenic from surface runoff from the surrounding catchment was estimated in a small subcatchment by measuring discharge volume and chemistry from the catchment. Contemporary atmospheric loading of arsenic to the watershed was measured in summer and winter by collecting rain and snow for chemical analyses.

Seasonality is an important feature of subarctic environments and early results from this study show that the mobility of arsenic varies across landscape compartments and is seasonally dependent. Lake sediments were a small source of arsenic to overlying waters during the open-water season when lake waters are well-oxygenated. These sediments became a substantial source of arsenic by mid-winter once anoxic conditions developed at the sediment boundary and water column arsenic concentrations increased almost three-fold compared with late summer measurements (September: 50 µg/L - April: 141 µg/L). Lake water arsenic concentrations decreased rapidly to less than 40 µg/L once snowmelt entered the lake but prior to the loss of ice cover and peak flow at the lake outlet. Terrestrial contributions of arsenic to the lake via surface runoff were isolated to the snowmelt period in early May and during record precipitation periods in June and July. Loading estimates during these periods indicate that substantial amounts of arsenic continue to be mobilized from the terrestrial to aquatic environment.

These observations highlight the importance of considering processes across seasons in evaluating the long-term fate of arsenic in shallow lakes in the region. The annual remobilization of sediment As into overlying waters under ice may be a significant process inhibiting the long-term chemical recovery of mine-impacted shallow lakes since it does not coincide with periods of high flow at lake outlets. Large winter increases in lake water arsenic also suggest that winter processes should be considered when evaluating exposure of aquatic life to legacy arsenic.

## **NWT-Wide Community-Based Water Quality Monitoring (CBM) Program**

Somers\*, G.

Water Resources Division, Environment and Natural Resources, Government of the  
Northwest Territories, Yellowknife, NT

[Gila\\_Somers@gov.nt.ca](mailto:Gila_Somers@gov.nt.ca)

During the development of *Northern Voices, Northern Waters: NWT Water Stewardship Strategy* (2010), NWT communities and Aboriginal governments highlighted the need to be more involved in and know more about water stewardship.

The NWT-wide Community-based Monitoring (CBM) program started in 2012 in response to community questions about water quality. The goal of the monitoring program is to have communities involved in water stewardship activities and to collect water quality monitoring information to help answer community questions about water quality. The program involves community members from 21 different communities in the NWT, staff from the Government of Northwest Territories-NWT's Department of Environment and Natural Resources (GNWT-ENR), and other water partners. The goal of the monitoring program is to give NWT residents the opportunity to do water monitoring and answer community questions about water quality.

The CBM Program is designed to allow community members to decide where to monitor water quality and to allow them to do the sampling themselves (community monitors). The GNWT-ENR and other water partners play coordinating and supporting roles within this program. These roles include 1) Providing ongoing training and support to the community monitors to collect water samples using standard methods. 2) Analyzing water quality data and providing results back to communities.

In 2017, GNWT-ENR hired independent consultants to look at all the water quality data collected by the CBM program. The consultants used standard methods to look for water quality trends (the general direction in which water quality is changing over time) across the NWT. They also looked at the data quality to see if sampling procedures used by the CBM program were giving the data needed to answer community questions, and they answered several community questions.

Differences in water quality across the NWT seem to be related to the speed of water flow and the type of rocks that the water is flowing through. Water quality in some regions is also being affected by climate change. Overall, the CBM program was found to be working very well with only a few adjustments recommended.

## **An investigation of variable fish mercury concentrations in Dehcho lakes**

Swanson\*, H.K.<sup>1</sup>, Low, G.<sup>2</sup>, Branfireun, B.<sup>3</sup>, Baker, L.<sup>1</sup>, Low, M.<sup>2</sup>, Ng, K<sup>3</sup>

(1) Department of Biology, University of Waterloo

(2) Dehcho AAROM

(3) Department of Biology and Department of Geography, Western University

[heidi.swanson@uwaterloo.ca](mailto:heidi.swanson@uwaterloo.ca)

Following on previous results from 2013-2015 that indicated considerable variability in fish mercury concentrations among lakes in the Dehcho region, we used a paired-lake study design to examine why lakes on the Horn Plateau (Big Island, Willow) have lower fish mercury concentrations than lakes in the Mackenzie lowlands (Ekali, Sanguex). We investigated whether there were differences between the regions (Horn Plateau and Mackenzie Lowlands) in size and characteristics of the catchments, invertebrate community composition, methyl mercury concentrations in invertebrates, and mercury concentrations in water and sediment that may explain mercury variability in fish. Results indicate that inflow waters to lakes have relatively high concentrations of methyl mercury (and high % methyl mercury). It thus appears that catchments are significant sources of methyl mercury to downstream lakes, which differs from the dominant paradigm of methylation occurring mostly in-lake. Because Ekali and Sanguex lakes have larger catchment: lake area ratios, we infer that these lakes are more influenced by their catchments than either Big Island or Willow lakes. Further, rates of mercury biomagnification through invertebrate communities were higher in the Mackenzie lowland lakes than in the Horn Plateau lakes.

We also found that methyl mercury concentrations were higher in littoral invertebrates than in profundal invertebrates, and higher in benthic invertebrates than in zooplankton. Analyses are continuing, but to date we conclude that: i) significant methylation of mercury is occurring in catchments; and, ii) catchment-derived methyl mercury is delivered primarily to littoral habitats where it accumulates in littoral benthic invertebrate food chains. Because Ekali and Sanguex are more influenced by their catchments than Willow and Big Island lakes, and likely have relatively more littoral habitat, mercury concentrations in predatory fish are higher. We make the further observation that beaver ponds and permafrost slumps lead to notably high mercury concentrations in downstream waters.