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# Canadian Aquatic Biomonitoring Network

## **5<sup>th</sup> BIENNIAL CABIN FORUM**

FORUM PROCEEDINGS

October 23-24, 2019

Yellowknife,

Northwest Territories

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## Executive Summary

On October 23 and 24, 2019 members of the Canadian Aquatic Biomonitoring Network (CABIN) and other interested participants gathered in Yellowknife, Northwest Territories, to discuss biological monitoring (or biomonitoring) activities for the protection of fresh water ecosystem health in the North, and across Canada.

The CABIN forum, organized by Environment and Climate Change Canada (ECCC), was preceeded by the Government of Northwest Territories' Water Stewardship Strategy Workshop and shared a core audience interested in discussing fresh water and fresh water protection in a changing climate. Unlike previous science-focused CABIN Forums, the emphasis of this event was on local community engagement in the context of northern aquatic ecosystems. The forum was attended by 115 participants, in-person and remote, representing Indigenous communities, Indigenous governments, community watershed stewards, non-government organizations, and scientists from government, industry and academia.

Key objectives of this forum included:

- to provide a venue for participants to interact, collaborate and learn from other members of the network,
- to provide an opportunity for information exchange among CABIN users and the ECCC CABIN National Team to address common needs and improvements for the program,
- to provide an opportunity for current members and potential monitoring network participants to learn about biological monitoring and how CABIN is or can be applied in northern environments for the protection of fresh water ecosystem health.

Presenters covered themes including field training, community-based monitoring, protecting northern streams, application to decision-making, and new directions for CABIN. Invited speakers from Indigenous communities shared stories about the importance of On-The-Land camps in fostering connection and the sharing of knowledge between Elders and youth in their communities. Some of the key messages shared by forum participants include:

- Water connects all of us, from youth to Elders, from communities to governments.
- Collaboration begins with building relationships between researchers and Indigenous communities. Relationships based on mutual respect take time, and should not be rushed.
- OCAP®<sup>1</sup> principles (Ownership, Control, Access, and Possession) must be respected when working with Indigenous Peoples and communities to connect traditional knowledge and western science.

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## Preface

The Canadian Aquatic Biomonitoring Network (CABIN) is an aquatic biomonitoring program for assessing the health of fresh water ecosystems in Canada. CABIN is based on the network of networks approach that promotes collaboration and data-sharing to achieve consistent and comparable reporting on fresh water quality and aquatic ecosystem conditions in Canada. The program is maintained by Environment and Climate Change Canada (ECCC) to support the collection, assessment, reporting and distribution of biological monitoring information. CABIN allows network members to take their observations and make a formalized scientific assessment using national standards.

Since 2010, ECCC along with various partners and collaborators, has organized national CABIN forums on a biennial basis. Previous CABIN forums have been largely science-focused. As the CABIN network expands, the benefit of other forum themes is recognized, including the theme of this forum, local community engagement.

The goal of these forums, regardless of theme, is to bring together a variety of current members and potential CABIN participants. These participants include Indigenous Peoples, community watershed stewards, and scientists from government, industry and academia to exchange information and promote collaboration. On October 23 and 24, 2019 the 5<sup>th</sup> CABIN Forum was held in Yellowknife, Northwest Territories (NT). The forum was preceded by the Government of Northwest Territories Water Stewardship Strategy Workshop and shared a core audience interested in discussing fresh water and fresh water protection in a changing climate.

The objectives of this Forum were:

- To provide a venue for participants to interact, collaborate and learn from other members of the network.
- To provide an opportunity for information exchange among CABIN users and the ECCC CABIN National Team to address common needs and improvements for the program.
- To provide an opportunity for current members and potential monitoring network participants to learn about biological monitoring and how CABIN is or can be applied in northern environments for the protection of fresh water ecosystem health.

The two-day forum was attended in-person and via webinar and included short presentations, interactive discussions, and hands-on exhibits highlighting fresh water benthic macroinvertebrates. The six session themes of the forum related to an introduction to biological monitoring, CABIN and community engagement, field training, applications to decision making, monitoring and protecting northern aquatic ecosystems, community-based monitoring, and new directions for CABIN. A brief overview of each presentation presented under the session themes is provided in the Presentation Session Summaries section of this document. Following presentations on each theme a discussion period was undertaken by participants and facilitated by forum organizers. Outcomes from these discussions are summarized in the Interactive Discussion Summaries section.

In-between session, several microscopes and example specimens with identification flashcards and invertebrate keys were made available. A CABIN sampling kit and water quality instruments were also on display for demonstration. These materials provided some hands on interaction for those new to biomonitoring and CABIN. Examples of CABIN's "Bug of the Month" factsheets were on display to illustrate how each monthly publication presents interesting facts about aquatic benthic macroinvertebrates.

## Agenda

### 5<sup>th</sup> Biennial CABIN Forum, Oct 23-24, 2019 Chateau Nova, Yellowknife, Northwest Territories

	<b>Wednesday October 23, 2019</b>
12:00-1:30	<b>Sign-in Desk Open</b>
	Lunch provided to registered participants
1:30-2:45	<b>Introduction to CABIN and Community Engagement:</b> <i>Begin a discussion about the importance of monitoring in the North and how communities can use CABIN; Hands on exhibits and interactive displays</i>
Session 1: Introduction to CABIN and Community Engagement – Kristie Trainor, ECCC, Facilitator	Opening Remarks <i>Jason Snaggs, Yellowknives Dene First Nation</i>
	Welcome <i>Kristie Trainor, Environment and Climate Change Canada</i>
	Exciting world of benthic invertebrates <i>Jennifer Lento, University of New Brunswick</i>
	Introduction to CABIN to monitor and assess watershed health <i>Stephanie Strachan, Environment and Climate Change Canada</i>
	Discussion and Hands on Exhibits
2:45-3:00	Coffee & tea break
3:00-4:30	<b>Training:</b> <i>Explore different ways of knowledge and skill transfer: on-the-land youth camps, post-secondary, community-based monitoring projects; Engage CABIN network on training needs and a new training delivery model through group discussion and feedback opportunities</i>
Session 2: Training – Nancy Glozier, ECCC, facilitator	Water education and training for Indigenous youth and their communities <i>Carli Lang, Water First</i>
	Nunavut Community Aquatic Monitoring Program (N-CAMP) <i>Sarah Arnold, Parks Canada</i>
	Engaging Northern Communities in Climate Change Science through On-the-Land Camps <i>Andrew Spring, Wilfrid Laurier University</i>
	CABIN training: Current and future directions <i>Emma Garden, Environment and Climate Change Canada</i>
	Discussion
4:30	Adjourn



	<b>Thursday October 24, 2019</b>
8:00-9:00	Coffee, tea & pastries
9:00-10:30	<b>CABIN Application to Decision-Making:</b> <i>Explore the application of CABIN to decision making in different jurisdictions; Discuss successes, challenges and opportunities to strengthen CABIN monitoring for decision-making</i>
Session 3: CABIN Application to Decision-Making- Paula Siwik, ECCC, facilitator	Application of CABIN in British Columbia <i>Jolene Raggett, BC Ministry of Environment and Climate Change Strategy</i>
	Biomonitoring in Transboundary Rivers in NWT <i>Annie Levasseur, Government of Northwest Territories</i>
	CABIN application for ecological monitoring and Arctic Park management <i>Paden Lennie, Parks Canada</i>
	Assessing ecosystem status with CABIN in Nahanni National Parks ( <i>cancelled</i> )
	Personal Reflections: On-the-Land Camps <i>Dalton Simba, Parks Canada</i>
	Applying CABIN field sampling approaches within the Oil Sands Area: Dealing with design complications - challenges, successes and recommendations <i>Nancy Glozier, Environment and Climate Change Canada</i>
	Discussion
10:30-10:45	Coffee & tea break
10:45-12:00	<b>Monitoring and Protecting Northern Aquatic Ecosystems:</b> <i>Explore current monitoring activities in the North; Discuss areas of importance, potential collaboration and development of Northern Biomonitoring Plan for CABIN</i>
Session 4: Monitoring and Protecting Northern Aquatic Ecosystems – Kelly Munkittrick, WLU, facilitator	Climate change concerns in the Inuvialuit Region <i>Charles Klengenberg, Inuvialuit Regional Corporation</i>
	Monitoring ecosystem health in the Inuvik Tuktoyuktuk and Dempster Highways <i>Jordan Musetta-Lambert, Wilfrid Laurier University</i>
	Circumpolar Biomonitoring Program of the Conservation of Arctic Flora and Fauna <i>Jennifer Lento, University of New Brunswick</i>
	Developing a Northern Biomonitoring Plan <i>Cari-Lyn Epp, Environment and Climate Change Canada</i>
	Discussion
12:00-1:00	Lunch provided to registered participants

	<b>Thursday October 24, 2019 (continued)</b>
1:00-2:30	<b>Community-Based Monitoring:</b> <i>Explore successes and challenges of community-based monitoring projects; Discuss value of community involvement in monitoring and potential for collaborative efforts</i>
Session 5: Community-Based Monitoring – Jennifer Lento, WLU, facilitator	Ka'a'gee Tu First Nation Stewardship & Guardian Projects: KTFN Monitoring and Land – Based Youth Camps <i>Melaine Simba, Dehcho First Nation</i>
	Thaidene Nene Ku = Water <i>Prairie Desjarlais, Łútsël K'édé Dene First Nation</i>
	Working with communities to monitor ecosystem health <i>Raegan Mallinson, Living Lakes Canada, and Catherine Paquette, World Wildlife Fund</i>
	Sharing community-based monitoring data <i>Lindsay Day, Gordon Foundation</i>
	Development of triggers for adapting a monitoring program <i>Kelly Munkittrick, Wilfrid Laurier University</i>
	Discussion
2:30-2:45	Coffee & tea break
2:45-4:00	<b>New Direction for the CABIN program:</b> <i>Learn about new directions for the CABIN program and current research projects; Discuss opportunities for collaboration and provide feedback for future improvements for CABIN</i>
Session 6: New Direction for the CABIN program – Kristie Trainor, ECC, facilitator.	Data Management and Open Data: Using the CABIN Web Application to Minimize Effort and Maximize Integration <i>Tim Pascoe, Environment and Climate Change Canada</i>
	New Protocol Developments and CABIN Approaches: Wetlands and Large Rivers <i>Emily McIvor, Environment and Climate Change Canada</i>
	Expanding our horizons with DNA metabarcoding <i>Donald Baird, Environment and Climate Change Canada</i>
	STREAM project <i>Chloe Robinson, University of Guelph</i>
	Discussion
4:00	Closing ceremony

## Presentation Session Summaries

The following provides summaries of what we heard during presentations made under the six session themes.

### Opening Remarks

*Jason Snaggs, CEO  
Yellowknives Dene First Nation*

I commend CABIN for focusing on the North for this forum. The North is an area of economic and industrial growth and with this can come large effects on the aquatic environment. We have seen the effects of development in contamination of lands, water and fish. We have also seen that impacts or improvements in one area can affect areas thousands of miles away, for example climate change or invasive species; it is all connected. CABIN is important for Indigenous culture as many individuals are stewards for the land. CABIN's work helps keep water health in check and is used as a warning bell to ensure we continue to measure & protect the life in our waters.

### Welcome

*Kristie Trainor, Manager  
Freshwater Quality Monitoring and Surveillance, Pacific-Arctic-Athabasca Watershed, ECCC*

We are fortunate to be able to gather in Yellowknife, on Chief Drygeese Territory, the traditional home of the Yellowknives Dene. These are also the traditional lands of the North Slave Métis. We extend our respect and appreciation to the Yellowknives Dene and the North Slave Métis for sharing their land with us.

This forum has a record number of participants – 115 people joining in-person and by webinar – and includes participants from communities, academia, Indigenous governments, non-governmental organizations, and territorial/provincial & federal governments. Looking at CABIN's network of networks as a whole, we see this same variety of network partners, and it is from this diversity that CABIN draws its strength. Many participants are new to CABIN, and this is an exciting opportunity to discuss biomonitoring and introduce how CABIN can be used in northern environments, to collaborate and learn from other members of the network, and to share information and identify ways to improve the CABIN program.

Before discussing why we are here today, let's first look back at where we have been. The first two CABIN forums, held in 2010 (Vancouver) and 2012 (Moncton), focused on core program delivery/training. In 2014 (Guelph), CABIN explored new research directions with a focus on DNA research. In 2017 (Edmonton), the CABIN forum focused on raising CABIN's profile through decision based applications. Past forums reflect the evolution of the CABIN program, and CABIN continues to evolve and grow. The 2019 forum, here in Yellowknife, is focused on local community engagement, how to improve our understanding of northern ecosystem health, and identify where CABIN training – delivered in a meaningful way in northern Canada – could be helpful. Climate change is a lived reality for everyone, particularly in the north where there is immense pressure

on arctic and northern ecosystems and communities. Our hope is to start a discussion on what co-development of a Northern Biomonitoring Plan could and should look like. No plan or document currently exists. Our goal here is to share information with each other about CABIN and northern ecosystems, and most importantly, to listen.

## Session 1: Introduction to CABIN and Community Engagement

### **Exciting world of benthic invertebrates**

*Jennifer Lento, Research Scientist  
University of New Brunswick*

This peek into the exciting world of benthic macroinvertebrates was full of images, videos and live demonstrations. Benthic macroinvertebrates are: benthic – bottom-dwelling, macro – can see with the naked eye, invertebrate – organisms without a backbone. Most of the specimens we talk about are young insects – their larval stage. Examples of how they live, breathe, feed, and even make jewelry were demonstrated. Their diversity and uniqueness was shown as well as how they could be good indicators of water quality. Some are very sensitive to pollution, so their presence can indicate good water quality. This presentation was followed up with live exhibits at the microscopes during the break.

### **Introduction to CABIN to monitor and assess watershed health**

*Stephanie Strachan, Regional CABIN Lead  
Freshwater Quality Monitoring and Surveillance, Pacific-Arctic-Athabasca Watershed, ECCC*

The CABIN protocol, database and online tools have been around for over 20 years but only recognized by the name CABIN since national implementation in 2006. Nearly one third of those who registered for the CABIN forum indicated that they were new to CABIN or knew very little about CABIN. This presentation provided both an overview of CABIN and touched on new things that were presented at this forum, as CABIN is a growing and evolving program. The most important point was that CABIN is collaborative. It is managed by ECCC but contributed to by many external organizations in a variety of ways, not just through data collections. The forum was hosted in Yellowknife with a focus on the north to help foster network collaborations.

## Session 2: Training

### **Water education and training for Indigenous youth and their communities**

*Carli Lang, Scientific Director  
Water First*

Water First works together with First Nations communities to address local water challenges and has collaborated with over 40 First Nations in Ontario, Quebec and Labrador on education and training projects. Water First aims to establish meaningful collaborations and respectful relationships, to hire and train locally, and to blend western science with traditional ecological

knowledge. There are 3 areas of focus; 1) youth education, 2) environmental programs, and 3) drinking water internships. Youth education is for all grades from K-12 and involves in-classroom and outdoor hands-on learning activities. Restoration or baseline environmental studies are a collaboration with local leaders to identify water quality concerns and design a study to be implemented by the community. Drinking water internships integrate Traditional Ecological Knowledge (TEK) throughout the program, increase local skills and promote employability.

### **Nunavut Community Aquatic Monitoring Program (N-CAMP)**

*Sarah Arnold, Ecologist Team Lead  
Parks Canada*

The Nunavut Community Aquatic Monitoring Program (N-CAMP) is a northern-based program that trains Nunavummiut in data collection for fisheries and aquatic monitoring. The training approach includes two-three days of classroom training followed by practical on-the-land skills training, where participants get practice with the scientific equipment and collect data for community projects. The certified training modules are based on other Canadian aquatic monitoring protocols, but adapted for Arctic conditions. N-CAMP started with community consultations in 2012 and 2013 followed by data collections in 2014, which included community training. This program is practical, adaptable and modular and it connects the communities with scientific experts. The program will continue to follow-up with participating communities, engage new communities and work to develop a data management strategy.

### **Engaging Northern Communities in Climate Change Science through On-the-Land Camps**

*Andrew Spring, Research Associate  
Wilfrid Laurier University*

Northern research projects at Wilfrid Laurier have prioritized youth engagement as a key way to mobilize knowledge, build capacity and strengthen relationships with community partners in the Northwest Territories. Weeklong camps focus on youth and include community members, knowledge holders, decision makers, and researchers. They help community youth to have direct engagement in the research projects occurring on their land, and promote communication between Elders, youth, and researchers. The purpose is to enable and empower youth to see the land from the science and traditional knowledge perspectives, encourage their involvement in monitoring and science initiatives in their communities and become future leaders.

### **CABIN training: Current and future directions**

*Emma Garden, CABIN Training Coordinator  
Freshwater Quality Monitoring and Surveillance, St Lawrence and Atlantic Coastal Watershed,  
ECCC*

Since beginning in the early 2000s, the CABIN training program has evolved and expanded to many audiences. Demand has continued to grow, averaging 200 registrants per year, with significant interest from community-based monitoring initiatives. While the program has exceeded expectations, the CABIN team recognizes there is room for improvement. It also

recognizes the need to work together with partners on a vision for future CABIN training. The 2019 CABIN Forum is the first step in starting a national conversation about building capacity through CABIN training and using CABIN tools as a way of knowing if water is healthy. To facilitate this, a brief background on CABIN training was provided emphasizing some of the successes, challenges, and developments the program has experienced over the years. The ECCC CABIN team is also reviewing the training program that includes a needs assessment, program evaluation, curriculum review, and feedback gathering.

## Session 3: CABIN Application to Decision-Making

### **Application of CABIN in British Columbia**

*Jolene Raggett, Environmental Impact Assessment Biologist  
BC Ministry of Environment and Climate Change Strategy*

The BC Ministry of Environment and Climate Change Strategy (ENV) has been working with ECCC since the mid-2000s to expand and promote the use of CABIN for monitoring and assessment in BC. A significant effort has been undertaken to collect CABIN data and Reference Condition Approach (RCA) models are now available for almost every major watershed in the province. ENV is now shifting to a less intensive phase of monitoring, which will focus on maintaining and updating the models and ensuring CABIN continues to provide a reliable assessment tool for CABIN users. For ENV, CABIN is an important part of evaluating aquatic ecosystems within multi-jurisdictional agreements, as the field methods and analytical tools are nationally standardized. CABIN assessment is also being considered for inclusion in both provincial *Water Quality Objectives* (WQOs) and *Water Objectives* (WOs) monitoring programs. These programs are developed in high priority areas where water resources may be affected by human activities. Work is underway to incorporate a *Biological Objective* using CABIN to provide a standardized and direct measure of aquatic ecosystem health, which will help characterize current conditions and measure the effectiveness of the WQOs and WOs in protecting aquatic life. Once biological monitoring is established as a routine component of these provincial programs, ENV will explore developing site-specific qualitative and quantitative biological objectives.

### **Biomonitoring in Transboundary Rivers in NWT**

*Annie Levasseur  
Water Management and Monitoring Division, Environment and Natural Resources, Government of Northwest Territories*

The Mackenzie River Basin Transboundary Waters Master Agreement was signed by the Government of Canada Northwest Territories Yukon, BC, Alberta, and Saskatchewan in 1997. It was designed to cooperatively manage water in a manner consistent with the ecological integrity of the aquatic ecosystem through the development of bilateral water management agreements. There is a biological component to the bilateral agreements that includes fish, invertebrates and aquatic mammals as indicators. The invertebrate indicators were tested in the Slave and Hay Rivers in 2017 and 2018 using a modified CABIN approach for Large Rivers. Hester-Dendy

Samplers were used at the start of the program and compared to CABIN kick sampling results, but did not reflect the abundance or richness seen in the kick samples. While the application of invertebrate indicators was successful, challenges included finding sites on the Slave River and difficulty sampling when high water conditions occurred.

### **CABIN application for ecological monitoring and Arctic Park management**

*Paden Lennie, Resource Management Technician  
Parks Canada*

The Western Arctic Parks Unit manages several sites including three National Parks (Ivvavik, Tuktut Nogait, Aulavik), the one and only Canadian Landmark (Pingo Canadian Land Mark) and one Natural Historical Site (Saoyú-?ehdacho). Each site is co-managed through local land claim agreements. All sites are located in the isolated backcountry with very few visitors and can be considered reference sites. The polar regions are expected to experience larger impacts from climate change, therefore, monitoring is essential. Ecological integrity monitoring alerts park managers to potential new or evolving ecological issues that may require management attention or action. Benthic invertebrates are useful indicators of water quality at remote sites because they represent the river conditions over a cumulative period before the sampling time. The objective of the benthic invertebrate monitoring in the Firth, Thomsen and Hornaday river systems is to quantify baseline diversity and abundance. Sampling uses a tailored version of CABIN field methods. Site-specific ecological and statistical threshold values will provide an early warning of unusual conditions within these freshwater systems.

### **Assessing ecosystem status with CABIN in Nahanni National Parks (cancelled)**

*Sarah Arnold, Ecologist Team Lead and Dalton Simba, Resource Management Technician  
Parks Canada*

Due to unforeseen circumstances, the talk for Nahanni Park was not available. Dalton Simba, as a community member, youth and currently an employee of Parks Canada, spoke personally about the value of On-The-Land camps for youth and the connection between traditional knowledge and scientific knowledge.

### **Personal Reflections: On-the-Land Camps**

*Dalton Simba, Resource Management Technician  
Parks Canada*

On-the-Land camps help to join the ecological perspective and traditional perspectives, and it is nice to see how the two contribute to each other. What the Elders are saying about ecological changes correlates well with what the data is saying from local Parks. Dalton has been able to see both perspectives, having come from a traditional cultural background and having a western education. He was part of the Youth Keepers program in 2014 and feels it is important to get more youth involved in ecological monitoring. This perspective suggests On-the-Land camps are a good way to bridge differences between youth and Elders, traditional knowledge and western science.

## **Applying CABIN field sampling approaches within the Oil Sands Area: Dealing with design complications - challenges, successes and recommendations**

*Nancy Glozier, Section Head*

*Freshwater Quality Monitoring and Surveillance, Pacific-Arctic-Athabasca Watershed, ECCC*

The presentation focused on the design aspects and challenges in applying CABIN field approaches to evaluate effects in the Oil Sands area. A brief background on the development and implementation of the Oil Sands Program was followed by a summary of the challenges in the design of a biomonitoring program in the area including; large rivers with largely sand substrate, co-occurring reference, habitat and industrial gradients within a longitudinal section of river/stream, and high year-to-year variability in discharge regimes. Despite these challenges, gradient designs using CABIN field approaches were very successful in detecting shifts in benthic macroinvertebrate community structure. Recommendations and lessons learned may be applicable to areas with similar challenges.

## **Session 4: Monitoring and Protecting Northern Aquatic Ecosystems**

### **Climate change concerns in the Inuvialuit Region**

*Charles Klengenberg, Director Inuvialuit Lands*

*Inuvialuit Regional Corporation*

The Government of Canada and the Inuvialuit signed the Inuvialuit Final Agreement (IFA) June 5, 1984. The basic goals of the IFA are to 1) preserve Inuvialuit cultural identity and values within a changing northern society, 2) enable Inuvialuit to be equal and meaningful participants in the northern and national economy and society, and 3) protect and preserve the Arctic wildlife, environment and biological productivity. The Inuvialuit Land Administration (ILA) is the division of Inuvialuit Regional Corporation responsible for managing and administering Inuvialuit-owned lands in the Inuvialuit Settlement Region. The ILA requires the use of community-based environmental monitors because traditional ecological knowledge is an essential component of monitoring the land. There is a need for increased Inuvialuit involvement and engagement in climate change and permafrost related monitoring and research. As a result, several projects have been developed in the Inuvialuit Settlement Region. A gap analysis identified training needs for community-based monitoring and strengthened partnerships among environmental monitors. The Imaryuk Monitoring Program (IMP) was developed to protect and conserve local fisheries near the Inuvik-Tuktoyaktuk Highway (ITH). The Tuktoyaktuk Community Corporation partnered with Aurora Research Institute to develop a training program to measure climate change. The Drilling Sumps Failure and Climate Change Project was developed to inventory and assess drilling waste sumps. The Munaqsi (Inuvialuit Guardians) Program was established to combine traditional and science-based knowledge to document changing environmental conditions.



## **Biological Monitoring to Detect Change in Stream Health Along the Dempster-Inuvik-Tuktoyaktuk-Corridor (DITC)**

*Jordan Musetta-Lambert, PhD Postdoctoral Researcher  
Wilfrid Laurier University*

There is currently a lack in understanding of the impact of Arctic corridor roads on stream food-webs, biodiversity, and distribution of aquatic invertebrates and fish. Increased sedimentation in streams caused by road erosion during periods of high stream flow as well as permafrost thaw-driven road slumping have been observed along the Dempster-Inuvik-Tuktoyaktuk Corridor (DITC) and may pose a threat for aquatic ecosystem services. The objective of this project is to establish a stream biomonitoring program along the DITC to study the effects of recent and legacy road development on stream ecosystem health. This study is using the CABIN protocol, water quality sampling, and examining ecosystem function (e.g., carbon cycling) to investigate the severity of ecological impacts in streams associated with road development. With assistance from environmental monitors in the Gwich'in Settlement Area and Inuvialuit Settlement Region, this study will produce ecological information that can be used by resource boards to develop management plans to protect aquatic habitat and ecosystem services.

## **Circumpolar Biomonitoring Program of the Conservation of Arctic Flora and Fauna**

*Jennifer Lento, Research Scientist  
University of New Brunswick*

Across the Arctic, variation in warming rates, development, and biogeography may be expected to contribute to changes in biodiversity of fresh water organisms. Critical to detecting such changes is the quantification of existing biodiversity patterns across the Arctic region. The Circumpolar Biodiversity Monitoring Program (CBMP) is the cornerstone program of the Conservation of Arctic Flora and Fauna (CAFF) working group of the Arctic Council. The CBMP is an international network of scientists, government agencies, Indigenous organizations and conservation groups that is working to facilitate more rapid detection, communication, and response to biodiversity-related trends and pressures in the Arctic. This is achieved by promoting coordination, harmonization, and collaboration in monitoring and assessment of Arctic ecosystems including fresh water, marine, terrestrial, and coastal habitats. The fresh water group of the CBMP (CBMP-Freshwater) has recently completed the first circumpolar assessments of fresh water flora and fauna to determine the state of Arctic fresh waters. This assessment made use of CABIN data from Arctic regions of Canada to evaluate circumpolar biodiversity trends in fresh water benthic macroinvertebrates (BMI). In rivers, alpha diversity (the number of taxa) decreased with increasing latitude. This trend was most evident above 68°N, and reflected the loss of EPT taxa (mayflies, stoneflies, and caddisflies) and increased dominance of Diptera (true flies, especially midges). The decrease in diversity was strongly related to a decrease in temperature, and reflected temperature tolerance levels of different organisms. The strength of the relationship between diversity and temperature suggests that BMI could be used as an indicator of climate change effects in the Arctic, with higher diversity (loss of diversity unique to the Arctic) occurring as a result of continued warming. These broad-scale diversity patterns can be used to make predictions about compositional changes that may be expected with continued climate change, but additional monitoring, including routine sampling, is required to detect

changes in the future. Please visit [caff.is/freshwater](http://caff.is/freshwater) for more details and for copies of the circumpolar assessment report.

### **Developing a Northern Biomonitoring Plan**

*Cari-Lyn Epp, CABIN National Team member*

*Freshwater Quality Monitoring and Surveillance, Pacific-Arctic-Athabasca Watershed, ECCC*

Biomonitoring is a tool that can be used to assess ecosystem health. In northern Canada, environmental pressures including climate change and cumulative effects can impact ecosystem health. ECCC's CABIN program provides national standardized methods and scientific expertise through a network of networks, to help assess changes in aquatic ecosystem health, and could be a useful platform to increase biomonitoring activities in the north. One of the intentions of hosting the forum in Yellowknife is to start a discussion on opportunities for co-development of a Northern Biomonitoring Plan, in order to improve the understanding of aquatic ecosystem health in Canada's north. To start the discussion on what a Northern Biomonitoring Plan could and should look like, ECCC plans to engage northern Indigenous communities and residents, to explore links with existing programs and partners (Indigenous governments, Territorial governments, Federal Parks, Northern research institutes, educational institutions etc.) and to focus on joint monitoring interests. CABIN forum participants are invited to provide contact information if they are interested in participating in the co-development of a Northern Biomonitoring Plan.

## **Session 5: Community-Based Monitoring**

### **Ka'a'gee Tu First Nation Stewardship & Guardian Projects: KTFN Monitoring and Land – Based Youth Camps**

*Melaine Simba*

*Dehcho First Nation*

Numerous monitoring activities are ongoing within the Dehcho community and in partnership with Wilfrid Laurier University, Prince of Wales Heritage Centre and the GNWT. The Dehcho-Aboriginal Aquatic Resources and Oceans Management (AAROM) is a regional program that facilitates community-based water monitoring in the Dehcho and is run through the Dehcho First Nations office. Monitoring is important to the Ka'a'gee Tu First Nation because they have seen the effects of climate change and are directly affected by it. For example, their community recently saw an early ice break-up that led to a grayling run far too early in the year. Many of their projects are fish-related, such as stock assessments. In addition environmental research, an archeological project, and contaminant monitoring are active projects with community members. Recycling and composting have also been initiated in the community. One of the challenges reported is the small community size; typically the same people are involved in many different activities.

## **Thaidene Nënë Ku = Water**

*Prairie Desjarlais*

*Łutsël K' é Dene First Nation*

The Government of Canada took steps to legally establish the Thaidene Nënë National Park Reserve in the Northwest Territories. As part of the formal establishment of Thaidene Nënë, an Agreement between the Government of Canada and the Łutsël K' é Dene First Nation (LKDFN) was signed in Łutsël K' é (August 21, 2019). Thaidene Nënë is part of a group of proposed protected areas around the East Arm of Great Slave Lake. The lives and cultures of all Indigenous peoples in this region are rooted in the lands and waters of Thaidene Nënë. It is a culturally rich area, where Indigenous traditions and harvesting are practiced. A mandate was given by the Elders to protect this area because of major mineral development and explorations in their territory. The Ni Hat' ni Dene ranger program was initiated in 2008 when a group of leaders, Elders and community members visited Haida Gwaii National Park and Spirit Bear Lodge in Klemtu to learn of the operations, infrastructure and to learn how to manage tourism in their economic development program. The ranger program is aimed at protecting animals, wildlife & land, and most importantly, water (Ku). Łutsël K' é is one of the best fishing spots in Canada, this is important to the LKDFN, (we are water people and water is our life). THE MANDATE TO PROTECT OUR WATER WILL LIVE AND CARRY ON.

## **Working with communities to monitor ecosystem health**

*Raegan Mallinson, Program Manager  
Living Lakes Canada*

*Catherine Paquette, Specialist-Freshwater  
World Wildlife Fund Canada*

World Wildlife Fund (WWF) Canada watershed health reports include four indicators, one of which relates to benthic macroinvertebrates. Most of the data used comes from groups who use the CABIN protocol. WWF reports also include recommendations about how fresh water management could be modernized. The recommendations include things like the need for more consistency around monitoring and analysis protocols, and on how we share data. Community based water monitoring (CBWM) groups could and should play a bigger role in the management of our freshwater resources. By working with CBWM groups from across the country we can not only ensure that they have the resources to play a more valued role in managing fresh water, but we can also work towards addressing the data deficiencies identified through watershed reports, all the while using a nationally standardized protocol like CABIN. WWF and Living Lakes Canada (LLC) have partnered with the University of Guelph and ECCC to advance CBWM group contributions to watershed health through the STREAM DNA metabarcoding project. LLC facilitates collaboration in education, monitoring, restoration and policy development initiatives for the long-term protection of Canada's lakes, rivers, wetlands and watersheds and has led water stewardship initiatives for over two decades. LLC's approach to deliver training in watersheds is based on community needs and requests. LLC recently delivered CABIN training to NGOs and First Nations in BC's Sunshine Coast, Fort St. John, Skeena Region, Columbia Basin, as well as Canmore, AB and Sudbury, ON.

## **Sharing community-based monitoring data**

*Lindsay Day, Coordinator DataStream*

*Gordon Foundation*

The Gordon Foundation is a philanthropic foundation that has been working in the area of water protection for several decades. They have led the development of DataStream, an open-access online platform to facilitate the sharing of water data. Communities are keenly interested in the health of their water and want to protect it because water is life. Important information can be gained from sampling and collecting data and visualizing that data. Water and wildlife are not confined by jurisdictional boundaries; sharing data is important for a better understanding of the health of the environment. DataStream operates on the FAIR principle: Findable, Accessible, Interoperable, Reusable data. DataStream collaborates with regional partners in the Mackenzie basin, Lake Winnipeg watershed, and Atlantic Canada. The most data and the most user accounts come from Community Based Monitoring. Anyone in the Mackenzie River basin interested in achieving the goal of ensuring that the water is safe to drink and the fish are safe to eat can use shared data through the Mackenzie DataStream. The goal is to promote knowledge sharing and advance collaborative water stewardship.

## **Development of triggers for adapting a monitoring program**

*Kelly Munkittrick, Executive Director*

*Cold Regions and Water Initiatives, Wilfrid Laurier University*

Monitoring is usually conducted to identify impacts, to look for change, to establish a baseline for future comparison, or to look for the causes of impacts. Monitoring is useful for 'when' and 'where' questions but harder to answer 'how', 'why', or 'what' questions. How much change is needed before it is considered a change? When does it influence management decisions? When does it indicate something unusual that should be investigated in order to be understood? Tracking change means determining if the change is expected, stable, and acceptable. A tiered and triggered adaptive monitoring approach will allow for wise investments and focused efforts.

## **Session 6: New Direction for the CABIN program**

### **Data Management and Open Data: Using the CABIN Web Application to Minimize Effort and Maximize Integration**

*Tim Pascoe, CABIN Regional Lead*

*Fresh Water Quality Monitoring and Surveillance, Hudson Bay & Great Lakes, ECCO*

While small projects can be successfully managed with a simple Excel file or two, by its very nature benthic biomonitoring can quickly exceed the realistic capacity of a file-based approach. Data entry, management, and quality control can quickly become unmanageable, leading to errors and inconsistencies in data. The CABIN web application addresses two key data issues in biomonitoring, highlighting the benefits of network participation. First, members can use the system to manage, analyze, and extract biomonitoring data from multiple field projects with very little effort. More importantly however, participation in CABIN provides access to data collected

by other CABIN members. This access allows users to leverage a significantly larger biomonitoring data set than could typically be collected by a single group. With a global move towards open data, due to its many benefits, the Government of Canada has adopted an 'Open by Default' stance to data release. CABIN is moving towards this approach for the next fiscal year, with the aim of expanding the usage of our data to improve and grow benthic biomonitoring in Canada. The current and new data sharing agreements were compared and database permissions related to existing data and new data were discussed.

### **New Protocol Developments and CABIN Approaches: Wetlands and Large Rivers**

*Emily McIvor, CABIN National Team member*

*Fresh Water Quality Monitoring and Surveillance, Pacific-Arctic-Athabasca Watershed, ECCC*

One of the roles of the CABIN National Team and its subgroups is to update existing protocols and, as needed and feasible, develop new CABIN protocols and approaches to expand standardized sampling into new aquatic habitats. In May of 2019, the newest protocol - CABIN Wetlands - was launched with online modules and a field practicum. The CABIN Wetlands protocol uses a sweep sampling technique in the aquatic vegetation to collect macroinvertebrates. More recently, an approach to sampling large rivers is also being developed. Questions from CABIN users were being asked regarding how to assess rivers, some very large, where appropriate reference sites cannot be found and, thus, a reference model is not available/or may not be developed. For these situations, the CABIN National Team is looking into a modified approach rather than a new protocol. Currently, this large river approach uses a standard CABIN kick(s) with alternative study designs to collect macroinvertebrates in the cobble/gravel substrates. These new protocols and approaches are to help expand CABIN sampling across the country in areas where traditional small stream sampling is not possible.

### **Expanding our horizons with DNA metabarcoding**

*Donald Baird, Research Scientist*

*ECCC*

This is a presentation of what we are doing with new data that are generated from metabarcoding techniques. We observe things in nature through different ways. We can observe nature through a microscope or through a DNA sequencer. It is analogous to how western science and traditional knowledge are different ways of observing nature. There is no right or wrong way – just different ways. New techniques with a DNA sequencer has allowed us to observe data in a new way. In comparing DNA and visual microscope observation there are things we see in each method that we don't see in the other – neither method is identical to the other or even better than the other. Using the Peace-Athabasca Delta work as a case study for the use of a DNA sequencer, we have shown the ability to detect a level of change even with a small number of sites. Currently we are using pattern matching & Artificial Intelligence techniques with observational data methods to build macroinvertebrate food webs and deriving new metrics. There is a lot of progress in this field of work and more to present in 2020.

## **STREAM: Sequencing The Rivers for Environmental Assessment and Monitoring**

*Chloe Robinson, Coordinator*

*STREAM, University of Guelph*

Despite the global importance of fresh water ecosystems, many are under threat and currently there is lack of an effective technique to monitor their health status. The STREAM (Sequencing The Rivers for Environmental Assessment and Monitoring) project aims to validate and implement DNA metabarcoding as a mainstream approach to assessing macroinvertebrate communities for river health. Implementing this approach, STREAM expects to:

1. educate and train communities of citizen scientists,
2. provide a timely capacity improvement for data generation and reporting ( $\leq 2$  months as opposed to current 8-12 months), and
3. improve the taxonomic resolution and ecological diagnostic power via metabarcoding data.

To date, STREAM has engaged over 10 community groups and collected close to 500 samples in the first year of the project. Going forward, the STREAM project aims to engage additional community groups, especially in data deficient areas such as the Northwest Territories, to gain a better understanding of fresh water health across Canada.

## Closing Remarks

*Kristie Trainor, Manager*

*Fresh Water Quality Monitoring and Surveillance, Pacific-Arctic-Athabasca Watershed, ECCC*

Throughout the many discussions we've had over the past two days, some common themes have resonated:

- Science in the north, for the north, by the north
- Importance of connection between youth and Elders for knowledge sharing
- Need for collaboration and relationship building
  - "Water connects all of us"
  - Importance of meeting with communities and coming out on the land
  - Monitoring that is community-led gives ownership to communities; outside scientists and researchers working in the north need to remember the OCAP® principles of Ownership, Control, Access and Possession with respect to data and Traditional Knowledge.

So much work is already underway. At the Water Stewardship Strategy workshop earlier this week, the Deputy Minister for GNWT Department of Environment and Natural Resources, Dr. Joe Dragon, made a comment about "many collective voices in the conversation". I see a place for CABIN as one of the connecting threads between the many groups that are part of that conversation.

**Closing ceremony: Dene drummers Closing Prayer Song**

## Interactive Discussion Summaries

Following each of the six themed presentation sessions, time was dedicated for participants to interact and discuss. The following summarizes four common themes from those discussions that arose in relation to CABIN and its application in the North.

### Improving CABIN involvement in the North

The first step in improving CABIN involvement in the North is connection. This CABIN forum was a good opportunity to initiate that connection and start the conversation about what collaboration and involvement with northern Indigenous communities could look like.

Involvement with Indigenous communities in relation to biomonitoring is important as many already spend time on the land and are therefore in a good position to conduct this type of monitoring. Training is the next step, which is both a key component to CABIN and how the sampling protocol is shared. Forum participants suggested that CABIN trainers may have to shift their traditional training model. Trainers should get out on the land with the community members to provide this training and to do the sampling side-by-side, as opposed to a short-term training in a central location away from participants' communities. This would also support more focus on building and maintaining relationships over the longer-term in relation to CABIN and northern Indigenous communities.

### Biomonitoring in the North

Arctic biological communities are unique. Climate change is being felt strongly in the North, and its effects will change aquatic benthic communities too. Climate change may result in increased aquatic species diversity, with southern species migrating to the north.

While this sounds "good", it is not natural and what is being lost is the uniqueness of the North. Current Ecological Integrity monitoring in the Western Arctic Parks is focused on gathering baseline data and monitoring for change. There would be value in incorporating metrics specifically related to baseline and climate change into CABIN monitoring. Further consideration is needed to figure out what those metrics would be. For example, there have been issues with permafrost slumps throughout the North, which could be one impact consideration in choosing metrics related to climate change.

### Connecting Western Science and Traditional Knowledge

Another consideration for CABIN is connecting western science-based ecological perspectives and traditional knowledge. Connecting these two types of information can assist and strengthen the understanding of northern aquatic ecosystems

From the onset of any research program, including CABIN, researchers who are working with Indigenous communities need to include community members and their knowledge, if shared. For example, talk to the Elders, the traditional knowledge holders and others who have lived and worked on the land and know it. They have seen how things are changing. In addition to witnessing change, traditional knowledge often provides the baseline/historical data in more remote places where it otherwise may not exist. Engagement with Indigenous communities early



on can also facilitate better understanding between researchers and communities. If the Elders have questions for the scientists, this gives them a chance to ask.

Another important consideration in connecting both western science and traditional knowledge, is to respect one another's science. Challenges still exist regarding the use and recording of traditional knowledge. Traditional knowledge is people's stories; it is a holistic knowledge and cannot be reduced to numbers stored in a database, as can be the approach with western science. It is also personal history, and there is an ownership to that – there needs to be an understanding and reassurance as to how and where this knowledge will be recorded, used and disseminated. Attribution is an important issue in relation to traditional knowledge that needs to be addressed. In that regard, the Principles of OCAP® (Ownership, Control, Access, and Possession) must apply.

### The Importance of Relationships

Related to the above theme, relationships are the key for a successful community-driven monitoring program. This includes relationships between Indigenous community members and researchers/trainers etc. coming into the community, but also among the community members who want to be involved. On-the-Land Camps provide an example of a successful relationship-building strategy, between youth and Elders, and between researchers and Indigenous community members. They build on relationships that may already exist and they aim to maintain relationships into the future. A group of community members that trains and grows together can form stronger relationships and increase the chances of long-term success. This is an important consideration for the CABIN program and biomonitoring in the North.

## Summary and Moving Forward

In this 5<sup>th</sup> CABIN Forum, with the theme local community engagement, participants representing a variety of perspectives (see Appendix 1) and sharing a common interest in northern fresh water environments and biomonitoring started on a path of collaboration.

The presentations, discussion and sharing met the forum objectives of supporting participants' interaction, collaboration and information sharing, while improving understanding of how CABIN is or can be applied in northern environments for the protection of fresh water ecosystem health. Common discussion themes further outlined considerations for the CABIN program moving forward in the North including shifts in how CABIN information and training is shared, the uniqueness of the northern aquatic environments and the environmental pressures faced, the importance of relationships and opportunity in bringing together traditional ecological knowledge and western science in relation to aquatic biomonitoring.

The ECCC CABIN National team and other participants across the country indicated that this forum brought them a broader awareness of the needs of the North, the monitoring activities of Indigenous communities and an acknowledgement of a need to build relationships with northern Indigenous communities. The experiences and information shared will contribute to improving understanding of northern aquatic ecosystem health, and identification of where CABIN training could be delivered in the North in a meaningful way.

The CABIN National Team is encouraged by the number of email addresses left by participants with an interest in CABIN training and/or the co-development of a Northern Biomonitoring Plan. Over the coming months and years, these contacts will help CABIN to create a path forward towards understanding, conserving and protecting ecosystem health in the North, alongside the Indigenous communities who live in the North.

If you want to be involved in the co-development of a Northern Biomonitoring Plan,  
please contact: [EC.CABIN.EC@canada.ca](mailto:EC.CABIN.EC@canada.ca)

## Appendix 1: Participant Feedback and Forum Participation

Feedback from participants indicated that the forum met or exceeded expectations. While there were technical difficulties with the webinar on Day 1, these were resolved and the feedback about the webinar broadcast on Day 2 was very positive. Future forums will consider successes and lessons learned from this biennial forum, considering the importance of regional engagement, the importance of connecting the network, and providing opportunities for program improvement, collaboration and scientific updates.

A total of 115 people participated in the 2019 CABIN forum in Yellowknife; 75 people in-person and 40 people via webinar (WebEx). The following organizations were represented:

<b>In person attendance</b>	
Government of Northwest Territories	Deninu K'ue First Nation
Parks Canada	Łútsël K'é First Nation
British Columbia Ministry of Environment and Climate Change Strategy	North Slave Métis Alliance
Environment and Climate Change Canada	Inuvialuit Regional Corporation
Mackenzie River Basin Board	Smith Landing First Nation
Nunavut Water Board	NWT Métis Nation
Inuvialuit Water Board	Tłıchų Government
Biologica Environmental Services	Dehcho First Nations
Living Lakes Canada	K'átł'odeeche First Nation
World Wildlife Fund Canada	Yellowknives Dene First Nation
Nature United	Wilfrid Laurier University
Ducks Unlimited	University of New Brunswick
The Gordon Foundation	University of Guelph
Canadian Rivers Institute	
<b>Web-Ex Participation</b>	
Department of Fisheries and Oceans (YK)	Minnow Environmental
Government of Newfoundland and Labrador	Stewardship Association of Municipalities (NL)
Province of Prince Edward Island	Keystone Environmental
Government of Yukon	BC Conservation Foundation
Parks Canada (MB)	Kerr Wood Leidal
Environment and Climate Change Canada	North/South Consultants
Government of New Brunswick	Echo Ecological
BC Ministry of Forest Lands Natural Resource Operations and Rural Development	Miramichi River Environmental Assessment Committee
Ontario Ministry of Natural Resources and Forestry	Ministère de l'Environnement et de la Lutte contre les changements climatiques du Québec
Fort Nelson First Nation	Ontario Tech University
EcoAnalysts	LimnoLogic Solutions
Biologica Environmental Services	Seine-Rat River Conservation District (MB)
Cordillera Consulting	BBA (BC)
Integrated Ecological Research	EDI Environmental Dynamics
Department of National Defense (NB)	Fish-Kissing Weasels Environmental
Royal Military College	Water First

The forum registration included two questions to gather information about forum participants, about their familiarity with environmental monitoring and specifically their familiarity with CABIN.

Most participants were very familiar with environmental monitoring and CABIN. The results presented below are based on the responses received from registrants.

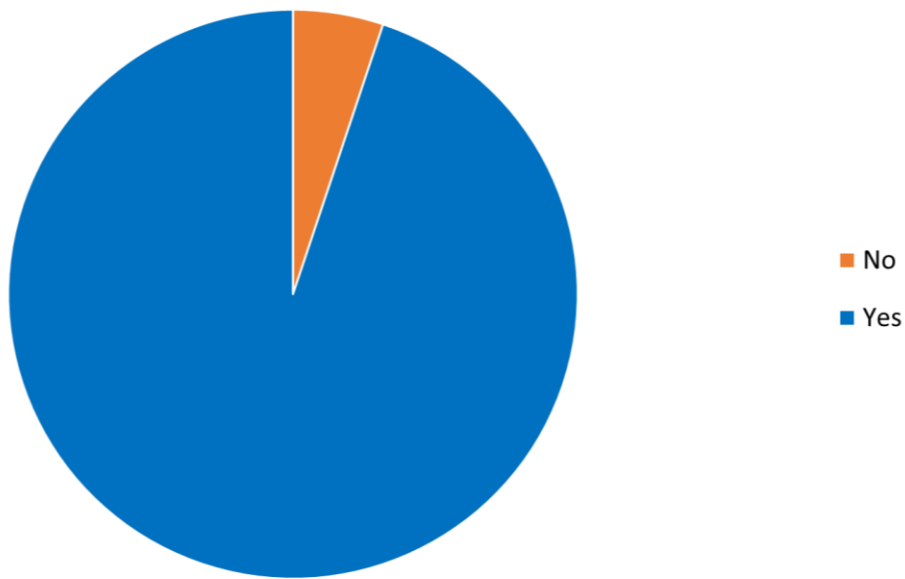


Figure 1: Proportion of forum registrants who indicated that they have been involved in environmental monitoring.

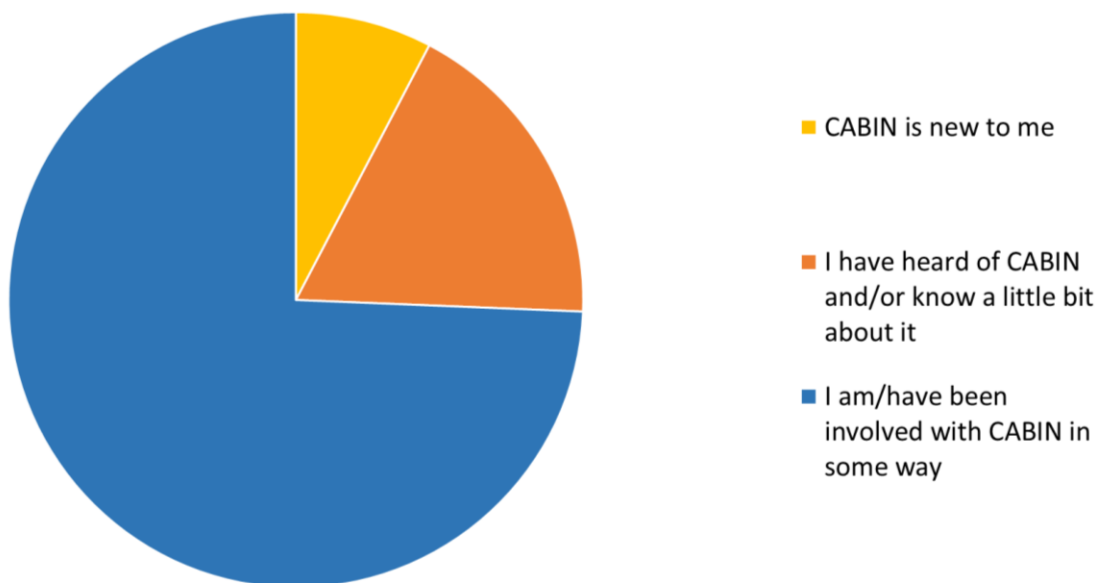


Figure 2: Proportion of forum registrant who identified their level of familiarity with CABIN.