



Environment and
Climate Change Canada

Environnement et
Changement climatique Canada

NATIONAL CABIN SCIENCE FORUM 2017

AGENDA AND ABSTRACTS

February 28 - March 1, 2017
Edmonton, Alberta



Canada 

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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 inter-agency 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 partners to take their observations and make a formalized scientific assessment using nationally comparable standards.

With the aim of engaging CABIN stakeholders from organizations across the country, ECCC's CABIN team partnered with and Alberta Environment and Parks (AEP) to host the fourth CABIN Science Forum in Edmonton, Alberta from February 28 to March 1, 2017. Previous CABIN Science Forums have been held in Vancouver, BC (2010), Fredericton, NB (2012), and Guelph, ON (2014) and have brought together CABIN users from a variety of sectors (i.e. forestry, mining, and agriculture), government agencies, academia, and community watershed programs (see Appendix for participant information). The objectives of the Science Forum were to:

To provide an opportunity for network users to learn about different applications of CABIN in a variety of sectors, successes and challenges, scientific advancements and the future directions of the program.

To provide a forum for users to interact and collaborate with other members of the network.

To provide an opportunity for information exchange and collaboration among CABIN users and the Environment Canada CABIN team, to address user needs.

The 2017 Forum opened with two plenary presentations followed by 29 platform presentations by various CABIN users which spanned eight topical sessions including large-scale applications of CABIN, CABIN biomonitoring activities in the prairies, and future considerations for CABIN. Interactive discussions were held during each session and both presentations and discussions were streamed over the internet to enable participants to interact remotely.

ACRONYMS

AAFC - Agriculture and Agri-Food Canada
AEP - Alberta Environment and Parks
AUSRIVAS - Australian River Assessment System
BMI - Benthic Macroinvertebrates
BCMoE - British Columbia Ministry of Environment
CABIN - Canadian Aquatic Biomonitoring Network
CFIA - Canadian Food Inspection Agency
CIMP - Cumulative Impact Monitoring Program
DFO - Department of Fisheries and Oceans
ECCC - Environment and Climate Change Canada
EPT - Ephemeroptera Plecoptera and Tricoptera
EROD - Ethoxyresorufin-O-deethylase
FIRNNO - The Freshwater Invertebrate Reference Network of Northern Ontario
GRDI - Genomics Research and Development Initiative
GIS - Geographic information systems
GHOST - Golden Horn Office of Science and Technology
JOSM - Joint Oil Sands Monitoring
LAR - Lower Athabasca River
LPTL - Lowest Practical Taxonomic Level
NWT - North West Territories
NRC - National Research Council
NRCan - National Resources Canada
OS - Oil Sands
PAC - Polyaromatic Compound
PHAC - Public Health Agency of Canada
RCA - Reference Condition Approach
RIVPACS - River Invertebrate Prediction and Classification System
SADI - Semantic Automatic Discovery and Integration
UINR - Unama'ki Institute of Natural Resources
WWF - World Wildlife Fund

AGENDA

Tuesday February 28, 2017

Session 1: Plenary

- 8:30 Welcome/Introduction – Garry Scrimgeour (AEP), Michelle Hiltz (InnoTech Alberta), Laura Maclean (ECCC)
- 8:45 The Once and Future Reference Condition - Trefor Reynoldson (GHOST Consulting)
- 9:30 Assessment of Biological Condition: Lower Athabasca River Tributaries and Mainstem – Robert Brua (ECCC)
- 10:15 BREAK (30 min)

Session 2: CABIN overview and national perspective

- 10:45 CABIN: An overview and national perspective - Stephanie Strachan (ECCC)
- 11:00 A Demonstration of the CABIN Online Tools: Saving time...and your data – Tim Pascoe (ECCC)
- 11:15 CABIN Bioassessment model development and evaluation: current framework and future directions- Lee Grapentine (ECCC)
- 11:30 Interactive Discussion (30 min)
- 12:00 LUNCH BREAK (90 min)

Session 3: Biomonitoring in the Natural Resources Sector

- 13:30 The use of CABIN to establish baseline environmental conditions in Ontario's Far North: A case study - Nicole Novodvorsky (Laurentian University)
- 13:45 The use of CABIN to establish baseline condition and assess the effects of Shale Gas extraction in northeast BC - Stephanie Strachan (ECCC)
- 14:00 Patterns of Stream Invertebrate Communities in Reference Areas within the Alberta Oil Sands Region - Nancy Glozier (ECCC)
- 14:15 Applying the Reference Condition Approach for Monitoring Reclamation Areas in the Athabasca Oil Sands Region – Jan Ciborowski (University of Windsor)
- 14:30 Interactive Discussion (15 min)
- 14:45 BREAK (30 min)

Session 4: Large Scale Applications of CABIN

- 15:15 Application of province wide CABIN monitoring by British Columbia Ministry of Environment - Jolene Raggett (BC Ministry of Environment)
- 15:30 CABIN monitoring in National Parks in Alberta and British Columbia for monitoring ecological integrity and management effectiveness - Shelley Humphries (Parks Canada)
- 15:45 Towards using CABIN for decision making in the NWT - Julian Kanigan (NWT Cumulative Impact Monitoring Program)
- 16:00 WWF-Canada Watershed Reports: Creating a National Assessment of the Health of and Threats to Canada's Rivers - Catherine Paquette (World Wildlife Fund)
- 16:15 Interactive Discussion (15 min)
- 16:30 Adjourn for the day & informal gathering at LOCAL Public Eatery, South Edmonton Common, 1820 99 St NW, Edmonton

Wednesday March 1, 2017

8:45 Welcome/Introduction Day 2 and review of Day 1 - Garry Scrimgeour (AEP)

Session 5: CABIN User applications

- 9:00 CABIN in a First Nations Natural Resource Context: Building Capacity for Stream Assessment in Unama'ki (Cape Breton), Nova Scotia - Emma Garden (Unama'ki Institute of Natural Resources)
- 9:15 A Citizen Science Approach to CABIN: Case Studies in the Columbia and Athabasca Watersheds - Heather Leschied (Living Lakes)/ Donna Mendelsohn (Upper Athabasca Community Based Monitoring)
- 9:30 The Impacts of Recent Wildfires on Northern Stream Communities - Caitlin Garner (Brock University)
- 9:45 CABIN Training and Sampling with communities to address specific local concerns – Examples from Hay River Area - Nancy Glozier (ECCC)
- 10:00 Interactive Discussion (15 min)
- 10:15 BREAK (30 min)

Session 6: Biomonitoring in the Prairies

- 10:45 Backwater Buggin' for Healthy Waterways in Manitoba - Dorteia Gregoire (Seine-Rat River Conservation District)
- 11:00 Saskatchewan Condition Assessment of Lotic Ecosystems: a multivariate tool for assessing the integrity of Northern Great Plains rivers and streams - Iain Phillips (University of Saskatchewan)
- 11:15 Prairie Stream Bioassessment: Going Beyond Bugs - Adam Yates (University of Western Ontario)/Bob Brua (ECCC)
- 11:30 Deriving Nutrient Objectives for Agricultural Streams in Alberta using Algal Bioassessments - Greg Piorkowski (Alberta Agriculture and Forestry)
- 11:45 Interactive Discussion (15 min)
- 12:00 LUNCH BREAK (90 min)

Session 7: Future considerations for CABIN

- 13:30 GIS in CABIN: Applications and Considerations - Adam Yates (University of Western Ontario)
- 13:45 CABIN and DNA-based biomonitoring: are we there yet? - Donald Baird (ECCC)
- 14:00 Untangling food webs using DNA and text-mining: New tools for biomonitoring? - Zacchaeus Compson (University of New Brunswick)
- 14:15 Interactive Discussion (30 min)
- 14:45 BREAK (30 min)

Session 8: Operational considerations

- 15:15 Implications of whirling disease to in-stream work - Fonya Irvine (Parks)
- 15:30 Habitat-specific effects of taxonomic sufficiency on detecting environmental change in larger rivers - Bob Brua (ECCC)
- 15:45 CABIN Does Wetlands: Status and application of a rapid biomonitoring protocol for Canada's weedy waters - Colin Curry (UNB)
- 16:00 CABIN – Embracing Innovation: How Far and How Fast? - Laura Maclean (ECCC)
- 16:15 Interactive Discussion / Wrap Up (30 min)
- 16:45 Adjourn

PRESENTATIONS

Session 1: Plenary

Welcome and CABIN updates

Laura Maclean (Environment and Climate Change Canada)

Michelle Hiltz (InnoTech Alberta)

Garry Scrimgeour (Alberta Environment and Parks)

The Once and Future Reference Condition

Trefor Reynoldson (GHOST Consulting)

The reference condition approach evolved from the application of multivariate statistics to problems with environmental assessment of ecosystem condition. Traditional methods were very much based on univariate laboratory experimental design with control and exposure to treatment. However, this approach did not incorporate the multivariate reality of real world conditions. Beginning in the 1970s and 80s well tested methods became available for addressing the complexity of natural environmental variability, culminating in national biomonitoring schemes in the United Kingdom. These methods were adopted initially to address environmental concerns with contaminated sediment in the Great Lakes and then for developing a biomonitoring programme for the Fraser River catchment. The reference condition approach provides a scientifically tested and rigorous predictive framework for assessing aquatic ecosystem condition, and could be used to provide restoration targets as well as in developing scenarios that predict response to environmental disturbance. Finally some of the current research questions for this approach were identified.

Assessment of Biological Condition: Lower Athabasca River Tributaries and Mainstem

Bob Brua (Environment and Climate Change Canada)

Joint Oil Sands Monitoring (JOSM) investigations for benthos and fish in the Lower Athabasca River (LAR) tributary, mainstem, and deltaic ecosystems evaluated the efficacy of Phase 2 Integrated Monitoring Plan designs for fish and benthos. The principal bioassessment questions included determining the status and trends of the biota and investigating potential linkages between biological pattern and environmental drivers at reference sites inside and outside the Oil Sand (OS) deposit that were upstream of OS development and at sites downstream of the deposit and development. While fish health was generally good in the tributaries and mainstem, slimy sculpin in tributaries exhibited consistent changes in fish health between reference and exposure sites within the OS deposit. These downstream responses are indicative of exposure to inducing compounds as EROD (Ethoxyresorufin-O-deethylase) activity and were associated with PAC body burden. Toxicity information suggests that sediments are the source of the elevated PACs in the water column, but further research is required to determine whether this increase is associated with development. In the mainstem, white sucker sampled below Fort McMurray showed a pattern indicative of nutrient enrichment: fish were older and longer, and had increased condition and internal fat store than reference fish. Benthic assemblages largely exhibited good ecological condition with high abundance of intolerant mayfly, stonefly and caddisfly taxa. In tributaries there was no significant difference between reference sites located outside of the OS region compared to those within the natural deposit, however, benthic assemblages in areas with an increased industrial footprint were mildly divergent from reference sites. In the LAR mainstem, assemblages in middle river reaches exposed to municipal sewage effluent and potential stressors from OS development had higher abundances of tolerant taxa. Benthos considerably downstream of the middle reaches shifted back

towards upstream reference communities. Delta benthic assemblages appear to be in a healthy state, exhibit high biodiversity, and strong seasonal and spatial variability of richness and composition. In summary, fish and benthos bioassessments indicate that LAR aquatic ecosystems are generally in good ecological condition but there are early warning signals that biotic change may be occurring in the OS region. Future assessment would benefit from a focus on determining the combined effects of nutrient enrichment and OS development as their cumulative effect has the potential to change biotic condition in LAR aquatic ecosystems.

Session 2: CABIN overview and national perspective

CABIN: An overview and national perspective

Stephanie Strachan (Environment and Climate Change Canada)

The Canadian Aquatic Biomonitoring Network (CABIN) is lead and maintained by Environment and Climate Change Canada (ECCC) and is based on a network-of-networks. CABIN began as federal research projects in the early 1990s and grew into a national standardized approach to biological monitoring and assessment promoting the use of shared data and bringing the benefits of online tools and resources. This presentation provided an overview of the “behind the scenes” maintenance structure for CABIN. The growth, current status and the value of client feedback to ongoing improvements to CABIN was discussed.

A demonstration of the CABIN online tools; saving time...and your data

Tim Pascoe (Environment and Climate Change Canada)

In any project, there comes a time when data management and analysis needs must be addressed. While small projects can sometimes be 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. Key components of CABIN are the data management and analysis tools provided via the web. An overview of the on-line system was given, including how information is structured, how data can be added and edited on-line, and what safeguards are taken to ensure consistent, accurate information. The various analytical and reporting options was showcased.

CABIN Bioassessment model development and evaluation: current framework and future directions

Lee Grapentine (Environment and Climate Change Canada)

The CABIN program provides guidance and analytical support for the development of area-specific bioassessment models based on benthic invertebrate and habitat data collected using a Reference Condition Approach sampling design. For the standard model, reference site benthic community data are classified into groups by cluster analysis and then related to natural habitat variables by discriminant function analysis. These relationships are then used to select the reference site group most similar to the test site based on habitat conditions for assessing the test site. Guidelines for the statistical procedures, documentation, and evaluation of model performance are available from the CABIN Science Team, which also reviews the model report. With the advancement of statistical and bioassessment procedures since the development of the standard model in the early 1990s, the Science Team is reviewing model structure and performance, focusing on several topics. These include the cluster analysis of benthic community data, statistical confidence and power, data quality, use of habitat variables, and repeated site

observations. Revisions to the bioassessment procedures, including alternate statistical methods, further QA/QC implementation, additional guidelines for the use of habitat variables (including GIS data), and modelling of temporal variation are being evaluated for possible implementation to enhance the relevance and performance of CABIN bioassessments.

Session 3: Biomonitoring in the natural resources sector

The use of CABIN to establish baseline environmental conditions in Ontario's Far North: A case study

Nicole Novodvorsky (Laurentian University)

The Ring of Fire Belt is a mineral development opportunity with the potential for nickel, copper, and platinum production as well as world-class chromite. Understanding baseline environmental conditions in the face of this potential development is important to detect impacts and monitor changing conditions. As part of the Freshwater Invertebrate Research Network of Northern Ontario (FIRNNO) programme, a network of stream reference sites was established in the Ring of Fire Belt following the CABIN field and laboratory protocols. This presentation focused on stream sampling efforts since 2013 and the application of these data to the development of CABIN models and student research projects. The importance of CABIN training and our collaborations and partnerships with government, universities, and First Nations groups was discussed.

The use of CABIN to establish baseline condition and assess the effects of Shale Gas extraction in northeast BC

Stephanie Strachan (Environment and Climate Change Canada)

The Petitot, Fort Nelson and Hay River basins, overlay the Horn River Basin, a deep shale formation underlying part of northeastern British Columbia and extending into the Northwest Territories, Canada. Although remote, this area is under considerable pressure from shale gas exploration and production. Recent estimates of gas reserves in this deposit place it among the largest sources in North America. Baseline water quality information from this northern riverine environment were established from which potential change in the aquatic environment can be measured. The results from the benthic macroinvertebrate monitoring component will be presented. The reference condition assessment model was described and the results of sites exposed to potential impacts of shale gas industry operations were presented.

Patterns of stream invertebrate communities in reference areas within the Alberta Oil Sands region

Nancy Glozier (Environment and Climate Change Canada)

Benthic invertebrate sampling in streams near the Oils Sands area of Northern Alberta began in the 1970's. Recent scientific reviews made recommendations to increase the ability to assess environmental impacts. In 2012 the Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring set out a phased, monitoring plan covering a range of components from water and air quality, to wildlife toxicity, biodiversity and aquatic ecosystem health. A key objective for aquatic ecosystem health was to improve the understanding of benthic community structure in local reference streams and rivers. In samples collected between 2011-2014, from over 50 reference sites, invertebrate communities were diverse, and consisted of typical erosional benthic taxa (EPT). Communities were similar within a river, and differences were linked to substrate, flow and algal primary production. Preliminary, multivariate analyses, reveal that

communities shifted further away from reference conditions as the proportion of disturbed area increased. Next steps will include determining the cause of these shifts as natural exposure to Oil Sands deposits and other changes in habitat may be contributing, at least in part, to these shifts.

Applying the Reference Condition Approach for monitoring reclamation areas in the Athabasca Oil Sands region

Jan Ciborowski (University of Windsor)

How do we quantify & evaluate condition?

- Identify both reference and degraded condition ranges of variation.
- Standards to designate locations as 'good' or 'bad'?
- Use biological condition indicators calibrated to anthropogenic disturb.
 - "Reference": areas of minimal disturbance;
 - "Degraded": deemed unacceptable by consensus, policy, or regulation.
- Assessment standards should be scaled to time since reclamation.
- How do we determine thresholds or transition points?
- Biological condition may be constrained rather than determined by disturbance.
- Assess patterns on the basis of boundaries (quantiles) rather than central moments (mean, median) of responses
- Biological responses may be gradual, or may exhibit multiple breakpoints (thresholds)
- Objective identification of disturbance thresholds can be conducive to identifying protection/restoration targets

Session 4: Large Scale Applications of CABIN

Application of province-wide CABIN monitoring by British Columbia Ministry of Environment

Jolene Raggett (British Columbia Ministry of Environment)

Recognizing the need for a consistent and scientifically defensible approach to biomonitoring, the BC Ministry of Environment (MoE) partnered with Environment Canada in 2007 to support and promote the use of the nationally standardized Canadian Aquatic Biomonitoring Network (CABIN) program in BC. Since this time, MoE has worked with project partners to collect data across the province to support the development of predictive models that encompass the major watersheds in BC. These models have been used by various levels of government, industry, stewardship groups, First Nations, and academic institutions to assess aquatic ecosystems and evaluate the effects of a wide range of land use activities. Going forward, there is strong potential to utilize BC's CABIN program to support important provincial government initiatives focussed on water resources.

CABIN monitoring in National Parks in Alberta and British Columbia for monitoring ecological integrity and management effectiveness.

Shelley Humphries (Parks Canada, Lake Louise, Yoho and Kootenay)

The mountain national parks of Canada are Yoho, Kootenay, Jasper, Banff, Waterton, Mt. Revelstoke and Glacier. These parks have been working collaboratively with Environment Canada and the CABIN program since 2006. Between 2007 and 2009 a reference collection was made across the seven parks. A predictive model was completed in 2011. We use this reference condition model to describe water quality for two main programs in the parks. Our condition monitoring program is based on a series

of measures and indicators and is intended to answer the general question about how each park is doing. Our management effectiveness program addresses site specific questions related primarily to human use and our park management.

Towards using CABIN for decision making in the Northwest Territories

Julian Kanigan (Government of Northwest Territories, Cumulative Impact Monitoring Program)

The Government of the Northwest Territories' Cumulative Impact Monitoring Program (NWT CIMP) is mandated to analyze cumulative impacts and environmental trends at a regional scale to provide information to regulators for better resource decision-making. Barriers to achieving our mandate include a broad and remote geographic scope and a lack of baseline information over large areas. Where monitoring is conducted, it is not often done in a standardized or consistent way. Given its interest in regional variability and cumulative impacts, NWT CIMP has used and promoted the Canadian Aquatic Biomonitoring Network protocol since 2009 in order to standardize data collection, analysis and reporting for aquatic health. In particular, NWT CIMP has used CABIN to assess the impacts of individual developments, the cumulative effects of natural and anthropogenic disturbances, and assemble regional baselines. To encourage an even broader set of data, NWT CIMP plans to promote CABIN with territorial regulators who can compel industry to monitor their project impacts. However, a complete suite of CABIN protocols would be required to make this a success, particularly for all sizes of lakes, wetlands, large rivers, and mud-bottom streams.

WWF-Canada Watershed Reports: Creating a national assessment of the health of and threats to Canada's rivers

Catherine Paquette (World Wildlife Foundation (WWF))

Since 2011, WWF-Canada has been working to complete the first national assessment of the country's rivers. Working with some of the country's leading freshwater scientists, WWF-Canada developed two assessment frameworks. The health assessment framework is based on four key indicators of river health, whereas the threats assessment framework is based on seven key stressors. These two assessment frameworks – collectively known as Watershed Reports – provide a consistent basis for evaluating the health of and threats to Canada's watersheds across the country.

To date, Watershed Reports have been completed for three quarters of Canada's 25 major watersheds, and a complete picture will be available in June, 2017. Based on the findings to date, Canada's watersheds are facing a series of significant threats, particularly pollution, habitat fragmentation and habitat loss. The results also reveal an even more troubling trend: there is a pronounced lack of available and accessible data in many watersheds across the country, including heavily populated ones like the Great Lakes and the St. Lawrence. With the assessment portion of the project reaching its conclusion, WWF-Canada's focus has turned to improving data availability and accessibility across the country while providing recommendations for a more open data monitoring model. Recommendations include increase in transparency and openness as well as linking smaller-scale community-based monitoring projects to larger, more regional databases.

Session 5: CABIN User applications

CABIN in a First Nations natural resource context: Building capacity for stream assessment in Unama'ki (Cape Breton), Nova Scotia

Emma Garden (Unama'ki Institute of Natural Resources)

As representatives of the five Mi'kmaw communities of Unama'ki (Cape Breton), the Unama'ki Institute of Natural Resources (UINR) strives to implement research programs that contribute to a culturally relevant understanding of its' environment. This involves blending western science and Mi'kmaq ecological knowledge in an approach called "Two-Eyed Seeing". As a western science method, CABIN offers an ecosystem-based tool that is compatible with the holistic Mi'kmaw view of the environment. Through CABIN and partnerships with Environment and Climate Change Canada, UINR has enhanced its internal research capacity and increased Mi'kmaq participation through training of staff and Aboriginal Fishery Guardians. UINR is now being sought out as a CABIN resource in Cape Breton, and has conducted sampling on behalf of angling groups and delivered a CABIN workshop to local Mi'kmaq natural resource students.

A Citizen Science approach to CABIN: Case studies in the Columbia and Athabasca watersheds Heather Leschied (Living Lakes) and Donna Mendelsohn (Upper Athabasca Community Based Monitoring)

Protecting and conserving Canada's lakes, rivers and wetlands are a top priority for water stewardship groups. These groups face many challenges developing and implementing monitoring plans that are appropriate for addressing concerns in their watersheds. Living Lakes Canada provides stewardship groups with the tools and training needed to conduct their own monitoring.

Using the CABIN protocol, Living Lakes Canada supports and trains groups, develops sampling plans, assists with data interpretation and implementing steps for appropriate action. Water stewardship groups gain access to the online database and analytical and report generating tools. CABIN also helps groups stay organized and focused, which leads to meaningful and credible water quality monitoring results.

This session focuses on three Community-Based Monitoring case studies: Flathead River, BC; Windermere Creek, a tributary of the Columbia River, BC; and, the Upper Athabasca, AB. These case studies have a variety of applications using citizen science; from supporting parks and protected area efforts to monitoring recovery following a flood event, and assessment of cumulative impacts from gravel mining, coal mining and other activities.

The impacts of recent wildfires on Northern stream communities Caitlin Garner (Brock University)

In northern Canada, aquatic ecosystems are valued for their cultural, economic, and environmental services. How these high-latitude ecosystems respond to more frequent and severe wildfires as a result of climate change requires further exploration. This study examines the impacts of recent (2014-16) wildfires on freshwater streams in the Dehcho and North Slave regions, Northwest Territories, through analysis of water chemistry and benthic macroinvertebrate assemblages. Macroinvertebrates and water samples were collected from burned stream catchments following the Canadian Aquatic Biomonitoring Network (CABIN) protocol. Water chemistry parameters and biological indices were compared to determine relationships between water quality and benthic macroinvertebrate diversity and abundance. Preliminary analyses suggest that wildfires cause perturbations to these streams which include increases in the abundance and diversity of stress-tolerant taxa, such as members of the dipteran family Chironomidae, and mollusk classes Bivalvia and Gastropoda. Burned streams were significantly less alkaline, and had higher levels of turbidity, total suspended solids, and dissolved metals such as arsenic and aluminum.

CABIN training and sampling with communities to address specific local concerns – examples from the Hay River area

Nancy Glozier (Environment and Climate Change Canada)

CABIN provides two types of training certification which are Field Assistant and Field Technician. Field Assistant provides training for sampling only and is delivered at some colleges as well as ECCC for community and First Nation groups. Field Assistants do not access online modules but may upgrade to Field Technician if they decide to complete within a certain time frame. A CABIN training course was held in the Hay River Area to certify Field Assistants and Field Technicians. The course was composed of First Nations, NGOs and other local Federal participants. Prior to the training local concerns were expressed regarding construction at two Rivers in the area. ECCC provided an opportunity for these newly trained participants to collect samples at these rivers. Despite the absence of a model in the Hay River area the data collected provided conclusive evidence that there had been no detrimental environmental effects.

Session 6: Biomonitoring in the Prairies

Backwater Buggin' for healthy waterways in Manitoba

Dorthea Gregoire (Seine-Rat River Conservation District)

Backwater Buggin' for Healthy Waterways is the latest effort by Seine-Rat River Conservation District (a charitable organization mandated to promote sustainable soil and water management through incentive based programming) to identify and address surface water quality issues in southeastern Manitoba. Through this project we engage local junior and high school students in assessing waterway health using CABIN protocols. Students are also creating a 'bug' library that will be used as an educational tool available throughout the region. Our goal is to collect information on the health of our waterways and to integrate local residents into the scientific process needed to address local water issues. Data collected during this project will be used by the Seine-Rat River Conservation District to help identify target areas for future program implementation.

Saskatchewan condition assessment of lotic ecosystems: a multivariate tool for assessing the integrity of Northern Great Plains rivers and streams

Iain Phillips (University of Saskatchewan)

The availability and quality of surface water in southern Saskatchewan is a key prerequisite for continued economic and population growth. To facilitate this expansion and development, tools for assessment of surface water quality are needed that go beyond classic water chemistry to provide a longer-term, more cumulative assessment of whole ecosystem health which are currently lacking. Here we present the ecosystem health measurement model developed at the Water Security Agency for surface waters. This ecosystem health tool is based on aquatic macroinvertebrate community composition, and sets site specific objectives using reference sites which are least-impacted by human activity. Based on a reference condition approach, we established criteria for least-human activity in 89 sites across southern Saskatchewan. The classification of reference sites using cluster analysis identify three biological groupings, distinguished by stream order and ecoregion. The communities are characterized primarily by chironomids, amphipods and *Caenis* sp. mayflies. Using this reference classification, it is now possible to use Test Site Analysis to compare sites to least impacted condition and identify site specific objectives. This multivariate ecosystem health tool is flexible in its construction, allowing continuing development to adapt to the stressors and requirements of the province as it grows.

Prairie stream bioassessment: going beyond bugs

Adam Yates (University of Western Ontario), Bob Brua (Environment and Climate Change Canada)

CABIN has traditionally relied on benthic macroinvertebrates (BMI) for assessments of river health. However, although composition of BMI communities provides useful information regarding the ecological structure of river ecosystems it provides limited insight into ecological processes. Monitoring of ecological processes is important as these functions provide many valuable ecosystem services such as water purification and nutrient cycling. The purpose of our presentation is twofold. First, to describe the benefits of incorporating indicators of ecological function in Canada's biomonitoring toolbox, and second to illustrate the effectiveness of these indicators using examples from research oriented assessments of Prairie streams in southern Manitoba. We focus on three functional indicators, stream metabolism, decomposition and metabolomics that can be rapidly adopted for large-scale assessments of river health. Described benefits include increased cost-effectiveness, more rapid response to stressors and greater geographic consistency. Inclusion of functional metrics in our national program will increase the power to detect change while also providing a more comprehensive assessment of river health.

Deriving nutrient objectives for agricultural streams in Alberta using algal bioassessments

Greg Piorkowski (Alberta Agriculture and Forestry)

Increasing agricultural intensity in prairie watersheds leads to nutrient enrichment in small streams that are tributaries to downstream rivers and lakes. Agricultural watershed management programs are continuously being applied across Alberta in an effort to mitigate non-point source nutrient pollution. However, establishing targets or measures of success for agricultural watershed management programs is difficult since little is known about the ecology of small prairie streams and what is considered suitable water quality. Most agricultural landscapes in the Parkland and Grassland ecoregions of Alberta are highly developed, resulting in a lack of reference or minimally impacted conditions, particularly for higher order streams that are often the outlet point of watershed management programs. Bioassessment approaches are being adapted to agricultural streams in an effort to set nutrient objectives based on stressor-response relationships. Pilot studies were performed to determine the most suitable bioassessment type. Aquatic macroinvertebrate sampling is better suited for agricultural landscapes in Foothill and Boreal ecoregions, but is challenging in Parkland and Grassland ecoregions where stream flows are lower and stream sediments are finer and enriched in organic detritus. Algal bioassessments, focusing on periphyton, were trialed and found to be suitable for determining algal community responses to nutrient concentrations, with floating periphyton samplers outperforming benthic periphyton samplers. Algal bioassessment methods are being employed in a large-scale stressor-response study applied to establish generalizable nutrient objectives for third- and fourth-order streams in the Parkland and Grassland ecoregions of Alberta.

Session 7: Future considerations for CABIN

GIS in CABIN: applications and considerations

Adam Yates (University of Western Ontario)

Geographic information systems (GIS) are powerful tools that allow rapid and detailed analysis of spatial data. Landscape data are routinely included in CABIN-based assessments for both site selection and site assessments. Key advantages of using GIS in CABIN include low cost of data collection, well established independence of landscape scale drivers from human effects and predictable relationships between landscape parameters and patterns of benthic macroinvertebrate community composition. However,

there are also several challenges associated with applying GIS data to CABIN including data availability, data resolution and data consistency across political boundaries. These advantages and challenges while advancing potential solutions were discussed prior to opening the floor for a brief discussion of challenges and solutions.

CABIN and DNA-based biomonitoring: are we there yet?

Donald Baird (Environment and Climate Change Canada)

CABIN scientists working with collaborators from the University of Guelph are pioneering the application of environmental DNA techniques both as a substitute and a complement to existing macroinvertebrate sample collection, enumeration and interpretation through a series of critical proofs-of-concept: These include the first description of macroinvertebrate composition from kick samples based only on bulk-extracted DNA, now termed 'metabarcoding', the first application of DNA bulk macroinvertebrate sample analysis at ecosystem scale (in the Peace-Athabasca Delta - linked to the Joint Canada-Alberta Oil Sands program) and the first application of DNA capture arrays to obtain quantitative estimates of relative composition within wetland benthos. Through the federal Genomics Research and Development Initiative (GRDI), we are now collaborating on a series of ecosystem projects in northern Alberta (Wood Buffalo National Park), in the St Lawrence River watershed and in rivers of Atlantic Canada, in collaboration with several other federal science departments (DFO, AAFC, NRCan, CFIA, PHAC, NRC, . In addition to bulk sample methods, we are also exploring the use of extracellular DNA from water samples as a proxy source of biomonitoring data both for CABIN assessments generally, and for surveillance of invasive species in the Red River.

Untangling food webs using DNA and text-mining: new tools for biomonitoring?

Zacchaeus Compson (University of New Brunswick)

Food webs require large amounts of data on community members and their measured associations. However, it is often difficult and expensive to determine this information because of sampling limitations and the high cost of training taxonomists. Recent advancements in genomics and computing provide new ways of overcoming these limitations. Using DNA to characterize aquatic communities is a sensitive technique that provides a standardized method of detection, but there is currently no way of extracting abundance and biomass data needed for food web analysis. Text-mining provides a way around this limitation, allowing trait data to be gathered for specific taxa across large databases. We used a scalable engine (Hydra, IPSNP Inc.) for semantic automatic discovery and integration (SADI) to query databases (e.g., Google Scholar, Web of Science) for missing data on benthic macroinvertebrate traits (e.g., trophic links, mean body size) that could not be gathered from existing food web databases. This allowed us to create heuristic food webs from taxa lists generated from DNA for two streams with different flow regimes that form the Peace-Athabasca Delta. We asked two questions. (1) How do food webs created using a traditional taxonomic approach (i.e., samples collected using the CABIN protocol) compare to food webs created from DNA? (2) How do food webs created using CABIN and DNA compare in terms of resolving differences in trophic structure (e.g., trophic height, linkage density) of two rivers draining into the Peace-Athabasca Delta? We discuss using DNA-generated food webs as a powerful tool for rapid bioassessment.

Session 8: Operational considerations

Implications of whirling disease to in-stream work

Fonya Irvine (Parks Canada, Banff National Park)

Proper decontamination of in-stream sampling gear and equipment is an effective measure for preventing the spread of aquatic invasive species, most notably *Myxobolus cerebralis*, the causative agent for whirling disease in salmonid fish. Many transmission pathways have been described for facilitating the spread of aquatic invasive species; however, the potential for researchers and contractors as vectors for dispersal have not been well documented in Canada. Researchers conducting in-stream work sometimes have to visit numerous sites in different watersheds thus increasing the risk of transferring aquatic invasive species to new areas. Mitigating the spread of whirling disease and other aquatic invasive species requires adherence to effective decontamination protocols for everyone conducting in-stream work.

Habitat-specific effects of taxonomic sufficiency on detecting environmental change in larger rivers

Bob Brua (Environment and Climate Change Canada)

Benthic macroinvertebrates (BMI) are used commonly by organizations to assess aquatic ecosystem health. There is considerable debate about the level of taxonomic resolution (taxonomic hierarchy; from genus to phylum) to apply in bioassessments. In addition, there has been little information regarding the taxonomic resolution needed to assess ecological change in large rivers or aquatic ecosystems with depauperate BMI assemblages. CABIN has traditionally relied on Family level taxonomy of benthic macroinvertebrates for assessments of river health. The objective of our presentation is to evaluate what level of taxonomic resolution is needed to detect environmental change among sites within habitats in the Athabasca River. BMI Taxonomic Richness was much lower in the sand habitats (61 taxa identified to lowest practical taxonomic level [LPTL]; mostly genus or species) than the cobble habitats (105 taxa) of the Athabasca River. In cobble habitats, sampling sites were equally distinguishable using LPTL or Family level BMI assemblages. However, Order level taxonomy was not as efficient in distinguishing among cobble sites in the Athabasca River. For sand habitats, only LPTL taxonomy was able to adequately discriminate among sampling sites. Sand habitats are dominated by midges and one genera of mayfly. Therefore, aggregation of the BMI assemblage into higher taxonomic levels, such as family or order, reduces the diversity in the BMI assemblage leading to an inability to adequately assess the variation in the BMI assemblage. These results have implications for sampling designs for ecological assessments of large rivers or rivers with depauperate BMI assemblages.

CABIN does wetlands: status and application of a rapid biomonitoring protocol for Canada's weedy waters

Colin Curry (University of New Brunswick)

Wetlands encompass a wide range of vegetated water bodies with complex hydrological dynamics. In Canada, wetlands are increasingly exposed to stressors from upstream resource development, and there is an urgent need for rapid biomonitoring tools that can detect and diagnose these impacts. The CABIN wetlands protocol uses a time-limited sample of the aquatic macroinvertebrate assemblage to characterize wetland biodiversity and serve as a basis for an assessment. To date the protocol has been applied in several diverse wetland systems (Peace-Athabasca Delta; St. Lawrence River wetlands; prairie pothole lakes). Identifying and measuring environmental parameters for wetlands, and the subsequent generation of assessment models represent the next steps in the development of the protocol. The vision for the wetland protocol includes the development of "extensions" for other taxa and more detailed measurement of environmental variables, particularly wetland hydrology. Emerging technologies, such as ecogenomics, can be adopted at an early stage to investigate multiple taxonomic groups and provide the increased taxonomic resolution needed for new assessment frameworks.

SUMMARY OF INTERACTIVE DISCUSSION SESSIONS

DAY 1 – February 28, 2017

Session 1: Plenary

A history of CABIN and how CABIN was created set the stage as the introduction to the forum. CABIN was modeled from several programs and research studies from around the globe, including those developed in the UK, the River Invertebrate Prediction and Classification System (RIVACS) and Australia, the Australian River Assessment System (AUSRIVAS). CABIN was proposed to Environment Canada in 1997-98 as a wadeable stream program and has grown to include large rivers and wetlands, and, in the past few years, CABIN has explored new data types such as GIS derived landscape data and DNA sequencing and has the potential to include modelling approaches to assess recovery or diagnose a problem. The take home message was; 'The RCA approach is rigorous and well tested and the National program has come a long way with so much promise with new technologies'.

CABIN has played a key role in the Alberta oil sands as part of Joint Oil Sands Monitoring (JOSM) to assess ecosystem health and cumulative effects. CABIN methods were used in the Athabasca River and surrounding tributaries. The mainstem CABIN methods were adapted for a large river and involved more kicknet samples than a small stream to account for the river's size. Assessment of biological condition in the oil sands involved ecosystem health, cumulative effects, status of fish and benthic communities. Although there is not an RCA developed for the oil sands region assessment has been in the form of comparing changes relative to historical data. As well as the effects of recent development using comparative studies within and outside of the geological oil sands areas. The details for JOSM can be found at the following link

<http://jointoilsandsmonitoring.ca/default.asp?n=D876B1A8-1&lang=en>

Session 2: CABIN overview and national perspective

CABIN continues to grow with more than 1000 trained users with almost half of those from consulting agencies and federal departments. The program started with 200 samples/year being entered into the database and has grown to 900 samples/year. Improvements to the program have been made from user feedback from previous science forums.

The new website was recently launched and some new features include bulk uploading capabilities. The online data management system has many advantages over spreadsheets especially as data are shared among users across regions. With more and more data generated for each sample site (i.e. water or sediment chemistry and GIS information), the bulk upload tool was necessary to ensure efficient data entry. We are working toward electronic field sheets and many other items identified by users.

There are now 15 reference condition assessment models across Canada for use in the CABIN website. A recent policy to review all models before upload to the website was made by the CABIN Science Team in 2015 and associated model documents to aid in interpretation are also provided on the CABIN website. Once reviewed, these models are tested for functionality and accuracy by ECCC. These steps were added as part of the quality assurance plan for CABIN. .

All new models make use of landscape level data. There are benefits to working with landscape level data: 1) it allows models to be constructed with historical databases, and 2) it is an economical way to

evaluate remote areas. However, difficulties deriving consistent landscape level data across political boundaries have proved challenging. The CABIN Team is working towards guidance for standardized GIS data using national layers whenever possible. Repeated site visits were shown to affect model performance but are critical to identify short term temporal variation. Landscape level climate data does not address the year to year variation observed at the site level.

The origins of CABIN developed in the Great Lakes then moved to streams and rivers. The development of an invertebrate wetlands protocol has been in progress for several years. The Wetland protocol is currently in the external review stage. The next steps include database application of wetlands data, analysis of assessment approaches for wetland invertebrate communities and training for wetland sampling. During the last few years in the Oil Sands region a new approach was used to sample the large Athabasca River mainstem and could have the potential to become a national protocol for large rivers with firm substrates. Large slow moving muddy bottom rivers continue to be a challenge. It is unlikely that muddy bottom rivers and streams would have a kick net sampling approach due to non-wadeable conditions.

Session 3: Biomonitoring in the Natural Resources Sector

ECCC is committed to expanding the collection of reference samples in areas of concern and potential risk. ECCC initiated a baseline water quality study (2012-2014) in northeast BC in an area affected by shale gas activity and is continuing this work in collaboration with BC Ministry of Environment. In this baseline study ECCC found that benthic communities were indicating environmental stress. Due to the extreme hydrological fluctuations during this short 3 year study, it is unclear if the effects were due to resource development or hydrological conditions. More work is needed to understand impacts of hydrology.

A collaborative invertebrate monitoring program between Ontario Ministry of Environment and Climate Change and Laurentian University has been ongoing in northern Ontario for many years. The area often referred to as the ring of fire (mining development area for chromite) is a remote, hard to access location, and this program investigated whether data collected from other regions could be useful to assess other areas with limited baseline information. They looked at the performance of predictive models for specific basins (i.e. Attawapiskat, Fraser and Yukon) versus a multi-basin model. The multi-basin model was similar to the single basin model in terms of classification rates but had higher Type 1 and Type 2 errors. Additional work is being done at Laurentian University with CABIN data looking at the implications of seasonal and ecozone differences to bioassessment between Hudson Bay lowlands and boreal shield. Another project focuses on temporal changes in benthos and water quality in an area recovering from mining impacts in Sudbury.

In northern Ontario, collaborations among academics, industry, First Nations and government are possible. Training First Nations groups to promote active participation in regional assessments should be a priority in remote locations.

Study designs for CABIN work in the oil sands resembled a gradient design more than a reference condition approach due to the unique geology of the area and how resource development has occurred on the landscape. Currently there is no RCA model for the oil sands area; multivariate statistics and biotic indexes have been used to compare the reference sites. Other oil sands studies included how to compare sites in a degraded continuum. This approach defines a reference degraded stressor pyramid using gradients in different stressors impacting the benthic community. This approach is also used to look at the reclamation of sites in the oil sands region.

Session 4: Large Scale Application of CABIN

BC Ministry of Environment (BCMoE) began using biomonitoring to evaluate effects of forestry in the Skeena River system with the first provincial model developed in 2007. Since then, the province has adopted CABIN as the provincial biomonitoring protocol and ecosystem indicator. ECCC and BCMOE have worked cooperatively to build reference condition models throughout the province. In the coming years after model coverage is complete around the province, BCMOE plans to shift their focus to less intense monitoring and toward keeping models up to date to apply in environmental assessments, cumulative effects assessment, and objectives development.

Parks Canada has 104 reference sites in BC and AB which contribute to two different models; the Mountain Parks RCA model used by Parks Canada and the Columbia/Okanagan model used by regional CABIN users in BC. Parks Canada has used CABIN for condition monitoring (status of Park) but also for management effectiveness assessment for recreation and wildlife management. Parks Canada will continue using CABIN in the coming years as it contributes to National Park Management Plans due in 2020 and to the State Of The Park due in 2018.

CABIN is expanding in the North. The Northwest Territories (NT) Cumulative Impact Monitoring Program (CIMP) is interested in effects at a regional scale and a holistic system for managing land and water. There are many challenges in the north: large rivers, remote location, little information, and lack of standardization. CIMP is using CABIN because of the standardization and the ability to share data among agencies. The government of NT is encouraging regulators to compel industry to adopt CABIN. The goal would be to use CABIN to share data, have accredited training, establish regional baselines, and conduct impact assessment.

DAY 2 – March 1, 2017

Session 5: CABIN User Applications

CABIN established a new Field Assistant level of certification for those interested in participating in the field sampling but not in accessing any of the online applications. This level of training is attractive for First Nation groups, college level and some community-based organizations. The Field Assistant Certification provides only the field training and allows these groups to sample under the guidance of a CABIN Certified Project Manager who is a fully certified in both the field and assessment skills. With this level of CABIN certification organizations such as the Living Lakes and the De'Cho First Nation Communities have been able to participate in sampling for various projects that often hold great importance to the individual or group on a personal level. Living Lakes provides opportunities for Field Assistant Trained individuals to participate in the collection of samples through the Citizen Science groups in Alberta and British Columbia.

Over the last few years, ECCC has tailored CABIN Field Training in the northern communities of Kakisa, Hay River and Baker Lake to allow for an exchange of knowledge that is both scientific and traditional. Some of the participants assisted in collecting CABIN samples following the certification course in streams of concern to the community. Unlike the standard training sessions posted on the CRI website, these northern training courses were requested by the local communities and integrated into ECCC's annual workplanning process to build capacity in northern communities and increase monitoring in these remote areas.

Session 6: Biomonitoring in the Prairies

Streams in the prairie provinces are challenging for the standard CABIN stream protocol. The CABIN travelling kick method can not be directly applied in slower moving, soft bottom streams and rivers and wetlands. Governments and other NGOs familiar with these types of streams in the prairies have been testing ways to assess aquatic communities from these habitats. Application of the Reference Condition Approach (RCA) can be challenging on landscapes where most of it has been altered by agriculture or other human disturbance. There is a necessity to explore alternate ways of collecting data or additional data collection on top of traditional CABIN sampling. Alternate collection methods are used in the wetlands with a modified kick which is slower and sweeps through the water and vegetation. Periphyton has also been collected in prairie streams and can have a large variability depending on the nutrients of the stream. The compositions of the aquatic communities in prairie streams are very different than traditional cobble bottom streams. Some metrics may need to be reconsidered for analysis or new ones developed to address these differences. Controlled waterways present other challenges on the prairies and should also be considered alongside human disturbance when sampling.

Prairie streams generally have more nutrients and may result in streams with large amounts of periphyton or other vegetation. Methods on how to account for the accumulation of debris in kick samples is of concern. Wetland samples pose similar difficulties with large amounts of vegetation collected in the net. As CABIN implements protocols for these systems new methods on how to handle vegetation should be included.

Traditional biomonitoring focuses on structural indicators such as the benthic invertebrate communities versus functional indicators which look at the processes which drive the ecosystem. Functional indicators directly measure ecosystem services at an ecosystem scale. They tend to focus on the underlying processes in the watershed such as carbon cycling. They provide a more integrated measure of stream health and are directly affected by a wide range of factors. They integrate over temporal and spatial scales. Functional indicators that have been tested include decomposition (cotton strip assay), stream metabolism (diel O₂ exchange) and metabolomics (metabolomics indicators of stress at the organism level). Integrating functional indicators as part of the CABIN toolbox could provide a broader and more complete picture of ecosystem health.

CABIN sampling is growing throughout the prairies as watershed groups integrate CABIN into their stream work. Similar to the growth in BC, train-the-trainer certification and field assistant certification of students and NGOs will help expand monitoring activities in the prairies. The challenges will be adapting CABIN protocols to sample the wadeable slow moving streams in these areas. A modified slow moving stream protocol for CABIN is a need identified from CABIN users in the prairie provinces.

Session 7: Future Considerations

CABIN is always evolving. Evidence of this evolution is seen in the changes to the protocol over time and the vision towards including new developments in technology. GIS technology has been applied to acquire useful landscape habitat variables and to aid in site selection and stratification of sampling sites and identifying least disturbed sites. There is a desire among CABIN users to provide more guidance for GIS in CABIN possibly using standardize data layers. GIS fits well into RCA because GIS variables are often unaffected by human activity (surface geology, climate) which is often a problem with site scale variables.

Advancements in genomics have been applied to CABIN samples for several years now with the work of Donald Baird and his collaborators. DNA sampling in CABIN has the potential to look at everything in an ecosystem and the power to answer many ecological questions. DNA can not only minimize the time for taxonomic identification, it can also eliminate the need for subsampling and allow for safer chemical use in the field. DNA can also now be used to visualize food webs and make connections from individuals to populations, communities and ecosystems. The DNA barcode library is still in development but with comparable sample costs it is a tool that is certainly gaining ground. With pilot projects currently running in Alberta (Peace-Athabasca Delta wetlands) and Atlantic Canada (rivers), it is anticipated that this new technique will be operationalised in future years, should these prove successful.

Session 8: Operational Considerations

As CABIN sampling expands into new areas and invasive species or disease spread within Canada, steps must be taken to deter the contamination of other waters. Parks Canada and ECCC sampling teams have used strategies and decontamination methods to clean equipment for invasive species known to date. Whirling disease is now being detected in Alberta streams, new protocols for decontamination of personal gear, boats and equipment are being taken to prevent the spread of the disease. Whirling disease is not classified as invasive species in Canada, rather a disease that affects trout populations. Whirling disease alternates between two hosts, salmonids and tubifex worms. Myxospores are released from decaying fish carcasses and are ingested by tubifex worms and develop into triactinomyxons within the gut epithelium. Once waterborne, the triactinomyxons float passively through the water column until contact with a salmonid is made. The trophozoites undergo sporogenesis to develop into myxospores where they wait to be released into the environment upon the fish's death.

The strategy for preventing the transfer of this disease to other unaffected streams requires meticulous care. Whirling disease has three primary modes of transfer: 1) infected fish/worms (dead or alive), 2) mud and 3) water. Typically the disease manifests as damage to cartilage, blackened tails and spinal damage. In Banff National Parks, positive fish did not exhibit these typical signs, rather it was swimming behavior that precipitated an investigation. In Aug 2016, presence of the disease was confirmed in Johnson Lake Reservoir in Banff National Park. It is now confirmed throughout the entire Bow River watershed. Disinfectant Quat is commercially available and the treatment of all equipment is 4000ppm for at least 10 minutes to provide good coverage.

An overarching theme to this year's CABIN forum was CABIN's sampling methods and new protocols. The release of the wetland protocol is expected this year with online training modules to be developed for CRI in the coming year. CABIN sampling protocols were modified for sample collections in the large Athabasca River mainstem. Replicate samples were taken at each site in the Athabasca mainstem in both sand and cobble habitats. CABIN has the ability to sample in a variety of rivers, streams and wetlands and will continue to advance in these areas produce new standardized protocols for the purpose of sharing data for assessment and reporting through CABIN web applications.

Key Implementation Considerations

Many productive and informative discussions were generated from the presentations over the two day forum. These discussions ranged from the push for new protocols (e.g. rivers, wetlands and slow flowing streams) to the possible integration of technologies into CABIN (e.g. paperless field sheets on tablets to standardization of GIS variables). One of CABIN's strengths is the contribution and commitment by partners who assist in advancing some of these user needs forward through testing and piloting new ideas. The feedback at the forum reaffirmed that CABIN users wish to participate in CABIN developments whenever possible. This year's forum also showed importance of partnerships and that academia, agencies, and NGOs are all finding unique uses for CABIN to deliver on their own objectives. ECCC work planning for 2017-18 is underway and user feedback, whether it is received at events like the Science Forum or through email communication with the CABIN team, drives our path forward. As always ECCC and CABIN are receptive to exploring partnership opportunities to accelerate and progress on these themes. All CABIN users should keep in mind that implementing innovation to application takes time and resources. CABIN will continue to follow a plan-do-check-improve model as we employ the latest research into routine monitoring.

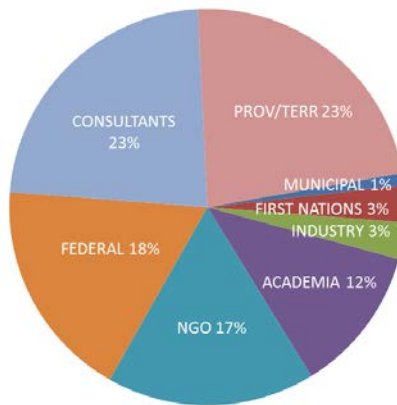
APPENDIX

Summary of Participants

A Total of 109 people participated in the CABIN Science Forum 73 in person and 36 over the internet via web-ex. Participants included those from Government, private industry, First Nations, non-government, universities and private individuals. The graphs below show the breakdown of these numbers.

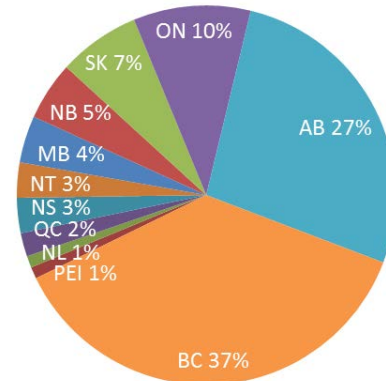
Registration by affiliation

MUNICIPAL	1%
FIRST NATIONS	3%
INDUSTRY	3%
ACADEMIA	12%
NGO	17%
FEDERAL	18%
CONSULTANTS	23%
PROVINCE/TERRITORY	23%



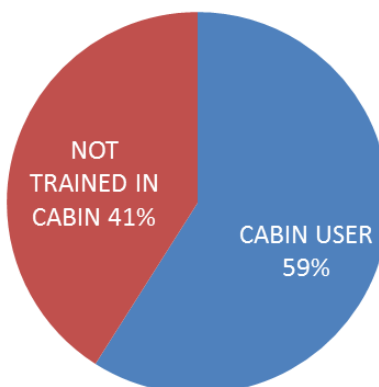
Registration by location

YT	0%
NL	1%
PEI	1%
QC	2%
NS	3%
NT	3%
MB	4%
NB	5%
SK	7%
ON	10%
AB	27%
BC	37%



Registration by CABIN experience

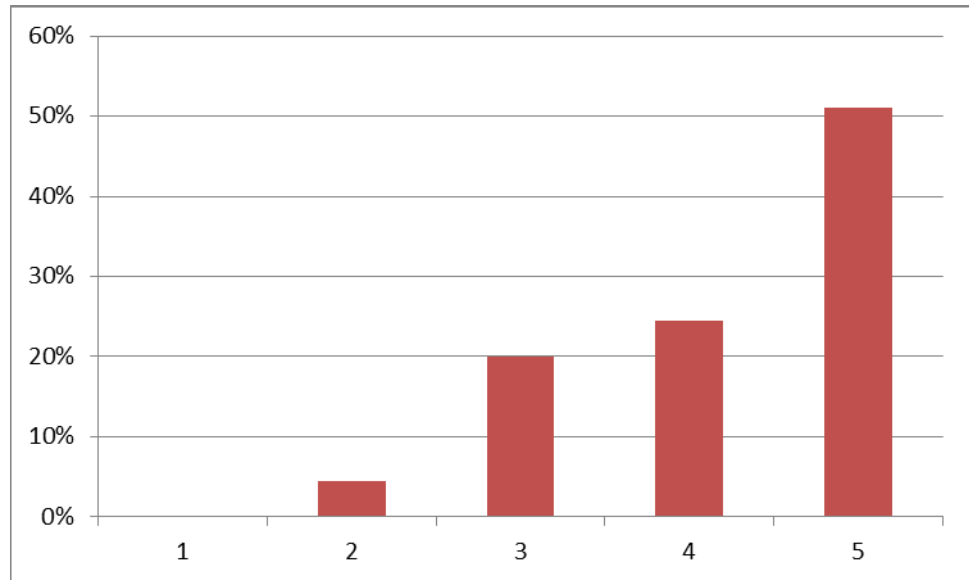
CABIN USER	59%
NOT TRAINED IN CABIN	41%



CABIN Science Forum 2017 Feedback (45 responses)

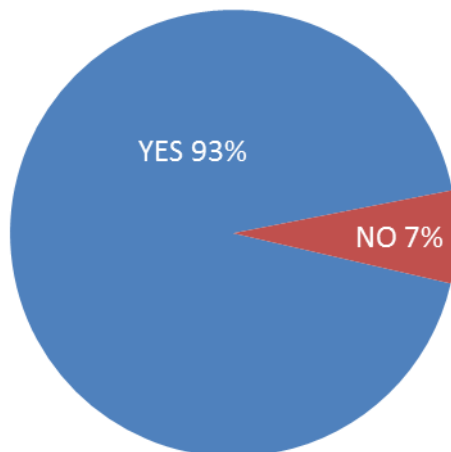
1. How would you rate the relevance of the topics discussed relative to your expectations?
(1 – not very, 5 – very)

1	0%
2	4%
3	20%
4	24%
5	51%



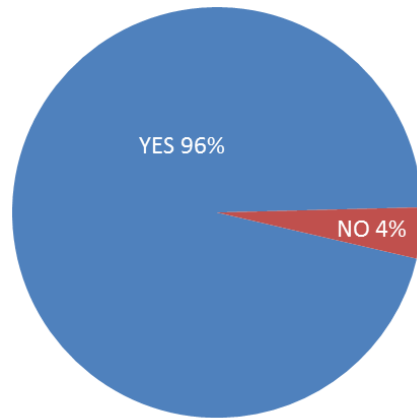
2. Was the time for questions or discussion adequate?

YES	93%
NO	7%



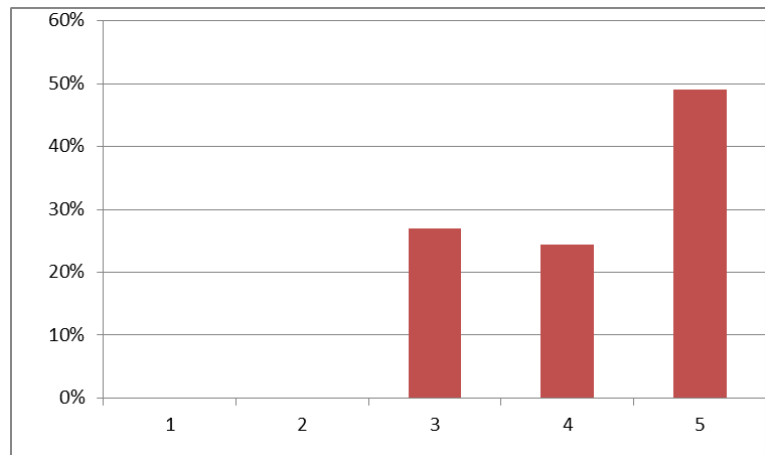
3. Were the quantity and variety of the presentations appropriate?

YES	96%
NO	4%



4. Please rate your overall satisfaction with the forum.
(1 – not very, 5 – very)

1	0%
2	0%
3	27%
4	24%
5	49%



5. Would you like to participate or recommend to someone else to attend a future forum? If so, what form of participation would you prefer?

PARTICIPATE IN PERSON	84%
WEBINAR	16%
DO NOT PARTICIPATE	0%



6. Please indicate how the forum could be improved.

- a) Allow webinar participants to listen through audio, and not just through a phone connection. Recording the presentations and providing them after the forum would benefit a lot of community groups.
- b) It would be great to have some round table discussions or further opportunities that encourage people to discuss issues or problem solve.
- c) Some of the question/answer periods were a bit abbreviated, but ample time was found in the coffee/lunch breaks for deeper discussion....great job!
- d) Provide agendas to webinar participants - it was hard to know which sessions were most appropriate without knowing topics to be discussed. Otherwise, webinar option was great.
- e) It was clear that you tried very hard to keep things on time but I think there were too many presentations with too short of times to be able to easily keep on time. That made it a bit challenging calling in for the webinar just for the topics that I wanted to hear. That said I really appreciated having the opportunity to call in for the webinar, especially since I couldn't make a case for being able to attend the whole forum. This way I could still take the time to do a few really key presentations.
- f) No need for improvement
- g) Examples are great, but tips and short informative discussion suggesting ways we can use CABIN or the data and reports it outputs would be very helpful. The presentations were quite short for the most part, which allows members to pay attention, but not share enough information during some talks.
- h) Through the webinar, it may be beneficial to have the audio going through the computer rather than having to call in. The phone volume can only be turned up so loud.
- i) I most enjoyed the presentations that used CABIN to connect to local communities and citizen science. (Beyond the academic use). There were some but I would enjoy more!
- j) Request that each registered person submit a brief background on their research or expertise if a consultant. Have the information e-mailed to attendees prior to the meeting. This way you'll know who's attending and which individuals you'll want to talk to regarding shared interests. Otherwise it's difficult to meet people with similar backgrounds, particularly if they aren't giving talks. Posters could be another way of communicating your work.
- k) For webinar: would prefer to hear audio through the internet rather than by phone-in, if possible. For those of us working in shared office space (e.g. cubicle), it isn't feasible to listen on speaker phone so it meant having to hold the handset.
- l) More discussion around results from CABIN monitoring programs. Show how this biomonitoring program is effective
- m) It was perfect!
- n) stretch in between sessions
- o) Perhaps a few longer slots for keynote talks or at least give the option to some individuals whose talks may be more involved than others to go long.
- p) Allowance for extra time for questions. Having a session on the findings from CABIN, and what the findings are telling us about the status of the watersheds being studied.
- q) Great to have in person and remote access to event. Great opportunity for networking and meeting between talks. I liked the length and frequency of breaks to allow introductions and discussions.
- r) Set up projector to show colours better.
- s) Would like to know new protocols that have been implemented within CABIN
- t) Consider using slido (platform) for questions. Participants can formulate questions during presentation, presenter/ facilitator can see them and choose.

- u) It would be great if all presentations (past years too) were available online anytime (youtube?)
Very informative. Lunch was very long....too long?
- v) Very pleased with the forum and the time given for discussion and networking.
- w) Please be more explicit about forum details (eg I'm a vegetarian, I had no idea lunch was provided and that I could specify dietary needs). Was that an email I missed? Lunch break too long. Everything else was great.
- x) Think it was excellent. Best one yet. Only possible suggestion would be to do a roundtable perhaps every other forum.
- y) Maybe poster presentations? Really appreciated seeing other people's data. Posters may make more in-depth discussions possible.