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National CABIN Science Forum 2012 Proceedings

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Canada

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Preface

The Canadian Aquatic Biomonitoring Network (CABIN) is an aquatic biological monitoring program for assessing the health of freshwater ecosystems in Canada. CABIN is based on a collaborative approach for data-sharing among partners to achieve consistent and comparable assessment on freshwater ecosystem health in Canada.

The CABIN program (i.e. online resources, training, regional coordination, QA/QC) is maintained by Environment Canada to support the comparable collection, assessment, and reporting of monitoring information for all network participants. To enhance collaboration, knowledge sharing and program development, Environment Canada and the Canadian Rivers Institute coordinated the second CABIN Science Forum in Fredericton, NB., on November 14 and 15, 2012. The first CABIN Science Forum was held in Vancouver, BC, in 2010, and brought together CABIN users from a variety of sectors (i.e. forestry, mining, and agriculture), government agencies, academia, and community watershed programs.

Similar to the 2010 Forum, the 2012 forum was attended by a variety of CABIN partners from all sectors (see participants in the appendix) and had the following objectives:

1. Provide an opportunity for network users to learn about different applications of CABIN in a variety of sectors, successes and challenges, and to learn about the future directions of the program.
2. Provide a forum for users to interact and collaborate with other members of the network.
3. Provide an opportunity for information exchange and collaboration among CABIN users and the Environment Canada CABIN Team to address user needs.

The 2-day forum included: two short practical courses on the first morning (Wetland Protocol development and Atlantic RCA model); presentations by the EC CABIN Team and CABIN partners focused on the program itself, application of CABIN by different groups, study design questions, and other habitats and environmental indicators; and, interactive discussions on the implementation and future direction of the CABIN program. Presentations and discussions were also streamed over the internet to enable participants to interact remotely.

Agenda

Wednesday November 14 (Day 1)		
8:00	**Registration opens**	***Foyer, Wu Centre***
9:00	**Short courses**	*The Atlantic Reference Condition Approach Model. Instructors D. Armanini (CRI), V. Mercier (Environment Canada), and R. Beiko (Dalhousie University).* ***Aitken Room, Wu Centre***
		CABIN Wetland Protocol Development - Field Demonstration. Instructors Alain Armellin and Emily McIvor (Environment Canada). ***Meet in Foyer, Wu Centre, at 8:30.***
12:00	***Lunch***	***Foyer, Wu Centre***
13:00	**Welcome and Introduction**	*Sue Farquharson (CRI), Vincent Mercier (Environment Canada) and Michelle Gray (CRI)* ***Kent Auditorium, Wu Centre.***
13:15	**News and Update on the CABIN program**	*Jean-François Bibeault (Environment Canada)*
13:30	**Presentations. Session 1: CABIN Program Overview**	*CABIN Science Team Overview and Activities (Donald Baird, CRI, Environment Canada)*
		A comparison of issues facing two national scale RCA based assessment programmes: CABIN and AUSRIVAS (Trefor Reynoldson, Ghost Environmental, and Susan Nichols, University of Canberra)
		The CABIN database, lessons learned in academic and private sectors (Michael White, Minnow Environmental Inc.).
14:30	***Break***	***Foyer, Wu Centre***
14:50	**Presentations. Session 2: CABIN applications.**	*CABIN and the Yukon Placer Mining Regulations (Aaron Foos, Environment Yukon, and Trefor Reynoldson, Ghost Consulting)*
		CABIN fever! (Shelley Denny, Unama'ki Institute of Natural Resources)
15:30	**Facilitated discussion: Direction and Operation of the CABIN Progra**	
16:30	**Day 1 wrap-up. S. Farquharson, V. Mercier and M. Gray**	
16:30-18:00	**Mixer**	**Cash Bar and Snacks.** ***Foyer, Wu Centre***

Thursday November 15 (Day 2)		
9:00	***Coffee***	
9:30	**Welcome to day 2, overview. *Kent Auditorium, Wu Centre***	
9:40	**Presentations. Session 3: CABIN applications *(cont.)***	*Application of CABIN at CFB Gagetown and LFCA TC Meaford (Tamsin Laing, Royal Military College of Canada, and Andy Smith, National Defence)*
		Applying CABIN to long-term monitoring at Parks Canada (Dan Kehler, Parks Canada)
		Community Based NGO Application of CABIN (Heather Leschied, Living Lakes Canada)
		Restoration of ecological integrity in large mountain rivers (Michelle Bowman, Forensecology)
11:00	**Break**	***Foyer, Wu Centre***
11:20	**Presentations. Session 4: Study Designs**	*Objective identification of reference sites using GIS (Adam Yates, University of Western Ontario)*
		Evaluating temporal variability of benthic invertebrate communities at reference sites in eastern Newfoundland (Amie MacDonald and Janet Feltham, Terra Nova National Park)
		What makes an RCA model valid, and how long and far does the validity extend? (Robert Bailey, U. of Cape Breton)
12:20	***Lunch***	***Foyer ,Wu Centre***
13:20	***Presentations. Session 5: Other Habitats and Environmental Indicators***	*The Community Aquatic Monitoring Program (CAMP): sort of CABIN without the fresh water, bugs and RCA (Simon Courtenay, Fisheries and Oceans Canada at the Canadian Rivers Institute, UNB).*
		CABIN Sampling Approaches in Large Rivers (Stephanie Strachan and Joseph Culp, Environment Canada)
		Flow monitoring with CABIN using the Canadian Ecological Flow Index (Jessica Orlofske, University of New-Brunswick, and Donald Baird, Environment Canada)
		An update on Biomonitoring 2.0: the future is now (Joel Gibson, University of Guelph)
14:40	***Break***	***Foyer ,Wu Centre***
15:00	***Facilitated discussion: Study Design, QA/QC and Data Interpretation***	
16:00	***Wrap up***	
16:15	**Close**	

Presentations

News and Update on the CABIN program (Jean-François Bibeault, Environment Canada CABIN Manager)

Jean-François opened the Science Workshop by providing participants with Environment Canada's (EC) perspective and priorities for the CABIN program. EC has the mandate of protecting Canada's waters in trans-boundary watersheds and in priority areas, which currently include the Great-Lakes—St. Lawrence River system, Lake Simcoe, the Lake Winnipeg watershed, and the Lower Athabasca. While EC has seen shifting priorities and some restructuring within the monitoring team, the CABIN program is still an important priority. The field component of the program should continue to build on its science base by strengthening field protocols, standardized training, field audits, and verification of data entry. Taxonomic analyses need to continue to rely on certified taxonomists, meet accuracy criteria, and follow QA/QC procedures. Interest in the program has grown substantially since 2009 with upward of 200 people registering for training in each of the last 3 years. Investment in the online database and tools will focus on upgrading to a new development platform (.net 4.0); meeting accessibility standards; enhancing bulk uploading of data, data extraction, and taxonomic information; and improving site and assessment reports. Lastly, support for the CABIN Science Team also remains important for EC (see D. Baird presentation).

Session 1: CABIN Program Overview

CABIN Science Team Overview and Activities
Donald Baird (donald.baird@ec.gc.ca), CRI, Environment Canada

Donald, co-chair for the Cabin Science Team (CST), introduced the members of the team, which include: Nancy Glozier (co-chair, EC), Sheena Pappas (secretariat, EC), Jan Ciborowski (U. of Windsor), Lee Grapentine (EC), Laura Rempel (DFO), Garry Scrimgeour (Parks Canada), Jason Duffe (EC), Robert Bailey (U. of Cape Breton), Trefor Reynoldson (Ghost Consulting, U. of Acadia), and Stephanie Strachan (EC). Donald made the point that the CABIN program needed stronger scientific oversight and direction. Thus, the CST provides scientific support to the CABIN program through the evaluation of new protocols (wetland and large river), peer-review of models and modeling techniques, input on new and emerging techniques (subsampling, biomonitoring 2.0), and feedback to CABIN members.

A comparison of issues facing two national scale RCA based assessment programmes: CABIN and AUSRIVAS
Trefor Reynoldson (mtrefor.reynoldson@gmail.com), Ghost Environmental, and Susan Nichols, University of Canberra

Trefor provided a broad overview of the evolution of national biomonitoring programs internationally, starting in Europe primarily with RIVPACS in the U.K. and Rapid Bioassessment Protocols by multiple states in the 1980's. The Australian AUSRIVAS, as well as Canada's CABIN, were both initiated during the 1990's and largely implemented on a large scale in the 2000's. As both programs mature and co-evolve, a number of parallel science development issues are appearing. They include: sampling protocols, defining reference sites, selecting reference sites in large rivers and areas of intense human activity, temporal variability in reference sites and updating models, improving modelling methods and assessment approaches, and the development of DNA barcoding technology and the requirements from traditional taxonomic analysis. Given the similarities in the two programs, enhanced collaboration would result in major co-benefits. There is also a need to balance new methods with past approaches, particularly in applying the reference-condition approach.

A question was raised as to why the AUSRIVAS program was stalled for a period of time in Australia. Trefor explained that there was a lack of scientific authority, with protocols differing among states, and that it was lacking a strong champion or driver at a national scale. Trefor was asked if the CABIN Science Team (CST) is formally working with the AUSRIVAS team on these common challenges. He responded that there was collaborative effort mostly focused on developing and improving model building approaches. While Donald added that the CST is open to it but that it's not really happening at the moment. Another question focused on how biomonitoring data were being used in Australia. Trefor pointed out that national state of the environment reports were produced on a regular basis.

The CABIN database, lessons learned in academic and private sectors

Michael White (mwhite@minnow-environmental.com), Minnow Environmental Inc.

Michael compared assessments made using regional models with site-specific models (i.e. similar habitat characteristics, nearest neighbour) and highlighted potential pitfalls and limitations with regional models based on three illustrative case studies (Yukon, Northern Ontario and Columbia-Okanagan). In both cases, judgments are required to make decisions but regional models require community groups to be defined, number of reference sites per group, and dealing with outlier communities and temporal variability. Both assessment approaches need to determine which habitat variables are most important and determine ranges of acceptable values. Considerations for deciding which approach to take also include sampling method, modelling perspective, and potential for making type 1 and 2 errors. Examination of the three case studies using regional models revealed a number of questions, including what happens when test sites lie at thresholds between groups or outside the range of groups, how to determine distinct biotic groups with cluster analysis, is the model reliable enough to keep the ability of committing type 1 errors at a minimum, was a complete set of habitat variables considered in the model, and whether inclusion of repeated reference sites over multiple years is valid. In conclusion, practitioners should not necessarily replace other types of experimental designs that may be more appropriate to their needs with regional models.

Session 2: CABIN applications

CABIN and the Yukon Placer Mining Regulations

Aaron Foos (Aaron.Foos@gov.yk.ca), Environment Yukon, and Trefor Reynoldson, Ghost Consulting

Placer mining uses water, motion and gravity to collect the flakes and nuggets of gold eroded from hard rock and carried downstream by watercourses. It uses no chemicals and its by-product is non-toxic, sediment laden water. Placer mining has been practiced in the Yukon since the Klondike Gold Rush of 1898 and has experienced increased mechanization through the century. Currently there are about 135 placer mining operations in the Yukon employing approximately 4 people per operation. The estimated value of gold extracted in 2012 was around $65,000,000 USD.

Work began in 1993 to monitor the effects of placer mining using biomonitoring. Between 1993 and 2006 an RCA (Reference Condition Approach) study design was developed for the Yukon and over 90 reference streams were sampled. In 2006, DFO (Department of Fisheries and Oceans), YG (Yukon Government), CYFN (Council for Yukon First Nations), and industry (Klondike Placer Miners Association) decided to use RCA to monitor watershed health under the new placer mining regulatory regime. DFO and YG collected additional reference site data and the first RCA model was developed by GHOST Consulting and uploaded to CABIN in 2006. Between 2007 and 2010 an additional 250 reference sites were collected and the CABIN RCA model was revised in 2008 and again in 2010. Since then, there has been ongoing aquatic health monitoring by DFO and YG to where there are now over 530 CABIN sites. Plans are to update the RCA model again in early 2013.

The goal of the Fish Habitat Management System for Yukon Placer Mining developed in 2007 is to maintain healthy stream systems and conserve fish and fish habitat and maintain a viable placer mining industry. The system uses an Adaptive Management Framework (AMF) which is based on monitoring results to ensure that risk management decisions are justified and all watershed class authorizations achieve objectives. This system is coordinated by the Yukon Placer Secretariat and relies on traditional knowledge and the results of CABIN, water quality monitoring, and economic health monitoring.

Aquatic health monitoring using CABIN is funded for approximately 40 sites per year by DFO and YG. The focus is moving away from collecting reference sites for model improvement to monitoring test sites. Some CABIN/RCA challenges have been related to interpreting what is causing sites to be out of reference and dealing with natural between-year variation such as flood events. Impacts on the management system from recent changes to the Fisheries Act under Bill C-38 are unknown at this time, but it is assumed that the class authorizations will remain in place. Under the adaptive management framework, the entire management system is scheduled for a five year review in 2013.

CABIN fever!

Shelley Denny (shelley.denny@uinr.ca), Unama'ki Institute of Natural Resources

The Unama'ki Institute of Natural Resources (UINR) represents the five Mi'kmaq communities in Cape Breton on natural resources issues. It embodies the concept of "Two-Eyed Seeing" or using the best in scientific research and Mi'kmaq traditional knowledge.

The Bras d'Or Lakes and its 5 rivers have been primary traditional fishing grounds for the Mi'kmaq of Cape Breton. It consists of a semi-enclosed estuary of interconnecting basins and channels and differs in temperature, salinity and nutrients from the Atlantic Ocean. The Bras d'Or Lakes is considered small (1,080km^2) and has a low flusing time. It has an average depth of around 30m, a small tidal range of less than 20cm and an average salinity of around 22ppt. It supports a variety of warm and cold water biota with sewage being its main pollution.

The UINR became involved with CABIN in 2010 in order to answer questions about the aquatic health of the Bras d'Or Lakes. There are now CABIN sites in each First Nation community as well as rivers important to the community. The monitoring has become a key component in the Middle River Ecological Assessment which is one of the larger rivers on the Bras d'Or Lakes and runs adjacent to the Wagmatcook First Nations community.

Session 3: CABIN applications cont.

Application of CABIN at CFB Gagetown and LFCA TC Meaford

Tamsin Laing (Tamsin.Laing@rmc.ca), Royal Military College of Canada, and Andy Smith, National Defence

CFB Gagetown

Canadian Forces Base (CFB) Gagetown is located in south central NB and is 1,100 km^2 in area. It includes 21,000 ha of maneuver areas, 30,000 ha of impact areas, 829 km of roads, 352 km of tracks, over 500 fords, 1,174 instream culverts and bridges, 3,272 km of watercourses, 156 lakes or ponds and 6487 ha of wetlands. The key aquatic species are Altantic salmon and brook trout.

There is currently a 5 year, $50 million Sedimentation and Erosion Control Program (SECP) in effect focussing on the improvements and decommissioning of roads, tracks, fords, other water crossings and revegetation of barren soils. The associated work includes stream restoration and wetland creation.

CFB Gagetown benthic monitoring goals are to evaluate the aquatic ecosystem health of its watercourses, to develop a protocol to use benthic invertebrates as an indicator of aquatic ecosystem status and sustainability and to assess the effectiveness of SECP and target restoration. Benthic monitoring programs started at CFB Gagetown in 2003 with the establishment of 39 sites located throughout the property. CABIN protocols were adopted in 2008. In 2011, the Environmental Sciences Group (ESG) from the Royal Military College of Canada was asked to take on the project and work the CFB Gagetown to review and optimize the biomonitoring program.

The CFB Gagetown benthic study has three components: land use analysis, field sampling program and multivariate statistical analysis.

The land use analysis established quantitative measures of disturbance related to military training activities. A review identified three measures of land use related to disturbance from military activities. These are the percentage of unforested land, the percentage of unforested land on slopes greater than 3% and the total road and track length. These measures were quantified for CFB Gagetown sites at both the watershed and reach scale (30m riparian buffer). This showed that Kerr Brook and Ellingham Brook were the watercourses most susceptible to catchment erosion. Several watercourses showed very little disturbance at the watershed level.

The field sampling program continued to monitor the CFB Gagetown sites to evaluate stream ecological condition. A subset of previous monitoring sites was sampled, in addition to several new ones on watercourses with no prior assessment. The geographical focus is the General Maneuver Area (GMA) but also includes sites from less disturbed (LD) areas. Weight of evidence approach was used for data interpretation with both univariate metrics (diversity, EPT) and multivariate statistical methods. In general, community assemblages are characteristic of fairly good water quality (high species richness, diversity, and high proportion of EPT taxa). Ranking of sites with respect to environmental quality is variable amongst years and metric results are sometimes contradictory.

A multivariate statistical analysis was conducted on the data collected between 2008 and 2011 in order to identify which environmental variables are important influences on benthic community structure. Differences in benthic assemblages amongst sites were largely related to natural habitat features (local geology, stream size, nutrient concentrations, canopy and macrophyte and periphyton coverage). Land use measures of disturbance in the reach riparian zone were a weak secondary gradient influencing benthic communities.

There are several recommendations for CFB Gagetown monitoring program. There will be a focussed increase of monitoring efforts on watercourses that appear most sensitive to catchment soil erosion (Kerr Brook and Ellingham Brook). Monitoring sites will be located on stream reaches that are influenced by increased sedimentation from catchment erosion. As well, good spatial representation of sites from other less-disturbed areas of CFB Gagetown will be included. The results will be used to set monitoring targets and identify where mitigation measures should be focussed.

LFCA TC Meaford

Land Force Central Area Training Centre (LFCA TC) Meaford is located in southern Ontario, north of Toronto on the shores of the Georgian Bay, east of Owen Sound. It was formerly agricultural land before becoming a tank range and artillery training facility almost 60 years ago. The training area is approximately 7,650 ha with numerous water courses, wetlands, grasslands and mixed forest. Almost 50% of the training area is an active range impact area.

The biomonitoring goals of LFCA TC Meaford are to assess the aquatic ecosystem condition using benthos as indicators and water and habitat quality as well as to provide a baseline for quantitatively and objectively assessing changes and/or improvements in the aquatic environment over time.

In 2011 a pilot biomonitoring study was introduced. Six test sites were located in areas that are potentially sensitive to impacts from site activities and also meet the CABIN requirements for sampling. Water and sediment quality were found to be generally good and benthic invertebrate metrics were largely indicatie of a healthy aquatic community.

Applying CABIN to long-term monitoring at Parks Canada

Dan Kehler (dan.kehler@pc.gc.ca), Parks Canada

Monitoring at Park Canada has two purposes: evaluating the effectiveness of park management actions and reporting to Canadians on the state of their protected areas. Reporting is done via a 5 year State of the Park Report that summarizes the monitoring information collected by major ecosystem (aquatic, forest, marine, alpine, tundra, coastal, glacier and wetland). In the aquatic ecosystem, benthic invertebrates were selected as one of a suite of measures that may also include: water quality index, aquatic connectivity, stream hydrology, temperature, lake ice, fish health, and lake productivity. Each measure is interpreted using targets and thresholds. Thresholds are points of management concern and blend scientific information and human values.

Benthic Invertebrates were chosen as an aquatic ecosystem measure as it is sensitive, integrative, has known responses to some stressors, is shared by many partners outside of parks and it is applicable across multiple parks. The CABIN protocol is currently being used by almost all National Parks east of Ontario, and by all seven mountain parks in Western Canada. Study designs vary from Park to Park in terms of the spatial and temporal allocation of sampling effort with the resampling interval ranging from 1 to 5 years. A key feature of many designs, however, is that the sampling locations are permanent.

The challenge is making the most of the data by taking advantage of the permanent nature of the sampling sites. Since this does not fit the traditional application of the reference condition approach associated with the CABIN program, Parks Canada is exploring other alternatives, as well as the reference condition approach to provide meaningful assessments of ecological condition, including developing thresholds of management concern.

Community Based NGO Application of CABIN

Heather Leschied (hleschied@gmail.com), Living Lakes Canada

Living Lakes Network Canada is a growing network of community organizations working for effective protection of Canada's freshwater resources. Living Lakes Network Canada links science to action by supporting water stewardship efforts in Canada and beyond. By uniting environmental NGOs who work for the health and sustainability of natural aquatic ecosystems and encouraging community based monitoring, Living Lakes Network Canada connects Canadians who are working to protect freshwater sources for future generations.

Community based monitoring is beneficial in building community trust and helping a community to establish a desired vision for itself as well as developing and extending social networks. It supplements traditional methods of data collection and enables scientific questions of citizens to be answered.

Some challenges and limitations can arise in data inaccuracy, lack of volunteer capacity and lack of participant objectivity. A potential lack of funding coupled with government reluctance to relinquish governance responsibilities can prevent merging the monitoring data with policy.

Successful community based monitoring programs are funded and linked with decision making. This is obtained by creating strong partnerships and accurately communicating results.

Communities benefit from using CABIN by enhancing their knowledge and capacity in local watersheds. CABIN provides credible baseline and trend data as well as the tools to assess and present water quality results.

Restoration of ecological integrity in large mountain rivers

Michelle Bowman (michelle.f.bowman@gmail.com), Forensecology

Acts and regulations of the Canadian National Parks act identify wastewater as 1 of 11 major anthropogenic threats to ecological integrity in National Parks. The maintenance or restoration of ecological integrity through the protection of natural resources and natural processes is the first priority when considering all aspects of the management of parks. Ecosystems have integrity when they have their native components (plants, animals and other organisms) and processes (such as growth and resproduction) intact.

Wastewater management concerns in mountain National parks focus on the Kicking Horse River in Yoho National Park, the Athabasca River in Jasper National Park and the Bow River in the Lake Louise and Banff National Parks.

CABIN is similar to Mountain River monitoring by being research based and utilizing similar sampling and bioassessment methods. They differ in study design and output for stake-holders, as well Mountain River monitoring incorporates a benthic algal component.

Some future suggestions for CABIN include updating modeling methods, improving habitat matching, incorporating other indicators and providing follow up guidance when a test site is divergent.

Session 4: Study Designs

Objective identification of reference sites using GIS

Adam Yates (ayates2@uwo.ca), University of Western Ontario

Adam demonstrated an objective approach to defining reference sites for an area through a southern Ontario case study. He established that selection of reference sites can be highly subjective if trying to describe them as *historical condition*, *minimally disturbed* or *best attainable*. However, least disturbed sites can be defined objectively and quantitatively using available GIS information on the human and natural landscape using 3 simple steps: (1) stratify the natural environment to ensure all stream “types” are sampled, (2) define human activity gradients (HAG) to quantify potential exposure, and (3) identify a threshold along the HAG to identify the least disturbed sites. These steps were then demonstrated for southern Ontario using surface geology to categorize watershed “types” and crop coverage as the HAG.

Least-disturbed watersheds for each "type" were then selected as those having the most amount of difference in crop coverage relative to the maximum – usually 5 to 25% of watersheds for each "type". Ground truthing least-disturbed should then be done to validate, followed by sampling of biota to assess whether they fall in natural groups along the natural environment and whether they can discriminate from highly exposed sites.

A question was raised as to how why geology was used to stratify the environment in this case (step 1). Adam responded that with the extent of landscape modification in Southern Ontario, how do you evaluate actual impact?

Evaluating temporal variability of benthic invertebrate communities at reference sites in eastern Newfoundland

Amie MacDonald and Janet Feltham (janet.feltham@pc.gc.ca), Terra Nova National Park

Amie presented the results of the Park's study to assess the effects of Hurricane Igor on benthic communities relative to those at known impacted sites. Benthic communities showed significant temporal variation at reference sites, as well as lower abundance following Igor, but no significant differences in taxonomic richness. In addition, invertebrate community changes were not reflected in fish communities. Between the reference and impact site there were significant differences in benthic communities, larger than those seen following Igor, though these weren't apparent when looking at abundance or taxa richness. In summary, the study has shown that: (1) benthic communities are dynamic and thus need to be tracked over time, (2) changes may be seen in taxonomic composition but not necessarily metrics like abundance and taxa richness, and (3) the magnitude of anthropogenic impacts exceeded those of a natural disturbance (Igor).

What makes an RCA model valid, and how long and far does the validity extend?

Robert Bailey (Robert_Bailey@cbu.ca), University of Cape Breton

Robert reviewed how reference condition approach models (RCA) are constructed conceptually and how they can assess condition at test sites. He then demonstrated 5 key conditions that are required for making an RCA model valid. These include: (1) the range of ecosystems of natural environment predictors is the same for *reference sites* as it is for *test sites*, (2) exposure of the ecosystem to the human activity of concern does not affect the natural environment predictors, (3) the amount and type of human activity are not determined by the natural environment, (4) the relationship between the biota and the natural environment predictors does not change with spatial or temporal extent of *reference sites*, and (5) the relationship between the biota and the natural environment predictors is the same in *reference sites* as it is in *test sites*. For each of these requirements, Robert provided the following recommendations: (1) make sure that natural environment of test sites is a subset of those for the reference sites, over the spatial and temporal extent of the study, (2) potential natural environment predictors should not be affected by human activities of concern, (3) constrain the spatial and temporal

extent of the model to uncorrelated human activity and natural environment, (4) re-calibrate models with changing spatial and temporal extent, and (5) evaluate by field experiment or simulation whether relationship between natural environment and biota is the same in *reference sites* and *test sites*.

Session 5: Other Habitats and Environmental Indicators

The Community Aquatic Monitoring Program (CAMP): sort of CABIN without the fresh water, bugs and RCA

Simon Courtenay (simon.courtenay@dfo-mpo.gc.ca), Fisheries and Oceans Canada at the Canadian Rivers Institute, UNB

In collaboration with the Southern Gulf of St. Lawrence Coalition on Sustainability and approximately 30 watershed groups DFO-Gulf Region runs the Community Aquatic Monitoring Program (CAMP; http://www.glf.dfo-mpo.gc.ca/e0006182). CAMP shares with CABIN the objective of measuring the health of aquatic environments but it operates in estuaries rather than fresh water, looks at nekton (nearshore fish, shrimp and crabs) rather than benthic invertebrates, and was not designed as a Reference Condition Approach, although we do plan to look at whether RCA can be applied. Monthly, during the summer, community volunteers pull a 30 X 2 m beach seine at six stations throughout their bay or estuary and enumerate the catch by species and life stage (adult vs young-of-the-year). They also collect information on the water temperature, salinity, oxygen content, nutrient content (nitrate, nitrite and phosphorous), substrate type (grain size, moisture content, organic content) and coverage by different kinds of submerged aquatic vegetation. CAMP began in 2003 as a pilot project with just four sites in the southern Gulf of St. Lawrence and has now grown to 35 sites. Data are compiled by DFO and made available to participating groups annually. CAMP has become DFO's major contribution to the Northumberland Strait – Environmental Monitoring Partnership (NorSt-EMP; http://www.cwn-rce.ca/initiatives/canadian-watershed-research-consortium-/watersheds-projects/dr.-michael-van-den-heuvel/). As well, CAMP data are finding application in a number of research projects including impacts of aquatic invasive species such as the European green crab (*Carcinus maenas*).

CABIN Sampling Approaches in Large Rivers

Stephanie Strachan (stephanie.strachan@ec.gc.ca) and Joseph Culp, Environment Canada

The definition of a large river varies and may be quantitative or qualitative. The definition may be based on drainage area >5000-20000km^2, depth >1m, width >50m, or based simply on the fact that it is too deep to be sampled using wadeable techniques. Invertebrates are widely used for bioassessment in wadeable streams but less so in non-wadeable streams. The general belief is that non-wadeable streams support less diversity and more pollution tolerant organisms because they tend to be turbid with finer substrates. However, there is a need to assess ecosystem health in larger rivers (e.g., Environment Effects Monitoring Program in the Fraser River, Integrated Monitoring Plan for the Oil Sands in the Athabasca River).

There are a variety of active and passive sampling techniques that have been used in large rivers. Passive methods include artificial substrates and drift nets. While artificial substrates are easy to deploy, they require multiple sampling trips, there is potential loss and they are not an indicator of sediment or habitat but rather colonization. Similarly, drift nets are easy to deploy and process, but can be highly variable. Active methods include bottom-grab, snag sampling and shoreline kicknet sampling. They all require a single sampling visit and reflect the resident assemblage. These methods also have their drawbacks. Bottom grab sampling is ineffective in rocky substrates and offers little or no knowledge as to the actual substrate sampled. Snag sampling may require a boat and has increased processing time due to extensive debris. Kicknet sampling and snag sampling are impossible where there are steep drop offs at the river's edge.

The existing CABIN protocol requires a single three minute traveling kicknet sample to be collected at each site which is equal to six times the bankfull width. The CABIN technique was applied along the shorelines of medium and large rivers in the Fraser River Basin and the Yukon River Basin. Ordination plots of the invertebrate communities from streams of all sizes show that the large river communities are not distinguishable from the small stream communities.

The USEPA (United States Environmental Protection Agency) developed a shoreline kicknet protocol for the bioassessment of non-wadeable streams similar to CABIN but with increased sampling effort. A preliminary comparison of samples collected from both the CABIN and modified USEPA methods was conducted to determine if the small fraction of the site sampled using CABIN was as representative of the benthic community as the extensive UPEPA method. The preliminary comparisons showed no difference between the methods. The large rivers in the preliminary study showed limited within site variation suggesting few replicates are needed to detect differences between sites.

More investigation is needed on the connection between shoreline habitats and main channel habitats. More investigation is still needed to determine if shoreline samples from large rivers can be mixed with full channel samples to define regional reference conditions. Regardless of the protocol, the most appropriate statistical assessment method (e.g. RCA or gradient design) will likely be system dependent given that "reference" sites are rare in these systems.

Flow monitoring with CABIN using the Canadian Ecological Flow Index

Jessica Orlofske (j.orlofske@unb.ca), University of New-Brunswick, and Donald Baird, Environment Canada

A hydrograph visually represents flow regime. It illustrates magnitude, timing, frequency, duration and rate of change as it relates to flow, but what about biology? Environmental flow is the flow or regime required to create or maintain habitat conditions favorable for life-sustaining processes. A relationship exists between the flow and the ecology of a river. This is a predictive, mechanistic framework relating organisms to a dynamic flow environment.

The Canadian Ecological Flow Index (CEFI) is an invertebrate based flow index. It relates organisms to velocity occurrence and creates patterns associated with hydrological conditions. CEFI uses central tendency to identify the range of observed velocity values for each taxa observed in biomonitoring samples.

The United States Environmental Protection Agency (US EPA) has a Freshwater Biological Traits Database used to measure the long term trend effects on stream and aquatic ecosystems. Traits are measureable, heritable and linked to fitness of the organism. The categories of traits are ecological, life history, morphological and mobility. Traits are excellent to use for large scale trend analysis because they vary less across geographical areas and are less susceptible to taxonomic inconsistencies in long term datasets.

The key now is to link the trends database with the CEFI database and explore patterns between invertebrate traits and velocity. A case study is being done in the Miramichi River in New Brunswick using 11 sites in 2011 and 20 sites in 2012. The goal is to use traits to estimate CEFI components for additional taxa or use directly in metric calculations.

An update on Biomonitoring 2.0: the future is now

Joel Gibson (jfgibson@uoguelph.ca), University of Guelph, Ian King, Shadi Shokralla, Donald Baird, G. Brian Golding, Rob Beiko, Sarah Rosolen, Jeff Shatford, & Mehrdad Hajibabaei

The Biomonitoring 2.0 approach represents a fundamentally new approach to ecosystem biomonitoring. To the existing model of site assessment based on morphological identification is added climate, hydrological, and geospatial data as well as DNA-sequence based biodiversity data. Extracting massive amounts of DNA sequence data from mixed environmental samples requires the use of next-generation sequencing. Illumina MiSeq® and Roche 454-pyrosequencing platforms are capable of producing over one million DNA sequences of up to 500 base pairs each from a single, mixed environmental sample. These sequences can then be used to rapidly generate accurate species lists for each sample and site. New, non-destructive approaches to DNA extraction and sequencing are also being developed by the Biomonitoring 2.0 team.

Discussions

Session 1: CABIN Program Direction and Operation

1. What are the key highlights of the day?

The use of CABIN in the Yukon placer mining industry and regulations was identified as the primary highlight. The question is: *why haven't other places (jurisdictions) adopted CABIN this way*? It was suggested that the linchpin for success requires a champion and, similarly to Australia, there needs to be clear policy driver that applies across the country. Currently is it a collection of regional initiatives that have created the need for a national program (re: bottom-up). Natural resource extraction (e.g. oil sands, mining) could be the national driver and that uptake would improve with better coverage of RCA models – the lack of RCA models prevent sites from being assessed in some areas. Another challenge, even in areas where CABIN has been in widespread use like British Columbia and the Yukon, is ensuring that data are collected consistently. Could the bioregional approach used by Parks Canada in Newfoundland be used as a model for stronger uptake?

PRIORITIES:

2. What areas of research or monitoring would be of highest priority?

Concern was raised about the durability or reliability of RCA models under climate change. Temporal variability at repeat reference sites needs to continue to be documented but we're not really in a position to address climate change.

For Parks Canada, reducing the cost of processing and analysing biota samples is becoming more important. This emphasizes the importance of developing genomic based technology and protocols.

More work on developing post assessment guidance when sites are found to be 'divergent' was also raised. This could follow the approach taken by the development of the Environmental Effects Monitoring Program with a tiered approach to management action for example. The CABIN team can provide guidance on study design but management framework will be specific for each jurisdiction.

Trait-based and/or metric based research should continue to improve diagnostic potential of CABIN assessments.

3. Any new protocols that would need to be developed?

No specific comments or suggestions were directed at this question. It was mentioned in Donald Baird's and Stephanie Strachan's presentation that the CABIN Science Team is looking at a wetland protocol and trying to address sampling in large rivers.

DATA ACCESS AND USE:

More complete and accessible study meta-data should improve usability of the data generated by different partners. In addition, the question was raised as to why people require an account to access available data. This was designed to control access to those who are familiar with the data and to formal requests.

The larger issue of data transferability and interopterability also needs to be addressed in order to have a more useful national level dataset that brings in valuable data from older monitoring efforts and different protocols so that biomonitoring can be used more reliably and at larger scales for assessment and decision-making. Is this the role of the CABIN Science Team (CST)? No, but the CST can evaluate options, suggest priorities and identify issues to the EC CABIN team.

4. What would be a good common data access criteria (e.g. 4 years historically)?

The default four-year window for access to data is too long. The time period should be variable, depending on the data manager. Data that are freely available should be flagged. The data access policy could also be reversed by asking data managers to specifically identify data they wish to withhold for four years, rather than applying the default access period of four years.

5. What web-based tool would you suggest improving for data interpretation?

Metrics need to be corrected as some of them are not calculated accurately. Please note that these corrections are currently underway (Tim Pascoe). Partners should also be allowed to augment usability of models in CABIN. Metric and trait-based reports for reference sites should be developed.

COMMUNICATION:

6. What would be your suggestion for enhancing communication with partners?

A concern was raised that there is a break in the communication chain among the partners. Is there a way of engaging support from the network, like a community of practice, to be used for communicating within the network to leverage resources?

Jean-François Bibeault provided a summary of Environment Canada's (EC) perspective on some of the issues raised during the discussion. In brief, we need to better leverage governmental priorities (e.g. Great Lakes—St. Lawrence, Lake Winnipeg) to benefit the network partners (e.g. data collection, model development and assessment) and continue to develop the science. We also need to keep an outlook on emerging issues, as future priorities, to better be able to respond collectively to environmental concerns when they begin to occur. However, EC needs to ensure it continues to play an important role in trans-boundary watersheds and recent fiscal contractions in many federal and provincial governments have made departments more cautious on program development and implementation. Regarding the timing of data released perhaps the new tools being developed or improved on the CABIN website can help. Jean-François also acknowledged that the CABIN Science Team can improve its communications with the CABIN community and, in so doing, perhaps find opportunities for joint funding of its science development projects.

Session 2: Study design, QA/QC, and Data Interpretation

SCALE FOR INTERPRETATION:

1. Do we need RCA models at local and more global scales?

What do we do when no RCA model has been developed for an area? As more people join the program there needs to be more guidance from the CABIN Team on which situations require which types of analyses. In addition, stronger coordination/communication among CABIN partners in these areas should be done by the regional leads for development of local models. However, some argue that larger-scale RCA models may not always be appropriate and that other types of models that include other habitat predictors need to be explored.

There is also interest in having better and quicker access to raw data for local-level assessments.

A question was raised as to whether principal component analysis could be used to reduce habitat variables when gradients are wide ranging. This hasn't been tested by Adam but could be looked into. Work published by Legendre and Legendre was suggested as a starting.

2. What is the value of CABIN at each scale?

The more recent practice of deriving GIS data to replace measured habitat variables is of concern. There should be more protocols/guidance on how GIS derived data should be used to increase reliability and comparability of this data.

ENHANCED PROCEDURES:

3. What are the main benefits you see from repeated sampling?

Repeating sampling at reference sites is important to track changes in biological communities over time. However, a question was raised as to whether we should include repeated visits of the same site in the development of RCA models, as this could violate assumptions of independence among samples. Although not clearly discussed, it was suggested that this would not be pseudo-replication but temporal repetition and thus, ok.

DECISION-MAKING SUPPORT:

4. How CABIN could be used as a performance indicator for impaired rivers and lakes?

It is already being used as a performance indicator. However, more work needs to be done to facilitate decision-making such as developing ecological targets and repeated sampling in areas of concern to track progress in ecological condition.

5. Any future adjustments to the program that could be made?

A specific need was identified for offering more training in BC to accommodate increased demand in the use of the CABIN protocol and tools. It was agreed that those taking CABIN online training should all have access to field certification. However, capacity at EC is not increasing in the current context and other options, such as a “train the trainer” approach, are being developed. It was also suggested that groups such as the Entomological Society of Ontario/Canada could be included in this training and CABIN workshops to benefit the program and provide potential trainers.

Need for further support for interpretation of CABIN results as program matures and moves from assessment into management decisions.

Summary of recommendations and suggestions for the national CABIN program

1. Although response is jurisdiction-specific, more post assessment guidance for dealing with *divergent* sites could be provided to facilitate management decisions.

2. Research in developing DNA-sequencing based taxonomic analysis is promising and should continue in order to make Biomonitoring 2.0 a reality.

3. More complete and accessible study meta-data should improve usability of the data generated by different partners, as would further efforts to assess interoperability and transferability of older data and data collected using different protocols. The data access and sharing policy should also be reviewed to accelerate data sharing where possible.

4. Metric and trait-based reports for reference should be developed.

5. Improved communication among partners and better leverage of government priorities would enable the players to better coordinate activities and develop the tools needed for more broadly assessing aquatic habitats across Canada.

6. More guidance on the use of GIS derived habitat variables should be provided to produce more reliable assessment and comparable datasets.

7. Availability of field certification in certain areas is limited and/or demand is outpacing EC's capacity. Practical solutions, such as training trainers outside EC, need to continue.

Appendix

Participants

Name	Affiliation
Aaron Foos	Yukon Government
Adam Yates	Western University
Alain Armellin	Environnement Canada
Alain Caissie	Fundy National Park
Alison Donovan	Canadian Rivers Institute - UNB
Amie MacDonald	Parks Canada/Mount Allison University
Andy Smith	CFB Gagetown, National Defence
Angela Denny	Unama'ki Institute of Natural Resources (UINR)
Anita Doucet	Les Ami(e)s de la Kouchibouguacis Inc.
Billie Joe Fowler	Tabusintac Watershed Association
Bonnie Robertson	AAFC
Caroline Savage	Environnement Canada
Chantal Sarrazin-Delay	Laurentian University
Charles Cormier	Friends of the Kouchibouguacis
Chelton VanGeloven	Province of British Columbia
Christine Drake	Parks Canada
Christine Garron	Environment Canada
Cindy Crane	PEI Department of Environment, Labour and Justice
Colin Curry	Canadian Rivers Institute
Dan Kehler	Parks Canada
Dave Langill	Maxxam
Dave Langill	Maxxam
David Armanini	Canadian Rivers Institute and Prothea
David Hryn	Environment Canada
David Jennings	Univ. of Alberta
Deanna McCullum	Department of National Defence
Devin Ward	NSMDC-AAROM
Donald Baird	Environment Canada
Emily McIvor	Environment Canada
Eric Luiker	Environment Canada
Erin Douthwright	NB Department of Environment and Local Government
Gary Lester	EcoAnalysts, Inc
Gila Somers	UNB
Ginger Gill	North/South Consultants Inc
Harry Collins	Miramichi River Environmetnal Assessment Committee
Heather Leschied	Living Lakes Canada
Ian King	Biodiversity Institute of Ontario, Univ. of Guelph
Janet Feltham	Parks Canada
Jean Beckerton	Environment Yukon
Jean Berlin KEMOIE	Student
Jean-François Bibeault	Environment Canada
Jessica Orlofske	University of New Brunswick - Fredericton, Canadian Rivers Institute
Jim Richard	Nova Scotia Community College
Joanne Sweeney	Provincial Environment and Conservation, NL
Jocelyne Heneberry	OMOE/Cooperative Freshwater Ecology Unit
Jody Fisher	BC Ministry of Environment
Joel Gibson	University of Guelph
Joseph Culp	Environment Canada & CRI
Julie Sircom	Grenfell Campus, Memorial University of Newfoundland
Kelly MacLean	Natural Resources Environmental Technology Student
Kristen Vinke	University of Prince Edward Island
Kristie Heard	Environment Canada
Kyle Brake	Dept of Environment, Gov of Newfoundland and Labrador
Laura Foy	n/a
Lauren Forrester	Royal Military College of Canada
Laurie Carr	LC ecological consulting
Leanne Zrum	North/South Consultants Inc.
Lee Grapentine	EC - WSTD
Leon Gaber	BC Ministry of Environment
Lesley Carter	Environment Canada
Lydia Stepanovic	Parks Canada
Lynn Parent	Pukaskwa National Park
Martin Jean	Environnement Canada
Matthew Smith	Cape Breton Highlands National Park

Name	Affiliation
Mia Edbrooke	AMEC Earth and Environmental
Michael Meunier	University of New Brunswick
Michael White	Minnow Environmental
Michelle Bowman	Forensecology
Michelle Gray	Canadian Rivers Institute
Mike Glennon	EcoAnalysts
Murray Somers	CRI/UNB
Nancy Glozier	Environment Canada
Natasha Popoff	Saskatchewan Ministry of Environment
Nathalie Lowry	Fisheries and Oceans Canada
Nathan Millar	Environment Yukon
Nicole Duke	Nb Department of Environment and Local Government
Pamela Reece	Bravo Zulu Environmental Consulting
Peter Crowley	Volunteer
Pina Viola	Environment Canada
Pippi Lawn	Parks Canada
Rebecca Hersom-Petersen	Morell River Management Coop
Rebecca Rozander	Summit Environmental Consultants Inc.
Rebekah Kipp	McGill University
Rex Turnbull	Labrador Southeast Coastal Action Program Inc.
Robert Bailey	Cape Breton University
Robert Beiko	Faculty of Computer Science, Dalhousie University
Samantha Bland	Southern Gulf of St. Lawrence Coalition
Scott Denkers	Hope Mountain Centre for Outdoor Learning
Shelley Denny	UINR
Simon Courtenay	DFO at CRI, Biology UNB
Stacey Greene	Laurantian University
Stephanie Strachan	Environment Canada
Susan Farquharson	Canadian Rivers Institute
Suzanne Earle	Golder Associates
Tamsin Laing	Environmental Science Group, Royal Military College
Tim Arciszewski	UNBSJ
Timothy Pascoe	Environment Canada
Trefor Reynoldson	Acadia University
Tyron Paul	UINR
Vincent Mercier	Environment Canada
Virgil Grecian	GENIVAR Inc
Vlad Trajkovic	MREAC
Wendy Monk	Environment Canada @ Canadian Rivers Institute
Zacharie Robichaud	Natural Resources Environmental Technology student

CONFERENCE PRESENTERS

THE COMMUNITY AQUATIC MONITORING PROGRAM (CAMP): SORT OF CABIN WITHOUT THE FRESH WATER, BUGS AND RCA

Simon has worked for DFO Gulf Region as a research scientist for the past 22 years. Since 2005 he has been posted to the Canadian Rivers Institute at the University of New Brunswick in Fredericton where he serves as a Research Professor in the Department of Biology. His research focuses on the uses that animals and plants make of estuaries (estuarine ecology) and human impacts on that ecology.

Simon Courtenay
Fisheries and Oceans Canada at the Canadian Rivers Institute, Department of Biology, UNB

OBJECTIVE IDENTIFICATION OF REFERENCE SITES USING GIS

Dr. Adam Yates is an Assistant Professor in the Department of Geography at the University of Western Ontario. His research integrates landscape and aquatic sciences to develop and apply environmental assessment approaches with the goal of detailing the effects of landscape patterns on aquatic ecosystem conditions. Adam's interest in landscape scale effects on stream ecosystems has led him to explore the potential of GIS techniques to improve the accuracy and precision of aquatic assessments.

Adam G. Yates
Assistant Professor, Department of Geography, Western University

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EVALUATING TEMPORAL VARIABILITY OF BENTHIC INVERTEBRATE COMMUNITIES AT REFERENCE SITES IN EASTERN NEWFOUNDLAND

Amie is a third-year biology student at Mount Allison University in Sackville, New Brunswick. She has spent two summers working with Resource Conservation in Terra Nova National Park, where she became involved in a research project examining temporal variation in benthic invertebrate communities at repeat monitoring sites with Dr. David Cote.

Amie MacDonald
Parks Canada/Student, Mount Allison University

CONFERENCE PRESENTERS

APPLYING CABIN TO LONG-TERM MONITORING AT PARKS CANADA

Dan works as a monitoring ecologist for Parks Canada, providing advice on experimental design and analysis across a variety of different projects. His background is in both ecology and statistics.

Dan Kehler
Monitoring Ecologist, Parks Canada

CABIN FEVER

Shelley is a Mi'kmaq originally from the community of Potlotek, NS. Always fascinated with water and the plants and animals that lived there, she pursued an education in biology. After graduating in 2005 with a Masters in Science from St. FX University, she began her employment with the Unama'ki Institute of Natural Resources in Eskasoni, NS. At UINR, she conducts research and gathers traditional knowledge on Bras d'Or Lakes species, especially those that are important to the Mi'kmaq for food, social or ceremonial purposes. Shelley currently resides in Eskasoni with her husband, Levi and three children, Cayden, Levi Jr. and Isabel.

Shelley Denny
Biologist, Unama'ki Institute of Natural Resources

FLOW MONITORING WITH CABIN USING THE CANADIAN ECOLOGICAL FLOW INDEX

Jessica is a Ph.D. candidate studying aquatic insect ecology at the University of New Brunswick with her supervisor Dr. Donald Baird. Jessica's dissertation research includes trait-based community ecology, with a focus on aquatic insect form and function, ecohydrology and ecohydraulics, related to the measurement and maintenance of environmental flows, and the theory and practice of biomontoring and bioindication. Jessica conducts her research in the Miramichi Basin of New Brunswick.

Jessica Orlofske
Canadian Rivers Institute & University of New Brunswick, Department of Biology

CONFERENCE PRESENTERS

A COMPARISON OF ISSUES FACING TWO NATIONAL SCALE RCA BASED ASSESSMENT PROGRAMMES: CABIN AND AUSRIVAS

Trefor Braban Reynoldson, a former Research Scientist with Environment Canada from 1987 until his retirement in 2004. He is now a senior scientist at GHOST Environmental Consulting, Canada, an adjunct professor at Acadia University in Nova Scotia, and has just completed a one year Professorial Fellowship at the University of Canberra. His research was in the development of the Reference Condition Approach, that he formalised as the CABIN national biomonitoring network for Canada.

Trefor B. Reynoldson
GHOST Environmental

GHOST
Environmental Consulting

A COMPARISON OF ISSUES FACING TWO NATIONAL SCALE RCA BASED ASSESSMENT PROGRAMMES: CABIN AND AUSRIVAS

Susan has particular interest in freshwater ecology and biological assessment of river condition. A fundamental interest in aquatic invertebrate ecology takes her into the field and the laboratory to research and apply the science that underpins assessment of human activities and the ecological responses to flow variation. Research and development of the Australian River Assessment System (AUSRIVAS) (the sampling methods, predictive modeling, and the reference condition approach) is a specific interest.

UNIVERSITY OF CANBERRA

Susan Nichols
University of Canberra

THE CABIN DATABASE, LESSONS LEARNED IN ACADEMIC AND PRIVATE SECTORS

The majority of Mike's research has focused on the response of benthic macroinvertebrate community structure to disturbance (M.Sc. - forestry, Ph.D. - water level, Post-doc - mining). Mike was first introduced to CABIN in 2001 while working for EC in the Reynoldson/Grapentine lab located at the Canada Centre for Inland Waters (CCIW). In his current position, at Minnow Environmental, Mike provides expertise concerning experimental design and statistical assessment of aquatic communities. Mike lives in Guelph, Ontario with his partner Heather, their newborn son Alden, and loyal dog Murray.

Mike White
Minnow Environmental, Georgetown, Ontario.

minnow
environmental inc.

CONFERENCE PRESENTERS

APPLICATION OF CABIN AT CFB GAGETOWN AND LFCA TC MEAFORD

Tamsin holds a Ph.D. in aquatic biology from Queen's University and is currently the scientific advisor and project leader for aquatic contaminated site programs at ESG. Over the past 10 years, she has worked on a variety of projects including the assessment and management/remediation of contaminated sediments, ecological risk assessment, and long-term monitoring. Recent projects include designing aquatic monitoring programs, as well as developing scientific guidance on long-term monitoring for federal contaminated sites.

Tamsin Laing
Environmental Sciences Group (ESG), Royal Military College of Canada

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APPLICATION OF CABIN AT CFB GAGETOWN AND LFCA TC MEAFORD

In his current role as Aquatic Biologist, Andy's work encompasses all aspects of the management of the fisheries and aquatic habitat at CFB Gagetown, NB. This includes fisheries and habitat inventories and monitoring, stream restoration, assessment of base development and military training activities, environmental training and outreach. He has previously worked in the Habitat Management Program at DFO and the Ministry of Natural Resources and Conservation Authorities in Ontario. Andy holds a MSc. in Biology from UNB.

Andy Smith
Canadian Forces Base Gagetown, National Defence

AN UPDATE ON BIOMONITORING 2.0: THE FUTURE IS NOW

Following a brief career as a high school Science teacher, Joel received his Ph.D. in Insect Evolutionary Biology from Carleton University in 2011. Since graduating, he has been working on the Biomonitoring 2.0 project with Dr. Mehrdad Hajibabaei at the University of Guelph. More details on him and the project can be found at www.biomonitoring2.org.

Joel Gibson
Biomonitoring 2.0, Biodiversity Institute of Ontario, University of Guelph

CONFERENCE PRESENTERS

CABIN SAMPLING APPROACHES IN LARGE RIVERS

Stephanie recevied her BSc in Biology from the University of Windsor working with Dr. Jan Ciborowski and MSc in Zoology from the University of Western working with Dr. Bob Bailey. She has worked for Environment Canada for 16 years. She is the regional CABIN lead for BC and the Yukon. She also manages the National CABIN Taxonomy Lab. She has been involved in CABIN and projects leading up to the development of CABIN since her university career.

Environment Canada | Environnement Canada

Stephanie Strachan
Environmental Monitoring Scientist, Environment Canada, Vancouver, BC

WHAT MAKES AN RCA MODEL VALID, AND HOW LONG AND FAR DOES THE VALIDITY EXTEND?

Robert Bailey is a BSc and MSc graduate of the University of Guelph, and was a Research Associate at the Institute for Environmental Studies at the University of Toronto for two years prior to completing his doctoral studies at The University of Western Ontario and becoming a faculty member at Western in 1987. In 2000, Bob was appointed Director of the Environmental Science Graduate Program at The University of Western Ontario and subsequently inaugural Director of Environmental Research. In 2009, Bob began a five year appointment as Vice-President, Academic & Professional Studies (Provost) at Cape Breton University, where he is also a Professor of Biology.

CAPE BRETON UNIVERSITY

Robert Bailey
Cape Breton University

CABIN IN YUKON: MONITORING AQUATIC HEALTH UNDER THE FISH HABITAT MANAGEMENT SYSTEM FOR YUKON PLACER MINING

Aaron grew up in the woods of Northern BC and Yukon. A tech diploma got him working for the Yukon Government Department of Environment where he enjoyed many years of wildlife and fisheries work. In 1998 he saw the light and migrated over to fisheries work full time, completing a degree in fisheries and aquaculture at Vancouver Island University along the way. He happily conducts many of the Yukon's fisheries and aquatic assessment programs as part of the small Fisheries unit based in Whitehorse.

Aaron Foos
A/Fisheries Biologist, Environment Yukon

Yukon Environment

CONFERENCE PRESENTERS

COMMUNITY BASED NGO APPLICATION OF CABIN

Heather is actively involved in supporting water stewardship efforts in the Columbia Basin. Her work has contributed to the precedent setting Shoreline Management Guidelines for one of the most heavily developed lakes in southeastern British Columbia, and was the success template for 11 other lakes in the Kootenay Region, and most recently Lake Winnipeg. Heather received an Honours Bachelor of Environmental Studies and Geography degree from Lakehead University in Thunder Bay, Ontario on the north shore of Lake Superior.

Heather Leschied
Program Manager, Living Lakes Canada

RESTORATION OF ECOLOGICAL INTEGRITY IN LARGE MOUNTAIN RIVERS

Michelle Bowman is an independent consultant for various provincial and federal government agencies. Although she is interested in the effects of multiple stressors on aquatic biodiversity in general, benthic algae and macroinvertebrate communities in streams are most often the focus of her research. Due to the multi-variable nature of these questions, developing multivariate study designs and analytical techniques appropriate for ecological systems has also become a significant part of her research.

Michelle Bowman
Forensecology

THE CABIN SCIENCE TEAM OVERVIEW AND ACTIVITIES

Since 2003, Dr. Baird has been employed as a Research Scientist with Environment Canada, where his responsibilities include developing the science component of Cabin and developing techniques and approaches to support national aquatic biodiversity status and trends reporting, which includes recent work on trait-based prediction and diagnostics development, Biomonitoring 2.0, and the development of new biomonitoring tools for the Lower Athabasca oil sands region. He is also a Research Professor, at the Canadian Rivers Institute, based at the University of New Brunswick.

Donald Baird
Environment Canada, Canadian Rivers Institute (UNB)