COMMUNITY SCIENCE WORKSHOP:

BIOMONITORING IN THE BOW

SUMMARY REPORT

WWF-Canada Photo

Living Lakes CANADA

Bow River Basin Council

ACKNOWLEDGEMENTS

The Bow River Basin Council and Living Lakes Canada would like to thank workshop presenters Environment and Climate Change Canada, the Oldman Watershed Council, Ghost Watershed Alliance Society, Elbow River Watershed Partnership and the University of Calgary. A special thank you also goes out to the City of Calgary for providing the space for this event in the City of Calgary Water Centre, and to funders Bow River Basin Council and Calgary Foundation for making this workshop possible.

FOR QUESTIONS ABOUT THIS REPORT, CONTACT:

Brooke Kapeller, Bow River Basin Council: brooke.kapeller@brbc.ab.ca

Rhia Mackenzie, Living Lakes Canada: rhia@livinglakescanada.ca

TABLE OF CONTENTS

LAND ACKNOWLEDGEMENT

In the spirit of Reconciliation, we acknowledge that this workshop and biomonitoring work took place on the traditional territories of the Blackfoot Confederacy (Siksika, Kainai, Piikani), the Tsuut'ina, the Îyâxe Nakoda Nations, and the Métis Nation (Region 3), in the Treaty 7 region of Southern Alberta.

1. SUMMARY OF THE WORKSHOP

On Friday November 4th, 2022, the Bow River Basin Council in partnership with Living Lakes Canada hosted a Community Science Workshop: Biomonitoring in the Bow. The structure consisted of morning presentations followed by an afternoon of breakout sessions on topics related to biomonitoring. It was an opportunity for anyone interested in biomonitoring and community science to connect with one another, learn about biomonitoring, and develop new collaborative opportunities. Most of the presenters focused on the Canadian Aquatic Biomonitoring Network (CABIN) protocol, with some discussion on STREAM (Sequencing the Rivers for Environmental Assessment and Monitoring), which utilizes eDNA metabarcoding technology of benthic macroinvertebrates for biomonitoring.

The morning presentations included:

- Emily McIvor, Environment and Climate Change Canada: The Canadian Aquatic Biomonitoring Network (CABIN)
- Rhia Mackenze from Living Lakes Canada: Sequencing the River for Environmental Assessment and Monitoring (STREAM) updates
- Sofie Forsström, Oldman Watershed Council: Community-based Aquatic Monitoring in the Oldman Watershed & Beyond
- Marina Krainer[a,b], Cal Hill[a], and Flora Giesbrecht[b], [a]Ghost Watershed Alliance Society and [b]Elbow River Watershed Partnership: Aquatic Biomonitoring in the Ghost and Elbow Watersheds
- David Barrett and Aphra Sutherland, University of Calgary: Biomonitoring in the Bow: to the CABIN and Beyond! Quantifying potential impacts of municipal wastewater effluent on the Bow River Ecosystem

The four breakout session topics were:

1. Mapping initiatives: CABIN/STREAM mapping exercise
2. Questions about CABIN/STREAM: Sticky note facilitation and discussion time
3. Capacity and support Q&A: Sticky note facilitation and discussion time
4. Data quality, management, and interpretation: Facilitated discussion time

The afternoon breakout sessions are further summarized in section 4. The purpose of this report is to summarize the information shared at the workshop and to provide additional information for people interested in learning more about biomonitoring community science.

FIGURE 1. WORKSHOP PRESENTERS. FROM LEFT TO RIGHT: APHRA SUTHERLAND, DAVID BARRETT, SOFIE FORSSTRÖM, RHIA MACKENZIE, EMILY MCIVOR, CAL HILL, MARINA KRAINER, FLORA GIESBRECHT

2. BACKGROUND ON BIOMONITORING

Aquatic biological monitoring (Biomonitoring) is observing, researching and measuring biological organisms and communities to detect change and impacts to the health of an ecosystem. Different aquatic communities, such as fish, phytoplankton, and benthic macroinvertebrates can be used, depending on the monitoring program.

Benthic macroinvertebrates (BMI) communities are often monitored, as they are excellent bioindicators of water quality and can indicate impact-affected sites within aquatic ecosystems. Alongside water chemistry parameters and habitat variables and features, biomonitoring BMI can be used to detect change and relative ecosystem health.

Community-based Water Monitoring Programs (CBWM) are multi-pronged and aim to answer site specific watershed questions and to protect, conserve and educate a variety of stakeholders about the health of and risks to the watershed. Biomonitoring has become an integral part of CBWM, and monitoring benthic macroinvertebrates is accessible as the assessment is a well-established federally developed methodology.

CABIN is a nationally standardized biomonitoring protocol, developed by Environment and Climate Change Canada (ECCC), and involves collecting benthic macroinvertebrate samples alongside habitat and water quality data to determine relative stream health and to monitor stream changes. Benthic macroinvertebrates, the community of organisms that live in the substrates along the bottom of a river or stream, are excellent bioindicators of aquatic health due to their high sensitivity to pollutants and climate change-related impacts. The benthics are collected by participants using the standardized CABIN kick-netting protocol. Once collected, the benthics are sent to qualified taxonomists who then identify which are present based on physical traits. The data collected is uploaded to the national CABIN database where certified CABIN users can run a statistical analysis tool that produces a stream health assessment.

The results of that identification and the other data collected is uploaded to the national CABIN database where certified CABIN users can run a powerful yet simple-to-use statistical analysis tool that produces a stream health assessment. This final product — the stream health assessment report — is widely acknowledged and accepted as a valuable indicator of stream health at the time of collection.

Training in the CABIN methods include two components, 1.) Online Modules are part of the CABIN training and are housed and managed by the Canadian Rivers Institute. 2) Participation in a 2-day field training that covers data collection techniques. There are no other prerequisites to join a CABIN training other than completing module 1 and 2 before the field certification.

STREAM (Sequencing The Rivers for Environmental Assessment and Monitoring) is a community-based project that is led by the Hajibabaei Lab at the University of Guelph's Centre for Biodiversity Genomics. This project is a nation-wide collaboration between Living Lakes Canada, Environment and Climate Change Canada (ECCC) and participants ranging from scientists to various community groups.

STREAM aims to produce data to enhance our understanding of stream biodiversity and the health of river systems across Canada. By collecting samples of benthic macroinvertebrates, STREAM applies DNA metabarcoding technology that has the potential to provide faster, more accurate results and is less expensive than morphological taxonomic identification due to STREAM's capacity to analyze samples in bulk. DNA metabarcoding is an emerging tool for monitoring present biodiversity that offers an enhanced look at aquatic biodiversity.

STREAM participants are trained to collect benthic macroinvertebrate samples using a modified version of ECCC's Canadian Aquatic Biomonitoring Network (CABIN) protocol. Living Lakes Canada trains and certifies organizations using the adapted CABIN protocol for STREAM and assists organizations in their first year of sampling. Where appropriate, Living Lakes Canada offers knowledge in site selection and monitoring. The organizations then commit to maintaining the project in later years, uploading results to the CABIN database and sharing data in open platforms. Participants learn and build skills for stream health assessments, open-sourced data inputs, and accessible data interpretation while contributing to STREAM.

In 2023, the STREAM project will expand to further our efforts in biomonitoring and environmental stewardship. Living Lakes Canada will continue to offer training and certification for STREAM. For more information about STREAM, please visit https://stream-dna.com/.

3. EASTERN SLOPES COLLABORATIVE

Living Lakes Canada and the Oldman Watershed Council launched a CBWM Collaborative across the Eastern Slopes in 2019. Living Lakes Canada has worked with partners to assess local community needs, share expertise and resources, and secure additional resources as required. Partner organizations include Watershed Advisory and Planning Councils (WPAC), local water stewardship groups, First Nations land managers, universities, municipal, provincial, and federal government agencies and other community organizations. The Eastern Slopes Collaborative have completed training and will continue to complete necessary training, identify local study objectives and sites, and collect data from streams using national CABIN sampling protocol and STREAM eDNA metabarcoding analysis. Living Lakes Canada will also work to support a reference model for the Eastern Slopes that can be used for assessing test sites using the Reference Condition Approach[1] (RCA).

Multiple land uses along the Eastern slopes of the Rockies will have an impact on water quality and aquatic ecosystems; there is a need for more monitoring both to establish baseline conditions and to measure change. Aquatic monitoring by the provincial government varies according to budget and priorities. An opportunity exists for local organizations and volunteers to work together to continually develop and implement CBWM programs to augment and complement government monitoring.

COMMUNITY-BASED MONITORING (CBM) PROGRAMS ARE:

- Driven by local community needs and values;
- Nimble and flexible because they are coordinated by smaller organizations;
- Able to make data accessible to the community in a timely fashion;
- Fantastic experiential learning activities and skills training, and;
- Opportunities to engage and motivate local citizens.

ENGAGED ORGANIZATIONS INCLUDE:

- ABI Environmental Services
- Alberta Environment and Parks
- Athabasca Watershed Council
- Blood Tribe Land Management
- Bow River Basin Council
- City of Calgary
- Cows and Fish
- Elbow River Watershed Partnership
- Environment and Climate Change Canada
- fRI Research
- Ghost Watershed Alliance Society
- Lesser Slave Watershed Council
- Living Lakes Canada
- Livingstone Land Owners Association
- Mighty Peace Watershed Alliance
- North Saskatchewan Watershed Alliance
- Oldman Watershed Council
- Parks Canada
- Red Deer River Watershed Alliance
- University of Calgary
- University of Guelph
- University of Victoria

4. SUMMARY OF BREAKOUT SESSIONS

There were four breakout sessions in the afternoon:

1. Mapping initiatives: CABIN/STREAM mapping exercise
2. Questions about CABIN/STREAM: Sticky note facilitation and discussion time
3. Capacity and support Q&A: Sticky note facilitation and discussion time
4. Data quality, management, and interpretation: Facilitated discussion time

The attendees were divided into four approximately equal groups and rotated through each session so that each facilitator was able to discuss the topics at hand with all attendees in a more in-depth manner.

4.1 Mapping Initiatives

Facilitator: Rhia MacKenzie, Living Lakes Canada

Note-taker: Alesia Cameron, Bow River Basin Council

This session had two large, printed maps and participants were asked to identify priority areas for biomonitoring. The facilitator posed four questions to each of the groups:

1. Post pink where you have sampled (monitored)
2. Post yellow where you would like to monitor
3. Are you doing any other environmental monitoring outside of CABIN/ STREAM?
4. List a main priority, priority area, or concern (with name and organization too)

FIGURE 2. PHOTO OF PRINTED MAPS

The information gathered in this session is summarized in the following map:

FIGURE 3. CLOSE UP PHOTO OF WHERE GROUPS WERE INTERESTED IN MONITORING AND WHERE GROUPS HAVE BEEN MONITORING

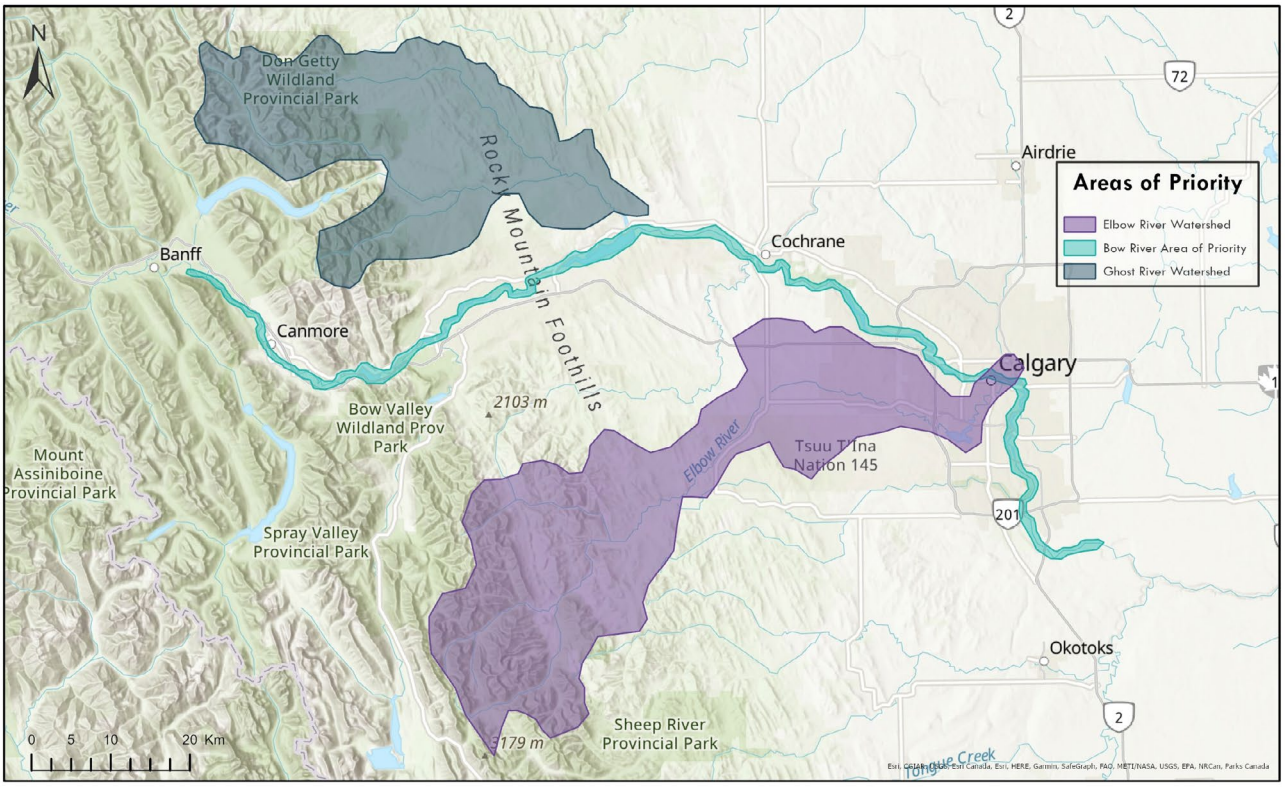


FIGURE 3B. MAP OF PRIORITY AREAS FOR FUTURE BIOMONITORING

AREAS OF WORK:

- Elbow River Watershed (mainstem + tributaries) upstream of the City of Calgary
- Ghost River Watershed (mainstem, headwaters + tributaries) upstream of the City of Calgary
- Bow River

AREAS TO PRIORITIZE:

- Nose Creek
- Bighill Creek
- Fish Creek
- Waiparous (including tributaries)
- Jumping Pound Creek
- Fisher Creek
- Whiskey Creek
- Pine Creek
- Policeman's flats
- Bonny brook

COMMON THEMES WERE DISCUSSED BY ATTENDEES:

LAND USE CONCERNS

Many people discussed concerns with land use pressures in the headwaters, in particular their impact on native trout habitat. Specific concerns were pressure related to industry (forestry, oil and gas), recreation (OHV use, random camping), as well as cattle grazing.

NATIVE TROUT

It was noted that the headwaters of the Bow Basin are habitat for threatened native trout species (Bull Trout and Westslope Cutthroat Trout). There are many streams in the area that are designated Critical Habitat by Fisheries and Oceans Canada[2]. Watershed Stewardship Groups are targeting biomonitoring efforts (along with other sampling programs) in areas where native trout are known to exist (either at present or historically).

DRINKING WATER QUALITY

There was discussion about the use of biomonitoring to understand drinking water quality, particularly within the City of Calgary. There may be support available for Watershed Stewardship Groups to conduct biomonitoring upstream of the City if it is relevant to drinking water quality. Further research and investigation is needed before this approach is applied.

4.2 Questions about CABIN/STREAM

Facilitators: Emily McIvor, Environment and Climate Change Canada; Sofie Forsström, Oldman Watershed Council

Note-taker: Alan Breakey, Bow River Basin Council

This session was an opportunity for attendees to discuss CABIN and/or STREAM in more detail with Emily (the Regional CABIN Lead with ECCC) and Sofie (a certified CABIN trainer in Alberta).

COMMON THEMES THAT WERE DISCUSSED:

TRAINING

Training information is available on the Canadian Rivers Institute website:

- https://www.canadianriversinstitute.com/training/cabin

There are multiple options for certification (Field Technician, Project Manager, etc.). The steps for CABIN training is as follows:

- April/May: online modules open for the new session.
- July/August/September: field component training happens during the summer. Module 1 must be completed prior to field training.
- March: data entry and remaining modules must be completed.

There are multiple options for field training (Environment and Climate Change Canada, Living Lakes Canada, Oldman Watershed Council). Most field courses are posted on the Canadian Rivers Institute website. The cost for training a CABIN candidate varies between $350 and $700.

If a community has sufficient interest in one of these programs, it is often cheaper for an instructor to travel to the community rather than the community members traveling to an instruction site. Private courses may also be available in some circumstances, pending discussion with a regional CABIN lead for possible options. Living Lakes Canada provides private CABIN courses. Please contact info@livinglakescanada.ca to inquire about a course.

ECCC Contact Information:

- Emily McIvor, Regional CABIN Lead: emily.mcivor@ec.gc.ca
- General CABIN email: f.RCBA-CABIN.f@ec.gc.ca

SAMPLING CONSISTENCY

The CABIN program is designed to minimize the number of variables impacting the data. For example, sampling of invertebrates is always conducted in the Fall. STREAM samples can be taken at anytime of year because the analysis doesn't rely on taxonomic identification. Nevertheless, the sampling consistency does not eliminate variables altogether. Watershed monitoring requires "setting up for a long term thing". There are so many variables affecting the monitoring parameters (for example, varying weather conditions) that data needs to be collected over long periods of time to make any sense of how these variations might impact any conclusions. If data is collected for a long enough period, certain decipherable patterns are likely to emerge.

VARIABILITY

There was considerable discussion on the topic of variability and how to establish valid baselines. There is natural variability and climate change-induced variability. The selection of "reference sites" must be done with extreme caution & care.

It is important not to be overwhelmed by the complexity of the variables and not let this complexity interfere with the collection of data. It is an evolving process that will ultimately result in a better understanding of our watersheds and the factors impacting them.

CABIN WETLANDS

CABIN Wetlands is in its formative stages. Wetland protocols are particularly difficult to establish because of the extreme complexity and variability of wetland environments.

4.3 Capacity & Support

Facilitators: Mike Murray, Bow River Basin Council; Hunter Smith, Living Lakes Canada
Note-taker: Medini Prasai, Bow River Basin Council

This session was an opportunity for groups to discuss and report on any concerns with capacity or support to undertake biomonitoring work.

There were a few specific questions posed to the attendees in this session regarding CABIN sampling as well as data:

CABIN SAMPLING: GROUP QUESTIONS

1. Do you feel your group would benefit from CABIN / STREAM training?
    - Resounding yes
2. Which species are you interested in sampling for?
    - Participants were given a list with completed assays for target taxa and they could check which species they were interested in monitoring with targeted eDNA (the identified list included zebra and quagga mussels, tiger salamander, western toad, northern pike, northern leopard frog, rainbow trout, cutthroat trout, Borela and Western Chorus Frog, Bull trout and Arctic Grayling)
3. What difficulties do you foresee implementing CABIN/ STREAM
    - Generally, equipment has not been a huge problem, sharing equipment might not work due to contamination (Whirling disease)
    - Volunteer retention has been the biggest issue. Keeping up with training new volunteers is hard
    - Access for CABIN training for members of the public rather than just community groups
    - Funding is always an issue (e.g., staff time, training costs, equipment, etc.)
    - Accessibility of sites of interest (cost of transport, time, money)
4. What needs do you have surrounding equipment?
    - Generally, equipment has not been a huge issue
    - Using hazardous materials was identified as an issue

LIVING LAKES CANADA TRAINING: GROUP QUESTIONS

Living Lakes Canada has funding to host CABIN/STREAM training in the Bow Basin July 2023.

1. Is there interest?
    - Very much yes
    - Interest in school group-based monitoring (X-Stream Science)
2. Is there a specific location that would be preferred?
    - Jumping pound near Cochrane stood out
    - An area done for swift water rescue was specifically mentioned
    - One hour outside of Calgary was suggested for ease of access
    - Canmore was also mentioned

DATA QUESTIONS

1. Where is your data stored?
    a. Is it with CABIN/STREAM database?
        - Groups that use CABIN store it with the CABIN database.
        - Other groups/organizations generally store their biomonitoring data internally
2. Is your data openly accessible?
        - Yes for all but fish creek
        - Interested in learning more about data accessibility

COMMON THEMES DISCUSSED BY ATTENDEES:

CABIN TRAINING

Many attendees were interested in participating in future training opportunities. Concerns regarding training were brought up:

- Timing mismatches: it is difficult for groups to get volunteers trained when the training opportunities only exist at specific times/places. It is also difficult to keep momentum going when training is not accessible at all times of the year.
- Local training opportunities: there is a need to develop training capacity locally, perhaps a Train-the-Trainer program in the Bow Basin so that there is a dedicated trainer for this region rather than relying on individuals from outside the local area. Training within 100 km of Calgary was discussed as being the best option.

VOLUNTEERS

There is a need for additional volunteers/people capacity to undertake CABIN sampling, specifically volunteers who are trained in the protocol. Sampling is possible with untrained volunteers but it takes much longer.

Concerns with volunteer retention were also discussed: volunteer turnover, shortage of volunteers, investment in training, etc.

4.4 Data Quality, Management, and Interpretation

Facilitators: David Barrett and Aphra Sutherland, University of Calgary

Note-taker: Wendell Koning, Bow River Basin Council

Dave and Aphra were very creative in their afternoon introduction – specifically they used a game to facilitate discussion and help attendees better understand the benthos of a typical river.

FIGURE 5. FACILITATED GAME USED TO DISCUSS THE BENTHOS OF A TYPICAL RIVER

Rivers change a lot as they move from upstream to downstream. They often start off nutrient limited (e.g., if from the east slopes of the Rocky Mountains) and after a distance downstream become nutrient enriched; upstream they may be a cold temperature stream and downstream, cool temperature and further yet, perhaps warm temperature; upstream they normally are a higher gradient, downstream a lower gradient as it flattens out; upstream, a narrow channel, while downstream the channel widens due to erosion and underlying geology; upstream it will have a boulder-cobble-gravel substrate, and downstream, a gravel to soft sediment substrate; and from low to higher salinity. Much of this is explained in more detail by what is called "the river continuum concept".[3]

Along with all the natural variation, one can expect changes in a river due to anthropogenic impacts such as roads, forestry, recreation, oil and gas activities, urban centres, stormwater, wastewater, agriculture.

The task participants were given in the breakout session was to place cut out images of benthic invertebrates along three locations in a river, in this case the Bow River, from upstream in the area around Banff, Canmore, to a mid-section along the Bow and the Bow River just upstream of Calgary, to a downstream section, namely the Bow River downstream of Calgary.

The invertebrate images corresponded to the EPT orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) - and these were compared to organisms in the Diptera class of invertebrates (true flies, midges, mosquitos). We were given 10 of each and instructed to place them in whatever composition we felt appropriate at the three sites. Participants, with much discussion, decided that there would be increases in abundance from upstream to downstream largely based on more food availability /productivity (nutrients feeding algal growth initiating the food chain). There were both grazers (especially the Dipterans)

and predators, with many more grazers in the middle and especially at the lowest site. The predators in the EPT orders dominated at the upper site and, but less so at the middle site. The lower site, while having an abundance of grazers would be less attractive to EPT due to warmer temperatures and lower dissolved oxygen levels (DO) (due to the high productivity) especially at nighttime (respiration driven reduction in DO). We challenge workshop attendees who have participated in the STREAM project to compare their benthic biodiversity reports with the workshop results to see if the benthic communities are present as expected based on this station.

The conclusion is that EPT are good indicators of the health of water bodies because these flies are more sensitive to environmental change than other benthic invertebrates. The abundance of these benthic invertebrates can be influenced by the many factors from water quality, temperature, suspended sediments and sedimentation. These types of invertebrates can be monitored to understand more about the health of a water body. Keep in mind, as per the river continuum concept, some of the faunal changes one sees in rivers can also be due to natural change and variation – and knowing the difference between natural and anthropogenic is a challenge for us in our work, with invertebrate monitoring providing an excellent insight into assessing and understanding aquatic conditions.

5. PRIORITIES IDENTIFIED

Participants of Biomonitoring in the Bow identified main priorities, needs and concerns. Based on participants priorities moving forward, five dominant needs and concerns were communicated throughout the event and they are as follows:

- Need for further training and greater capacity
- Need for support and capacity for data storage, analysis and interpretation,
- Need to create a community-based water monitoring program in partnership with the City of Calgary to address potential impacts of the Calgary water treatment facility,
- Concern about multiple land-use pressures and the need to have effective tools to monitor impacts and lastly,
- Concern for species at risk Bull Trout (*Salvelinus confluentus*) and Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) and their critical habitat delineation.

Further training and certification in CABIN and STREAM of volunteers and organizations' members was identified as a priority. Biomonitoring has become an integral part of community-based water monitoring programs throughout the Eastern Slopes of the Rockies, as such more training and certification is needed. Living Lakes Canada, Oldman Watershed Council and Environment Climate Change Canada can offer training and certification. A training sign-up sheet was used as a first step to address this need. Beginning in 2023 STREAM will have its own training and certification that will be offered by Living Lakes Canada.

Analysis and interpretation of data collected through the CABIN and STREAM protocols are important for understanding changes in the ecosystems. Participants need assistance and support to carry out analysis. There is no CABIN reference model for the Eastern Slopes and as such, the CABIN RCA analytical tools are unavailable for use. Participants voiced the need for a CABIN reference model for the Eastern Slopes and analytical tools to investigate STREAM data results. A central data storage repository for additional watershed data would be beneficial for easy data access and for organizations to identify gaps.

City of Calgary environmental management staff expressed they would like to support watershed community groups to collaborate on a water monitoring program that would incorporate CABIN and STREAM biomonitoring to assess potential impacts from the city's water treatment facility. University of Calgary researchers echoed the need for further research upstream and downstream of the facility to assess impacts. The Bow River Basin is a priority area for multiple organizations.

Land-use pressure from industry, agriculture and recreational activities along the Eastern Slopes was a major concern. Participants were interested in the best ways to monitor and measure impacts, particularly logging impacts to waterways, sedimentation due to OHV use in waterways, and water quantity issues relating to droughts, industry and irrigation consumption of water.

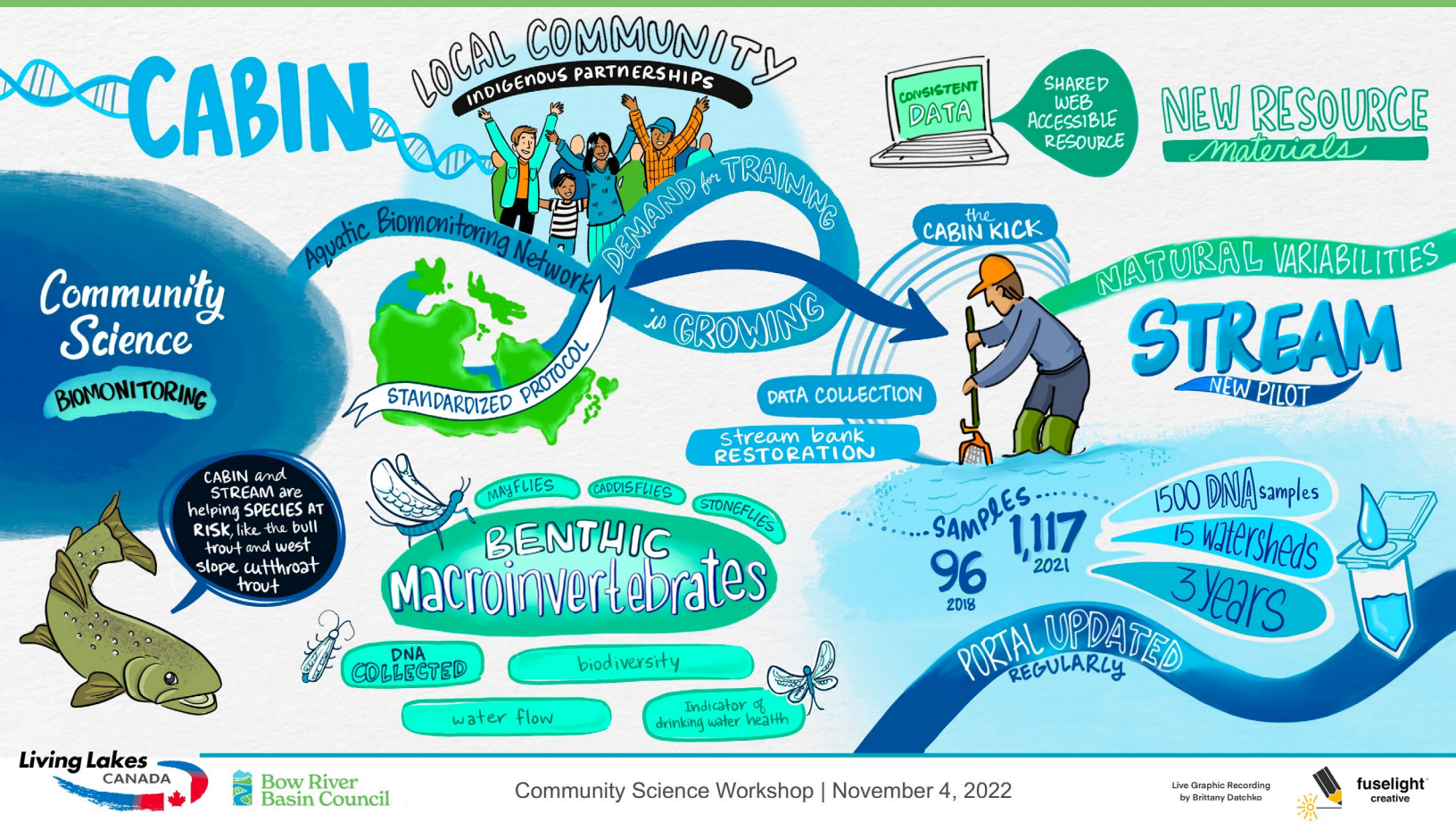
In face of the mounting land use pressures, participants are concerned about species- at- risk critical habitat including Bull Trout and Westslope Cutthroat Trout and question whether the recovery strategies were doing enough to protect these species and their habitat. The Oldman Watershed Council and Ghost Watershed Alliance Society expressed apprehension around the spread of Whirling disease in Westslope Cutthroat Trout and immense fishing pressure throughout multiple waterways. Organizations have begun using eDNA metabarcoding to detect the presence of the Tubifex worm host of Whirling disease. Groups have also worked in collaboration to educate anglers on the need to stop the spread of Whirling disease through conducting provincial decontamination protocols.

6. FUTURE RECOMMENDATIONS AND OPPORTUNITIES

Addressing priority needs and concerns are the basis of future recommendations. Below is a list of stakeholder-guided suggestions for future Eastern Slopes Collaborative operations.

- Increased CABIN and STREAM certification trainings
- Create an Eastern Slopes Collaborative central data storage system
- Garner greater support in data analysis and interpretation; as a webinar, workshop, or educational modules.
- Investigate what is required for a CABIN reference model for the Eastern Slopes and whether the model would be most effective as a sub-watershed model
- Explore whether the STREAM R script created for Atlantic Canada could be exported to the Eastern Slopes and what other STREAM analytical tools could be accessed and utilized.
- Support further collaboration with organizations, the City of Calgary and the University of Calgary to design a community-based aquatic monitoring program that integrates biomonitoring data collection and impacts analysis.
- Research additional methods or analytical tools to biomonitor a variety of land-use impacts.
- Continue and expand monitoring for Whirling disease hosts. Continue and expand decontamination education.
- Acquire multiple level government agencies' support to monitor species-at-risk fish and fish habitat.

Opportunities exist to engage more stakeholders to become active members of the Eastern Slopes Collaborative. Furthermore, turning data collection and analysis into actionable management results is a priority for the Eastern Slopes Collaborative. As such, a Learning Action Alliance Framework[4] could create wider stakeholder engagement and cross-sectional effective water management.



The visual graphic recording of the workshop by Fuselight Creative.

7. POST-EVENT COMMUNICATIONS

7.1 Infographic

A visual graphic recording of the Biomonitoring in the Bow Workshop was created by Fuselight Creative. Watch a time lapse video of the graphic recording from the Biomonitoring in the Bow workshop.

7.2 Workshop Summary Article

A summary article was written and shared on both the Living Lakes Canada and BRBC websites, as well as shared with all media outlets in the area.

The article can be read here:
https://livinglakescanada.ca/2022/11/17/wading-into-water-concerns-in-the-bow-basin/

8. RESOURCES AND ADDITIONAL INFORMATION

8.1 Organizations involved in the workshop:

- Bow River Basin Council: https://brbc.ab.ca/
- Living Lakes Canada: https://livinglakescanada.ca/
- Oldman Watershed Council: https://oldmanwatershed.ca/
- Ghost Watershed Alliance Society: https://www.ghostwatershed.ca/
- Elbow River Watershed Partnership https://www.erwp.org/
- Alberta Watershed Planning and Advisory Councils: https://www.alberta.ca/watershed-planning-and-advisory-councils.aspx

8.2 CABIN training:

ECCC CABIN Regional Contact: Emily McIvor, emily.mcivor@ec.gc.ca

Canadian Rivers Institute CABIN website (for course information/registration/etc.): https://www.canadianriversinstitute.com/training/cabin

Living Lakes Canada: Raegan Mallinson, Program Manager and CABIN/STREAM trainer: raegan@livinglakescanada.ca

8.3 Organizations involved in the workshop:

For details on the STREAM program, please visit: https://stream-dna.com/

In 2023, the STREAM project will expand to further our efforts in biomonitoring and environmental stewardship. Living Lakes Canada will continue to offer training and certification for STREAM.

Living Lakes Canada: Raegan Mallinson, Program Manager and CABIN/STREAM trainer: raegan@livinglakescanada.ca

ENDNOTES

1 https://www.sciencedirect.com/science/article/pii/S1462901117304355

2 Government of Canada. (2022). Critical Habitat of Species at Risk. Retrieved from https://open.canada.ca/data/en/dataset/db177a8c-5d7d-49eb-8290-31e6a45d786c.

3 Vannote, R.L, G.W. Minshall, K.W. Cummins, J.R. Sedell. C.E. Cushing. 1980. The river continuum concept. Can. J. Fish Aquat. Sci. 37: 130-137.

4 https://open.canada.ca/data/en/dataset/13564ca4-e330-40a5-9521-bfb1be767147


Living Lakes
CANADA


Bow River
Basin Council