



TREAM

Sequencing The Rivers for Environmental Assessment and Monitoring



Environment and
Climate Change Canada
Environnement et
Changement climatique Canada

UNIVERSITY
of GUELPH





STREAM

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

STREAM generates DNA-based data on benthic macroinvertebrates, the community of organisms (bugs) that live in the substrates of

rivers and streams. These benthic macroinvertebrates are collected from rivers across Canada following adjusted CABIN protocols. A technology called "DNA metabarcoding" is used to analyze and characterize DNA from benthic samples. This DNA is compared to known DNA barcode libraries to identify organisms that are present.

STREAM is investigating the potential for DNA metabarcoding in routine biological monitoring to assess freshwater health. DNA

metabarcoding has the potential to provide faster turnaround times for results given the greater capacity to analyze samples in bulk. It is also more cost-effective than analyzing samples using morphological taxonomic identification and has the potential to provide more accurate, enhanced biodiversity information.

This project is funded in part by Genome Canada, Ontario Genomics and Illumina, which support the University of Guelph in providing sample analysis for participants.



The Canadian Aquatic Biomonitoring Network (CABIN) is a nationally standardized biomonitoring program for freshwater ecosystems in Canada. Developed by ECCC, CABIN provides consistent, comparable and scientifically rigorous approaches to aquatic biomonitoring and assessment.

The CABIN program focuses on benthic macroinvertebrates. These organisms are excellent

indicators of aquatic health due to their high sensitivity to pollutants and climate change related impacts.

CABIN includes sampling protocols for the collection of benthic macroinvertebrates, alongside habitat and water quality information. CABIN training and certification for these protocols is available through the CABIN Training program. Living Lakes

Canada was one of the first nongovernmental organizations (NGOs) certified to deliver CABIN field training.

More information about CABIN can be found on the ECCC website.

STREAM-adjusted CABIN protocols include:

Considerations to minimize DNA contamination, ensuring proper sample preservation, sample handling, storage, and shipping.



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BENEFITS

All participating organizations and community groups are essential for the STREAM project. By collecting benthic macroinvertebrate samples, your organization or group contributes to closing Canada's watershed data gaps and the better understanding of aquatic ecosystem health across the country.

STREAM offers support to participating organizations and community groups by providing equipment allocation, field training, sample collection, and shipping. Samples contributed to the project are analyzed at the University of Guelph at no cost in 2023.

Your organization or group will receive a benthic macroinvertebrate data report from the University of Guelph, indicating trends in macroinvertebrate communities and inferring freshwater health status.



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HOW THE PROGRAM WORKS

1

CABIN and STREAM training

CABIN training was created by ECCC in association with the Canadian Rivers Institute (CRI). It is a prerequisite to participate in the STREAM project. CABIN Training and Certification can be completed through the CABIN Training program, or through one of the Living Lakes Canada STREAM field training courses listed on the CABIN website. Please refer to the CABIN website for further information about CABIN, training, or other general updates.

Once participants are CABIN-trained, the STREAM procedure for collecting benthic macroinvertebrate DNA samples in wadeable streams is explained in person, during the STREAM field training course led by Living Lakes Canada. CABIN training and any associated costs will depend on the level of certification required for each given group.



Photo credit: ©Tamanna Kohi/STREAM

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Collecting STREAM samples

As part of the STREAM project, ECCC has developed procedures for decontamination and sample processing techniques. The collection of three distinct biological replicate samples is recommended at each site. Replicate samples are collected by sampling in a riffle (3-minute kick net). This process is repeated two more times within the same riffle with each sample collected upstream of the last.

Benthic macroinvertebrate DNA samples are preserved using propylene glycol-based antifreeze or denatured alcohol at a concentration greater than 90%. This includes rubbing alcohol (ethanol anhydrous, isopropynol etc.) that can be purchased over-the-counter at drug stores.



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Labelling and shipping STREAM samples

All steps are outlined in the provided STREAM Shipping Standard Operation Procedure (SOP). Each sample jar requires key information to ensure it is properly identified.

Groups are encouraged to send samples directly after collection to avoid a bottleneck of samples awaiting processing in the fall and winter. Prior to shipping, groups notify the University of Guelph by completing copies of the STREAM Sample Manifest with the required sample information. Samples must be shipped by a GROUND courier, such as Purolator, following Transportation of Dangerous Goods (TDG) requirements.



Photo credit: ©Catherine Paquette/WWF-Canada

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Analysis of STREAM samples

There are no current DNA-based analytical tools available through the CABIN Database to analyze benthic macroinvertebrate data using DNA metabarcoding identifications. STREAM examines the potential for DNA metabarcoding in the context of nation-wide biomonitoring.

STREAM benthic macroinvertebrate DNA samples are analyzed at the Hajibabaei Lab using the latest DNA analysis pipelines. Analysis takes approximately two months, depending on lab capacity. Sample analysis may be delayed from September-November due to increased workload from seasonal biomonitoring programs.

A report is generated and includes the total number of phyla, classes, orders, families, genera and species, as well as taxa tables highlighting bioindicator species that can suggest water quality status. The results from DNA metabarcoding identification, such as taxa lists, are stored in the CABIN database under the STREAM-BERGE project.

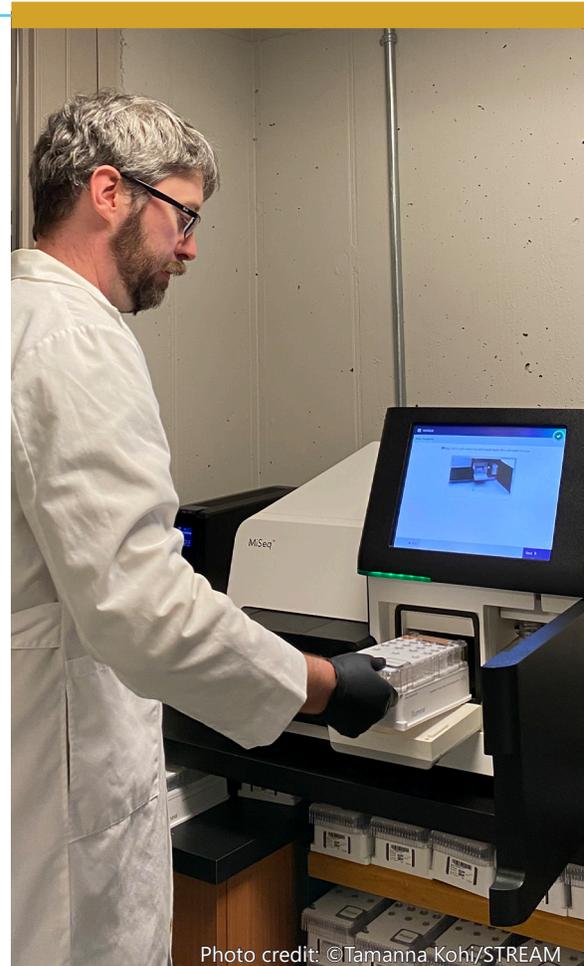
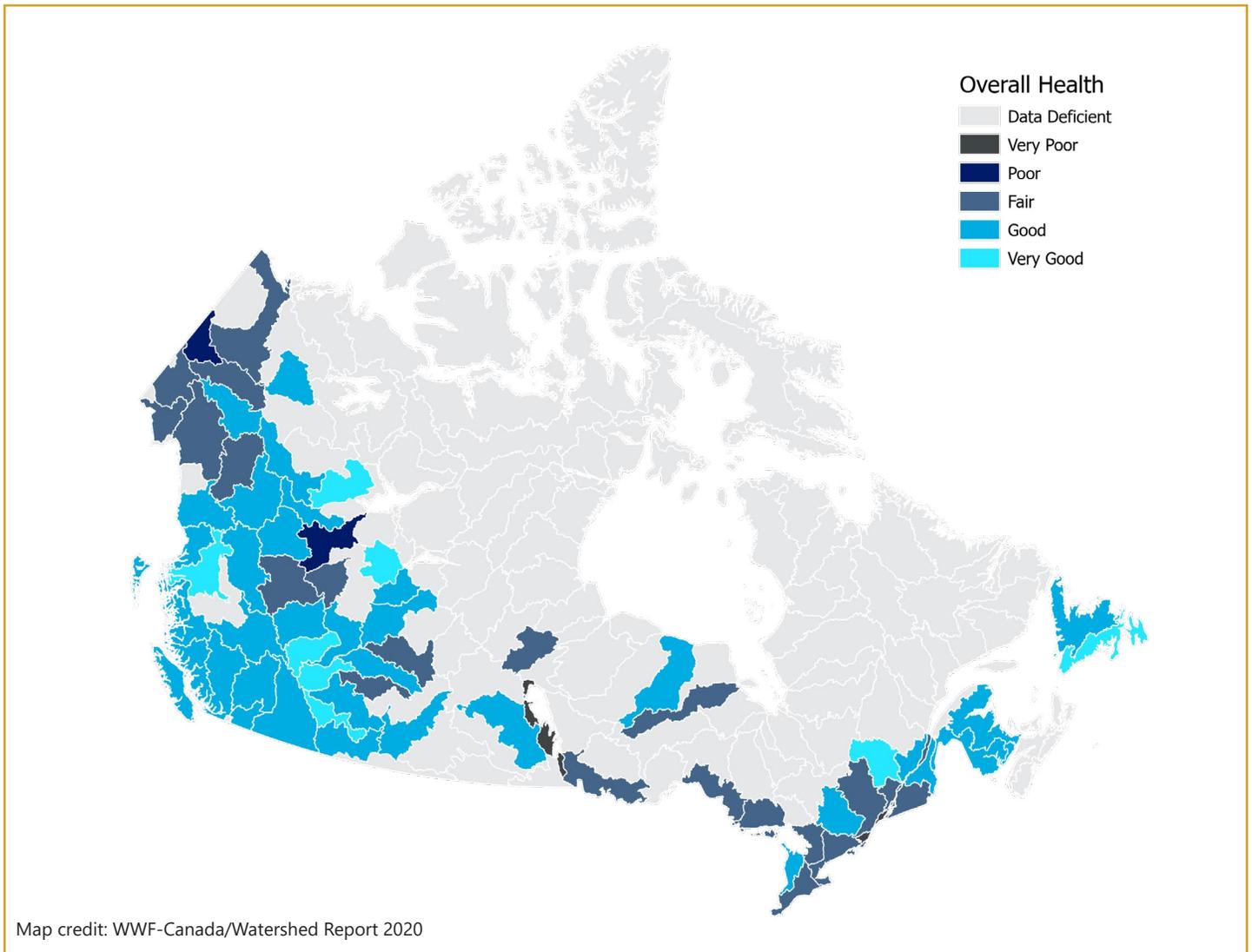


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In 2017, WWF-Canada released the Watershed Reports—the first national assessment on the health of freshwater in Canada. The reports identified data gaps and threats in 110 (66%) of Canada’s 167 watersheds. This formed the basis for the STREAM project, which formally launched in 2019.

In a 2020 re-assessment, WWF-Canada was still unable to assign scores for 60% of Canada’s sub-watersheds due to data deficiencies. Despite significant efforts, data deficiency remains a major challenge in understanding the health of Canada’s watersheds.

As a community-based water monitoring program that is national in scope, STREAM collects data to fill these important knowledge gaps. Analyzing data collected by STREAM participants can help us to understand human impacts on freshwater ecosystems in Canada.

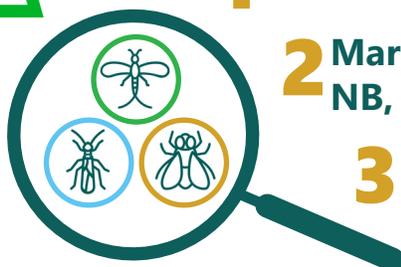
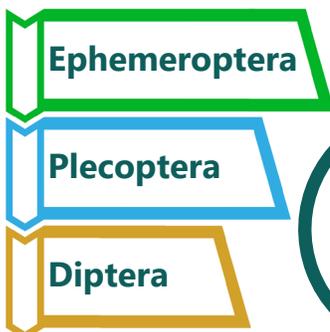


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2018 - 2021 Highlights



TOP BENTHOS



TOP WATERSHEDS with most sequenced samples

- 1 Columbia, BC
- 2 Maritime Coastal, NB, QC, NS, PEI
- 3 Pacific Coastal, BC

SAMPLES OVER TIME



For more information, visit: stream-dna.com/data-portal/

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Photo credit: ©Raegan Mallinson/Living Lakes Canada

**Questions?
Want to get involved?**

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stream-dna.com

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