

A person wearing a brown cap and a dark jacket with a light blue stripe is sitting on a boat. They are holding a yellow handheld electronic device in their right hand and a pen in their left hand. The background shows a body of water and a distant shoreline under a cloudy sky.

Featured Case Studies

Elevating Community-Based Water Monitoring in Canada

APRIL 2019





About This Document

This document features a rich diversity of community-based water monitoring initiatives across Canada. These case studies are intended to serve as a companion document for the final recommendations of Elevating Community-Based Water Monitoring in Canada, a collaborative initiative aimed to foster federal government engagement and support for community-based water monitoring (CBWM) in Canada.

These case studies were prepared by The Gordon Foundation, Living Lakes Canada and WWF-Canada. All three organizations engage with CBWM in different ways and are committed to advancing collaborative and evidence-based water stewardship across Canada.

The convening team thanks the many advisors and authors whose insight and contributions made this work possible.

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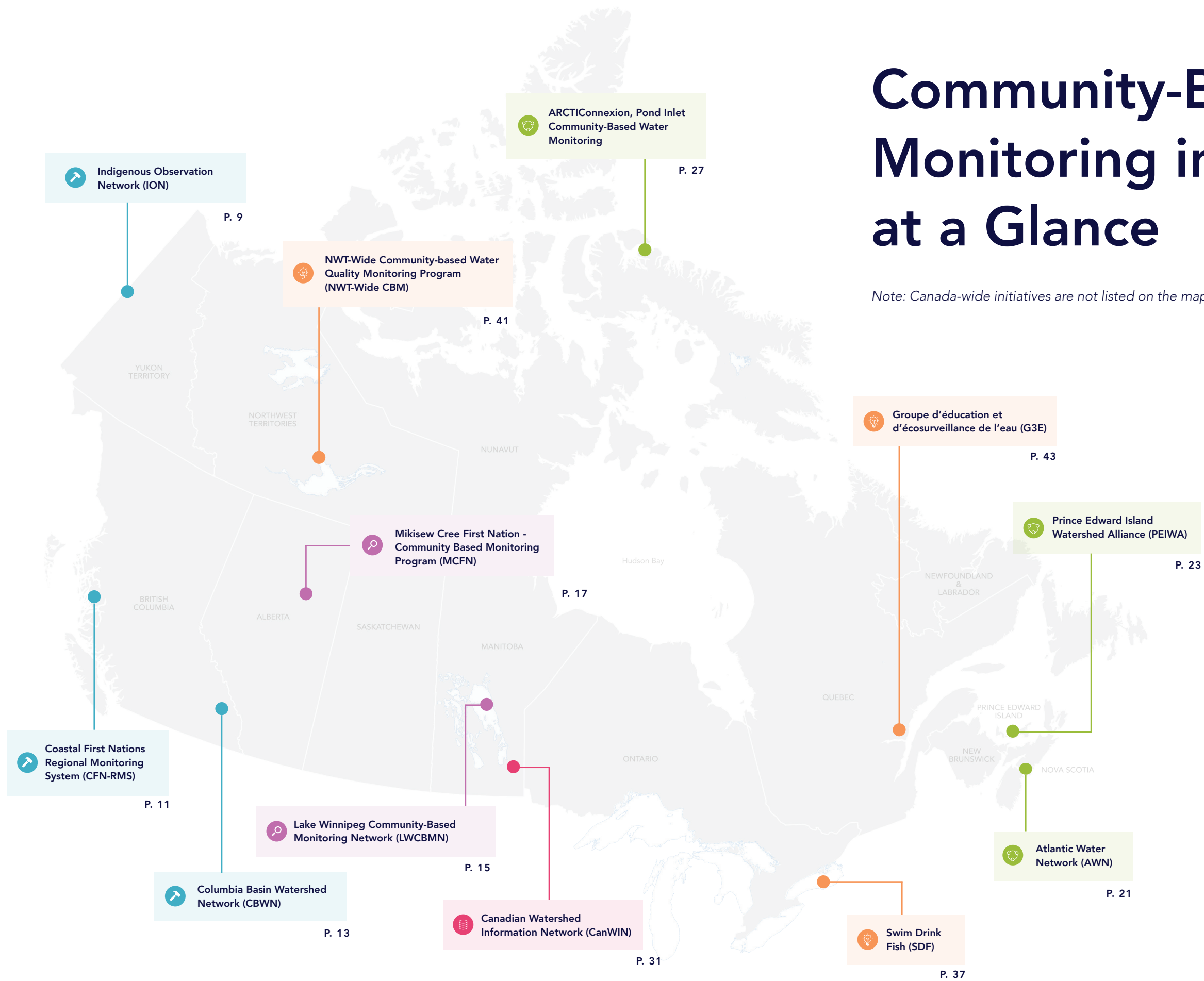
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Community-Based Water Monitoring in Canada at a Glance

Note: Canada-wide initiatives are not listed on the map.



Case Study Themes

- Capacity Building
- Effective Monitoring
- Regional & National Collaboration
- Data Management
- Data to Inform Decision-Making

Canada-Wide Initiatives

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Atlantic Coastal Action Program (ACAP)

New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador

Objectives

ACAP was a federal government initiative operated by Environment Canada. Its purpose was to help Atlantic Canadians restore and sustain local watersheds and adjacent coastal areas. Environment Canada and 15 ACAP groups (also known as the “ACAP family”) worked together to develop environmental management plans, raise awareness, and advance scientific research to inform restoration efforts for freshwater systems, estuaries and Atlantic harbours.

Model

ACAP served as an umbrella entity for member community-based organizations, each of which operated independently with a Board of Directors and full-time staff. It was designed to provide a “new framework of governance which allowed the public to have more meaningful involvement in decision-making. It would involve all sectors (governments, industry, communities) working together towards a common vision of sustainability”¹.

Funding

From 1991 to 2009, ACAP provided long-term core funding to ACAP groups. These initial investments allowed groups to leverage further funding from additional sources including philanthropic organizations, academic grants, and other levels of government. In 2009, through the Atlantic Ecosystem Initiative, the model shifted from core funding to project-based funding. This has had a significant negative impact on the capacity of individual organizations to continue their monitoring activities, particularly smaller, less resourced groups.

Who’s involved

Governments, community-based organizations, industry, and the general public.

Core capacity building activities

Environment Canada funding enabled each organization to maintain staff, allowed for the development of Comprehensive Environmental Management Plans, and meant each group’s office could continue to operate.

Highlights

Leveraging resources: Studies of ACAP’s costs and benefits between 1997 and 2001 revealed that the government’s investment resulted in significant economic, social and ecological gains. Had the government itself undertaken the same degree of monitoring performed by the ACAP groups, it would have cost Environment Canada twelve times the amount of money. ACAP clearly demonstrates how core government funding can have substantial impacts and be leveraged beyond the initial investment².

For more information, see McNeil, Rousseau, and Hildebrand (2006).

¹ McNeil et al., p. 369

² Wattie, 2016

Indigenous Observation Network (ION)

Yukon River Basin, Transboundary

Objectives

ION is the largest international, Indigenous-led monitoring initiative combining Indigenous Knowledge and western science to research, sustain and protect the Yukon River Basin (YRB). The network studies and monitors climate sensitive parameters to address landscape and water quality changes along the Yukon River and its tributaries. Through this research, ION provides long-term datasets and critical information that have implications for watershed planning at community, watershed, and global scales.

Model

ION is based on a partnership model between Alaska Native Tribes and First Nations, the Yukon River Inter-Tribal Watershed Council (YRITWC), and the United States Geological Survey (USGS). YRITWC is an Indigenous non-profit organization, consisting of 74 First Nations and Alaska Native Tribes.

Funding

The YRITWC, USGS and Indigenous governments work together to submit short-term proposals (one to three years) to U.S. and Canadian funding agencies and private foundations, while Indigenous governments have provided in-kind contributions. Individual Alaska Native Tribes and First Nations provide staff time and equipment (for example use of boats) for water quality sampling. In Alaska, the water quality samplers are funded by the U.S. EPA IGAP (Indian General Assistance Program), while in Yukon and B.C., Canada, First Nations do not receive any specific sources of funding to participate in the program.

Who's involved

Over 300 community members have been trained to conduct sampling and analysis of water quality data. The YRITWC provides support for monitoring through sample collection, processing and shipment within communities and to the

USGS. The USGS provides data analysis and interpretation support. The YRITWC and USGS work to make the data publicly available through raw data files and engaging outreach materials.

Core capacity building activities

- Water quality data collection for more than 30 different biogeochemical parameters over 50 sites from Atlin, B.C., to Kotlik, Alaska
- Combined with USGS, ION has water data spanning more than 30 years for some sites
- 1500+ samples have been collected to date, covering the entire 2,300-mile reach of the Yukon River
- The Active Layer Network monitors 17 sites throughout the YRB to study the impact of permafrost on water quality
- Data management and visualization is provided through USGS Sciencebase, Circumpolar Active Layer Monitoring (CALM) program, and FieldScope online platforms³

Highlights

ION datasets are directly linked with decision-making processes such as the Yukon River Watershed Plan and are focused on prioritizing Indigenous water rights and governance. Indigenous leadership in CBM within the YRB has been essential to meeting community needs. As a "bridging organization," YRITWC plays a key role in facilitating cross-sector collaboration. Strong collaborative relationships ensure that technical and financial capacities are fairly distributed. Peer-reviewed publications based on ION data are a testament to quality of the data collected.

For more information, see the Yukon River Inter-Tribal Watershed Council website: www.yritwc.org/science

³ Schuster, 2011; Herman-Mercer, 2016; Herman-Mercer et al., 2018; Toohey et al., 2018



Coastal First Nations Regional Monitoring System (RMS)

Coastal First Nation territories in the North and Central Coast of British Columbia and Haida Gwaii

Objectives

The RMS facilitates coordinated monitoring by Coastal Guardian Watchmen in First Nations to strengthen relationships with resource users, build an enforcement presence in the region and establish a solid baseline of data for decision-making. Specifically, the RMS seeks to: develop a standardized approach to monitoring priority issues at the regional scale; provide tools for communities to collect, store, and retrieve data; compile and compare coast-wide data; and empower communities to use the information in planning and decision-making. The water monitoring component of the RMS consists of stream surveys to collect water quality data, conduct salmon habitat assessments, and survey returning salmon to improve knowledge in priority watersheds. Protocols for monitoring oceanographic conditions will soon be added to the RMS.

Model

The RMS was developed with the Coastal First Nations’ Stewardship Offices and is administered by the Coastal Stewardship Network (CSN), a program of the Coastal First Nations – Great Bear Initiative. The Coastal Stewardship Network (formerly the Coastal Guardian Watchmen Network) supports the stewardship staff of the alliance of First Nations, providing regional and technical support to individual First Nations and coordinating the RMS.

Funding

CSN is funded through philanthropic grants and government-to-government agreements. Individual First Nations fund Coastal Guardian Watchmen programs from own-source revenue, Coast Funds, carbon credits, grants, agreements with federal and provincial governments, and/or fee-for-service. Coast Funds was created in 2007 to help support a sustainable economy in the Great Bear Rainforest and Haida Gwaii.

Who’s involved

Current members include the Stewardship Offices of First Nations Communities on the North and Central Coast of British Columbia, Haida Gwaii, and North Vancouver Island (Haida, Heiltsuk, Gitga’at, Kitasoo/Xai’xias, Metlakatla, Nuxalk, Wuikinuxv, and Nanwakolas Nations).

Capacity building activities

The RMS supports monitoring by providing:

- a standardized approach to monitoring priority issues at the regional scale
- tools for communities to collect, store, and retrieve their data (including the custom-designed CoastTracker app, which is used on tablets to collect data)
- coast-wide data to compile and compare for use by communities
- support for data management, use, and information-sharing
- a two-year Guardian Watchmen training program delivered by CSN alongside Vancouver Island University.

Highlights

- Stable funding:** First Nations successfully leverage funding from different sources to fulfill Nation-identified needs for long-term research and monitoring.
- Ongoing training:** Skills are kept current and orientation to new developments in the CoastTracker is provided.
- Adaptive design:** With support from the CSN, member Nations of the RMS evaluate the system to ensure it meets the changing needs of First Nations; keeps pace with advances in technology; continues to inform First Nations’ land and marine planning; and promotes collaboration between Guardian Watchmen and non-Indigenous monitoring groups⁴.

For more information, see the Coastal First Nations website <https://coastalfirstnations.ca/our-environment/programs/regional-monitoring-system/>

⁴ Kotaska, 2013

Columbia Basin Watershed Network (CBWN)

Columbia River Basin, British Columbia

Objectives

Water stewardship groups in the basin have identified water monitoring as a priority. CBWN aims to promote discussion and participation in water-monitoring activities across the basin. CBWN is also collaborating on a regional water monitoring framework and open access Data Hub initiative with Living Lakes Canada, which will help member groups share data. CBWN is committed to working with groups and government agencies to ensure that this data is meaningful, is used to support decisions and is used to help communities understand watersheds and the impacts that development and climate change have on them.

Model

CBWN is led by a Board of Directors at the regional level. Member organizations coordinate and conduct water quality and quantity monitoring in their respective jurisdictions. Member organizations also engage in a variety of stewardship, research and educational activities. The CBWN supports these activities through training, advice, linking people with appropriate skills/knowledge to groups, and grant-writing assistance.

Funding

CBWN was primarily funded by a grant from the Columbia Basin Trust. CBWN also relies on grants from the Loblaw's Water Fund and Lush Cosmetics and benefits from significant in-kind contributions from member groups and individuals.

Who's involved

Members include representatives from across and beyond the Canadian portion of the Columbia River Basin, including: regional First Nations councils; local non-profit watershed stewardship groups; municipal, provincial and federal agencies; regional colleges and provincial universities; and residents of the Columbia Basin not affiliated with any member group. The CBWN science advisory committee provides advice for ongoing development of a basin-wide monitoring framework and Data Hub dialogue facilitated by

Living Lakes Canada, and provides advice to individual groups on appropriate monitoring design, protocols and equipment.

Initially, the Columbia Basin Water Quality Monitoring Project (CBWQ) was a CBWN project coordinated by Mainstreams Environmental Society. When the CBWQ became a separate entity it remained closely linked to the CBWN and the data collected will be made available on a Columbia Basin open access data hub when completed.

Core capacity building activities

CBWN organizes workshops for member groups that cover technical field-based skills, communication skills, mapping skills, fundraising skills and greater understanding of water governance. CBWN provides training and equipment to regional non-profit groups, and fundraises for local water monitoring projects. Increasing the capacity of the individual groups encourages greater independence and effectiveness of their stewardship activities and builds water-literate and climate-resilient communities.

Highlights

CBWN plays a key role in supporting and coordinating water monitoring and information sharing among water stewards in the Columbia River watershed. In addition to coordinating the Basin's monitoring network, CBWN is spearheading an open access data hub initiative to house regionally collected data which should provide significant near-term support to individual groups in their watershed-specific work. CBWN has served as a core distribution hub for Columbia Basin-wide water information and has a number of avenues of communication through which to distribute knowledge and resources.

For more information, see the Columbia Basin Watershed Network website: <http://cbwn.ca>





Lake Winnipeg Community-Based Monitoring Network (LWCBMN)

Lake Winnipeg Watershed

Objectives

The LWCBMN, coordinated by the Lake Winnipeg Foundation (LWF), was launched in fall 2015 to increase the spatial and temporal resolution of phosphorus monitoring. Across the Lake Winnipeg watershed, this network mobilizes citizens to generate useful and credible water quality data to identify phosphorus hotspots—areas that contribute a disproportionately high phosphorus load to local waterways. LWCBMN volunteers follow scientifically-vetted sampling protocols to ensure the credibility of data. Protocols are compatible with provincial and federal water-quality monitoring initiatives, which means LWCBMN data can be easily integrated into decision-making processes, and can guide evidence-based policies and practices.

Model

LWCBMN is guided by the expertise of LWF’s Science Advisory Council (SAC), composed of nationally recognized freshwater scientists from across the country. Recognizing the potential of citizen science to improve phosphorus monitoring, LWF’s SAC has developed and refined robust data collection and analysis protocols. Regional watershed districts and conservation partners throughout Manitoba provide on-the-ground expertise and support for sampling activities, as well as connections to local volunteers.

Funding

Annual funding is received from multiple private and public foundations. Recently, the network received a four-year federal funding commitment from ECCC. All funding to-date is project-based.

Who’s involved

LWF’s CBM coordinator works alongside citizen volunteers, watershed district staff and government partners to coordinate sampling activities and lab analyses. LWF’s science advisors review all interpreted data and network reports.

Core monitoring activities

Water samples collected by citizen science volunteers and watershed district staff are analyzed for phosphorus concentration by LWF staff and science advisors. LWF staff generate annual regional reports, and map phosphorus hotspots to inform policy development. Regular field audits ensure protocols are followed, proper training is conducted and appropriate equipment is being used. LWCBMN is participating in an inter-agency lab comparison study with ECCC, DFO and Manitoba Sustainable Development to ensure that all phosphorus data collected is compatible. LWF just partnered with The Gordon Foundation to launch Lake Winnipeg DataStream, to share CBWM data as part of the national DataStream network.

Highlights

Because volunteers are dispersed across Manitoba and sample sites are chosen near where they live, LWCBMN can quickly mobilize volunteers to collect samples when it matters most (for instance during high-water events). Data collection and analysis protocols and equipment are scientifically rigorous, generate relevant data, are simple, and reduce the chance of human error. LWCBMN makes use of existing monitoring infrastructure through the Water Survey of Canada National Hydrometric Network. LWCBMN data is currently used to inform decision-making by watershed district managers, and has been acknowledged as increasing provincial capacity to target phosphorus load reductions and improve water quality across Manitoba.

For more information, see the Lake Winnipeg Community-Based Monitoring Network website:
www.lakewinnipegfoundation.org/lake-winnipeg-community-based-monitoring-network



Mikisew Cree First Nation - Community Based Monitoring Program (MCFN-CBM)

Peace Athabasca Delta (PAD), northeastern Alberta. The PAD is defined as the delta region that mostly overlaps with the Mikisew Cree's traditional territories and Wood Buffalo National Park. This includes areas of study from Peace Point at the northwestern limit, the Slave River as the northernmost point, Sandy Point at the upper northeastern point, Birch River as the southwestern point, Baseline 27 as the southern point and Richardson or Jackfish Lake as the southeastern limit.

Objectives

Through its CBM program, MCFN seeks to sustain healthy traditional lands that support MCFN members for the next seven generations. The program's mission is to protect MCFN Treaty and Aboriginal Rights through active monitoring of the environment using traditional knowledge and science in a respectful balance. Since 2008, the MCFN CBM program has been using scientific methods and local Indigenous and traditional knowledge and wisdom passed down by Elders to watch, listen, understand and report on activities that may cause harm to their traditional lands and resources in the PAD.

Model

To ensure the success of the program, MCFN CBM works with a variety of partners. For example, they have a strong informal partnership with Parks Canada to coordinate research into wild foods. A customized data collection and management app has also been developed through a partnership.

Funding

The MCFN CBM program has an established office on the Doghead Reserve in Fort Chipewyan and maintains one full time staff member and two part time staff. Funding is provided by the First Nation with additional support provided by the provincial and federal governments.

Who's involved

The MCFN CBM program employs professionally trained Environmental Guardians who are members of MCFN. The program relies routinely on input from community Elders.

Core monitoring activities

MCFN CBM programs measure water depth and navigation, water quality, ice thickness and snow depth. CBM staff collaborate with other Indigenous, federal, provincial, territorial and university researchers in examining fish and wildlife contaminants. MCFN CBM Guardians also respond to emergencies such as the October 2013 Obed spill.

The results of their studies are used to inform community members about the state of the traditional territory, to assist the leadership in establishment of Indigenous policies and to inform consultation processes surrounding the impacts of resource development.

Highlights

The program relies on both scientific and Indigenous Knowledge monitoring methods so members can better understand environmental changes at local and regional scales.

For more information see the Mikisew Cree First Nation-Community Based Monitoring Program website: mikisewgir.com/cbm/



Canadian Aquatic Biomonitoring Network (CABIN)

National

Objectives

To measure changes in biological communities in order to assess freshwater ecosystems.

Model

CABIN is a program developed by Environment and Climate Change Canada (ECCC) that coordinates monitoring and analysis efforts across the country. CABIN is responsible for creating a standardized monitoring protocol that all participants must follow. Approved methods and tools are developed based on rigorous science and evolve with current research. To be able to fully participate in CABIN, individuals and organizations must have undergone a training program that includes a data collection field practicum delivered by ECCC and various third parties and online modules on data entry, reporting and analysis through the Canadian Rivers Institute. This standardization ensures that the data produced is of the highest quality, and can be confidently used by any participant.

Funding

CABIN is supported by the federal government through its online database as well as reporting and analysis tools. Each organization participating in CABIN is responsible for its own funding for training, monitoring and analysis.

Who's involved

Participants in the CABIN program include federal, provincial and territorial government scientists, academia, industry, CBWM groups, environmental organizations, and First Nation communities. Provided participants have completed the training and adhere to the strict monitoring, data management and analysis protocols, anyone can join.

Core monitoring activities

CABIN has created, and continually updates, their own standardized monitoring protocol. This includes how to properly perform a kick-sample, which environmental conditions surrounding the sample site to note, water quality parameters to measure and how to classify the geomorphology of the area. A procedure is currently being developed for use of environmental DNA (eDNA) within the CABIN protocol for benthic analysis. CABIN uses site-specific data to create reference condition models for given watersheds and areas. Analysis tools depend on the development of regional models by ECCC that use the Reference Condition Approach.

Living Lakes Canada is exploring how the CABIN protocol can include Indigenous Knowledge by adding traditional stream names and other water-related vocabulary in participants' respective Indigenous languages.

Highlights

CABIN relies on standardized data collection techniques and training in data entry, reporting and analysis tools for participants, with QA/QC built into the data collection techniques. The program is currently used for wadeable streams. Protocols for large rivers and wetlands are in development.

For more information, see the ECCC CABIN resource website: www.canada.ca/en/environment-climate-change/services/canadian-aquatic-biomonitoring-network.html

Atlantic Water Network (AWN)

Inland waters, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador

Objectives

The mission of AWN (formerly CBEMN, the Community-Based Environmental Monitoring Network) is to build capacity among stewardship and watershed organizations by providing access to water monitoring and conservation resources such as standardized training via WET-Pro water monitoring kits, a secure and open access data hub (Atlantic DataStream) and the free use of an environmental monitoring equipment bank.

Model

AWN operates as an umbrella organization for not-for-profit community-based monitoring organizations in Atlantic Canada. The network is governed by an advisory committee composed of academics, government representatives, CBM organizational representatives and concerned citizens. AWN's core operations are run by two full-time staff, though this number fluctuates depending on funding availability.

Funding

For over a decade, AWN has been housed in the Geography and Environmental Studies department of St. Mary's University in Halifax, Nova Scotia. AWN activities received core funding from a five-year SSHRC grant for the CURA H2O project (2011-2016) which built capacity and provided resources for water monitoring in Atlantic Canada. Upon completion of this initiative, which was focused primarily on developing a standardized approach to water quality monitoring, AWN was successful in obtaining three-year core funding from ECCC's Atlantic Ecosystems Initiative and has since broadened its mandate. The network relies heavily on supplemental funding from provincial governments, philanthropic sources and plenty of in-kind support.

Who's involved

Approximately 30 not-for-profit water stewardship organizations make up the network. AWN supports regional academic research and has fostered relationships with provincial and federal governments.

Core collaboration activities

AWN facilitates collaborative water monitoring and environmental stewardship in Atlantic Canada by providing training, equipment loans (online WET-Pro training and complementary toolkits), data management resources (including data sharing on Atlantic DataStream) and support in the development of watershed-specific monitoring plans. WET-Pro training describes watershed processes, outlines quality assurance and quality control measures and describes what parameters a program should include based on local concerns.

Highlights

By sharing resources, AWN has contributed to the development of a standardized approach to water quality monitoring across Atlantic Canada through its online database, WET-Pro training and toolkit.

Alignment among monitoring protocols and data management strategies was ensured through collaboration with ECCC and Nova Scotia Environment in the development of AWN content. Collaboration with academic researchers has helped measure and communicate the credibility of CBWM data to other audiences⁵.

For more information see the Atlantic Water Network website atlwaternetwork.ca

⁵ Shelton, 2013



Prince Edward Island Watershed Alliance (PEIWA)

Inland waters, Prince Edward Island (PEI)

Objectives

PEIWA is a non-profit co-operative association of 24 community-based, not-for-profit watershed management groups on PEI. PEIWA supports the development of new and existing Watershed Groups in meeting their objectives to improve and protect the environmental quality of their waters. PEIWA aims to facilitate collaboration and communication among groups by providing opportunities to convene for training, collective input in public policy and raising awareness of local watershed issues.

Model

As an umbrella organization the Alliance serves as the main voice for all of the groups which together account for water stewardship activities covering approximately 95 percent of PEI. PEIWA prioritizes principles of collaboration and resource-sharing but respects the autonomy of individual member groups to achieve their own locally specific research, conservation and management goals.

Funding

The provincial government of PEI provides multi-year, core funding to members of the Alliance through a Watershed Management Fund that is divided among the groups via a specific funding formula that focuses on watershed size, community involvement and performance indicators such as leveraging capacity. Organizations have leveraged provincial funds by approximately 5:1 by fundraising through other sources including federal environmental funding streams (such as the Eco-Action program), with some minimal funding provided by philanthropic foundations and the private sector.

Who's involved

Watershed groups are typically composed of a volunteer Board of Directors, a paid coordinator, field crew supervisor, seasonal employees, and volunteer stewards and monitors.

Core Collaboration activities

- Water quality monitoring for key parameters of local and regional interest including temperature, nitrates (including reduction trials), dissolved oxygen, pH, and suspended sediments
- Estuarine monitoring including estuary watch to locate and record anoxic events
- Fish population monitoring
- Stream restoration
- Participation in the CABIN program
- Watershed groups also monitor coastal erosion, tree distribution, species at risk, and soils.

Highlights

Leveraging capacity: while core funding provided through the WMF is enough to cover operational costs, some groups have higher capacity to leverage these funds and expand programming. Partnering on projects and funding applications has led to fairer resource distribution.

Strong partnerships: partnerships established with local farmers, woodlot owners, and community organizations has helped minimize the impacts of local industries on freshwater health. Often this involves educating industries about provincial incentive programs (e.g., ALUS, NAPA), etc.).

Policy results: PEIWA members have been instrumental in contributing to the development of the province's *Watershed Strategy* and recently drafted *Water Act* (2017).

For more information see the Prince Edward Island Watershed Alliance website: www.peiwatershedalliance.org

Ecological Monitoring and Assessment Network (EMAN)

Canada-wide

Objectives

The Ecological Monitoring and Assessment Network (EMAN) was established as a national network of organizations involved in ecological monitoring in Canada to better detect, describe, and report on ecosystem changes. EMAN promoted the integration of long-term, multidisciplinary ecosystem research projects and their results across Canada. EMAN helped to standardize protocols and contributed to making data accessible between the network partners and communicating the information to decision-makers.

Model

Environment Canada established EMAN in 1994 and funded the EMAN Coordinating Office (EMAN CO) to coordinate ecological monitoring and research to meet national, regional and local needs for environmental information on ecosystem function and change.

Funding

EMAN was funded by Environment Canada from 1994 to 2010 and its operating budget supported network activities. In the end, relying solely on a single source of funding, particularly government funding, proved risky with budget cuts. A model with more distributed authority in terms of governance and funding would have increased the resiliency of the network.

Who's involved

EMAN was a cooperative partnership of government and non-governmental organizations, academic institutions, Indigenous organizations and community groups. EMAN partners worked collaboratively to improve the effectiveness of ecosystem monitoring and to demonstrate its relevance by better informing decision-making and influencing behaviours.

Core collaboration activities

EMAN connected different stakeholders through a shared goal of ecosystem monitoring to detect changes over time through standardized protocols. Monitoring protocols allowed for standardization in study design, sampling procedures, sample and data analysis, and reporting methods, ensuring information was useful for issues analysis and ecological understanding at the local, national and international scale. Standardized monitoring protocols included those for marine, freshwater and terrestrial ecosystems. EMAN co-produced ecological assessments and reports, organized annual science meetings across Canada for network partners and training opportunities in standardized protocols, and provided other tools and resources (such as the EMAN data repository). Despite these successes, greater impact and influence over decision-making could be better achieved if the network also engaged decision- and policy-makers.

Highlights

Many conservation professionals and citizen scientists continue to monitor using EMAN protocols. EMAN demonstrated the importance of collaborative, multi-stakeholder monitoring, and made the case for citizen science as a way to effectively monitor ecosystem change across Canada. EMAN also demonstrated the importance of secured funding and a leadership role through a coordinating office to strengthen the network.

For more information, see the archived ECCC website for EMAN: www.ec.gc.ca/faunescience-wildlifescience/default.asp?n=E19163B6-1

ARCTIConnexion, Pond Inlet

Community-Based Water Monitoring

Pond Inlet, Nunavut and adjacent watersheds

***From climate change to water quality and wealth:
Inuit researchers advancing monitoring capacity
for Arctic water systems in Nunavut***

Objectives

ARCTIConnexion's objectives have been to implement a novel research framework based on community leadership, cultural relevance, and youth skills development for advancing scientifically rigorous water research capacity in Nunavut.

Model

A non-profit organization, ARCTIConnexion promotes a vision for research that is driven by and for Indigenous communities, and for Indigenous youth to train other youth in collaboration with academic scientists and community researchers. The program is mentor-based: university researchers mentor Inuit researchers, helping guide the development of studies from initial questions to publication.

Funding

Funding has been project-based to date. Community and university researchers apply for joint research funding to support community-based research projects. Initial Pond Inlet funding was provided by Health Canada's Climate Change and Health Adaptation Program. Federal financial support has also been provided by INAC through the Nunavut General Monitoring Program, and SSHRC Insight Development Grant.

Who's involved

Staff and university researchers, program initiator Tim Anaviapik Soucie and community members including Inuit youth.

Core collaboration activities

Local watershed monitoring is carried out using field- and satellite-based data that integrates climate (weather), landscape parameters (vegetation, soils, permafrost), hydrological conditions (stream flow, water level) and water quality measures (DO, pH, conductivity, bacterial, benthic invertebrates). Participatory mapping and traditional knowledge is used to guide the research locations and questions.

To-date, key successes include: developing research and leadership skills in Inuit youth; reframing the position of Inuit Knowledge and Scientific knowledge in Arctic research settings; project expansion to the communities of Arviat, Baker Lake (2018), and Taloyoak, Nunavut (2019); community laboratory infrastructure for water quality assessment in Pond Inlet and Baker Lake and increased understanding of the connections between landscape, climate and water.

Highlights

Research by Inuit, for Inuit: Community-led research with scientific mentorship builds true research capacity in a decolonizing and empowering spirit of Truth and Reconciliation. A mentorship approach to the research transforms a conventional Arctic science approach into a more sustainable, meaningful and impactful relationship.

For more information, see the ARCTIConnexion website:
arcticonnexion.ca/project/pond-inlet/





DataStream

Mackenzie River Basin, Atlantic Canada, Lake Winnipeg Watershed

Objectives

DataStream provides the infrastructure to support open sharing of water quality data across multiple programs and jurisdictions. DataStream’s mission is to promote knowledge sharing and advance evidence-based, collaborative decision-making so our waters remain healthy for generations to come.

Model

DataStream is led by The Gordon Foundation at the national level and is carried out in collaboration with regional monitoring networks. The Gordon Foundation coordinates input from regional partners, data contributors, subject matter experts and advisors. Expert product managers and engineers at Tesera Systems Inc. develop the software and implement feedback in accordance with agile best practices.

DataStream’s approach has an embedded economy of scale, meaning that with each new iteration and improvement to the system, every monitoring organization, contributor and user benefits.

Funding

The Gordon Foundation works with regional partners to secure funds needed to build new local hubs and ensure sufficient HR resources are available to inform context-specific development, launch and rollout of regional DataStream hubs. The Gordon Foundation funds its programs through a combination of its own endowment and funds raised externally. Regional partners contribute either in-kind or financial resources to support DataStream infrastructure improvements (no minimum contribution required).

Who’s involved

Regional partners include DataStream’s founding partner, the Government of the Northwest Territories (GNWT), in the Mackenzie River Basin; the Atlantic Water Network (AWN) in Atlantic Canada; and the Lake Winnipeg Foundation in the Lake Winnipeg watershed. Contributors, known as data stewards, include watershed groups, Indigenous Guardian programs, governments and researchers.

Core data management activities

Independent home for data: Provides a long-term home for data collected across sectors with a focus on community monitoring initiatives.

User-friendly access: Allows users to easily access, search, visualize and download datasets.

Data model: Ensures data is available in consistent, predictable, useful and internationally recognized formats [EPA-developed exchange of water quality data (WQX) standards].

Quality control: Automated validation ensures consistent quality and ready-to-use data.

DataStream is already being applied in a real-world setting by: 1) CBWM organizations and Indigenous governments (24 communities contribute data to Mackenzie DataStream, 41 CBWM groups currently share data on Atlantic DataStream), GNWT uses DataStream as part of its NWT Water Stewardship Strategy; 2) academic research funded by the GNWT Cumulative Impacts Monitoring Program, which requires submission on DataStream; 3) ECCC and provincial governments are collaborating with DataStream to bring regional, long-term monitoring data online.

Highlights

Strong partnership model: All activities are carried out in partnership with leading organizations across the country that are well-placed to effect change at the right levels.

Ethically open access: DataStream is free and open for anyone to use. Since its inception, DataStream has gradually been implementing processes in line with FAIR data principles (data is Findable, Accessible, Interoperable and Reusable).

For more information see the Gordon Foundation website: <http://gordonfoundation.ca/initiatives/datastream/>



Canadian Watershed Information Network (CanWIN)

Hudson Bay Watershed

Objectives

The Canadian Watershed Information Network (CanWIN) is a web-based collaborative platform hosted at the University of Manitoba (UM) within the Centre for Earth Observation Science (CEOS). Its mandate is to support research, education, management, policy and evidence-based decision-making about nutrient- and climate-related issues in the Nelson River and Hudson Bay watersheds. CanWIN's mission is to provide a web-based collaborative platform that integrates disparate watershed-related data from a site-specific (local) level with data at provincial, national and global scales; to communicate key research findings in plain language; to provide open access to research data and reports in non-proprietary formats and to use ethical data sharing methods to address unique key stakeholder needs and privacy concerns (for example Inuit and First Nations) while finding ways to share and integrate Indigenous Knowledge and science.

Model

CanWIN (formerly the Lake Winnipeg Basin Information Network) was created by Environment Canada as part of the Lake Winnipeg Basin Initiative under Canada's Action Plan on Clean Water and was transferred in 2012 to the UM. CanWIN works with a variety of stakeholders, including researchers and non-governmental agencies to build standardized and interoperable tools to increase accessibility and ease of data sharing across the watershed. We provide an open by default platform which allows upload of any data type and visualization of certain types (e.g. csv, pdf).

Funding

Initiative funding is provided through the UM and the Lake Winnipeg Basin Program funded by ECCC. Additional funders include Manitoba Hydro and the Lake Winnipeg Foundation. Maintenance, development and upgrade of core systems is provided by the UM computer services. Services include systems administration (hardware and software maintenance and upgrades, database management, data security, backup services) and permanent housing of documents within the UM libraries. Total in-kind support provided by the UM is approximately \$150,000 per year.

Who's involved

Collaborators include freshwater and arctic researchers, federal and provincial agencies, and non-profit organizations. CanWIN is also a member of the Canadian Consortium for Arctic Data Interoperability (CCADI), a consortium of five universities, two Inuit organizations, and a variety of government and non-governmental agencies.

Core data management activities

CanWIN currently hosts many different types of data, from community-based monitoring to historical and active research programs. CanWIN provides support to users on managing the complete data lifecycle, from project conception to data sharing and archiving.

Highlights

By working with multiple data managers, users and subject matter experts, CanWIN is working towards national and international standards for a common vocabulary and metadata standard, which increases the interoperability and therefore usability of the data. This harmonizing of disparate data and language enables users to ask new research questions by giving them the ability to analyze complex, multi-themed watershed issues across broad spatial and temporal extents.

For more information see the University of Manitoba website: <http://lwbi.cc.umanitoba.ca>

Exchange for Local Observations and Knowledge of the Arctic (ELOKA)

Arctic, International

Objectives

ELOKA's goal is to facilitate the collection, preservation, exchange, and use of local observations and Indigenous Knowledge of the Arctic to meet local and regional decision-making needs. ELOKA provides support to Indigenous organizations, communities, and researchers across a number of areas related to data management and use. ELOKA's work is intended to support communities in attaining data and information sovereignty in the Arctic (in other words, communities decide how their data are protected or shared).

Model

The ELOKA leadership team works closely with Indigenous organizations, local communities, the research and funders to establish an effective, flexible working model that evolves as the broader context changes. ELOKA is hosted by the National Snow and Ice Data Center (NSIDC), which provides stable data repository services and technical expertise.

Funding

ELOKA receives funding through the National Science Foundation to provide a range of data management support services. A set of separate, complementary grants that use the ELOKA infrastructure and expertise have been established, including contracts with individual partners.

Who's involved

ELOKA operates under the premise that meaningful knowledge exchange can only be achieved by linking physical networks (technology) and human networks (community members, researchers, decision-makers, trainees, others). ELOKA partners with Indigenous community members and representative organizations and networks all across the Arctic, from Canada and the U.S. to Greenland and Russia.

Core data management activities

ELOKA builds partnerships with Arctic Indigenous communities and researchers to create digital tools to support the curation and sharing of Indigenous Knowledge and local observations following best practices. Key activities include: data preservation and archiving; facilitation of data discovery and distribution; dynamic data presentation that maintains relevant context around the information; digital mapping and community-contributed mapping and GIS; assistance in developing data management plans, data collection protocols, documentation, and organization; developing connections between Indigenous Knowledge and conventional science approaches to Arctic observing; convening workshops to facilitate exchange around themes related to data sovereignty, data management, and community-based observing, and matchmaking between scientists and Arctic communities based on research needs, interests, and questions.

Highlights

Management of community-contributed data has both technical and social dimensions: There is no single approach that will address data management needs and concerns for all communities.

Data management technologies and infrastructures should be context-appropriate: Because of the limited Internet bandwidth in many parts of the Arctic, ELOKA has made efforts to minimize the bandwidth speed required to use applications by developing optimized technologies.

Projects should recognize and support data sovereignty: ELOKA provides data management support to CBM initiatives with the explicit goal of upholding Indigenous ownership and authority over Indigenous Knowledge and data⁵.

For more information see the ELOKA website: eloka-arctic.org

⁶ Pulsifer and McNeave, 2014



WWF-Canada's Watershed Reports

Canada-wide, basin and sub-watershed scale

Objectives

WWF-Canada set out to create the first national picture of the health of and threats to Canada's freshwater. A key part of the creation of Watershed Reports was considering how this information could be used, and how best to make that happen.

Model

WWF-Canada is a national non-governmental organization with a mandate to reverse the decline of wildlife.

Funding

Funding is provided by various foundations, corporate partnerships and grants.

Who's involved

WWF-Canada staff are responsible for gathering data collected by outside organizations and partners. These partners include government departments (federal, provincial and territorial), other environmental non-governmental organizations (ENGOS), watershed groups, conservation authorities and community-based monitoring groups. WWF staff run the analysis and attribute overall scores to watersheds and sub-watersheds. These results are then published on the Watershed Reports interactive website.

Core activities

While WWF-Canada doesn't engage in monitoring, the Watershed Reports use data from as many monitoring organizations as possible. Watershed Reports take data and through analysis transform them to create a product that is easily transmissible and understood. To create Watershed Reports, WWF-Canada first consulted with leading freshwater scientists to develop an assessment framework. That framework was then used to produce reports on the health and threats to Canadian rivers. An interactive website was designed to publish the results, engage Canadians and raise awareness about the watersheds they live in.

This platform and project can give a voice to smaller monitoring groups and make them a part of national freshwater discussions. Often, groups operating on a smaller scale have nowhere to share their data, meaning it doesn't get used as much as it could. Watershed Reports gives them that option.

WWF-Canada communicates every aspect of the Water Reports process which includes providing information about the analysis (methods, scripts) as well as results. Through this exercise, WWF-Canada has also shared many of its key learnings and suggestions for monitoring and analysis in Canada.

For more information see the website for WWF-Canada's Watershed Reports: watershedreports.wwf.ca/#canada/by/threat-overall/profile

Highlights

Since its creation, Watershed Reports has been used by many individuals and organizations to advocate for infrastructure, water management and policy changes. Many organizations use the results as leverage to support their own work, or even use it to establish priorities. Key takeaways include:

1. **Identify the audience:** knowing the intended audience has played a large part in determining how to effectively communicate the reports.
2. **Ground truth:** while this project was national in scale, WWF-Canada continually connected with local organizations and data providers to ensure consistency between results and reality.



Swim Drink Fish (SDF)

National, with initiatives at different scales. Swim Guide is an international program.

Objectives

Swimmable, drinkable, fishable water for everyone.

Model

SDF is a stewardship organization focused on blending science, law, education, and storytelling with technology. SDF has eight initiatives, each of which has a specific mission contributing to the goal of building a national movement of active, informed, and engaged individuals.

Funding

SDF Galas provide unrestricted funds that allow the organization to respond to community needs. Flagship initiatives have a major foundation or government funder.

Who's involved

Core staff carry out operations for SDF's various initiatives and volunteers make the vision come to life. SDF's community-based recreational water quality monitoring program in Toronto counts between 100 and 200 volunteers a year, and is managed by a single coordinator.

Core activities

SDF uses digital communications technology to promote public access to information wherever and whenever people need it. Programs typically translate scientific or policy information into simple data points that are accessible to the general public. Once translated, SDF uses made-in-house apps and web platforms to communicate that information to the public.

All of SDF's platforms are free to use for other non-profit affiliates. The following are three examples:

1. **Swim Guide:** Website and app to help easily find close swimming beaches, and protect public health with current information on water quality. Available in English, French and Spanish, Swim Guide shares data for 8,000 beaches in ten countries, and counts nearly three million users. Swim Guide also runs Swim Drink Fish operates community monitoring programs in Toronto, Vancouver, Niagara, and Zhiibaahaasing First Nation.

2. **Great Lakes Guide:** Digital content and data that connects people to the Great Lakes and highlights the region's ecological, cultural, and economic significance
3. **Great Lakes Communities Monitoring Initiative:** Establishing six volunteer-led recreational water quality monitoring hubs on the Great Lakes to bring affordable water quality monitoring to underserved communities.

Key lessons - there is demand for data sharing standards, especially in a field where monitoring practices are relatively well-established and consistent. The biggest challenge continues to be the clash between today's "open by default" mentality and the traditionally closed mentality of government and institutional data-holders. Whenever Swim Drink Fish has struggled to deliver current water quality information to the public, it has been largely due to attitudes towards data sharing, rather than because of technical or financial barriers.

Highlights

Data collection: Wherever Swim Drink Fish is active, data collection has increased.

Data openness: Part of Swim Drink Fish's work involves actively promoting the release of data, including machine readable data, to the general public.

Data exchange: One of Swim Drink Fish's main data initiatives is the development of data-exchange standards that allow beach managers to share beach water quality information automatically across jurisdictions.

For more information see the Swim Drink Fish website: www.swimdrinkfish.ca

Canadian Shellfish Sanitation Program (CSSSP)

Canada-wide

Objectives

The goal of the program is to protect Canadians from the health risks associated with the consumption of contaminated bivalve molluscan shellfish (for example, mussels, oysters and clams). Under the CSSSP, ECCC's Shellfish Water Classification Program (SWCP) conducts surveys of bivalve molluscan shellfish growing areas for the purposes of classifying areas for harvesting of species such as clams, oysters, mussels and scallops.

Governance

The CSSSP is a federal food safety program jointly administered by the Canadian Food Inspection Agency (CFIA), DFO and ECCC. The program is governed by a memorandum of understanding. Legal authority for the Canadian Shellfish Sanitation Program is provided by the Fisheries Act, the *Management of Contaminated Fisheries Regulations*, the *Fish Inspection Act* and the *Fish Inspection Regulations*.

Funding

Under the agreement, ECCC pays for the analysis of marine water quality samples for the purpose of reclassification of the harvesting areas.

Who's involved

CFIA, DFO and ECCC. In 2005, Tsleil-Waututh Nation (TWN), a Central Coast Salish community, requested that the CSSSP be expanded into their traditional territory to classify potential shellfish harvesting areas. Intended uses for shellfish are wide-ranging and may include: wild harvest, aquaculture, Food, Social and Ceremonial (FSC) and recreation, among others.

Core activities

These areas were previously impacted by sewage discharges from wastewater treatment plants, and at that time were classified as closed. Following wastewater impact assessments conducted by ECCC, a survey of the potential harvesting area was completed under a collaborative agreement, whereby ECCC staff trained TWN members to collect water quality samples for delivery to ECCC's microbiology laboratory in North Vancouver. Key components of the current Agreement for Community Based Monitoring in Indian Arm for the reclassification of existing prohibited areas within Burrard Inlet include:

- No money is included in the agreement. All efforts are provided through in-kind support.
- ECCC provides sampler training, sampling equipment, laboratory analyses and project coordination.
- All work financed using program funds.
- TWN provides dedicated trained personnel, sampling vessel, related CCG-approved safety equipment and vehicle for sample cooler delivery. All work provided using band funds.

Highlights

On October 25, 2016, the TWN completed their first FSC harvest in 34 years with the collection of 17.9 kg of soft shell clams. This agreement demonstrates the power of partnerships and how a willingness to experiment with alternative service delivery models can effectively connect community-based monitoring to decision-making in a way that truly matters to local communities.

For more information see the Canadian Shellfish Sanitation Program website: www.inspection.gc.ca/food/fish-and-seafood/shellfish-sanitation/eng/1299826806807/1299826912745

NWT-Wide Community-based Water Quality Monitoring Program

Northwest Territories

Objectives

The Northwest Territories (NWT)-Wide Community-Based Water Quality Monitoring Program (NWT-Wide CBM) was developed to support communities in the development and implementation of aquatic community-based monitoring and research programs. These were designed to address concerns about changes to water quality over time including the impacts from stressors from upstream development and climate change, among others. Growth of CBM in the territory will increase awareness of water issues, improve traditional knowledge collection and application as well as increase community involvement in and ownership of research and monitoring program design.

Model

The Department of Environment and Natural Resources (ENR) is the lead agency coordinating implementation of the NWT Water Stewardship Strategy. The NWT-Wide CBM program was developed collaboratively by ENR alongside Indigenous, federal and municipal governments, non-governmental organizations, communities and others. Part of ENR's responsibility is to provide capacity supports to communities across the NWT as they become more involved in water stewardship activities, including through monitoring and research.

Funding

The NWT-wide CBM program is funded through the ENR.

Who's involved

ENR works with 21 communities across the territory to monitor water quality at over 40 sites on 24 NWT rivers and lakes.

Core activities

ENR plays a coordinating role in delivery of the overall program. This includes providing CBM partners throughout the territory with information about monitoring design, access to hands-on training, funding through equipment and monitoring resources, and support for data collection, analysis and management. Communities are involved through every step of the program from sampling site selection to data collection and program evaluation. The following are examples of past and ongoing NWT-Wide CBM projects: 2013 monitoring; Slave River and Delta Partnership; Community-based Cumulative Effects Monitoring Framework; Cumulative Effects Monitoring Pilot Project; Drinking Water.

Beginning in 2016, all data from currently funded NWT-Wide CBM water quality monitoring initiatives is available on Mackenzie DataStream.

Highlights

Decision-making: the NWT-Wide CBM Program is shaped by community questions about their watersheds, this ensures that information collected by local monitors is relevant for local decision-making. "Though CBM is geared to local-level concerns, identifying linkages with other levels of decision-making increases the usefulness of CBM data... With respect to transboundary waterways, CBM information will support implementation of bilateral water management plans with upstream jurisdictions"⁵.

Participation: a high degree of community participation in the program from inception through to delivery and evaluation fosters community buy-in for ongoing activities and trust in the data generated.

Data accessibility: CBM results are shared with communities before being distributed elsewhere in both raw and analyzed and interpreted formats ensuring that it is both meaningful and understandable.

For more information see the description of the NWT-wide CBM Program on the GNWT website: <https://www.enr.gov.nt.ca/en/services/water-management/community-based-monitoring>

⁷ Somers as cited in Kanu et al., 2016, p.16

Groupe d'éducation et d'écosurveillance de l'eau (G3E)

Québec, Prince-Edward Island, French communities in New-Brunswick and Manitoba

Objectives

Since 1989, G3E has worked towards the protection of aquatic ecosystems. They have developed citizen science initiatives as well as educational and scientific tools useful for aquatic ecological monitoring. G3E invites communities to use them to keep an eye on the health of their home waters and to make informed decisions about conservation, restoration or awareness activities.

Model

G3E operates many programs under four broader umbrellas: citizen science; nature and education; training and education toolkits; and broader public activities. Under the citizen science umbrella are three main programs, each with its own goals, target audience and methods: 1) J'adopte un cours d'eau (Adopt a River) 2) Survol Benthos (Benthic overview), and 3) Des cours d'eau branchés (Live-stream Your River App).

Funding

Having received initial support from ECCC's Biosphere and from a variety of different partners, G3E now finances its activities through both government and private funding.

Who's involved

Each program targets different sectors of society, from education and school groups, other ENGOs and watershed groups, labs, government departments (such as SEPAQ) and the public. The different programs offer the training necessary for participants. Scientific and educational tools as well as protocols are adapted for the audience.

Core activities

Adopt a River is an educational program with a citizen science approach. It encourages youth to take action to protect their rivers. Participants assess freshwater health through physicochemical and bacteriological tests, by monitoring benthic macroinvertebrates and recording fish observations. These activities are followed by environmental awareness raising and restoration efforts. The Survol Benthos program monitors the health of small streams using benthic macroinvertebrates as indicators. An online interactive map allows for anyone to quickly understand the health of sites using indices. The Live-stream Your River App is available through iTunes and includes a step-by-step protocol to quickly identify the health of a water body. Des rivières surveillées: s'adapter pour l'avenir is a permanent CBWM project aiming to document the impact of climate change on riverine ecosystems.

Highlights

Having a team of regional coordinators has allowed the program to reach a greater area and audience and to collaborate with a diverse group of external partners. Knowledge sharing and transfer is achieved in large part by the regional coordinating team and the openness of G3E and its partners in sharing tools and experience. Since 2000, 50,000+ youth and 50+ organizations have participated in G3E projects, and more than 275 bodies of water have been studied and adopted. The province uses the benthic data collected, which has doubled the territory covered by benthic monitoring. Regional coordinators, watershed groups, provincial parks and certain NGOs also integrate the data into their own assessments, guiding protection and conservation actions.

For more information see the G3E website: www.g3e-ewag.ca/home.html



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