Supporting the Sustainability of Indigenous Community-Based Climate Monitoring

Final Guidance

DATE OF SUBMISSION:

February 26, 2021

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SUGGESTED CITATION:

Thompson, A. Eyzaguirre, J. and Olson, E. and (2021). Supporting the Sustainability of Indigenous Community-Based Climate Monitoring. Final Guidance.

Strategies to Sustainability

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Strategies to Sustainability

Summary

This short report provides guidance for Indigenous communities to sustain community-based climate monitoring projects beyond individual funding opportunities. It includes recommendations that will be relevant to a wide variety of projects. Where possible, we provide tailored guidance for monitoring programs at different phases (which we term **emerging**, **growing** or **maturing**). Identifying first what phase your monitoring work is in will help determine what guidance may be most relevant. The guidance in the report covers five overarching themes, described below.

Community Priorities and Concerns. Monitoring that addresses a community's key concerns is more likely to garner and sustain interest. Ensuring that community members can participate in establishing the monitoring questions and developing the monitoring plan will help to develop a strong foundation for "emerging" programs; for "growing" and "maturing" projects, ensuring that the program remains relevant to the community is very important. Building connections between Elders, youth, and monitors can strengthen interest in monitoring, and cultivate champions for community-based monitoring.

Funding. Funding shortfalls are a persistent barrier to sustaining community-based monitoring. Strategies such as focusing effort on obtaining funding opportunities that meet community monitoring goals and objectives, identifying core funding needs to sustain monitoring work, and diversifying funding sources and can all help ensure your monitoring program can weather changes in funding availability. It's never too early to think about financial sustainability.

Institutional Capacity. Community capacity is critical to sustain climate-monitoring work over the long term. This section describes individual-level considerations, like skills-training, mentorship, recruitment, and retention, as well as institutional considerations, which speak to governance best practices. Effective governance of the monitoring enterprise can build and maintain community trust.

Partnerships. Partnering with external organizations can help fill gaps in local talent, lend credibility to the monitoring enterprise and broaden the reach of climate-monitoring goals. Communities can be selective in their partnerships and focus on those with shared objectives, who respect the community's vision for climate monitoring and truly complement community assets.

Efficiencies. As communities gain experience in climate monitoring, opportunities to optimize their activities will help to reduce program costs. Efficiencies can be found by tweaking the monitoring plan, using new technologies to automate monitoring, or paying attention to "economies of scale," all of which can help stretch monitoring dollars and make best use of available resources.

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1 Introduction

Indigenous communities are investing significant time, resources and energy in initiating and implementing community-based climate monitoring projects. This document provides guidance to sustain community-based climate monitoring beyond the timelines of individual funding opportunities Thinking about sustainability from the start offers many benefits to communities, partners and funders alike.

This document contains guidance by the Indigenous Community Based Climate Monitoring (ICBCM) Program to help Indigenous monitoring practitioners work toward long-term sustainability (see Box 1) of community-based monitoring. The document helps community-based monitoring (CBM) practitioners think through elements that have helped others sustain their work. The document is not a recipe or cookbook or a manual on how to do community-based monitoring. CBM practitioners can use this guidance as i) planning tool for climate monitoring project; ii) advice to take in and adjust as needed, to help sustain your work; iii) as a basis for discussion with partners on how to address areas that need further attention. Its application will vary community to community, and their unique circumstances, environmental institutions, and knowledge systems.

Box 1: Defining sustainability

In its broadest sense, and for purposes of this guidance document, the term "sustainability" is defined as the ability of communities to derive benefits from community-based climate monitoring efforts over the long term. The term sustainability has many synonyms (PCI 2014), including these:

- Independence
- self-reliance
- self-sustaining
- lasting
- mainstreaming
- continuation
- durability
- maintenance
- routinization
- stabilization
- integration

Why is sustainability of monitoring work important? Significant resources and effort are going into scoping, designing, planning and implementing Indigenous community-based climate monitoring projects. Often these projects rely on grant funding. The momentum and relationships built within communities can lose steam if monitoring activities come to a halt or staff are let go when funding dries up. However, building long-term data sets is essential for understanding and managing the impacts of climate change. Detecting the climate change signal from the natural variability of the climate can take 30 years of monitoring. Planning for sustainability from the start can help set communities up for success, including guiding strategic choices on the funding sources and partnerships they pursue and refining the monitoring plan over time based on the community's vision of sustainability. Sustainability efforts that are an afterthought or put in place too late are a missed opportunity.

Sustainability is relevant to each phase of a CBM project. A team of co-authors of the Indigenous Community-Based Climate Monitoring toolkit (in preparation) have developed a generic framework for Indigenous climate-monitoring projects (Figure 1). This framework describes seven CBM project phases,

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embedded within the concept of an Ethical Space.[1] Those phases are useful for the detailed planning and execution of CBM project. When it comes to thinking about project sustainability however, a coarser grouping of CBM phases applies.

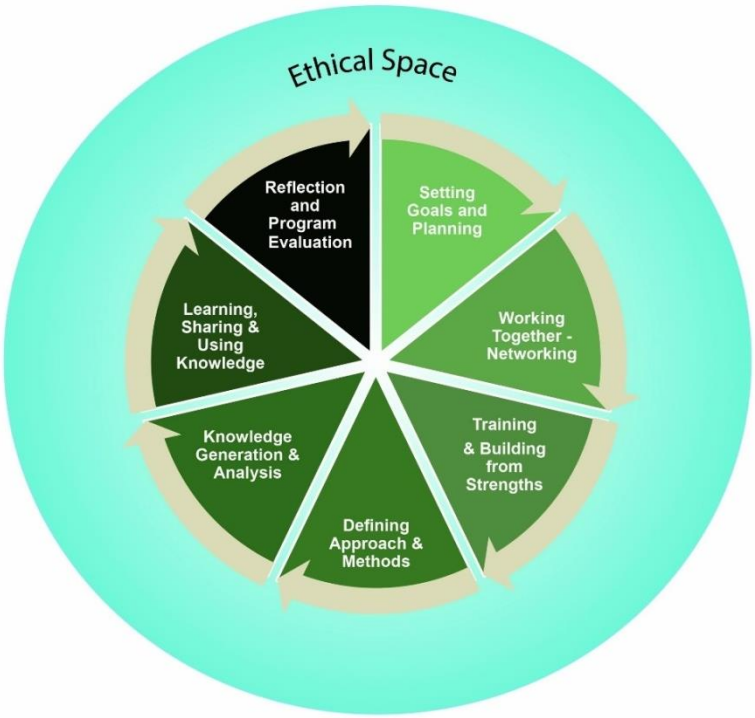

Figure 1 The ICBCM Framework involves seven CBM project phases, embedded within the Ethical Space framework.

This document provides guidance to sustain community-based climate monitoring beyond the timelines of individual funding opportunities. Guidance is tailored to three phases of CBM: **emerging**, **growing**, and **maturing** projects. This typology describes projects that are just getting started (**emerging**), those that are now up and running but still learning & growing (**growing**), and those that have developed long-term monitoring programs, and may be scaling-up (**maturing**). Table 1 provides additional detail on the characteristics of these phases.

Table 1. Approximate relevance of different tasks at different phases of the ICBCM framework

Project phase	Phase characteristics
Emerging	• Seeking community input on goals, objectives, values and concerns; • Data collection has not yet commenced; • Limited staff capacity for monitoring (work is primarily being done on "side of desk").
Growing	• Data collection and use of data has commenced, but methods need refinement; • Internal capacity is increasing (part or full-time staff dedicated to CBM); • Partnerships are being sought to strengthen capacity.
Maturing	• Monitoring, analysis, and reporting methods have been refined; data is being used to affect decision making; • Partners play a key role in monitoring project; • New monitoring initiatives are being considered / added;

[1] Ethical space describes a framework in which multiple ways of knowing are granted respect and equal standing, emphasizing nation to nation relationships, cross-cultural literacy, a balance of power between parties, and where trust and respect are fostered.

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	• Multiple funding sources.

The guidance in this document falls into these five "action categories":

- Community Priorities and Concerns (Section 2);
- Funding (Section 3);
- Institutional Capacity (Section 4);
- Partnerships (Section 5); and
- Efficiencies (Section 6).

Within each category, we discuss specific actions that can help foster project sustainability, and provide tools and resources that help CBM practitioners identify how they can apply the guidance to their project.

2 Community Priorities and Concerns

Climate monitoring grounded in priority values and concerns of the community is more likely to take off and stand the test of time. Engagement of community members in clarifying monitoring questions and in preparing a plan can go a long way in creating the foundation for monitoring projects in the "emerging" stages. Monitoring projects in the "growing" and "maturing" stages need to take care in sustaining community interest. Building connections between Elders and youth is one way to cultivate champions for community-based monitoring.

INTEGRATE CLIMATE MONITORING WITH PRIORITY VALUES AND CONCERNS OF THE COMMUNITY

Building enthusiasm for, and sustained interest in community-based climate monitoring is easier if monitoring is grounded in community values and concerns. Community values and priority concerns translate into key questions that monitoring and research can help answer (Danielsen et al. 2018b). A key priority is to conduct sufficient engagement with diverse groups of community members to ensure that a community's Indigenous Knowledge meaningfully informs CBM planning and implementation from the start.

Engage with Community Members to Scope Monitoring

Identify priority values and needs

Conducting engagement with diverse groups of community members will help to clarify core long-term values, needs and concerns. Engagement should be as inclusive of the community (i.e., targeting Elders, youth, land-users, women, men, etc.) as possible (Cave et al. 2018; Eyzaguirre and Olson 2019; Pollock and Whitelaw 2005). A facilitator is often involved in these early steps. Rather than in introducing their own ideas, facilitators mainly guide discussions and help community members come to a consensus (Danielsen et al. 2018b). Discussions may go off topic, but it is important to make space for participants to speak their mind during consultations, even for topics that may not be immediately relevant (e.g., residential school experiences) (Cave et al 2018). Making space for topics that are top-of-mind will help ensure that individuals feel heard, and feel comfortable sharing their knowledge, even if it means that

consultations take longer. If possible, holding engagement sessions on the land is preferable (Wicehtowak Limnos Consulting Services Ltd. 2019).

A topic to raise in these scoping discussions is community members' perspectives on long-term sustainability of climate monitoring:

- Does it mean to merely finish the community-based climate monitoring project that was started?
- Will it mean continuing the work after the grant ends?
- Will it mean assigning climate-monitoring to a new group within or outside the community to continue the work or seek to embed climate monitoring within an existing program to continue the work?

Clarify the monitoring questions

Rather than organizing monitoring around valued components (e.g., "moose are important"), it is best to craft a question that explains the importance of the issue to the community (e.g., "how is the moose population being affected by climate change?") (Reynolds et al. 2016). When data collection and reporting efforts are guided by clear, well-defined, simple questions, monitoring is more likely to result in useful and usable information for community decision-making (Eyzaguirre and Olson 2019). Ultimately, if monitoring helps resolve uncertainties and improves decision-making, community members will be invested in ensuring that monitoring is sustained.

Thinking through the following items helps craft good monitoring questions (Pickard et al. 2020):

- why the issue is important,
- what you need to know about the resource,
- how monitoring and / or data will support decision-making about the issue,
- how stakeholders and / or rights-holders may be impacted by decisions.

Leverage existing expertise and capacity within the community

Learning about successes and failures of previous or ongoing monitoring projects within the community can give new climate-monitoring projects a leg up (Pickard et al. 2020; TNC Canada 2016). Taking the time to track down these lessons also helps identify existing human capacity (staff or community members knowledgeable about a given topic) and physical infrastructure (e.g., stream gauges) for possible use in your project and can give an idea of what is possible to achieve given the resources available in the community (Johnson et al. 2018).

Develop a monitoring plan

Once monitoring questions are clear, it is important to develop a monitoring plan. Without a well thought out plan, it can be easy to stray from objectives, giving way to data collection that is not as rigorous or as relevant to monitoring questions as initially envisioned, or as community members expect. Recommended resources for monitoring plan development are provided in the Tools and Resources section below.

As CBM programs mature, it is important to solicit feedback from the community and periodically review the monitoring plan. For example, consultations may identify new monitoring questions, or help clarify how data collection or analysis can be adjusted to support decision making processes(Johnson et al. 2016). This is further discussed in section 4.

Sustain Long-Term Community Interest

Although preliminary engagement is particularly important for **emerging** projects, it is an ongoing need for all CBM projects. For **growing** and **maturing** CBM projects, a significant factor contributing to long-term sustainability is continued alignment of a CBM program with community priorities (Cave et al. 2018; Johnson et al. 2018). Engagement at later stages of a project provides an opportunity to report back on project achievements and ensure that emerging community priorities are integrated in monitoring. Grant-funded projects that are able to change to address a shared community vision are more sustainable than those that failed to account for community needs and desires (Riggs 2012).

Integrate Monitoring into Ongoing Activities

Sustaining long-term community interest in CBM can be facilitated by integrating monitoring into day-to-day community activities and outings, like fishing, hunting, trapping, and land-camps (Johnson et al. 2016). Community members are much more likely to participate in data collection if it can be a part of their routine, rather than if it requires them to make trips solely for the purpose of monitoring.

Having community members contribute to CBM through opportunistic observations offers numerous benefits. First, it can reduce overall monitoring costs if it decreases the need to make dedicated monitoring trips. Second, if community members are involved in data collection, they are more likely to vocally support the program, especially if they can see the link between their work and the outcomes of monitoring. Finally, if monitors (or monitoring trainees) are sent into the field with land-users, the program will be supporting knowledge sharing and peer learning, which is an effective approach to build capacity and skills.

For some CBM programs, opportunistic observations provide sufficient data for the purposes of the program. For example, a monitoring program in northern Russia relies entirely on fishers to report their observations while on the water: how many fish they catch of each species, and the fishing methods they use (Danielsen et al. 2018a). For many CBM programs however, opportunistic observations will need to be supplemented with systematic data collection plan to obtain sufficient data and statistical power to detect changes.

Youth and Elder Engagement

Fostering connections and knowledge sharing between youth and Elders is way to build support for a CBM program – not only will connecting youth and Elders provide a venue for sharing feedback about the program, connecting youth and Elders is a common priority among Indigenous stewardship programs (Peachey 2015). Youth engagement is highly recommended, because youth engaged in CBM may grow into future CBM champions. Champions are formal or informal leaders that play an important role in "softening the ground" for new ventures, by, for example, easing peers' concerns and mobilizing others' participation (Johnson et al. 2004).

Although bringing together youth and Elders can be resource intensive, the benefits are many. Recommendations to involve and bring together youth and Elders through monitoring include (Cave et al. 2018; Gérin-Lajoie et al. 2018; Peachey 2015):

- Create job shadowing and employment opportunities for youth to train as monitors;
- Host trainings, workshops, and land-based activities (e.g., camps, hunts, gatherings, etc.);
- Conduct outreach in schools to solicit youth interest in monitoring;

- Ensure Elders are properly compensated for their time;
- Develop youth and / or Elders council to guide monitoring;
- Integrate Indigenous language in CBM initiatives; and
- Provide the space for spirituality, prayer, and healing.

Creating a coordinator position or building that task into an existing staff's duties can help ensure that youth and Elder participation is prioritized.

Common Challenges

- **Jumping to data collection without meaningfully understanding community priorities and values**. In setting up CBM initiatives, there is a tendency to progress to data collection before finalizing community engagement. This can result in one or more seasons of collecting data before realizing that the resulting data are not relevant to decision makers and do not help answer your key questions (Lemos et al. 2012; Reynolds 2012). As a consequence, community members and leadership can reduce their support for the CBM project and halt its momentum (Whitelaw et al. 2003)
- **Incomplete monitoring design**. A monitoring plan should outline what data is to be collected, and how it will be collected. These elements need not be complex, but should be well thought through – it is essential that data is collected in a rigorous and transparent process, and that it be able to address the monitoring question outlined in the monitoring plan (Parlee 2018). Although corrections to the initial plan are to be expected (no one gets it right on the first try), one that gets close to the desired outcome will help to generate support for the program, rather than one that must be completely redesigned (Conrad and Hilchey 2011).

Tools and Resources

- Indigenous Guardians Toolkit: Create a Vision, Plan, and Prioritize https://www.indigenousguardianstoolkit.ca/section/building-vision-what-do-you-want-achieve
- Centre for Indigenous Environmental Resources: Hydro-Climatic Monitoring Roadmap http://www.yourcier.org/uploads/2/5/6/1/25611440/essa_cier_monitoringroadmap.pdf
- Wicehtowak Limnos Consulting Services Ltd.: "Community engagement sessions: How to engage communities?" (p13 in WHAT WE HEARD: Central Canada Indigenous Community-Based Climate Monitoring Forum Summary Report) https://static1.squarespace.com/static/5b5f2faeee175972108d5f0d/t/5d67ecaaaf72b00001543897/1567091884049/ICBCM_Forum+Report+Regina+2019.pdf
- See Annex A in this document: Community Ownership Tool: Questions to Help Spot and Promote Community Ownership
- See Annex B in this document: Checklist Clarifying Expectations for Champions of Change

3 Funding

Funding shortfalls are a persistent barrier to sustaining community-based monitoring. Strategies such as focusing on funding opportunities that match community monitoring goals and objectives, diversifying funding sources and identifying core funding needs to sustain monitoring work can all help ensure climate monitoring activities, and the benefits that flow from them, last. It's never too early to think about financial sustainability.

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CONNECT MONITORING GOALS AND OBJECTIVES TO FUNDING OPPORTUNITIES

Despite the rapid rise of CBM projects funded in Canada over the past two decades, lack of funding remains a significant barrier to the long-term sustainability of community-based monitoring. Most importantly, CBM practitioners report that obtaining sufficient long-term funding is a barrier to developing long-term datasets (Carlson et al. 2017; Living Lakes Canada et al. 2018). In addition, funding opportunities often permit certain forms of activities or spending categories and not others. For example, a grant may stipulate that funds should target training instead of monitoring alone (Peachey 2015). For CBM programs, finding the right sources of funding can help foster program sustainability. The following guidance helps navigate the search for funding sources.

Align Funding with Project Activities

As a CBM projects or programs grow, their budgetary needs, project activities, and capacity to undertake monitoring will change. For **emerging** projects, a greater proportion of costs will need to be allocated towards capital purchases (e.g., monitoring equipment, IT systems, vehicles, etc.) as well as planning processes (e.g., engagement, research) that are required to start-up a monitoring project. For **growing** and **maturing** projects, these one-time costs are largely replaced by spending on staff salaries, as well as the costs to maintain the monitoring network. It follows that the types of funding opportunities CBM projects pursue should change through time, consistent with their goals, and budgetary requirements.

This means that for **emerging** or **growing** programs, ideal funding opportunities would permit spending on community engagement, monitoring plan development, and capital purchases (Pollock and Whitelaw 2005). Newer CBM projects may be motivated to apply for grants even though they may not be a good match for what their project is trying to do. If capacity is limited, time spent applying for one grant may divert resources away from project activities, or from applying to a more suitable grant. Careful consideration of how a funding opportunity will contribute to climate-monitoring outcomes is valuable in ensuring the invested dollars go far (Shearer et al. 2009).

For **growing** or **maturing** projects, the types of funding opportunities to look for will differ. As internal capacity to write funding proposals increases, it is possible to be both more selective and choose the best funding opportunities for your program, and submit more funding applications, in order to obtain more funding. Although the “best” funding opportunity will differ by program, for more mature programs, these opportunities should be multi-year, and be sufficient to cover staff salaries, as well as the ongoing maintenance costs to ensure sustained data-collection.

The topic of paying for data collection versus recruiting volunteers is often debated in the CBM literature. Employing locals as data collectors helps build capacity for high quality and consistent data collection, and retain that capacity within a community; however, it can significantly increase CBM budgets (relative to recruiting volunteers) (Cave et al. 2018; Johnson et al. 2016). On the other hand, relying on volunteers can help reduce monitoring costs, although organizing volunteers can be a logistical challenge (Wilson et al. 2018). Since volunteers are not compensated for their labour, they may not always be available to collect data, which can result in gaps in data collection. In addition, community members’ volunteer time spent collecting data can count as in-kind contributions to a funding proposal, which can be attractive to funders.

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Either as paid staff or volunteers, relying on locals can help support project sustainability by developing capacity within the community, and reducing the need to pay consultants. This topic is discussed further in Section 4.

Diversify Funding Sources

Seeking and obtaining financial resources from a diverse set of funders can help foster the sustainability of climate monitoring activities in communities. Obtaining multiple funding sources will help CBM projects withstand changes in funding availability across funders. Projects relying on a single grant program can face severe disruptions if a funding program is discontinued or there are changes to funding rules. Diversifying funding sources may also help to even out proposal application efforts throughout the year (Riggs 2012). This may be more feasible for more mature projects, however, as newer projects may have a limited capacity to respond to grants, and may not be able to be as choosy.

CBM projects should consider all available funding models, to find alignment with their climate-monitoring needs and opportunities. Available funding sources for CBMs include (but are not limited to) grant-based funds, which may originate from governments (federal, provincial, or territorial departments, or Indigenous governments[2], Indigenous community organizations (e.g., Coastal First Nations), NGOs, industry or private foundations. In some cases, the data communities collect and analyze through their climate-monitoring projects may serve the commercial needs of others. Creating a social enterprise[3] – i.e., a business with specified social, cultural or environmental objectives – is one way to recover the cost of climate monitoring while still meeting communities' information needs. Social enterprises or other Indigenous owned businesses can help create new revenue streams and help ensure that staff and profits remain within communities. SmartICE (https://smartice.org/) is one such example of a venture that combines monitoring of sea-ice thickness and production of sea-ice hazard maps to inform safe ice travel by community members with the generation of tailored datasets for sale to commercial clients in winter fishing, tourism, shipping and sea-lift.

Partnerships with other organizations (e.g., academics, industry, and NGOs) may help unlock access to otherwise unavailable funding (e.g., academic research grants) and offer many other benefits, including providing trainings, covering some costs of monitoring, and providing employment for monitoring tasks. Partnerships are discussed further in Section 5.

The Tools and Resources section includes many documents that summarize available community-based monitoring funding opportunities, which can be evaluated against your project's needs.

Plan for Financial and Project Sustainability from the Start

Although securing sufficient long-term funding is a core component of CBM sustainability, it's not a panacea; CBM project sustainability relies on the successful management of all project functions to consistently achieve goals and outcomes (Riggs 2012). In fact, with careful consideration, CBM sustainability can be achieved even if budgets are squeezed, by scaling-down program elements, and ensuring that monitoring goals are still met (Riggs 2012).

[2] Eligibility for different funding sources may differ for First Nations, Métis, and Inuit communities.

[3] For a review of Indigenous entrepreneurship in the context of the social economy see: Henderson, G.E., 2018. Indigenous entrepreneurship and social entrepreneurship in Canada. Supreme Court Law Review, 83(2), pp.241-278. https://www.researchgate.net/publication/320843404_Indigenous_Entrepreneurship_and_Social_Entrepreneurship_in_Canada

As early as possible (ideally, when applying for funding), it is beneficial to assess how your climate-monitoring project can adapt to budgetary changes while continuing to achieve its goals and outcomes. This assessment should identify essential activities and how they may be scaled down while still being a useful project, trade-offs between retaining staff and / or volunteers, and other modifications that should be made to processes and operations (Peachey 2015). This exercise will reveal an approximate minimum budgetary threshold (above which project goals and outcomes can still be met), as well as project features that can be obtained with additional levels of funding, all of which can help guide future funding decisions, and demonstrate the importance of program sustainability to potential funders.

Growing projects in particular, with a few seasons of data collection, analysis and reporting under their belts, are in a good position to identify their core funding needs to continue monitoring work in the long term. Project partners should take time to work together to identify these core funding and resource needs (what is needed and how much) and develop a plan to obtain the funds (how and who) before grant funding (ICBCM Program funding, in this case) runs out.

Tools and Resources

- Indigenous Guardians Toolkit: Fund an Indigenous Guardians Program (https://www.indigenousguardianstoolkit.ca/chapter/fund-indigenous-guardian-program)
- Integrated Governance Solutions Inc: Guardian Watchmen Funding Opportunities for the North Vancouver Island Ha-ma-yas Stewardship Network & Member Nations. (https://www.indigenousguardianstoolkit.ca/community-resource/guardian-watchman-funding-opportunities-north-vancouver-island-ha-ma-yas)
- Indigenous Community Based Climate Monitoring Program: "Funding Programs Accessible to Indigenous Peoples" [attach or reference excel spreadsheet? CBM - Resources - Funding Programs Accessible to Indigenous Peoples - Inventory (ICBCM Program).xlsx]
- Riggs (2012). Strategies for Sustainability of Grant-funded Programs https://digitalcommons.usu.edu/extension_curall/1002/
- Sigman et al (2015). Community-Based Monitoring of Alaska's Coastal and Ocean Environment: Best Practices for Linking Alaska Citizens with Science. https://doi.org/10.4027/cbmacoe.2015
- Indigenous Peoples Funding and Resource Guide (2014), compiled by International Funders for Indigenous Peoples. It includes tips for finding relevant foundations and grantmakers and for writing a successful proposal. https://internationalfunders.org/wp-content/uploads/2015/02/Indigenous-Peoples-Funding-and-Resource-Guide.pdf
- Kanuu is an Indigenous-led social enterprise that provides skill development, coaching, and ongoing support in entrepreneurship for Indigenous Peoples in Canada and beyond. https://www.kanuu.ca/

4 Institutional Capacity

Community capacity is critical to sustain climate-monitoring work over the long term. Capacity includes skills and abilities of individuals. Practices regarding training, mentorship, recruitment and retention are important to consider. Capacity also includes the existence and strength of institutions to keep monitoring work organized and beneficial to community members. Effective governance of the monitoring enterprise, including choices to refine monitoring methodologies, can build community trust.

STRENGTHEN INSTITUTIONAL CAPACITY

Community capacity is critical to ensure the long-term sustainability of climate monitoring. As a CBM project or program matures, the type of capacity, where it should be located (external or within the community) and how to strengthen capacities cost-efficiently differs. This section discusses:

- Developing human capacity for monitoring;
- Strengthening governance for monitoring; and
- Refining CBM methodologies.

Develop Human Capacity for Monitoring.

To enable monitoring, staff and / or volunteers may need to be trained on monitoring basics. Building community capacity to monitor is a core tenant of the ICBCM program; in many cases capacity is best obtained by recruiting and training community members as data collectors. Several training options are available, including college or university programs and certificates. In deciding on training needs questions to ask include the following (McKay 2017):

- What are your community's monitoring goals?
- What are the current community human assets (e.g., levels of education, background, training experience)?
- What is your community capacity to undertake and / or invest in training opportunities?

As projects scale up (i.e., those in the **growing** or **maturing** phases) the demand for additional capacity and expertise will grow (e.g., for program coordination, data analysis / reporting, IT services, grant-writing, etc.), and may exceed the existing capacity within a community. In the short-term, addressing capacity gaps may be achieved by investing in staff's professional development, recruiting trainers for specific skills development, by partnering with external agencies (this is discussed further in Section 5), or herring outside of the community (Wicehtowak Limnos Consulting Services Ltd. 2019).

In some instances, relying on partners to accomplish certain CBM tasks may reduce costs for the community (e.g., graduate students who may collect a season's worth of field data, or a partner who may contribute in-kind IT support), there are significant benefits associated with developing community capacity. Seeing community members rather than external partners conduct monitoring can motivate others within the community to support CBM, and help strengthen community stewardship over local resources (Cave et al. 2018; Eyzaguirre and Olson 2019).

Some Indigenous stewardship programs have developed training programs to foster local talent, covering a range of skills, including GIS, data collection, research methodologies, and resource management. In some instances, these training courses are offered as one-off courses, while other organizations have partnered with local schools to offer trainings as part of the curriculum. Investing in training locals provides direct benefits to CBM programs by ensuring a pool of qualified monitoring professionals, as well as indirect benefits by increasing employment readiness among all trainees (Peachey 2015).

Conducting outreach in schools (e.g., presentations about monitoring, demonstrations, games, hands-on exercises like dissections, or bringing students on field trips) can inform students about what monitoring is and why its important, and may even create future monitoring champions (Brook et al. 2009). Some CBM

programs create educational opportunities for youth and Elders to come together, and this is an important way to build community capacity through mentorship (Peachey 2015).

Identify a Monitoring Champion

Identifying a local champion who sees the value of research and monitoring for their community is key for monitoring success (Brook et al. 2009). A local champion will sustain momentum and drive the program forward, even when resources for monitoring are slim. The champion also plays a key role in coordinating among partners, conducting outreach, seeking funding, building capacity, and conducting long-term strategic planning (Brook et al. 2009; Pollock and Whitelaw 2005). Clarifying expectations for monitoring champions is discussed further in Annex B.

Attract and Retain Staff and Volunteers

Finding and retaining staff and volunteers to continue monitoring work is not a simple task. Because annual CBM budgets are variable, it can be difficult to attract employees who are looking for long-term work (Cave et al. 2018). In addition, some positions may require specialized skillsets, which may not be available in some communities (Living Lakes Canada et al. 2018; Peachey 2015). Staff turnover can be particularly problematic for CBM programs because the sudden loss of staff (or volunteers) can interrupt data collection and create gaps in long-term datasets (Conrad and Hilchey 2011).

Attracting and retaining staff may be facilitated by implementing the following recommendations (Danielsen et al. 2018a):

- **Simplifying data-collection approaches**. Reducing the complexity of data-collection will make monitoring easier for staff and volunteers, and reduce errors in data collection. Where possible, integrating data collection into community members' daily activities can help facilitate frequent data collection (versus asking them to make trips exclusively for data collection.
- **Reporting back**. Providing semi-regular feedback to staff, volunteers, and community members on CBM progress, including important findings, achievement of goals, and how CBM is influencing decision-making will help maintain enthusiasm in the project, and help make them feel like their contributions are supporting local stewardship.

Strengthen Governance Processes and Structures

As CBM programs grow, so does the need to formalize governance structures. Insufficient and / or unclear governance is a barrier to achieving goals and outcomes, and can contribute to the demise of CBM programs (Danielsen et al. 2018a). Clarifying who among CBM participants (staff, volunteers, partners) is responsible for what, who sets priorities, how decisions are made and how account is rendered will help to maintain confidence and trust in the program (Community Action for a Renewed Environment n.d.). There is no right or wrong way to organize a CBM program. Every community will need to determine the structures and processes that best meet their needs and correspond to the knowledge systems and decision-making institutions in which they are embedded (TNC Canada 2016).

For **emerging** programs, Danielsen et al. (2018a) recommend initially embedding the CBM project within an existing program or department. This will help insure CBM activities against changes in external funding availability and reduce the burden of establishing new institutional structures. Once CBM programs are more established, they may be sufficiently autonomous and self-sustaining to establish independent governance. Danielsen et al. (2018a) recommend waiting approximately 10 years before becoming fully independent.

Refine CBM methodology

Issues with data quality often plague CBM programs, particularly in the first few years that they attempt data collection (Whitelaw et al. 2003). Insufficient rigor in the monitoring plan, issues with sampling devices or with data collection, are all challenges that can result in inaccurate or insufficient data, or worse, data that are misaligned with the monitoring question (Brook et al. 2009). These errors can lead to mistrust in the CBM program and may be a barrier to long-term sustainability (Conrad and Hilchey 2011).

For this reason, it is very important to invest time in carefully developing an effective monitoring plan that makes the best use of available resources. Tools such as power analysis can help communities identify an effective sampling design which can detect changes to the identified indicators with the minimum amount of effort. Talking to other experienced monitoring practitioners may help you to develop a workable design. Its also important to make course corrections to the monitoring plan, soliciting feedback from CBM staff / volunteers, community leaders and members, and if necessary, external scientists. Although it can be tempting to make wholesale changes to elements that are not working, remember that changes to data collection methods may complicate the development of a long-term dataset (i.e., data collected before and after methods changes may not be comparable) (McKay and Johnson 2017a).

Methods to seek efficiencies in CBM routines are described further in Section 6.

Tools and Resources

- Sigman et al 2015: "Tips for engaging community members and sustaining participation" in Community-Based Monitoring of Alaska's Coastal and Ocean Environment: Best Practices for Linking Alaska Citizens with Science https://seagrant.uaf.edu/bookstore/pubs/SG-ED-78.html
- Indigenous Guardians Toolkit: "Hire and Manage Staff" https://www.indigenousguardianstoolkit.ca/chapter/hire-and-manage-staff
- Indigenous Guardians Toolkit: "Develop Training and Build Capacity" https://www.indigenousguardianstoolkit.ca/chapter/develop-training-and-build-capacity
- Examples of training programs on environmental monitoring:
  - Link to training resources on Toolkit
  - Building Environmental Aboriginal Human Resources (BEAHR) - Customizable Environmental Training for Indigenous Communities. Eco Canada. https://www.eco.ca/beahr/
  - EcoTrust Canada Observer-Based Fisheries Monitoring – Training Program https://ecotrust.ca/priorities/fisheries/observer-based-fisheries-monitoring/
- In this PPT, the Centre for Indigenous Environmental Resources (CIER) provides a summary of training opportunities of relevance to Indigenous community-based climate monitoring. http://www.yourcier.org/uploads/2/5/6/1/25611440/icbcm_symposium_training_and_programs.pdf
- Statistical Power Analysis: https://www.statisticssolutions.com/statistical-power-analysis/

5 Partnerships

Partnerships with external organizations can help take community dollars further, fill gaps in local talent, lend credibility to the monitoring enterprise and broaden the reach of climate-monitoring goals. Communities can be selective in their partnerships and focus on those with shared objectives, who respect the community's vision for climate monitoring and truly complement

CULTIVATE PARTNERSHIPS

Partnerships with external organizations can help foster long-term sustainability in CBM projects. Partners offer numerous benefits to CBM projects, including, but not limited to (Brook et al. 2009; McKay and Johnson 2017b; Persoon 2016; Pollock and Whitelaw 2005; TNC Canada 2016; Whitelaw et al. 2003):

- Providing specialized expertise, and / or filling gaps in local talent;
- Training on CBM skills;
- Lending credibility to CBM methods and disseminating research findings, often through academic publications;
- Providing access to otherwise unavailable funding;
- Strengthening CBM methods by providing additional perspectives;
- Increasing access to additional collaborations through the co-development of new projects;
- Sharing the responsibility of project sustainability; and
- Improving community-partner relationships, which can benefit other community organizations that are already working with the partner.

However, partnerships are not a panacea, and not all partnerships result in sustainable monitoring projects. Many CBM projects or programs created through partnerships do not reflect community priorities. Instead, they prioritize partners' research agendas, which may not be relevant to the community (Danielsen et al. 2018a). This often occurs when partner agencies exclude communities from the planning phase, and is a barrier to the sustainability of CBM: volunteers may lose interest in data collection that does not support their priorities, and community decision-makers will not lend support to a monitoring initiative that fails to support their decision-making needs (Danielsen et al. 2018a). This section includes guidance for CBM practitioners to help think through finding the right organization(s) with which to partner.

Partner with Organizations that Share Similar Objectives

A main consideration when seeking partners is ensuring that their objectives are aligned with yours. Partners should be willing to support your project's objectives, and not impose their own agenda on the climate-monitoring project (Wicehtowak Limnos Consulting Services Ltd. 2019).

Partners can help fill gaps in capacity that prevent getting started on or executing a monitoring plan. Undertaking a skills-mapping exercise can help identify the capacity that a CBM program is missing, and organizations that might be recruited to fill those gaps (Johnson et al. 2016). This is particularly relevant for **emerging** programs, which may need to seek support of external partners to fulfill many of their needs. Skills mapping remains useful for **growing** and **maturing** projects as well. As CBM projects grow and scale up, it is necessary to adapt the organizational structure to ensure objectives can still be met. A skills-mapping exercise can help resolve uncertainties about positions to fill internally and where partnerships should be sought.

Where partners are intimately involved in a CBM project's design, the relationship should be collaborative, and not privilege the partner's objectives over those of the community. Beyond the planning stage, successful partnerships should rely on collaboration to inform how data are collected, how the data

are interpreted, utilized, stored and protected ensure the partnering organization share their goals and vision and respects the communities values and role.

For important partnerships, establishing a memorandum of understanding and data sharing agreement between your organization and the partner can help to reduce misunderstandings, and ensure a partner's long-term commitment to climate monitoring work. An agreement that transparently outlines the roles, responsibilities, and obligations of all parties, and the ownership, management and use of generated data all the while safeguarding the community's vision, will help build a community's trust in the program, particularly when the partner is not well known (Community Action for a Renewed Environment n.d.).

Tools and Resources

- Community Action for a Renewed Environment: Project Sustainability Checklist (Section II). https://19january2017snapshot.epa.gov/sites/production/files/2015-04/documents/care_sustainability_checklist.pdf
- Indigenous Guardians Toolkit: Establish Relationships with Resource Agencies: https://www.indigenousguardianstoolkit.ca/section/what-are-some-ways-engage-resource-agencies
- Indigenous Guardians Toolkit: Create a Network or Alliance https://www.indigenousguardianstoolkit.ca/chapter/create-network-or-alliance
- Inuit Tapiriit Kanatami & Nunavut Research Institute: Negotiating Research Relationships With Inuit Communities, A Guide For Researchers: https://www.itk.ca/wp-content/uploads/2016/07/Negotitiating-Research-Relationships-Researchers-Guide_0.pdf
- Tondu et al (2014): Working with northern communities to build collaborative research partnerships: Perspectives from early career researchers. https://journalhosting.ucalgary.ca/index.php/arctic/article/view/67461

6 Efficiencies

As communities gain experience in climate monitoring the opportunities to fine tune their operations will become evident. Seeking efficiencies, either by streamlining monitoring routines, using technology or paying attention to "economies of scale", helps stretch monitoring dollars and make best use of staffing resources.

SEEK EFFICIENCIES

Fiscal sustainability is a key component of overall CBM sustainability – if costs can be reduced, resources may be diverted from fundraising to accomplishing monitoring tasks (Gofman 2010). Cost-efficiencies in CBM programs may be obtained through:

- Streamlining work routines;
- Automating monitoring tasks;
- Benefitting from economies of scale;
- Strengthening institutional capacity (see discussion in Section 4); and
- Cultivating partnerships (see discussion in Section 5)

Streamline CBM Routines

The first few years of a CBM project will yield important lessons about what works and what does not work in executing the monitoring plan. Implementation problems, such as deviations in how monitoring protocols are applied, can limit the usefulness of monitoring data. Section 4 highlights the importance of taking time to learn from mistakes and periodically revising the monitoring plan. Streamlining CBM routines can be a component of these revisions, where inefficient processes are substituted with more efficient ones. Over time, gradual revisions to the monitoring plan will help optimize data collection, analysis, and reporting, and increase confidence in the results.

Automate Monitoring Functions

The large scale of Indigenous territories can make monitoring valued components very costly. Investing in monitoring automation is one way to decrease the costs associated with sending data collectors to sampling sites across the territory (e.g., fuel, and vehicle upkeep), not to mention the risks associated with travel to remote regions.

Satellite imagery can provide real-time data on numerous environmental parameters and indicators (e.g., land cover and some climate variables) for very large regions for free or at a low cost (Kerr and Ostrovsky 2003; Turner et al. 2015). With data dating back to the 1970s, satellite imagery can also be useful in establishing baseline conditions, even if the data are not used for ongoing monitoring. Automation can also involve the use of data-loggers that make and store regularly scheduled measurements, which may be used instead of, or as a complement to, data collection by people.

Table 2 describes some trade-offs worth considering when examining opportunities for monitoring automation (Pickard et al. 2020).

Table 2. Pros and cons of automated monitoring systems.

Pro	Con
• **Satellite imagery** can provide coverage across large territories. • Low resolution **satellite imagery** can be obtained cheaply, or for free.	• **Satellite imagery** has a low return frequency (images every two weeks or less frequently), which makes detecting within-season changes difficult. • High resolution **satellite imagery** is expensive.
• **Data loggers** let you make frequent observations (every minute or hour) and are inexpensive to maintain.	• Some **data loggers** have a high upfront cost, so it may be difficult to achieve broad spatial coverage.
• Using **staff** as monitors gives you "eyes and ears" on the ground, can support broader goals like building connection to the land and knowledge sharing (e.g., if monitors are paired with youth or elders)	• Costs associated with human observers (**staff**) can be high. These include salary costs, as well as upkeep of transportation equipment.

Use of technology, including automation, is also helpful in managing, storing, sharing and analyzing large amounts of data. Data platforms that are open source and open access can help keep maintenance costs and efforts low. CMB practitioners can also program analysis routines in software applications for rapid analysis of both qualitative and quantitative data.

Benefit from Economies of Scale

As CBM activities grow, communities may be able to more efficiently use the resources they have by leveraging economies of scale. For example, larger CBM programs may be able to hire specialized staff (e.g., for volunteer coordination, fundraising, data analysis, IT support, etc.) full-time, instead of asking

one staff member to take on multiple responsibilities. Specialized staff would be expected to be more efficient at their work, compared to a single staff member juggling multiple responsibilities. Although this effect may be most pronounced for large CBM programs, **emerging** and **growing** programs may be able to achieve a similar outcome by sharing resources with other community organizations. For example, an agreement with a lands stewardship office could permit their resident GIS analyst to dedicate 20% of their time to the CBM project.

As CBM projects mature, some of the fixed costs associated with initiating CBM projects may be avoided. For example, expanding the scope of the monitoring network by adding new sites is much more affordable than developing a new monitoring program, because some of the fixed costs like community consultations and monitoring plan development may not be required. Furthermore, as new programs are added, it may be possible to reduce costs by integrating data collection among all programs (i.e., data collectors make the same number of visits to field sites, but collect additional data at each site).

Tools and Resources

- National Collaborating Centre for Aboriginal Health: Indigenous Approaches to Program Evaluation https://www.ccnsa-nccah.ca/docs/context/FS-IndigenousApproachesProgramEvaluation-EN.pdf
- Centre for Indigenous Environmental Resources: Hydro-Climatic Monitoring Roadmap http://www.yourcier.org/uploads/2/5/6/1/25611440/essa_cier_monitoringroadmap.pdf
- Indigenous Guardians Toolkit: Create a Network or Alliance https://www.indigenousguardianstoolkit.ca/chapter/create-network-or-alliance
- Case Study 5: Mackenzie DataStream: Scaling-Up Community Monitoring Efforts Through Data Sharing http://awsassets.wwf.ca/downloads/realizing_the_potential_of_community_based_monitoring_in_assessing_the_health_of_our_.pdf

7 Conclusions

Lack of stable funding can create barriers for sustained community-based monitoring. However, chasing funding dollars is not the only strategy to boost the sustainability of monitoring work. This report provides guidance to help think through key considerations for CBM practitioners seeking to maintain their monitoring work in the long run. The intent is for this guidance is general enough to be relevant in a range of contexts but specific enough to be useful. The literature on CBM is rapidly expanding; each section of this document provides additional Tools and Resources for readers looking for more information.

This report contains a mix of guidance that applies to CBCM projects or programs in all phases – whether **emerging**, **growing** or **maturing**— and guidance intended for project/ programs at specific phases. Identifying first what phase your program is in (**emerging**, **growing** or **maturing**) will help determine what guidance may be most relevant at this time.

Key takeaways from the report are as follows:

- Integrate CBM with **community priorities and concerns**. Monitoring that addresses a community's key concerns is more likely to garner and sustain interest. Ensuring that community priorities and values are documented through community engagement will help establish a meaningful program. As programs grow and mature, make sure that the monitoring plan remains relevant to the community through ongoing consultations.

- Align **funding** opportunities with monitoring goals and objectives. Funding shortfalls are a persistent barrier to developing long-term CBM. Strategies such as focusing effort on obtaining funding opportunities that meet community monitoring goals and objectives, identifying core funding needs to sustain monitoring work, and diversifying funding sources and can all help ensure your monitoring program can weather changes in funding availability. Careful consideration of how your budget may be affected by external factors will help build resilience against untimely changes in funding availability. It's never too early to think about financial sustainability.

- Build **institutional capacity** for monitoring. Developing and retaining individual and institutional capacity to build a monitoring network and undertake consistent monitoring is critical to sustain climate-monitoring work over the long term. Effective governance of the monitoring enterprise can engender community trust.

- Cultivate **partnerships** with external organizations, like NGOs, academia, and industry. Partnering with external organizations can help fill gaps in local talent, lend credibility to the monitoring enterprise and broaden the reach of climate-monitoring goals. Communities can be selective in their partnerships and focus on those with shared objectives, who respect the community's vision for climate monitoring and truly complement community assets.

- Seek **efficiencies** in your CBM program. As communities gain experience in climate monitoring, opportunities to optimize their activities will help to reduce program costs. Efficiencies can be found by streamlining monitoring routines, taking advantage of automated monitoring, and leveraging economies of scale.

GCDOCS # 89746294
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Annex A

COMMUNITY OWNERSHIP TOOL: QUESTIONS TO HELP SPOT AND PROMOTE COMMUNITY OWNERSHIP

In setting goals and planning a community-based climate monitoring initiative:

- How are community members participating in the planning of the project? How were/are decisions about priorities made?
- How do you know that the climate-monitoring project responds directly to community members' priority values and concerns?
- How does the project build upon the efforts of groups or relationships that pre-date this funding opportunity?
- Is the story that is presented about "community problems" adequately balanced with the story of "endeavors to change this"?

In executing the monitoring plan and generating knowledge:

- Can community members of various ages, gender, position, etc. articulate the climate-monitoring project's goals or effects?
- Are elements of reciprocity present? To what extent are local resources and/or in-kind contributions being mobilized to support the project?
- Is the implementation team clear about how climate monitoring is and will continue to affect people's daily lives in the community?
- To what extent is there collaboration on climate monitoring with other neighboring communities, government programs and companies operating in the area?

Adapted from a publication by Jennifer Lentfer
http://www.how-matters.org/2010/09/13/spotting-community-ownership/

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Annex B

CHECKLIST: CLARIFYING EXPECTATIONS FOR CHAMPIONS OF CHANGE

Item	Yes / No	If No, plans to address it
Has the role of the champion (or champions) been clarified and understood?		
Is it clear for champions what is not their role and responsibility?		
Does the champion(s) demonstrate passion for the topic?		
Do champions have access to managerial support?		
Do champions have the necessary skills to elicit peer support?		
Do champions have the necessary skills to navigate the community's socio-political environment?		
Do champions demonstrate strong communication and networking skills?		

Adapted from: Project Concern International [PCI] 2014. A Resource Guide for Enhancing Potential for Sustainable Impact - Food and Nutrition Security.

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