Community-based monitoring infrastructures for pan-Arctic observing: Policy-regulatory, technological, social, and economic dimensions

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Introduction:

This statement draws on contributions from community-based and community-led monitoring (CBM/CLM)[1] practitioners during workshops held in Fairbanks, Alaska, (May 2017; Fidel et al. 2017) and Québec City (December 2017; report forthcoming) that were supported by and contributed to the Integrated Arctic Observing System (INTAROS; see also AOS statement by Stein Sandven). Participants represented twenty North American CBM programs and several participants from Europe also contributed based on their experience with Arctic CBM programs.

Rapid environmental and social change and the need for development, risk management, and diversified and robust local and regional economies in the Arctic form the backdrop for Arctic community engagement in CBM. There is a sense of "urgency to the situation, a climate crisis" (Fairbanks workshop – henceforth "FB"), and a need to understand, document and communicate changes that are occurring to improve decision-making.

[1]Without attempting to offer a catch-all definition, CBM programs are monitoring programs based in communities with significant community involvement; CBL programs are community-initiated and led. We use CBM to refer to both types of programs in this statement.

The value of CBM to Arctic residents is greater when they are meaningfully engaged in the entire process from program design to implementation, interpretation, and use of observations (Quebec workshop – henceforth "QC"). Robust engagement increases the likelihood that monitoring will respond to local information needs (e.g., "Is my food safe to eat?") and/or monitor something of cultural or economic value to communities (FB & QC). The latter often benefit from contributions by Indigenous knowledge holders based on an alignment with their values and activities. Programs that monitor health, status, trends, migration, and other attributes of animal and plant populations, particularly populations with a high subsistence or economic value, fall in this category. CBM programs that focus on social, cultural, and human health monitoring, although less visible within the Arctic observing community, are also important to communities (FB & QC). Such programs may collect information, for example, about Indigenous language learning and transmission or the frequency and quality of land-based experience as one determinant of human health and well-being (QC).

Workshop participants discussed several topics relevant to the "business case" theme of AOS 2018, including sustainability, contributions of CBM programs to decision-making, and challenges and opportunities for data management and networking of CBM programs. Below, we introduce discussion points that emerge from four "infrastructures" underlying successful CBM programs: policy/regulatory, technological, social, and economic dimensions.

(1) Policy-regulatory: How can the Arctic observing community support development of <u>adaptive governance</u> mechanisms that utilize CBM data and information in a timely manner?

"The gap between information and action needs to be shortened. Information is needed to make choices; information needs to be in the hands of people who are adapting" (FB).

Governance systems play a significant role in shaping the form and function of CBM programs (Wilson et al. 2018). For information generated through CBM programs to have a greater social impact, there needs to be an uptake by decision-making bodies at relevant scales, which may include local, regional, national, or international scales (or multiple scales, depending on the focus of monitoring) (FB). This essential link between CBM and governance reflects the policy and regulatory infrastructure that underlies CBM.

Non-residents of the Arctic often decide science priorities used to inform policy, and therefore these priorities may not be aligned with community concerns and cannot inform local decision-making. (Well-functioning co-management boards are a notable exception, as they can provide institutional support for prioritizing community perspectives). Resource management agencies need to incorporate community observations into management decisions (FB). Use of CBM information by decision-makers will improve well-being, help sustain community interest and ensure that monitoring is meaningful for Arctic residents (FB & QC).

CBM can shorten the time from observation to decision in local decision-making (Berkes and Armitage 2010; Danielsen et al. 2010) and provides information for sustainable management adapted to local realities. Regulations pertaining to wildlife management, for example, are not able to keep up with the rapid environmental changes occurring across the Arctic (FB), including

changes in species distribution (Pecl et al. 2017; Post et al. 2013). CBM programs that provide opportunity for interpretation by community members also enhance the quality of knowledge available for decision-making.

Our work indicates that policy and regulatory infrastructures need to adapt to shorten the time between observation and decision. This would facilitate rapid adjustments in quotas and other management tools to "real word" situations, as provided through CBM. A discussion to address this issue could encompass implications for income generation in small, rural communities or benefits for larger-scale sustainability planning and coordination at the pan-Arctic level, with the potential to significantly improve the "business case" for investments in monitoring.

(2) Technological: How can the Arctic observing community support coordination and networking of CBM data platforms?

"We need to take the relatively little information we have and pull it together to see the big picture." (FB)

We observe a flourishing of investment in and attention to technological infrastructure for CBM data. At QC, four programs described emerging platforms capable of storing and sharing CBM data at different scales (SIKU, SmartICE, eNuk, and the Mackenzie Data Stream). Two other initiatives, the Geomatics and Cartographic Research and Information Centre and the Exchange for Local Observations and Knowledge of the Arctic (ELOKA), adapt open source software to meet data and information management needs of community partners. The goals of all of these platforms differ – some are intended to be program specific, while others aim to host data contributed by diverse CBM programs. At QC, CBM programs agreed that additional coordination and networking would be beneficial to minimize the risk of effort duplication and to develop opportunities for cross-fertilization and interoperability between platforms.

Technology and Internet access remains uneven across the Arctic, with high levels of inequality in access persisting in many regions. Government investment in technological infrastructure needs to prioritize addressing these inequities. In addition, communities are increasingly concerned about maintaining control over and managing data at the local level, and are interested in developing capacity to host data through long-term local repositories. These community interests should be prioritized as part of technological infrastructure development for CBM.

We suggest a conversation at AOS about the need for greater coordination and networking among data platforms that host CBM data and how these systems are situated within the broader data ecosystem (Chandler et al. 2016). These infrastructures need to be able to support locally and regionally specific needs, diverse indicators, and ethics considerations that are determined by community members; they will therefore need to be highly flexible. While technology infrastructures are useful tools for data management, visualization, and sharing, we perceive a risk that these infrastructures may divert attention and funding away from the underlying CBM programs (Brammer et al. 2016). It may be useful to view technology as only one component of the infrastructures necessary for robust and effective Arctic observing systems, and to allocate resources accordingly.

(3) Social: How can the Arctic observing community better understand and support social learning and knowledge transmission that happens around CBM programs at the community level?

Research points to the important role of social learning (learning by social groups that results in changes at the group level) in supporting resilience in social-ecological systems (de Kraker 2017). Social learning can occur informally or can be supported more deliberately through design of formal learning opportunities. Within CBM programs, practitioners suggest that social systems for distribution of resources and information within communities play an important role facilitating use of observations locally. This might be considered part of the social infrastructure that underlies successful programs.

CBM programs build on and contribute to this social infrastructure in several ways. For example, programs may explicitly utilize popular knowledge transmission mechanisms, such as community radio, videos and Facebook (Mustonen et al. 2018). They may design data collection around activities that are already transpiring, such as routine hunting trips. Some CBM programs support opportunities for formal social learning through culture camps, elder-youth connection programs, training, and mentorship of youth to learn land- and sea-based skills. For example, the Western Beluga Health Monitoring Program in the Inuvialuit Settlement Region works with residents to collect samples at beluga harvest camps (QC). In this way, formal programs reinforce social values, such as language and Indigenous knowledge transmission (see also: Johnson 2016).

The informal and formal context of social learning as it occurs around CBM programs has yet to be studied, however (Funder et al. 2013). In addition, we are not aware of any studies done to evaluate the effectiveness of CBM programs from a community perspective. "North-North" exchanges between CBM practitioners from different communities or regions also promote social learning that can strengthen effectiveness of monitoring (Mustonen et al. 2018). We propose a discussion at the Arctic Observing Summit 2018 of the role of social learning in enhancing societal benefits of CBM programs, and of the ways that the Arctic observing community can support research on social learning.

(4) Economic: How can CBM contribute to community economic development?

A critical element of CBM program sustainability and impact is economic benefit for Arctic residents. Community-led economic development and diversification is a priority shared by many Arctic communities (Arctic Council 2016). In many cases, improved livelihoods, including economic development, is the motivation for becoming active in CBM programs. Employment opportunities from research may also contribute significantly to household economies in some Arctic communities (Carr et al. 2013). Some CBM programs employ coordinators and data collectors; motivation to participate can be at least somewhat influenced by compensation (FB & QC). Programs such as SmartICE are developing as social enterprises that regard research funding alone as unsustainable for long-term monitoring and instead are prioritizing building connections to and addressing the needs of the private sector with community knowledge and expertise, while at the same time fulfilling community information needs. Such an approach also

builds the business case for the creation of professional monitoring positions based in Arctic communities.

We propose a discussion at AOS focused on ways to foster CBM contributions to community economic development. It would be helpful to collect examples of programs that do this well, and to identify innovations that could be tested. These might include: linking CBM to environmental and social certification processes for products such as fish, meat, fur, and handicrafts, or connecting CBM to tourism offerings, for example by enabling communities to engage tourists in observing and monitoring activities. Such innovations might further improve the "business case" for investments in monitoring.

Concluding comments: CBM infrastructures for a pan-Arctic observing system

The points introduced above represent diverse components of infrastructure, extending beyond science and technology, that underlie successful CBM programs. Many Arctic communities see the need for CBM programs that prioritize community information needs; these are diverse and encompass not only natural systems but also social, economic, policy, and regulatory systems, and the interactions of all of the above (see Pulsifer et al. 2011). Communities also see value in coordinating and contributing data and information at different scales, provided that infrastructure and capacity are in place to maintain local control over data, including data use to inform decisions. This requires investment in network building for CBM programs that begins by facilitating community-to-community linkages while also exploring other possible network formations. Additional networking could facilitate information sharing, promote utilization of CBM information in decision-making, and help avoid duplication of effort in technological development.

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