



Research

## A multiple evidence-based approach to Métis community-based monitoring: a case study from the South Athabasca Oil Sands Area, Alberta, Canada

*Dermot T. O'Connor*<sup>1</sup>, *Diane Scoville*<sup>2</sup>, *Ron Donald*<sup>2</sup>, *Virginia Donald*<sup>2</sup>, *John Witney*<sup>2</sup>, *Ole Ellefson*<sup>2</sup>, *Garry Jewell*<sup>2</sup>, *Louella Jewell*<sup>2</sup> and *Vicky Silkie*<sup>2</sup>

**ABSTRACT.** This original research article provides a case study that describes how Métis indigenous knowledge was incorporated into the design of a community-based monitoring (CBM) program in the South Athabasca Oil Sands Area of Alberta, Canada. Athabasca Landing Métis Community (ALMC) members have traditional knowledge of local wildlife and climatic conditions in a region that has seen intense oil and gas-related industrial activity over the last 50 years. Informed by a multiple evidence-based approach to CBM, ALMC's program design combined traditional hunting, fishing, trapping, and plant gathering activities with photomapping methods. By taking geo-referenced photos of their environmental observations, which they shared with other project participants during regular monitoring meetings, Métis knowledge holders connected changes in local conditions such as resource scarcity or species abundance to broader ecological processes including climate change. Further, the monitoring program had an innovative cultural camp component that brought elders, heads of family, and youth together to deliberately interact and pass on Indigenous and local knowledge. The information drawn from photomapping, cultural camps, and traditional knowledge shared during meetings was gathered into a database. The database serves as a repository of traditional knowledge and land use data that will support ALMC's ongoing efforts to identify territory to promote self-governance and assert rights to lands and resources. We discuss how the ALMC's adoption of a multiple evidence-based approach to monitoring asserts control over data collection methods, storage, and dissemination, supports local capacity for self-determination, and amplifies the voices of Métis harvesters in the resource management sector.

**Key Words:** *community-based monitoring; Indigenous and local knowledge; Métis; multiple evidence-based approach; photomapping; South Athabasca Oil Sands*

### INTRODUCTION: THE MULTIPLE EVIDENCE-BASED APPROACH TO INDIGENOUS COMMUNITY-BASED MONITORING

As documented in a proliferation of publications in recent years, Indigenous peoples in Canada are asserting their rights to territorial sovereignty, resource management, and environmental protection, in part through the implementation of Indigenous community-based monitoring (ICBM) programs (McKay and Johnson 2017, Wilson et al. 2018, Brunet et al. 2020, Caverley et al. 2020, Gerbrandt and Westman 2020, Natcher and Brunet 2020, Reed et al. 2020). Indigenous control over environmental monitoring is consistent with an ethos that recognizes that Indigenous peoples have managed lands and natural resources according to their own needs, values, and knowledge systems for thousands of years and that this process was disrupted by settler colonialism and capitalism (Angell and Parkins 2011, Baker and Westman 2018, Ellis 2005).

In the international literature on the subject, ICBM is purportedly a means for Indigenous peoples to identify and mitigate negative effects of industrialization (Ansell and Koening 2011, Pyke et al. 2018, Bach et al. 2019), capture the spatial dimensions of changes to their territories and environments (Buckland-Nicks 2015), and enhance community capacity for collecting and analyzing data (Reed et al. 2020), including Indigenous Knowledge-based information (Natcher and Brunet 2020). Despite the promise of ICBM in practice these programs are often dominated by Western science in the choice of research questions and data collection methods (Reed et al. 2020); the geographical scope, values, and indicators are shaped by industrial interests (Noble and Birk 2011, Cronmiller and Noble 2018); and funding conditions and

priorities are imposed by colonial governments, making ICBMs more reflective of technocratic concerns than the priorities of Indigenous knowledge holders and communities (Austin et al. 2018, Natcher and Brunet 2020). To overcome these constraints on Indigenous input, a multiple evidence based approach to ICBM allows researchers to identify how and when Western scientific knowledge can help structure an ICBM while recognizing that by definition, the ICBM must be initiated, designed, and led by Indigenous knowledge holders (Tengö et al. 2021).

To address the gap between the promise of ICBM and the forces that restrain Indigenous knowledge-based input (namely favoring Western-scientific methods, industrial interests, and bureaucratic priorities), we explore how Athabasca Landing Métis Community (ALMC) members designed and implemented an ICBM program using a multiple evidence-based approach (MEB). This article serves as a case study about how to build an ICBM that showcases Indigenous knowledge and community involvement from program design to data collection through to reporting. Instead of focusing only on scientific rigor in data collection methods and sampling, the ALMC's MEB approach to ICBM emphasizes community-based selection of values and indicators, qualitative interpretations of observed patterns, and place-based conclusions about environmental change. This has resulted in further avenues to explore research collaboration with western scientists, including in water quality sampling, moose tracking using field cameras, caribou range identification, and Wood Bison recovery. However, the core of the program remains its commitment to showcasing Indigenous knowledge, rather than Western scientific sampling methods, bureaucratic priorities, or industrial interests.

<sup>1</sup>Oak Road Concepts, <sup>2</sup>Athabasca Landing Métis Community

### **ATHABASCA LANDING MÉTIS COMMUNITY**

The Métis people of western North America emerged in the 18th century through a process of ethnogenesis initiated by the intermarriage of Europeans and Indigenous peoples (Ens and Sawchuk 2016). Athabasca Landing Métis Community (ALMC) members are descended from a group of Métis people who occupied the area along the Athabasca River north of Edmonton during the fur-trade and prior to the establishment of effective control over the area by the Euro-Canadian state. The Hudson's Bay Post was established on a loop of the Athabasca River in 1877 and Métis freighters, hunters, and trappers lived near the post and provided labor and supplies in the form of fish, wild meat, and fur (Gregory 1986). The Catholic Church had a consistent presence at Athabasca Landing by the 1880s (Brandak 1972). In the 1890s the area saw an influx of settlers and migrants because it was the shortest overland route between the railway terminal in Edmonton and the Athabasca River steamboat transport route, becoming a main depot to supply the Hudson's Bay Company (Innis 1999 [1930]).

The influx of settlers around Athabasca Landing from the 1890s onward saw the enclosure of crownlands into private homesteads and the establishment of agriculture and forestry (Dyce 2013). The onset of conventional oil and gas exploration and extraction from the 1950s and the growth of the modern service and retail sectors in the town of Athabasca further undermined fur trade-related commercial trapping and freighting which had once been the dominant economic activities of the Métis around Athabasca Landing. The growth of large-scale industrial oil sands extraction downstream at Fort McMurray changed the socioeconomic and environmental conditions of the entire Athabasca River valley by the 1960s (Longley 2016). While adapting to these economic and environmental changes, generations of Athabasca Landing Métis people have maintained their traditional cultural practices based on subsistence hunting, trapping, fishing, and gathering food alongside domestic agriculture, employment in the natural resources sector, and integration with the modern capitalist economy as workers and entrepreneurs.

Because of the continuity of traditional hunting, fishing, trapping, and gathering over multiple generations, ALMC members have developed a body of knowledge about local history, the economy, politics, and the environment. This traditional knowledge, or Indigenous and local knowledge, includes awareness of how forestry, conventional oil and gas drilling, agriculture, and transportation affect the forests, wildlife, waterways, and air quality. The Athabasca Oil Sands feature mineable surface deposits north of Fort McMurray and deeper bitumen deposits below the South Athabasca Oil Sands in the Athabasca River watershed south of Fort McMurray. Since the 1960s large-scale surface mining has been commercially viable north of Fort McMurray. After exploration in the 1980s and 1990s, oil sands extraction has expanded using in-situ techniques and technologies into the South Athabasca Oil Sands since the 2000s (Alberta Culture and Tourism 2019). In the face of environmental changes and threats to the sustainability of traditional harvesting of food due to fears of pollution and contamination, ALMC have formally organized governance structures to assert their constitutionally protected rights and have taken measures to enhance their role as environmental stewards.

Athabasca Landing Métis Community Association (ALMCA) is a community-based, volunteer-run organization that represents about 150 Métis people in and around the town of Athabasca, Alberta. ALMC members assert constitutionally recognized rights to hunt, trap, and fish for food on crown lands and waterways and these lands have been noticeably altered by industrial activity in the last 50 years. Interest among Athabasca Landing Métis Community (ALMC) members in the assertion of Indigenous rights and active participation in environmental resource management, impact assessment, and monitoring has been prompted by their experiences with the environmental and socioeconomic effects of oil sands development.

In response to a call for submissions to Environment and Climate Change Canada's Indigenous Fund for Community Based Environmental Monitoring Program, social scientist Dermot O'Connor and Métis traditional knowledge holder Diane Scoville worked with ALMC to develop a CBM proposal for funding, which was accepted in June 2019. Since then, all of the listed authors have cooperated on the design and implementation of the CBM as described in more detail in the methods section below. This program, as it is described here, exemplifies the multiple evidence-based approach to ICBM. The case points to some methodological and theoretical benefits of Indigenous control over monitoring that are broadly applicable to similar efforts to implement ICBM using MEB approaches in other communities.

### **ALMC ADOPTS A MULTIPLE EVIDENCE-BASED APPROACH TO COMMUNITY-BASED MONITORING**

In the northern Canadian context, climate change, increased natural resource extraction, and declining population numbers of game typically harvested for subsistence purposes have created shared interests among Indigenous peoples, climate scientists, and biologists in wildlife monitoring (Brook et al. 2009, Wilson et al. 2018). However, collaborative efforts to implement community-based monitoring programs risk being impeded from differing worldviews and communication gaps between harvester communities, scientists, and regulators (Brook et al. 2009). In the Alberta oil sands, "Indigenous-led environmental monitoring initiatives ... have been underfunded over the last decade, resulting in the absence of community baselines, indicators and thresholds centered on local values" (Reed et al. 2020:1284). This is changing in line with the reconciliation agenda and a commitment by the Federal and Provincial governments to fund Indigenous community-based monitoring (ICBM) projects. Especially considering commitments by Provincial and Federal governments to the principles of the United Nations Declaration on the Rights of Indigenous Peoples, there is currently a greater emphasis on Indigenous participation in resource management and environmental monitoring (Caverley et al. 2020).

ICBM in particular has been an area in which Indigenous peoples in Canada have asserted their influence and rights to territorial management through surveillance and monitoring of industrial impacts (Natcher and Brunet 2020). Some of the benefits of ICBM include opportunities for Indigenous peoples to participate in industrial impact mitigation, early detection of environmental risks, and employment opportunities. It has also enabled Indigenous peoples to contribute to establishing impact assessment baselines, trends, and the spatial aspects of environmental changes. Further, "ICBM has proven effective in

compensating for inadequate monitoring efforts from centralized settler governments who have failed to integrate Indigenous knowledge and observations into environmental policy” (Tanner 2008, as cited in Natcher and Brunet 2020:1280).

Incorporation of local and traditional knowledge in CBM programs can widen and deepen the knowledge available to monitor and understand changes to the environment (Berkes et al. 2007). Indigenous and local knowledge (ILK) “systems involve social and ecological knowledge practices and beliefs pertaining to the relationship of living beings, including people, with one another and with their environments,” which can contribute to ecosystem stewardship (Tengö et al. 2021:504). The participation of Indigenous monitors and the incorporation of traditional knowledge (or rather, ILK) in CBM has been proposed as a means to bridge gaps between local people and external scientific experts and researchers in the Canadian resource sector, particularly in the north (Castleden et al. 2012, McKay and Johnson 2017).

During the initial phases of program design, the author group sought guidance on ways to incorporate ILK in CBM from an emerging body of literature, much of it based on recent work in Alberta’s oil sands (McKay and Johnson 2017, Wilson et al. 2018, Brunet et al. 2020, Caverley et al. 2020, Gerbrandt and Westman 2020, Natcher and Brunet 2020, Reed et al. 2020, Tengö et al. 2021). An MEB approach recognizes that scientific knowledge and ILK are distinct knowledge systems that “may have aspects of overlap as well as incommensurability, but present relevant and complementary knowledge for biodiversity and ecosystem governance” (Tengö et al. 2021:504). The MEB approach emphasizes creating synergies between knowledge systems and can be considered a means to guide collaborative projects that incorporate diverse knowledge systems, woven together into a more diverse and comprehensive knowledge base. MEB weaves together ILK and scientific knowledge through engagement between actors, institutions, and processes to generate collaborative pathways of resource management or environmental stewardship efforts that respect the various knowledge holders (Tengö et al. 2021).

While developing ALMC’s program, the authors paid special attention to the experience of other Indigenous groups in the province. In the Alberta Oil Sands, economic imperatives to develop resources have undermined processes to consult, assess impacts, and accommodate Indigenous interests prompting calls for greater participation in impact assessment on the part of Cree, Dene, and Métis communities (Baker and Westman 2018). Although the Alberta Government and a number of independent scientific studies suggest that the environmental and health impacts of oil sands development are negligible and that the economic benefits far outweigh the environmental risks, “Indigenous residents of the oil sands regions point to their own observations and contend that rather than having negligible impacts, oil sands development is having a deleterious effect on the environment and their own health” (Natcher et al. 2020:1331). As Gerbrandt and Westman (2020) point out, Indigenous communities in Alberta’s oil sands are demanding more active roles in consultation, environmental management, and monitoring. “Indigenous Peoples’ power and capacity to engage strategically with the oil industry and state process, in this region, have developed considerably during the present century, and

monitoring teams sometimes are among the most highly trained workers in their communities” (Gerbrandt and Westman 2020:1307).

Brunet et al. (2020) developed a co-designed research protocol with the Cold Lake First Nation to study the population health of fish that they argue is a tangible example of a multiple-evidence-based approach. Their work demonstrates how complementarities between different knowledge systems within a collaborative research process can generate a cohesive narrative to improve fisheries management but still respect culture, rights, and traditional harvesting practices and food provisioning (Brunet et al. 2020). Participation in ICBM is one way for Indigenous communities in Alberta to take action to protect the environment and assert their territorial sovereignty. “Although in its simplest form ICBM is considered to be a continuous data collection process, that can in some instances be embedded in Indigenous ways of knowing, it is also a political act that can, under the right circumstances, support self-determination and meaningful co-governance with settler governments” (Natcher and Brunet 2020:1281).

The shortcomings of ICBM approaches are that they reveal a disconnect between Indigenous knowledge and dominant epistemological frameworks used by government and industry-employed scientists, they risk the appropriation or loss of control over traditional knowledge, and they involve the imposition of scientific methods, indicators, and protocols (Natcher and Brunet 2020). To overcome some of these pitfalls, proponents of the MEB approach to ICBMs suggest that practitioners include several ethical considerations, according to Tengö et al. (2021). First, ILK must be recognized as a valid and legitimate source of knowledge, including in research design, decision making, and handling and dissemination of data. Second, there must be a recognition that ILK is relevant to management practices, governance, and decision making, including in the selection of tools and methods for information collection. Third the knowledge and values of Indigenous peoples, including their views on human-nature relationships and ecosystems must be taken into account using collaborative, participatory, or culturally appropriate methods of information collection. Fourth, within the ICBM research design, the local scale and local agency is empowered through free, prior, and informed consent and joint knowledge sharing protocols. Fifth, Indigenous peoples must be recognized as knowledge holders and rights-bearers and mutually agree with scientists on terms and procedures for collaboration (Tengö et al. 2021).

Expanding on the push for an MEB framework is the additional step of supporting Indigenous governance through the ICBM process. An Indigenous governance framework posits that Indigenous people who can exercise sovereignty and assert their rights are uniquely positioned to develop their own territorial management and monitoring frameworks (Reed et al. 2020). ICBM can be a means to advance sustainable self-determination via a community-driven process to promote livelihoods, governance, food security, and sustainable relationships between people, nature, and homelands. First, the ICBM must recognize historical and ongoing legacies of settler colonialism. Second, environmental governance must redistribute power to Indigenous communities. Third, participants must advocate for Indigenous community-led and inter-Indigenous cooperation to advance

ICBM programs outside of the state-led parameters. Fourth, the literature on ICBM must attempt to “decolonize” and reflect attempts by Indigenous communities to decolonize ICBM. Finally, non-indigenous designers of ICBM programs must invite Indigenous peoples to be co-designers of programs in support of sustainable self-determination lens (Reed et al. 2020).

What is novel about the contribution of this study to the body of literature on ICBM and MEB is that it describes the experience of a Métis community as they adapted and implemented an ICBM on their own terms. Unlike the First Nations communities in Treaty 6 and Treaty 8 Territories in northern Alberta (and parts of Saskatchewan and British Columbia), Athabasca Landing Métis Community (ALMC) has not signed a Treaty with the “Crown” and therefore does not have reserve lands or treaty lands entitlements. And unlike members of the Métis Settlements General Council based in Alberta, ALMC does not have a recognized settlement or jurisdictional land base. ALMC does not have stable and consistent sources of government funding to promote its governance objectives. Further, ALMC is represented by a community association that is largely run by volunteers.

Designing, obtaining funding, and implementing its ICBM program was therefore a means through which ALMC could access federal government funding to move toward the community goals of self-governance, the assertion of rights, and greater involvement in environmental protection. This reflects a concerted response to the broader political, economic, and regulatory context in which Indigenous peoples in communities close to natural resource extractive projects have experienced environmental and socioeconomic changes directly.

By deploying the MEB approach, ALMC sought to overcome some of the constraints on Indigenous influence in ICBM, including scientific, politico-economic, and bureaucratic constraints on the selection of geographic areas, indicators and data collection methods. The authors of this article sought to find novel ways to expand the participation of Métis knowledge holders and harvesters in a community-designed and implemented ICBM. The MEB approach provided a framework to address the institutional factors (availability of federal government funding to an underfunded community-based organization), epistemological differences between participants informed by Western social science and ILK, and the ethical impetus to develop a collaborative process that braided Western and Indigenous science.

## METHODS

ALMC’s ICBM program was initially envisioned to last from 2019 to 2022 and was developed by ALMC’s Board in collaboration with an external social science research consultant. The objectives and methods were refined following initial planning and training workshops with community-based harvesters in the summer of 2019. The objectives of the ICBM were to document the availability, abundance, and quality of traditional food resources in the Athabasca Oil Sands Area. Further, the ICBM was intended to enhance the capacity for ALMC harvesters (including elders and youth) to participate in self-governance, Métis cultural retention, natural resource management, and environmental protection. Finally, the ICBM was intended to enhance ALMC’s capacity to manage its traditional knowledge and traditional land and resource use data to promote cultural retention and engage

with government and industry to assess the effects of local industrial activity in the oil sands area, particularly on the traditional food system. The choice of valued components in the environment, geographic areas for monitoring, and indicators of environmental change were left up to the harvesters to define.

The MEB approach to monitoring meant that ALMC implicitly accepted the equality but also the distinction between Western science and Indigenous knowledge. However, ALMC harvesters were less comfortable with adopting science-based sampling methods, particularly in the selection of species and geographic locations for monitoring. Rather than random sampling, ALMC harvesters preferred to choose locations for monitoring based on their preferred hunting, fishing, and gathering areas and they preferred to monitor species they traditionally hunt, fish, trap, or gather for food. Further, they preferred to develop their own ways of sharing knowledge and communicating about the findings of their environmental monitoring activities, including the use of cultural camps, photo-documentation, regular information, and knowledge-sharing meetings, and the publication of this article.

ALMC’s approach to ICBM featured several unique monitoring methods and knowledge sharing approaches. Although framing ALMC’s proposals for federal and provincial government funding for ICBM in 2018 and 2019 required O’Connor to use the language of scientific rigor and methodological orthodoxy, the Métis knowledge holders who supported the proposal, including Diane Scoville and Ron and Virginia Donald, were more interested in implementing ways to monitor the local environment that allowed them to cultivate, consolidate, and share knowledge within the community and between generations, rather than with the general public. Although O’Connor’s role in the project as a non-Indigenous social scientist involved geo-data collection and data management, the process of data collection, storage, and dissemination has followed ALMC’s priorities, values, and protocols, rather than the prerogatives of government or industry.

Diane Scoville is a Métis community leader and traditional harvester who participated extensively in program design, facilitation, and implementation and who was an advocate of the need to focus efforts on the cultivation and retention of local Métis knowledge. Key to this is the protection of the confidentiality of information that was collected as environmental observations. Ron and Virginia Donald and John Witney are members of the ALMC Board of Directors who championed the program, participated actively in its design, and who have provided their extensive Métis (Indigenous and local) knowledge to the project. They were the authors of the idea of cultural camps and inter-generational knowledge sharing as a component of environmental monitoring as the program got started in early 2019. This approach to knowledge cultivation and transfer is unique and unconventional in ICBM, which tends to prioritize surveys, sampling, and tangible publishable data-sets.

Garry and Louella Jewell, Vicky Silkie and Ole Ellefson are Métis harvesters with extensive experience hunting, fishing, trapping, and gathering food. They, along with the Donalds and Witney, were the primary sources of Métis knowledge and they passed along skills to youth, shared their photos and observations through the data collection process (described in more detail below), and participated in quarterly knowledge-sharing

workshops from which this article emerged. All of the authors recognized through the three years of implementing the program that there was a need to decolonize and reclaim ICBM that came out of ALMC members' experiences living with the cumulative effects of natural resource development and settler-colonialism within the traditional territory of the Athabasca Landing Métis.

Our description of ALMC's ICBM program design is intended to serve as a case study that explores how to implement Indigenous knowledge into community-based monitoring to promote Indigenous self-government, rights, and environmental protection. Key to the approach are the methods of monitoring that ALMC adopted. Some of these methods resemble classic ways to collect data in community-based monitoring efforts, such as photomapping of traditional resources and observations of environmental changes (Bennett and Lantz 2014, Chanteloup et al. 2019). However, other methods, such as holding cultural camps, generate less tangible data but instead promote the cultivation, consolidation, and sharing of traditional Métis knowledge, customs, and practices, including transferring skills to younger generations.

ALMC's ICBM was initiated by the local community, involves members' input in delineating priorities, species, geographic areas, and methods, and the monitoring work was and is being conducted by community members. These program design choices were made in line with the ethical position that those who must live with the effects of industrial activity ought to have a say in how impacts are identified, assessed, and monitored (O'Faircheallaigh 2017). The information collected during monitoring activities is stored in ALMC's monitoring database and contributes to ongoing efforts to assert its territorial rights, including in the assessment and monitoring of industrial effects, both in project-specific contexts and in regional effects assessments. The objective of ALMC's approach to ICBM is not only to translate information into forms that scientists or the general public will understand but rather to collect, consolidate, and share information within the community in ways that support self-determination. ALMC's control over the information collected as proprietary information is therefore essential to asserting its rights and controlling how and when the information is published in ways that support ALMC's objectives of self-determination, protection of rights, and environmental enhancement. In this sense, ALMC argues affirmatively that indeed, ICBM can be a tool to promote self-determination (Reed et al. 2020).

Developed during a series of ICBM planning meetings in 2019 that involved the authors and several other ALMC community members, the planned ICBM Project activities, data collection methods, and knowledge sharing activities included the following:

- Cultural camps: Traditional Métis cultural and food harvesting camps were staged at locations identified by ALMC for 2 to 3 days each quarter (in spring, summer, fall, and winter) from 2019 through the spring of 2022 to promote traditional food harvesting by season, species, and promote cultural retention and traditional knowledge transfer between elders and youth. Summer harvesting camps were held at Steepbank Lake, fall fishing camps at Touchwood Lake, and winter camps were held at Lac La Biche. Spring

camps focused on visits to traplines operated by Garry and Louella Jewell and Vicky Silkie. The camps provided an opportunity for ALMC traditional knowledge holders to observe the quality, availability, and sustainability of wildlife habitat and traditional food resources, establish local baselines, map changes to the landscape in subsequent years, and identify areas of concern. Following cultural camps, harvesters met to share observations. During these meetings the ideas discussed in this article emerged.

- Photomapping of harvesting and traditional resource sites: Fifteen ALMC hunters, fishers, trappers, and gatherers were trained to photograph traditional resource observations with location information enabled on smartphones. The harvesters/monitors ranged in age from approximately 50 to 80 years. Eight were women and seven were men. Various types of phones and camera software were used, provided they contained GPS location information in the photograph's metadata. Participants then emailed photos and observations to a dedicated email. These photos were then compiled into a Google Earth KMZ file showing the location, source, and related notes or observations. These observations included photos of wildlife hunted by ALMC members for food including moose, deer, elk, bear, and fur bearing mammals, fish, traditional plants, and changing environmental conditions such as noticeably high or low water levels. In addition to the Google Earth KMZ geo-referenced database, each entry and photograph was backed up in a spreadsheet and stored in a data cloud. Photos were sent directly from the source with ease allowing for direct to digital data input. Even hunters in the field could snap a photo and send it to the project email without much trouble provided there was cell phone reception. Harvesters tended to send photos and observations more frequently immediately following cultural camps or quarterly data sharing meetings, but they could send anytime that was convenient. Rather than using rigorous sampling protocols for the selection of locations to monitor or resource observations to include, the program design allowed ALMC harvesters to establish their priorities for locations, wildlife species of interest, and environmental observations for inclusion in the database. These environmental observations consisted of photos, traditional resources (plants, animals, land, and water), locations, associated traditional uses (hunting, fishing, trapping, gathering, camping), and seasons (summer, fall, winter, spring).
- Fish counts: Fishermen and women voluntarily recorded data on fish counts, species, date, and location of catch and photo-map locations where nets were set for subsistence purposes for inclusion in the database. The intention was to track fish abundance and availability over time in key harvesting lakes (Steepbank Lake, Touchwood Lake, and Lac La Biche). Some of the seasonal cultural camps incorporated fishing activities and these generated some of the larger fish counts.
- Internal information and knowledge sharing: Quarterly data sharing, training, and discussion meetings were held in order to maintain harvester and volunteer interest, identify new concerns, and document qualitative or narrative

information about photographs, harvesting observations, and project-related activities. Additional harvesters were introduced to the program at these meetings. The geo-referenced database and back-up spreadsheet are maintained on a server accessible to ALMC's contract staff and Board of Directors. At the close of the 3-year program term (2019–2022), all photos, datasets, and published materials were returned on a hard drive to ALMC.

- Limited public dissemination of information: Although the data generated from this ICBM is not publicly available, ALMC has agreed to disseminate its findings, methods, and some of its observations in partial form through publications such as this article. Again, this is because ALMC's approach to ICBM is geared toward internal knowledge documentation and retention, rather than external knowledge sharing. Where it is suitable to assert ALMC's rights and interests, during consultation or engagement, information stored in its database could be released. For example, in the event that an industrial project such as a mine or a pipeline intersected with areas of high intensity of use or data collection within the ICBM, then that information could be selectively released to demonstrate the potential negative effects of the project. In this way, the decolonized ICBM has generated proprietary data that is used by ALMC to protect and assert its rights but without violating its confidentiality or the privacy of its members.

The data collection, information storage, and knowledge-sharing methods described here are indicative of the MEB approach to ICBM chosen and developed by ALMC according to its own values, preferences, and protocols. Although the methods have aspects drawn from Western environmental science such as photomapping of wildlife and georeferencing observed environmental changes, the data is not publicly available. Rather it is maintained in a proprietary fashion by ALMC, in accordance with its own information protocols established by ALMC's Board of Directors for this ICBM. If or when ALMC is prepared to publish or otherwise release portions of this data or select findings from its ICBM activities, it will do so in ways that promote its self-governance, rights, and environmental protection, consistent with recent recommendations to improve multiple evidence-based approaches to ICBM (Brunet et al. 2020, Natcher and Brunet 2020, Reed et al. 2020, Tengö et al. 2021).

## RESULTS

At the time of writing (August 2022), the CBM had been underway for approximately 36 months. Fifteen harvesters (hunters, fishers, trappers, gatherers) had been trained in the use of photomapping methods in the CBM and had contributed photos and observations to the database. As of August 2022, the database contained a total of 369 separate locations associated with approximately 1000 photographs of traditional food resources, wildlife, environmental changes, and locations of interest for traditional cultural practices. Multiple images of the same location were often emailed to the project facilitator. At some locations, multiple species were observed, or multiple harvesting activities were pursued. There are thus more activities by location (386) than the total number of locations (see Fig. 1 and Table 1). The geodatabase creates a record of both the geographic scope of the observations but also contains qualitative

information on the date, time, season, species, and related traditional use activity associated with the photograph.

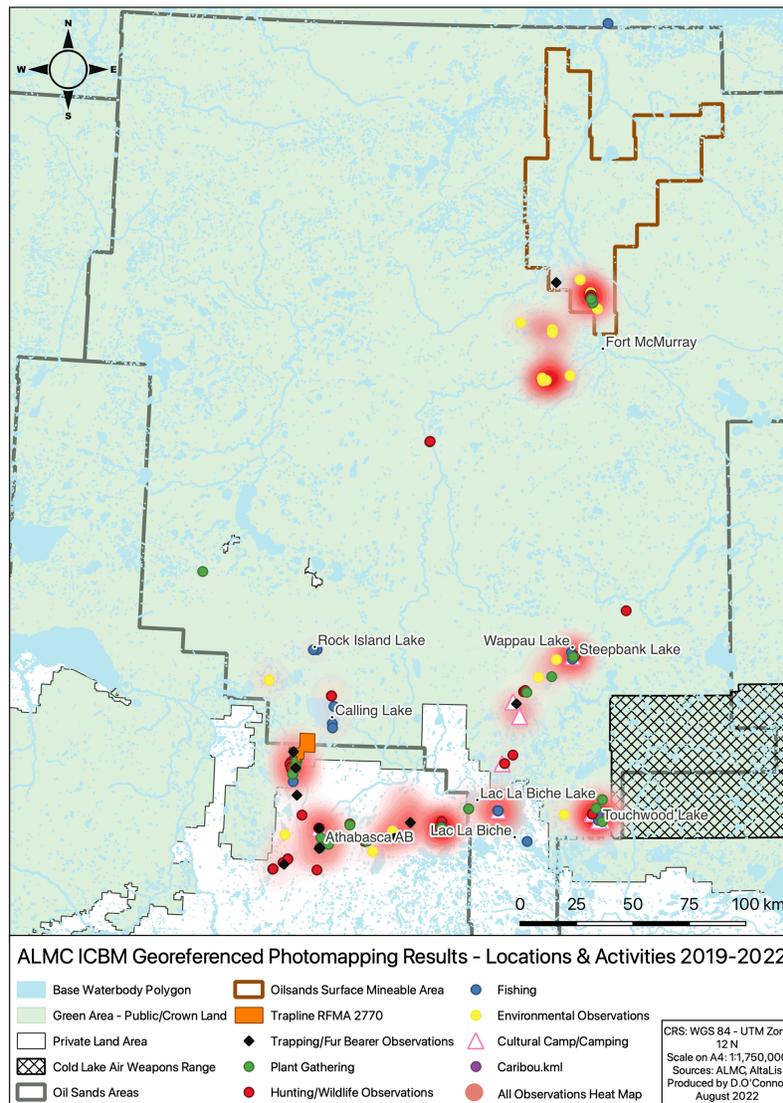
**Table 1.** Harvesting activities by location, documented in photograph database (2019–2022).

Agriculture	Hunting	Fishing	Trapping	Gathering	Environmental Observation	Camping
11	215	63	23	40	24	10
Total Activities-Locations Documented 386						

The map in Figure 1 depicts the locations of observations photomapped by ALMC harvesters. The data is arranged and presented by associated traditional activity (trapping, plant gathering, hunting, fishing) with associated resource such as wildlife, furbearers, camping areas, and environmental observations. The categories of locations and activities are also overlaid with a layer of all the observations in the database presented as a heat map. The more concentrated the number of observations in close proximity to one another, the greater the visible intensity of color on the map. There are “hot spots” of observations around Fort McMurray that were predominantly environmental observations in close proximity to the oil sands surface mineable area, the location of the open pit bitumen mines. Additional hot spots of monitoring observations were around Touchwood Lake consisting mostly of fishing, camping, hunting, plant gathering, and some environmental observations. Likewise, around Wappau Lake and Steepbank Lake there were hot spots consisting of plant gathering, camping, fishing, and environmental observations. Around the trapline operated by Garry and Louella Jewell and Vicky Silkie (Registered Fur Management Area 2770) there were also hot spots of observations consisting of hunting, trapping, plant gathering, and fishing. In the areas in which ALMC members reside, in rural areas and on farms around Athabasca and between Athabasca and Lac La Biche, there were several concentrated areas of observations of wildlife, hunting, trapping, and plant gathering. These findings suggest that ALMC harvesters have preferred areas in which they tend to make observations about wildlife, plants, and the environment based on where they prefer to hunt, fish, gather, and trap.

As depicted in Table 1, the most common reported traditional-use activity associated with observations that harvesters reported in the database through the photomapping activity was hunting. Project monitors identified 215 separate locations with a species that was hunted for food. As Table 1 indicates, fishing was the next most common traditional harvesting activity associated with species observations in the database, with 63 separate locations associated with fish habitat and fish harvesting activities. Trapping was associated with observations of species at 23 locations. Agriculture, domestic livestock raising and plant cultivation, was documented at 11 locations. Ten sites were associated with traditional camping activities, referring to the locations of cultural camps. An additional 24 entries were included in the database as observations of environmental changes such as forest fire burns, erosion, or water quality observations in fish habitats. These results of ALMC's

**Fig. 1.** Results of Athabasca Landing Métis Community's (ALMC) photomapping method of documenting resource and harvesting sites, 2019–2022.



photomapping indicate the relative importance of wildlife indicators associated with traditional hunting, fishing, gathering, and trapping.

From the results of the first three years of ALMC's ICBM, the community now has hundreds of documented sites of importance for the exercise of constitutionally protected hunting, fishing, and trapping rights. This georeferenced data serves as an important baseline for future studies of potential impacts to ALMC's hunting, fishing, trapping, and gathering activities from planned industrial activities or ongoing climate change.

ALMC's monitoring activities also generated important information about the frequency of observation of various species that are important for traditional hunting, fishing, trapping, and gathering. Photos and observations generated by ALMC

harvesters and monitors through the photomapping project and stored in the geo-database have been summarized in Table 2. In total, 20 different locations were associated with fur bearers, with the most commonly sighted fur-bearer being beaver. This is expected as ALMC trappers have traditionally valued beaver for its contribution to the fur trade but trapping beaver continues to be an important part of ALMC's culture and traditions. Other species observed in the geodatabase were red fox, coyote, wolf, muskrat, and lynx.

A variety of fish species were also documented by ALMC monitors as part of the exercise of their fishing rights, during cultural camps and while enjoying the lakes and rivers in the Athabasca watershed. The most commonly observed fish were walleye (also known as pickerel), which were harvested at 26

**Table 2.** Species encountered by Athabasca Landing Métis Community harvesters, documented in photo-map database (2019–2022).

Fur Bearers					
Fox	Wolf	Muskrat	Lynx	Beaver	Coyote
5	2	1	1	6	5
Fish					
Tullibee	Sucker	Whitefish	Perch	Northern Pike/ Jackfish	Walleye/ Pickerel
4	1	19	5	13	26
Cervidae					
Elk	Moose	White Tailed Deer	Mule Deer	Unspecified Deer	Woodland Caribou
20	18	131	14	4	1
Plants					
Medicinal Plants	Trees	Edible Berry (Blueberry, Cranberry, Raspberry, Strawberry, Raspberry)			
34	24	15			
Birds					
Birds (Grouse, Eagle, Crow, Raven, Crane, Canada Geese, Ducks)					
9					
Furbearers	Fish	Cervidae	Plants	Birds	Total Observations (Species -locations)
20	68	188	73	9	358

separate locations. Lake whitefish were harvested at 19 separate locations. The next most frequently occurring fish species in the database was northern pike, known locally as jackfish. Other species identified by harvesters were yellow perch, tullibee, and suckers (see Table 2).

The results of ALMC’s ICBM also revealed that harvesters pay a great deal of attention to big game that are traditionally hunted for food. The most commonly identified species observed in the database was white tailed deer. One hundred and thirty-one locations were associated with white tailed deer in the database. Fourteen mule deer were also observed along with four other deer for which the species was not specified. Clearly deer are abundant in the local environment monitored by ALMC members. As Table 2 shows, 20 elk were observed and documented in the geodatabase. Elk are an important species for traditional subsistence hunting. Further, 18 moose were observed and documented. Moose are also a favorite species for subsistence hunters in the ALMC. During the course of the ICBM, ALMC harvesters documented only one case of an encounter with woodland caribou. Woodland caribou are listed as a species at risk in Alberta and ALMC members have noticed a decline in caribou sightings since the 1980s. To promote woodland caribou recovery, ALMC harvesters do not hunt the species.

Although encounters with large animals such as bears, moose, and deer often incite excitement and make for good photo-opportunities, the use of traditional food and medicinal plants sourced from trees, bushes, and flowers is an important component of ALMC’s way of life. The ICBM provided an opportunity for ALMC monitors to identify plants that are important for traditional harvesting and cultural use. As previously documented in the literature, Métis harvesters tend to be protective and secretive about the location of viable family plant and food harvesting areas (Joly et al. 2018). For this reason, the precise location of plant harvesting activities is not provided in detail here, however, the species that were identified and

included in the geodatabase include several species of medicinal plants such as shrubby cinquefoil, Junegrass, horsetail, nettles, milkweed, Hudson Bay anemone, Canada goldenrod, kinnikinnick, swamp currant, bluebells, Labrador tea, hazelnut, dwarf horsetail, bunchberry dogwood, red osier dogwood, balsam poplar, tansy, milk vetch. Several species of edible berry fruits were also harvested and documented in the geodatabase, including blueberry, cranberry, wild raspberry, and woodland strawberry.

As depicted in Table 2, ALMC monitors also documented the presence of several notable species of birds such as crows and ravens, which are abundant in the parkland environment around Athabasca. They also included in the geodatabase observations of Bald Eagles, which are considered sacred, and Sandhill Cranes, which are endangered and rare to see. Other birds are traditionally harvested for food including Canada Geese and ducks but these birds only appeared infrequently in the geodatabase.

Between 2019 and 2022, a total of 358 species were observed at the 369 unique locations entered in the geodatabase. This implies that there were multiple species encountered at the same place, such as birds and fish observed from the water on fishing trips. Likewise, it is common to harvest multiple species of fish in the fishing nets set by Métis harvesters in lakes such as Touchwood Lake, Lac La Biche, or Rock Island Lake.

As of August 2022, there had been 12 quarterly data sharing meetings at which participants discussed findings, clarified the location of photographs and traditional resource observations, refined methods, and planned upcoming harvesting trips. Some of these meetings had to be moved to a teleconference format during the emergency public health measures to address the COVID-19 pandemic from March 2020 to January 2022. Attendance at the meetings and participation in the CBM grew moderately with at least one additional participant added to the program after each cultural camp and meeting prior to the

**Table 3.** Fish counts by lake during cultural camps, 2019–2020.

Date	Lac La Biche	Touchwood Lake	Rock Island Lake
Oct 2019		4 Whitefish, 6 Jackfish/Pike, 56 walleye/pickereel	
Dec 2019	15 whitefish, 5 jackfish/pike, 80 pickereel/perch, 2 suckers		
Feb 2020	10 pickereel/perch, 3 whitefish, 1 tullibee		
Jul 2020			47 walleye/pickereel, 47 whitefish and 1 jackfish/pike
Sep 2020		4 walleye/pickereel, 17 whitefish	

pandemic. After shifting quarterly data sharing meetings to a video-conference format, attendance at the quarterly meetings declined only to the core author group. This was because of perceived burnout from videoconferencing and a stated preference for face-to-face meetings, particularly to discuss monitoring, knowledge sharing, and to plan, write, and edit this article.

From August 2019 to January 2022 there were nine cultural camps held in various locations involving gathering, fishing, hunting, trapping, and sharing inter-generational knowledge about the environment and Métis traditions, customs, and practices, including environmental stewardship, conservation, and traditional ways of conserving and managing resources. The location and timing of these camps and the number of allowable participants had to be altered to reflect restrictions on outdoor gathering that were periodically in place in Alberta during the pandemic. For example, prior to the pandemic, ALMC held a summer harvesting camp in the Steepbank Lake area in 2019. The 24 camp participants arrived on a Friday in August and recreated the elements of a traditional Métis harvesting camp consisting of shelter, water source, campfire, and traditional food processing infrastructure. The main activities at this harvesting camp were gill-net fishing, berry picking, medicinal plant harvesting, and wildlife-watching. At the harvesting camp, elders taught youth how to set traditional gill nets in Steepbank Lake. After a day of fishing, the group was surprised to find no fish in the net in Steepbank so they moved the net to nearby Wappau Lake. After catching 12 white sucker and one walleye in Wappau Lake in the gill net, the fish were cleaned and processed in camp. Youth were taught to descale the fish, clean the guts, and cut the meat into filets while looking for any signs of deformity, disease, or lesion on the fish to ensure it was suitable for consumption.

Although the initial plan was to meticulously document fish counts from each of the cultural camps, in practice only a few detailed fish counts were kept from the cultural camps (see Table 3). In October 2019 at Touchwood Lake a fall harvesting and fishing camp was attended by 17 people including elders and youth. The group set several nets in Touchwood Lake and hauled in a total of 56 walleye, six pike, and four whitefish over two days of gill net fishing. According to the field notes made by one of the authors and camp participant, “we found that the Pickerel (walleye) were feeding heavily on the Whitefish. Note that we found Whitefish in the entrails of pickereel. It is our opinion that harvesting these large Pickerel should help the health of the lake.” Another participant’s notes stated: “the livers and lungs were good colour - reddish. The females had lots of eggs.” Following

the successful fishing expedition, elders and youth shared time in camp cleaning and fileting fish to distribute among the families present at the camp and supplement the winter food supply.

A third cultural camp was held at Lac La Biche Lake in December 2019. The timing of the camp was delayed because of unseasonably warm temperatures and longer than usual waits for the lake ice to freeze to the point where it is safe for ice fishing. Over the course of the two day harvesting camp, several nets were set and a variety of fish were hauled out including 80 pickereel (walleye), 15 lake whitefish, and five northern pike. These fish were hauled to a warmer location for cleaning and processing because the temperature was cold enough to freeze the catch in a short time (approximately -10 °Celsius).

After public health restrictions came into place from March 2020 to July 2021, cultural camp activities took place in smaller groups of less than 10 or between members of the same multi-generational households. During this time of economic shutdowns and financial hardships for many families, having recourse to traditional food harvesting contributed to food security. Although the older members of the community had long been involved in traditional harvesting, for some of the younger members, having the opportunity to fish, gather, trap, and hunt for food during an economic crisis taught them first-hand the value of traditional food provisioning systems.

Beyond the fish counts and photo-documentation results, the achievements of the cultural/harvesting camps are better described in qualitative rather than quantitative terms. Several dozen people participated in the camps and enjoyed spending time in nature in the company of community members. Traditional knowledge of the local environment and traditional resources was passed through demonstration and storytelling from elders to younger people. Further, appreciation for the CBM program was increased. During the course of their participation in CBM activities (cultural camps, photomapping, traditional harvesting and data sharing meetings), participants made a series of observations about the local environment including the weather, the status and quality of forests, water quality in lakes and rivers, and the status of wildlife. There is not enough space to discuss each of these observations in turn, but some examples of these observations are discussed here for their relevance in contributing to further research, environmental protection, asserting ALMC’s rights, and as early-warning signs of potential environmental changes.

First, CBM participants observed that the lakes within the geographic area of focus for the CBM featured more algae in 2019

and 2020 than they had noticed in previous years. Lac La Biche had algae blooms as did Wappau Lake. Further, there were several observations of worms in fish in Touchwood Lake and Lac La Biche. Lac La Biche and Calling Lake took longer to freeze in the late fall and early winter (December 2019). Together these findings suggest that there may be a warming trend in the local climate that is indicated by warmer water temperatures. Further evidence of longer term temperature levels and time series data of water temperature in each of these lakes would be required to confirm this hypothesis that climate change is indicated locally by warming water temperatures.

Second, in areas that are usually known to have large quantities of blueberries, ALMC ICBM participants in 2020 did not pick as many pails of blueberries as they usually had in previous years. The wet climactic conditions and fluctuating temperatures early in the growing season may have had a negative effect on blueberry plant health. Furthermore, in the main berry gathering areas there were what appeared to be more observations of black bears than anecdotally noticed by participants in past years. This was indicative of a greater presence of black bears based on comparison with past experience. The relationship between potential decline in wild blueberry occurrences, climate change, and the impact on black bear population in the South Athabasca Oil Sands area might be of interest to local wildlife biologists, industrial project proponents, and policy makers. The interaction between bears and humans in the South Athabasca Oil Sands area, particularly around food waste management and safety in possible situations of seasonal wild food scarcity is of concern to all parties who share the boreal forest with black bears.

Third, regular expeditions to fish along the Athabasca River over the last several decades have given ALMC monitors experience with the local watershed. Of particular concern is the fluctuation of water levels in the Athabasca River that are perceived to be at historically low levels. Whether or not this is the case needs to be corroborated with hydrological data and evidence collected by scientists. However, if water levels within the Athabasca River basin are in decline or otherwise in flux compared to historical levels, then this example suggests the potential role of ILK in CBM programs as a source of early warnings of environmental change. The role of CBM participants in raising alarm bells on potentially significant changes should be of interest to policy makers and environmental scientists in charge of watershed management, particularly considering the amount of industrial activity both up and downstream from Athabasca Landing (including hydroelectric dams, coal mines, pulp and paper mills, towns and cities, and oil sands mines). Furthermore, as a drainage basin for a large expanse of central and northern Alberta and with its sources high in the Athabasca glacier of the Rocky Mountains, water levels, flow, and water quality in the Athabasca River are particularly relevant as indicators of climate change (glacial melt), rainfall, erosion, industrial effects on freshwater resources.

A key result of implementation of ALMC's ICBM has been the expansion of its internal capacity for information gathering, knowledge cultivation and retention and intra-community knowledge transfer, particularly between generations. This process of knowledge enhancement has been promoted by participation in the ICBM, not because of the prerogatives of

government and industry, but according to ALMC's own values, beliefs, priorities, and protocols. ALMC control over its Métis knowledge, its traditional use information and its data means that ALMC has a proprietary and confidential database that it can use to assert and protect its rights and the local environment when it chooses to engage in consultation with industry and government over impacts to the environment, wildlife, water, and to Indigenous rights.

Finally, the capacity of ALMC to engage with the provincial and federal governments to credibly assert its rights has also been enhanced as a result of the ICBM. ALMC can use its database to generate "heat maps" that can selectively show how its members are using a particular area, or the database can be used to export datapoints that show the wide geographic extent in which its members harvest or otherwise travel for traditional purposes, including for monitoring activities that are closely connected with the exercise of its harvesting rights. This is because ALMC hunters, fishers, trappers, and plant gatherers tend to collect environmental observations when they are on the land exercising their rights. Further, they tend to notice impacts to the environment that would affect the exercise of their rights, such as deforestation in sensitive moose habitats or an increased presence of deer on roads in areas that have been recently logged.

## DISCUSSION

Through ICBMs, Indigenous peoples in Canada and particularly in Alberta assert their rights, leverage greater control over resource management, and take part in environmental protection (McKay and Johnson 2017, Wilson et al. 2018, Brunet et al. 2020, Caverley et al. 2020, Gerbrandt and Westman 2020, Natcher and Brunet 2020, Reed et al. 2020). However, monitoring programs are often limited by inadequate access to funding, fragmentation of information and datasets, and capacity limits that impede data management and reporting (Bradshaw 2003, Whitelaw et al. 2003, Conrad and Hilchey 2011, Johnson et al. 2015). Other shortcomings of ICBM approaches are that they reveal a disconnect between Indigenous knowledge and scientific paradigms used by government and industry-employed scientists; participation poses the risk of loss of control over traditional knowledge, and they usually involve the imposition of scientific methods, indicators, and protocols that can alienate Indigenous knowledge holders (Natcher and Brunet 2020). ALMC's participation in a government-funded ICBM also faced these challenges but by implementing the MEB approach, ALMC was able to assert more control and autonomy in the selection of valued components, indicators, and data collection methods.

Proponents of MEB approaches emphasize the need for the recognition of ILK as a valid source of knowledge, including in research design, decision making, and dissemination of data (Tengö et al. 2021). They recognize that ILK is relevant to management practices, governance, and decision making, including in the selection of tools and methods for information collection. MEB proponents such as Tengö et al. take seriously the knowledge and values of Indigenous peoples through the use of collaborative, participatory, or culturally appropriate methods of information collection. Within the ICBM research design, the local scale and local agency is empowered through free, prior, and informed consent and joint knowledge sharing protocols. As proponents of MEB posit, Indigenous peoples must be

recognized as knowledge holders and rights bearers and mutually agree with scientists on terms and procedures for collaboration (Tengö et al. 2021).

Expanding on the push for an MEB framework is the additional step of supporting Indigenous governance through the ICBM process. An Indigenous governance framework posits that Indigenous people exercise sovereignty and are uniquely positioned to develop their own territorial management and monitoring frameworks (Reed et al. 2020). Indigenous ICBM can be a means to advance the goals of self-determination. Following the advice of Reed et al., the ALMC program design, as described in this article, began by recognizing that the ICBM is proposed within a context of historical and ongoing settler colonialism. Second, ALMC viewed the ICBM and related funding as one way to redistribute power over environmental governance to its community, through the board and participating community members. Third, ALMC monitors, particularly during quarterly data sharing meetings, regularly advocated for additional Indigenous community-led and inter-Indigenous cooperation to advance their rights. As reflected in the emerging literature on ICBM, ALMC also sought to “decolonize” ICBM (McKay and Johnson 2017, Wilson et al. 2018, Brunet et al. 2020, Caverley et al. 2020, Gerbrandt and Westman 2020, Natcher and Brunet 2020, Reed et al. 2020).

In the Reed et al. (2020) article, non-Indigenous designers of ICBM programs are called to invite Indigenous peoples to be co-designers of programs in support of sustainable self-determination. In the ALMC case described here, the non-Indigenous participant in the program design and in the author group (O'Connor) was invited by ALMC to provide technical support to their efforts to fund, design, and implement the ICBM. The community-led impetus for the program and community leadership of the program enabled ALMC to exert control. By taking a MEB approach, ALMC's program remained focused on Indigenous knowledge as a means to monitor the local environment using indicators, methods, and data reporting protocols designed by the community, for the community, using knowledge and observations chosen by Métis knowledge holders.

The MEB approach is not without its challenges. There are limits on the amount of time and energy that can be dedicated to monitoring activities with the effect that data collection is not as systematic as it would be in a scientific study, consistent with previous findings (Conrad and Hilchey 2011, Johnson et al. 2015, Brammer et al. 2016). Nevertheless, the value of confidential information collection on harvests and wildlife sightings within the community still holds intrinsic value to ALMC, regardless of whether or not it meets scientific standards of sample size, objectivity, and sufficiently large numbers of cases. Further, having a database of recently documented moose sightings, for example, can provide evidence in support of ALMC's claims that they are exercising rights in a particular area and could be impacted by any new industrial project in that area.

Where ALMC's decolonized approach and its methodology may have the greatest potential to contribute to local and regional monitoring is in the area of water quality and aquatic ecosystem health. Documented counts of fish caught in different lakes on a regular basis over the course of several years have provided a

moderately large dataset of fish catches by lake, species, and date. These fish catches were well documented and photographed and any abnormalities such as lesions, parasites, or tumors were noted. Other findings such as the presence of other prey fish in the innards of predator fish or the presence of roe in carcasses were all noted. As a result of this study's findings on fish habitat, ALMC is developing additional community-based research into the health of wild fish populations such as those conducted by Natcher et al. (2020) and Brunet et al. (2020) who begin with Indigenous peoples' concerns about the safety of wild fish consumption and provide scientific evidence to contribute to the conversation on the need for enhanced environmental protection measures in wild fisheries.

In addition, the findings of this study are being used as a platform to deepen ALMC's participation in local woodland caribou and wood bison recovery initiatives in collaboration with provincial and federal government agencies such as Alberta Environment and Parks and Environment and Climate Change Canada along with other regional Indigenous groups. Within ALMC's MEB approach to ICBM, collaboration with scientists and non-Indigenous researchers is enabled, but the research questions, methods, and dissemination of findings serve ALMC's values, objectives, and protocols and not the other way around. As ALMC's approach to MEB as described in this article has demonstrated, generating opportunities for Indigenous harvesters to establish their own study areas, priority species for monitoring, and preferred data collection methods results in qualitatively rich, geo-referenced data that can contribute to conservation efforts as distinct but equal sources of knowledge alongside Western scientific approaches.

## CONCLUSION

In the process of designing and implementing the ICBM in early 2019, the ALMC authors (Donald, Donald, Ellefson, Jewell, Jewell, Witney, and Silkie) along with Scoville and O'Connor found that the MEB approach provided theoretical justification for the ethical position of empowering Indigenous ways of knowing, voices, and methods as epistemologically equal to Western science.

The purpose of describing ALMC's efforts to design, implement, and disseminate information about its ICBM is to contribute to the theoretical and methodological debates within the ICBM literature. Rather than a neoliberal version of monitoring that invites electronic data input from the general public without any guarantee of influencing decision making and with the risk of data fragmentation and sample bias (Bradshaw 2003, Whitelaw et al. 2003, Conrad and Hilchey 2011, Johnson et al. 2015, Brammer et al. 2016); ALMC's approach empowered Indigenous and local knowledge alongside Western social science and environmental science within the multiple evidence-based approach (Tengö et al. 2021).

The findings of the ICBM described in this paper indicate that the theoretical empowerment of Indigenous and local knowledge can be implemented in practice in ICBM using a multiple evidence-based approach that showcases Indigenous and local knowledge holders and supports self-determination (Reed et al. 2020). ALMC's experience with implementing its ICBM was widely inspired by the principles of Indigenous self-determination, the assertion of rights, including rights to

territory, and the protection of the environment. ICBM can contribute to these goals if monitoring programs are designed by Indigenous community members, implemented according to local values, ethics, and protocols, and when information generated from these efforts are released in ways that support the Indigenous community's governance goals, however they choose to define them.

---

#### Acknowledgments:

*This project was undertaken with the financial support of the Government of Canada through the federal department of Environment and Climate Change. This research was initiated by the Board of Directors of the Athabasca Landing Métis Community Association and has been implemented in the spirit of self-government, truth, and reconciliation. Permission to publish this article was provided by the Athabasca Landing Métis Community in accordance with its research and information sharing protocols.*

#### Data Availability:

*The article describes the qualitative findings of a community based monitoring program run by an Indigenous community. With the exception of the lead author, the co-authors are all members of the Indigenous community and consider themselves to be traditional knowledge holders. The qualitative information they share and discuss here is what they are comfortable publishing. Whereas one part of the program was the collection of photos, GPS points, and field observations of wildlife and visible signs of local environmental changes, this quantitative and geo-referenced data is not publicly available. This is because the quantitative and geo-referenced information depicts sites of importance for traditional hunting, fishing, gathering, and trapping, which the co-authors consider to be confidential and private. The conclusions presented are made on the basis of the qualitative information provided by the co-authors and do not rely on or discuss the quantitative and geo-referenced data that was also collected as part of the Program. If you have additional questions or concerns about the data statement, the lead author will gladly provide it.*

---

#### LITERATURE CITED

Alberta Culture and Tourism. 2019. Energy heritage: oil sands. Alberta Culture and Tourism, Edmonton, Alberta, Canada. <http://history.alberta.ca/energyheritage/sands/default.aspx>

Angell, A. C., and J. R. Parkins. 2011. Resource development and aboriginal culture in the Canadian north. *Polar Record* 47 (1):67-79. <https://doi.org/10.1017/S0032247410000124>

Ansell, S., and J. Koenig. 2011. CyberTracker: an integral management tool used by rangers in the Djelk Indigenous Protected Area, central Arnhem Land, Australia. *Ecological Management & Restoration* 12(1):13-25. <https://doi.org/10.1111/j.1442-8903.2011.00575.x>

Austin, B. J., C. J. Robinson, J. A. Fitzsimons, M. Sandford, E. J. Ens, J. M. Macdonald, M. Hockings, D. G. Hinchley, F. B. McDonald, C. Corrigan, et al. 2018. Integrated measures of

indigenous land and sea management effectiveness: challenges and opportunities for improved conservation partnerships in Australia. *Conservation and Society* 16(3):372-384. [https://doi.org/10.4103/cs.cs\\_16\\_123](https://doi.org/10.4103/cs.cs_16_123)

Bach, T. M., C. A. Kulk, and H. Rangan. 2019. From killing lists to healthy country: aboriginal approaches to weed control in the Kimberley, Western Australia. *Journal of Environmental Management* 229:182-192. <https://doi.org/10.1016/j.jenvman.2018.06.050>

Baker, J. M., and C. N. Westman. 2018. Extracting knowledge: social science, environmental impact assessment, and Indigenous consultation in the oil sands of Alberta, Canada. *Extractive Industries and Society* 5(1):144-153. <https://doi.org/10.1016/j.exis.2017.12.008>

Bennett, T. D., and T. C. Lantz. 2014. Participatory photomapping: a method for documenting, contextualizing, and sharing indigenous observations of environmental conditions. *Polar Geography* 37(1):28-47. <https://doi.org/10.1080/1088937X.2013.873089>

Berkes, F. M., M. Kislalioglu Berkes, and H. Fast. 2007. Collaborative integrated management in Canada's north: the role of local and traditional knowledge and community-based monitoring. *Coastal Management* 35(1):143-162. <https://doi.org/10.1080/08920750600970487>

Bradshaw, B. 2003. Questioning the credibility and capacity of community-based resource management. *Canadian Geographer* 47(2):137-150. <https://doi.org/10.1111/1541-0064.t01-1-00001>

Brammer, J. R., N. D., Brunet, A. C. Burton, A. Cuerrier, F. Danielsen, K. Dewan, T. M. Hermann, M. V. Jackson, R. Kennett, G. Larocque, et al. 2016. The role of digital data entry in participatory environmental monitoring. *Conservation Biology* 30(6):1277-1287. <https://doi.org/10.1111/cobi.12727>

Brandak, G. M. 1972. A study of missionary activity in the diocese of Athabasca, 1884-1903. Thesis. Waterloo Lutheran University, Waterloo, Ontario, Canada. <http://scholars.wlu.ca/etd/1483>

Brook, R. K., S. J. Kutz, A. M. Veitch, R. A. Popko, B. T. Elkin, and G. Guthrie. 2009. Fostering community-based wildlife health monitoring and research in the Canadian North. *EcoHealth* 6 (2):266-278. <https://doi.org/10.1007/s10393-009-0256-7>

Brunet, N., T. Jardine, P. Jones, F. Macdermid, G. Reed, A. M. Bogdan, D. Tchir, and D. Natcher. 2020. Towards indigenous community-led monitoring of fish in the oil sands region of Canada: lessons at the intersection of cultural consensus and fish science. *Extractive Industries and Society* 7:1319-1329. <https://doi.org/10.1016/j.exis.2020.06.014>

Buckland-Nicks, A. 2015. Keys to success: a case study approach to understanding community-based water monitoring uptake in governmental decision-making. Thesis. Dalhousie University, Halifax, Nova Scotia, Canada.

Castleden, H., V. Sloan Morgan, and C. Lamb. 2012. "I spent the first year drinking tea": exploring Canadian university researchers' perspectives on community-based participatory research involving Indigenous peoples. *Canadian Geographer/Le Géographe canadien* 56(2):160-179. <https://doi.org/10.1111/j.1541-0064.2012.00432.x>

- Caverley, N., A. Lyall, S. Pizzirani, and J. Bulkan. 2020. Articulating indigenous rights within the inclusive development framework: an assessment of forest stewardship policies and practices in British Columbia, Canada. *Society & Natural Resources* 33(1):25-45. <https://doi.org/10.1080/08941920.2019.1597237>
- Chanteloup, L., F. Joliet, and T. M. Herrmann. 2019. Learning and insights from a participatory photography project with Cree and Inuit about the land (Nunavik, Canada). *Polar Geography* 42(2):125-143. <https://doi.org/10.1080/1088937X.2019.1578291>
- Conrad, C. C., and K. G. Hilchey. 2011. A review of citizen science and community-based environmental monitoring: issues and opportunities. *Environmental Monitoring and Assessment* 176 (1-4):273-291. <https://doi.org/10.1007/s10661-010-1582-5>
- Cronmiller, J. G., and B. F. Noble. 2018. The discontinuity of environmental effects monitoring in the Lower Athabasca region of Alberta, Canada: institutional challenges to long-term monitoring and cumulative effects management. *Environmental Reviews* 26(2):169-180. <https://doi.org/10.1139/er-2017-0083>
- Dyce, M. 2013. "The gateway to the last great west": spatial histories of the Athabasca Landing Trail. *Canadian Historical Review* 94(2):177-206. <https://doi.org/10.3138/chr.1208>
- Ellis, S. C. 2005. Meaningful consideration? A review of traditional knowledge in environmental decision making. *Arctic* 58(1):66-77. <https://doi.org/10.14430/arctic390>
- Ens, G. J., and J. Sawchuk. 2016. From new peoples to new nations: aspects of Métis history and identity from the eighteenth to the twenty-first centuries. University of Toronto Press, Toronto, Ontario, Canada. <https://doi.org/10.3138/9781442621497>
- Gerbrandt, J., and C. Westman. 2020. When a pipe breaks: monitoring an emergency spill in the oil sands and documenting its erasure of indigenous interests in land. *Extractive Industries and Society* 7:1301-1308. <https://doi.org/10.1016/j.exis.2020.07.012>
- Gregory, E. D. 1986. Athabasca Landing: an illustrated history, a seventy-fifth anniversary project. Athabasca Historical Society and Athabasca University, Athabasca, Alberta, Canada.
- Innis, H. A. 1999[1930]. The fur trade in Canada: an introduction to Canadian economic history. University of Toronto Press, Toronto, Ontario, Canada.
- Johnson, N., L. Alessa, C. Behe, F. Danielsen, S. Gearheard, V. Gofman-Wallingford, A. Kliskey, E. M. Krümmel, A. Lynch, T. Mustonen, et al. 2015. The contributions of community-based monitoring and traditional knowledge to Arctic observing networks: reflections on the state of the field. *Arctic* 68(5):28-40. <https://doi.org/10.14430/arctic4447>
- Joly, T., H. Longley, C. Wells and J. Gerbrandt. 2018. Ethnographic refusal in traditional land use mapping: consultation, impact assessment, and sovereignty in the Athabasca oil sands region. *Extractive Industries and Society* 5 (2):335-343. <https://doi.org/10.1016/j.exis.2018.03.002>
- Longley, H. 2016. Bitumen exploration and the southern re-inscription of northeastern Alberta: 1875-1967. *RCC Perspectives* 4(1):17-24.
- McKay, A. J., and C. J. Johnson. 2017. Confronting barriers and recognizing opportunities: developing effective community-based environmental monitoring programs to meet the needs of Aboriginal communities. *Environmental Impact Assessment Review* 64:16-25. <https://doi.org/10.1016/j.eiar.2017.01.002>
- Natcher, D., and N. Brunet. 2020. Extractive resource industries and indigenous community-based monitoring: cooperation or cooptation? *Extractive Industries and Society* 7:1279-1282. <https://doi.org/10.1016/j.exis.2020.10.005>
- Natcher, D., N. Brunet, A. M. Bogdan, and D. Tchir. 2020. Seeking indigenous consensus on the impacts of oil sands development in Alberta, Canada. *Extractive Industries and Society* 7:1330-1337 <https://doi.org/10.1016/j.exis.2020.06.013>
- Noble, B., and J. Birk. 2011. Comfort monitoring? Environmental assessment follow-up under community-industry negotiated environmental agreements. *Environmental Impact Assessment Review* 31(1):17-24. <https://doi.org/10.1016/j.eiar.2010.05.002>
- O'Faircheallaigh, C. 2017. Shaping projects, shaping impacts: community-controlled impact assessments and negotiated agreements. *Third World Quarterly* 38(5):1181-1197. <https://doi.org/10.1080/01436597.2017.1279539>
- Pyke, M. L., S. Toussaint, P. G. Close, R. J. Dobbs, I. Davey, K. George, D. Oades, D. Sibosado, P. McCarthy, C. Tigan, B. Angus (Jnr), E. Riley, D. Cox, Z. Cox, B. Smith, P. Cox, A. Wiggan, and J. Clifton. 2018. Wetlands need people: a framework for understanding and promoting Australian indigenous wetland management. *Ecology and Society* 23(3):43. <https://doi.org/10.5751/ES-10283-230343>
- Reed, G., N. Brunet, and D. Natcher. 2020. Can indigenous community-based monitoring act as a tool for sustainable self-determination? *Extractive Industries and Society* 7(4):1283-1291. <https://doi.org/10.1016/j.exis.2020.04.006>
- Tengö, M., B. Austin, F. Danielsen, and Á. Fernández-Llamazares. 2021. Creating synergies between citizen science and Indigenous and local knowledge. *BioScience* 71(5):503-518. <https://doi.org/10.1093/biosci/biab023>
- Whitelaw, G., H. Vaughan, B. Craig, and D. Atkinson. 2003. Establishing the Canadian Community Monitoring Network. *Environmental Monitoring and Assessment* 88:409-418. <https://doi.org/10.1023/A:1025545813057>
- Wilson, N. J., E. Mutter, J. Inkster, and T. Satterfield. 2018. Community-based monitoring as the practice of Indigenous governance: a case study of Indigenous-led water quality monitoring in the Yukon River Basin. *Journal of Environmental Management* 210:290-298. <https://doi.org/10.1016/j.jenvman.2018.01.020>