The practicalities of co-production of knowledge in conserving caribou

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Abstract: Steep declines in the Bathurst and Bluenose East Caribou Herds in Canada have highlighted the need for co-production of knowledge to understand a complex socio-ecological system. Our research group of non-Indigenous scientists has found success by applying our technical skills to address questions of greatest concern to Indigenous partners. These successes have not been without challenges, and we are learning to check our own biases to better plan for the time and funding required for meaningful exchanges of knowledge, and to communicate early and often with our partners about how best to support their capacity to affect change in caribou co-management. We share some lessons learned and encourage fellow researchers to embrace co-production of knowledge to address the many complex issues facing deer conservation worldwide.

Keywords: Co-management, exchange of knowledge, Indigenous knowledge, *Rangifer tarandus*

Introduction

The Bathurst and Bluenose East Herds of barren-ground caribou (Rangifer tarandus groenlandicus) have experienced severe declines in abundance. The Bathurst Herd has declined by more than 98% since 1986, leading to harvest restrictions and changes in their range (Fig. 2; Mennell 2021, Gunn and Russell 2022, Gurarie et al. 2024). The extent of the decline has caused heartbreak, deprived Indigenous people of meat and other essentials including hides and sinews and threatened their cultural identity.

For years, local Indigenous knowledge holders have warned that the mines and associated roads are harming caribou (Parlee et al. 2018), interrupting movement patterns and generating dust that impacts forage quality (Legat et al. 2014). Other compounding factors (e.g., increased insect harassment and changes in forage availability due to climate change) have also been implicated in the decline of caribou along with predation, parasites and harvesting (GNWT 2018). The causes of the decline can, then, be

characterized as “wicked”, in the sense that they are complex, involve conflicting viewpoints, and do not have straightforward technical solutions. While there are diverse views about using the term “wicked” (Lönngren & van Poeck 2021), the term draws attention to the paradigm that relying on classical reductionist science and linear problem-solving does not effectively address complex socio-ecological problems.

The Bluenose East and Bathurst Caribou Herd ranges overlap the traditional use areas of three Indigenous Peoples who have settled land claim agreements with the territorial and federal governments in Canada (Sahtú, Inuit, and Tłı̨chǫ), and three Peoples whose land claims are underway (Yellow Knives Dene First Nation, North Slave Métis, and Łutselk’e Dene First Nation). These land claim agreements shifted stewardship of caribou in northern Canada from centralized territorial government management to the formation of co-management boards and advisory committees such as the Bathurst Caribou Advisory Committee). Indigenous Peoples bring their unique experiences, traditions, and knowledge to the table, and add necessary and nuanced perspectives to the complex socio-ecological issues facing caribou.

The complexities of the Bathurst herd’s decline have highlighted the need for the co-production of knowledge and to acknowledge previous shortcomings in our approach as research scientists working on the decline, which had such far-reaching impacts on Indigenous communities. We use ‘co-production’ in the sense of drawing on collective Indigenous knowledge and experience (Bandola-Gill et al. 2023) to inform management decisions, develop research hypotheses and methods, and contextualize findings. We are aware of earlier shortcomings in reaching out to the collective knowledge of Indigenous People in the management of the Bathurst caribou herd (Parlee et al. 2018) which added complexity to understanding why the herd was declining and appropriate management. In a global context, even a brief survey of worldwide deer literature, such as in South America (Weber and Gonzalez 2003), suggests that complex socio-ecological threats to deer are common, and that co-production of knowledge could be highly effective in guiding conservation decisions. The call for co-production of knowledge is echoed elsewhere for globally-vulnerable or threatened deer. For example, a recent review of Eld’s deer (*Rucervus eldii*), a tropical Asian deer which was once widespread but is now restricted to scattered populations, acknowledged the need to “make use of all existing knowledge and experience to devise effective conservation strategies” (Wong et al. 2021). Similarly, both academic research and involvement of local people were seen as necessary to support the conservation of the Javan deer (*Rusa timorensis*), which IUCN rates as vulnerable (Firdaus et al. 2023).

One recent catalyst in sharing knowledge on the ranges of the Bathurst and Bluenose East Herds is our team’s international and inter-disciplinary Fate of the Caribou Project (FotC), working from four universities across the United States (fateofthecaribou.esf.edu). We at FotC recognize that bridging

Indigenous knowledge and "Western" academic science is an increasingly widespread theme in global conservation (Wheeler and Root-Bernstein 2020), but know, too, that misuse and misappropriation of Indigenous knowledge can cause significant harm (Parlee et al 2018, Pristupa et al. 2018). For the Bathurst herd, Indigenous knowledge emphasized the role of mining in the herd's decline but initial management actions relied less on Indigenous knowledge and more on restricting hunting (Parlee et al. 2018).

We were aware of the practical pitfalls that Pristupa et al. (2016) describe in linking Indigenous knowledge into management decisions. We noted that one conclusion was to increase involvement of interdisciplinary-skilled researchers and local knowledge holders and we have endeavored to achieve that. In this paper, we share our lessons that we learnt and we hope our experience as non-Indigenous researchers learning to participate in co-production of knowledge is helpful to the Deer Specialist Group as we all work toward a sustainable future for deer and the people who rely on them.

FotC is a multi-disciplinary research group funded by the United States National Science Foundation's (NSF) Navigating the New Arctic initiative (NSF 2018). Like many research programs that have sought to incorporate Traditional Ecological Knowledge and different ways of knowing into their research in recent years, we have experienced successes and challenges to doing so in a way that builds trust and doesn't take advantage of Indigenous Communities.

At FotC, we specialize in movement and behavior analysis, remote sensing of vegetation changes, demographic modeling, geographic and synthetic population modeling, and graphic design and science communication. Our goal is to leverage our technical expertise to provide useful tools that amplify the voices of community-based caribou stewards and to study questions of greatest concern to communities living with caribou. For example, "How does the winter road impact Bathurst caribou?" (Canada) and "Why is the Western Arctic Caribou Herd not migrating near our village anymore?" (Alaska). First, we built on existing relationships between team members and Indigenous communities in Alaska and Canada to listen to their most pressing concerns. We collaborate with Indigenous governments, Indigenous Government Organizations (IGOs), co-management boards, and communities (e.g., Wek'èezhìı Renewable Resources Board [WRRB], Tłı̨chǫ Government [TG], Western Arctic Caribou Herd Working Group, NSMA).

Recently, FotC members travelled to Yellowknife, Canada to have collaborative focus groups with members of NSMA, the Kugluktuk Angoniatit Association (KAA), and Dechinta Centre for Research and Learning to introduce our project and hear their concerns about caribou. While in early stages, these discussions have provided insight and context for behaviors and range shifts that we only glimpse from

data like GPS collar locations. For example, NSMA members shared that the changes in caribou survival we documented may be related to warmer winter weather causing more freeze-thaw cycles, creating ice that makes it hard for caribou to forage on ground-dwelling lichen (NMSA Pers. Comm. 2024).

Additionally, we are collaborating with the NMSA for sound monitoring along the NWT mine supply ice road, as many NSMA members believe the noise and sight of the traffic is disrupting caribou migration routes and winter foraging. Recording and analyzing the 'acoustic ecology' near the road provides insights on the amount of traffic on the road, how loud or disruptive that traffic may be, and behavioral responses of caribou and other animals to the road. The NSMA placed acoustic recorders and our role is to process their acoustic recordings. We are using our access to contemporary acoustic analysis tools that were built for Arctic sound monitoring (Çoban et al. 2022) and supercomputing resources from the US National Center for Atmospheric Research. The ability to process big data has allowed us to forge a similar relationship with the KAA and Government of Nunavut (GN), processing data from a 2021 acoustic and camera trap monitoring project on the Bathurst calving grounds. Leveraging our resources and skills in this way has allowed us to support existing community-led monitoring efforts.

Similarly, post-doc Benjamin Larue at the University of Montana is analyzing the camera trap data from the 2021 project on the Bathurst calving grounds, which was designed by the KAA, GN, and Government of Northwest Territories (GNWT). The study was in response to community concerns about possible grizzly bear predation on the calving grounds and directly supports Inuit knowledge and observations. Recently, Benjamin received funding to use the remote cameras on the calving grounds of the Bluenose East Herd in collaboration with the KAA.

One key to working with communities is collaborative and innovative communication. Last year, we published a multimedia essay in partnership with the WRRB, TG, and others, demonstrating a shift in the winter range of the Bathurst Herd, and increased spatial overlap with the neighboring Bluenose East and Beverly Herds (Brose et al. 2024a). This shift was quantified and analyzed by our team (Gurarie et al. 2024) but originally observed by local hunters and biologists. The essay incorporated both the scientific findings of the range shift and the insights and impacts experienced by local communities, to bring awareness to the real-life consequences of the Bathurst Herd's decline. We also designed graphical summary posters highlighting the winter range overlap between the three herds (Brose et al. 2024b). With support from the WRRB, we had the summary translated into Tłı̨chǫ, making it more accessible to Tłı̨chǫ hunters and community members. We are currently developing an animation of Bathurst caribou movements around the ice road at the request of TG to showcase what they already observe on the land: that caribou seldom cross the road when mining traffic is active. These projects, while outside the normal

“comfort zone” of academic publications, have greatly increased our positive and long-term contributions to caribou co-management by making findings accessible and demonstrable to a wide audience.

These projects and others we are working on would not be possible without the support, patience and diligence of our research partners, and the extraordinary effort by the post-docs and graduate students on our project. Our team members have traveled to Yellowknife and other northern communities repeatedly to meet with people, participate in research activities, and immerse themselves in the communities most affected by the declines in caribou. The value of on-the-ground collaboration and learning cannot be overstated. While we budgeted for travel and honoraria in our funding proposals, we perhaps underestimated the need for and cost of frequent travel to remote areas of Canada and Alaska. When in doubt, we advise budgeting more than you think you need when planning co-production of knowledge initiatives.

Our successes have not been without setbacks and complications, and we are far from being experts on co-production of knowledge. Therefore, we share some “lessons learned” with open minds and acknowledge our own bias as a North American-based team of non-Indigenous, Western researchers. Our biggest constraint thus far, besides our own learning curve, has been the time it takes to build trusting and meaningful relationships with communities. Understandably, many Indigenous communities are wary of research scientists who come from afar proclaiming good intentions. It takes repeated visits, reliable on-the-ground effort, and consistent follow-up to build trust and engage respectfully with communities. While we entered this project with previously-established relationships and team members who are trusted in many of the communities we work with, it has still taken several years to strengthen those relationships and build new ones. Researchers and funding entities should keep this in mind when planning and budgeting for new projects. Similarly, it has taken longer to develop good, culturally-appropriate, and relevant communication products than we anticipated. This, too, should be accounted for in project planning and budgets, including budgeting to pay translators who can translate products into relevant local languages.

More broadly, our whole team is continuously learning how to better engage in co-production by checking our own preconceived hypotheses, adjusting our communications, and rethinking the potential benefits and drawbacks of research approaches. For example, we learned early on that the use of GPS collars on caribou was considered disrespectful by some Indigenous people. Indeed, the capture and instrumenting of caribou is invasive, requiring helicopter pursuit, net-gunning, restraint, blood sampling, and other biological measurements. While as biologists, we perceive GPS collars as valuable for tracking movements of free-ranging animals, we also have learnt about recurrent concerns. Collars may change caribou behavior, caribou don’t like being watched so closely, and that releasing caribou after capture is

disrespectful because it spurns the gift that the caribou themselves have given when they allow themselves to be harvested or caught (Legat 2012). Younger generations may appear more open to collaring, but many community members have stressed that we must clearly communicate why collaring is necessary and how it may be useful in addressing their concerns about caribou.

These perspectives have shifted our own views of using GPS collar data. First, we feel it places an onus on us to learn as much as possible from existing GPS collar data and to address questions of direct and immediate concern to our community partners. Thus, we are returning the power of those data to those communities, to the best of our ability. We have followed what we have heard from Indigenous elders and acknowledged the role of caribou learning and remembering in analyses of their movements. We are also learning about how elders see the importance of individuals while we tend to apply statistics that downplay individuality. Our second response to these concerns is to further develop and improve methods for collecting and analyzing ecological data with respectful, non-invasive methods, i.e., remote acoustic and cameras give us many ears and eyes on the caribou landscape with minimal disturbance.

As we enter the last 1-2 years of our NSF Navigating the New Arctic funding cycle, we find ourselves asking, “What is the legacy of our project?” and “How we can best serve our partner communities beyond the lifetime of our funding?” One answer may be our Knowledge of the Caribou database initiative – building search tools to catalog existing compilations of Indigenous knowledge documented in the minutes and transcripts of co-management meetings and public hearings. Early in the FotC project, we had to respect that people in the communities are busy with their own lives and we had to fit in with their timetables. Just as importantly, they had often already shared their knowledge in other forums. Our focus is now on making it more efficient to find by compiling the Indigenous knowledge available in the large amount of the ‘gray literature’, i.e., co-management and environmental assessment board public registries and other online sources.

The most meaningful FotC legacy will be the lasting impact of contributing to real change in caribou co-management and policy. We have developed analytical tools (e.g., Couriot et al.’s 2022 TuktuTools R package for analyzing movements, Berner et al.’s 2024 Arctic Aboveground Plant Biomass Synthesis Dataset) and scientific papers which answer questions initiated by Arctic communities. Through our partnerships and communications, we are developing research products that can be used by our collaborators to support their capacity to speak up on development projects and management changes (e.g., one-page graphic summaries of research papers; fateofthecaribou.github.io/Resources.html).

Ultimately, we hope the relationships and trust we have built with partner communities will encourage other researchers to embrace the necessary work of co-production of knowledge, to communicate early

and often with partners about what kinds of outputs are most useful, and to leave sufficient time and funding to develop those products. Co-production of knowledge is essential to shape a just and sustainable future for humans and non-humans. At FotC, we have found success by bringing together a multi-talented team and network of partners to address the "wicked" problem of caribou declines from many angles; simultaneously, we have had to learn and adjust while our funding clock continues to tick, with our partners patiently guiding us. As we have learned, co-production of knowledge must be undertaken with care, forethought, and a plan for long-term impacts that will outlive ephemeral funding and personnel. Co-production of knowledge cannot and should never be an "add-on" to a traditional scientific study; it must be "baked in" from a project's conception. The words that FotC members heard when meeting with our collaborators in the communities still resonate with us: "Be friendly, open; remember whose land your research is on; begin consultation with communities before the research even starts; show up; have local people facilitate discussions; [practice] reciprocity; respect for community, respect for animals."

As Ophélie watched the caribou near the ice road, she reflected on her experience with NSMA: "As researchers, we spend most of our time behind our computer screen, analyzing data. This experience with NSMA taught me that we can learn a lot by spending time in the field, with the people who live there. I am convinced that the research we are producing together will be more powerful than research done alone."

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Figures

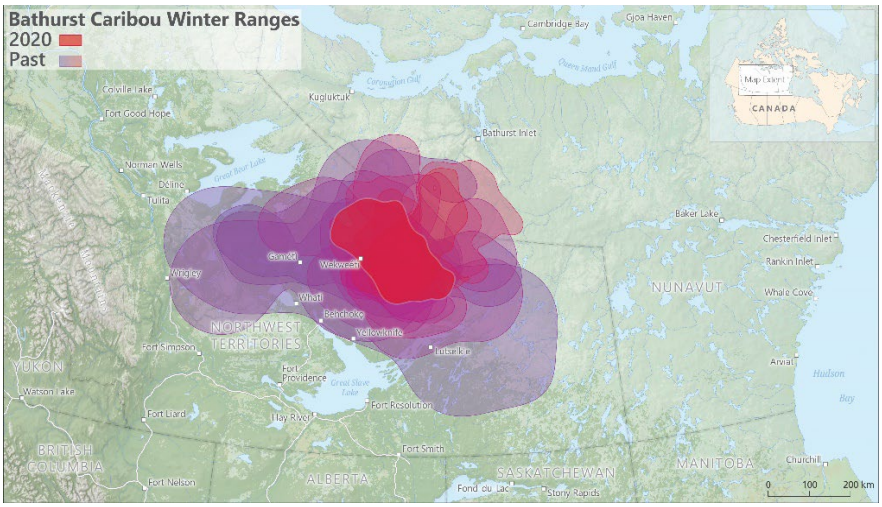

Figure 1. Barren-ground caribou (*Rangifer tarandus groenlandicus*) from the Bathurst herd during fall migration to their winter ranges. Photo by Anne Gunn.

Figure 2. The winter range of the Bathurst Caribou Herd in northern Canada has shrunk as the population has declined by 98% since 1986. Map by Ian Freeman, Wyoming Migration Initiative.