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Appendix 1. Community-collaborative research background.

In northern Canada, landscapes, people and wildlife are inextricably and compellingly intertwined. Federal control over wildlife and the exclusion of indigenous people in wildlife management and decision-making for much of the 19th century has generated environmental, jurisdictional, and political conflicts revolving around natural resources (Sandlos 2011). For many years science-based wildlife conservation approaches often had negative impacts on the traditional harvesting practices of indigenous peoples. For example, concerns about declining populations led to legislative controls by the federal government in the early 1900s, prohibiting (and in some cases criminalizing) subsistence hunting of caribou and other large mammals and birds by Dene and Inuit hunters in the Northwest Territories (Sandlos 2011). Understanding the historical context of unequal power relations is an important part of developing new approaches to environmental research (Fletcher 2003, Nadasdy 2005, McGregor et al. 2010, Tobias et al. 2013).

In the 1970s researchers working in the north began to acknowledge the importance of indigenous people's knowledge and priorities in natural resource research (Cruikshank 1981). However, early traditional knowledge (TK) research focused mostly on collecting objective and quantifiable information that could be packaged and accessed within scientific frameworks (Stevenson 1998). This led to substantial misrepresentation and the appropriation of knowledge (Nadasdy 2005, Castleden et al. 2012). A more recent shift in the orientation of research advocates for collaborative processes that serve indigenous interests, provide ownership and control of research outcomes, and include local people in decision-making processes (Hall 1979,

Simpson 1999, Smith 1999, Simpson and Driben 2000). For example, community-based participatory research frameworks emerged in response to disrespectful and exclusionary approaches that concentrated research *on* people rather than *with* people (Simpson and Driben 2000, Fletcher 2003)

Participatory research (also including community-engaged, community-participatory, community-based, collaborative, cooperative; Ferreira and Gendron 2011) is intended to include people as active participants in all phases of the research process to “facilitate a more accurate and authentic analysis of social reality” (Hall 1979) and have been adapted in the fields of education (Hall 2005), public health (Christopher et al. 2011, Ferreira and Gendron 2011, Tobias et al. 2013), social science (Fletcher 2003), resource management (McKinley et al. 2012), and linguistics (Czaykowska-Higgins 2009) among others. The principles of participatory research include fostering a co-learning environment, answering relevant community-driven questions, focusing on co-capacity building and sustainable solutions, sharing decision-making responsibilities, and above all reflecting critically on the roles and power relations of those involved in the research process (Cornwall and Jewkes 1995, O'Fallon and Dearth 2002, Davidson-Hunt and O'Flaherty 2007)

In alignment with the principals of participatory research we brought together an interdisciplinary team of research partners and co-authors to build a solid foundation across diverse fields. Our research process was iterative and built on information and questions developed and refined over time. Significant knowledge exchange and *łeghágots'enetę* “learning together” between the co-authors and research partners occurred as ideas for the project were developed, at focus group meetings, during the selection of the field sampling sites, while

collecting samples, and on the land during day trips, hunting trips and overnight trips to cabins. The distinct disciplinary backgrounds of team members, who spoke different first languages, necessitated significant dialogue to come to common understanding for a project.

The commitment, interest and openness of community research partners in the Sahtú region was crucial to the collaborative research process. Michael Neyelle, Walter Bayha, Frederick Andrew, and Leon Andrew are all native Dene language speakers and have significant TK experience and knowledge from their personal experiences and their parents and *ʔehtséokə* “grandparents”. They have worked in collaboration with the *ʔehdzo Got'ıne Gots'é Nákedi* (Sahtú Renewable Resources Board; SRRB) and other non-Dene researchers on various research projects over the years. Their interest in this research project, commitment to helping support the research, guidance on TK practices, and help with interpretation of the language, and their leadership positions within the communities allowed for new knowledge to be created and a common understanding to be reached. A focus on language during the research process was a means for Dene and non-Dene speakers to explore knowledge and understanding of the environment in more depth. For example, TK holders were able to unearth older knowledge that is not used every day. Non-Dene partners were able to explore the ways in which the words we use and the ideas we express influence the collaborative environment.

The project also included extended place-based research by non-Dene partners (Jean Polfus and Deborah Simmons live and work in the community of Tulít'a) that allowed for opportunities to participate in activities on-the-land and in the communities (thus learning was not restricted to research activities/agendas). Jean Polfus also traveled throughout the communities in the Sahtú to provide support for the *ʔehdzo Got'ıne* (Renewable Resources

Councils), collect caribou fecal samples with community members, participate in hunting activities, meet with students at local schools and Aurora Colleges and coordinate sampling efforts. The understanding required to respond appropriately to cultural cues and respectfully engage in *łeghágots'enetę* “learning together” is on-going, intangible and personal (for all research partners and co-authors) – but this exploration provides the necessary foundation needed to produce truly collaborative research.

Over time relationships were fostered that provided space for non-Dene researchers to learn important lessons regarding hunting traditions, on-the-land safety, and Dene *zekwé zezah* “caribou laws” required to demonstrate respect for the land and wildlife. Likewise, community members were also able to benefit from the collaborative relationship through increased contact with “outsider knowledge” (Caine et al. 2007), including expertise in wildlife biology, population genetics and linguistics, the chance to be involved in long-term natural resource management research and planning, and access to other resources that the non-Dene researchers could more easily acquire. The union of knowledge traditions can only be achieved through shared experiences, considerable time, and strong local and regional governance (McGregor et al. 2010). A large amount of knowledge was gained over time and cannot be readily summarized in a manuscript. The research process was organic and agreement on the interpretation of the results was gradual, forcing everyone to explore their own knowledge in depth, and in some cases leading to new questions and additional analysis.

Meeting the demands of academic requirements, funding agencies, and indigenous communities in the same process is fundamentally challenging and levels of participation, control and ownership of the research process and products often vary based on the complex

constraints on each project (Cornwall and Jewkes 1995, Simpson and Driben 2000, Tondu et al. 2014). Our research benefitted considerably from the partnership with the SRRB. The board is a land-claim organization responsible for managing renewable resources. The SRRB's contributions to this project allowed our research to be firmly grounded in the communities needs and questions from the onset of the research because the project was built on past-experiences and related work. The SRRB also facilitated ongoing communication with the public and local research partners by developing connections between various research agendas and other co-occurring projects. The opportunity for long-term planning and stability in the research process (implemented through connections with multiple community-driven projects and long term institutional research strategies and programs) is an important contribution of collaborative interdisciplinary research and the SRRB's involvement was essential to the success of the long term collaborative project. Thus, we were able to produce research contributions that were deeper and more robust than could have been achieved by a single, stand-alone academic research project.



Figure A1.1. We discussed traditional knowledge themes, language, and genetic data with a local group of experts (advisory group, including co-authors) in two separate 3-day meetings to clarify and develop important concepts and themes related to caribou populations in the Sahtú region and Nahanni National Park Reserve of the Northwest Territories, Canada. Advisory group members June 2014 in Tulít'a, Northwest Territories: Gordon Yakeleya, Frederick Andrew, Michael Neyelle, Jean Polfus, Walter Bayha, Camilla Rabisca, Deborah Simmons, Michel Lafferty, and Judy Lafferty.



Figure A1.2. Advisory group members February 2015 at Deochah (Bennett Field), Northwest Territories: Back two rows – Jean Polfus, Gordon Yakeleya, Frederick Andrew, Richard Kochon, Jimmy Dillon, Walter Bayha, Deborah Simmons, Leon Andrew, Nicole Beaudry (ethnomusicologist), Michael Neyelle, and Lucy Jackson. Front row – Corrine Andrew (cook), Gabe Kochon, Maurice Mendo, and Hyacinth Kochon.

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