

*Ph.D. Thesis – Plain Language Summary*

# AN INTERDISCIPLINARY APPROACH TO DESCRIBING BIOLOGICAL DIVERSITY

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**AN INTERDISCIPLINARY  
APPROACH TO DESCRIBING  
BIOLOGICAL DIVERSITY**

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# MÁHSI CHO

I would like to express heartfelt gratitude to the communities of the Sahtú region for their generous hospitality and for always making me feel welcome.  
Máhsi Cho.





Amundsen Gulf

VICTORIA ISLAND

McClintock Channel

Gulf of Boothia

BOOTHIA PENINSULA

Coronation Sound

Queen Maude Gulf

Rae Strait

Inuvik

Colville Lake

Fort Good Hope

Great Bear Lake

Norman Wells

Déline

Tulit'a

NUNAVUT

NORTHWEST TERRITORIES

YUKON

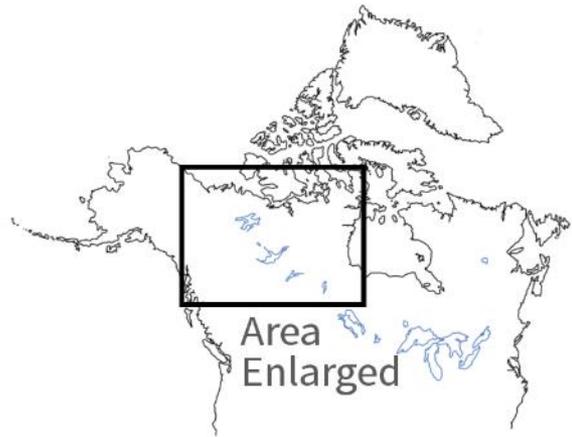
Yellowknife

Great Slave Lake

MACKENZIE MOUNTAINS

CASLIAR MOUNTAINS

CANADA



Area Enlarged

NORTH AMERICA

# BACKGROUND

September 18, 2012

ʔehdzo Got'Inę (RRC)

Gathering in Fort Good Hope

Renewable Resources Council Gathering, Fort Good Hope, September 18, 2012

## Caribou Research Resolution

### Whereas

1. The Renewable Resources Councils (RRCs) of the Sahtú Region are concerned that knowledge and stewardship role of our people is not being properly respected and accommodated in caribou research and management – traditional knowledge is the missing piece.
2. As Sahtu Dene and Metis harvesters, our relationship with caribou is part of who we are.
3. There are many questions that need to be worked on about caribou populations and health and community harvesting practices, especially in the context of increasing resource development.
4. Sahtu Dene and Metis elders and harvesters do not support caribou collaring as a research method, since it is disrespectful to the caribou and affects caribou health.
5. According to Section 13.9.6 of the Sahtú Dene and Métis Comprehensive Land Claim Agreement, Renewable Resources Councils “shall participate in the collection and provision, to government and the Board, of local harvesting data and other locally available data respecting wildlife and wildlife habitat.”
6. According to Section 13.8.40 of the land claim, “wildlife research or harvesting studies conducted in the settlement area by government or by the Board or with government assistance shall directly involve Renewable Resources Councils and participant harvesters to the greatest extent possible.”
7. The SRRB and NWT Environment and Natural Resources must renew their commitment to fulfill the land claim responsibility to directly involve RRCs and



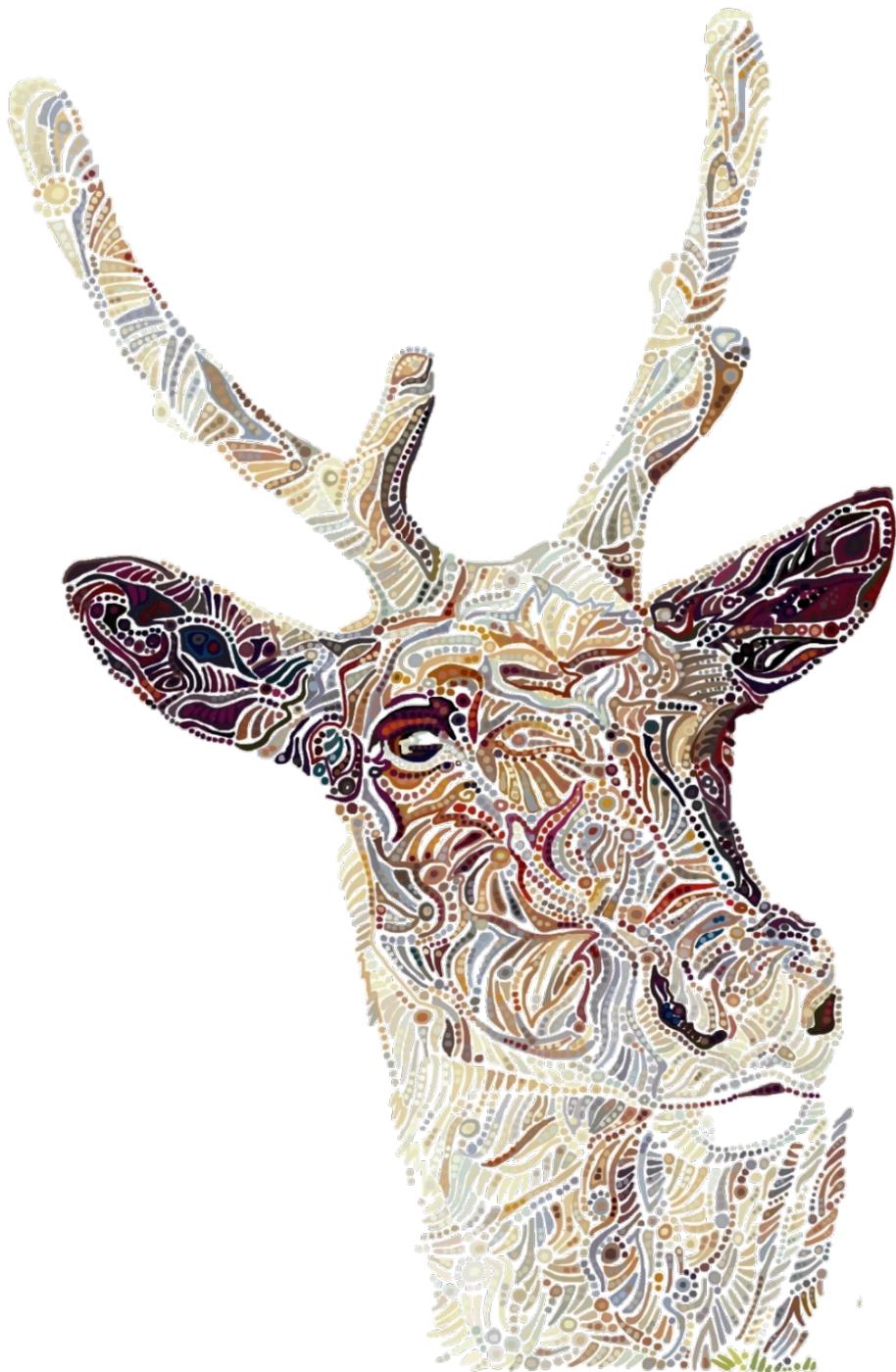
In September 2012 the ʔehdzo Got'Inę (Renewable Resources Councils) passed a joint resolution that called for a renewed commitment to adopt traditional knowledge and Dene law as the guiding principles in caribou research. This resolution is the origin of the caribou research described in this thesis.



Łeghágots'enetę

Learning together

The Dene concept of learning together has been a useful approach from which to view this collaborative research project.



# THESIS ORGANIZATION

*Introduction* 1

Chapter 2: Łeghágots'enetę  
(learning together) 2

Chapter 3: Ancient  
diversification in glacial refugia  
leads to intraspecific diversity 3

Chapter 4: Creative  
convergence: exploring  
biocultural diversity through art 4

*Conclusion* 5

# ACADEMIC JOURNAL ARTICLES

Chapters 2, 3 and 4 have been published in academic journals and include community collaborators as co-authors.

2 Polfus, J. L., M. Manseau, D. Simmons, M. Neyelle, W. Bayha, F. Andrew, L. Andrew, C. F. C. Klütsch, K. Rice, and P. Wilson. 2016. *Łeghągots'enetę* (learning together): the importance of indigenous perspectives in the identification of biological variation. *Ecology and Society*. **21**(2):18



3 Polfus, J. L., M. Manseau, C. F. C. Klütsch, D. Simmons, and P. J. Wilson. 2016. Ancient diversification in glacial refugia leads to intraspecific diversity in a Holarctic mammal. *Journal of Biogeography*. **44**:386-396



4 Polfus, J. L., D. Simmons, M. Neyelle, W. Bayha, F. Andrew, L. Andrew, B. G. Merkle, K. Rice, and M. Manseau. 2017. Creative convergence: exploring biocultural diversity through art. *Ecology and Society*. **22**(2):4



# INTRODUCTION

Recognizing and describing patterns of animal and plant life in the world – also known as biodiversity – is fundamental to understanding our environment and to the field of conservation biology.



# LANGUAGE

People in all cultures use language to describe *kinds* of things and to organize patterns of repetition found in the world.

Different languages and knowledge systems can provide complementary descriptions biodiversity.

Indigenous knowledge holds detailed information about the environment that has been largely overlooked by outside scientists.





# BIOCULTURAL DIVERSITY

Social-ecological systems are dynamic relationships between human cultures, living things and environments.

Biocultural diversity highlights the interactions between human diversity and the diversity of biological systems.

# PLAIN LANGUAGE SUMMARY - INTRODUCTION

- Caribou are central to the livelihoods and identities of indigenous people.
- Caribou have different behaviors, fur colors, and life-styles in different places. Understanding and describing this variation has been difficult.
- Interdisciplinary research approaches can be used to help describe caribou types and the interdependent relationships between people and wildlife in complex social-ecological systems.
- In this dissertation I use multiple methods to describe caribou in the Sahtú. These methods include population genetics, phylogenetics, traditional knowledge, Dene language, and visual approaches.
- A collaborative process of research that facilitates **łeghágots'enetę** (learning together) has the potential to produce sustainable conservation solutions, develop effective wildlife management policies, and ensure caribou remain an important part of the landscape.



# INTERDISCIPLINARY APPROACH

Working collaboratively with communities and understanding biocultural social-ecological systems requires a flexible, creative and interdisciplinary research approach.

Our research methods included community-based participatory research, language-based methods, population genetics, phylogenetics and visual facilitation.





# COMMUNITY- COLLABORATIVE METHODS

1

Partner with ʔehdzo Got'ıneḡ  
Gots'ę Nákedı & ʔehdzo  
Got'ıneḡ

2

Community-based  
caribou scat collection

3

Genetic Analysis

4

Knowledge Sharing  
Meetings



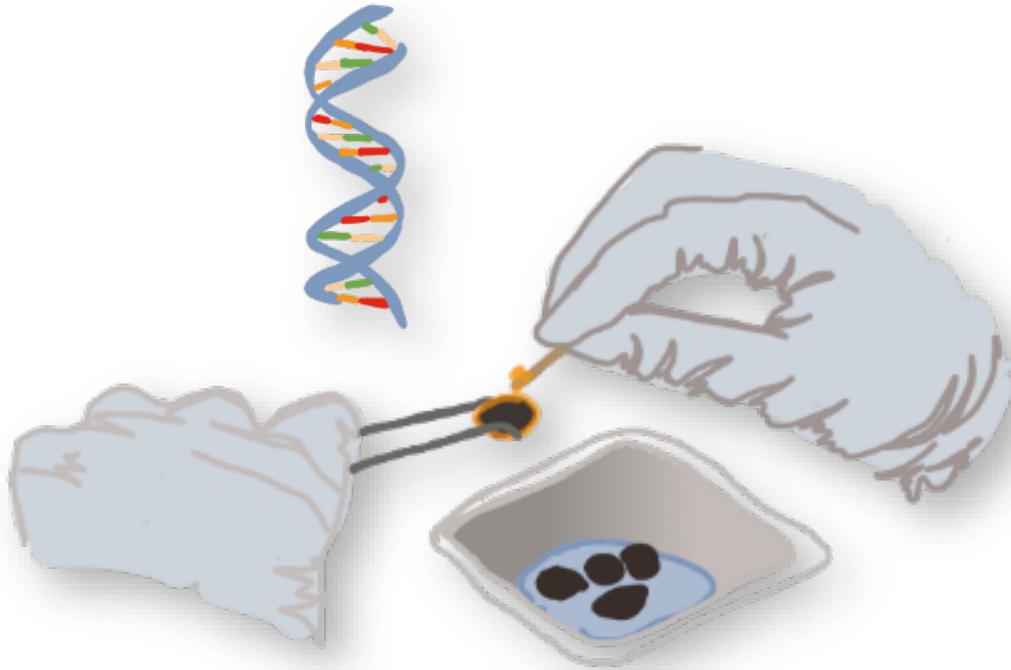
Our project was initiated through collaborations with the SRRB and the RRCs. We held planning meetings to develop research priorities, questions and methods. We developed a Memorandum of Understanding with each RRC to confirm the governing principles of the research.

## 2 COMMUNITY-BASED CARIBOU SCAT COLLECTION



Our project was unique in that we worked with community members to noninvasively collect scat (poop) samples and we paid people 25\$ gift cards for gas for every pile of caribou scat they collected.

### 3 GENETIC ANALYSIS



To understand caribou population structure we analyzed the outside of the scat samples. We use two markers: nuclear DNA that provides a more recent snapshot of caribou variation and mtDNA that provides information about ancestral lineages of caribou.

## 4 KNOWLEDGE SHARING MEETINGS



To ensure a collaborative production of knowledge we engaged in deliberate co-analysis of our data with an advisory group. We discussed themes, language, and ideas in two separate 3-day meetings to clarify and develop important concepts.

# ADVISORY GROUP

The advisory group helped identify Dene concepts, interpret results in collaboration, work across disciplines, and support the research process.

Members of the advisory group also co-authored reports and publications, helped review manuscripts, co-presented results and reviewed other products of the research.





There are three main types of caribou in the Sahtú region.



Charles Oudzi, of Colville Lake, collects caribou scat (poop) samples on **Tets'ehxe** (Drum in the **Shúhtagot'ıne Néné** (Mackenzie Mountains)). Caribou scat samples provided non-invasive genetic information that was used to analyze the connectivity and relationships between different caribou populations.

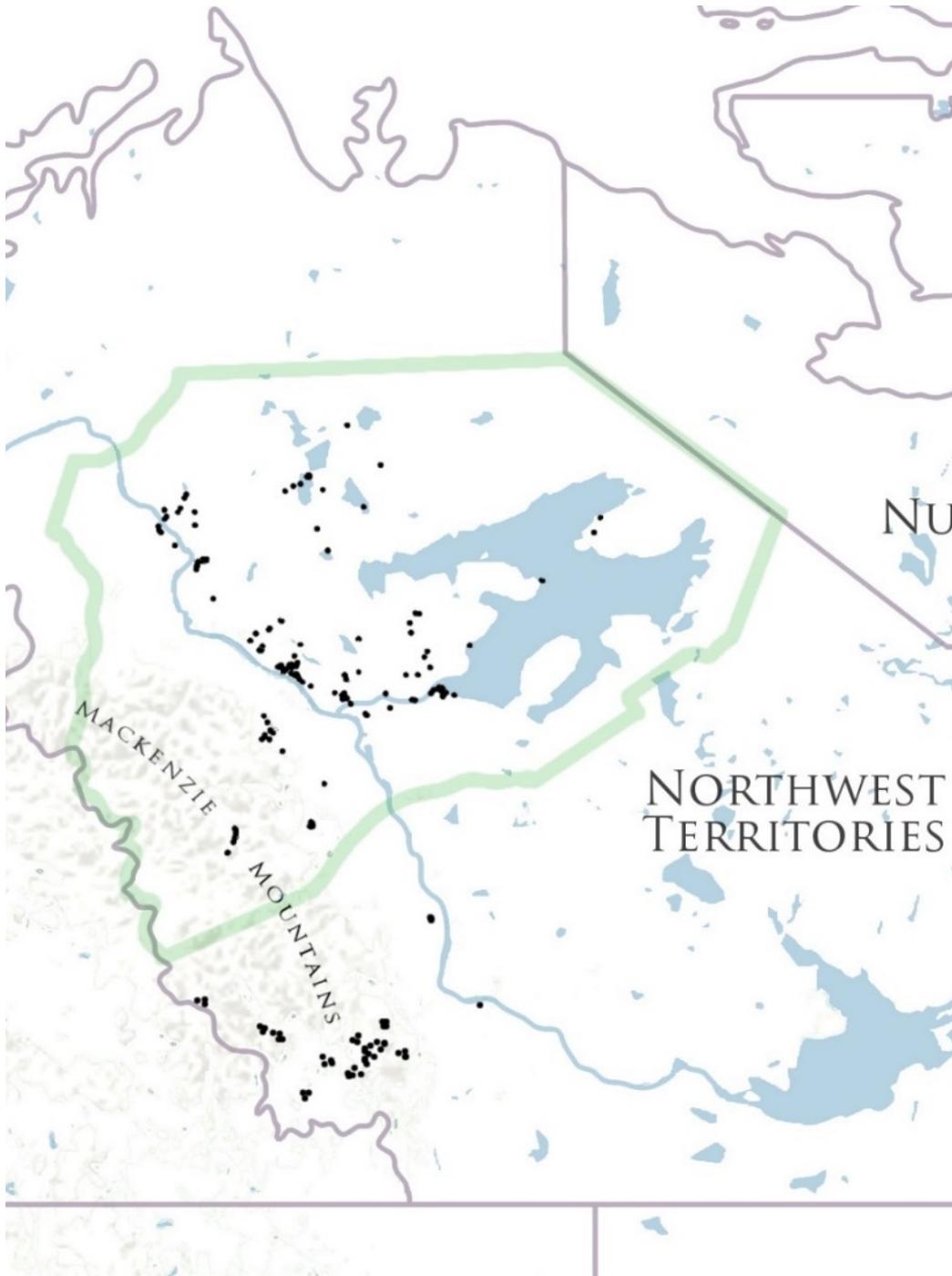
# SCAT SAMPLES

We collected over 1000  
caribou scat (poop) samples

Over 100 people participated

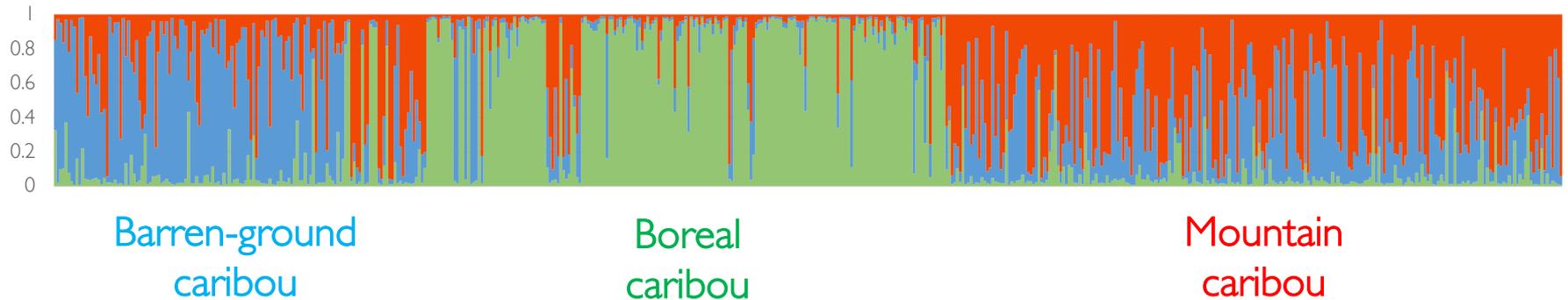
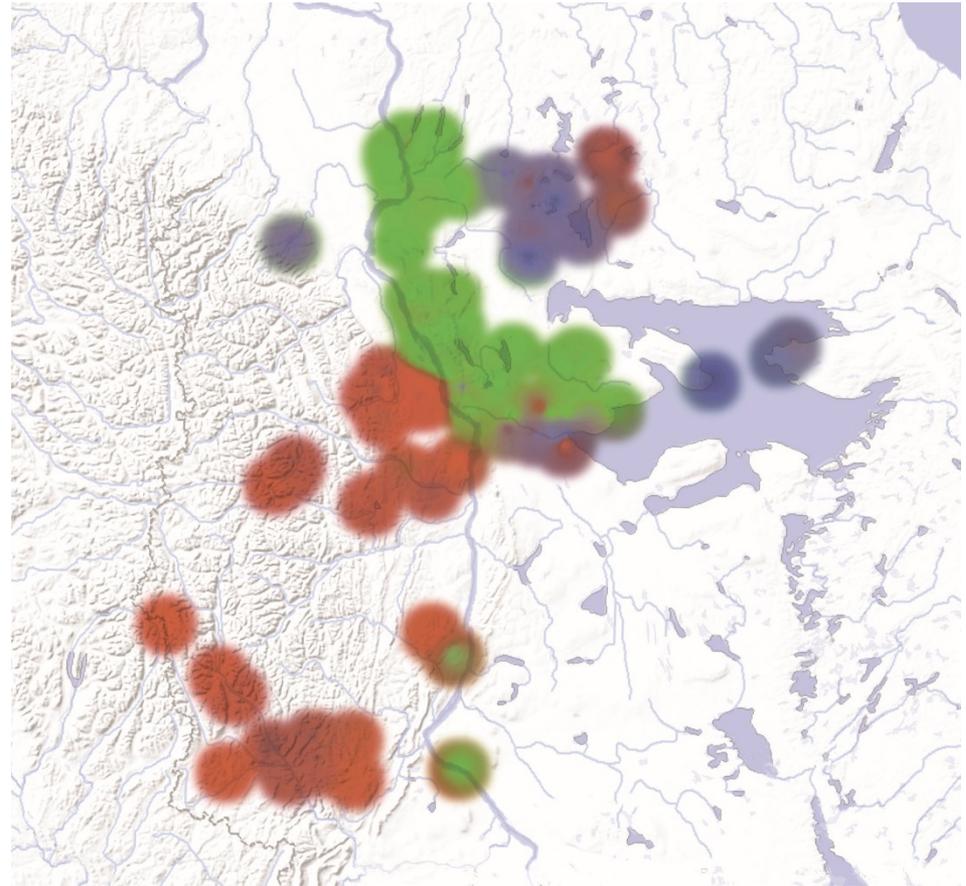
996 scat samples were  
amplified

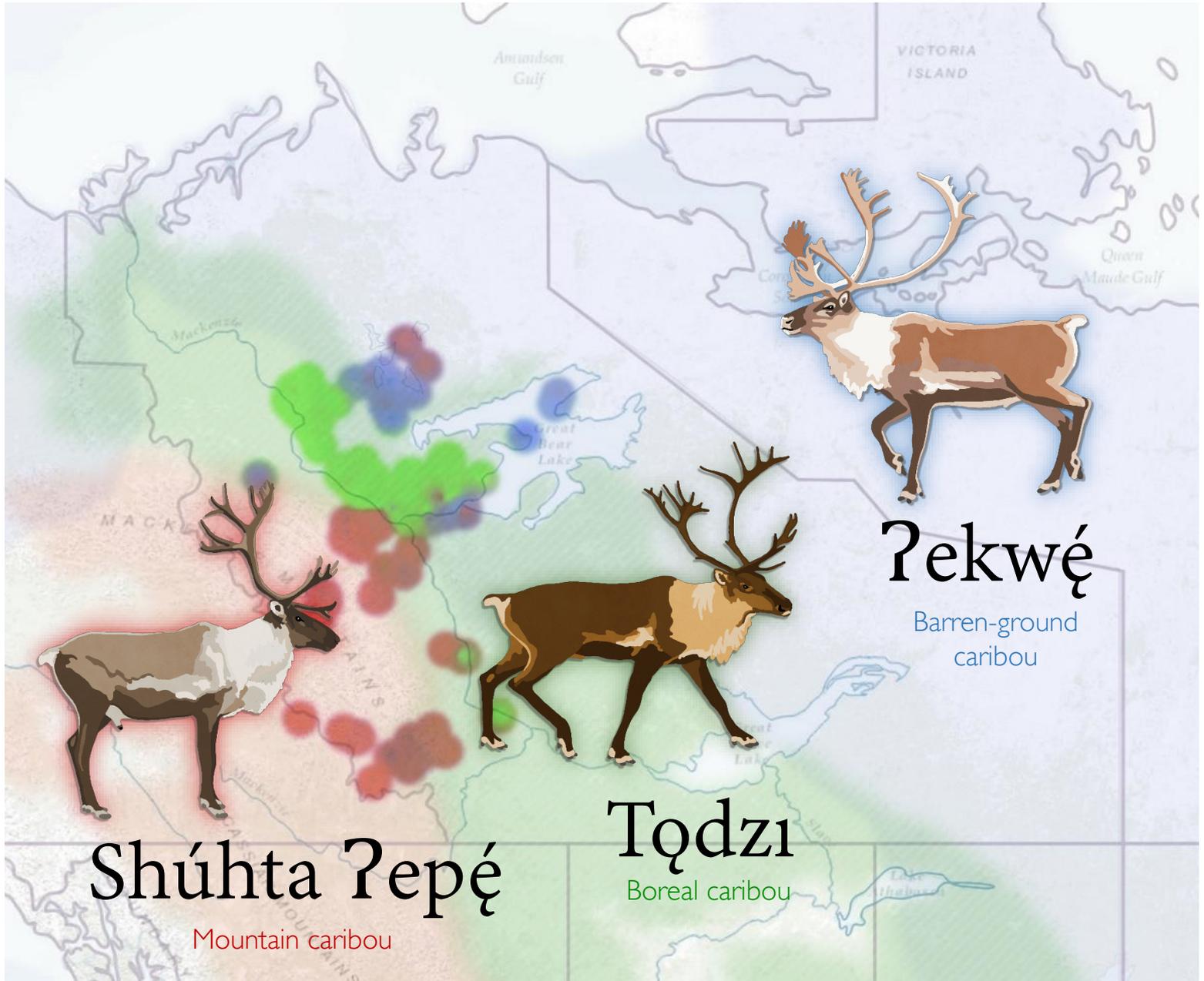
We identified 555 unique  
individual caribou



# GENETIC STRUCTURE

We found support for three genetic groups of caribou in the region using genetic analysis.





Shúhta ʔepé

Mountain caribou

Tòdzi

Boreal caribou

ʔekwé

Barren-ground caribou

A person wearing a black hoodie and a blue Nike baseball cap is kneeling in a field of dry grass, skinning a caribou. The caribou is lying on its side, and the person is using a knife to remove the hide. The caribou has large, light-colored antlers. The scene is outdoors in a natural setting.

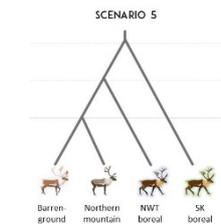
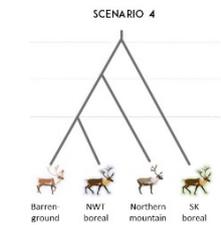
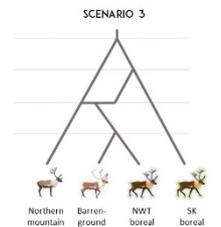
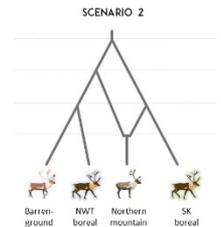
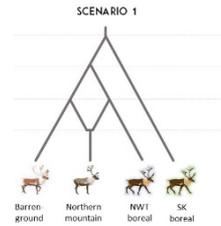
The genetic differentiation corresponded to the caribou types recognized by Dene people.

# SUMMARY OF CHAPTER TWO

- The chapter examines how traditional knowledge, Dene language, and cultural practices help us understand the evolutionary processes that have maintained and created caribou diversity in the Sahtú region.
- The genetic analysis groups caribou into types that correspond to the caribou types recognized by Dene people: **t̥d̥zi** (boreal woodland caribou), **ɬekwé** (barren-ground caribou), and **shúhta ɬepé** (mountain caribou).
- We present culturally respectful and relevant descriptions of caribou variation through partnerships that respect the lives and experiences of people that depend on the land.
- The research makes the case that by prioritizing mutual learning, researchers can broaden their understanding of biodiversity and establish a common language for collaboration.

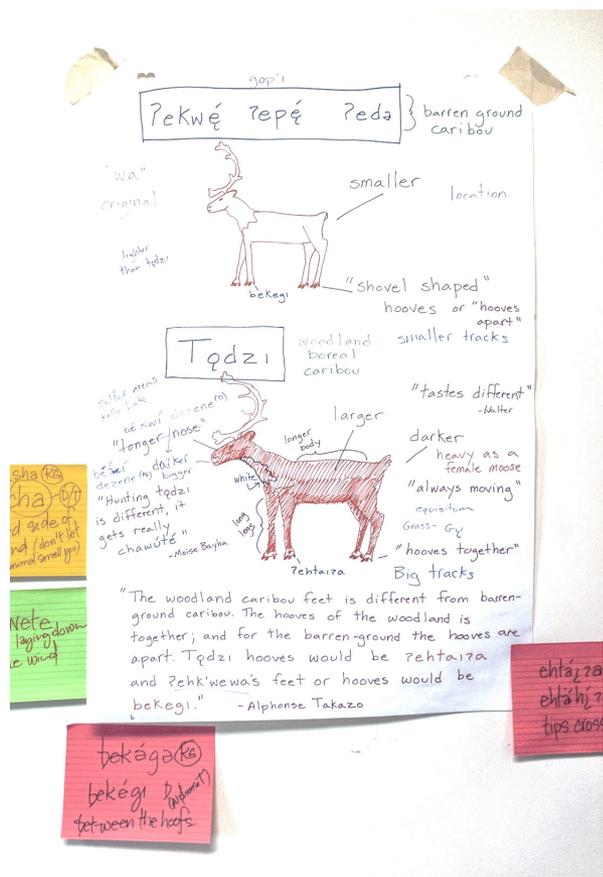
# SUMMARY OF CHAPTER THREE

- The glacial-interglacial cycles of the last ice age have shaped the three types of caribou in the region: **t̥ɔdʒɪ** (boreal woodland caribou), **ɬekwɛ́** (barren-ground caribou), and **shúhta ɬepé** (mountain caribou).
- We used a computer simulations to find out whether **t̥ɔdʒɪ** first came to the Sahtú after the ice age from south or north of the ice sheets.
- Results reveal that Sahtú **t̥ɔdʒɪ** evolved independently from the northern lineage. This contrasts with **t̥ɔdʒɪ** from southern Canada which belong to a lineage known to have come from south of the ice sheets – in what is present day USA.
- The results are an example of intraspecific parallel origins in caribou and contribute important insights into the history of caribou during the last ice age.



# SUMMARY OF CHAPTER FOUR

- This chapter examines how art and other visual techniques can be used to develop robust cross-cultural collaborations and help us display the importance of biocultural diversity.
- We provided ideas for using illustrations, diagrams, drawings and other visual aids to increase research potential during all stages of the research process.
- Results point to the potential for art to be used to improve communication, participation, and knowledge production among interdisciplinary research collaborations and across language and knowledge systems.



# CONCLUSIONS

The research outlines comprehensive descriptions of caribou populations that reflect biocultural diversity and strengthen cross-cultural collaboration.





# LANGUAGE

Including Dene language helps to strengthen people's relationship with wildlife.

Language acknowledges traditional stewardship systems.

Using Dene language has the potential to allow for the development of common-ground from which new relationships can form.

# CARIBOU DIVERSITY

There are likely important adaptive traits that are necessary to retaining caribou variation in the Sahtú.

Sahtú **t̥d̥zi** are especially unique and adapted to the forest of the Sahtú.



# IMPACT

The results will help with the Sahtú **t̥odzi** federal recovery planning process lead by the GNWT.

The research has helped with the development of community-based caribou management plans.

Results challenge the appropriateness of using Designatable Units to describe caribou across Canada.

We show that researchers must include traditional knowledge and Indigenous languages in the development of policies related to the Species at Risk Act.



# MÁHSI CHO

I am especially indebted to my collaborators from the Sahtú who taught me important lessons and shared their knowledge and expertise. Their remarkable vision in identifying the need for collaborative caribou research is what made this project possible.

Specifically, I would like to empathetically thank Walter Bayha, Frederick Andrew, Leon Andrew, Michael Neyelle, Gordon Yakeleya, and Morris Modeste – each of whom helped me grow and introduced me to new ideas, language, and beautiful places that I will never forget. I also received significant help and guidance from Roger Boniface, Wilfred Jackson, Lucy Jackson, Lawrence Manuel, Patricia Manuel, Michel Lafferty, Judy Lafferty, Camilla Rabisca, the late Angus Shae, Roger Odgaard, Ricky Andrew, Maurice Mendo, Roderick Yallee, Stella Bayha, William Horassi, Robert Horassi, Dion Lennie, David Menacho, Frank Andrew, Julie Lennie, Joanne Krutko, Angus Lennie, Eugene Boulanger, Jane Modeste, Morris Neyelle, Charlie Neyelle, Mitchell Naedzo, Jimmy Dillon, Alfred Taniton, Leon Modeste, Richard Kochon, Gabe Kochon, Hyacinthe Kochon, and Marie Kochon along with so many others who are too numerous to name, but to whom I extend my utmost thanks. While this dissertation outlines the academic outcomes of my research, my experiences living and working in the Sahtú have culminated in significant personal growth that reflects much more than science and research. Máhsi cho to all those who helped to enrich my education in more ways than I can express.

~ Jean Polfus

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