GRADE 11 LIFE SCIENCES:

CARIBOU WITHIN THE ECOSYSTEM

ILLUSTRATED BY VIOLET GATENSBY, 2022.

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SOUTHERN LAKES CARIBOU IN THE SCHOOLS:

A COMMUNITY-BASED LEARNING RESOURCE

Compiled and edited in 2022 by:
Rivers to Ridges
2180 2nd Avenue
Whitehorse, Yukon
Canada Y1A 5N6

Cover art by:
Violet Gatensby
instagram.com/violet.gatensby

All interior art by:
Tedd Tucker,
Berwin
www.berwin.ca

Elder facilitation and leadership provided by:
Copper Joe Jack (Go' gon'),
Land and Peoples Relationship Model
www.respectcareshare.ca

www.southernlakescaribou.com/educators

 This publication is designed to provide local Indigenous Knowledge and Western scientific information in regard to the Southern Lakes Caribou. Please consult with local Elders, Knowledge Holders and community experts whenever possible.

Southern Lakes Caribou in the Schools: your local Southern Lakes Yukon First Nation Community Booklet or Southern Lakes Caribou in the Schools: Learning Resource

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GRADE 11 LIFE SCIENCES:
CARIBOU WITHIN THE ECOSYSTEM

BIG IDEAS

- Evolution occurs at the population level

CONTENT	CURRICULAR COMPETENCIES
• First Nations understandings of interrelationships between organisms • Microevolution (change within a species that occurs over time in a population) • Adaptation to changing environments	• Experience and interpret the local environment • Apply First Nations perspectives and knowledges, other ways of knowing and local knowledge as sources of information • Communicate scientific ideas and information, and perhaps a suggested course of action for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions and representations • Express and reflect on a variety of experiences, perspectives and worldviews through place

LEARNING TARGETS

1. I am able to integrate Yukon First Nations and Western scientific understandings of interrelationships between Caribou and the Southern Lakes ecosystem.
2. I am able to describe how microevolution and natural selection impact Caribou in the Southern Lakes.
3. I am able to investigate and reflect on a variety of experiences, perspectives and worldviews regarding SLC monitoring.
4. I am able to use evidence-based arguments and scientific language to communicate a suggested course of action for the monitoring of the Southern Lakes Caribou.

PRIOR LEARNINGS

Prior to teaching the following activities and games, it would be helpful if the students had a basic overview of Southern Lakes Caribou seasonal movement and seasonal rounds. Some helpful resources are listed below.

- C. (n.d.-a). *Southern Lakes Caribou |*. https://southernlakescaribou.com
- *Caribou in the Schools: Community Booklet (for your community)*

MICROEVOLUTION AND PREDATOR/PREY DYNAMICS

From density dependence and microevolution interactively determine effects of phenology mismatch on population dynamics :

- Life cycle events in plants and animals are typically adaptively tuned to anticipate predictable seasonal changes in environmental conditions or resources. Climate change is expected to affect the temporal component of species' interactions, e.g. by creating a mismatch between a predator's breeding time (when ample food supply is critical) and the time when prey abundance is high.[21]

- There are also many other predicted impacts of climate change to consider.

WOLF MANAGEMENT AND PREDATOR CONTROL

Wolf harvest may be used as a community-based management tool to reduce local predation on Caribou, but it is subject to a number of criteria, including verifiable harvest reporting for Caribou and wolves, a harvest relationship plan for all users, and an agreed upon, collaborative approach to program design, implementation and evaluation.[22]

- Large-scale predator control is one other management tool that has been used in the past in Yukon. [T]here is strong public opposition from Yukoners to using this approach as an ungulate management tool; moreover, this type of program is costly, has only short term impacts unless it is intensive and maintained indefinitely, and lacks community involvement. Any predator control program specific to wolves must respect the Yukon Wolf Conservation Management Plan.
- Sources of mortality for adult Caribou include harvest and natural sources of mortality including predation. In their assessment of the effects of wolf control, Hayes et al. (2003) detected no difference between adult female survival in their "treatment" and three neighbouring "control" herds, suggesting wolf predation did not have a significant effect on this vital rate in an area where wolves had alternate prey (Dall's sheep and moose). However, Hayes et al. (2003) did report an increase in recruitment for the Aishihik herd following wolf removal.

IMPORTANT NOTES

- One of the key factors to monitor with Caribou populations is mezì dēsia/caribou calf (Dän'ke, Ta'an Män dialect) numbers, especially if herds numbers are to grow. If mezì dēsia numbers are low, some targeted wolf trapping may be effective if maintained over many years, but many other factors can affect the survival of calves, including weather and predation from other carnivores (mostly bears).
- **Predation is completely natural and these animals have evolved in dynamic multi-predator, multi-prey systems.** The factor that often leads to herd declines is people. In some cases, if a herd is to recover, wolf control can be used, but the Southern Lakes herds recovered without the use of predator control, mostly by limiting human harvest.

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21 Reed, Gienapp, & Visser, 2014, Density dependence and microevolution interactively determine effects of phenology mismatch on population dynamics.

22 Science-based guidelines for management of northern mountain caribou in yukon: Summary, 2016, Yukon. https://open.yukon.ca/sites/default/files/northern-mountain-caribou-guidelines-2016_0.pdf.

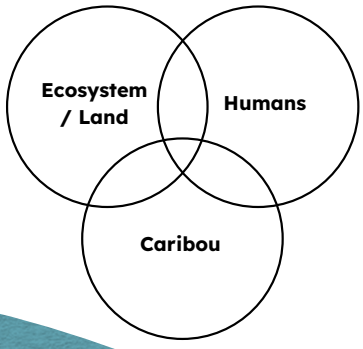
PART 1: OPENING CIRCLE AND CARIBOU INTERCONNECTIONS WITHIN THE ECOSYSTEM

LEARNING TARGET:

I am able to integrate Yukon First Nations and Western scientific understandings of interrelationships between Caribou and the Southern Lakes ecosystem.

MATERIALS

- **Caribou artifact: sewing materials, Caribou tufting, snare, clothing, lichen sample, or swatch of Caribou hide or photos printed (Appendix 1B and 2C)**
- **No Voice perspective Venn diagram framework (below)**
- **Community Booklet (for your community)**



TIME: 30 MINUTES - 1 HOUR

OPENING: CONNECTING WHAT WE KNOW

Gather in a circle. Ask the students how they would define 'interconnection or interrelationships between organisms' (e.g., plants as indicators of timing for corresponding events, decaying animals as plant nutrients and predators consuming prey).

Invite an elder or Knowledge Holder to share stories bout the Southern Lakes Caribou (SLC) and their deep connection to the land and waterways.

- Prepare a small homemade gift or card to present to the Elder or visitor in gratitude.
- Ask in advance for permission to photograph or record any visitors.
- Set a group agreement of how to receive and respect the visiting Elder, specialist or guest speaker.

In advance of the special guest, students will reflect on the collective Caribou knowledge and questions. Pass a Caribou artifact around the circle, and invite the students to share something they know about Caribou or a question they have about Caribou. Encourage students to share any stories or personal connections they have with Caribou. Have one or more students document the knowledge and questions on a chart paper, or smart board, using the Venn diagram framework below. **Nän/land, Udzí/Caribou and Hän/person or people** (Dän'ke, Kwanlin Dün First Nations Dialect) are terms to use as you work on the Venn diagram. Use the online dictionary for pronunciation.

ASSESSMENT OPPORTUNITIES

Are students able to:

- Contribute a question, fact or story related to Caribou?

Note: The guest speaker may also be connected through a video or recording of an Elder or specialist sharing their story and experience of working with the SLCRP.

ACTIVITY: SPENDING TIME WITH ELDERS

Gather in a circle. Invite the students to acknowledge the Yukon First Nations Traditional Territory that the activity is taking place on. If they are present, introduce and welcome the visiting Elder or visitor. Go around in the circle, and have students introduce themselves if needed.

Invite the visiting Elder or visitor to share their knowledge about the SLC and the SLCRP. Ensure time for students to ask questions.

If an Elder is not present, ask the students if they know of any Elders or Traditional Knowledge Holder in their communities or lives that are important to them. Invite students to share any teachings they have learned about how to treat Caribou or how to act when out on the land related to Yukon First Nations ways of Knowing, Doing and Being (e.g., sustainable or respectful harvesting practices, respect for the land, waters and seasonal activities).

ASSESSMENT OPPORTUNITIES

Are students able to:

- Interact respectfully with the visiting Elder(s)?

CLOSING: NO VOICE PERSPECTIVE

Gather in a circle, outdoors if possible, once more. Use something (e.g., a mat, chair or small table with Caribou artifact or something to represent Caribou) to show that a space is being held in the circle for a non-human 'voice'.

Give students a piece of paper on which to draw or write. Invite students to consider what the **No Voice** perspective would share with the group at this time.

Tell students that the **No Voice** perspective is a way for humans to give a 'voice' to the entity being talked about, in this case Caribou. The **No Voice** perspective involves leaving an open seat for the entity to 'sit at the table' with those making decisions. This helps foster a sense of cooperation and unity between stakeholders at the table, because everyone is reminded that the common goal is to make the best decisions on behalf of the non-human beings in our care.

ASK STUDENTS

- We share the land with the SLC. What messages might they want to share with our community?
- What do the SLC need in order to stay healthy in the years to come?
- What questions would the SLC ask us if they could speak to us directly?
- If the Caribou could ask us to pause and pay attention, what would they say?

ASSESSMENT OPPORTUNITIES

Are students able to:

- Share a closing reflection from the **No Voice** perspective?

ADDITIONAL ACTIVITY: PORTRAITS OF CONNECTION

Reflecting on the connections raised through conversation as a class and with the visiting Elder, as well as the interconnections between humans, the land, water and Caribou, invite students to examine their own lives and how they are connected to Caribou. Encourage students to consider who in their family and community could have Caribou stories to share.

Students will be invited to interview and create a detailed portrait of two or three people in their lives, sharing the Caribou story from their perspective.

***Consider providing a list of community organizations students could approach to interview, keeping in mind that not all students may have (or be aware of) their own connections to Caribou.**

Some starting points for interview questions could be:

- Were you/your family impacted by the SLCRP?
- What is the significance of Caribou in your life?
- Do you remember when you first became aware of the importance of Caribou in your life?
- Who in your life has challenged you to consider the voice of Caribou?
- What would you like future generations to remember, when thinking about the SLC?

Decide as a class (or individually with each student) how students' portraits will be presented. These could be photographs or sketches, with detailed captions, written as mini biographies, or captured through audio recording or video clips.

PART 2: EXPLORING NATURAL SELECTION

LEARNING TARGET:

I am able to describe how microevolution and natural selection impact Caribou in the Southern Lakes.

MATERIALS

- **Natural Selection Worksheet printed (Appendix 4d)**
- **food/lichen (popsicle sticks, bean bags, spruce cones, rocks, paper pieces)**
- **Community Booklet (for your community)**

TIME: 30 MINUTES - 1 HOUR

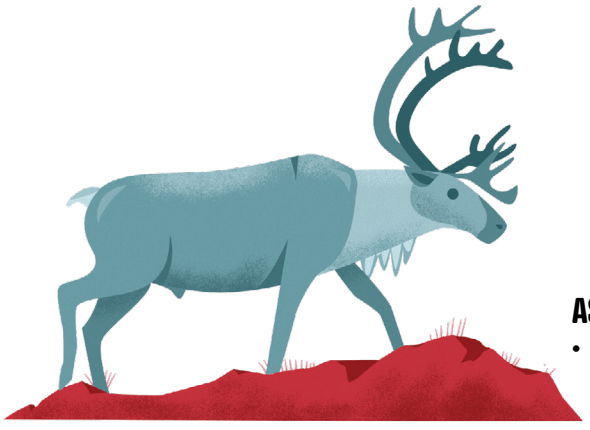
OPENING: INVESTIGATION MICROEVOLUTION

ASK STUDENTS

- What does microevolution mean? (change within a species that occurs over time in a population)
- Is a Caribou's environment connected to their behaviour and vice versa? (Evolution can be behavioural because it is shaped by the environment, leading to advantages. For example, one of the mountain Caribou's reproductive strategies is to spread out to avoid predators. Another example is the habitat use. Comparing mountain Caribou who move from highlands to lowlands and take advantage of ground lichens while southern mountain Caribou have evolved in higher snowfall areas, requiring them to depend on arboreal lichens.)
- How do physical changes relate to microevolution? (As a species, mountain Caribou...be examples in that they differ between the types of Caribou.)

Review the **main mechanisms** for microevolution (mutation, migration, genetic drift and natural selection). Brainstorm examples of each mechanism in relation to the SLC context.

- **Mutation:** some genes randomly mutated (however, any particular mutation is rare, and this process alone cannot account for a big change in genetics over one generation).
- **Migration:** some Caribou with gene X immigrated from another population, or some Caribou with gene Y emigrated.
- **Genetic drift:** when the Caribou reproduce, just by random luck more calves with gene X than gene Y ended up in the offspring.
- **Natural selection:** Caribou with gene X escaped predation and survived to reproduce more frequently than Caribou with gene Y, so that more of gene X reproduce into the next generation.
    - There is **variation in traits**. For example, some Caribou have large racks and some have smaller racks.
    - There is **differential reproduction**. Unlimited population growth is not supported within the environment, and so not all individuals get to reproduce to their full potential. For example, Caribou with larger racks are often able to reproduce more often.
    - There is **heredity**. Large racks have a genetic basis. This means that surviving Caribou with large racks have babies with a higher likelihood of having a large rack as well.
    - What does this mean? More advantageous traits, such as having a larger rack, allows these Caribou to have more offspring. This trait then becomes more common in the population. If this process continues, eventually, all individuals in the population will have big racks.



ASK STUDENTS

- Can you think of some evolutionary disadvantages to having a large set of antlers?

ACTIVITY: SELECTED NATURALLY

Students will take on the role of a population of foraging Caribou (Adapted from A Game of Selection[23]). Individuals will vary in their ability to move while foraging, and students will observe how the population evolves by natural selection as the game progresses.

- Inform students that they will be taking on the role of a population of foraging animals trying to feed on lichen (represented by popsicle sticks, spruce cones, coloured rocks or pieces of paper).
- Students will have one of three particular four legged movement patterns while foraging for lichen. The three movement patterns are:
    - **Freestylers:** can move freestyle on all fours
    - **Side-to-siders:** must move their right foot and hand in tandem, their left hand and foot in tandem
    - **Hoppers:** can only move by hopping forward on all fours while keeping hands together and feet together during the hop

SET UP

- Divide the students into these three movement types. Start the game with a very small number of freestylers. This allows you to suggest that freestyles are a new mutation in the population (and as such start out with low numbers). Students can observe the progression of this mutation through the population.
- Have the students line up along the edge of a designated game area (the size of the area used will depend on the number of students).
- Randomly distribute the pieces of lichen within the game area. Avoid large clumps of lichen. Distribute double the number of pieces of lichen as there are students.

GAME PLAY

- There are four generations (rounds) in the game. During a generation, students will have twenty seconds (the time may be adjusted depending on the size of the game area) to collect as much lichen as possible while moving in their four-legged movement pattern.
- Students that collect at least two pieces of lichen are able to gather enough food and survive. If students collect less than two pieces of lichen, they die and move to the side of the game area designated as the dead zone.
- Students that collect four or more pieces of lichen are able to reproduce. To reproduce, a student brings a "dead" participant from the dead zone back into the game. This newly born player inherits the same movement pattern as the player that reproduced. After reproduction, take a count of the different movement types (have students record this data in the Natural Selection worksheet in Appendix 4D)
- Repeat the process for the remaining three generations. Tally the number of each movement pattern at the end of each generation and record the data.

CLOSING: GRAPHING RESULTS

Have students graph the change in movement patterns within the population over the generations of the game.

ASK STUDENTS

- How are each of the key elements of natural selection (variation, selection and heredity) present in this game?
- How did the mutation move through the population?
- What were the findings from the data gathered? From each generation?

ASSESSMENT OPPORTUNITIES

Are students able to:

- Make inferences about Caribou microevolution (mechanism of natural selection) based on the graphing data from the Selected Naturally game?

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23 Kellogg Biological Station. Michigan State University. (2011). K-12 Partnership Lesson Plan: A Game of Selection… You Win or You Die. Exploring Evolution by Natural selection. https://kbsgk12project.kbs.msu.edu/wp-content/uploads/2015/10/A-game-of-selection-lesson-plan.pdf.

PART 3: WOLVES, CARIBOU AND PEOPLE: TRADITIONAL AND MODERN MONITORING TECHNIQUES

LEARNING TARGETS:

I am able to investigate and reflect on a variety of experiences, perspectives and worldviews regarding Southern Lakes Caribou monitoring.

I am able to use evidence-based arguments and scientific language to communicate a suggested course of action for the monitoring of the SLC.

MATERIALS

- **Community Booklet for your community**
- **Southern Lakes Caribou Monitoring Worksheet printed (Appendix 4E)**
- **Community Booklet (for your community)**

TIME: 30 MINUTES - 3 HOURS

OPENING: CLASS DISCUSSION

Tell students that they are going to be discussing the monitoring and management techniques for the Southern Lakes Caribou (SLC) in the Southern Lakes over the next five years.

ASK STUDENTS

- What are some examples of traditional Caribou stewardship? Does anyone know any of the Traditional Laws around Caribou harvest or monitoring?
- What are some examples of traditional **ägay/wolf** management practices? (impacts of predation)
- What are some modern ways in which Caribou and wolves are managed? (GPS collaring, taking samples to test for genetic diversity, disease, diet and aerial surveys)

In pairs or small groups, have students reflect on the following questions and record their group's answers:

- What questions do you have about monitoring techniques being used?
- What kind of data do you think should be collected on the SLC in order to make appropriate management decisions?
- How could **ägay/wolf** monitoring support Caribou management decisions in the Southern Lakes?
- Hypothesize why the SLC exhibit behavioural or movement pattern changes. What evidence could you gather to support your hypothesis? Why is seasonal movement behaviour important for us to understand when making decisions on behalf of the SLC?
- How might DNA research help scientists better understand evolution? Why is this important information to collect?

ACTIVITY: CONSIDERING CARIBOU ON THE LAND

Take students on a hike to an alpine area with a local Elder, Traditional Knowledge Holder or Game Guardian to a local patch of Caribou habitat near your community.

Give each student a clipboard with paper and a writing utensil. Allow students to pose the questions above to the Elders or visitors, and also to share some of their ideas and reflections as well.

At an appropriate time on the hike, allow students to find a spot to sit on their own for five to fifteen minutes of quiet, solo reflection and observation. Encourage students to leave paper, pencils and any technology behind. Prepare the students for this time with one of the following suggestions:

- Simply sit and let your mind wander as you observe the landscape and let the content settle in. What information/data do we need in order to be better stewards for the SLC?
- Imagine yourself transported back in time, five, ten, fifteen, one hundred years. Imagine what the landscape would look like. What would still be present 100 or more years ago? How do changes in the landscape influence the monitoring activities happening now and in the future?
- Consider the area from the perspective of a moving Caribou. Why is seasonal movement behaviour important for us to understand when making decisions on behalf of the SLC?
- Think about the impacts of geography, human features and habitat on Caribou movement. Why do you think Caribou may do things the way they do?

CLOSING: REFLECTING TOGETHER

Have students come back together in a circle to share their reflections.

One or more students can present the guest with a homemade card and gift (card or gift made by students or wild-harvested flowers) to show gratitude for the time and/or teachings shared with the students.

If an Elder or visitor is not present, ask the students if they know of any Elders or youth in their communities or lives that are important to them. Invite students to share any teachings they have learned about how to treat Caribou and how to act when out on the land in relation to Yukon First Nations ways of Knowing, Doing and Being (e.g., sustainable or respectful harvesting practices, respect for the land, waters and seasonal activities).

Give the students time to work individually or in small groups to use the information they have gathered from all sources to complete the SLC monitoring worksheet (Appendix 4E).

ASSESSMENT OPPORTUNITIES

Are students able to:

- Share a closing reflection/question/insight about their experience that demonstrates active listening?
- Acknowledge differing viewpoints respectfully?
- Explain their reasoning for the importance of and necessary continued use of monitoring techniques (traditional and/or modern)?

ASSESSMENT

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Formative and self-assessment opportunities are listed throughout the activity plans. The rubric below can be used or adapted as necessary for summative assessment. It may be used to assess the learning targets set out on the previous pages.

ASSESSMENT FRAMEWORK	1 EMERGING	2 DEVELOPING	3 PROFICIENT	4 EXTENDING
PART 1: I am able to integrate Yukon First Nations and Western scientific understandings of interrelationships between Caribou and the Southern Lakes ecosystem.	Not yet able to use Yukon First Nations or Western scientific understandings to address interrelationships	Initial comprehension of Yukon First Nations and/or Western scientific understandings of interrelationships	Uses Yukon First Nations and Western scientific understandings to discuss interrelationships between Caribou and the Southern Lakes ecosystem. Able to respond with the **No Voice** perspective	Uses Yukon First Nations and Western scientific understandings to discuss interrelationships between Caribou and the Southern Lakes ecosystem. Able to respond thoughtfully with the **No Voice** perspective
PART 2: I am able to describe how microevolution and natural selection impact Caribou in the Southern Lakes.	Not yet able to use microevolution or natural selection to infer impacts on SLC	Uses microevolution or natural selection knowledge to infer impacts on SLC	Uses microevolution and natural selection knowledge to infer impacts on SLC	Uses microevolution and natural selection knowledge to infer impacts on SLC and provides detailed explanations
PART 3: I am able to investigate and reflect on a variety of experiences, perspectives and worldviews regarding SLC monitoring.	Some comments on either experiences, perspectives or worldviews. Connections do not directly address the monitoring of the SLC	Includes a variety of experiences, perspectives, and worldviews that connect partially to the monitoring of the SLC	Includes a variety of experiences, perspectives, and worldviews that connect directly to the monitoring of the SLC	Includes a variety of thoughtful and complex experiences, perspectives, worldviews, and adds additional resources outside of the classroom
PART 4: I am able to use evidence-based arguments and scientific language to communicate a suggested course of action for the monitoring of the SLC.	Unable to propose actions focused on the monitoring of SLC. Does not use evidence-based arguments or scientific language	Proposes some actions focused on the monitoring of SLC. Uses some evidence-based arguments or scientific language	Proposes relevant actions focused on the monitoring of SLC. Uses evidence-based arguments and scientific language	Propose multiple and/or complex actions focused on the monitoring of SLC. Uses evidence-based arguments and scientific language fluently

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ARTIFACTS

Appendix 1B

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CARIBOU

LICHEN

CARIBOU HIDE

TENDON USED FOR SEWING

SNARE

CARIBOU HAIR/
TUFTING

ARTIFACTS

Appendix 2C

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CARIBOU SKIN PARKA

SNOWSHOE BABICHE

ICE PATCHES

TRADITIONAL TOOLS

NATURAL SELECTION WORKSHEET

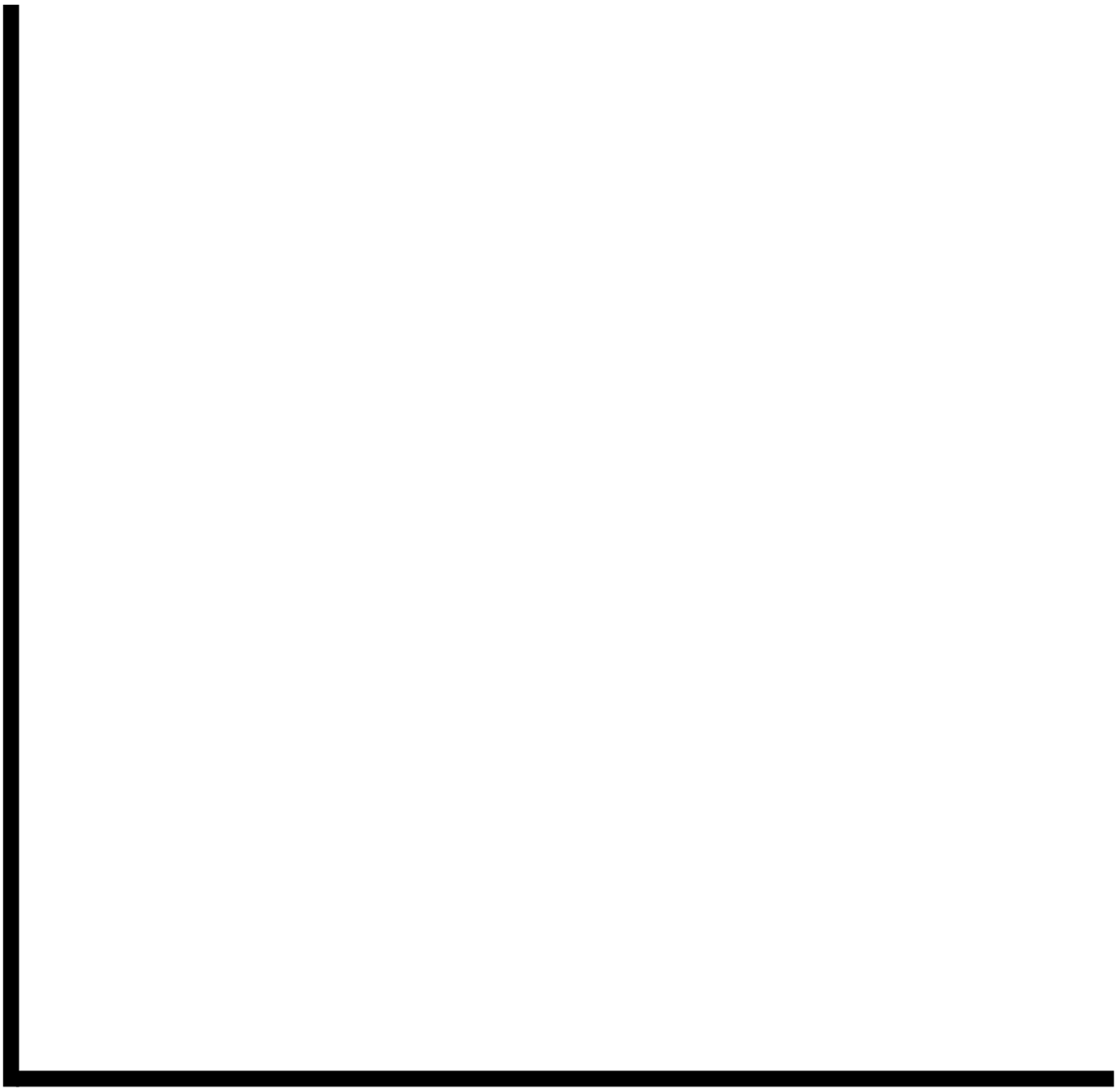
Appendix 4D

Name: _____ **Date:** _____

1. Fill in this table as you complete each generation (round) of the game.

Generation	Freestylers	Side-to-siders	Hoppers
0			
1			
2			
3			
4			

2. Using the table above plot the frequency of the three types of movement across the generations. Be sure to properly label each axis.



SOUTHERN LAKES CARIBOU MONITORING TABLE

Appendix 4E

Name: _____ Date: _____

Based on the data you have collected from Elders, Traditional Knowledge Holders, community members, visitors and additional research, use the table below to recommend five actions that should be taken to successfully monitor the Southern Lakes Caribou over the next five years. Be sure to explain your reasoning by citing evidence gathered from any of the sources listed above.

Suggested Monitoring Action	Evidence Based Reasoning