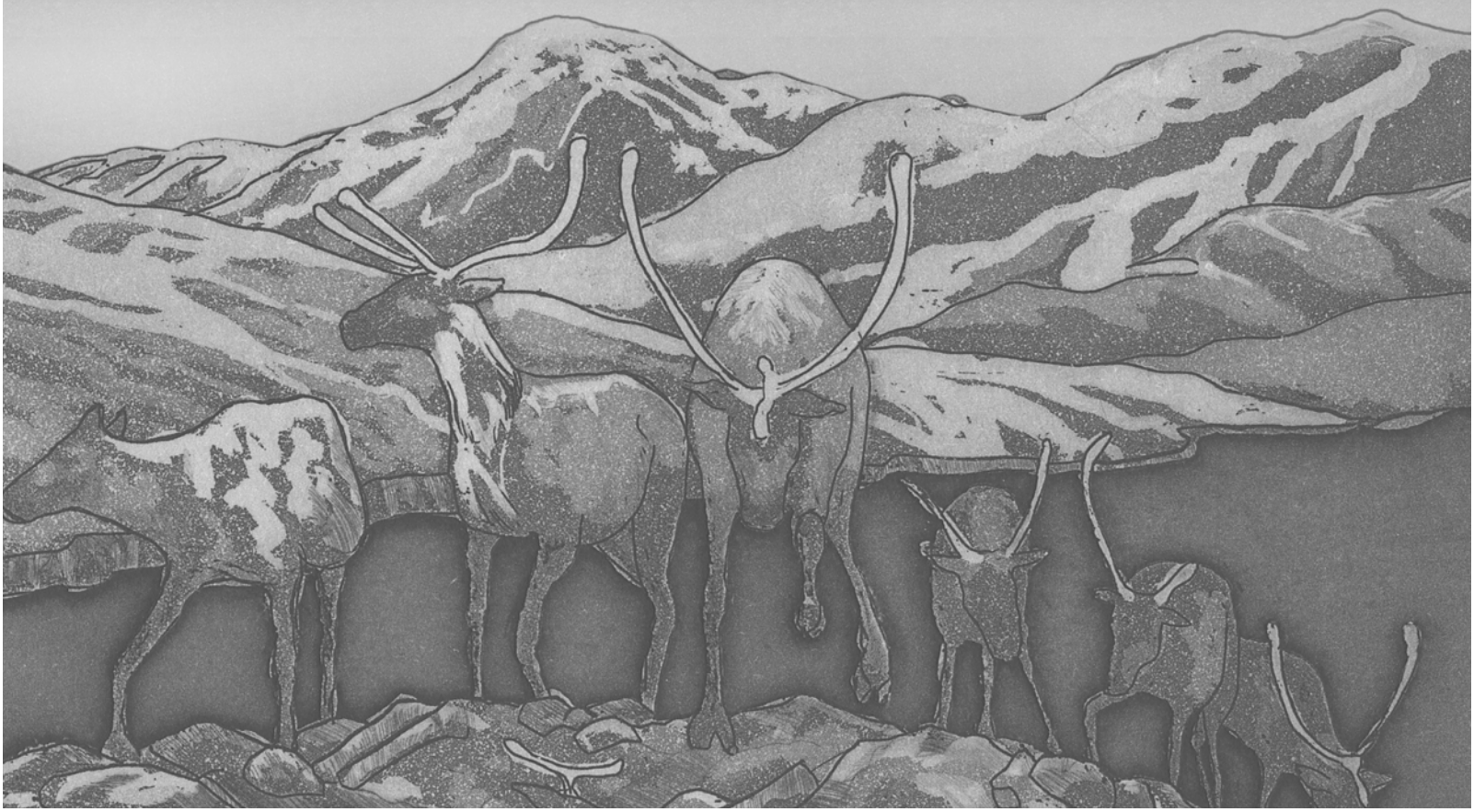
An Educator's Guide to Wild Caribou of North America

Project Caribou



Environmental Education and Youth Programs
Government of Yukon, Department of Environment
Conservation Officer Services
Box 2703, Whitehorse, Yukon Y1A 2C6
(867) 667-3675 or 1-800-661-0408
fax (867) 393-6206
envirowild@gov.yk.ca

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Doug Urquhart (illustrations)
3, 20, 26, 27, 29, 31, 34, 36, 42, 53, 63, 68, 75, 84, 98, 121

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Tanya Handley (illustrations)
vii, 37, 40, 43, 102, 103

Jennifer Staniforth (illustrations)
4, 5, 10, 63

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132

Joyce Majiski
Cover, i

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Project manager:

Remy Rodden, Government of Yukon, Department of Environment

Consultants:

Darielle Talarico, Arctic Vision, Whitehorse, Yukon

Principal writer:

Kirsten Madsen, Whitehorse, Yukon

Original illustrations:

Jennifer Staniforth, Doug Urquhart, Tanya Handley
Cover: Joyce Majiski

Editing and production:

Walker LeBrun Creative Services, Whitehorse, Yukon
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Vanessa Stewart
Michal Wojcik

Department of Education
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May Gudmundson
Linda Hamilton
Elaine McLeod
Cathy Harrison
Colleen O'Brien
Eleonor O'Donovan
Vern Peters
Janet McDonald
Trevor Ratcliff
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Joan Eamer
Don Russell
Debbie van de Wetering

Canadian Heritage
Brent Liddle
Margret Njootli

Other
Margeurite Kuiack
Kirsten Madsen
Joyce Majiski
Jill Pangman
Sharon Russell
Darielle Talarico
Doug Urquhart

Northwest Territories

Department of Environment and Natural Resources
Anne Gunn
Brenda Hans
Nic Larter
John Nagy
Rosanna Strong
Alasdair Veitch
Jan Adamczewski
Bruno Croft
Kerri Garner

Nunavut

Department of Environment
Mike Ferguson
Elise Maltin

Newfoundland & Labrador

Department of Fisheries and Land Resources
Ralph Jarvis
Lucy O'Driscoll

Ontario

Ministry of Natural Resources and Forestry
Ted Armstrong
Barrie Martin
Tom Purdy

Other
Sue Gesner

Quebec

Department of Natural Resources and Wildlife
Diane Ostiguy
Christine Robitaille
Martin Hugues St-Laurent

Université Laval
Steeve Côté

Nova Scotia

Department of Natural Resources
Julie Towers

Saskatchewan

Ministry of Environment
Lizabeth Nicholls
Tim Trottier

Manitoba

Manitoba Conservation
Cam Elliott
Michael Goodyear

Other
Ryan Brook

Alaska

Department of Fish and Game
Robin Dublin
Meghan Nedwick
Jennifer Dau

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Using this resource

You, the teacher and learner, are the best judge of how to use this book. In this section we'd like to point out the features and general layout, so that you can best decide how it will be of use in your particular context.

The "All About Caribou" section contains basic, factual background information on caribou in North America, including information on basic biology, ecosystem interactions, and management and protection issues. This is the section to which you and your students may refer for an overview of specific or general topics. Basic research can be done using this section.

The "Activities" section presents 16 activities that cover several different caribou topics and reflect a range of teaching methods and target age/grade levels. The layout is based on the *Project WILD* model, so you may be familiar with it. If not, note that each activity includes a sidebar identifying the age, subject, skills that are addressed, as well as its setting and duration. If the activity does not directly target your grade level, please make adaptations; in fact, we offer suggestions as to how you might modify the activity for a lower or higher age level.

The "Case Studies" section offers in-depth information about a number of North American caribou herds. You may wish to compare different herds, so each case study is presented in a standard format.

The "Appendices" consist of two helpful references: the "Conceptual Framework" that guided the development of **Project Caribou** and gives a sense of what caribou experts feel is important for all learners to understand, and a glossary of terms used in this guide.

Various options in the "Cross-referencing Index" allow you to access portions of the text in different ways.

Preface to first edition

Caribou touch us in many ways, some of which we may not even be aware. Canadians daily see the image of the caribou on the 25-cent coin. Santa's reindeer are an indelible part of Christmas for millions of North Americans. Many First Nation groups depend on caribou as a staple food source. Images of the huge northern herds remind us of our last true wilderness areas. Caribou are an inescapable part of our cultural landscape, and somehow we all share a deep-rooted respect for this incredible animal.

Project Caribou was conceived in recognition of the importance of *Rangifer tarandus*. Many biologists now view caribou as an indicator species for ecosystem health in the North. If caribou populations are faltering, it means that we should be on the lookout for changes in other aspects of the environment as well.

Project Caribou is the result of the efforts of a group of dedicated individuals who believe a well-informed populace – beginning with teachers and school-age children – is vital to the long-term survival of caribou and their habitat. These individuals collectively spent a considerable amount of time on this learning resource. The work was carried out in addition to their regular heavy workloads and, in many cases, without pay. They are true champions for the natural environment. Please refer to the Acknowledgments page for a list of contributors.

Our goal was to produce a learning package general enough for use in any context, yet with specific case study information to meet specific regional needs. It is also a dynamic resource to be supplemented, adapted and updated for years to come.

It must be acknowledged that many wonderful learning packages on caribou have preceded this one, most notably those produced by the Beverly and Qamanirjuaq and Porcupine Caribou Management boards. **Project Caribou** is seen as a way of building and complementing existing resources and making caribou education available to a wider audience.

We hope through the use of **Project Caribou** that you will pick up some of the infectious enthusiasm for caribou that is shared by those who have put this package together. After all, the caribou's future is deeply linked with our own.

Remy Rodden
Manager, Environmental Education and Youth Programs
Government of Yukon, Department of Environment

Most of the activities in this book are the result of a two-day writing workshop held concurrently with the 8th Annual North American Caribou Conference in Whitehorse in 1998. Biologists, teachers, wildlife educators and others came together to learn about caribou and generate activity ideas – a very stimulating creative process. Special thanks to all those who participated!

Preface to second edition

Welcome to the updated edition of **Project Caribou**. Since the first edition was published in 2001, we have become even more aware of this keystone species and its importance in northern ecosystems. If caribou truly are an “indicator” species that give us an idea of ecosystem health, then perhaps we have reason for concern: almost all of our wild caribou populations have declined in the past years. The tundra herds seem to be particularly affected, and these animals are tremendously important for the people of the North. Traditional lifestyles are threatened.

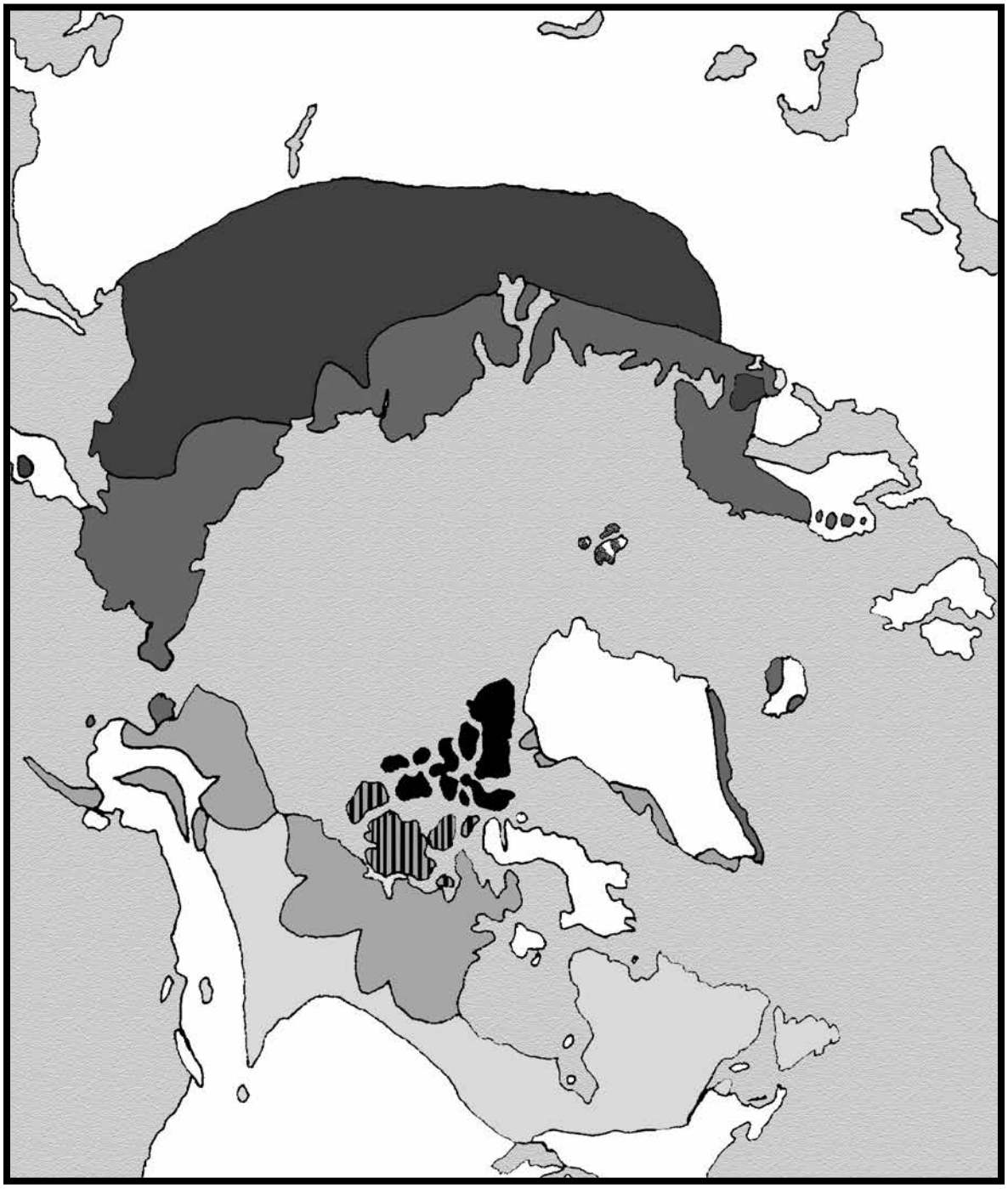
Now more than ever, learning resources like **Project Caribou** can help us understand and act for caribou and the environment that supports us all. There seems to be a public thirst for knowledge and considerable concern about caribou. Activities and information from this resource have been borrowed and adapted for use in national parks, wildlife agencies and management boards around the continent. The resource has been translated into French by the Government of Quebec, and elements are being converted into Inuktitut, the official Inuit language of Nunavut.

Please use this resource! And long live the caribou!

Remy Rodden
Manager, Environmental Education and Youth Programs
Government of Yukon, Department of Environment

This edition is dedicated to Doug Urquhart (1947–2015).

Areas occupied by Caribou subspecies



= Peary caribou

= Barren-ground caribou

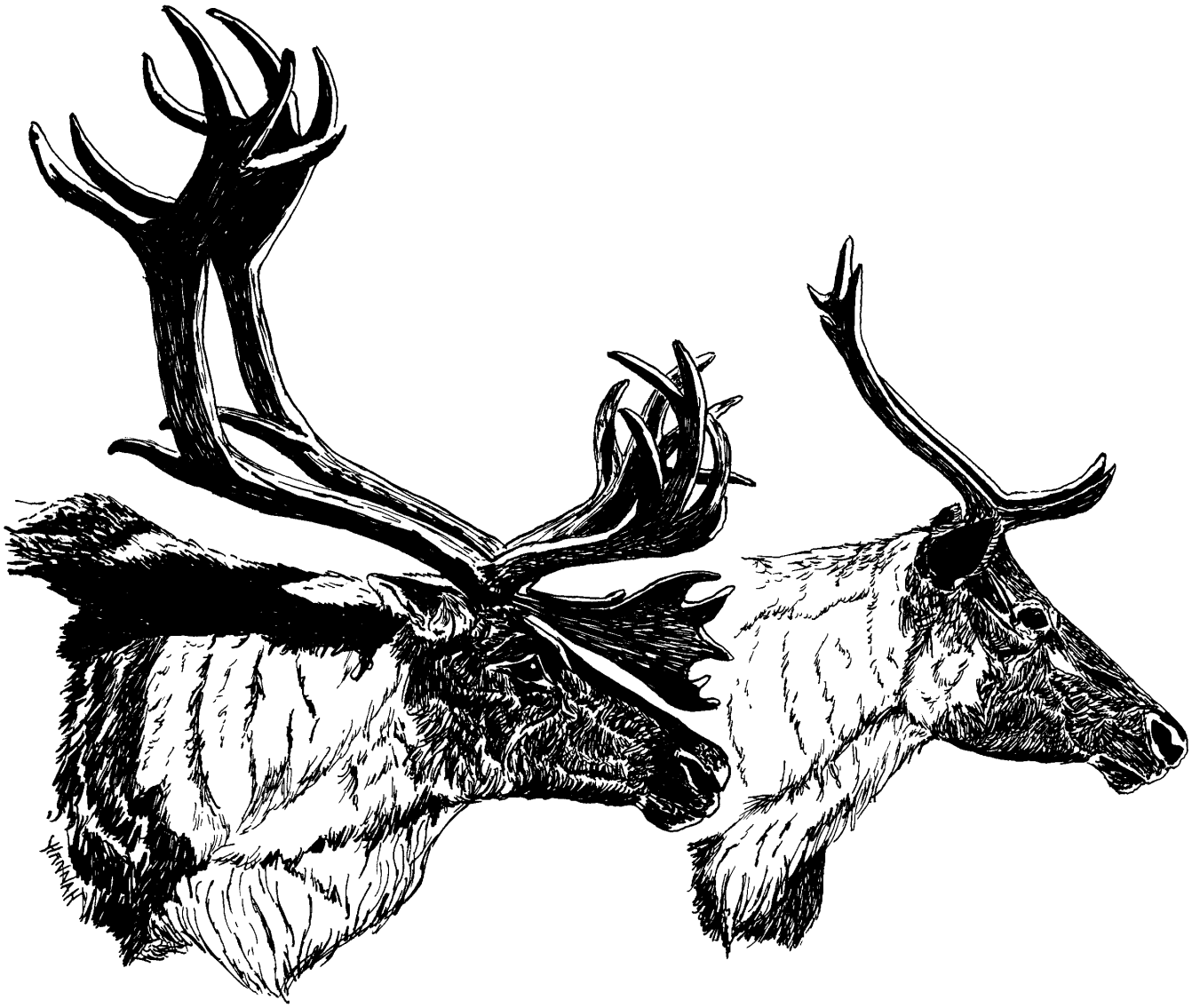
= Woodland caribou

= Reindeer, both wild and domestic

= Wild forest reindeer

= Svalbard reindeer

All about caribou



What's in a name?

The most common names for this animal are "caribou" in North America and "reindeer" in Europe. The word caribou originates from the early French explorers who likely converted the Mi'kmaq word *xaibu*, which means "pawer" or "shoveller," to describe the species. European arctic explorers never adopted the Inuktitut word for caribou, *tuktu*, but preferred in their journals to use the term "the deer" as a short form of reindeer. The word reindeer comes from the Lapland language where the word *reino* means young reindeer. Other terms date back to 1500 C.E. in French as *rangier* and *rangifere*.

Caribou and you

Have you seen any caribou recently? Try looking in your pocket or in your wallet. That's a caribou, right there on the Canadian quarter. The caribou is an animal that is a part of ecosystems all the way around the northern part of the globe. It is an important part of circumpolar biodiversity.

Caribou mean different things to different people. For many northern Indigenous groups, caribou represent a living part of a cultural heritage that goes back for centuries. What do caribou mean to you? This guide is intended to help you answer that question by learning more about this amazing animal.

Female and male barren-ground caribou

Origins of Caribou

The caribou is an ancient relative of the deer that may have originated in northeastern Asia or northwestern North America. The earliest fossils of caribou date back 1.5 million years and were found at Fort Selkirk, Yukon. During the last ice age, when most of North America was covered by thick sheets of ice, parts of what is now the Yukon and Alaska remained ice-free. This refuge, or *refugium*, was called Beringia. The animals and plants that lived here escaped the glacial onslaught. Caribou were present at the time of Beringia and ranged the same areas as the woolly mammoth, steppe bison, camel and giant beaver. Many of these exotic animals did not outlast the cold climate, but some of the Beringian animals that did survive include caribou, moose, muskox and grizzly bears.

Caribou and other members of the deer family belong to a group of animals called ungulates. The word "ungulate" comes from the Latin word for hoof. There are two orders of ungulates: *Perissodactyls*, like elephants and horses, have an odd number of toes; *Artiodactyls*, including caribou, elk and bison, have an even number of toes. Caribou, moose, elk, mule deer and white-tailed deer all belong to the order *Artiodactyla* and to the deer family, *Cervidae*.

All caribou belong to the same genus and species. They share the name *Rangifer tarandus*. There are five subspecies of caribou in North America and four others in Eurasia. In Eurasia, the species are called reindeer, and they may be wild, semi-domestic or domestic. In North America, the species are called caribou. In North America these subspecies are:

Rangifer tarandus tarandus: tundra reindeer brought to North America from Eurasia. Although some have escaped into the wild these are primarily semi-domestic in nature.

Rangifer tarandus groenlandicus: barren-ground caribou.

Rangifer tarandus caribou: woodland or mountain caribou.

Rangifer tarandus pearyi: Peary caribou, which live on Arctic Islands.

Rangifer tarandus granti: Grant's caribou, which live in Alaska and the northern Yukon. The Porcupine Herd belongs to this subspecies.

The wild caribou of North America are generally identified as being either "woodland" or "barren-ground" caribou. Woodland caribou are generally heavier and larger than barren-ground caribou. They are found south of the Arctic Circle. Barren-ground caribou migrate the longest distances between their winter and summer ranges.

Family Ties

Caribou Taxonomic Chart

A taxonomic chart illustrates the position of caribou in the overall classification of organisms. Each level in the chart contains species that share the same anatomical and morphological characteristics.

Kingdom

Animalia

Phylum

Chordata

Class

Mammalia

Order

Artiodactyla
(Even-toed ungulates)

Suborder

Ruminantia
(Cud-chewers)

Family

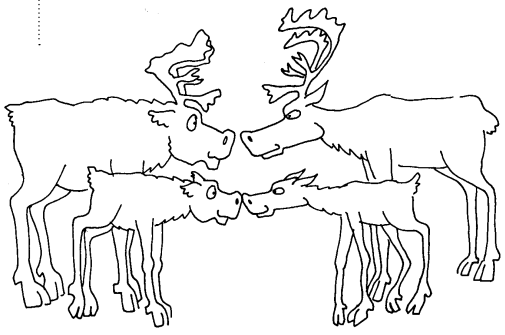
Cervidae

Genus

Rangifer

Species

Tarandus



Woodland (left) and barren-ground caribou

Adapted for northern living

Woodland caribou, Southern Lakes caribou herd, Yukon

Caribou were living in North America during the last few ice ages. Caribou have evolved over a million years of glacial-influenced climates. Thus, caribou have developed adaptations allowing them to thrive in landscapes covered in snow and cold temperatures.

Caribou can truly be called “chionophiles,” a word that means snow-loving animals.

Caribou have physical and behavioural characteristics that help them survive cold winter environments. Their shape, for example, plays a role in keeping them warm. Caribou have compact bodies, small tails and short ears. These features reduce surface area and thus the amount of heat that can be lost through the skin. In contrast, the arctic fox also has similar adaptations to survive in the cold. The red fox living in southern and warmer regions have a less compact body, a longer tail, and larger ears for better thermoregulation.

Caribou hoof

Caribou further regulate their body temperature through their short, thick muzzles (the part of the head that includes the nose and mouth). The muzzle acts as a heat exchanger, warming and cooling air to reduce heat and moisture loss as the caribou breathe in and out.

To keep the heat in, caribou have two layers of fur covering their bodies, ears and muzzles. They have fine, crinkly underfur and a thick coat of guard hairs on top. The guard hairs are hollow. The air in this hollow hair act as insulation; keeping in the caribou’s body heat. The hollow, buoyant hair and large flexible feet of the caribou also make them excellent swimmers. Many caribou herds cross wide stretches of open or fast-moving water during their migrations.

The hair that covers the body of the caribou is called the “pelage.” The pelage varies in colour throughout the year and is darkest in the summer. Peary caribou are the lightest in colour, nearly white, while woodland caribou are dark brown.

Summer may be the most difficult season of the year for caribou. At this time, they go to alpine snow patches to cool off and to escape the insects that torment them. Barren-ground caribou search out windy areas on the coastal plain for the same reasons.

The hooves of caribou are large and wide. They work in the same way as snowshoes to help the caribou travel over the snow with less effort. Caribou have two small toes called "dew claws" and two large, crescent-shaped toes that support most of their weight. In the winter, the fleshy pads on these toes grow longer and form a tough, hornlike rim. Caribou use these large, sharp-edged hooves to dig through the snow and uncover the lichens that sustain them in winter months. Biologists call this activity "cratering" because of the crater-like cavity the caribou's hooves leave in the snow.

An antlered animal

Caribou are the only members of the deer family whose females as well as males grow antlers. There is so much variation in the way the antlers grow that no two antlers are ever the same, even on the same animal. The antlers of female and young male caribou are smaller and simpler than those of mature bull caribou. Sometimes females do not grow antlers at all.

Caribou shed their antlers every year. Antlers reach their maximum size when the caribou are four or five years old. Scientists have separated barren-ground caribou from woodland caribou based on the cross-section of their antlers. When cut crosswise, the woodland caribou antler is round while the barren-ground antler is compressed.

Antlers grow from two permanent bony stumps on the caribou's head called "pedicles." A special layer of fuzzy, hairy skin called "velvet" covers antlers when they are growing. This skin contains a network of blood vessels that deposit the minerals necessary to build the antlers. Growing antlers are fragile and sensitive. It takes three to six months to grow antlers.

Antlers have grown to their full size and become hard by the time fall arrives. The blood supply to them is cut off as the bone becomes denser. Bull caribou rub their antlers on trees and shrubs, peeling the velvet off in strips. Bulls use their antlers to challenge and threaten other bulls for mating opportunities with cows during the rut, or breeding season.

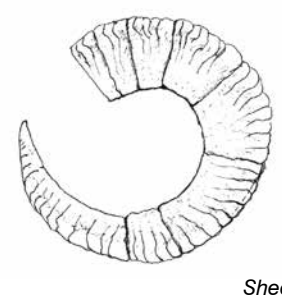
Males and females grow antlers at different times. Male barren-ground caribou start growing antlers in March and have a complete set ready for the rut in October. Bull caribou shed their antlers in the fall, after the rut, when hormone levels decrease. Female antler growth is controlled by hormone levels, but generally occurs in May or June. Young females and non-pregnant females generally grow antlers earlier; with pregnant females starting to grow antlers about two weeks after giving birth. They use their antlers to defend their feeding areas (craters in the snow) from

Antler or horn?

Caribou, elk and deer have antlers. Goats, sheep and cattle have horns.

Antlers are generally only grown by males, with caribou being the exception to the rule. Antlers are made from bone that grows faster than any other kind of bone. An antler can grow up to one inch a day in the summer! The antlers of older animals are usually more elaborately branched, but the number of points does not signify the age of the animal.

In contrast, horns are permanent and grow slowly larger each year. Horns are not branched like antlers, and they usually grow in yearly 'rings' from which the animal's age can be counted. Horns are made of keratin, which is the same material that your fingernails are made of. Usually both sexes of animals grow horns.



Sheep horn

Caribou antler

the larger but antler-less males. Cows need high-quality food to nourish growing fetuses or young calves.

Caribou behaviour

Making 'sense' of the world

Like other animals, caribou rely on their senses to help them find food, avoid danger and recognize other animals. Caribou rely mostly on their keen sense of smell. They can use their noses to find food plants located deep under the snow. A cow caribou can recognize her own calf by its individual smell, even in a large herd of jostling caribou.

Sight and sound are less important senses for caribou when assessing danger. Sometimes caribou appear not to be disturbed by people who are standing still. However, caribou are very good at detecting movement, even in poor light. Their eyes are large and are located on the sides of their heads so they can see a wide range of what's around them.

Caribou are more curious than other North American deer species. If they haven't been able to verify something as having the scent of danger, they will often move closer to investigate it. People who are downwind of caribou have been able to entice the curious creatures by making odd movements and postures. But if the wind changes, wary caribou will flee to safer ground!

The caribou herd

Caribou need to be able to do two things at once: they need to eat, and they need to keep watch for predators. Like many other animals, caribou fill this need by gathering in herds. When caribou are in a group, several animals will be looking up and around while others are eating. They sniff

Porcupine caribou herd on summer range

the air regularly and can recognize predators by scent. They can alert other caribou to danger.

Barren-ground caribou form different kinds of herds at different times of the year. Prior to calving, pregnant cows will band together in small groups called "maternity bands." After the young are born, the mothers and calves may form "nursery bands." Larger and larger groups of caribou may move together through the summer as a strategy to reduce harassment by insects. When cool August nights mean fewer insects, these large groups break up and animals wander in smaller groups until fall. By early September larger groups again start to form and continue through fall migration. In winter, bull caribou may avoid groups of cow caribou and their calves, because they know that predators like wolves are drawn to the vulnerable young caribou. Also, they may be challenged for feeding territories by cow caribou, which still have their antlers.

There are other advantages to travelling in herds. By travelling together to calving grounds in large groups, pregnant cow caribou in the barren-ground herds reduce the risk of predators killing their calves by sharing the risk with thousands of others. As well, the animals in the centre of the herd are better protected from predators, who may attack unprotected animals or stragglers. In the same way, forming a tightly knit herd may help caribou protect themselves from aggravating clouds of insects.

Woodland caribou are much more solitary. Prior to calving, pregnant cows may separate to give birth and raise their calves in secluded patches of forest. Caribou are most scattered across the range in summer. They do, however, band together in the fall when males are courting females, especially just before winter. Cows, calves and teenage caribou of both sexes travel in small bands throughout the winter, while mature bulls separate until late winter when, for a very brief time, most members of the herd gather together in search of the fresh green plants that appear where the snow has melted.

Woodland caribou, Southern Lakes caribou herd, Yukon

Caribou communication

While caribou occasionally snort, grunt, pant and bellow, they are generally silent animals. The most common sound associated with caribou is a curious clicking noise. This clicking sound is produced when caribou walk. It is caused by tendons slipping over bones in the feet. Some Indigenous groups imitated in their ceremonial dances the sound of the caribou clicking. They used decorative rattles made of hollowed, dried hooves strung together.

When an unknown entity appears on the horizon, caribou will try to identify it using their sense of smell. It they can't smell anything, they will circle downwind of the entity to pick up the scent. They move in a trot, keeping their tails up and their heads held high to test the wind for smells.

If they become alarmed, caribou will sometimes rear up on their hind legs and bound forward. This is called an "excitation leap." While doing this, they deposit a scent from a gland (the tarsal gland) between their toes. This scent, left on the ground, will warn other caribou passing over that spot.

Mother caribou communicate with their calves in several ways. A mother will teach her calf to follow her by using a technique called head-bobbing. She lowers her head to the ground and bobs it up and down when danger is near. If she becomes alarmed, she may push and nudge the calf to make it run, and she may encourage it with grunts. Or she may teach the calf to lie down, and then attempt to 'lead' the predator away, like mother ducks that feign a broken wing. By watching their mothers, calves learn the proper responses to danger. The calves' behaviours are reinforced by the rest of the herd.

Caribou and calf (Porcupine caribou herd)

Caribou habitat

All animals, including humans, have basic needs. They need food, water, shelter, space and to reproduce. The animal must be able to circulate freely from one place (summer range) to the other (winter range). An area in which all these needs are met for caribou is called the caribou's "habitat." It is the place where the caribou lives.

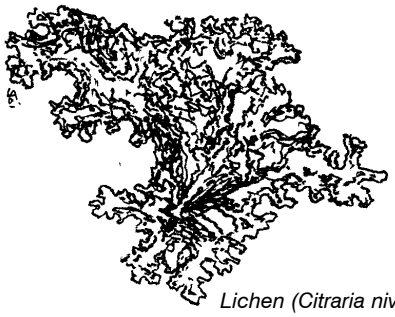
Some areas are more important than others for the survival of caribou herds; these are called "key habitats." Caribou need access to winter ranges with good snow conditions where they can find food. They need safe places to give birth to their calves and areas where they can find relief from insects during the summer.

Because caribou are often on the move, they can be versatile in their feeding habits and eat plants from a variety of habitats.

Caribou share their habitats with an astonishing variety of creatures. They are all part of the ecosystem, and support and sustain themselves to mutual benefit. A naturally functioning ecosystem is more than a food chain. Predators chase caribou, and so do tiny insects, whose larvae grow inside a caribou host. Caribou scour the tundra and forest floors to devour lichen, but their travelling hooves help other plants spread and take root elsewhere. Their fecal pellets return nutrients to feed such things as mosquito larvae in wet areas and plants.

Caribou, Porcupine caribou herd

Willow (Salix sp.)



Lichen (Citraria nivalis)

Dwarf birch (Betula glandulosa)

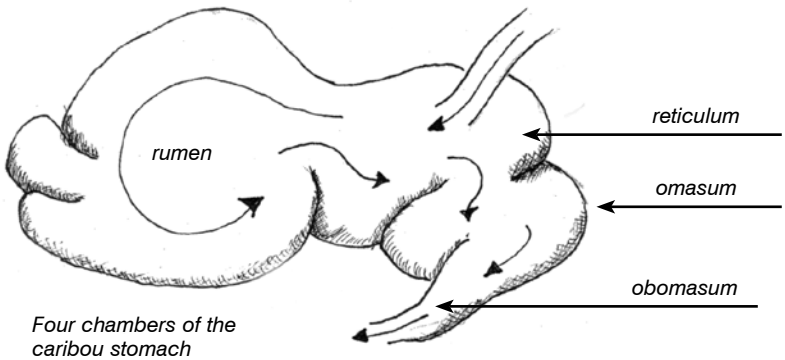
Cotton grass (Eriophorum scheuchzeri)

What do caribou eat?

Caribou are "herbivores," or plant-eating animals. The average caribou eats at least three kilograms of vegetation each day – the equivalent of about two garbage bags of food! Caribou eat different types of plants during the year, but their most important food is lichen. "Fruticose" ground lichens are the most significant. Famous among these is "reindeer lichen," called *Cladina rangiferina*. In winter, when green vegetation is not available, caribou depend on the lichens they find beneath the snow. In boreal forests, caribou will eat lichens growing on the ground or on trees. Caribou will also eat winter green plants like lingonberry (low-bush cranberry sedges, *Vaccinium*) and horsetails (*Equisetum*).

In summer there is a wider variety of food available for caribou. They munch on summer greens like grasses, sedges and dwarf willow or birch leaves. Peary caribou, which live on islands in the Arctic Ocean, enjoy the protein-rich flowers of purple saxifrage (*Saxifraga oppositifolia*) and lousewort (*Pedicularis* sp.). Caribou continue to eat these plants for as long as they can during the short northern growing season. When fall arrives, they return to eating lichens, as well as mushrooms if they are available.

Caribou are cud-chewing animals, like cows or moose. These animals chew their food, swallow it, regurgitate it and chew it again. Their stomachs are separated into four chambers to help break down food. Food enters the first chamber of the stomach, called the "rumen," while the caribou is grazing. Bacteria in the rumen break down the plant material until the caribou is at rest in a safe place. Then the caribou "ruminates," or further grinds the food. The food is regurgitated in small portions, called "cud," and chewed by the caribou until it is reduced to pulp. The food then goes into the second and third stomachs, the "reticulum" and "omasum," where most of the water is removed from it. The fourth and final stomach chamber is the "abomasum," which is most similar to the human stomach. Here, food nutrients begin to be absorbed into the blood.



Four chambers of the caribou stomach

Liking lichens

Lichens are the colourful, crusty plants that cling to alpine rocks. They are also the wire-like tangles and many-branched clumps covering tundra boulders, rock outcrops and sandy forest floors. They are also the long dry green strings, or "old man's beard," that hang from trees in boreal forests. There are over two thousand kinds of lichens, and while these dry plants may not appear delicious to you they are a primary food source for caribou.

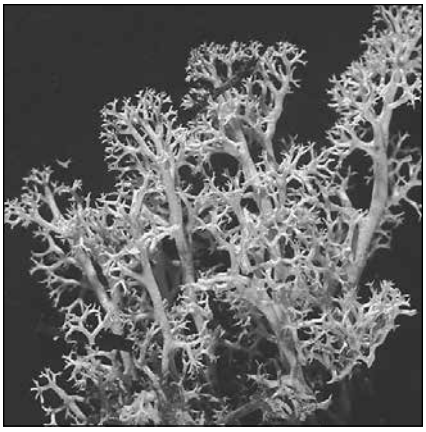
Lichens are made up of two kinds of plants – algae and fungi – that live together in a mutually beneficial, or symbiotic, relationship. Algae contain chlorophyll, which produces sugars and starches through the process of photosynthesis. Fungi are able to store lots of water to support the algae, in return absorbing the sugars and starches produced by the algae.

Lichens come in many shapes and sizes. They do not have roots, stems, leaves or flowers. There are three main groups of lichens. "Crustose" lichens are flat lichens that often attach themselves to rocks. "Foliose" lichens have a leaflike form. "Fruticose" lichens are tufted, or composed of erect stalks.

Lichens need water to grow. They act like sponges, absorbing moisture from the air, rain and snowmelt. When there is no moisture available, lichens dry out and become dormant. In the north, the season when lichens can grow is very short. Thus, even small-sized lichens can be decades or centuries old.

Lichens have been used by humans to dye cloth, ferment beer and set fragrances in perfume. They have also been used in medicated lotions and toothpaste. Lichens can also be used to monitor air pollution. Because they live for many years and absorb particles from air and water, lichens can contain high concentrations of chemicals and even radioactive fallout, carried in pollution from around the world.

Caribou need to eat 2 garbage bags full each day!



Reindeer moss (Cladina mitis) is an important lichen for woodland caribou.

The places where caribou dig for ground lichens are called "craters."

Grizzly bears and wolves are the major predators of caribou.

Natural threats to caribou

Caribou predators

Predators are animals that kill and feed on other animals. Though these predators are often considered to be harmful to caribou, they benefit the herd by removing the diseased and old individuals, making the caribou population stronger. Caribou are a source of food for several northern predators as well as for humans.

Wolves

Apart from humans, wolves are the major predators of most caribou herds. During the winter wolves hunt in packs, which are usually made up of seven to nine wolves. An average wolf pack will kill a caribou every few days in the winter. They will spend a day or less feeding on the carcass, since what's left of the carcass freezes into solid ice.

The wolf pack may "test" a herd of caribou by chasing them and watching for weaker animals that fall behind or are careless. They will then pursue and kill these animals. Wolves will also ambush caribou on trails between lakes, attempting to cut them off from the rest of the herd or to chase them into deep, soft snow.

Wolves usually attack the caribou's head, neck or shoulders. They will try to push the caribou off its feet, or hang with their teeth clenched in the caribou's muzzle or throat. A wolf's jaws can crush the skull of a calf.

Caribou respond to attacks by wolves by trying to outrun them. Where natural cover such as boulder-strewn terrain, ravines and forest occur, caribou will scatter to confuse the wolves. On frozen lakes and in large forest openings they will bunch together to find safety in numbers. If they are cornered, caribou have little means of defence and are usually killed. Bull caribou are especially vulnerable to attacks by wolves and other predators during the rut season, when they are exhausted and distracted.

Bears

Bears are major predators of newborn caribou calves on some calving grounds, and they may gather in places where calving activity is concentrated. Bears are omnivores, which means they will eat a variety of foods including plants, berries, insects and meat. When caribou migrate through a bear's territory, the opportunistic bear may try for some fresh meat, perhaps killing a bull caribou that is exhausted from the rut season. A bear may scavenge the carcasses of caribou killed by wolves or other predators. The two types of bears that feed on caribou are grizzly and black bear.

Golden eagles

The largest of the birds of prey, the golden eagle is an efficient and capable hunter. Where golden eagles are common, they will prey on newborn caribou calves, swooping down with talons outstretched to kill the young animals.

Wolverines

Wolverines are compact animals with strong teeth and jaws and neck muscles that enable them to crush bones and tear at frozen flesh. They will often scavenge caribou that have been killed by bears or wolves but are also capable of killing newborn calves and sick or dying caribou.

Other scavengers

Many other animals in the northern ecosystem take advantage of caribou that have been killed. Lynx and foxes will prey on newborn caribou and also scavenge carcasses, as will birds such as eagles, hawks, ravens, owls, gulls, jaegers, jays, woodpeckers and chickadees. These and other animals are opportunistic predators. They take advantage of circumstances that allow them to overcome prey that would normally escape.

Tiny attackers: insects and parasites

There are other, much smaller members of the caribou's habitat that can have a big effect on the caribou's health. Blood-sucking insects like mosquitoes, blackflies, biting midges and bulldog flies are "micropredators" of caribou. They persistently attack caribou to get the blood they need to hatch their eggs. In summer, these flies often torment caribou, distracting the calves from nursing and the adults from feeding. Caribou will rush wildly about, trying to avoid insect harassment, sometimes injuring themselves in the process.

Refer to the "Bot fly boogie" activity on page 44 for illustrations of the life cycle of parasites described here.

Tormenting insects keep caribou on the move searching for windy areas like hilltops and mountain ridges, rock reefs, lakeshore and forest openings, or snow patches that offer respite from the buzzing horde. Gathering in large herds, up to 100,000 animals, is another strategy migratory caribou use to block insects.

Parasites are dependent on the host animals that they live with for all or part of their life cycle. Among the parasites that affect caribou are a variety of worms, insects and microscopic animals called protozoa. Parasites alone are unlikely to kill a caribou, but they may cause the animal to be weak, malnourished, or generally in poor condition. They may also distract them to the point where predators are able to catch them more easily.

Some of the parasites and diseases affecting caribou can be passed along to humans, if they pass through dogs, which act as intermediary hosts. All can be avoided by thoroughly cooking affected caribou organs and meat before eating and/or feeding to dogs.

Caribou often gather on ice and snow patches to escape insects.

Tapeworms

Several species of tapeworms (*Taenia* sp.) can be found in caribou. The immature forms of the tapeworms hatch from eggs inside the caribou and form themselves into cysts on the caribou's organs or muscles. If an infected caribou is killed and eaten by a wolf or dog, the cysts hatch into tapeworms that live in the predator's gut. Some kinds of tapeworms can be up to five metres long! These adult tapeworms lay eggs that pass out in the wolf's droppings. The eggs end up on plants that are eaten by caribou, and the cycle continues.

Warble flies

Several fly species (*Oedemagena tarandi*) parasitize caribou year-round. Warble flies, which look like small bumblebees, chase caribou around during the late summer and lay their eggs in the caribou's hair on the leg and flank. Larvae hatch from these eggs, burrow through the caribou's skin, and migrate to the animal's back. Here they form cysts and live through the winter, poking a small hole in the caribou's skin through which to breathe. The next spring, the larvae pop out through the breathing hole and develop into an adult fly. These flies only live for about a week, during which time they search for another caribou on which to lay their eggs and continue the cycle. It has been estimated that a female warble fly can fly 1,000 km looking for a caribou. Warble fly larvae are edible and considered a delicacy by some Inuit.

Nose bot flies

Female nose bot flies (*Cephenemya trompe*) deposit eggs near the nose opening of the caribou in the summer. The larvae hatch and attach themselves to the inside walls of passages behind the caribou's nose. Over 150 nose bot larvae have been found in a single caribou. This many can make breathing difficult, especially if the caribou is running fast. The larvae grow all winter. In the spring, the annoyed caribou sneeze out the bots, and they grow into bumblebee-like flies.

Protozoa

Protozoa are primitive, one-celled animals. They can't be seen by humans except under a microscope. One kind of protozoa, *Besnoitia*, can cause caribou bones and tendons to become pitted and rough. It is believed to be passed on by biting insects such as black flies. *Sarcocystis* (see diagram in "Bot fly boogie" activity on page 50) has a life cycle similar to that of tapeworms. *Giardia* (sometimes called "beaver fever" in humans) is contracted through infected drinking water.

Liver fluke (*Fascioloïdes magna*)

Caribou are the ultimate hosts of this parasite, which introduces its eggs into the environment through caribou droppings. The intermediary hosts are gastropodes (snails), which eat the eggs and release the larvae of the liver fluke onto vegetation. The caribou may inadvertently eat this vegetation, and once they have ingested it, the larvae will nest in the caribou's liver where they will complete their life cycle. Yellowish cysts

measuring up to 10 cm in diameter may then form on the liver. The cysts will contain one or two adult parasites that resemble bloodsuckers.

While a parasite-infested liver is not particularly attractive, caribou rarely become ill from these parasites and eating caribou meat from an infected animal generally presents no danger.

Other threats

Caribou calves are barely larger than mature arctic hares when they are born. They are very vulnerable at this time. If the weather is poor on the calving grounds, strong winds may keep a calf from standing up to feed. Exposure to cold, wet conditions may also cause calves to weaken and die. Though calving grounds are chosen in areas where few predators roam, many caribou calves are killed by wolves, golden eagles, gulls or grizzlies.

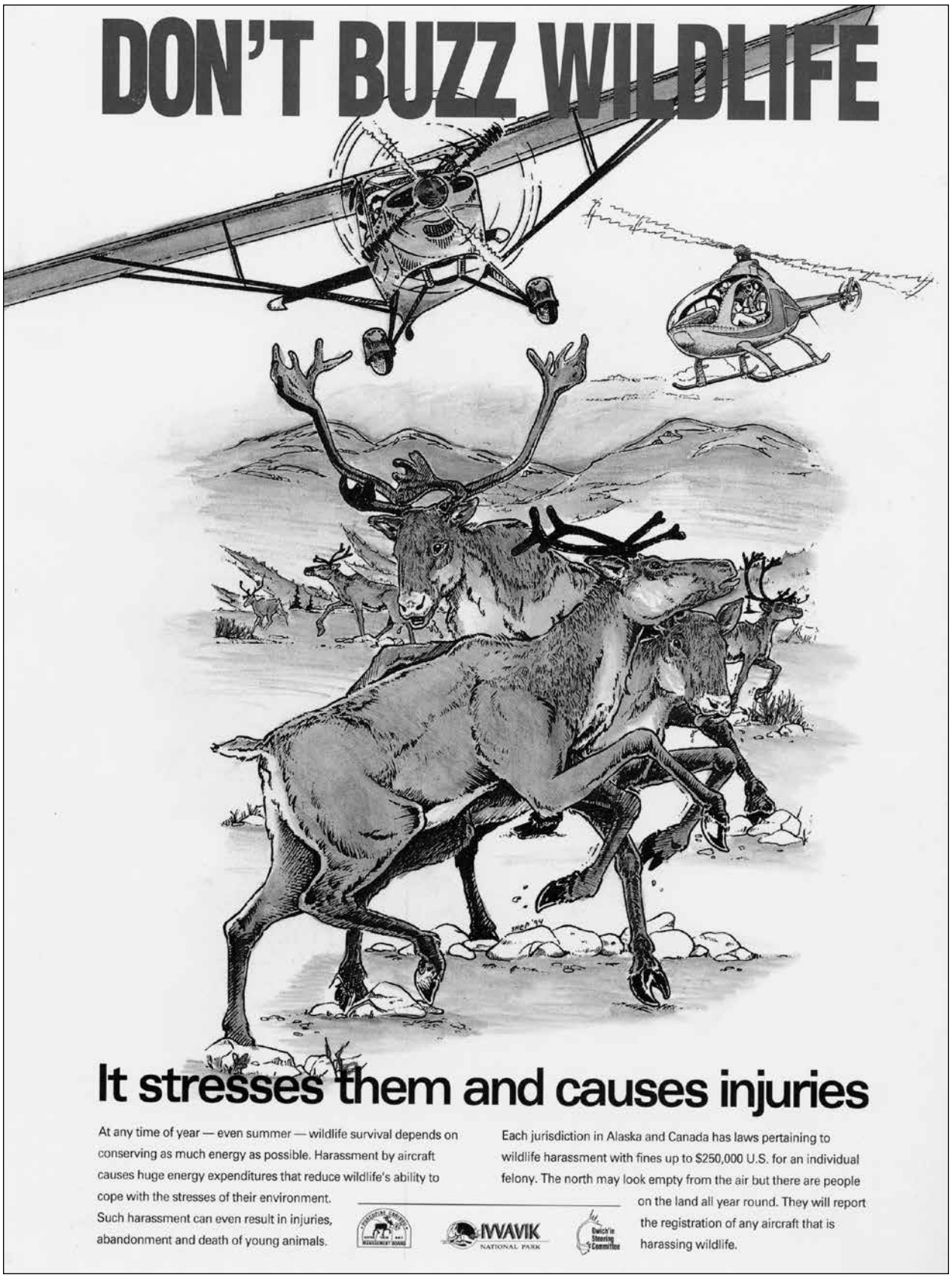
Migratory caribou move over a treacherous landscape of melting or falling snow, icy cold rivers and rocky terrain. An accident can occur at any time of the year, but particularly during migrations. River crossings are especially dangerous. During spring migration, rivers are flooding and choked with broken ice. Even very young calves attempt to cross, swimming beside their mothers' sheltering bodies. Strong currents can carry calves away, or they may be hit by floating ice chunks and injured or killed.

Other caribou are killed during the large herd migrations. Insect hordes or predators may cause the herd to stampede wildly, trampling calves and injuring adults. If calves lose or are deserted by their mothers during these stampedes, they will die. Another cow will not accept a calf that is not her own.

Barren-ground caribou crossing the Porcupine River

Caribou tragedy

Human actions can have a profound impact on caribou. In 1984 10,000 caribou were drowned as they attempted to cross the Caniapiscau River in northern Quebec. A hydro dam had changed the flow rate and quantity of water in the river. The caribou were swept over Limestone Falls to their death.


DON'T BUZZ WILDLIFE
It stresses them and causes injuries
At any time of year — even summer — wildlife survival depends on conserving as much energy as possible. Harassment by aircraft causes huge energy expenditures that reduce wildlife's ability to cope with the stresses of their environment. Such harassment can even result in injuries, abandonment and death of young animals.
Each jurisdiction in Alaska and Canada has laws pertaining to wildlife harassment with fines up to $250,000 U.S. for an individual felony. The north may look empty from the air but there are people on the land all year round. They will report the registration of any aircraft that is harassing wildlife.
IVVAVIK
NATIONAL PARK
Owich'in Steering Committee

Caribou are susceptible to some bacterial diseases. One of these is called "brucellosis." It causes female caribou to abort or give birth to weakened calves. Sometimes the cow will retain the afterbirth, which may cause an infection. Abortion and sterility caused by brucellosis reduce the productivity of a caribou herd.

Humans also kill caribou, through traditional and sport hunting and also through the direct and indirect effects of their activities. Habitat encroachment, resource development and long-term processes such as climate change and pollution may all have great impact on the survival of wild caribou herds.

Seasonal movements of caribou

Some caribou are migratory, moving great distances from winter to summer grazing ranges and calving areas. The barren-ground caribou are well known for their incredible long-distance migrations. The Leaf River Herd, a woodland/tundra ecotype, of Québec (Nunavik), covers over 400,000 square kilometres in its annual migratory cycle. Caribou are synonymous with life. During the winter of 1892-1893, half of the population of the community of Kuujjuaq died of starvation because hunters were unable to track the caribou herd.

Some herds of mountain and woodland caribou also make seasonal movements from summer to winter range and have distinct calving areas. Woodland caribou in other parts of the continent are not truly migratory, but sedentary, occupying summer and winter ranges that overlap to a large extent. They may move within a range of only a few hundred square kilometres over the seasons.

Winter

Caribou live with snow, cold weather and short days during the long winter. Caribou do not travel great distances in the winter. Their winter ranges are usually in areas where snow can be dug easily. Caribou make "craters" in the snow with their hooves, searching for ground lichens.

Spring

When the snow begins to melt and the days grow longer, caribou begin to feel the migration urge. Pregnant cow caribou are the first to move towards calving grounds. Bulls, young caribou and cows that have not bred begin to migrate to summer ranges a few weeks later.

Caribou calves are born in the spring, from mid-May to mid-June, depending on the herd. Introduced reindeer (see sidebar on next page) can even calve at the end of April. The timing of caribou births appears to match the times when new, nutrient-rich vegetation is at maximum growth.

In large migratory herds like the barren ground herds and woodland/tundra ecotype herds, calves are born in special areas called "calving

Calving time

Most caribou calves are born within a few days of each other. Their mothers have migrated to calving grounds or scattered to secluded patches of forest, places where they feel safe and protected from harm. It may take a cow from 15 minutes to several hours to give birth. When the calf is born, the mother caribou licks it clean. The calf suckles to get milk. Calves push against their mothers' udders (an act known as "bunting") to stimulate milk production.

All this physical contact helps to forge a strong maternal bond between the cow and her calf. They learn how to recognize each other's scent so they can find each other if they are separated. This is important because caribou travel long distances in herds that can include thousands of other caribou.

Young calf calling for its mother

Domesticated reindeer: caribou cousins

Reindeer are thought to have first been domesticated more than 2,000 years ago by people who lived in the mountains along the Russian/Mongolian border. Reindeer may have been used by these people to help with hunting wild animals. Since that time, reindeer have served a wide variety of purposes for people in northern Europe and Asia, from supplying milk, food and clothing to pulling sleds. Today, reindeer herding remains a way of life for many Arctic peoples, including the Sami in Scandinavia and the Nenets and Chukchi in Russia.

Reindeer herding was introduced to North America in the late 19th century, when an American missionary came up with the idea of 'importing' reindeer from Siberia in an effort to ease the starvation facing Indigenous peoples on Alaska's northwest coast. Whalers, and later, miners, were depleting caribou herds and marine mammals that these people depended on. It was felt that the introduction of domesticated reindeer would provide the natives with a reliable source of food. Herders from Siberia, and later, Sami herders from Norway, were brought over to teach the local people how to herd the reindeer. Reindeer were used at this time for food and also as pack and sled animals, particularly during the Gold Rush.

grounds," which can vary from year to year but are often in traditional locations. Caribou calving grounds are areas where new spring vegetation appears first. They may also be areas that offer better protection from predators and insects. Among the woodland/forest dwelling ecotype caribou, cows separate to search out secluded locations for calving on treed islands in lakes and muskegs.

Caribou calves grow up fast. They are able to stand shakily and walk a few steps within an hour of being born. After a day, they may be running and trotting. Only a couple of days after being born, calves are able to keep up a running pace and even swim across streams!

Because they are born at about the same time, calves grow up together and develop at similar rates, learning to keep up with the herd by the time it begins to move. Calves that are born early in spring, during migration on the barren lands, or after the calving season are not very strong. They are more likely to be killed by predators or abandoned by their mothers when they cannot keep up with the rest of the herd.

Calves remain close by their mothers throughout the summer. They learn behavioural responses from their mothers and from the rest of the herd, such as how to recognize and react to danger. By the fall, they are weaned and no longer dependent on their mothers for milk.

Summer

Caribou herds continue to move about in their summer ranges. For barren-ground and woodland/tundra ecotype caribou these are north of the tree line. Woodland caribou (mountain ecotype) move to moist alpine tundra and open mountain meadows, while woodland caribou (forest dwelling ecotype) move to open spruce and pine forests close to wetlands and lakeshore. By being continually on the move, caribou can avoid overgrazing and also take advantage of a wide variety of habitats. With the

Porcupine caribou herd travelling through summer range

new growth of grasses, herbs and shrubs, caribou can diversify their diet. During the long summer days they eat steadily, building up fat reserves for the fall rut and the winter. This good life in summer is often disturbed by hordes of parasitic flies and mosquitoes. These insects drive the caribou to seek relief areas in mountains, on snow banks and even in lakes and oceans.

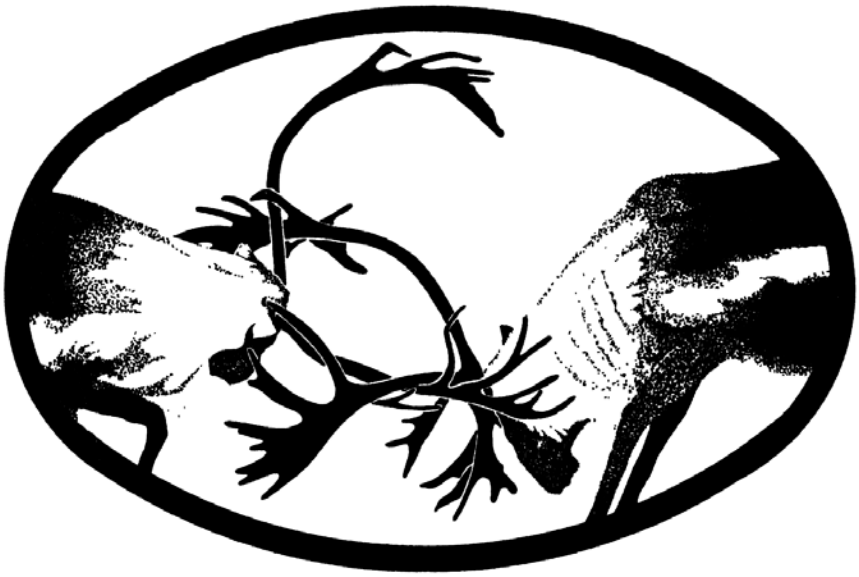
Fall

As cold weather approaches, the summer movements of the caribou within the herd blend together and become a fall migration. Barren-ground and woodland (tundra ecotype) caribou move south from the northern tundra towards the boreal forest or other more sheltered areas where snow and weather conditions are better. Similarly, woodland caribou (mountain ecotype) move from exposed locations into valley bottoms, and woodland caribou (forest dwelling ecotype) move to sandy forest openings and muskeg wetlands to feed on lichens growing on trees and on the forest floor.

Caribou mating season: in a 'rut'

The mating season of certain ungulates like caribou, elk and moose is called the "rut." During this time, bull caribou grow thick white manes, and their necks swell to twice their normal size. Bulls thrash against trees, rubbing the velvet off their antlers. They become restless and aggressive They eat very little and begin to emit strong odours. (At this time, hunters avoid killing them, because their meat is tough and strong-tasting.)

During the rut, caribou challenge other bulls to ritualized sparring matches in an attempt to prove dominance. They face each other in a "threat position," with heads low to the ground and antlers thrust forward. If a challenge is accepted, the bulls clash together and push and twist their heads from side to side. The bull that manages to push the other



Two bulls sparring during the rut

Attempts to introduce reindeer herds to the Canadian north have met with varying degrees of success. Reindeer were brought over from Alaska in the 1930s, in one case taking five years to move across the Arctic to the Mackenzie Delta. The plan was to establish a herd of reindeer owned by the government, from which interested Inuit could borrow to start their own small herds. Several family-owned herds were established, but the experiment was not a success. Only one commercial reindeer venture is still operating, at Reindeer Station, near Tuktoyaktuk. This herd, today numbering about 8,000 animals, has operated as a private business since the mid-1970s.

Reindeer were introduced to another Arctic community, Sanikiluaq, on the Northwest Territories' Belcher Islands, in 1978. Native caribou had disappeared from these Hudson Bay islands because of severe weather conditions. The government introduced the reindeer to the islands, hoping to supplement the Inuit traditional diet of marine foods. The reindeer are now free-roaming on the islands, managed and hunted by the local Inuit.

Herding of reindeer did not catch on in a significant way with Indigenous Peoples in Arctic North America, who continue to prefer to hunt wild caribou. Today, about 50,000 reindeer remain, most of which are in Alaska. Reindeer provide profit to today's herders through the sale of meat and antler velvet, which is valued in Asia as a health aid.

Clothing from caribou

You may have heard of Hollofil and other types of modern outdoor clothing made from synthetic fabrics. This clothing can be a good insulator, but the original 'hollow-fill' came courtesy of the caribou. Northern native peoples have been using caribou skins to make clothing for centuries, knowing that such clothing provides excellent insulation and durability in a harsh winter environment.

Each caribou hair consists of a network of large cells arranged like a honeycomb to trap air. Air is also trapped between each of the densely matted hairs. This air acts as an excellent insulator. Ice and snow collecting between the hairs can easily be beaten off with a wooden or bone beater, a drying technique that doesn't work as well with modern fabrics. Traditional clothing made from caribou skins can be a lifesaver for an Inuit hunter caught in a fierce storm.

backwards has established dominance. These battles can sometimes become violent, resulting in injuries and even deaths. Occasionally, the antlers of two sparring bulls become locked together, and both may be killed by predators or die of starvation.

Some woodland caribou bulls herd groups of females into "harems" and attempt to prevent other bulls from mating with them. Barren-ground caribou are constantly mingling and breaking into new groups.

During the rut, bulls approach cows from behind with outstretched necks. These usually silent creatures make a hoarse, coughing sound. If a cow is not ready to mate she will run away. But if she has come into "heat", she will allow the bull to move closer, mount and mate with her. The bull then moves on to other cows. By the end of the rut season, bull caribou are exhausted and depleted of the energy fat reserves they have built up over the summer. They are in rough shape and susceptible to predation as they face another long, cold winter.

Humans and Caribou

Caribou have always formed a basic part of the cultures of people living in the Arctic and subarctic. Caribou have provided meat for people and their dogs; fat for light and cooking; hides for clothing and shelter; and bones for needles, fish hooks and ornaments.

People also formed mythologies and legends and structured their cultures around the caribou. They travelled to known migration routes to intercept herds for hunting. They told stories about caribou. They taught their children to respect these animals. Traditional hunters believed that if they had the right thoughts about animals and treated the carcasses properly, they would always have enough to eat.

They also created taboos that showed their respect. For example, in both Inuit and Dene cultures it was taboo to mix foods from the water with foods from the land. Therefore, caribou and fish could not be eaten on the same day. Inuit did not even cook caribou over driftwood fires because the wood came from the sea.

Using every part of the caribou

Resourceful northern peoples know not to let anything go to waste. Their respect for the caribou they hunt and their survival needs lead them to find innovative uses for all parts of the animal.

(The discussion below uses the past tense. Please be aware, however, that caribou is still an integral part of many northern cultures, and much of what is described is still in practice today).

They ate caribou meat fresh or dried. It could also be pounded and added to berries and grease to make "pemmican," which lasted a long time. Sections of the caribou's head such as the tongue, nose and chin were

considered delicacies. The brains were eaten or used to cure hides. The velvet on the antlers was singed and eaten. The rest of the antler bone was used to make a variety of carved items including buttons, fishing jigs, knife handles and the ribs of kayaks.

Many organs were also used. The heart, liver and kidneys were roasted and eaten. The stomach was cleaned and washed and then used to store fat, blood, or water. The intestines were washed and cut up and added to stews. The blood was collected and used to add flavour to soups. People did not eat the lungs, but fed them to their dogs.

Bones were scraped clean of meat and used to make tools like scrapers, knives, needles and fish hooks. They could also be ground into bonemeal for cooking. Boiled bones provided grease. Bone marrow was eaten raw or cooked. Hooves were boiled until tender, eaten raw or dried. Hollowed hooves were made into decorative rattles.

Caribou hides were also used in various ways. Dried or untanned hide, also called rawhide, was used to make drums, rattles and buckets, or was stretched over boats. When rawhide is stretched in strips and dried, it forms "babiche," a tough thong used in the webbing of snowshoes, dog harnesses, snares and bowstrings.

Tanned hides were used to make clothing: moccasins, mitts, mukluks, pants, shirts and dresses. Tanned hides were also cut and sewn to make many other things, from pouches and packsacks to bow strings and baby belts. They were also sewn together and draped over frames to make skin houses.

Hides tanned with the hair on were used to make warm winter clothing: parkas, mittens and pants. They could be used as robes or sleeping mats. Sewn together and draped over willow poles, they made winter dwellings.

Caribou=Life

Caribou means life for Inuit people. During the 1892-1893 winter, half the population living in Kuujjuaq starved to death when the hunters could not find the caribou herd.

Traditional hunting methods

Caribou was the staple around which many northern communities were organized, and hunting caribou was often a community activity in which everyone participated.

One common hunting method was to build an enclosure to entrap migrating caribou. These corrals or impoundments were constructed in clearings or on frozen lakes. They were built of brush and consisted of an exterior fence that could be over a kilometre long, surrounding a maze of shorter brush fences with babiche snares in the openings. The caribou were driven into the corral. Women and children surrounded it, shouting to keep the caribou from breaking out. The hunters then attacked the snared caribou with spears and the loose caribou with bows and arrows.

Out on the tundra, where there was no brush from which to construct corrals, hunters placed sticks topped by fluttering strips of hide. These sticks were arranged in rows to lead caribou towards blinds constructed of

stones. Women and children again took part, chasing the caribou towards hunters hiding behind the blinds.

In similar fashion, Inuit built long rows of stone cairns they called “inukshuks,” meaning “resembling a person.” Migrating caribou were thought to perceive these stone men as hunters and avoided passing through them. In this way, the hunters were able to lead caribou to areas where they could ambush them.

During migration periods, many hunting groups waited at traditional river and lake crossings, and speared caribou as they swam. From a kayak or canoe, the hunters could lean over with a short lance and pierce the animals’ backs, then retrieve the floating carcasses of caribou later.

Several solitary hunting methods were also used. Caribou inhabiting forest areas in winter could be chased through deep snow by a hunter until they were tired enough to allow the hunter within bow and arrow range. Hunters also tried to trick caribou, draping themselves with caribou skins and holding antlers over their heads and moving towards unwary caribou until they came within arrow range.

Caribou snares were made with babiche. The snares were set at antler level and tied to sturdy trees or poles that would get entangled in brush when dragged about by the harried animal.

During the rut period, bull caribou were sometimes lured towards the sounds of other bulls fighting over a female. The unfortunate animals actually encountered hunters rattling pieces of antler together!

It is still possible today to see the remains of caribou fences and hunting camps on the tundra. The small, squat, stone men – inukshuks – built by hunting communities of the past are still present on the windswept northern coastal plains.

Barren-ground caribou crossing the Porcupine River

Changing relationships

The arrival of Europeans changed the northern people's relationship with the caribou. The nature of the caribou harvest was dramatically altered by the needs of whalers who travelled the arctic seas in the 1800s. They needed caribou for provisions. So did later waves of fur traders and trappers, prospectors and miners, who all added their needs to the caribou harvest. Between 1890 and 1910, professional meat hunters worked to feed all the people on the land. In the 1930s, a great deal of caribou meat was needed to feed the animals of the many people who used dogs and sleds for travel. The introduction of the rifle made it easier to kill the caribou and lessened the amount of skill needed in the hunt.

In less than a generation, mechanized transportation and high-powered rifles have again revolutionized hunting.

Present day use of caribou

The dietary and cultural aspects of the caribou remain important to northern Indigenous groups. Caribou is a nutritional food source, high in protein and low in fat. Hides and antlers are still used to make clothing and artwork; crafts and art are now an important aspect of the northern tourism industry.

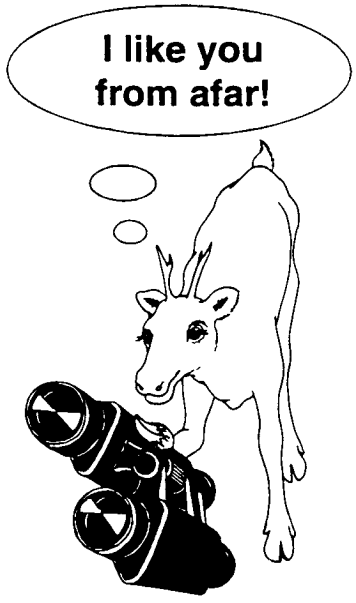
The hunt has a cultural importance to the community as well. Being able to procure one's own food and enjoy sharing it with others is a source of satisfaction, self-worth and dignity. Hunting is an integral part of northern society and culture, and it offers a lifestyle alternative to buying imported foods from retail stores.

Caribou are hunted every month of the year and consumed every day by the Indigenous people of Alaska, Yukon, NWT, Nunavut, Manitoba and Québec (Nunavik). Non-Indigenous northerners also hunt caribou on a seasonal basis as dictated by wildlife regulations. Other people can come from southern parts of Canada or foreign countries to hunt caribou. Caribou thus have both recreational and subsistence value.

Tourists also enjoy caribou for sightseeing and photography. People camping, hiking or canoeing are thrilled at the sight of wild caribou. The sight of these wild herds gives people a strong feeling of being in the wilderness.

Want to find caribou?

Start by learning more about caribou. Think about their needs. Where would caribou find food, water and shelter in this season? Study caribou migration routes and the kinds of habitat they might choose at various times of the year. In the summer, caribou are more likely to be spotted on breezy ridges or seen as brown specks on remnant snow patches, where they seek relief from insects. Remember to think about whether your presence might be a disturbance to caribou.



Please keep your distance.

Human-related threats to Caribou

Whereas before northern people were dependent on caribou populations for survival, now the caribou's fate is often held in the hands of people.

Oil and gas development on calving grounds

Concentrated human activity in caribou calving grounds – such as oil and gas exploration or development – could interfere with instinctive maternal behaviours or cause cows to abandon traditional calving areas for less favourable ones where food may be scarce or calves more at risk of predation. At birthing times, cows are wary and will flee if disturbed. Calves that are not yet steady on their feet may have a difficult time keeping up with their mothers.

There are several theories about why barren-ground caribou return to traditional calving grounds year after year. One is that caribou are avoiding insects and predators present in greater numbers at this time of the year in the southern parts of their range. Another is that cow caribou need the new, nitrogen-rich vegetation that occurs on the calving grounds. For whatever reason, traditional northern calving grounds are critical habitat for many barren-ground caribou herds.

Mining and exploration

This type of resource development can also contribute to the destruction of the caribou's habitat, increase human access to lands roamed by caribou, and result in higher levels of disturbance in habitats considered to be at risk.

Porcupine caribou on the Dempster Highway

Forest fires

Forest fires, whether caused by human intervention or by nature, can contribute to the destruction of vast expanses of grounds that are the winter habitat of forest-dwelling woodland caribou. As human activity in the boreal forest increases, so do the risks associated with forest fires.

Climate change

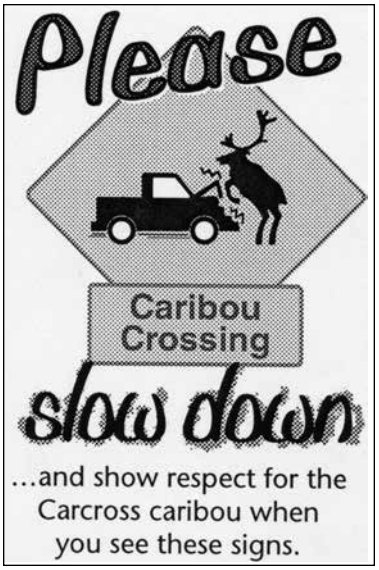
How are caribou affected by climate change? In the North, scientists and Inuit have already observed an increase in temperature, which is the beginning of a domino effect. With higher temperatures, snowfalls are more abundant, and the snow itself is heavier and wetter. The permafrost melts and the soil softens, leading to landslides and rock falls. What's more, water bodies freeze later in the season, which means that ice is thinner and melts sooner and more rapidly. To compound matters, river ice breaks up earlier. Although caribou are excellent swimmers, they are at risk of drowning when the thin ice can no longer support their weight. It even becomes more challenging for them to move through the heavy snow.

Migrating caribou travel great distances between their different habitats. Year after year, they follow the same migratory routes. When it is time to calve, they travel to the tundra. For decades, females have been gathering there by the thousands to give birth to their calves away from the threat of predators. Come winter, the caribou take refuge in the boreal forest.

In winter, caribou must expend more energy to find food under the thick, heavy snow. They use their hooves to "crater" for lichens. An animal that uses up a great deal of energy to find food will consequently have lower reserves for growth. For example, biologists have discovered that weight decreases in calves that have to expend more energy than is normally required to move around and deal with rough winter conditions.

As if this were not enough, they must also contend with the myriad of mosquitoes, blackflies and other biting insects. These enemies, which do not normally survive the rigours of winter, are now reaching latitudes farther to the north simply because the warmer climate makes it possible. Caribou that are particularly bothered by biting insects already travel long distances to get away from the swarms, and having to take even longer detours will only make them expend more energy.

On the other hand, climate change could also make life easier for caribou. Significantly higher May temperatures have been recorded in Kuujjuaq, in Northern Quebec. Warmer weather during this critical period ushers in an earlier spring with the result that vegetation begins growing sooner, and females that are about to give birth – and their nascent calves – are better nourished. The better the calves eat, the bigger and fatter they grow and, by extension, the better their chances for surviving the winter, and the greater the likelihood the herd will grow in number. The calves will grow into strapping adults, which, three or four years later, will give birth to even more, healthier calves of their own.



Road sign posted in the range of the Southern Lakes caribou herd, Yukon

Logging on west side of Marsh Lake, Yukon

But are the caribou better off or worse off as a result of climate change? Will their numbers increase or decrease? We will just have to wait and see.

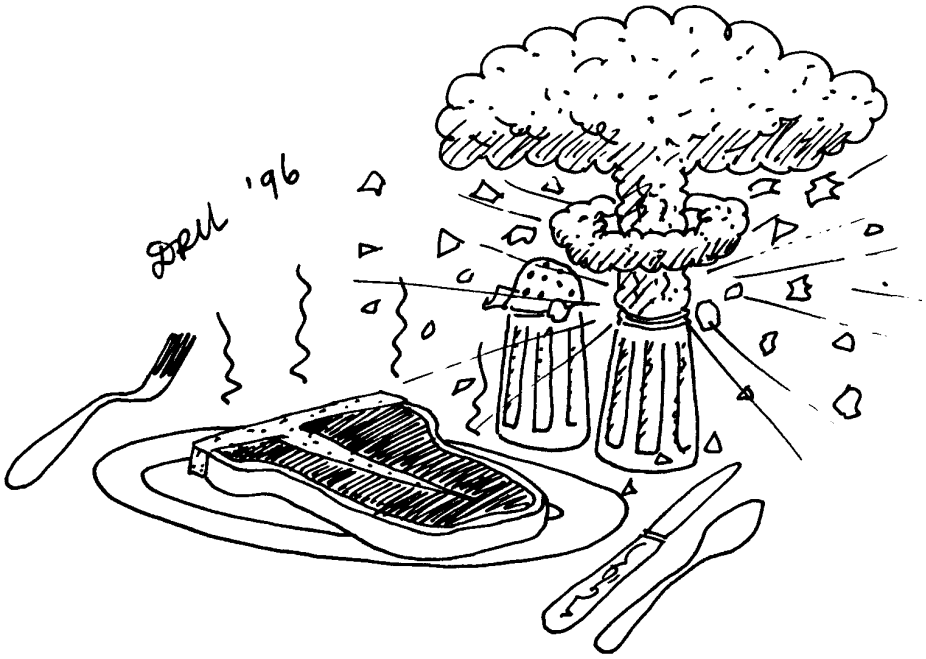
Logging on caribou ranges

Woodland caribou depend on lichens from the forest floor for winter food. Cows seek out the mature forested islands in muskegs for raising calves. Caribou need the shelter of forest for cover. Caribou ranges are typically large, harbouring small herds of animals. Caribou must travel constantly to avoid overgrazing in habitat where the food source is thinly scattered, grows slowly and is sensitive to disturbance. Intensive logging activity on woodland caribou ranges could destroy important feeding grounds, calving areas and forest cover. This destruction might occur at too rapid a rate for caribou to adapt. It could mean that in the long run, fewer and fewer caribou will be able to survive in forests subjected to logging.

Hydroelectric development

The construction of reservoirs in the regions that are home to caribou in Quebec and Labrador has reduced the size of the winter habitat of the tundra ecotype migratory and forest-dwelling ecotype herds. Flooding vast expanses of land has reduced the size not only of their winter habitat, but also of their traditional calving grounds, which are located primarily in marshes and muskegs.

The vast expanses of water associated with the hydroelectric reservoirs themselves also disturb the migratory movement of certain herds of caribou. The ice barriers that form after back flooding in winter and spring



are perceived as an obstacle and an added risk of injury for the tundra ecotype migratory herds. Sections of open water along rivers downstream from hydroelectric plants represent an added risk of drowning.

Roads

Ancient northern hunters knew that caribou were wary of unusual linear structures. They were able to guide the caribou for hunting using flimsy antler fences or rows of stone piles. In a similar way, reindeer herders in Scandinavia sometimes guided their animals by laying dark strips of cloth on the ground. In a modern society where roads, power lines and oil pipelines cut across the landscape, the caribou's wariness may have many implications for their survival.

Roads have several major effects on caribou. One major problem with roads is they offer hunters increased access. Herds that once were available only to small groups of subsistence hunters travelling over the land become accessible to many people. Roads also provide a hunting corridor for wolves, which use the plowed surface to travel and survey their prey from the road.

Another consideration is whether the vehicles and people travelling along roads will disrupt the movements of caribou herds. If caribou avoid crossing roads, their range on the other side of the road is lost to them. Roads also attract tourists, and the more traffic, the more chances that caribou will be hit and killed by vehicles. Tourists may also start forest fires.

Roads, once in place, tend to encourage further industrial expansion and development. The compounding effects of development on fragile northern ecosystems are not fully understood. Logging, increased air travel and hydroelectric dams could all pose threats to caribou herds.

Disturbance

Activities associated with hunting and northern travel can pose problems for caribou. Snow machines, automobiles and aircraft that chase caribou or frighten them into running long distances can cause a problem called "stress syndrome" or exertional myopathy. Violent exertion causes chemicals to build up in muscles faster than blood can remove them. The changes this causes in the muscle can bring death to the caribou, hours, days or even weeks after the harassment occurred. Panicked caribou can also injure themselves in other ways. Hunters must be aware that the survivors of a hunted caribou group may suffer as much as their quarry

Lichen contamination

Pollution caused by people living far from the territory of the caribou may still have an effect on the caribou and those that depend on them. One example of this effect is that of the radioactive element cesium.

Caribou tracks in soft mud

Caribou depend on lichens as a primary source of food in the winter months. Lichens take nutrition from moisture. Lichens grow very slowly and live a very long time; because of this, nutrients are more concentrated in lichens than in other plants. Unfortunately, heavy metals such as cadmium and cesium accumulate and become concentrated in the same way. Cesium is passed along to caribou that eat the lichens. Radioactive elements like cesium may cause cancer.

In northern Canada, tests have shown the levels of contamination to be low enough that Health and Welfare Canada has not recommended against the human consumption of caribou meat. However, contamination levels were so high in northern Europe after the Chernobyl nuclear disaster that reindeer meat had to be destroyed. Even in Canada, levels of contamination increased by up to 25% in some caribou herds after the disaster.

Cesium does not persist in the body tissues of caribou. This means that the level of it found in the meat will be higher in winter, when the animals are on a lichen diet, than in summer, when caribou eat a wider variety of plants. However, other forms of pollution, like heavy metal fallout, do accumulate in body tissues such as the liver and kidneys. The caribou of the far north are a powerful symbol of the potentially devastating effects of human activity, even on the other side of the world. Perhaps this example will encourage people to understand that every action has a consequence.

Studying caribou in the wild

Traditional knowledge of caribou was gathered through centuries of observing the behaviour of the animals. Traditional knowledge led to values and hunting practices that promoted respect and complete use of the animal, rather than wasteful or unwise killing. Traditional knowledge of the caribou is centred in northern Indigenous communities and cultures, passed on through an enduring oral tradition. Indigenous people use the knowledge that has been passed down to them in their interactions with caribou in the present.

Governments and biologists gather scientific knowledge about caribou. It is based on repeatable observations, experiments and data gathering. Scientific knowledge is based on a written record.

Both scientific and traditional knowledge about caribou can be used together in wildlife management to ensure the survival of healthy caribou populations despite hunting and resource development.

Biologists study animals to learn the best ways of managing them for the survival of ecosystems. Caribou and other large mammals can be considered "indicator species": that is, if they survive in healthy populations, then so do many other members of the ecosystem. Biologists gather information about caribou in several ways. They may do aerial or ground surveys to count caribou herds and study their composition (the numbers of various sex and age classes). Biologists can also get information about caribou from native and non-native hunters by doing harvest studies. They can tag caribou and find out where the caribou are killed by collecting tags from hunters. Another kind of study involves putting radio collars on caribou. These collars transmit a signal that can be picked up from an airplane or by satellite. Radio-collaring allows scientists to track the movements of individual caribou through the seasons.

Woodland caribou equipped with a radio collar

Caribou viewing tips

- Always observe caribou from a distance. If a caribou becomes alert or nervous and begins to move away, you are too close.
- Use binoculars or spotting scopes to get a better view.
- Try to minimize the noise you make: talk in whispers and limit the clicking of cameras.
- Never come between a cow caribou and her calf.
- Avoid bull caribou during the rut season when they may be aggressive.
- Behave like a guest in their wild habitat: do not bother them.

If you can't find any caribou, keep in mind that people have been baffled by the movements of caribou for centuries. Some, like the men of Sir John Franklin's expedition in 1821, have starved to death because they miscalculated the behaviour of caribou. Hopefully, your caribou mission doesn't have such high stakes!

Predator control

A highly controversial method of increasing caribou populations involves reducing predator numbers. Wolves are the usual target. A common, lethal method of predator control is aerial shooting from helicopters. A non-lethal method is the sterilization of breeding wolves so that they are unable to reproduce. Because they are complex and controversial, most modern predator control programs are highly scrutinized and thoroughly studied to assess their effectiveness.

Working to protect caribou

The more we learn about the effects humans have on animals, the more we realize that we need to foresee the consequences of our actions and plan accordingly. This is called wildlife management.

In the past, humans did not have the means to seriously alter the natural environment and the abundance of wildlife that depends on it. New developments in technology and the explosive growth of human populations have given us the power to wipe out entire species. We have learned that wildlife needs protection, or stewardship, to survive in the world of today.

Wildlife management can take many forms. It can include licensing hunters and setting hunting seasons and quotas. It can also mean allocating resources to certain users, like Indigenous groups or resident hunters. Another important way wildlife management works is by protecting habitat or setting guidelines for its use.

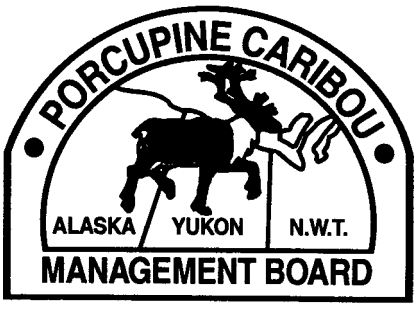
Another management tool is to make efforts to reduce caribou mortality. Predator control programs are one way governments have tried to protect caribou populations. Hunting of caribou can also be restricted. The government restricts non-native hunters by imposing seasons, quotas and licensing requirements. Indigenous hunters are generally assured access to caribou and other game animals for food.

The management of caribou is made more complicated by the fact that these animals migrate great distances. Caribou pay little attention to political boundaries, crossing through adjacent provinces, territories and even countries. Wildlife managers are learning to balance traditional and scientific knowledge about caribou when making decisions.

Successful management of the caribou is challenging because different people may have different ideas about how many animals should be harvested every year and how many caribou each person should get. Other people may have different ideas about how the land should be used and what the best ways are to protect caribou and their habitat.

Many jurisdictions are focusing on “integrated management” of wildlife. In Manitoba, for example, department wildlife biologists review logging plans with respect to wildlife habitat and have the ability to adapt operations to accommodate wildlife requirements. The new discipline of conservation biology guides this process.

Another way that management of caribou has improved in recent years is through a process called “co-management.” Co-management is a partnership where all people who rely on the caribou in an area are involved in making decisions about how they are managed. This often involves biologists, government representatives, Indigenous people and other stakeholders.



How can you help protect caribou?

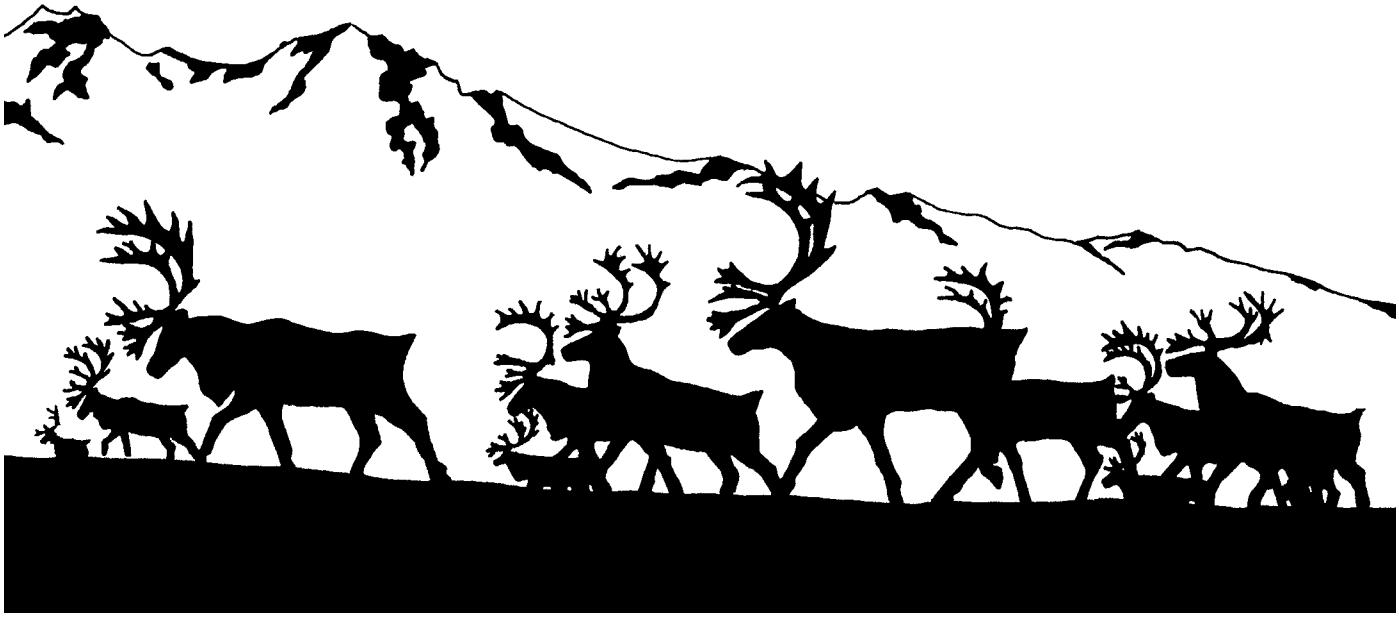
One way you can help protect caribou is by learning more about caribou, their habitat and the threats to their survival. Without public support, wildlife management programs have limited success. Students can become involved in caribou and other wildlife issues by participating in public consultations regarding issues that affect caribou. Issues may be local or national, such as when land use regulations are being established or changed.

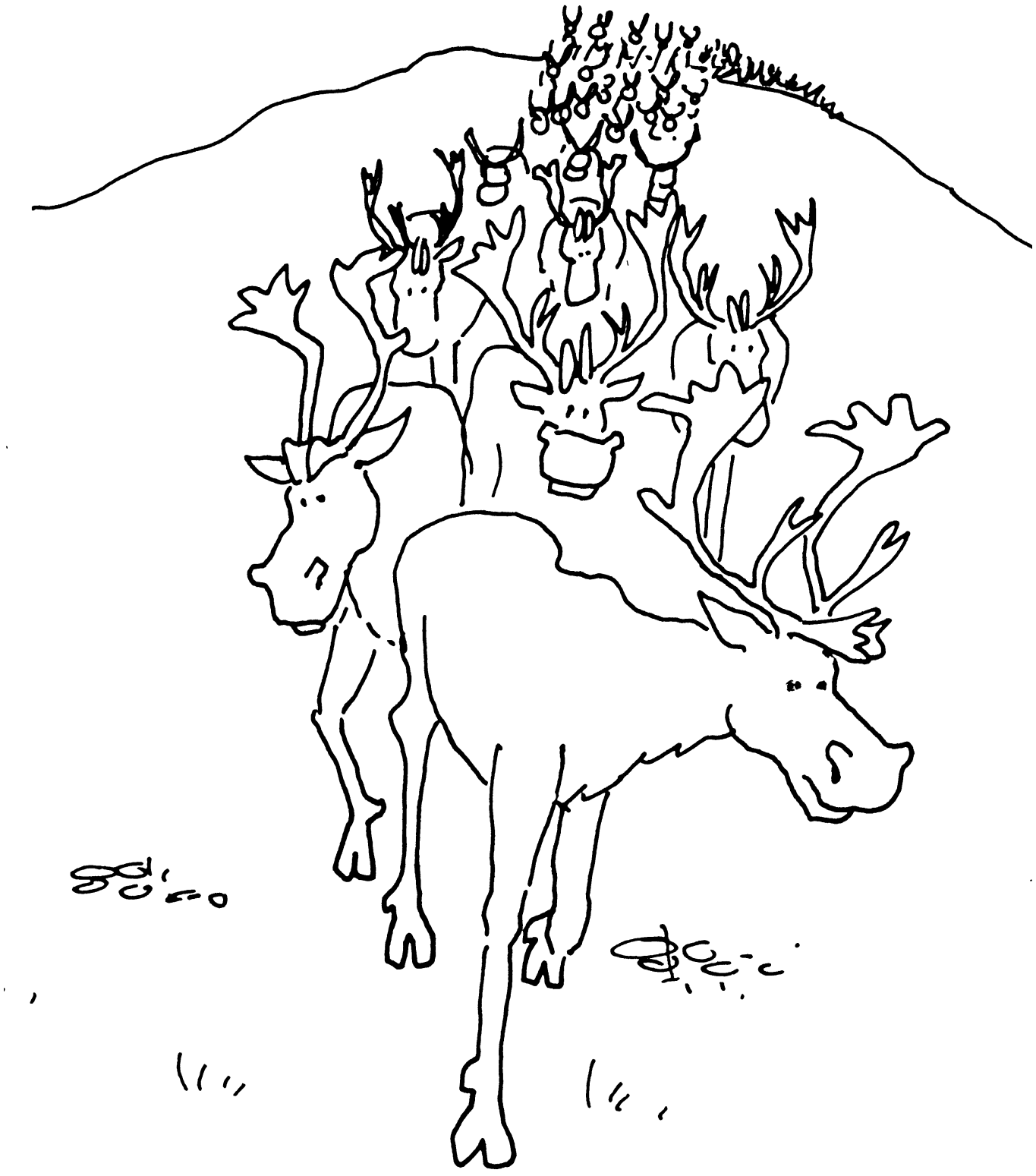
Students can also contact local government, non-profit and private wildlife agencies for ideas on how to help caribou and their habitat. People face important choices now and in the future about how we use and affect the natural world. These choices can affect caribou and other living things.

Students can explore questions about caribou in the following activities and in discussions with their friends, families and communities. By turning education into action, students can make a difference to caribou. Their concern and activism can ensure that caribou continue to be an important part of northern ecosystems and communities, and a connection to the wild.

Students can also study biology to become northern wildlife biologists. Many universities offer programs in wildlife studies, and classroom meetings can also be organized.

Activities





Barren-ground caribou migration

(Adapted from *Below Zero*)

Objectives

Students will:

1. Understand the annual migration cycle of barren-ground caribou herds.
2. Understand how hunting and predation affect caribou populations.
3. Play an active game that demonstrates the above concepts.

Method

Students learn about the migration cycle of barren-ground caribou by playing an active outdoor game that represents the annual movements of a caribou herd.

Background

Barren-ground caribou are well known for their incredible long-distance migrations. Caribou live with snow, cold weather and short days during the long winter. Caribou do not travel great distances in the winter. Their winter ranges are usually in areas where they can easily dig through snow. When the snow begins to melt and the days grow longer, caribou begin to feel the migration urge. Pregnant cow caribou are the first to move towards calving grounds. Bulls, young caribou and cows that have not bred begin to migrate to summer ranges a few weeks later. In the large barren-ground herds, calves are born in special areas called "calving grounds," which can vary from year to year but are often in traditional locations.

Caribou herds continue to move about in their summer ranges. For barren-ground caribou these are north of tree line. By being continually on the move, caribou can avoid overgrazing and also take advantage of a wide variety of habitats. With the new growth of grasses, herbs and shrubs, caribou can diversify their diet. During the long summer days, they eat steadily, building up fat reserves for the fall rut and the winter. As cold weather approaches, the summer movements of the caribou within the herd blend together and become a fall migration. Barren-ground caribou move south from the northern tundra towards the boreal forest or other more sheltered areas where snow and weather conditions are better.

Apart from humans, wolves are the major predator of most caribou herds. During the winter wolves hunt in packs, which are usually made up of seven to nine wolves. An average wolf pack will kill a caribou every few days in the winter. The wolf pack may "test" a herd of caribou by chasing them and watching for weaker animals that fall behind or are careless. They will then pursue and kill these animals.

Wolves will also ambush caribou on trails between lakes, attempting to cut them off from the rest of the herd or to chase them into deep, soft snow.

Age

Grades 4 – 12

Subjects

Science, Physical Education, Social Studies

Skills

Discussion, application, physical mobility

Duration

One 60-minute period

Setting

Outdoors

Materials

- Popsicle sticks to serve as food tokens (8 x number of "caribou," e.g., 160 food tokens for 20 caribou)

  Note: Popsicle sticks spray-painted fluorescent orange work well in snow, or use coloured plastic coffee stir sticks.
- Two long ropes or skipping ropes to represent a river
- 12 pylons or flagging tape tied to long sticks to represent boundaries of special areas
- Six boxes or bright yellow ice cream pails for collecting tokens

Caribou respond to attacks by wolves by trying to outrun them. Where natural cover such as boulder-strewn terrain, ravines and forest occur, caribou will scatter to confuse the wolves. On frozen lakes and in large forest openings they will bunch together to find safety in numbers.

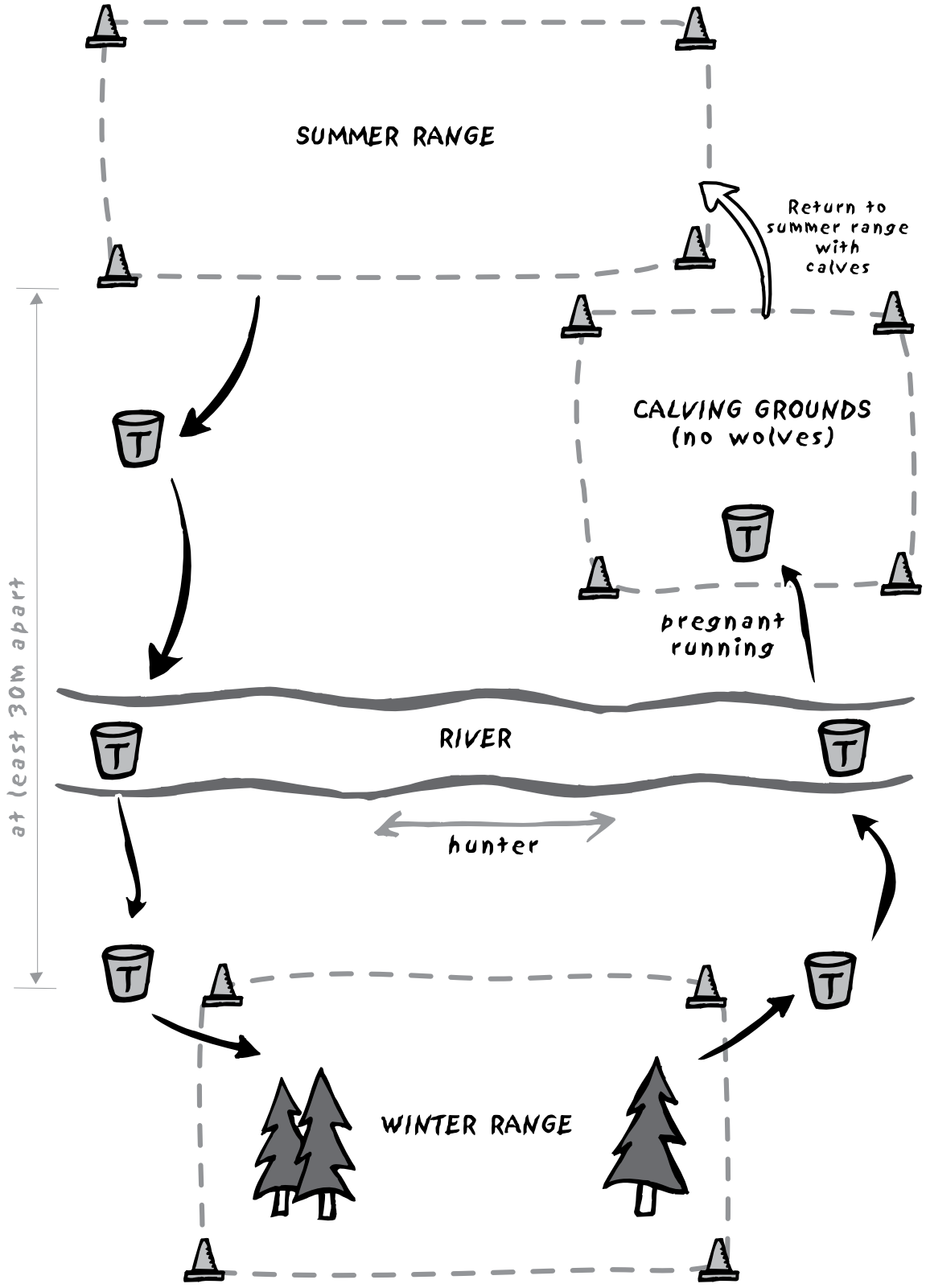
Set-up

1. Refer to the caribou migration diagram on page 37. Use four pylons or flags to mark the corners of the summer range. Similarly mark the corners of the winter range at the other end of the playing field. Use four more pylons or flags to mark the corners of the calving grounds. If possible, orient the playing field so that the summer range is in the north and the winter range is in the south. If your outdoor area has trees, it is appropriate to mark the winter range in that area. Place token collection pails in the circle "T" locations indicated in the caribou migration diagram.
2. Scatter most of the food tokens in the summer range, reserving one food token per caribou for the winter range.
3. Use the ropes to represent the river and choose two participants to wriggle the ropes. (This is a good role for mobility challenged participants.) The two participants who represent the river will also be the persons who empty the token pails each round.

Procedure

1. Choose two fast runners as wolves. Choose another as the hunter. The hunter represents the traditional First Nation people who are allowed to take caribou for subsistence (food) any time the caribou migrate near the community.
2. Briefly explain the life cycle of the caribou. It helps to walk the participants through the playing field, explaining what happens at each point in the cycle, showing them where to collect and drop tokens, and demonstrating how to move in each phase.
3. The activity begins in summer. The caribou move constantly back and forth across the tundra picking up one food token at a time. Summer is a time of plenty when caribou replenish fat reserves and improve their health. The caribou are preparing for the rigours of the fall migration, the period of rut and winter severity.
4. The wolves try to catch caribou. When a wolf tags a caribou, he or she takes the caribou's food tokens and escorts the caribou to the calving grounds. The caribou that are caught become unborn calves waiting for the herd to reach the calving grounds in the spring, when they can re-enter the game.
5. When the activity leader calls "fall," the caribou begin their southern migration. To represent the energy expenditures during the migration, each caribou deposits one food token in the first pail, then another in the next pail when he or she jumps across the river. They deposit another food token on their journey from the river to the winter range.

Caribou migration diagram



6. During the migration, the wolves follow the caribou, taking as many caribou as possible, but only one at a time. Wolves must stay two metres away from the caribou at the token deposit pails. Each wolf must get at least 25 food tokens to avoid starvation and thus survive each round (yearly cycle). Wolves need more food tokens than the hunter because of their higher energy expenditure following the caribou.

7. The hunter moves back and forth along the river and hunts caribou as they migrate past his community. (We are not aware of any women participating in the actual taking of game in this traditional society. However, women play an essential role in the processing of the meat.) The hunter takes the food tokens of the caribou he catches and takes his kill(s) to the calving grounds. He may then return to the river area and hunt for more caribou. The hunter must get at least 12 tokens per yearly cycle to feed himself and his family and relatives.

8. The leader calls “winter” and the caribou proceed to the winter range in the transitional forest. Each caribou must collect at least one food token to sustain life. The caribou have to keep moving to avoid predators.

9. The leader calls “spring” and the caribou begin the migration north toward the calving grounds. The caribou must deposit one food token each on the journey to the river, jump across the river, deposit another token after crossing the river and proceed to the calving grounds. Caribou who do not successfully jump across the river are dead of exhaustion and must go to the calving grounds where they can rejoin the game.

10. Caribou who successfully crossed the river must now run with their hands on their knees to represent the extra energy it takes to travel while pregnant with an unborn calf.

11. When the caribou arrive at the calving grounds, they must each deposit one food token. Any caribou who has at least two food tokens left may choose a calf and give one token to the calf. The wolves do not follow the caribou into the calving grounds. This represents the time wolves spend raising their families.

12. The river participants empty the token pails, allocating five per caribou to the summer range and one per caribou to the winter range in preparation for round two (year two). The leader or recorder records the population of surviving caribou and newborn calves by having the caribou show their food tokens. These are then collected and redistributed to the summer range. Caribou who have no remaining food tokens die and stay in the calving grounds until the next round. Caribou who only have one food token remaining survive but do not reproduce.

13. Wolves compare food tokens. The wolf who has the most food tokens is able to reproduce and goes to the calving ground to select a wolf pup who will join the hunt in the next round. Any wolf who does not have at least 25 tokens starves, deposits all food tokens into one of the pails and goes to the calving grounds to await the next round.
14. The hunter must have at least 12 tokens to survive. If he has more, he can go to the calving grounds to select a participant to join him in the hunt for the next round. All his food tokens must be deposited into one of the pails before the next round.
15. Round two and succeeding rounds begin with summer on the tundra and with the caribou collecting food tokens in preparation for the migration. The recorder should also record the number of wolves and hunter each round.
16. After about four rounds, stop the play and discuss what the participants observed about the life cycle of the barren-ground caribou.

Extensions

Play the game with an increased number of hunters and allow the hunters to travel throughout the caribou range. This represents the recent increasing population of First Nation hunters and their changes in technology such as automatic rifles, snowmobiles and use of aircraft to travel to the herds' locations.

What effect does this have on the caribou population? Can participants predict what would happen to the caribou herd if the size of the annual hunt were not controlled?

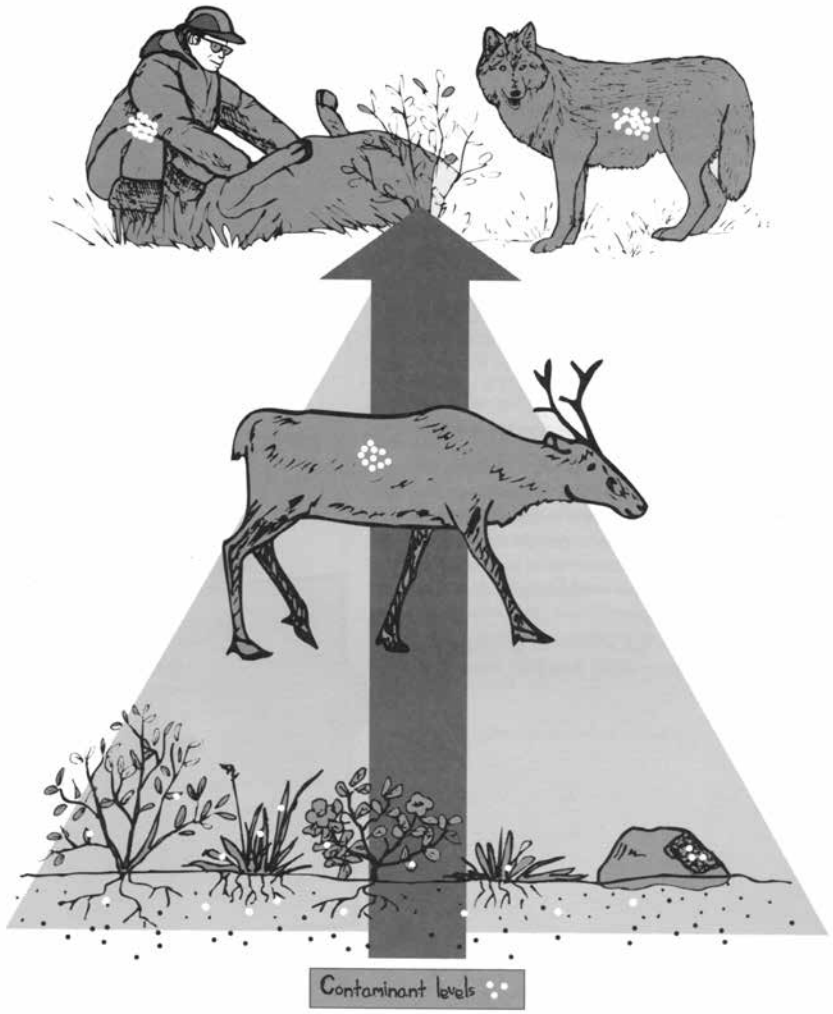
In Saskatchewan, Manitoba, Nunavut and the Northwest Territories, the food replacement value of the meat from the Beverly and Qamanirjuaq barren-ground caribou herd is well over $15 million annually.

The population statistics for the caribou, wolves and hunters can be transferred to a graph in different colours. Wildlife biologists estimate an acceptable loss to the herd is about 5% in any one year, or about one participant in 20.

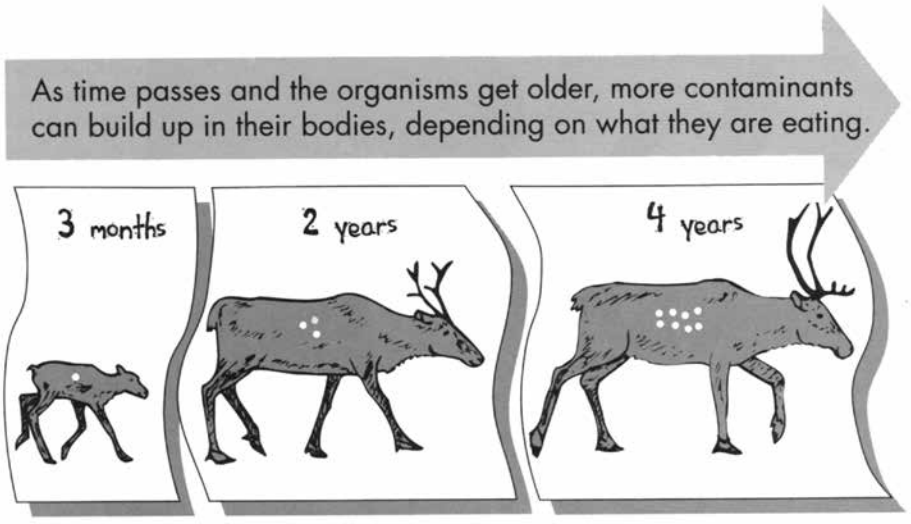
Evaluation

1. Ask the participants to describe the stages in the annual barren-ground caribou migration.
2. Ask the participants to list the hazards caribou face throughout the year from their physical environment and from predators (including hunters).
3. Discuss how recruitment to the herd helped to offset losses due to hunting and predators.
4. Discuss what hunters might do if the wolves are predating too heavily on the caribou herd.

Biomagnification



Bioaccumulation



Bioaccumulation: the story of time

(Adapted from *Contaminants Found Me* by the Yukon Contaminants Committee)

Objectives

Students should be able to:

1. Understand that contaminants occur naturally and will accumulate in organisms over time.
2. Play an active game that allows them to understand how contaminants build up in caribou over time.

Background

Naturally occurring substances are found in the soils of the earth. These substances originate from the rock under the soil. Rock contains a variety of elements. The roots of the willow or any plant might absorb these elements. Some plants absorb some elements more easily than other plants. Willow, for example, absorbs cadmium more readily than does dogwood. Elements absorbed from some soils may be in amounts that can cause environmental or human health concerns.

Caribou eat great quantities of lichens. Lichens do not have a root system that can absorb contaminants from the soil. However, lichens are sensitive to airborne contaminants, either naturally occurring (such as volcanic activity or forest fires) or human-made (such as pollution or radio-nuclides).

It is useful for people to know at what amounts essential elements become harmful, and where in an organism these elements will concentrate. Cadmium tends to concentrate in an animal's liver or kidneys. Mercury concentrates in the brain. Aluminum concentrates in bones. These metals are water soluble, but may be difficult to eliminate. "Organochlorines" (PCBs, toxaphene or DDT) concentrate in fatty tissue and are more difficult for an organism to eliminate.

"Biomagnification" is a process whereby an animal eats a plant or another animal, consuming the contaminants stored in that organism. Contaminant values increase, or magnify, with each "trophic level." Trophic levels are successive levels of nourishment in a food chain.

"Bioaccumulation" is a normal and essential process for the growth and nurturing of organisms. All animals bioaccumulate vital nutrients daily. Bioaccumulation also refers to the building up of contaminants in the body over time, as animals eat food or drink water containing the contaminants. Contaminants are either water soluble or fat soluble. Contaminants such as organochlorines are fat soluble. They are not easily eliminated from organisms. Contaminants such as metals are water soluble and are more readily eliminated through normal bodily functions.

Method

1. Select four students to represent caribou and assign them letters A through D.

Age

Grades 6 – 8

Subjects

Science, Math, Physical Education

Skills

Concept development, application, counting, physical mobility

Duration

20 minutes

Setting

Outside or gymnasium

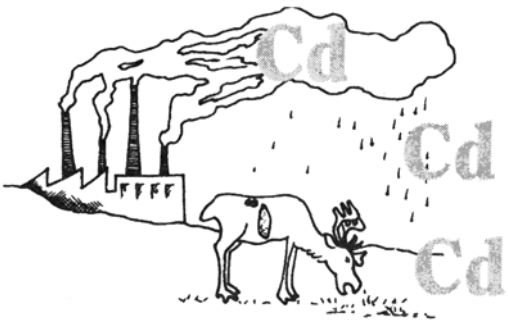
Materials

- Stopwatch or clock with a second hand
- Chart paper
- "Bioaccumulation" illustration on page 40
- Tokens with a value of 5. For a class of 20 students, you will need approximately 10 sheets of tokens. (A photocopy master is on page 43.)

Adaptations for different ages

Primary: Play a simplified version of the game.

Senior: Make the game more complicated. Introduce various kinds of shrubs and their different abilities to absorb different elements. Have several caribou play at once. To show the effects of contaminants, place a limit. When caribou have gathered enough tokens to reach the limit, they die and become hunters who are allowed to tag other caribou. Watch and record the results.



2. Ask other students to be willows. Each willow holds a few tokens with a value of 5. Each of these tokens represents contaminants in the environment.
3. Set the playing area boundaries. This activity can be done in a classroom or on an outdoor playing field.
4. Play one caribou at a time. Caribou A goes first and is allowed three minutes to gather willow. Since it is the oldest, it gets the most time. Caribou B is not as old, so it is allowed two minutes to gather willow. Caribou C is younger still, and is allowed one minute. Caribou D is a calf and is allowed only 30 seconds.

   The object of the game is for each caribou to tag as many willows as possible. When a willow is tagged, it must give the caribou one token only, then scatter. Encourage willows to keep moving, refraining from standing still and handing tokens to caribou. A willow can be tagged a number of times, handing out as many tokens as required.
5. Count and record tokens on chart paper after each caribou has had its turn.

Results

The oldest caribou usually gathers the most tokens, and the youngest caribou gathers the least. An extremely fast caribou will collect more tokens, therefore simulating the accumulation of more toxins. In discussion with the group, point out that individual caribou in nature may indeed gather more food and contaminants due to access to better food sources. Regardless of the actual amounts, bioaccumulation takes place to lesser or greater degree.

Variations

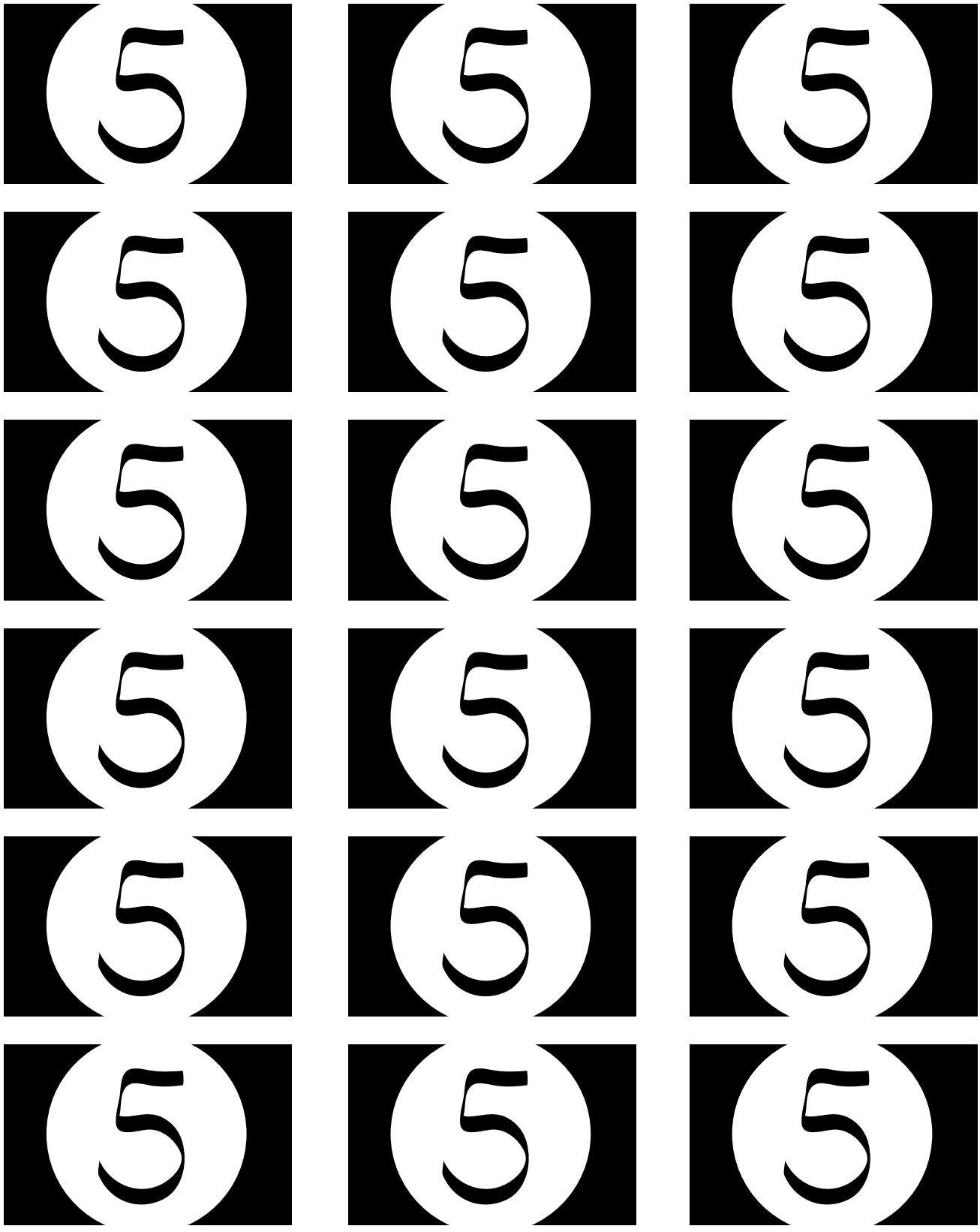
1. Mark some of the tokens with a “C” to signify contaminants and others with an “N” to signify nutrients. Discuss ‘acceptable’ and ‘unacceptable’ levels of contaminants. When the caribou have gathered an unacceptable number of contaminant tokens, have them become willows.
2. Experiment with times and numbers of contaminant tokens.

Extensions

1. Do a classroom case study on contaminants and caribou.
2. Study the effects of an industrial accident such as a nuclear meltdown or an oil spill. Map the way that contaminants move through the environment.

Evaluation

1. Discuss what contaminants are.
2. Ask students to define biomagnification and explain how it works.
3. Ask students to define bioaccumulation and explain how it works.



Age

Grades 5 – 10

Subjects

Drama, Biology

Skills

Comparison, identification, physical mobility, visualization, research

Duration

Two 45-minute periods

Group size

25

Setting

Indoor/outdoor

Materials

- Cartoon caricatures of parasite life cycles are on pages 47 to 50
- Costumes and props, elaborate or simple
- Warbles: branches
- Caribou: blanket, straws
- Bot flies: straws, rice, blanket, extended tube, fake dog doo
- Tapeworm: suction cups, tape measure

Bot fly boogie

Objectives

Students should be able to:

1. Recognize caribou parasites.

2. Illustrate and describe the life cycles of:

   - Bot flies
   - Warble flies
   - Tapeworms
   - Protozoa (e.g., sarcocystis)

3. Discuss the broader ecological significance of caribou parasites on caribou and the predators that prey on them.

4. Understand how to prevent parasites from spreading from caribou to humans.

Method

Students will develop and present a dramatic presentation to illustrate the life cycles of caribou parasites.

Background

Parasites are dependent on the host animals that they live with for all or part of their life cycle. Among the parasites that affect caribou are a variety of worms, insects and microscopic animals called protozoa. Parasites alone are unlikely to kill a caribou, but they may cause the animal to be weak, malnourished, or generally in poor condition. They may also distract them to the point where predators are able to catch them more easily.

Some of the parasites and diseases affecting caribou can be passed along to humans, if they pass through the intermediary host: dogs and wolves. All can be avoided by thoroughly cooking affected caribou organs and meat before eating and/or feeding to dogs.

Tapeworms

Several tapeworms can be found in caribou. The immature forms of the tapeworms hatch from eggs inside the caribou and form themselves into cysts on the caribou's organs or muscles. If an infected caribou is killed and eaten by a wolf or dog, the cysts hatch into tapeworms that live in the predator's gut. Some kinds of tapeworms can be up to five metres long! These adult tapeworms lay eggs that pass out in the wolf's droppings. The eggs end up on plants that caribou eat, and the cycle continues.

Roundworms

Thread lungworms, also known as roundworms, live in the lungs of caribou, where they lay their eggs. The eggs hatch into tiny, immature worms. These worms migrate up a caribou's windpipe and are eventually swallowed, passing through the digestive system and ending up in the

caribou's feces. They continue growing on vegetation and, if eaten by another caribou, travel through that caribou's bloodstream to reach the lungs, beginning the cycle again. Thread lungworms can cause pneumonia in caribou.

Warble flies

Several fly species parasitize caribou year-round. Warble flies, which look like small bumblebees, chase caribou around during the late summer and lay their eggs in the caribou's hair on the leg and flank. Larvae hatch from these eggs, burrow through the caribou's skin, and migrate to the animal's back. Here they form cysts and live through the winter, poking a small hole in the caribou's skin through which to breathe. The next spring, the larvae pop out through the breathing hole and develop into an adult fly. These flies only live for about a week, during which time they search for another caribou on which to lay their eggs and continue the cycle. Warble fly larvae are edible and considered a delicacy by some Inuit.

Nose bot flies

Female nose bot flies deposit larvae near the nose opening of the caribou in the summer. The larvae hatch and attach themselves to the inside walls of passages behind the caribou's nose. Over 150 nose bot larvae have been found in a single caribou. This many can make breathing difficult, especially if the caribou is running fast. The larvae grow all winter. In the spring, the annoyed caribou sneeze out the bots, and they grow into bumblebee-like flies.

Protozoa

Protozoa are primitive, one-celled animals. They can't be seen by humans except under a microscope. One kind of protozoa, Besnoitia, can cause caribou bones and tendons to become pitted and rough. It is believed to be passed on by biting insects such as black flies. Sarcocystis (see diagram in "Bot fly boogie" activity) has a life cycle similar to that of tapeworms. Giardia (sometimes call "beaver fever" in humans) is contracted through infected drinking water.

Procedure

1. Introduce students to the concept of parasites and provide them with background information.
2. Divide students into groups and assign each group a parasite. Provide them with the appropriate life cycle illustration.
3. Have each group research their specific parasite using available materials.
4. Ask each group to prepare a dramatic presentation enacting its parasite's life cycle.
5. Have each group make its presentation to the other students without disclosing which parasite they are depicting.

6. As the other students are viewing the presentations, ask them to try to guess which parasite is being portrayed, writing its name on a secret ballot.

Variations

1. Have the students portray the event first from the parasite's perspective and then from the caribou's perspective.
2. Have the students make their own drawings of parasites and their life cycles.

Extensions

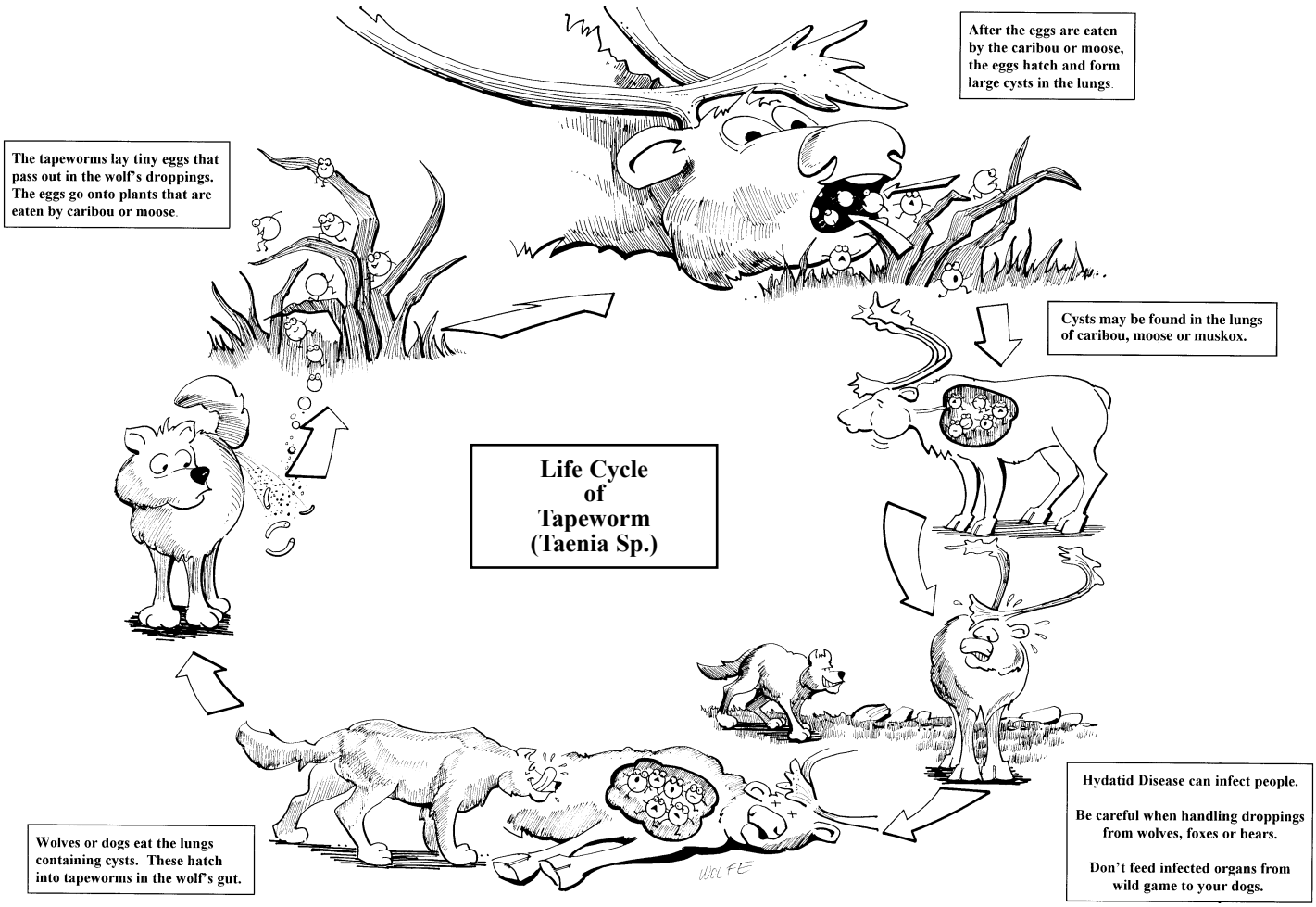
1. Have students research some parasites that live on humans.
2. Look at some actual parasites, using a microscope if available.

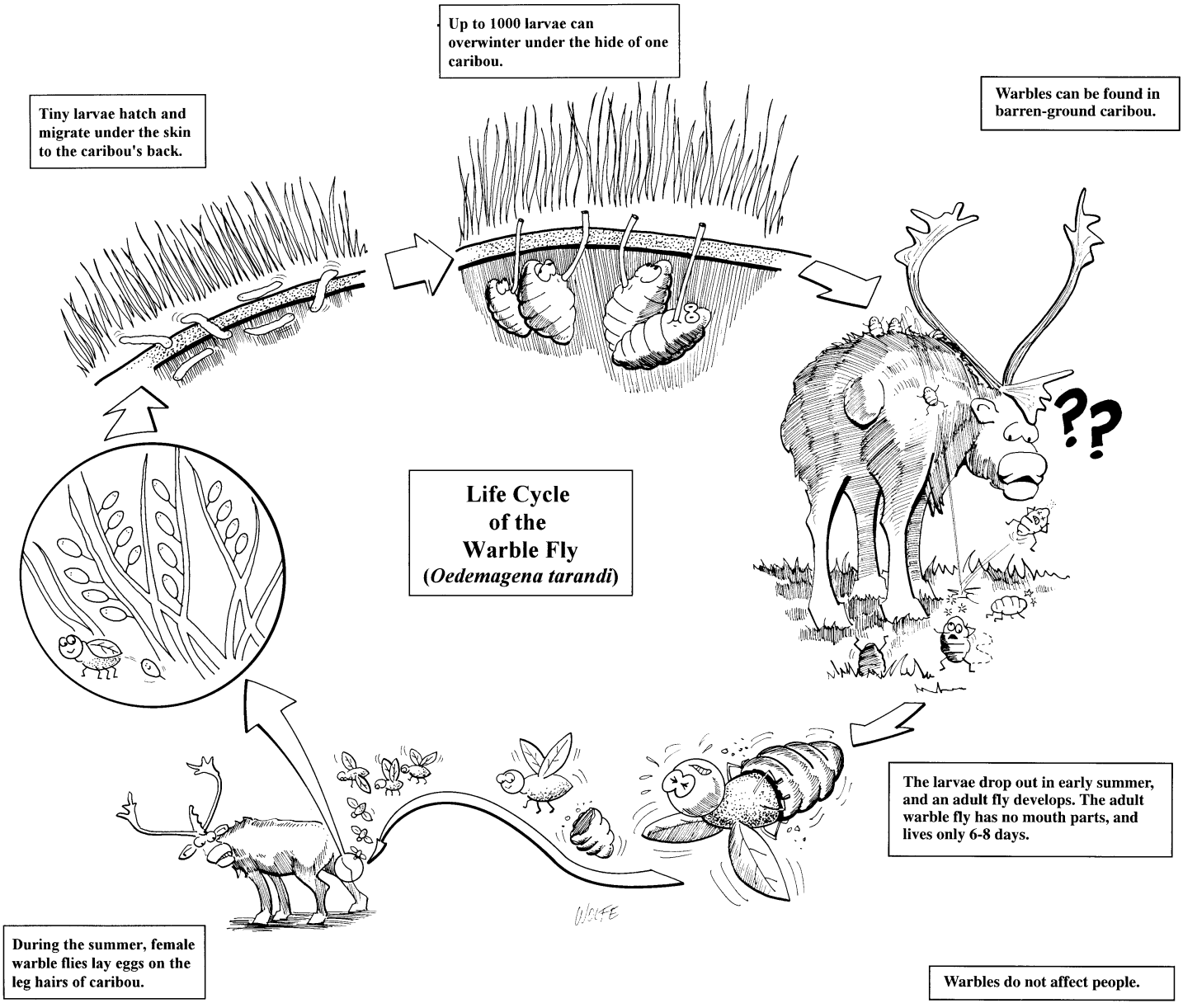
Evaluation

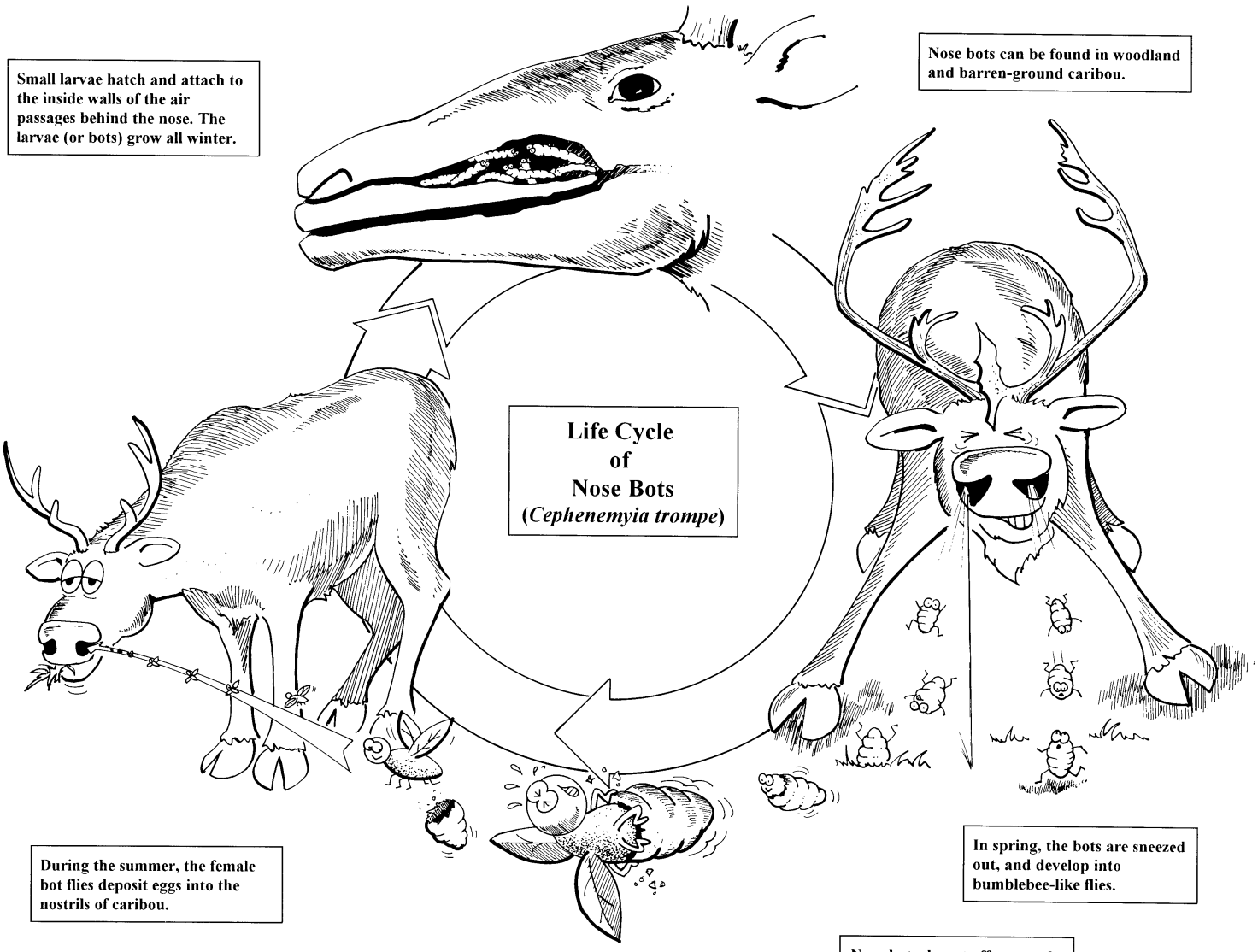
1. Discuss what parasites are.
2. Ask students to name three parasites that live on caribou.
3. Discuss whether humans act as hosts for parasites.
4. Discuss whether some parasites may be useful to their host animals.

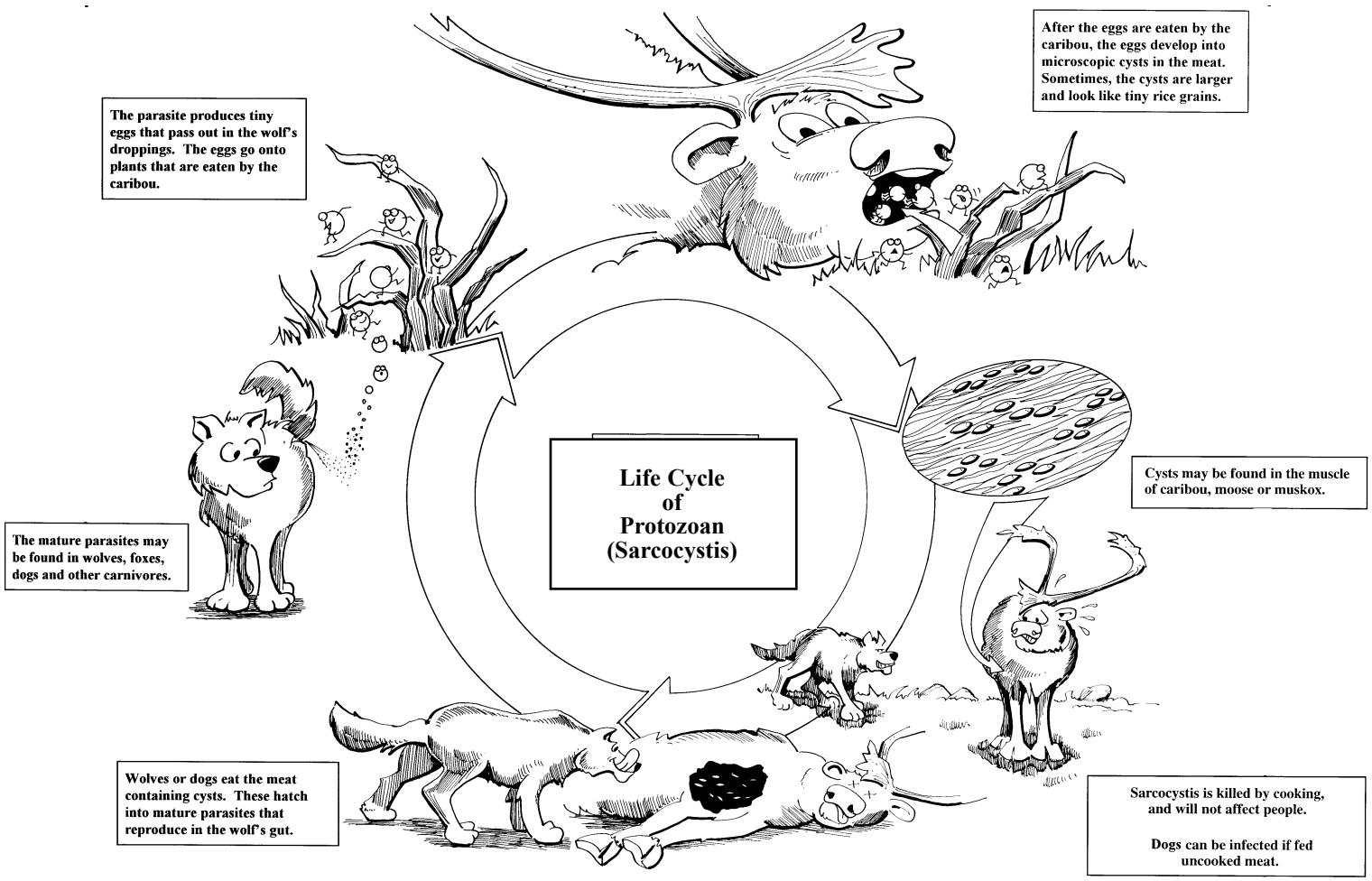
Adaptations for different ages

Primary: Working with the entire class, study one parasite and how it uses its host during its life cycle. Then divide the class into several groups and have them act out the parasite's life cycle.


Life Cycle
of
Tapeworm
(Taenia Sp.)
After the eggs are eaten by the caribou or moose, the eggs hatch and form large cysts in the lungs.
Cysts may be found in the lungs of caribou, moose or muskox.
Hydatid Disease can infect people.
Be careful when handling droppings from wolves, foxes or bears.
Don't feed infected organs from wild game to your dogs.
Wolves or dogs eat the lungs containing cysts. These hatch into tapeworms in the wolf's gut.
The tapeworms lay tiny eggs that pass out in the wolf's droppings. The eggs go onto plants that are eaten by caribou or moose.


Up to 1000 larvae can overwinter under the hide of one caribou.
Warbles can be found in barren-ground caribou.
Tiny larvae hatch and migrate under the skin to the caribou's back.
??
Life Cycle of the Warble Fly (*Oedemagena tarandi*)
The larvae drop out in early summer, and an adult fly develops. The adult warble fly has no mouth parts, and lives only 6-8 days.
During the summer, female warble flies lay eggs on the leg hairs of caribou.
Warbles do not affect people.


Small larvae hatch and attach to the inside walls of the air passages behind the nose. The larvae (or bots) grow all winter.
Nose bots can be found in woodland and barren-ground caribou.
Life Cycle of Nose Bots (*Cephenemyia trompe*)
During the summer, the female bot flies deposit eggs into the nostrils of caribou.
In spring, the bots are sneezed out, and develop into bumblebee-like flies.
Nose bots do not affect people.


Life Cycle of Protozoan (Sarcocystis)
The parasite produces tiny eggs that pass out in the wolf's droppings. The eggs go onto plants that are eaten by the caribou.
After the eggs are eaten by the caribou, the eggs develop into microscopic cysts in the meat. Sometimes, the cysts are larger and look like tiny rice grains.
Cysts may be found in the muscle of caribou, moose or muskox.
Sarcocystis is killed by cooking, and will not affect people.
Dogs can be infected if fed uncooked meat.
Wolves or dogs eat the meat containing cysts. These hatch into mature parasites that reproduce in the wolf's gut.
The mature parasites may be found in wolves, foxes, dogs and other carnivores.

Build-a-caribou

(Adapted from a concept developed by Doug Urquhart)

Objectives

Students should be able to:

1. Describe adaptations of caribou to their environment.
2. Describe how adaptations can help caribou survive in their habitat.
3. Build a model caribou with exaggerated body parts, symbolizing the caribou's adaptations.

Method

Students learn about caribou adaptations by building models of caribou, highlighting these adaptations.

Background

Animals are the products of countless adaptations over long periods of time. Adaptations increase the animals' likelihood of surviving in their habitat. When a habitat changes, either slowly or catastrophically, the species of animals with adaptations that allow them many options are the ones most likely to survive. Species that have adapted to a very narrow range of habitat conditions are extremely vulnerable to change and may be more susceptible than other animals to death or extinction. Some animals from Beringia still survive today, for example, yet others have become extinct.

Caribou were living in North America during the last few ice ages (Wisconsin and Illinoian). Caribou have evolved over a million years of glacial influenced climates. Thus, caribou have developed adaptations allowing them to thrive in landscapes covered in snow and climates of cold temperatures.

Caribou can truly be called "chionophiles," a word that means snow-loving animals. Caribou have physical and behavioural characteristics that help them survive cold winter environments. Their shape, for example, plays a role in keeping them warm. Caribou have compact bodies, small tails and short ears. These features reduce surface area and thus the amount of heat that can be lost through the skin. In contrast, snakes have long, skinny bodies to increase their surface area so that they can regulate their body temperature through their skin.

To keep the heat in, caribou have two layers of fur covering their bodies and their ears, noses and muzzles. They have fine, crinkly underfur and a thick coat of guard hairs on top. The guard hairs are hollow. The air cells in this hollow hair act as insulation, keeping in the caribou's body heat. The hollow, buoyant hair and large flexible feet of the caribou also make them excellent swimmers. Many caribou herds cross wide stretches of open or fast-moving water during their migrations.

Age

Grades 3 – 8

Subjects

Science, Art

Skills

Analysis, application, classification, invention

Duration

Two 45-minute class periods

Setting

Indoors

Materials

- Pipe cleaners
- Pop cans
- Empty toilet paper rolls or pieces of cylindrical wood
- Brown or beige felt
- Fake fur
- Art supplies and materials that can be used to create "symbolic" caribou body parts

Caribou further regulate their body temperature through their short, thick muzzles (the part of the head that includes the nose and mouth). This muzzle acts as a heat exchanger, warming and cooling air to reduce heat and moisture loss as the caribou breathe in and out.

Summer may be the most difficult season of the year for caribou. At this time, they go to alpine snow patches to cool off and to escape the insects that torment them. Barren-ground caribou search out windy areas on the coastal plain for the same reasons.

The hooves of caribou are large and wide. They work in the same way as people's snowshoes to help the caribou travel over the snow with less effort. Caribou have two small toes called "dew claws" and two large, crescent-shaped toes that support most of their weight. In the winter, the fleshy pads on these toes grow longer and form a tough, hornlike rim. Caribou use these large, sharp-edged hooves to dig through the snow and uncover the lichens that sustain them in winter months.

Procedure

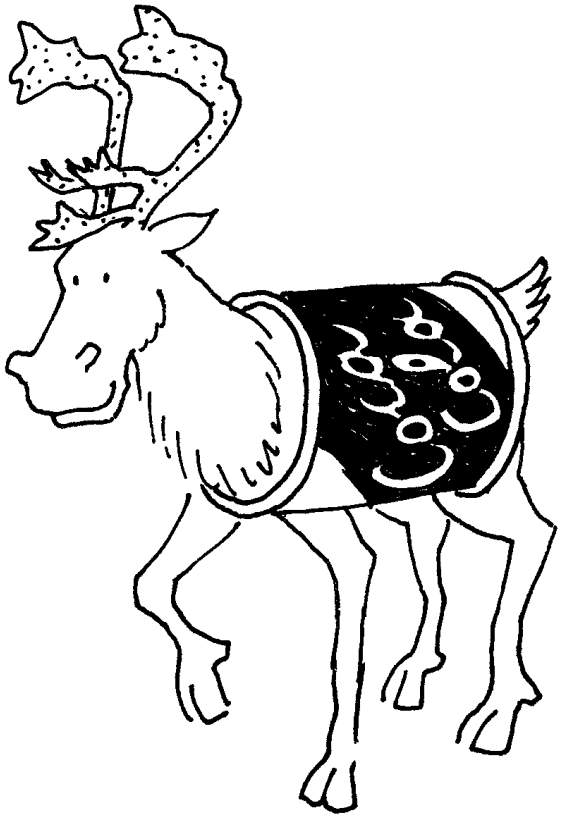
1. Discuss animal adaptations. Use examples such as long necks on giraffes to allow them to reach high vegetation, or large eyes and deep facial disks on owls, allowing them to gather light for hunting in the dark. Have students brainstorm some other animal adaptations and how they help the animal survive in its habitat.
2. Discuss and research caribou adaptations with the class, using the material given above as well as other sources.
3. Break the class into small groups. Have each group brainstorm ways to build their own caribou, using materials that symbolize caribou body parts.
4. Using available materials, have students build their own model caribou. They might use, for example, a pop can or other cylindrical object to symbolize the caribou's round body, adapted to minimize heat loss. They might use branches for antlers. They might use straw to symbolize the caribou's hollow hair. Remind the students to keep caribou adaptations in mind while they are building their caribou.
5. Have each group display their creation and explain it to the class.

Extensions

1. Discuss some other animal adaptations and how they help animals survive in their habitat.
2. Imagine that caribou were suddenly transported to a very different habitat, for example, the desert or the ocean. Draw a picture of what the caribou might look like if it had 'adapted' to its new environment.
3. Invent an animal that would be adapted to live in your neighbourhood. Consider mouth, shape, coloration, food, shelter, reproduction and other characteristics. Draw and describe your animal.

Evaluation

1. Ask students to identify different kinds of adaptations in humans.
2. Ask students to name four ways in which caribou have adapted to their environment.



Adaptations for different ages

Primary: Have students dress each other as though they were caribou, using objects to signify caribou body parts and their adaptations.

Age

Grades 4 – 10

Subjects

Biology

Skills

Evaluation, application, synthesis

Duration

One 45-minute period

Setting

Classroom

Materials

- Bingo cards made from master sheet and answer sheets (supplied in this guide)
- Bowl or bag to hold the bingo questions
- Beans, tokens, or squares of paper for marking bingo squares

Caribou bingo

(Adapted from a game developed by Margeurite Kuiack for the Yukon Southern Lakes Caribou School Program)

Objectives

Students should be able to:

1. Demonstrate their general knowledge of caribou.
2. Play a simple bingo-style game.

Note: This activity would be best used at the end of the unit as it ties everything together.

Method

Students play a variation of the bingo game that will help them demonstrate their general knowledge of caribou.

Background

This is a fun game that is intended as a simple review of the information included in this educational kit.

Procedure

1 First make up the bingo cards for your class. Photocopy a number of card sheets on page 56 equivalent to your class size. Photocopy the card answer sheets (one-half as many as your class size) on pages 57 and 58. Cut up the answers so that they can be pasted onto the bingo cards randomly under the appropriate columns. You may wish to get a student to do this.

2. Distribute prepared bingo cards to the students.
3. Cut out the bingo questions and put them into a bowl or bag. Stir them up. You may wish to give one student the task of selecting and/or reading the questions.
4. Instruct the students on the game rules. There are five categories. For each round, a question from one category will be read. The answers to the questions can be found on selected bingo boards. If your board contains the correct answer to the question read, place a marker (bean or other token) on that square. Questions will be read until someone calls “bingo!” You may call “bingo!” when five squares in a row (straight across or diagonal) are covered with markers.
5. It is up the teacher to decide whether to have students give the correct response after each question or to wait until the end of the game.
6. The game is over when a student calls “bingo!” You may wish to play several times.

Variations

1. Make up your own questions and answers that reflect caribou characteristics in your area.
2. Have the students make up their own caribou bingo game.
3. Play "blackout bingo": students cannot call "bingo!" until every square on their game cards is covered.

Extensions

Think of some other simple games that may be adapted to the caribou theme.

Evaluation

This game is intended as an evaluative tool. The students can switch game boards and play the game several times so all have the chance to be "winners."

Adaptations for different ages

Primary: This game can be simplified, using questions and answers geared to the students' age level.

Senior: Play the game with more complex questions geared to the students' age level.

Card sheet

Caribou Bingo

People and Caribou	Habitat	Adaptations and Behaviour	Conservation and management	Hazards

Card Answer sheet 1

People and caribou	Habitat	Adaptations and behaviour	Hazards	Conservation and management
Insulation	*Calving grounds*	*Chionophile*	*Wolves*	*Traditional knowledge*
Hollowed caribou hooves	*Beringia*	*Ungulates*	*Golden Eagle*	*Indicator species*
Warble flies	*Barren-ground*	*Velvet*	*Black flies*	*Satellite and radio-collaring*
Fish hooks	*Crustose*	*Pelage*	*Nose bot flies*	*Co-management*
Fish	*Fungi*	*Cratering*	*Brucellosis*	*Licences and quotas*

Card Answer sheet 2

People and caribou	Habitat	Adaptations and behaviour	Hazards	Conservation and management
Pemmican	*Low snowfall*	*Dew claws*	*Habitat encroachment*	*Aerial surveys*
Babiche	*Fall migration*	*Lichen*	*Oil and gas*	*Analyze their droppings*
Inukshuks	*Key habitats*	*Rut*	*Roads*	*Poaching*
Gold Rush	*Ecosystem*	*Tendons*	*Stress syndrome*	*Harvest study*
Trophy hunters	*Tundra*	*Females have antlers*	*Bioaccumulation*	*Composition count*

Categories, questions and answers

People and caribou

Q. Northern Indigenous people used caribou skins to make clothing because it provides excellent what? *A. Insulation*

Q. Some Indigenous groups imitated the sound of the caribou's clicking using decorative rattles made out of what? *A. Hollowed caribou hooves*

Q. Which caribou parasite is considered a delicacy by some Inuit? *A. Warble flies*

Q. Caribou bones were used by arctic peoples to make ornaments, needles and what else? *A. Fish hooks*

Q. In some Inuit and Dene cultures it was bad luck to eat caribou and what on the same day? *A. Fish*

Q. Caribou meat that is pounded and mixed with berries and grease is called what? *A. Pemmican*

Q. Rawhide that is stretched into strips and dried is called what? *A. Babiche*

Q. What is the name of the stone figures built by Inuit that resemble human figures? *A. Inukshuks*

Q. In the late 1800s/early 1900s, caribou were harvested by professional meat hunters to feed people participating in what? *A. Gold Rush*

Q. People who hunt for recreation and not subsistence are sometimes called what? *A. Trophy hunters*

Habitat

Q. Barren-ground caribou give birth in special areas called what? *A. Calving grounds*

Q. What is the name of the area of Yukon and Alaska that remained ice-free during the last ice age? *A. Beringia*

Q. The family of caribou that travel long distances to calving grounds north of tree line are called what? *A. Barren-ground*

Q. Lichens that are flat and attach themselves to rocks are called what? *A. Crustose*

Q. Lichens are made up of two kinds of plants, algae and what? *A. Fungi*

Q. Caribou need winter habitat that has what characteristic? *A. Low snowfall*

Q. As cold weather approaches, caribou band together and begin their annual what? *A. Fall migration*

Q. Areas that are of prime importance to the survival of caribou herds are called what? *A. Key habitats*

Q. Caribou share their habitat with a large variety of creatures. All together they make up a what? *A. Ecosystem*

Q. The treeless area in the far north of Canada is known as what? *A. Tundra*

Adaptations and behaviour

Q. What is the word that means “snow-loving animal?” *A. Chionophile*

Q. Caribou and other members of the deer family belong to a group of animals called what? *A. Ungulates*

Q. The layer of fuzzy skin covering the caribou’s antlers is called what? *A. Velvet*

Q. The hair that covers the body of the caribou is called what? *A. Pelage*

Q. When caribou dig through the snow with their wide hooves in search of lichens it is called what? *A. Cratering*

Q. The caribou’s two small toes are called what? *A. Dew claws*

Q. What is the caribou’s main winter food? *A. Lichen*

Q. The mating season of caribou and other ungulates is called the what? *A. Rut*

Q. The ‘clicking’ sound made by the caribou’s feet is caused by bones and what? *A. Tendons*

Q. What makes caribou different from other members of the deer family? *A. Females have antlers*

Hazards

Q. Which animals are the major predators of most caribou herds? *A. Wolves*

Q. Which bird of prey will hunt for newborn caribou calves? *A. Golden Eagle*

Q. What is a bloodsucker that persistently torments caribou during the summer? *A. Black flies*

Q. The larvae of which parasite is sneezed out of caribou’s noses? *A. Nose bot flies*

Q. Which bacterial disease causes caribou to abort or give birth to weakened calves? *A. Brucellosis*

Q. A large housing subdivision built in an area that is used during the winter by a caribou herd might be called what? *A. Habitat encroachment*

Q. What kind of development is proposed for the calving grounds of the Porcupine caribou herd? *A. Oil and gas*

Q. Which linear constructs may affect the movements of migrating caribou herds? *A. Roads*

Q. If caribou are chased by snow machines or aircraft, the resulting violent exertion may cause what? *A. Stress syndrome*

Q. What is it called when contaminants such as metals like cadmium, aluminum and mercury build up in animals? *A. Bioaccumulation*

Conservation and management

Q. What is one name for values and practices gathered by northern people through centuries of observing caribou behaviour? *A. Traditional knowledge*

Q. Large mammals like caribou that can give information about the health of other members of their ecosystem are called what? *A. Indicator species*

Q. What kind of research method allows scientists to track the movements of individual caribou year-round? *A. Satellite and radio-collaring*

Q. What is it called when several agencies, organizations or governments work together to manage wildlife? *A. Co-management*

Q. What are some ways that wildlife managers can restrict the number of caribou being hunted? *A. Licences and quotas*

Q. What is one way that biologists count the number of caribou in a herd? *A. Aerial surveys*

Q. What is one way that biologists can study caribou food habits? *A. Analyze their droppings*

Q. What is it called when an animal like caribou is hunted illegally? *A. Poaching*

Q. What is it called when biologists use questionnaires and do interviews with hunters? *A. Harvest study*

Q. What is it called when biologists try to estimate the numbers of bulls, cows and calves in a herd? *A. Composition count*

Age

Grades 4 – 8

Subjects

Science, Visual Art, Social Studies

Skills

Discussion, description, analysis, drawing, evaluation, research

Duration

Two 45-minute class periods

Setting

Classroom

Materials

- Books and other resources on Beringia
- Two very large sheets of paper or poster board suitable for creating a large diorama
- Paper and drawing supplies
- Double-sided tape or other removable fastening material

Caribou and mammoth together?

Objectives

Students should be able to:

1. Recognize that caribou are an ancient deer that have been in existence for millions of years.
2. Describe how a good portion of northern Canada and Alaska, known as Beringia, was never glaciated.
3. Identify some of the animals that lived during the time of Beringia.

Method

Students will learn about Beringia and the animals, including caribou, that lived at the time. They will use their knowledge to create a diorama of animals at the time of Beringia and today.

Background

During the last ice age, when most of North America was covered by thick sheets of ice, parts of what is now the Yukon and Alaska remained ice-free. This refuge, or *refugium*, is called Beringia. The animals and plants that lived there escaped the glacial onslaught. Caribou were present at the time of Beringia and ranged the same areas as the woolly mammoth, steppe bison, camel and giant beaver. Many of these exotic animals did not outlast the cold climate, but some of the Beringian animals that did survive include caribou, moose, muskox and grizzly bears.

The caribou is an ancient relative of the deer that may have originated in northeastern Asia or northwestern North America. The earliest fossils of caribou date back 1.5 million years and were found at Fort Selkirk, Yukon. Caribou were living in North America during the last few ice ages (Wisconsin and Illinoian). They have evolved over a million years of glacial-influenced climates. Because of this, caribou have developed adaptations that allow them to thrive in landscapes covered in snow and in cold climates.

Procedure

1. Share information about Beringia with the students.
2. Have students do independent research on Beringia, studying the climate, environment and the variety of animals that lived during that time.
3. Divide the students into two groups. Ask one group to create a mural of a Beringian landscape as it may have looked in the past, using a large piece of paper or poster board. Ask the students not to add any animals to the dioramas. Tape the paper to a wall so that all the students can work at once on different parts of the mural.

4. On a second large piece of paper, have the second group of students create a mural of the environment of an area of the northern Yukon as it looks today. Again, ask the students not to add any animals to the dioramas.
5. When the landscape posters are complete, ask the students to draw some pictures of Beringian animals on cardboard or sturdy paper. Some examples are mammoth, giant beaver, hyena, large camel, giant moose, giant pica, short-faced skunk, and ground sloth. Other, more familiar examples are caribou, muskox and grizzly bear. Have the students cut out the pictures they have drawn
6. Attach double-sided tape or other fastener material to the back of the animal cutouts.
7. Place the cutouts on the Beringia mural. Experiment with which animals can also be placed on the present-day mural. As you move the animals back and forth, have students think about the following questions: Which animals from Beringia, besides caribou, are still found in Yukon and Alaska today? Which animals have relatives that survive today? Are they all in Canada? Animals such as the camel are no longer found here. Why not? How have animals adapted to the changing temperatures? Which Beringian animals are now extinct?

Variations

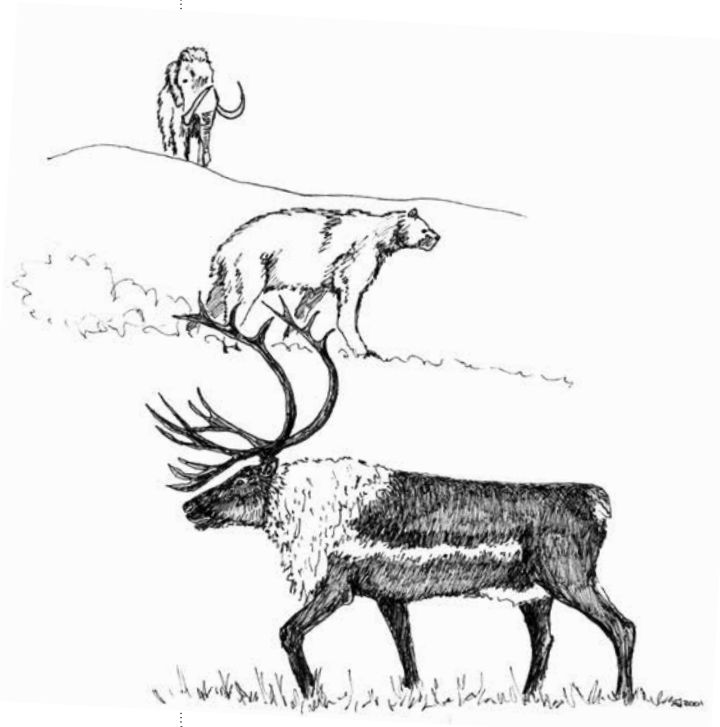
Have each student do an individual research project on a Beringian animal.

Extensions

Take the class on a field trip to the Yukon Beringia Centre, if in Yukon, or to another museum of prehistory.

Evaluation

1. Ask students to name two kinds of animals that lived in the time of Beringia and are now extinct.
2. Ask students to name two kinds of animals that lived in the time of Beringia and still exist today.
3. Ask students to explain what a refugium is.



Age

Grades 2 – 5

Subjects

Social Studies, Science

Skills

Analysis, application, discussion, drawing, mapping, evaluation

Duration

30 – 90 minutes

Group size

Any

Setting

Indoors

Materials

- Pencil and paper
- Playing cards (or other polygon shapes)
- String
- Sample floor plans (optional)

Caribou need a home, too!

Objectives

Students should become aware that human activities can have an impact on caribou.

Method

Students draw floor plans for houses and then consider the effects on their activities of removing some of the space from use. The process is repeated for caribou ranges.

Background

Caribou require large ranges that meet their habitat requirements for food, water and shelter from predators, insects and weather. Caribou ranges include calving grounds, summer range, migration routes, winter range and other seasonally important areas. Human disturbance may prevent caribou from accessing critical habitat, destroy habitat or disrupt the movement of caribou herds.

Procedure

1. Have students brainstorm their daily living needs and the kinds of rooms they have in their homes to meet those needs.
2. Have each student or pair of students draw a floor plan of a house including rooms, hallways, doors, etc.
3. Give each student one or more playing cards to place anywhere on their floor plans. Then explain that these portions of their houses have been blocked off and can no longer be used. Discuss how the loss of these spaces affects the way they use their houses. Discuss where they can place the cards to have the least effect on their activities.
4. Brainstorm with the students on the habitat needs of caribou.
5. Have each student (or pair) design on paper a caribou range that incorporates all of the caribou's habitat needs.
6. Brainstorm the kinds of human activity that may occur in a caribou range. Have students place one or more playing cards over their caribou ranges. (The cards represent areas of human disturbance that may exclude caribou or alter their behaviour. String may be used to represent linear developments such as roads and pipelines.) Discuss how the disturbance could affect the activity of caribou in their ranges.

Variations

Have the students include on their range maps other animals who share their habitat with caribou. Examine with the class how other animals might be affected by changes to their habitat, and how this, too, affects caribou.

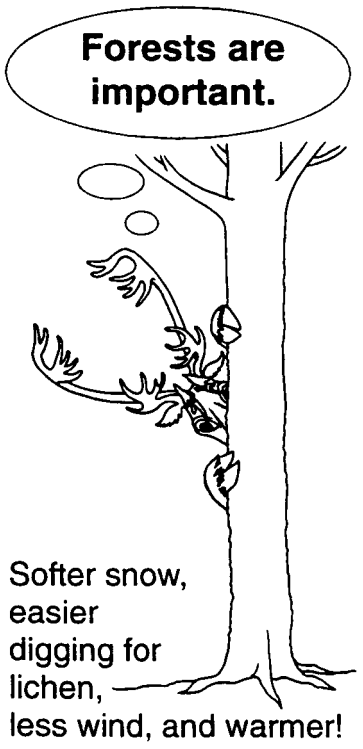
Extensions

1. Formulate research questions to test the effects of human disturbance on caribou.
2. Have the students consider both the direct and indirect effects of development. For example, a factory placed near the caribou range might remove some space from the range. This is a direct impact. However, the people who move to the town to work in the factory present an indirect impact associated with the factory. The influx of people might mean an increase in the number and type of recreational activities taking place on the caribou range. Another indirect impact would be any pollution produced by the factory that might harm plants the caribou eat.
3. Do this activity in conjunction with the "Barren-ground caribou migration" activity (page 35) for a physical demonstration of habitat disruption.

Evaluation

Discuss with students:

1. The basic habitat needs of caribou.
2. Ways that human activity can disrupt caribou's use of habitat.
3. Ways that these effects can be mitigated.



Age

Grades 6 – 12

Subjects

Science, Mathematics, Vocational Agriculture, Social Studies

Skills

Analysis, computation (calculating percentages), evaluation

Duration

Two 45-minute periods

Group size

Any

Setting

Indoors

Materials

- Paper and pencils
- Condition, reproduction and management cards (photocopy masters on page 69 to 72)
- Dice: one per student

Checks and balances

(Adapted from *Project WILD Activity Guide*)

Objectives

Students will be able to:

1. Evaluate hypothetical wildlife management decisions.
2. Identify at least four factors that can affect the size of a wildlife population.

Method

Students become managers of a herd of animals in a paper-and-pencil and discussion-based game.

Background

Wildlife managers attempt to maintain healthy populations of wild animals, while many factors affect the populations. Some of these factors are loss of habitat, weather conditions, pollution of food and water sources, development of other natural resources, poaching and recreation pressures. Many people are unaware of how such pressures can affect wildlife.

In Canada, provincial and territorial wildlife agencies manage wildlife populations within their respective boundaries. The Canadian Wildlife Service, under Environment Canada, is responsible for some policies and programs affecting migratory species of animals (principally birds), as well as the import and export of animals and animal products, inter-provincial transportation of all species, and additional wildlife-related responsibilities.

Wildlife management is based on the best scientific and technical knowledge available. Such knowledge is growing; however, it is still limited and is continually affected by changes in the complex relationships between wildlife, human beings, and their shared environments.

In a sense, everyone shares responsibility for wildlife management. Although there are legally responsible agencies, their work requires the thoughtful and informed co-operation of citizens. There are frequently differences of opinion about the most appropriate policies and programs affecting wildlife. Individual citizens, private conservation groups, private industry, community groups and others all make important contributions to the overall conservation and protection of wildlife and its habitat.

The major purpose of this activity is for students hypothetically to assume the role of wildlife managers in a game situation and thus gain insight into some of the complex variables that influence stewardship of the wildlife resource.

Procedure

1. Each student is the manager of a caribou population. The carrying capacity of the habitat is 100 animals. The point of the activity is to end up with a viable population after nine rounds, representing nine years. If at any time the student's population of caribou reaches less than 10 or more than 200 individual animals, that student no longer has a viable herd and observes the other students until the conclusion of the activity.

2. Each student has a starting population of 100 animals. The cards are separated into three decks totalling 36 cards: a condition deck (18 cards), a reproduction deck (9 cards), and a management deck (9 cards). Shuffle the cards within each deck. Explain that cards will be drawn in the following sequence: condition card, reproduction card, condition card, management card. This sequence of draw will be repeated, each repetition representing an annual cycle. (The students may think of each draw as representing a different season, e.g., autumn, winter, spring, summer.) As each card is drawn, it is read aloud to the entire class. Each student then rolls his or her die and follows the instructions on the card to determine his or her herd population's new size. Some computations will result in fractions; numbers may be rounded to the nearest whole.

   Note: Students may object to the use of dice to determine the impact of decisions made for wildlife management purposes. Their concerns are appropriate; wildlife management is based on more than the chance elements reflected in the use of dice. However, chance has an impact on caribou as well, as in the case of weather conditions in a given year. Encourage the students to discuss and consider what is realistic and what is unrealistic about the impact of dice in this activity, and to recognize that wildlife management is far more complex than can be represented through this activity.

3. Wrap up the activity with a class discussion. Include topics such as:

- The apparent impacts of the condition, reproduction and management cards.
- The benefits and disadvantages of the management decisions made.
- Outcomes of the different management strategies used by different students. (Ask students to discuss how they might manage their herds differently given a second chance.)
- Realistic and unrealistic aspects of the activity.
- Examples of ways in which habitat can be improved in the short and long term.
- The necessity, benefits and disadvantages of human management of wildlife populations for both people and animals.

Variations

1. Add a monetary aspect to the activity. For example, students allowing hunting might have more revenue available for projects like habitat enhancement based on income from sale of hunting licences. Expenses might include salaries of wildlife managers, funds for research, feeding animals in severe conditions, relocation, etc.
2. After using the given cards once, students may want to experiment with changing some of the parameters on the supplied cards or making additional cards. Students may also want to make additional complete sets of cards for use by small groups or individual students.

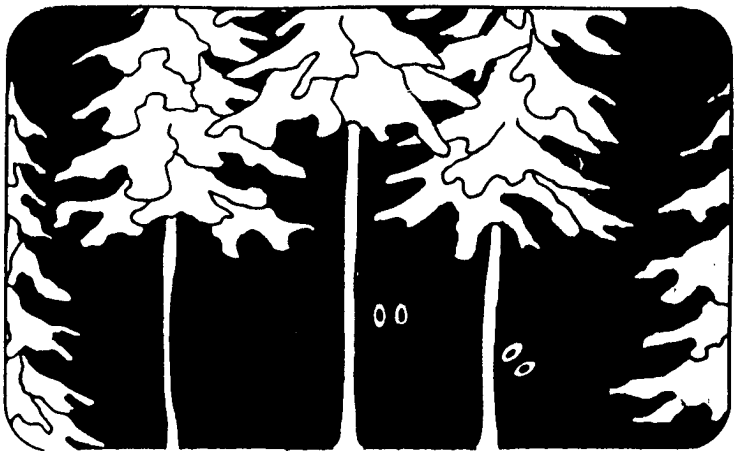
Extensions

1. Have the students do a research project on the management of a specific caribou herd.
2. Invite a wildlife manager from a local government to talk to the class about wildlife management.

Evaluation

Discuss with students:

1. Four factors that can affect the size of a wildlife population.
2. The idea that wildlife management may involve more management of people than of wildlife.



Reproduction cards

Reproduction card: excellent year

This has been an excellent reproduction year. Increase your herd by (100/your current population size) times five times your roll, if your population is over 50 individuals. If your population is between 50 and 10, increase your population by the number equal to three times your roll. If your population is under 10, you may not reproduce.

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Reproduction card: average year

This has been an average reproduction year. Increase your herd by (100/your current population size) times three times your roll, if your current population is over 50 individuals. If your population is between 50 and 10, increase your population by the number equal to two times your roll. If your population is under 10, you may not reproduce.

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Condition cards

HABITAT LOSS CARD

The building of a new mining town has occurred, destroying critical habitat. Decrease herd size by the number five times your roll.

WEATHER CARD

A cold, wet calving season has had a serious negative impact on the survival of the herd. Decrease your herd by the percentage equal to five times your roll.

HABITAT LOSS CARD

Oil and gas development of calving grounds has destroyed critical habitat. Decrease herd size by the number five times your roll.

WEATHER CARD

Swollen rivers caused by torrential rain have had a negative impact on the survival of the herd. Decrease your herd by the percentage equal to five times your roll.

HABITAT DEGRADATION CARD

An increase in logging roads has occurred, damaging critical habitat. Decrease herd by the number equal to three times your roll.

WEATHER CARD

A mild winter with little snow has had a dramatic positive impact on the survival of the herd. Increase your herd by the percentage equal to five times your roll.

HABITAT DEGRADATION CARD

Aircraft have begun flying over the herd's calving grounds. Decrease herd by the number equal to three times your roll.

WEATHER CARD

A dry summer has lessened insect harassment and had a positive impact on the herd. Increase your herd by the percentage equal to five times your roll.

HABITAT DEGRADATION CARD

Construction of a pipeline has occurred, damaging critical habitat. Decrease herd by the number equal to three times your roll.

HABITAT DEGRADATION CARD

Mineral exploration has occurred, damaging critical habitat. Decrease herd by the number equal to three times your roll.

HABITAT LOSS CARD

Oil and gas exploration has occurred, resulting in a loss of critical habitat. Decrease herd by the number equal to three times your roll.

HABITAT LOSS CARD

A forest fire has resulted in a loss of critical habitat. Decrease herd by the number equal to three times your roll.

PREDATOR CARD

An increase in the wolf population has occurred, affecting the herd size. Decrease herd size by the percentage equal to your roll.

HABITAT LOSS CARD

A hydroelectric power development has resulted in a loss of critical habitat. Decrease herd by the number equal to three times your roll.

DISEASE CARD

Disease has struck the herd. Decrease herd by the percentage equal to your roll.

HABITAT LOSS CARD

Increased traffic along a traditional migration route has resulted in a loss of critical habitat. Decrease herd by the number equal to three times your roll.

POACHING CARD

Poaching, illegal killing of animals, has reduced the size of the herd. Decrease herd by the number equal to two times your roll.

HABITAT LOSS CARD

Clearcut logging has resulted in a loss of critical habitat. Decrease herd by the number equal to three times your roll.

Management Cards

EDUCATION CARD

Project Wild and other education activities have led to increased understanding of wildlife and habitat. Increase or decrease herd (students decide which before rolling the die) by the percentage equal to two times your roll.

HABITAT IMPROVEMENT CARD

Oil and gas exploration have been stopped in the herd's calving grounds, improving critical habitat. Increase herd by five times your roll.

LAW ENFORCEMENT CARD

More Conservation Officers and law enforcement activities have protected the herd against illegal actions like poaching. Increase herd by the percentage equal to two times your roll.

HABITAT RESTORATION CARD

A national park has been created in the herd's calving grounds. Increase herd by the percentage equal to five times your roll.

HABITAT ACQUISITION CARD

Habitat acquisition has increased the area of available and suitable habitat. Increase the herd by five times your roll.

HABITAT ALTERATION CARD

A small forest fire has occurred, altering critical habitat. Increase or decrease herd (students decide which before rolling the die) by the percentage equal to two times your roll.

HUNTING CARD

A request for a hunting season has been made. Do you wish to allow hunting in your area? If yes, decrease your herd by the percentage equal to five times your roll. If no, record no change in the size of your herd.

RESEARCH CARD

A long-term study in vegetation mapping has been successfully accomplished. Increase or decrease herd (students decide which before rolling the die) by two times your roll.

PREDATOR CONTROL

An aerial wolf kill has been requested to combat the recent and rapid decline of the caribou herd population. Do you wish to allow predator control in your area? If yes, increase your herd by the percentage equal to five times your roll. If no, record no change in the size of your herd.

Co-management role play

Age

Grades 6 – 12

Subjects

Social Studies, Science, Language Arts

Skills

Analysis, application, discussion, evaluation, public speaking

Duration

Two 45-minute periods

Setting

Classroom

Materials

Role cards (photocopy masters on page 76)

Objectives

Students should be able to:

1. Understand that North America's largest caribou herds are managed cooperatively by governments and local residents who use the caribou.
2. Understand some of the different viewpoints and perspectives held by different members of co-management boards.
3. Identify social and ecological considerations where human land-use conflicts with wildlife habitat needs.
4. Understand the importance of rational land-use decisions.

Method

Students play roles of different members of a caribou management board and make a decision about a key management issue.

Background

Co-management is a process that brings local resource users and government representatives together to share the management responsibility for local or regional resources. It is an alternative approach to managing local resources that has been gaining increasing support throughout Canada. The cooperative approach to management can involve government wildlife and fisheries staff, wildlife boards, First Nations, community hunters and trappers associations, and others. These groups work together, using both scientific and traditional knowledge to manage resources.

Co-management has been used particularly with respect to Indigenous land claims. In Indigenous settlement claim areas, co-management boards are made up of both Indigenous and government appointees, working to effectively manage wildlife populations and their habitats. This approach has provided opportunities for Inuit and other Indigenous people to participate in resource management decision-making, a process from which they had largely been excluded in the past. Co-management regimes that have been established as a result of land claims are providing a new level of power sharing in resource planning and management.

There are many co-management agreements that take a variety of forms and address a range of issues. For example, the Beverly and Qamanirjuaq and Porcupine caribou management boards focus on migratory caribou that cross several jurisdictions. Other co-management boards have been created as the result of land claim settlements such as the *Inuvialuit Final Agreement*, which created a variety of co-management boards at local and regional levels. Another example is the Yukon Fish and Wildlife Management Board, which is composed of several stakeholders including

Indigenous, non-Indigenous and government groups. Co-management groups work together to meet designated needs and responsibilities, making decisions, conducting and commissioning research, and sharing recommendations and information.

In this activity, students will act as members of a caribou co-management board, representing a variety of stakeholder organizations. These representatives must work together to make decisions regarding caribou management. The activity uses a role-play strategy that illustrates the complexities of decision-making when people with different points of view are involved.

In this fictional situation, the students are members of a co-management board that works on issues relating to a relatively remote northern caribou herd. The herd ranges close to the students' community during its fall migration, and winters in forested areas near the town. A mining company has discovered valuable silver deposits in an area 50 kilometres from town and proposes to open a mine in this area. The proposed site is in a relatively rarely used part of the caribou's winter range. However, the company wishes to build an all-weather road linking the community with the mine. The road cuts through the main migration route of the caribou. The road could disturb caribou, thus affecting the number of caribou in the area and the length of time they stay near the community. It may disrupt the caribou's migration pattern and give local community hunters easier access to the caribou. Many people in your community depend on caribou for their winter meat supply. The mine and associated workers would bring economic growth to the community and provide jobs for locals. The co-management board must make a recommendation regarding the mine. The board may recommend against it, for it, or propose guidelines or modifications to the company's plans.

Procedure

1. Photocopy the role cards on page 76, one set for each group of students, and cut them up.
2. Familiarize the students with the concept of co-management as described above or as it applies to your community. Tell the students that they are going to act as members of a co-management board. Read aloud the fictional situation that will be discussed.
3. Divide the class into groups of approximately five students. Place a stack of role cards in the centre of each group.
4. Have each group member pick a card from the stack. Each student must debate the issue from the viewpoint of the person described in the role card.
5. Have one student in each group take notes on the discussion. Encourage each group to come to an agreement using co-operation and compromise.

6. At the end of the allotted time, have one student from each group read the group's recommendations. If the group has not yet reached consensus, have the student explain to the class what issues held the group up and why they were so difficult to resolve. Remind students that it is not always possible for everyone to agree.
7. You may wish to do the activity several times, giving the students a chance to play various roles. Afterwards, have the students discuss what they learned from the activity. Did playing a role affect their own opinions on the issue?

Variations

1. Use dilemma cards from the "Caribou dilemmas" activity (page 77). Debate the issues described on the cards using the students' roles as members of the co-management board.
2. Have students think up their own caribou management issues and discuss them while playing the roles of members of the co-management board.
3. Have students think up their own roles to play in the management scenario. Or have students play themselves, writing a brief description of what influences their viewpoint in a format similar to the role cards.

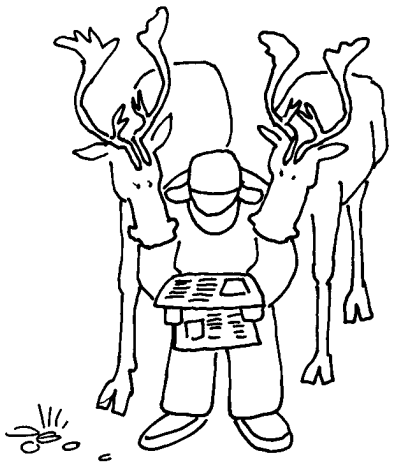
Extensions

1. Have students or groups of students research a co-management board in Canada, describing its history, purpose, members and activities.

Evaluation

Discuss with students:

1. The concept of co-management.
2. Why co-management might be necessary or useful in the management of caribou herds.



Role cards: Members of the Caribou Co-management Board

Jake or Josie Armstrong

Construction worker representing the local labour union

You and your fellow union members would be employed during road construction and also possibly in the mine. You are also an avid hunter who has supplemented your winter food with caribou for many years.

James or Janie Wilson

Wildlife biologist representing the government

You are 25, a new biologist to the area. You are not totally familiar with local issues, but you are concerned that adequate research and wildlife surveys have not been done.

Jim or Janine James

College student representing the local First Nation

You see the possibility of jobs for yourself and your friends if the mine opens, yet you are worried about the effects of the road and mine on the caribou. Your family depends on caribou meat for food. The caribou is an important part of your culture.

Elmer or Elma Friesen

Trapper representing the local trapping association

You have lived on the land for many years, trapping local fur-bearing animals. You are now in your 60s. You worry about the mine's and the road's effects on the land. You must speak for other trappers, yet you are near retirement age and might consider moving south if reimbursed generously for your trapping rights.

Larry or Louise Willis

Elder representing the local First Nation

You fear the changes the mine will bring to both the community and the natural environment, yet you know that the mine may provide good jobs for members of your community.

Fred or Freida Lewis

Business owner representing the local chamber of commerce

You own a gift shop in the centre of town. You know that new development will bring more customers to town and more money into the community and local businesses. You are also an avid skier and use trails that would be disrupted by road construction.

Heather or Harold Hakamoto

Writer representing the local environmental group

Your organization wants to protect the caribou from habitat destruction and overhunting, but you also see your community suffering from unemployment. You know the road may increase wildlife viewing and thus tourism opportunities.

Dilemmas caribou style

(Adapted from *Project WILD*'s Ethi-reasoning activity)

Objectives

Students should be able to:

1. Examine their values and beliefs related to wildlife and other elements of the environment.
2. Evaluate possible actions they might take that have an impact on wildlife and the environment.

Method

Students read, discuss, make judgements and write about hypothetical dilemmas concerning wildlife and/or natural resources.

Background

This activity is designed to give students the opportunity to examine their values and beliefs as they relate to wildlife and other elements of the environment. It is not the intent of this activity to prescribe "right" and "wrong" answers for the students, except with respect to legislation.

Laws affecting wildlife and the environment vary from jurisdiction to jurisdiction. Each jurisdiction has a wildlife agency that is legally responsible for caring for most wildlife within the province or territory. Students can contact the agency in their province or territory to request general information about laws affecting wildlife in their area. For example, it is legal to hunt and fish for some animals in all areas; however, which animals can be hunted, and under which conditions, are specified by laws and regulations for which the government wildlife agency is responsible.

There are also federal laws and regulations affecting wildlife. Students can contact the Canadian Wildlife Service for information about such laws. For example, federal law protects non-game migratory birds from shooting or any other intentional cause of death, injury or harassment. It is also generally illegal to possess nests and eggs of game birds, even those found lying on the ground. Threatened and endangered species are protected by law in some jurisdictions. It is also against the law to intentionally harm songbirds.

Caribou, like other wildlife, are affected by the guidelines and laws enacted by governments and management agencies. There are many laws, and they are complex. Again, it is useful and important to contact local authorities about the laws protecting and affecting wildlife in your area.

Whether or not students agree with certain laws and regulations, questions of law can be separated from questions of ethics. An individual's choices as to what seem right or wrong for them in terms of values and behaviours is a personal code of ethics. Hunting, for example,

Age

Grades 5 – 12

Subjects

Social Studies, Science, Language Arts

Skills

Analysis, application, discussion, evaluation, problem solving, synthesis, writing

Duration

One 30 – 45 minute period

Group size

Any, but small groups of two to four students are recommended

Setting

Indoors or outdoors

Materials

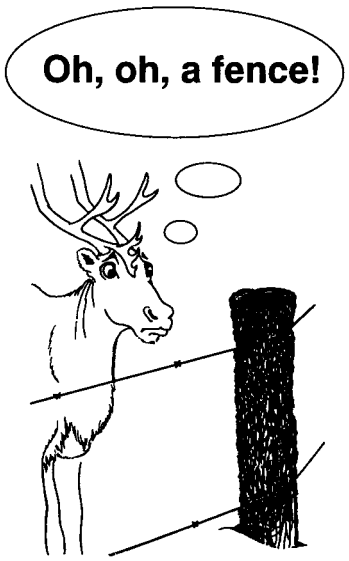
Copies of caribou dilemma cards (photocopy masters supplied in this guide)

is controversial for some people from an ethical point of view. Some people say that even though hunting is legal, it is unethical, because a human being is taking the life of a wild animal. Others believe hunting to be a responsible and ethical practice, whether as a form of recreation, for the purpose of acquiring food, or in order to control animal populations. These differences of belief may be sincerely held. Whether or not a person chooses to hunt is a personal choice dictated by one's personal ethics. Conflicts arise, however, when a person motivated by one set of ethics tries for force their ethics onto others through activities such as arguments, harassment or legislative action.

It is the purpose of this activity to provide students with an opportunity to come to their own judgments about what they think are the most responsible and appropriate actions to take in situations affecting wildlife and the environment.

Procedure

1. Photocopy and cut up the dilemma cards on pages 80 - 83. You will need one card per student.
2. Divide the class into groups of four, and give each group four different dilemma cards. Place them face down in the centre of the group.
3. Ask a student in each group to draw a card from the top of the stack. The student studies the situation, decides what he or she should do about it, and formulates his or her reasons.
4. When the student is ready – typically in less than two minutes – the student reads the situation and the options aloud to the rest of the group. The student gives the decision they have chosen and briefly describes the reasoning involved. In turn, each of the other members of the group is invited to comment on the dilemma and state what they would do in the situation. Group discussion of each dilemma should take about five minutes. The student whose dilemma is being discussed should have the opportunity to ask questions of the other members of the group and to offer clarification about their decision. The discussion gives the students experience in having ideas examined by peers and is intended to remind the students of the need to take personal responsibility for decision-making. It is not necessary and may not be desirable for the students to reach consensus; there are legitimately differing views of the most appropriate and responsible actions to take in many situations. The purpose is to provide students with an opportunity to examine, express, clarify and take responsibility for their own reasoning.
5. The card is then returned to the bottom of the stack and the next student selects a card from the top of the stack. This process continues until all students have had the opportunity to make and defend their decisions about the various dilemmas.



Caribou do not jump fences.

Variations

1. Have students make up their own dilemma cards.
2. Adapt the discussions to a debate format.
3. Have the students play various roles during the discussions. Role playing possibilities include conservationist, hunter, government worker, person who lives in a city, person who lives in a small town, etc. How do these roles change the way students look at ethical dilemmas?

Extensions

1. Have students choose issues affecting caribou and then attempt to create management guidelines that can be accepted by a wide variety of interests.
2. Have a policy maker from a local wildlife agency or First Nation organization come into the classroom and discuss the way policy decisions are made.

Evaluation

Ask students to choose a dilemma concerning caribou and write a short paragraph on the positive and negative effects of all the options listed for that dilemma. Students should identify what seems in their judgment to be the most responsible decision and explain their reasoning. Students should also indicate what additional information, if any, is needed in order to make a responsible and informed decision.

Adaptations for different ages

Primary: Using simplified versions of the dilemmas, have the students discuss how they feel about them. Ask the students to think about where their opinions on these issues come from. Have the students think about possible sources they could go to for more information about wildlife issues.

CARIBOU DILEMMA CARD #1

You are a member of an environmental group that supports animal rights. However, the caribou population in your area is so high that it is eating all of the food resources very quickly. The data that researchers have collected suggests that if nothing is done, the population will crash in less than 10 years due to a food shortage. Wildlife managers have suggested that the number of caribou must be reduced in order to protect the entire population from starvation in the future. However, some members of your group have argued that killing is not a suitable way to limit the population. Your group must vote to decide how to deal with this problem. Do you:

- Vote to allow hunters to kill more caribou?
- Vote to leave the caribou population alone to regulate itself naturally?
- Take some other course of action?

CARIBOU DILEMMA CARD #2

Two years ago you bought and began using a cottage located near a lake. Recently, researchers have determined that a local caribou herd has stopped using the area around your cabin because your presence is scaring them away. They have found that this is an important area during the time that the calves are being born because the lake has many islands which wolves cannot reach. Do you:

- Keep using your cabin and hope the caribou will get used to you?
- Try to keep quiet when at your cabin to minimize the disturbance?
- Sell your cabin and find one somewhere else to go?
- Move your cabin out of the area?
- Take some other course of action?

CARIBOU DILEMMA CARD #3

You are a wildlife biologist. One of the most southerly woodland caribou populations in North America is located on an island several miles offshore in an inland lake. There are no predators on this island. This area has the highest known density of woodland caribou in the world, specifically because there are no wolves. During a recent severe winter, the lake froze from the mainland to the island, and two wolves travelled to the island. The sex and age of these wolves is not known, but it is possible that they will breed, increase in number, and dramatically reduce the caribou population over time. Do you:

- Consider this a natural situation and monitor the establishment of the wolf population and the expected negative impacts on the caribou population, then publish your results?
- Try to kill the wolves before they can breed and increase in number, so that this unique caribou ecosystem will remain?
- Establish a committee to study the question?
- Do nothing?
- Take some other course of action?

CARIBOU DILEMMA CARD #4

You are a hunter out searching for a moose during hunting season. You spot one and shoot it, but when you get up close to it, you realize that it is actually a woodland caribou, which cannot be legally hunted in this area. Do you:

- Bury the caribou in the snow?
- Inform the Conservation Officer that you found a caribou carcass that someone shot?
- Tell the Conservation Officer that you shot a caribou by mistake?
- Take the caribou home to eat?
- Take some other course of action?

CARIBOU DILEMMA CARD #5

You are a wildlife biologist who has been contracted by the government to conduct research on barren-ground caribou. One of the projects important to your research involves capturing animals and outfitting them with satellite collars. This will allow you to track their locations with a high degree of accuracy. When seeking project support you discover two conflicting views. Many Elders feel that this practice shows great disrespect to the animals and are morally opposed to it. On the other hand, a majority of hunters is in support because it will help them better understand the caribou and allow them to travel directly to the herd, saving a great deal of time and money. Do you:

- Abandon plans to satellite-collar caribou?
- Work with the community to find alternate ways of collecting the data you need?
- Ignore the views of the Elders and side with the majority?
- Try to convince the Elders to let you tag one animal as a demonstration in hopes of gaining their support?
- Take some other course of action?

CARIBOU DILEMMA CARD #6

You are a young woman living on a caribou range. Since graduating from high school you have worked in part-time, temporary jobs and are currently unemployed. Just when you think you may have to leave community to find work elsewhere, you hear that a large corporation is proposing a diamond mine in the area, promising many jobs for young northerners. This development may have a negative impact on the caribou upon which most of your family depends. You know that the caribou have not travelled through that area for many years, but you also know from your relatives that caribou migration patterns change over time. In the future the caribou may come in contact with the development. Do you:

- Support the proposal and apply for a high paying job?
- Campaign to prevent the mine from going ahead?
- Move to Edmonton and look for work?
- Support the mine as a source of employment for your friends but not work there yourself?
- Remain in the community, live a traditional lifestyle and earn extra money working part-time at the band office?
- Take some other course of action?

CARIBOU DILEMMA CARD #7

You are a wildlife biologist. An all-weather road is being built to give northern communities road access to communities in the south. This road cuts through the main migration route of a large herd of barren-ground caribou. Local hunters now have easy access to the caribou. First Nation Elders are worried that the hunting pressure keeps the leaders of the herd from migrating to their traditional areas. They say that shooting the leaders is disrespectful to the caribou and that herd knowledge will be lost. Conservation Officers have seen the herd turn back and take an alternate route when hunting pressure on the highway is great. Do you:

- Ignore the concerns of the Elders as most animals still cross the road at some point?
- Close the highway for a period of time when the main herd approaches to allow the leaders to go to traditional areas undisturbed by hunters?
- Try to institute an educational program and ask hunters not to hunt caribou when the main herd approaches?
- Take some other course of action?

CARIBOU DILEMMA CARD #8

You are a young Indigenous man who lives in a remote northern community. Your community depends on a herd of barren-ground caribou for much of its food, crafts and clothing. Your culture has depended on the caribou for thousands of years. Your community has worked for many years to keep the range of the herd free from any development. However, there is little local employment. An oil company wants to start oil development in the winter range of the herd and has offered young people from your community jobs and training. A job would give you money and a sense of worth but would go against the wishes of your community. Do you:

- Take the job and live a good "southern" style of life?
- Take the job and try to make sure the company follows all environmental regulations?
- Take the training and then quit, as the training might help you get a job within your community?
- Stay in your community and try to get odds jobs when you can?
- Take some other course of action?

CARIBOU DILEMMA CARD #9

You are a scientist who has discovered that there is a chemical in the noses of caribou that can be used to make a cure for the common cold. You are all set to patent your idea when you realize that many caribou must be killed in order to obtain the chemicals. Do you:

- Keep working to come up with a cure that doesn't need caribou noses?
- Patent your idea and make a huge fortune?
- Sell your idea to someone else and make a small fortune?
- Take some other course of action?

CARIBOU DILEMMA CARD #10

You have lived and worked in a small northern community for 20 years. A PhD student from a southern university has contacted you about doing a study of traditional knowledge about caribou in a northern native community. The student has never been to the north and wants to know how to get started with her project. Do you:

- Tell her to forget it because you sense that people are fed up with southern researchers?
- Send her some relevant literature about doing research in the north and/or advise her to contact a First Nation government directly?
- Advise her that traditional knowledge is a touchy subject for research and that she had better make a trip to the north and talk to a lot of people before she decides to pursue this as a thesis project?
- Take some other course of action?

CARIBOU DILEMMA CARD #11

You are the chief executive officer of a large oil company that wants to drill exploratory wells in the calving grounds of a caribou herd. Local First Nations people depend on the herd for food and clothing. The oil is needed to serve the growing demand for fuel by southern interests, but the cost of finding oil and transporting it may outweigh the environmental cost. Do you:

- Proceed to drill with environmental safeguards in place to protect the caribou?
- Drill for oil regardless of the environment and give royalty payments to the Indigenous people to compensate for damages?
- Decide to drill for oil in less environmentally sensitive areas and recommend protection of the calving grounds?
- Take some other course of action?

CARIBOU DILEMMA CARD #12

You are a wildlife manager. In your area, woodland caribou occupy a large portion of the landscape at some times during the year, but are never found in high densities. Moose also occur in the area. People hunt moose but are not allowed to hunt caribou. Current logging practices improve the habitat for moose, but are clearly not beneficial to caribou populations. Scientists believe that changes in forestry practices will allow the caribou to continue to occupy their range, while also allowing forestry to continue. However, moose habitat will not improve to the same degree, and the forestry industry will not be able to harvest as much wood every year. Do you:

- Continue with current logging practices to maintain wood harvest and improve moose hunting?
- Change logging practices to ensure the survival of caribou, and accept reduced wood harvest and moose populations?
- Change logging practices to ensure the survival of caribou, and restrict moose hunting to protect the diminished moose population?
- Take some other course of action?

CARIBOU DILEMMA CARD #13

You are a biologist responsible for wildlife viewing in your area. A large barren-ground caribou herd is not crossing the highway that crosses their winter range. Regulations are in place which prohibit hunting along the highway. Local business owners are concerned that with the restrictions on hunting, there will be fewer hunters and thus fewer benefits to the local communities. Wildlife viewing opportunities exist, but there is some concern that the increased traffic caused by wildlife viewers could cause even greater disturbance by increasing road traffic. Local businesses are beginning to exert political pressure to remove the corridor restriction. Do you:

- Advertise the wildlife viewing opportunity in hopes that it will increase education and awareness of the herd?
- Monitor the situation to see how the herd is reacting to the highway with the new corridor in place?
- Allow some hunting from the highway?
- Close the highway altogether when the herd is passing by?
- Take some other course of action?

CARIBOU DILEMMA CARD #14

You are a farmer who has just received an agricultural permit to grow potatoes on your land, which is located 50 kilometres from the nearest small community. After planting your crops, you receive a letter from a conservation organization telling you that your fences pose a threat to a local woodland caribou herd. The herd's movement within its range is restricted by the fences, and several caribou have become entangled in the wire. Do you:

- Look for safer ways to construct your fences?
- Remove the fences and allow wild animals to tramp through your fields?
- Relocate your farm to another area?
- Leave your fences the way they are and hope the caribou will learn to use another route?
- Take some other course of action?

CARIBOU DILEMMA CARD #15

You love to ride your snowmobile. You hear that a local snowmobiler association is planning to construct a series of trails in a beautiful wilderness area. This area is within the range of a local woodland caribou herd. A meeting is planned to discuss the trail construction. Do you:

- Get ready to experience some new snowmobile thrills?
- Attend the meeting and tell the association to scrap its plans because of possible effects on caribou?
- Ask a biologist to do a study on the area before the trail plan goes ahead?
- Attempt to educate snowmobilers on methods to avoid disturbing caribou during sensitive parts of their breeding cycle?
- Take some other course of action?

CARIBOU DILEMMA CARD #16

You are a community health worker. A local study has determined that there are toxic levels of cadmium in the kidneys of caribou and has calculated that eating a certain amount of kidneys from older female caribou is a health risk. The results of this study have been sensationalized by the media and people have stopped eating caribou kidneys altogether. Do you:

- Assume that kidneys are not very important to northern diets and so there is no need to intervene?
- Consult with the communities about the importance of kidneys to local people and then decide if this needs further work?
- Consult with local people about the importance of kidneys to local diets and try to figure out how many kidneys of what age caribou could be consumed?
- Investigate the source of the health standard on cadmium to see if it is relevant to northern diets and lifestyles, make a judgment about the likelihood of anyone becoming seriously contaminated by cadmium in kidneys, and then make a statement about the risk as you see it?
- Take some other course of action?

Age

Grades K – 12

Subjects

Drama, Language Arts, Music

Skills

Listening, imagining, role-playing

Duration

Several periods

Setting

Indoors

Materials

- Copies of caribou stories (supplied in this guide and available elsewhere)
- Drama/audio aids such as drums
- Recorded drum music and caribou sounds
- Art supplies

First Peoples' stories about caribou

Objectives

Students should be able to:

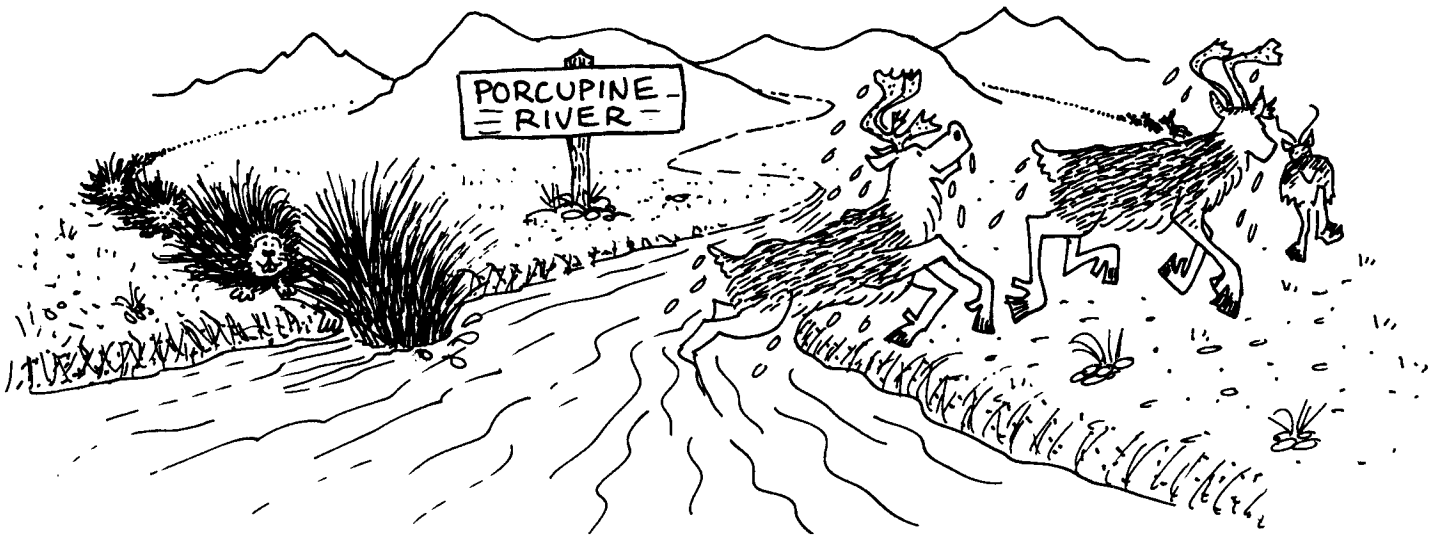
1. Understand the importance of caribou to Inuit and other Indigenous cultures as expressed through stories, music and visual art.
2. Study and understand one story about caribou.
3. Illustrate, dramatize or create their own legends about caribou.

Method

Students read or listen to a story about caribou and draw pictures and/or create a dramatization of the story.

Background

Caribou are important to many Indigenous cultures across Canada. They have always formed a basic part of the cultures of people living in the Arctic and subarctic. People such as the Vuntut Gwich'in of Old Crow (see Porcupine caribou herd case study) have depended upon caribou for thousands of years for food, clothing and a way of life that involves close ties with the northern land. Many other Dene and Inuit cultures have also depended upon caribou.



All human cultures create stories that express ideas about the world around them. They sing songs, tell tales and create dances and artwork that express how they feel about important natural creatures and places. Stories are passed on from generation to generation, sharing important information about culture and environment. Animals are depicted in stories and legends in various ways according to beliefs about them and their importance. In the North, many stories contain powerful figures based on animals such as the bear and the raven.

People also formed mythologies and legends and structured their cultures around the caribou. They travelled to known migration routes to intercept herds for hunting. They told stories about caribou. They taught their children to respect these animals. Traditional hunters believed that if they had the right thoughts about animals and treated the carcasses properly, they would always have enough to eat.

Procedure

1. Discuss the importance of caribou as portrayed in legends and stories from various cultures, using background information and other sources.
2. Read aloud or have students read a story about caribou. (Two sample stories are given at the end of this lesson plan.)
3. Separate the students into groups. Ask each group to dramatize the story. The students may wish to mime the story, use sounds, or add dialogue.
4. Have each group present its caribou skit to the class.
5. As a follow-up discussion, ask the students to think about what the story taught them about caribou behaviour and about the relationship between people of various cultures and caribou.

Variations

1. Have each group present a play using a different caribou legend.
2. Have students write their own stories and dramatize or illustrate them.

Extensions

1. Find First Nation tales about caribou on the internet.
2. Research other traditional stories about caribou and share them with the class or school.

Evaluation

Discuss with students how one First Nation culture views caribou and how this view is expressed in stories and other art forms.

Adaptations for different ages

Primary: Have students draw pictures based on what they hear in the story. Have each student explain their drawing to the class.

Senior: Have each student write their own legend about caribou. Students may also illustrate their stories.

The Man Who Became a Caribou

(From the Government of Northwest Territories)

An Inuit man was unhappy because he was a poor hunter.

One day he decided to leave home. He left all his weapons and began to walk inland. All the time, as he was walking, he thought, “I wish I were an animal, not a man. No one can be as unhappy as I am.”

He saw some ptarmigan eating the leaves and berries and making little noises. He followed the ptarmigan all day hoping they would feel sorry for him and, perhaps by their magic, change him into a ptarmigan. At last he came to a village where, he knew, the ptarmigan lived when they changed themselves into people.

“I’m sorry,” said the chief of the village, “You cannot stay with us. You will not like being chased by the big birds of the air and men with their bows and arrows.”

So the hunter left the village and, seeing some arctic hares playing among the rocks, he thought, “That’s the life I want. They seem very happy.” He followed the two hares all day and at last, saw them enter a little house at the bottom of a hill. When he got inside the house there were two old people already there, but no hares.

“Why have you followed us?” asked the man.

“I want to be a hare,” answered the hunter.

“I’m sorry,” said the hare. “You cannot stay with us. You will not like being hunted by the big birds of the air and the men with their bows and arrows.”

So the hunter left the little house and walked further inland until he saw a herd of caribou. All day he followed them until, in the evening, he came to a large village. Knowing that all the men were in the meeting house, the hunter went there, hoping that he could talk to the chief.

“Why were you following us all day?” asked the chief.

“I was not hunting you,” said the man. “See, I have no weapons.” Then the man told everyone of his wish to become a caribou and how he had talked to both the ptarmigan and the hares. They felt sorry for him so the chief allowed the hunter to join them.

When the hunter ran with the caribou herd he found it difficult. He could not run quickly. He found the food unpleasant to eat and he did not grow big like the other caribou. Also, he was always afraid because the men came with their bows and arrows, and he never knew whether they were near. Sometimes, there were traps set for caribou, sometimes holes in the ground for them to fall into, but the old hunter who had become a caribou was never caught. Because he was old, however, he decided he would like to see his family again, so he went to see the chief.

“It will be very hard,” said the chief. “You are a clever caribou now. It will be hard for you to learn to be a man again.”

“I know,” said the hunter, “but I must see my family before I die.”

For many days the hunter who had become a caribou walked. When he was getting near his village he was so excited he forgot about the traps, and his legs were caught so that he could not move.

In the evening two boys came and they were very happy to find a caribou in their trap. Before they could shoot him the hunter spoke. The two boys were afraid.

“Don’t shoot me,” said the hunter, “Just take your knife and take off my skin.”

The two boys did what they were told and were surprised to find a man inside the skin. They recognized him as their father who had left home many years before.

The Boy Who Found the Lost Tribe of Caribou

(Told by Donald Kaglik of Inuvik in *People and Caribou in the Northwest Territories*)

A group of Inuit lived along the seashore. Now, there lived a poor boy whose parents had died, and he was living with his grandparents, who were very old. The ruler, knowing this, called the boy over to his place and asked him if he would do odd chores for him. He would always make sure the boy and his grandparents had something to eat. The boy was very glad and he ran home and told his grandfather and grandmother.

The years went by and he became a boy whom no one could beat in sports. One winter he was allowed to go out hunting, but he had to listen to all that was said in the meeting before the hunt. The hunt was very good. They had almost enough meat to last through the long winter.

The ruler then decided to teach the boy how to get a caribou with a knife, without the use of a bow and arrow. The boy was now very excited, for he was always anxious to learn of new ways to catch his game.

They had to use a skin to cover themselves with and sneak up to the herd until they were close, and then use a knife to kill. It had to be placed in just the right spot.

When it was time for him to try this new way of hunting, he crept very close to some caribou. But just as he was ready to spring, the caribou spoke to him. “You must be using my brother’s skin to cover yourself with. Why don’t you put it on the right way and I will tell you what to do?” Was he going mad, or was the caribou really speaking to him?

The caribou continued, “Those of us who are to be leaders in the future have this gift of being able to lift the face-mask, and so we are able to speak on behalf of our people. Now close your eyes and slip the coat on, and I’ll tell you more as we travel. Hurry, for we do not have much time.” He did as he was told, and to his surprise, he was now a caribou.

“Follow me,” the caribou said, and now they were all travelling at a great speed.

After a bit he saw that he was getting left behind, and now he stumbled. He didn’t know how far they had gone when he heard a voice saying, “We are safe now, and you can have a rest. We have been going for a good half-a-day, and now I will tell you how we travel. When we are running at high speed, we never look back at the ground. This slows you down. Hold your head high and just look where the ground meets the sky, and run. This way you can see your direction and also anything that may be on the ground to trip you. I will give you a test run after you have had a little more rest.”

They ran and soon the ground below him seemed to be a blur. Soon they turned and they were on their way back to the herd.

Once back he realized that he was hungry. As they fed on the sweet lichen, his friend told him, “You must never stray far from us until we have told you more of the dangers we face in life.”

To his surprise, there was a lot he had to learn. First of all he was told never to go near anything if he was not sure what it was. He was told of wolves, and always to stay with the herd when in danger. Also, there would be times when they would be hunted by humans.

Now, the air was cool and there was snow on the ground. The next day they had a long journey to make, and the only time they would stop was in the evening to feed and bed down. To his surprise, there were a few browsing around and feeding. He looked around, but there were no lichens he could find.

His friend came over to him and said, “I will have to show you how to search for food in the winter. However, you must not waste any food when you eat. You must always eat all you find, for those who waste food don’t always find food when the chips are down.”

He took him aside and told him to dig in the snow and turn up the ground. To his surprise, there were berries and fresh plants. They were very delicious and he ate all he had found. Now his friend told him, "Never dig for food till you are hungry. That is our way of life."

The winter was long and the days grew short, and there were times when he bedded down without anything to eat, for he would be too tired to eat. And then he would be up very early for another long day.

Soon the days were long and the sun shone very warm. Spring was here and now they were to watch even more carefully than before, for they were now passing a very dangerous country where a different tribe of Inuit lived. Water was beginning to show in some places.

One day they were attacked, and he was wounded in the neck by what he knew to be an arrow. To his own surprise, he was able to slip out of his coat. He was now back in human form. To his surprise, there was his hunting knife still in his belt.

Now as he lay where he had fallen, one of the hunters came running to his aid. He looked in awe and wonder as he saw he was from a different tribe. At last he spoke, and asked, "Where did you come from? For I know your tribe of people. From a long way back I have heard many stories and tales of them."

He told him what had happened, and as he spoke, he saw others come and they were listening as well. After applying some kind of spruce tree gum to his wound, they built a fire and had some roasted meat like he had never tasted before. At first he was a little slow in eating, for he remembered the friends he had made. Soon he was over it and he enjoyed his meal. He helped in preparing the meat to pack, for he was told that he was now one of the tribe.

Age

Grades 8 – 12

Subjects

Science, Math, Social Studies

Skills

Analysis, application, species identification, drawing, measuring, mapping, reporting

Duration

Two one-hour class periods

Group size

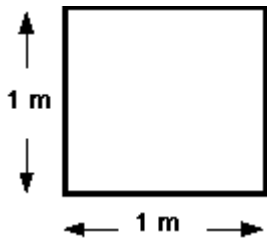
Variable

Setting

Known lichen area

Materials

- Samples of lichens
- 1 x 1 metre quadrat made of wood or wire (see illustration below)
- Grid paper and pencil
- Clipboard



A quadrat is a rigid frame of a standard size. It can be made from wood, wire or other rigid material. Classroom metre sticks fastened with masking tape can make a good temporary quadrat.

Likin' lichen

Objectives

Students should be able to:

1. Identify the various species of lichen in their area.
2. Conduct a ground study and measure the amount of lichen in a given area.
3. Research and identify airborne pollutants lichen may absorb in their tissues.

Method

Students will be given samples of the types of lichen they may find in their area and identify them as fruticose, crustose or foliose. (They may also find filamentous.) Students will do a ground plot survey and determine the percentage composition of lichen in a specific area.

Background

Caribou are herbivores, or plant-eating animals. The average caribou eats at least three kilograms of vegetation each day, the equivalent of about two garbage bags of food! Caribou eat different types of plants during the year, but their most important food is lichen. “Fruticose” ground lichens are the most significant. Famous among these is the “reindeer lichen,” called *Cladina rangiferina*. In winter, when green vegetation is not available, caribou depend on the lichens they find beneath the snow. In boreal forests, caribou will eat lichens growing on the ground or on trees.

Lichens are made up of two kinds of plants – algae and fungi – that live together in a mutually beneficial, or symbiotic, relationship. Algae contain chlorophyll, which produces sugars and starches through the process of photosynthesis. Fungi are able to store lots of water to support the algae, in return absorbing the sugars and starches produced by the algae.

Lichens come in many shapes and sizes. They do not have roots, stems, leaves or flowers. There are over two thousand kinds of lichens. These are divided into three main groups. “Crustose” lichens are flat lichens that often attach themselves to rocks. “Foliose” lichens have a leaf-like form. “Fruticose” lichens are tufted, or composed of erect stalks.

Lichens need water to grow. They act like sponges, absorbing moisture from the air, rain and snowmelt. When there is no moisture available, lichens dry out and become dormant. In the north, the season when lichens can grow is very short. Thus, even small-sized lichens can be decades or centuries old.

Pollution caused by people living far from the territory of the caribou may still have an effect on the caribou and those that depend on them. One example of this effect is that of the mercury. Caribou depend on lichens as a primary source of food in the winter months. Lichens take nutrition from

moisture. Lichens grow very slowly and live a very long time; because of this nutrients are more concentrated in lichens than in other plants. Unfortunately, heavy metals such as cadmium and mercury accumulate and become concentrated in the same way. These elements are passed along to caribou that eat the lichens.

In northern Canada, tests have shown the levels of contamination to be low enough that Health and Welfare Canada has not recommended against the human consumption of caribou meat. However, levels of another element, cesium, were so high in northern Europe after the Chernobyl nuclear disaster that reindeer meat had to be destroyed. Even in Canada, levels of contamination increased by up to 25% in some caribou herds after the disaster.

Fortunately, cesium does not persist in the body tissues of caribou, and levels have returned to normal. However, some elements like cadmium and mercury can build up over time in the livers and kidneys of the caribou. This means that levels will be higher in winter, when the animals are on a lichen diet, than in summer, when caribou eat a wider variety of plants. The caribou of the far north are a powerful symbol of resilience.

When studying large communities of plants or animals, scientists are unable to examine every individual. Instead, they take random samples and apply statistical analysis to determine 'average' characteristics of the group. For forest floor cover studies, scientists use simple devices called quadrats for sampling. Quadrats are placed on the ground, and everything found within its frame is measured carefully. In this activity, students follow the same process.

Reindeer moss (Cladina mitis) is an important lichen for woodland caribou.

Procedure

1. Pre-measure sample area.
2. Provide students with background information and samples of lichen in a manner appropriate to the group.
3. Discuss with the group proper survey techniques and procedures.
4. Divide students into pairs and provide them with proper materials.
5. Go to sample area.
6. Place quadrat in sample area. Identify all the ground cover lichen and other types of vegetation that fall inside the quadrat.
7. Map the plot on grid paper, indicating the vegetation. Label the map.
8. Find the percentage of each type of lichen for the sample area.
9. Combine group data for the area and find the average percentage ground cover of lichen for the entire area.
10. Prepare written submissions as if they were to be presented to caribou biologists.

Variations

1. Have students study (and possibly map) the effects of various air- and water-borne contaminants on lichens and caribou.
2. With the help of a chemistry teacher, have students test lichens for minerals and contaminants.

Extensions

1. Invite someone who does vegetation mapping to come into the classroom and talk about their work, possibly assisting with the activity.
2. Do the “Bioaccumulation: the story of time” activity (page 41) described in this guide.

Evaluation

Discuss with students:

1. Two different varieties of lichens.
2. Why people perform vegetation mapping and how mapping helps in understanding and managing caribou herds.
3. How heavy metals like cesium accumulate in caribou.

Song for a Caribou

Objectives

Students should be able to:

1. Write a factual song about caribou to an original or familiar tune.
2. Recognize references to caribou/reindeer in popular music.
3. Perform in a caribou song festival or Christmas concert with reference to caribou.

Method

Students brainstorm a list of songs that have reference to reindeer or caribou (mostly Christmas songs), write new songs about caribou and perform them for the class or school.

Background

Everyone knows the famous Rudolph, the red-nosed reindeer, but they may not know that Rudolph is related to the caribou. Songs about animals can be beautiful, silly, entertaining or educational. We sing songs to entertain ourselves and others and to share cultural information.

Caribou and other wild animals are sometimes used in songs as symbols. This means they are used to suggest meanings based on people's knowledge of caribou and concepts related to caribou. Reindeer symbolize Christmas for many people because they are used in Christmas songs and carols.

Procedure

1. Have students brainstorm songs that have reference to reindeer and caribou. You may wish to expand this to other Canadian animals if the students have difficulty.
2. Play a song that makes reference to caribou. Hand out lyric sheets to students and have them sing along.
3. Using a web format on the blackboard or a large piece of paper, have the students write down as many facts about caribou as they can think of. Break the students into pairs. Tell them each pair is going to write its own song about caribou. The lyrics may rhyme or they may not. The song may tell a story about caribou. Ask the students to include in the song some factual information they have learned about caribou. You may wish to provide a sample tune for the students to work with. For example, you may ask them to use the tune of "Rudolph" and write their own lyrics, e.g., "Rangifer, the barren-ground caribou, had some very hollow fur. . . . "
4. Have each pair sing or present its song to the class. (Some students may wish to simply read the lyrics aloud.)

Age

Grades 4 – 8

Subjects

Music, Language Arts, Drama

Skills

Writing, musical skills, performance

Duration

Three 30-minute class periods, with optional school presentation

Setting

Classroom, plus optional school presentation

Materials

- Pencil and paper
- Audio player

Adaptations for different ages

Primary: Have students think of and sing other songs they know that feature Canadian animals.

5. If this activity is being undertaken in a music class, you may wish to set one or two of the caribou songs to music and have the students play along on instruments.
6. If possible, teach several of the best songs to the entire class and have the students perform them in a song festival or school concert.

Variations

1. Have each pair of students write one verse in a class song about caribou.
2. Have students add a verse to "The Caribou Song" or write a song to the tune of "Rudolph."
3. Write a rap about caribou.

Extensions

1. Study how other animals are portrayed in songs. Are the portrayals accurate?

Evaluation

1. Have the students name three songs that feature Canadian wild animals.
2. Discuss how one of these songs portrays the animal. Discuss the accuracy (or lack thereof) of the portrayal. Discuss what the song teaches about the animal.

Southern Lakes caribou

The Caribou Song

(by Remy Rodden, ©1997 Think About…Productions, reproduced with permission)

Once upon a time throughout this land the caribou did roam
Thousands and thousands wandered through the hills
Our backyard was their home
They provided food and shelter for the First Ones
Then along came the miners and the rails, the habitat began to change
And up went the fences and the roads in the middle of their winter range
Now the Carcross herd is barely just surviving
We've got to do something soon

O caribou, caribou
Symbol of the northland, the wilderness so true
O caribou, caribou
We will be in trouble if we don't take care of you

Now the caribou is perfect for the North, it's adapted to a land that's cold
Its hooves are big and wide and they act like snowshoes
and shovels in the deep, deep snow
And their hollow hair keeps them toasty warm
They dine on lichens, a kind of plant, that no other critter wants to eat
So caribou survive where other animals can't, they have a very special niche
And the caribou when it dies, it feeds its neighbours
The wolves and the ravens too

O caribou, caribou
Symbol of the northland, the wilderness so true
O caribou, caribou
We will be in trouble if we don't take care of you

As goes the land so go ourselves, and all of us depend on the land
If the wildlife is in trouble then we are too, so we'd better lend a helping hand
Won't you take the time to try and help your neighbour
Everything's connected somehow

O caribou, caribou
Symbol of the northland, the wilderness so true
O caribou, caribou
If we take care of your habitat, we'll be taking care of you

Age

Grades 4 – 8

Subjects

Art, Biology, Social Studies, Language Arts

Skills

Drawing, creating, analysis, application

Duration

Two 45-minute periods

Setting

Classroom

Materials

- Canadian quarter
- Books about Canadian coats of arms
- Images of Santa's reindeer
- Pen and paper
- Drawing supplies

Symbolic Caribou

Objectives

Students should be able to:

1. Recognize that caribou are found in symbols and signs of traditional and modern popular culture.
2. Understand how wild animals are used as symbols of qualities held by countries or people.
3. Create their own 'coat of arms' based on their knowledge of caribou biology.

Method

Students will research how caribou are portrayed in coats of arms, on Canadian money and in popular culture, and then create a coat of arms from the caribou's perspective.

Background

Caribou and other wild animals are sometimes used as symbols. This means they are used to suggest meanings based on people's knowledge of caribou and concepts related to caribou. For example, many countries have in their coats of arms animals that are seen as powerful, such as lions or eagles, or animals that are seen as wise, such as owls or foxes.

The province of Newfoundland has a caribou-like animal on its coat of arms, but it is actually an elk. The coat of arms was designed in 1638, when elk were erroneously believed to inhabit Newfoundland. What people thought were elk were actually caribou! Newfoundland re-adopted its coat of arms in the 1920s.

Caribou can also be found in popular culture. Santa's reindeer are a kind of caribou. And, of course, caribou can be found on the Canadian quarter, used every day by millions of people.

Procedure

1. Call out the names of a number of animals and have the students brainstorm qualities associated with the animals. Are these qualities based on the animal's biology and life cycle, or are they based on inaccurate human perceptions of the animals?
2. Have the students brainstorm places where they may have seen caribou portrayed. Remind the class that reindeer are a kind of caribou. Once they make the connection to reindeer, it may open up some new ideas. Discuss the importance of caribou to traditional cultures, early pioneers and northerners in remote areas. Remind the class that we tend to incorporate important species into our cultural symbols.

3. Break the class into small groups.
4. Tell each group that they are going to make their own caribou coat of arms. The coat of arms can be a drawing or collage of drawings by students in the group. It can include pasted-on features cut out from magazines or objects glued onto the paper.
5. Remind the students to think about things that are important to the caribou when making their coats of arms. For example, it might include lichen or other important caribou foods. It might include wolves or other animals that interact with caribou. They may add a drawing of a river to symbolize barren-ground caribou migration. Also have them keep in mind that they can use symbols to show parts of caribou biology. They can exaggerate important parts of the caribou's body, such as the hollow hooves or branched antlers.
6. Have each group present their coats of arms to the class and explain what each part symbolizes.

Variations

1. Have the class redesign the coat of arms for their province or territory, incorporating symbols that they feel are important.

Extensions

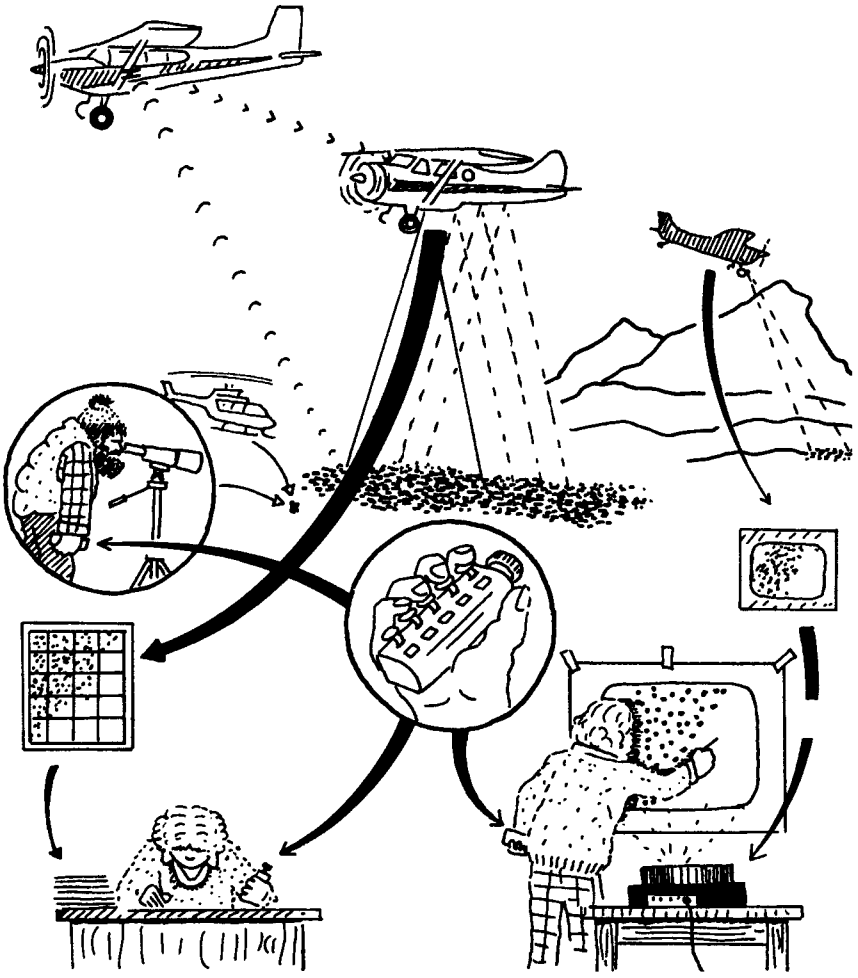
1. Have the class study the coats of arms of other Canadian provinces and territories and learn what each symbolizes.
2. Read a story or legend that involves caribou and have a class discussion about the symbolism in the story.

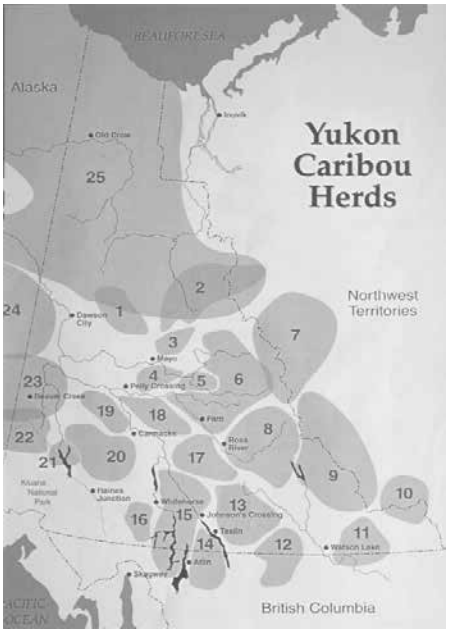
Evaluation

Discuss with students:

1. What a symbol is and why humans use animals as symbols.
2. How caribou are portrayed as symbols and whether or not the portrayals are accurate.

Tundra Ghost by Willow Q. Jones, Fairbanks, Alaska. 1998. Metal and caribou bone sculpture. (Photo used with permission of artist.)




Alaska
Yukon
Caribou
Herds
Northwest
Territories
British Columbia
25
2
24
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14

What is a caribou herd?

Objectives

Students should be able to:

1. Describe how caribou herds are identified.
2. Understand why caribou and other animals move in herds or large groups.
3. Experience a simulation of a caribou herd in migration.

Method

Students will study a caribou herd (preferably local) to find out how it is defined, map its range, view videotapes and/or listen to audiotapes of a caribou herd in migration.

Background

Caribou need to be able to do two things at once: they need to eat, and they need to keep watch for predators. Like many other animals, caribou fill this need by gathering in herds. When caribou are in a group, several animals will be looking up and around while others are eating. They sniff the air regularly and can recognize predators by scent. They can alert other caribou to danger.

Barren-ground caribou form different kinds of herds at different times of the year. Prior to calving, pregnant cows will band together in small groups called "maternity bands." After the young are born, the mothers and calves may form "nursery bands." Larger and larger groups of caribou may move together through the summer as a strategy to reduce harassment by insects. When cool August nights mean fewer insects, these large groups break up and animals wander in smaller groups until fall. By early September larger groups again start to reform and continue through fall migration. In winter, bull caribou may avoid groups of cow caribou and their calves, because they know that predators like wolves are drawn to the vulnerable young caribou. Also, they may be challenged for feeding territories by the cow caribou, which still have their antlers.

There are other advantages to travelling in herds. By travelling together to calving grounds in large groups, pregnant cow caribou in the barren-ground herds reduce the risk of predators killing their calves by sharing the risk with thousands of others. The animals in the centre of the caribou herd are better protected from predators that may attack unprotected animals or stragglers. In the same way, forming a tightly knit herd may help caribou protect themselves from aggravating clouds of insects.

Woodland caribou are much more solitary. Prior to calving, pregnant cows may separate to give birth and raise their calves in secluded patches of forest. Caribou are most scattered across the range in summer. They do, however, band together in the fall when males are courting females,

Age

Grades 8 – 12

Subjects

Biology, Geography, Math, Language Arts

Skills

Mapping, writing, mathematical calculations

Duration

One or two 45-minute periods

Setting

Indoors

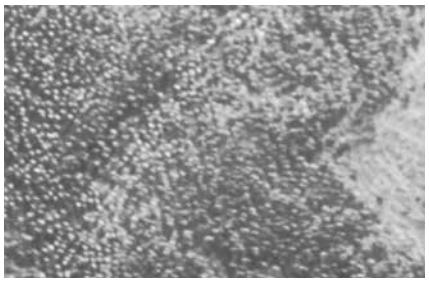
Materials

- Map of the region of the study herd
- Map of the range of the study herd including calving and wintering areas. Contact a local biologist for help obtaining these.
- Audiotapes and videotapes of caribou herds in migration

Adaptations for different ages

Primary: After showing a video or playing audiotapes of caribou, have students act out being a herd. You may wish to do this activity outside where the students can run around, asking the herd to "migrate" in various directions or adding a tag element by making several students "wolves." Remind the students about the noises made by a herd, including grunting and clacking noises.

Senior: Divide students into small groups and have each group research and contact biologists that study a particular herd and ask about management.



A huge caribou concentration in the northern Yukon

especially just before winter. Cows, calves and teenage caribou of both sexes travel in small bands throughout the winter, while mature bulls separate until late winter when, for a very brief time, most members of the herd gather together in search of the fresh green plants appearing where snow has melted.

Biologists and managers need to understand what defines a caribou population and where it is located in order to effectively study and manage it. Caribou herds are often named for where their calving grounds are, or for the geographical area where they are found. The Porcupine caribou herd, for example, is named for a river that the herd crosses during its annual migration.

Procedure

1. Begin with a general discussion of herds and groups, the advantages of travelling in a herd and how herds are named.
2. Have the students look at regional maps of the study herd. Discuss features after which the herd could be named.
3. Hand out range maps and have the students draw the range as indicated on their base maps.
4. Have the students calculate the total area of the range and divide by the total number of caribou in the herd to come up with a caribou/area in km^2 figure. You may wish to have the students compare this figure to that of other herds (which they may have to calculate). Are they similar? What might cause the differences?
5. Finish this activity by listening to tapes of herds and/or watching videotapes of caribou herds in migration. Ask the students to imagine what it would be like to be in the middle of a caribou herd. Then have them write about their impressions as a short descriptive paragraph or poem.

Variations

Have students make up range maps for a fictional caribou herd, describe the herd's characteristics, and give it a name. They may also make a density calculation for their herd.

Extensions

Do the aquatic extension of the Project WILD activity "Muskox Manoeuvres".

Evaluation

Discuss with students:

1. Some of the advantages of travelling in a herd.
2. Why and how caribou herds are named.
3. How population density of a caribou herd is calculated.

Ya gotta lichen caribou!

(Adapted from *Wildlife Trees* with permission of Wild BC, Habitat Conservation Trust Fund)

Objectives

Students should be able to:

1. Understand the role trees play in the life cycle of the caribou.
2. Understand the concept of habitat fragmentation.
3. Describe how habitat fragmentation affects caribou.

Method

Groups of students become four separate herds vying for food, water and space in this physically active demonstration of how our old forests are becoming more and more fragmented.

Background

Habitat fragmentation is the breaking up or destruction of a habitat's components. Fragmentation occurs when it becomes difficult for a species to cross from one section of an originally intact habitat to another or for that species to survive in a habitat that no longer provides the necessary food, water, shelter or space.

Fragmentation can happen on many levels, from small, or "microhabitats", to large, or "macrohabitats." For example, in some urban parks and housing developments fragmentation can occur by the removal of the forest "understory." The understory can consist of a variety of different bushes, ferns, flowers and leaf litter which provide food and shelter for various creatures. Humidity, wind exposure, light availability and temperature also have an affect on the life cycles of the species found in this microhabitat.

On the macrohabitat level, the loss of habitat or habitat fragmentation through resource extraction, agriculture, road building and urban encroachment have contributed to the loss of trees. One species that uses trees and could be affected by habitat fragmentation is the caribou.

During the summer, caribou depend on a variety of grasses, sedges, horsetails, flowering plants, and the leaves of willow and dwarf birch for their diet. In the winter, when snow covers most of the vegetation on the ground, the caribou's diet consists exclusively of lichens. Caribou do not depend on specific, individual trees. However, they do rely on having stands of trees with enough diversity to provide lichens for immediate use as well as stands of trees that will ensure dispersal of lichens to future generations of trees. Often the trees that provide the most lichens are living trees with larger diameters. Stands of mature forests, with their wide crowns and multi-layered canopies, provide areas with less snow cover and protection from wind.

Age

Grades 4 – 12

Subjects

Science, Math, Social Studies, Physical Education

Skills

Application, comparing similarities and differences, description, discussion, evaluation, generalization, physical mobility

Duration

30 – 45 minutes

Group size

15 and larger

Setting

Indoors or outdoors (large area needed)

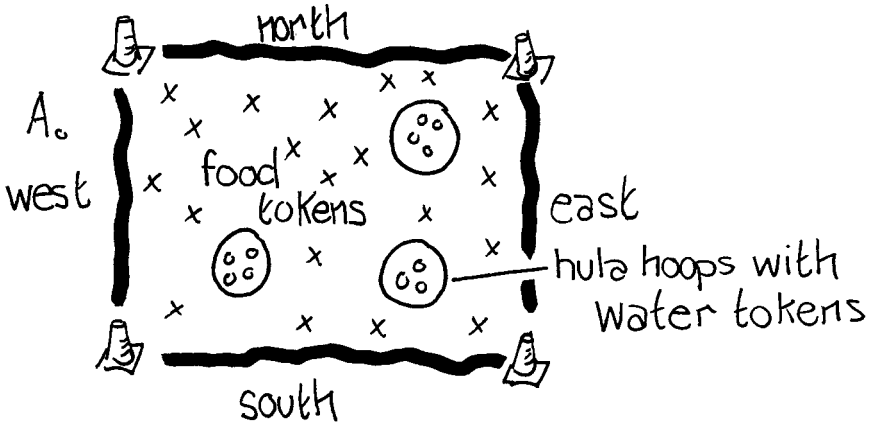
Materials

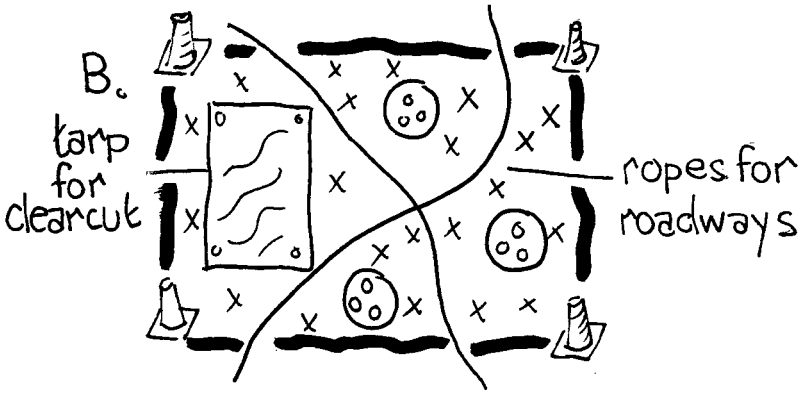
- Four pylons
- Food and water tokens (different coloured popsicle sticks)
- Three hula hoops
- Suitable lengths of rope to delineate roads
- Tarps to indicate clearcuts or urban development

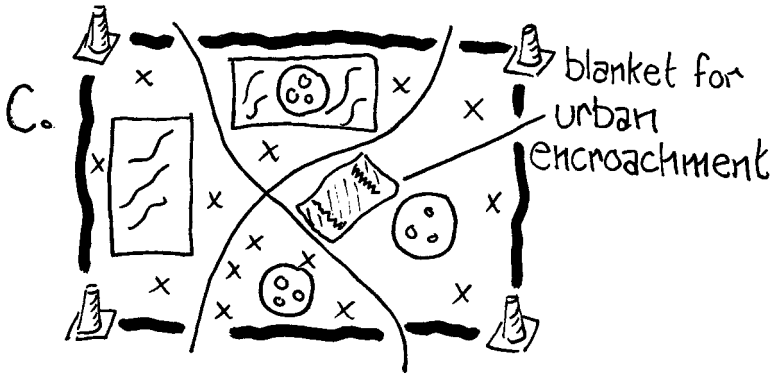
In the past, large clearcuts have suited the food needs of other, more adaptive ungulates such as mule deer. The increase of their numbers has strengthened populations of wolves who in turn have preyed upon some caribou populations. Logging and mining roads have increased the accessibility by humans to hunt caribou. The increasing number of roads in general has meant urban encroachment, which in turn affects traditional feeding territories and migration routes of the caribou.

Procedure

1. Prior to the start of this activity, ask the students to describe the components of habitat. What do all animals need to survive? Together discuss the habitat requirements of caribou. Brainstorm with the students what some of the limiting factors are that affect the survival of caribou.
2. Discuss with the students the term habitat fragmentation and what it means. Tell the students that they are going to participate in an activity that looks at how fragmentation of habitat affects caribou.
3. To start this activity, mark out the winter habitat of the caribou as shown in diagram A below.







4. Spread food tokens throughout the winter habitat and place water tokens within the hoops.
5. Divide the students into four herds: North, South, East and West. Although caribou drop their antlers in winter, the caribou for this activity can hold their hands above their heads like antlers. Have all the caribou stand facing away from the habitat with one herd on each side of the square. They may only exit or enter the square from their side.
6. On your signal, have the caribou run into the habitat to get both a food (lichen) and water token. There should be enough for everyone.
7. Prior to introducing the effect of habitat fragmentation on caribou populations, try introducing a predator such as wolves to demonstrate that animal populations are not static year after year but are continually changing in response to a variety of natural limiting factors. Natural limiting factors tend to maintain populations of species in predictable ranges. This balance of nature often goes up and down over time.

   Since wolves hunt in packs, the wolves in this activity must hold hands and encircle the caribou they wish to eat. If they capture a caribou, they must take it to the sidelines before entering the habitat again. The goal for the caribou is to reach the sidelines with both a food and water token without being caught. This round may be tried several times depending on the success of the wolves.
8. In the next round, with the caribou facing away, distribute the food and water tokens as before, but add some roads and/or clearcuts as shown in diagram B. For the purposes of the activity, caribou are not allowed to cross roads or clearcuts. Those caribou unable to get both food and water will die and become part of the habitat. After the round, those caribou that have died can now become wolves in the next round. Try this a couple of times so the students get a good idea of what is happening.

Adaptations for different ages

Primary: Have students discuss the concept of habitat. What are some of the things they have in their own habitats (their bedrooms, houses, cities or towns)? Which of these things are essential? Have students discuss the essential components of caribou habitat. Primary students can play a simplified version of the game above. Have several students play wolves and the rest play caribou. Have the wolves attempt to capture the caribou by running around an open area. Then block off part of the area (i.e., fragment the habitat) and play again. Try several variations. The students can then see that fragmenting the habitat makes it easier for the caribou to be hunted.

Note: If the wolves are becoming too successful, the caribou that have died could then become deer, which feed in clearcuts and can move throughout the habitat.

9. End the activity by asking the students what could be done to decrease habitat fragmentation for the caribou. Deactivation of logging roads is an example of something that is being done in real life situations.

Variations

Have students brainstorm other factors that contribute to habitat fragmentation. Try adding factors such as urban encroachment, clearcuts, agricultural development, hiking trails, etc. as shown in diagram C.

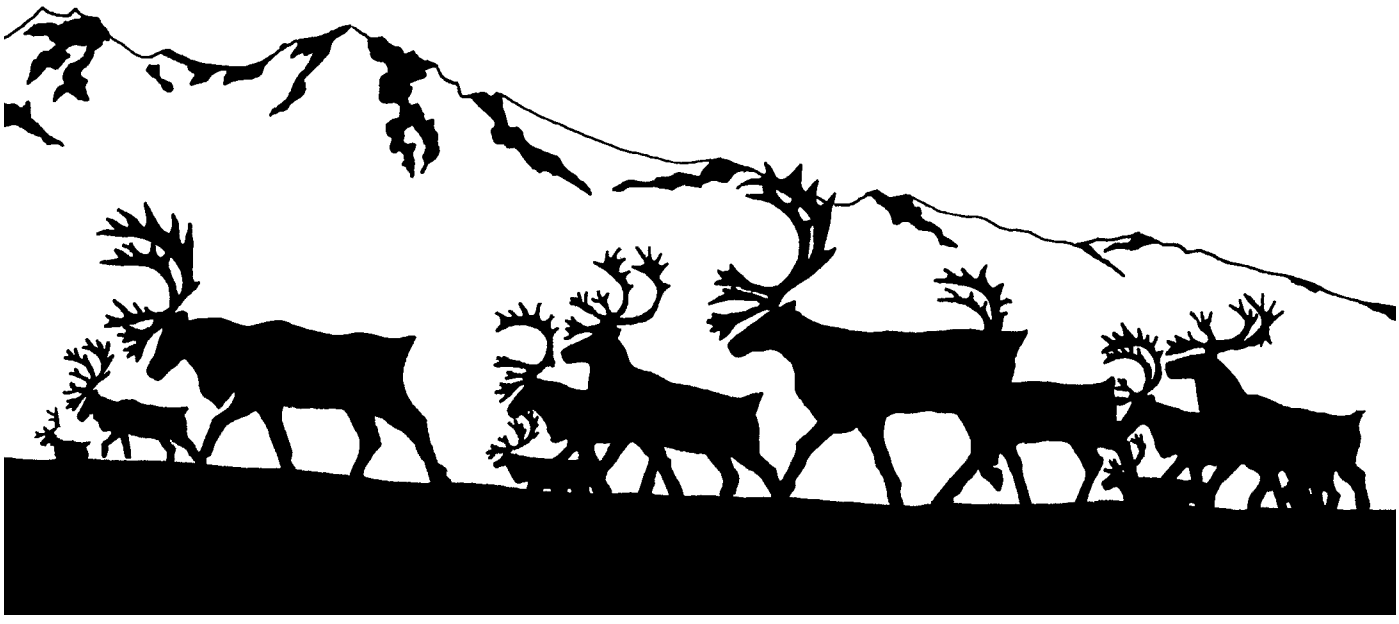
Extensions

1. Have students graph the progress of the herds by following the steps outlined in the Project WILD activity "Oh Deer" (*Project WILD Activity Guide*, Canadian Wildlife Federation, 1996).
2. Have students research current logging practices by writing to appropriate agencies or by asking community experts to present the new methods. They can then make changes to the activity that include:
   - Smaller clearcuts and partial cutting.
   - Wildlife corridors.
   - Deactivation of logging roads.
3. Using maps and aerial photos, discuss the effect roads have played on caribou and other species.

Evaluation

1. Ask students to name the essential components of habitat.
2. Ask students to define habitat fragmentation.

Case studies



Case study

The woodland caribou, migratory ecotype (barren-ground caribou)

The Rivière-George and Rivière-aux-Feuilles herds

By Diane Ostiguy (2011), updated by Steeve Côté (2017)

Unique characteristics

While all Quebec caribou belong to the woodland caribou subspecies (*Rangifer tarandus caribou*), biologists are by no means in agreement with this classification, most recommending instead that the "ecotype" concept be used to distinguish between different populations and to ensure their management and conservation. An ecotype is a population presenting special characteristics that differentiate it from other populations of the same species. These distinctive attributes are the result of the natural selection process exerted by factors related to behaviour and a specific habitat. The three recognized ecotypes of caribou are the barren-ground ecotype (also called the migratory ecotype), the forest-dwelling ecotype (also known as the sedentary ecotype), and the mountain ecotype.

The barren-ground ecotype involves populations that are often high in number, reaching hundreds of thousands of animals; in other words, the largest caribou herds are of the barren-ground ecotype. Most years, these caribou migrate several thousands of kilometers between the boreal forest, the taiga, and the tundra. There are two recognized herds in Quebec: the Rivière-George Herd (GRH) and the Rivière-aux-Feuilles Herd (LRH).

Rivière-George Herd

Elsewhere in North America, caribou herds generally migrate from the tundra to the taiga in a north-south pattern (in accordance with the season), regularly crossing the tree line, which typically runs east-west. The Rivière-George Herd also migrates between the tundra and the taiga, but in an east-west direction, because of the particular topography of the land. The females head east to reach the tundra plateaus east of the Rivière-George during calving, then return west to complete their annual cycle. Apart from this annual rite, it is difficult to predict the movements of large caribou herds with any certainty.

Rivière-aux-Feuilles Herd

At the time the herd was discovered in 1975, the females calved on the banks of the Rivière-aux-Feuilles (hence the name of the herd). Even though the calving grounds are no longer located there, the name has been retained.

From 1975 to the mid-1990s, and perhaps even somewhat before, the females moved north about 400 km to find new calving grounds. Today, these grounds cover some 45,000 km^2 in the New Quebec crater area, north of the Ungava Peninsula. The region now forms part of the Pingualuit Provincial Park. Managed by the Kativik Regional Government, the park is home to several points of interest, including the Pingualuit Crater and part of the calving grounds.

Distribution and ecosystem

The caribou of these herds inhabit the administrative region of Northern Quebec, an immense area covering 847,348 km^2, and extending from 49° latitude North to beyond 62°, or more than 1,300 km, 98.4% of which is public lands. The administrative region is divided into three separate sectors: Nunavik, the James Bay region, and the Cree Regional Authority.

In such a vast area, the climate varies from south to north. The section between the 49th and 50th parallels has a cold continental climate: summers are short and hot, and winters are cold, with snowfall less abundant than in the province's southern regions. The average temperature in the hottest months is approximately 21°C during the day and 9°C at night; in the coldest months, the range is from -10°C to -23°C.

The northern extremity of the Ungava Peninsula has a polar climate. In the hottest summer months, the average temperature is only 10°C in the daytime and 5°C at night. Average winter temperatures vary between -19°C in the daytime and -28°C at night. At this latitude, the cold creates an extremely dry climate, with an average of only 510 mm of precipitation annually. These harsh conditions have a noticeable effect on the

number of days of plant growth, which is lower by approximately 40% than in the south of the province.

Physical features such as soil characteristics and topography are dramatic. This region is home to the oldest rocks on the planet (2.5 to 4 billion years). Composed of rounded hills, glacial valleys, long lakes, and rocky surfaces marked by the passage of glaciers, it offers a variety of exceptional landscapes. The area abounds in mineral resources; rock formations are home to a number of copper, gold, zinc, nickel, and silver deposits. The potential presence of diamond and uranium deposits is also noteworthy. Permafrost covers a major part of the land. In the northeast, there are several plateaus, as well as the Torngat Mountain Range. Mt. D'Iberville, Quebec's highest peak at an altitude of 1,652 m, can also be found here.

The water system is very well developed; there are several small lakes and a good number of powerful rivers. The province's huge hydroelectric developments are located in this area.

Within this panorama, the caribou move about from the boreal forest to the tundra. Depending on the time of year, they frequent boreal forest moss stands, taiga lichen stands, or the plateaus of the grassy and brush tundra.

Rivière-George herd

The herd gets its name from the calving grounds that used to cover Quebec's Rivière-George region, north of 57° N. The herd currently occupies an area of nearly 100,000 km^2 in the eastern portion of the Quebec-Labrador Peninsula.

Rivière-aux-Feuilles herd

The distribution area of the Rivière-aux-Feuilles herd has changed over the past several years, along with the changes observed in the herd's size. The LRH caribou travel increasingly farther south during their winter migration, and their distribution area has grown with the population. The LRH at one time shared part of its winter range to the west of the Caniapiscau Reservoir with the Rivière-George Herd. In March or April, the LRH starts migrating northward, toward its calving grounds in the northern Ungava Peninsula. The LRH currently occupies the western portion of the Quebec-Labrador Peninsula, migrating from the northern areas of that region to the James Bay area for the winter. With the observed decline in GRH numbers, the wintering areas no longer overlap, as the GRH is now restricting its travel, especially in the northeast of the peninsula.

Social, cultural, and economic importance

For centuries, the caribou has been vital to the life of Indigenous Peoples, providing food, clothing, shelter, medicine, and even toys. The Naskapi are one of the First Nations whose way of life is most closely tied to the barren-ground caribou. (Even if other foodstuffs were available, the Naskapi have always said they were hungry when there were no caribou.) They honoured the animal and showed their respect, in part, by harvesting only enough to meet their needs, and also by using all parts of those killed. If anyone failed to respect this resource, they would have to make amends, for fear that the caribou might disappear. The caribou were not only a pillar of the physical aspect of Naskapi life, but also of the Nation's spiritual well-being.

The caribou hunt was a group activity, and, according to all accounts, the strict preserve of men. The hunt took place at a certain distance from the camp, and a number of techniques could be used, depending on circumstances and location: an ambush in the water near the river bank, the use of decoys, or on a frozen lake in deep snow. The hunt took place throughout the entire year, but mainly in the fall. A felled caribou was left where it killed, tied to large trees, until the family – elders, women and children – arrived to dress it. The animals could also be brought back to camp, if not too far away. Traditionally, the caribou was killed with a spear, but rifles have been the weapon of choice since the Naskapi came into contact with merchants. The animal was offered to the oldest hunter of the tribe or the head of the expedition, who was responsible for distribution. Individuals too old to hunt and widows were given meat, as were hunters who had not been part of the expedition.

On the Quebec-Labrador Peninsula, caribou are still an important part of the Inuit, Cree, Naskapi and Innu diet, both for its nutritional and energy value and its cultural importance. It also represents economic potential for Indigenous and non-Indigenous entrepreneurs alike, thanks to sport-hunting opportunities afforded to non-Indigenous clients.

Sport hunting has been of major economic important for the area, and has aided in the development of communities. The sale of hunting licences has added millions of dollars to Quebec government coffers. The GRH was closed to sport hunting in 2012, and there will be no sport hunting of the LRH after January 2018.

History and current status

In Quebec, the oldest known caribou fossil is a pair of antlers about 40,600 years old discovered in St. Antonin, near Rivière du Loup.

Rivière-George herd

John Cabot was likely the source of the first written observation of a New World caribou, when he visited Newfoundland in 1497. In his 1576-1578 quest for the Northwest Passage, Martin Frobisher was the first European to describe the caribou of the tundra, and Samuel de Champlain and other French explorers made mention of the species in the early 17th century.

History teaches us that populations of migratory tundra caribou experience major variations of abundance, going from extreme rarity to oversupply. Explorers' accounts clearly show that the Quebec-Labrador Peninsula populations had declined considerably at the turn of the 19th century. Historical studies by naturalists indicate that 13,567 caribou hides were traded in Moravian missions from Labrador to Hebron and Okak from 1894 to 1903, but absolutely none from 1914 to 1923. Between 1925 and 1942, Hudson's Bay Company trading post books for the Upper Ungava and Labrador did not mention the presence of any significant caribou populations. During the same period, very few wolves and wolverine, if any, were spotted or harvested, again suggesting low caribou densities.

Indigenous elders still remember major fluctuations in the early 20th century, at which time the herds had almost disappeared. Naturalists Elton (1942) and Rousseau (1950 and 1951) sounded the alarm about dwindling populations in the 1940s and 1950s. Rousseau estimated the total population of barren-ground caribou at 3,500, stating the species could disappear completely from the area; the caribou remained extremely rare until the mid-1970s, when their numbers skyrocketed. Recent computer population models, however, indicate that there must have been at least 60,000 animals there in the 1950s to obtain the numbers seen in 1990.

Although winter aerial surveys began in the mid-1950s and continued in the 1960s and 1970s, it was not until 1976 that a survey was made solely of the Rivière-George Herd. Other inventories were conducted in 1980 and 1982 based on field counts during the calving season in mid-June; these confirmed the growth of the herd. In 1984, the aerial photocensus was first used, as usual focusing on the calving grounds in mid-June. After five consecutive inventories two years apart, from 1980 to 1988, five years elapsed before the next was conducted. To address the uncertainty as to herd size, a major project was launched in 1993 to conduct two independent surveys of the GRH.

One of the surveys used the original aerial photocensus technique, but using improved technology (GPS, onboard computers, radar altimeters, etc.). The other concentrated on the large post-calving aggregations that followed July's period of insect harassment. The inventory findings were very similar, and the two estimates were combined, with the final approximation of the size of the Rivière-George herd for 1993 standing at 775,891.

In July 2001, another census was taken using the post-calving technique; the data showed that the population had shrunk by some 50% to some 385,000 animals. A July 2010 census taken by Quebec's Department of Natural Resources and Wildlife in cooperation with wildlife managers from Newfoundland and Labrador put the herd size at 75,000. Since then, at least three other surveys have been done and in 2016 the GRH was estimated to be fewer than 9,000 animals, a decline of more than 99% since 1990. Caribou numbers were therefore extremely low between the turn of the 20th century and the 1960s, rose rapidly during the 1970s and 1980s, and declined sharply thereafter. The history of these considerable population variations demonstrates the fragile ecological balance that exists in the tundra.

Rivière-aux-Feuilles herd

Toward the end of the 19th century, there was a period of abundance, following which, over the first half of the 20th century, there were no herds west of Ungava Bay. At the time, only the Rivière-George Herd was known to

exist. For the first time, in 1975, calving grounds were discovered along the Rivière-aux-Feuilles. This herd seems to have experienced some growth from 1975 to 1986, given the rise in the number of females in the calving grounds. In June 1991, a photographic survey found approximately 276,000 animals(including calves). A July 2001, found another increase to at least 628,000 animals (fall population, including calves), making it the largest in the province. Since then, however, the estimated population fell to 430,000 in 2011 and to 199,000 in 2016.

Existing and future threats

The caribou's habitat is increasingly exposed to human activity linked to the economic development of the North. As early as the end of the 1970s, the construction of Phase I of the James Bay hydroelectric project caused the flooding of some lichen woodlands. In the mid-1990s, the Great Whale River project was tabled by Hydro-Quebec and the Quebec government, as it would have affected areas frequented by the GRH and the LRH in the winter, as well as those used by the woodland caribou.

The huge expanses of water associated with hydroelectric dams may both facilitate and disrupt migration. Migratory caribou travel vast distances from one season to the next, and, in winter, much of the area covered is composed of the frozen surface of lakes, where the snow is shallower and harder, and thus able to better support the weight of individuals. However, the "ice barriers" formed by lower dam water levels in the winter and spring may constitute an obstacle and thus increase the risk of injury. Areas of open water downstream of the generating stations may also represent an additional risk – this time, of drowning. The roads and transmission lines that go hand-in-hand with such projects may be perceived as obstacles by the caribou, thereby hampering their movement; collisions with motor vehicles can also occur. The most significant consequence of roads and power lines is enhanced contact with caribou habitat, and, as a result, more sport hunting and poaching. In the past, for example, winter road access to the La Grande station greatly facilitated sport hunting and access to both the GRH and, more recently, the LRH.

Mining exploration and development may also be harmful to the caribou and their habitat. Apart from the more frequent human presence in the area, construction of the related facilities result in the destruction of a part of that habitat, and the attendant roadwork also disturbs the caribou.

All major development projects, whether hydroelectric or mining, are subject to an environmental-impact assessment. These studies make it possible to determine the extent of the anticipated negative effects on plant life and wildlife, as well as the optimal alternative and the compensation measures to be implemented.

GRH caribou were exposed to low-level flights by military fighter aircraft in the Goose Bay area, Labrador, and northeastern Quebec. The flight-training area was reconfigured in 1996 to reduce the potential disturbance of the animals' traditional habitat, and the Department of National Defence has implemented an impressive avoidance and monitoring program aimed at limiting the repercussions of training on the caribou.

Management

The Department of Natural Resources and Wildlife is responsible for ensuring wildlife protection and management. Caribou management in Northern Quebec presents a special challenge, as this area is occupied by various distinct Indigenous groups, including, in particular, the Inuit, who inhabit the area north of the 55th parallel; the Cree, who generally share the area between the 49th and 55th parallels with non-Indigenous people; the Innu; and the Naskapi community of Kawawachikamach. The influence each group has on area management and development has created a unique, complex sociopolitical dynamic.

Following the announcement of the James Bay hydroelectric project, negotiations took place between the Indigenous groups and the Quebec and federal governments. These talks led to the 1975 signing of the James Bay and Northern Quebec Agreement with the Cree and Inuit, and the 1978 signing of the Northeastern Quebec Agreement with the Naskapi. On February 7, 2002, Quebec and the Cree concluded a new and historic 50-year comprehensive political and economic agreement referred to as the "Paix des braves".

Two statutes enacted by Quebec's National Assembly govern caribou management and harvesting in Northern Quebec: the *Act Respecting Hunting and Fishing Rights in the James Bay and New Québec Territories* and the *Act Respecting the Conservation and Development of Wildlife*. The latter allows the Minister of Natural Resources and Wildlife to establish the framework regulating sport hunting It should be noted, however, that, in the event of a conflict, the first Act takes precedence over the second..

The *Act Respecting Hunting and Fishing Rights in the James Bay and New Québec Territories* stems from the two agreements mentioned above, and authorizes Indigenous Peoples' right to harvest, regardless of season and quotas, in accordance with the "principle of conservation". Commercial harvesting is also allowed, and includes hunting for trading purposes and the capture and raising of species such as the caribou; it is the exclusive right of Indigenous people until November 10, 2024. Unfortunately, however, the caribou have never been present in sufficient numbers to allow for the established harvesting goals.

A joint committee – the Hunting, Fishing and Trapping Coordinating Committee (HFTCC) – is made up of Indigenous and government representatives who study, administer, and in some cases supervise and regulate hunting, fishing and trapping activities. The HFTCC can set the maximum limit on caribou harvested by Indigenous and non-Indigenous people alike. The Minister of Natural Resources and Wildlife is then obliged to enforce this limit.

In Northern Quebec, the Cree, Inuit, Naskapi and Innu currently practise subsistence hunting. The means used to monitor the harvest varies according to nation. The Mistissini, Whapmagoostui, and Chisasibi communities are responsible for most of the Cree harvest (upwards of 80%), some of which comes from the LRH and GRH. Most harvest estimates are based on past surveys conducted in some communities.

The Department of Natural Resources and Wildlife and HFTCC have established a Northern Quebec Caribou Management Plan, which takes account of the various user groups while promoting economic development and respecting the need to conserve caribou habitat and the characteristics of each herd. The Plan is first and foremost a decision-making tool for the Quebec government and HFTCC.

Many stakeholders are involved: Indigenous people, outfitters, sport hunters, Hydro-Quebec, mining companies, the Department of National Defence, private businesses, and so on. One of the challenges of the Management Plan consists in incorporating social concerns into caribou management. As well, managing caribou means taking the knowledge of those stakeholders into consideration (traditional Indigenous knowledge, information on the caribou and sport hunting acquired by outfitters, and scientific data).

Furthermore, the Plan provides for caribou harvesting linked to population variations. Four abundance levels have been established: maximum, high, moderate, and "crisis for users". By way of illustration, the crisis level for the GRH and LRH has been set at 50,000 animals; below this level, sport hunting of these herds would be reduced or prohibited. The maximum level is 400,000 for the LRH and 600,000 for the GRH. These figures are based on existing knowledge; modifications could eventually be made in accordance with changes in population. The Plan is reviewed and updated in accordance with the latest data. Because of the dramatic decline in caribou numbers, sport hunting opportunities are being eliminated.

Research

Because management and conservation decisions must be based on the available information, research is crucial.

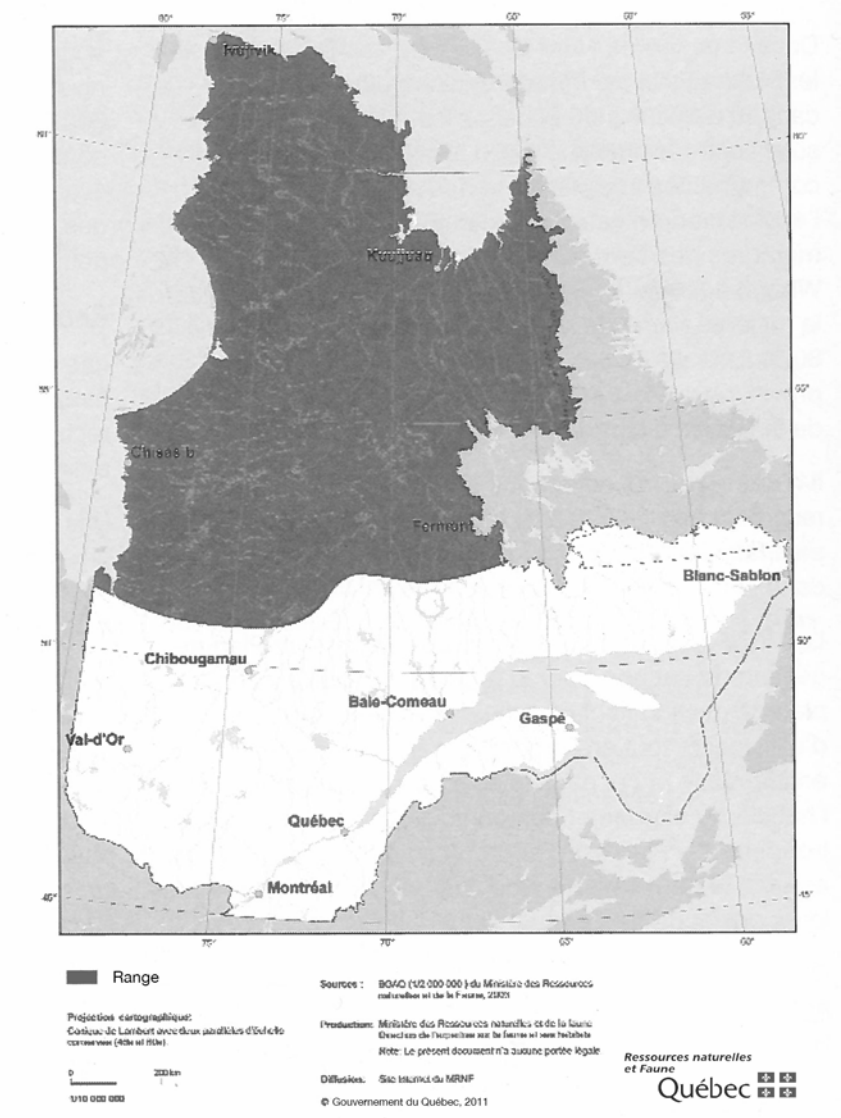
One example of an ongoing project is a long-term research program involving Laval University in partnership with the Department of Natural Resources and Wildlife, known as Caribou Ungava. The goal of the project is to determine the main factors influencing GRH and LRH caribou population sizes. The parameters under study include reproductive success, physical condition and survival rate, as related to environmental variations. The project is also exploring interactions between climate, population density, habitat, and migration routes. More than 120 caribou are currently being monitored via satellite-linked tracking instruments, and that number is growing. Several private and public partners, including GlenCore Mine Raglan, which operates a mine in Nunavik, the Makivik Corporation,

and many others, have contributed to project funding. For more information, go to: www.caribou-ungava.ulaval.ca/en/accueil.

Plan Nord

The Plan Nord, a sustainable-development project launched by the Quebec government, aims at exploiting the mining, energy and tourist potential of northern Quebec in partnership with northern communities, including the First Nations and the Inuit. The attendant initiatives, measures, and projects will incorporate requirements on environmental protection and biodiversity conservation, and will reflect an approach that takes account of the distinctiveness of northern ecosystems and the concerns of the public.

For more information, go to: www.plannord.gouv.qc.ca/en.



Range of barren-ground caribou in Quebec.

Case study

The woodland caribou, forest-dwelling ecotype (forest-dwelling caribou)

By Christine Robitaille (2011), updated by Martin-Hugues St-Laurent (2017)

Unique characteristics

While all Quebec caribou belong to the woodland caribou subspecies (*Rangifer tarandus caribou*), biologists often don't agree with this classification, most recommending instead that the "ecotype" concept be used to distinguish between different populations and to ensure their management and conservation. An ecotype is a population presenting special characteristics that differentiate it from other populations of the same species. These distinctive attributes are the result of the natural selection process exerted by factors related to behaviour and a specific habitat. The three recognized ecotypes of caribou are the barren-ground ecotype (also called the migratory ecotype), the forest-dwelling ecotype (also known as the sedentary ecotype), and the mountain ecotype.

The following constitutes a description of the current status of the woodland caribou, forest-dwelling ecotype, or forest-dwelling caribou.

The forest-dwelling caribou is characterized by low population density. Herds stay south of the northern tree line all year round. Unlike the barren-ground caribou, the forest-dwelling caribou does not migrate over great distances, but may occupy large home ranges (1,500 km^2). During the calving periods, females travel to various sites in the surrounding muskeg and woodlands to reduce the risk of predation.

In March 2005, the forest-dwelling caribou was designated a "vulnerable species" under Quebec's A*ct Respecting Threatened or Vulnerable Species*. This population also forms part of the forest-dwelling caribou, boreal population, which has been designated as a threatened species under Canada's *Species at Risk Act*.

Distribution and ecosystem

The forest-dwelling caribou inhabits the boreal forest, which is composed primarily of conifers and represents one-third of the planet's wooded area. In Canada, it covers a strip approximately 500 km wide that extends from Yukon to Newfoundland and Labrador. It also contains the largest stretches of wetlands and lakes in the world. In Quebec, this represents more than 70% of all forest land.

Forest-dwelling caribou herds live the entire year between the 49th and 54th parallels; in all, between 6,000 and 12,000 heads are distributed over 644,000 km^2. Almost 80% of these are found in the Côte-Nord, Saguenay–Lac-Saint-Jean, and Northern-Quebec areas. There are, however, two isolated herds that live south of the 49th parallel. One was re-introduced into the Charlevoix area between 1969 and 1972, following the disappearance of the caribou from this region in the early 20th century; with a current population of approximately 75 animals, it occupies the Grands Jardins Provincial Park and adjacent territory. The other herd, which is natural in origin, is located near Val-d'Or in Abitibi-Témiscamingue. Gradually cut off by the disappearance of neighbouring herds, this population has persisted despite its small size (about 18 head).

Over the winter, the forest-dwelling caribou gather into small herds; in the spring, they spread out over the entire area. They inhabit mainly mature spruce stands, lichen stands and muskeg, but can also be found in moss stands in the central part of the province. Further south, the caribou occupy balsam fir/ white birch stands.

Social, cultural, and economic importance

The forest-dwelling caribou has a social, cultural, and historical value for many Indigenous communities, for which the subsistence harvest is very important.

More recently, the forest-dwelling caribou has acquired a social value with the public, as its vulnerable status is now well known. With respect to biodiversity conservation, it has become an emblem of the boreal forest.

History and current status

At one time, the forest-dwelling caribou could be observed in all the Canadian provinces and most American states near the 49th parallel. However, in central and eastern Quebec, the large herds that had previously numbered in the hundreds to the thousands

disappeared in the early 1900s, and the southern boundary of the forest-dwelling caribou's geographical range has continued to recede northward since the middle of the 19th century.

Existing and future threats

Forest fires are natural phenomena that occur in 100- to 300-year cycles. Although natural, they do have an impact on caribou habitat, and the animals must wait some 40 years before the forest returns to its pre-fire state and they can again feed on lichen. Nevertheless, the caribou has managed to adapt to this feature of the boreal forest.

That habitat is also affected by timber-harvesting activities, which are more frequent and larger in scope. Like forest fires, these operations can promote regeneration of hardwoods in certain areas – a phenomenon known as "hardwood conversion". Unlike logging, however, fires most often spare large conifers that ensure natural regeneration. Deciduous trees attract moose, which in turn attract wolves, a major predator. The open spaces thus created also make an ideal environment for blueberries and raspberries. While caribou are not partial to such food, the black bear is, and prey on the calves opportunistically. These predators may therefore have a significant effect on forest-dwelling caribou populations, and could in part explain their decline. The caribou has faced predation for thousands of years, however, and managed to endure. The direct cause of the caribou's dwindling numbers remains changes to habitat that, in turn, have resulted in increased predation.

Since 2001, sport hunting of the forest-dwelling caribou has been banned in Quebec. However, just over one-third of its winter range overlaps the territory of the barren-ground caribou, for which sport hunting is allowed. As it is impossible to make a distinction between the two ecotypes, there is every likelihood that the forest-dwelling caribou is killed during the authorized hunting season. As the caribou is not a prolific species, sport hunting represents just one more barrier to its survival.

Management and research

In March 2005, the forest-dwelling caribou was designated a vulnerable species under Quebec's *Act Respecting Threatened or Vulnerable Species*; the province's *Forest-Dwelling Caribou Recovery Plan* was approved and made public in April 2009 and a new plan published in 2013. The objectives of this plan are to:

1. Maintain suitable habitat conditions for the forest-dwelling ecotype.
2. Establish and maintain a minimum population of 11,000 head (1.7/100 km^2), uniformely distributed in the plan application range.
3. Obtain the support of the public and the involvement of First Nations and other contributors.
4. Pursue the acquisition of scientific knowledge.

To protect the caribou, the Plan specifies five priority areas for action – survival rate, habitat preservation, forest-management methods, public support, and knowledge acquisition – as well as 11 attendant measures. One of the main recommendations concerns the development of forest-management plans with the goal of maintaining suitable habitat conditions for the species recovery and self-sustainability.

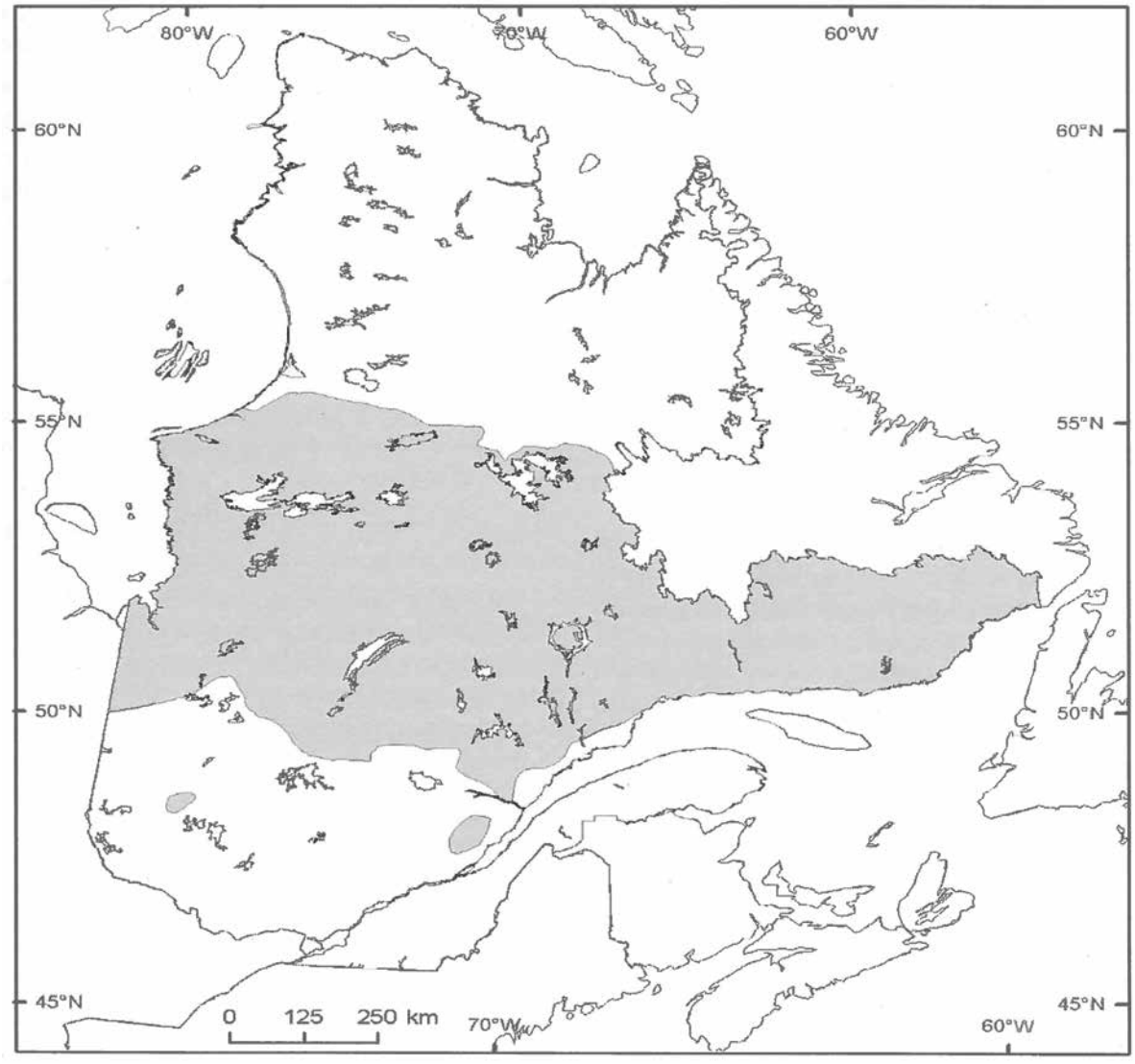
The Forest-Dwelling Caribou Recovery Team is composed of some 40 stakeholders from federal and provincial government departments, the logging industry, environmental groups, and Indigenous communities. Team members have identified action priorities for the years to come; on the basis of those priorities, several implementation groups have been established to deal with habitat-management strategy, protected areas, anthropogenic developments, communications, and the Indigenous harvest. The team is actively implementing recovery measures, and a number of research projects are being conducted on the forest-dwelling caribou and its habitat and predators.

Under Quebec's *Act Respecting Threatened or Vulnerable Species* and *Act Respecting the Conservation and Development of Wildlife*, caribou habitat is defined as "a forest territory frequented by caribou and used by caribou for calving, breeding or winter feeding".

At present, the Charlevoix herd's habitat, which extends over 603 km^2, is protected. This habitat includes the entire area of the Grands Jardins Provincial Park, or

310 km^2. The Val-d'Or herd benefits from the protection offered by the Caribous de Val-d'Or biodiversity reserve, which encompasses a large part of its seasonal habitats.

Some logging companies are helping develop and incorporate woodland-caribou habitat-development plans aimed at protecting certain forest massifs known to be favourable for caribou.



Range of woodland caribou in Quebec.

Case study

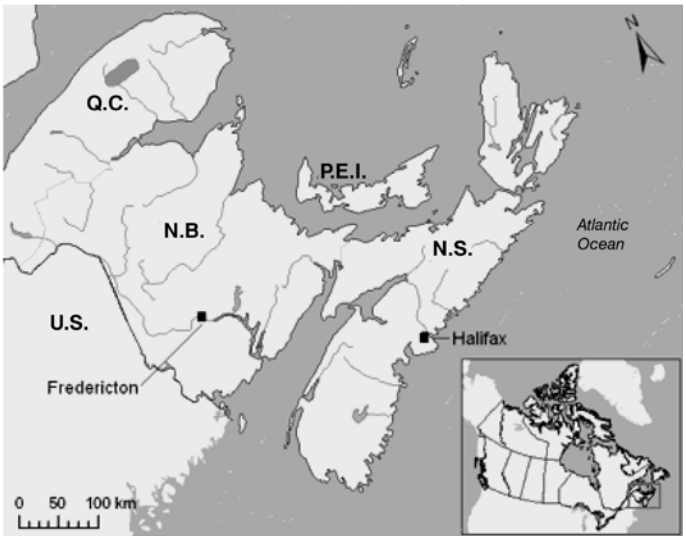
The caribou of the Gaspé Peninsula: an isolated, distinct herd

By Christine Robitaille (2011), updated by Martin-Hugues St-Laurent (2017)

Distribution and ecosystem

The subspecies known as the "woodland" caribou (*Rangifer tarandus caribou*) is the only subspecies of caribou found in Quebec. However, in all, the province is home to three different ecotypes, classified in accordance with habitat type and specific behaviour: the barren-ground, woodland, and mountain caribou.

In Quebec, the mountain caribou is represented by two herds: the Gaspésie herd and the Torngat Mountain herd. The latter make their home in the northeastern tip of Quebec, near the Labrador border, while the former frequent primarily the Gaspésie Provincial Park, an area of 802 km^2, as well as a zone outside park boundaries. GPS telemetry conducted on the population confirmed that the caribou population is concentrated in three distinct sectors – i.e., on mounts Albert and Logan, as well as various peaks in the McGerrigle Range – with no frequent interaction between these locations. However, some movement of the females has been noted between mounts Albert and McGerrigle, and between Mt. Albert and the Vallières de St. Réal area.



In eastern North America, this isolated population is now the only representative of the species south of the St. Lawrence River.

In the summer, the caribou spend their time in mature coniferous stands in the subalpine and mountain belt, as well as in alpine tundra, but stay away from cutblocks and regenerating stands. The high temperatures in the mountain peaks likely encourage the animals to seek out coulees or persistent snow pockets.

The new vegetation that appears in transitional forests and subalpine stands might also encourage the animals to leave the peaks to look for food. Caribou have been observed near lakes and swamps characterized by moss, lichen, and shrub growth; however, they also seem to return to the alpine plateaus in summer to avoid insect harassment.

Optimal winter habitat in the boreal forest consists of a varied topography allowing for different snowpack conditions throughout the season, and the attendant improved access to food resources at this arduous time of year.

Arboreal lichen, found primarily in mature fir stands, play a major role in the diet of the Gaspésie Peninsula caribou during winter, as they constitute an essential food source when ground lichen become hard to come by in alpine environments. The animals also make considerable use of the peaks.

In winter, caribou still occupy alpine tundra on the summits but also forests of mature and old-growth conifers, where arboreal lichens are more abundant. They make choices throughout their food-seeking journey, selecting those mature fir stands characterized by denser snow, larger-diameter trees, and more lichen.

From late May to mid-June, the females isolate themselves from each other on bare summits and subalpine shrubs for calving.

Because of the altitudinal distribution of habitat types in the Gaspésie caribou distribution range, and considering that predators (bears and coyotes) and alternative prey (deer and moose) are mostly found in the low-elevation areas (e.g., valleys), caribou in Gaspésie do not have access to a lot of "safe" areas out of the mountain summits and subalpine krummoltz

and shrubs. Indeed, small zones of stunted fir and white spruce may be found on the tundra at an elevation above 915 meters. Subalpine mature fir cover areas are nevertheless important, as a major wintering range. Critical summer habitat includes the tundra of Mt. Albert and Mt. Jacques Cartier. Logging, which was allowed in the park until 1977, eliminated part of the forest habitat, including arboreal lichen zones.

The caribou population of the Gaspé Peninsula occupies a mountainous environment composed of forests of mature conifers and, on the upper slopes, of alpine meadow. Telemetry surveys showed that hardwood forests found at low elevation are rarely used in the Mt. Albert and McGerrigle Range areas. In all sectors, there are few immature stands within the Gaspésie National Park limits, but these regenerating cutblocks are very abundant outside the park limits, making the disturbed habitat an impediment to caribou movement.

Although the Gaspésie Provincial Park forest has experienced a few minor natural disturbances, there have not been any major fires in the park since 1965, when 22 km^2 of the forest around Mt. Richardson was destroyed. The spruce budworm (*Choristoneura fumiferana*) does not seem to have made major inroads into the park's wooded stands.

The seasonal use of the territory occupied by the Gaspé Peninsula caribou has already been studied several times since 1987, with telemetry data covering the 1987-1992, 1998-2001 and 2013-2016 periods. Habitat selection patterns seem to have changed slightly but significantly during this 30 years period, with differences among individuals and between sexes, the males being more prone to make excursions out of the Gaspésie National Park limits.

These changes may be related to the arrival of a new predator, the coyote, in the early '80s and could now explain why the alpine is more intensively used, along with the fact that mature forest has been intensively harvested in the surrounding 30 km outside the park limits. Consequently, the entire peninsula is currently more suitable to predators than it is to caribou. Despite this kind of alpine refugium, caribou are still suffering from anthropogenic disturbances related to back-country skiing, hiking and snowshoeing. Females appear to be more efficient at protecting their offspring in an open environment than a wooded one, but are sometimes displaced by skiers and hikers, and could end in riskier habitats where predators are more abundant or more efficient.

Social, cultural, and economic importance

Before the colonization of the banks of the St. Lawrence, the Mi'kmaq had an in-depth knowledge of the natural routes of the Gaspésie Provincial Park area and spent much of the year harvesting seafood. They likely only rarely frequented the area occupied by the caribou and characterized by high mountains, as no trace of their passage has ever been found at those altitudes. Elsewhere in Quebec, the caribou was used primarily by the Cree, Algonquin, Innu, and Inuit, who travelled to the heart of the province in winter when shoreline resources became scarce.

The post-colonization era witnessed the beginning of the caribou hunt. The hunt was prohibited when the park was created in 1937, then banned forever from the entire Gaspé Peninsula in 1949. Since 1977, all forms of logging and mining have been off-limits in the park. One of the objectives of establishing the park was to preserve the caribou in order to ensure their permanent presence.

In North America, the caribou has since become an emblem of boreal-forest biodiversity conservation. The Gaspé Peninsula caribou is one of the vulnerable species best known to Quebecers. In addition to the related ecological, scientific, and heritage dimensions, its protection also has an economic aspect. This population, which constitutes the last vestige of the herds that formerly occupied northeastern North America, constitutes an undeniable tourist attraction for the area.

History and current status

From the last glacial stage up until the end of the 19th century, the caribou populated northeastern North America (Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Maine, as well as northern New Hampshire, Vermont, and New York). Following sustained colonization along both banks of the St. Lawrence, the forests were cleared for agriculture and the timber trade, and the caribou range moved north,

far from human activity, roads, and villages. The caribou disappeared from almost the entire southeast portion of its distribution area in only about 50 years – a very rapid phenomenon.

By the turn of the 20th century, the caribou had disappeared from the northern United States and the Atlantic Provinces, with its distribution area receding to the northern Saguenay. The Gaspésie herd thus constitutes the only relict of this species south of the St. Lawrence. Essentially confined to the Gaspésie Provincial Park, the herd was protected by the creation of that park in 1937 and a prohibition on hunting in 1949. This population was designated "threatened" in April 1984, and "endangered" in 2000, by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2000). Based on genetic diversity, movement, behavior and distribution, this population was recently identified as one of the 12 Designatable Units for caribou in Canada, i.e., a significant unit that is an irreplaceable component of Canada's biodiversity (COSEWIC, 2011). At the provincial level, the Gaspésie caribou was designated as "threatened" in 2009.

In 1953, a census of the Gaspé Peninsula caribou was taken for the first time, with the population estimated at 775 head, after a minimum of 318 animals had been identified by a combination of aerial and ground surveys.

Since then, survey methods have been considerably refined; with airplanes replaced by helicopters, it has been possible to demarcate the aerial inventory sector in accordance with the area used by the caribou, and the parameters used in classifying the caribou are now extremely accurate. Despite well-defined logistics, sophisticated technology, and the standardization of data; however, much still remains to be discovered.

Estimates of the size of this small, isolated population went from 500 to 1,000 in the 1950s, to 300 or 400 in 1969, and to some 300 in 1978. Fall aerial surveys taken from 1984 to 1986 showed 250 head. Another estimate made in 1988 was 218 caribou; thereafter, the figures varied from 150 to 250 for the 1988-1991 period, and stabilized at around 200 in 1991, then at 200 to 250 between 1993 and 1996.

Since 2002, the size of the caribou population is varying between 100 and 200 animals, and the percentage of calves varies at around between 3 and 18%, almost always below the goal of 17%. With an estimated adult survival rate of 87% and recruitment rates often below 30 calves per 100 females in the fall, demographic scenarios and population viability analyses anticipated a severe decline and potential extirpation within 50 years.

In 2016, estimates of the caribou population of the Gaspé Peninsula stood at around 100 animals.

With a view to implementing effective protection measures appropriate to the dynamic ecological context of this remnant, genetically distinct, and vulnerable population, the Quebec Ministry of Forests, Wildlife and Parks (MFFP) has, since 1983, continued inventorying the Gaspé Peninsula caribou each fall; the animals are counted and their sex and age are determined. This valuable tool provides information on changes in population composition. The Gaspésie Woodland Caribou Recovery Team can then see the effects of recovery measures on the herd. Those efforts – for example, predator control – are subsequently adjusted in accordance with the degree to which recovery-plan objectives (2002-2012) have been met.

Under the *Regulation Respecting Wildlife Habitats* and the *Act Respecting the Conservation and Development of Wildlife*, certain activities carried out in the area occupied by the caribou are now managed within a legal habitat which was established in 1993 and extended to 1025 km^2 in 2009. In addition to encompassing the boundaries of the Gaspésie Provincial Park, various portions of the territory covered by the Chic Choc Wildlife Reserve – i.e., Petit Mont Ste. Anne and Mont Vallières de St. Réal – are also included. The existing caribou distribution area apparently extends beyond this species' legal habit boundaries, especially in the Mt. Logan area.

Existing and future threats

The Gaspésie herd may well disappear because of its low numbers (natural disasters), restricted residual habitat (vulnerability during major episodes of snow, rain-on-snow, ice, spruce budworm outbreak and forest fires, and following climate changes), vulnerability to predation (by coyotes and bears), and disturbances by recreational use.

Despite the protection offered by the park, the small population, its restricted distribution area, and its low calf survival rate (due to predation by coyotes and bears) are cause for concern. These factors make the population susceptible to genetic drift and inbreeding, as well as to unanticipated extinction following rare climatic events.

At present, predation is the main threat. The rejuvenation of the forest around the park is detrimental to the caribou and favourable to the coyote and black bear. Calves are victims of predation by the former, which colonized the Gaspé Peninsula in the mid-1970s, and by the latter, which frequents the mountain peaks used by the herd. One measure allowing for population recovery is the use of trapping to control the number of predators likely to frequent those peaks between May and October, a strategy that was used successfully between 1990 and 1996, and again, with more variable success, since 2001. The purpose of this action is to re-establish the predator/prey balance – a balance that has been negatively affected by human intervention. However, this costly and ethically disputable measure must remain temporary, although identified as the only way to maintain this population on the short term in recent population viability analyses.

Between 1987 and 1993, the summer mortality rate of the calves in the Gaspésie population was close to 90%, primarily because of predation by the black bear (three of 11 cases) and coyotes (seven out of 11). Between 1990 and 1992, the Gaspésie Woodland Caribou Recovery Team removed 70 coyotes and 37 black bear from the park; by 1992, calf survival had improved, but since then, the Department of Natural Resources and Wildlife removed on average between 15 and 20 bears and coyotes (respectively) but with variable effect on recruitment, most of the years having lower values than the self-sustainability recruitment threshold. Human access to Mt. McGerrigle was also restricted to prevent the caribou from taking refuge in the forest cover, where the calves are more vulnerable to coyotes.

Caribou populations cannot survive without suitable habitats, in terms of quantity as well as quality. The loss, degradation, and fragmentation of those habitats are attributable to the cumulative effects of a number of different factors, both natural and human. While predators inflict the heaviest losses on the woodland caribou, this factor than can be controlled through harvest. Disturbances and fragmentation of the caribou habitat; however, results in the isolation of the caribou population, low numbers, and predation pressure by bear and coyote. Increased access to preferred habitat and the resulting disturbances are other aspects that increasingly seem to come from human use and activity, rather than natural causes.

A study conducted in the Gaspésie Provincial Park showed that the presence of park users has modified caribou behaviour, causing them to flee and abandon previously frequented sites. Protection measures were taken to mitigate those effects; for example, access to the mountain peaks is now prohibited in mating and calving season.

The long-term effects of such disturbances, however, are still being assessed by a team from the Université du Quebec à Rimouski, in collaboration with the Université de Sherbrooke, University of Northern British Columbia, the Department of Natural Resources and Wildlife and park authorities. In the park, the observation of the mountain caribou is one of the main attractions available to the public. In the mountains, it is easier to observe the caribou from a distance. Even in this environment, visitors disturb the herd and increase the risk of mortality. The emphasis must therefore be shifted to interpretation activities that focus on the caribou's history, habitat, etc. to generate economic spinoffs, rather than its direct observation.

Management and research

The G*aspésie Woodland Caribou Recovery Plan (2002-2012)* was drafted by representatives of various Quebec government departments, community organizations, and university researchers, as is the next version that should be published soon (2017 – 2027).

Although much of the legal habitat is located inside park boundaries, many caribou have used and been observed in areas adjacent to the park – alpine and subalpine environments that constitute extensions of those found in the park. The caribou use them regularly for summer and winter feeding, as well as for calving. Telemetry data and observations of the animals or their tracks confirm the use of areas outside the park.

Logging operations are impacting caribou habitat by altering the forest cover and the production of arboreal lichen. Given the existing status of the caribou population, forest practices, even when in compliance with the *Regulations Respecting Standards of Forest Management for Forests in the Public Domain*, do not provide sufficient protection for the habitat of this species in the sectors concerned. The protection of caribou habitat is vital to maintaining the species throughout the area occupied (the Gaspésie Provincial Park as well as areas outside its boundaries).

Several aspects of woodland caribou biology and the species' occupancy of the territory still remain unknown or require better documentation. For example, not enough is known about predator-prey relationships. Research is necessary to increase understanding of the impact of forestry and softwood regeneration practices on the caribou and its habitat, as well as on the role of the protected zones inside developed areas. Recent studies have shown that timber harvesting on the fringes of the caribou range has led to disequilibrium between habitat quality for predators and alternative prey vs. habitat quality for caribou. Alternative forest management practices could be more beneficial to caribou than the more classic, intensive forestry practices.

Provincial parks are established to protect representative or special natural environments. These areas can also be highlighted through the interpretation of their associated natural and cultural heritage, as well as through extensive open-air activities. Conservation challenges stem from the search for a balance between the protection of and access to these areas.

In Quebec's Gaspésie Provincial Park, these specific challenges apply primarily to the caribou and its habitat. In order to reduce disturbances, predation, and habitat loss and fragmentation, several measures have been implemented:

- Access to certain mountains has been modified in accordance with breeding, gestation and calving seasons, as well as during the caribou's main daily activities.
- The *Gaspésie Woodland Caribou Recovery Plan (2002-2012)* has been developed and implemented, and another version (2017 – 2027) is currently in revision.
- There has been predator control in the Gaspé Peninsula caribou since 2001.
- A research program to acquire new relevant scientific knowledge on this herd is now in place.

To ensure that these measures aimed at enhancing our knowledge and properly managing the environment are effective, a conservation plan has been established.

Maintaining the integrity of the alpine meadow also represents a major challenge. Trampling of the vegetation, erosion, and the arrival of more competitive or invasive species are important conservation issues that require everyone's participation.

For recovery efforts to be continued, collective awareness is necessary, and sustainable development choices will have to be made.

Case study

The Porcupine caribou herd: The international wanderers

Prepared by Kirsten Madsen (2001), updated by Dorothy Cooley (2010) and Mike Suitor (2017)

Range and ecosystem

The Porcupine caribou herd (PCH) is a barren-ground caribou herd that ranges from northeastern Alaska across northern Yukon to the Mackenzie Delta in the Northwest Territories (NWT). The herd winters in the boreal forest of the Richardson and Ogilvie mountain ranges in Canada and south of the Brooks Range in Alaska. In recent years, the herd has wintered in Alaska and in the central portion of its range in Canada. The caribou feed among the trees, using their hooves to dig for lichens. Wary of predators, they move to clearings and hilltops with open views to rest and ruminate.

In spring, pregnant female caribou lead the migration to calving grounds located on the coastal plain and foothills of Alaska's Arctic National Wildlife Refuge (ANWR) and Yukon's Ivvavik National Park. The reason the herd returns each year to traditional calving grounds is not fully understood. However, it is likely that they choose these areas because spring vegetation appears here first. They may also choose these locations because they offer better protection from predators and insects.

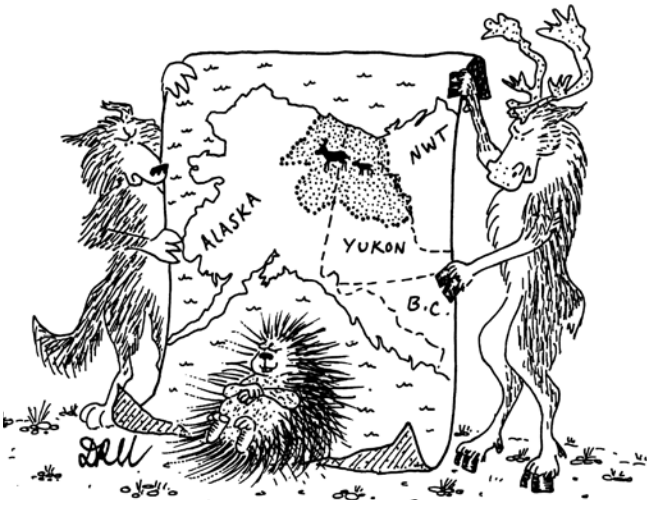
After an arduous journey, the females rest in the calving grounds where each cow gives birth to a single calf in early June. The newborn calves struggle to their feet and begin walking within hours of birth. They must quickly learn to follow their mothers during the herd's migration. Though resilient, nearly half the calves die in their first year of life. Travelling with the herd is perilous, and many die of pneumonia, by drowning or by having become separated from their mothers. Predators such as grizzly bears, wolves and golden eagles also prey on the calves.

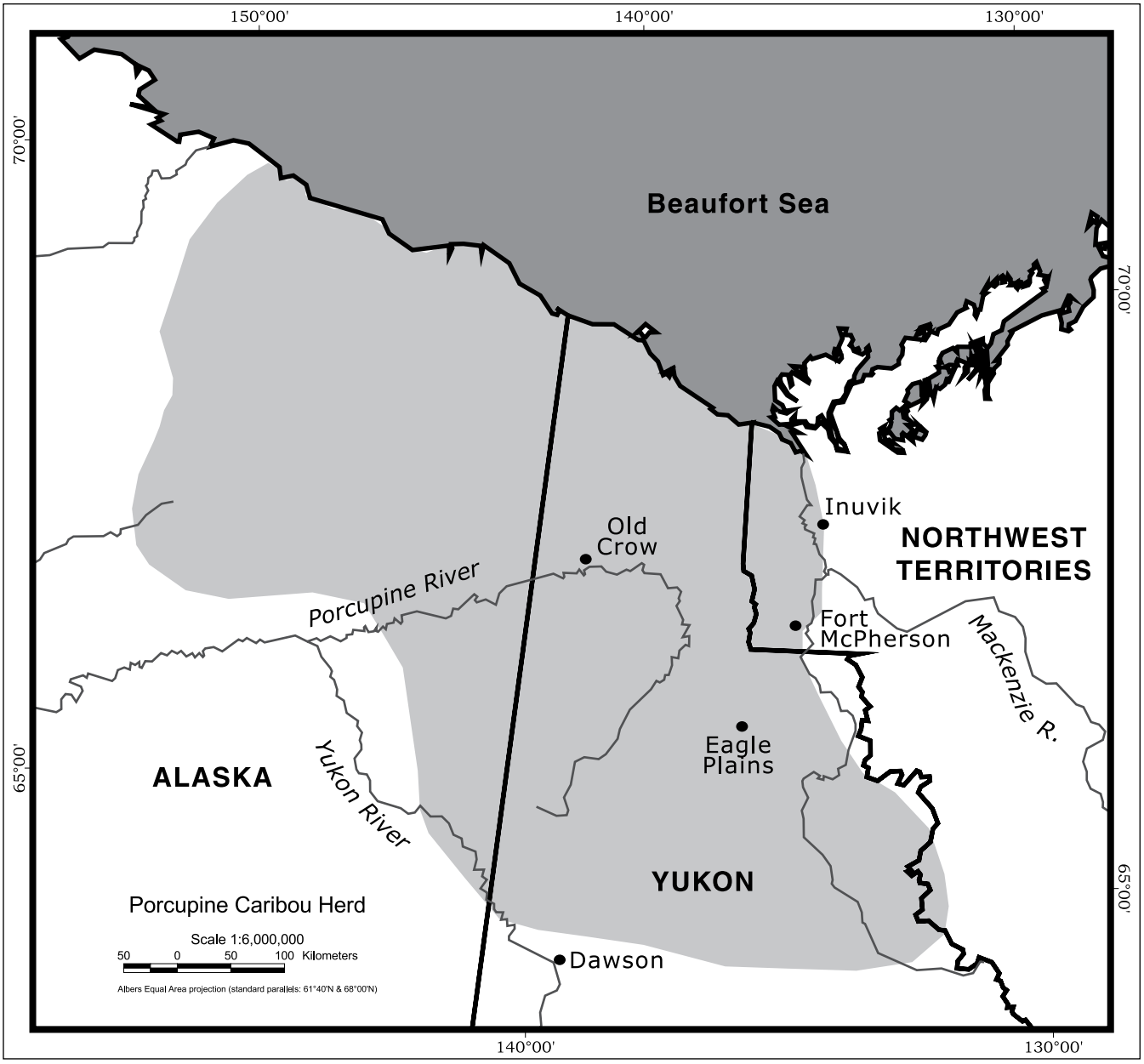
The PCH spends the short northern summer moving about the tundra in large groups. They seek relief from mosquitoes and parasitic insects by searching out windswept areas. Among the foods in their summer diet are grasses, sedges and shrubs. During late August, the herd almost becomes restless, moving large distances throughout its range before eventually deciding to move southward towards the boreal forest and their wintering locations. This usually takes place between September and November. Fall is also mating time. The bull caribou spar with each other to establish dominance. Breeding takes place, and the cycle of the herd continues.

Unique characteristics

The PCH is one of the largest herds of mammals in North America. Numbering 197,000 in 2013, the herd appears as a massive moving river of caribou passing over the landscape. Each year, the herd completes an arduous journey. The known range of the herd is about 260,000 km^2. The herd travels to different habitats within this range on a seasonal basis. Even very young calves travel with the herd, crossing open tundra plain, hills and mountain passes, and swimming swift-flowing streams and rivers. River crossings are particularly treacherous, especially during spring break-up when chunks of ice fill the streams.

The herd's annual migration brings them close to several northern communities. The Indigenous Peoples of these communities have an ancient relationship with the caribou, relying on the bounty of the herd for food, clothing and an intimate connection to the land. Though the people of these northern communities have experienced many changes, this relationship with the caribou remains strong. The PCH has returned year after year, and the people of the north rely on them to do so.

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Beaufort Sea
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Eagle Plains
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Scale 1:6,000,000
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Dawson

Cultural and social significance

The PCH is hunted by Gwich'in, Northern Tutchone, Han, Inuvialuit and Inupiat from 17 communities. Some of these groups have relied on this herd for centuries to provide food, clothing and shelter. But the ties between the people and the herd go much deeper. The PCH is part of their entire social and cultural fabric.

The Inuvialuit of the Mackenzie Delta area of the Northwest Territories traditionally hunted the PCH to provide food for themselves and their sled dogs. They used hides with fur intact to make parkas and fur boots. Today, Inuvialuit hunters from Tuktoyaktuk and Aklavik begin to harvest PCH caribou in July, when the caribou move past their whaling camps on the Arctic coast. Inuvialuit and Dene hunters from Tsiigehchic, Inuvik and Fort McPherson are able to hunt the caribou in the late summer as they move southward through the Richardson Mountains.

The Gwich'in people of Old Crow, Yukon, are one of the most consistent users of the PCH. Each year, the herd passes very close to the village on its migration across the Porcupine River. The relationship between the people and the caribou is an ancient one. A fleshing tool made from caribou antler that is at least 1,350 years old has been found near Old Crow. Ancient wooden fences, which were used to guide and trap the caribou, have also been found near the village. For thousands of years, the Gwich'in have lived off the land and taught their children how to hunt, use and care for their most important resource, the caribou. In the past, the Gwich'in used nearly every part of the caribou: fat for light and cooking, hides for clothing and shelter, and bones for needles, fish hooks, and ornaments.

Today, many of these traditions are still passed on. Young people are shown how to hunt wisely, share the meat and give thanks. They also learn how to preserve the meat and prepare the hides. Elders share their knowledge of traditions with their people. The fall hunt along the Porcupine River is one of the most important times of the year. The herd's arrival is anxiously awaited. The animals are in prime condition after a summer of feeding on the tundra. A supply of caribou is needed to last through the long winter, and the entire community is involved in the hunt and preparation of the meat. In an isolated community such as Old Crow, which has no road access, caribou meat provides a healthy, nutritious staple.

The people of Old Crow value their subsistence lifestyle and relationship with the caribou. Norma Kassi, a former member of the Yukon Legislative Assembly from Old Crow, says, "We have lived here for thousands of years, and we know what we need to sustain us. The caribou are our life. We must safeguard them forever." The late Johnny Abel, onetime Chief of the Vuntut Gwich'in Tribal Council, put it this way: "I sure don't want to see our kids, one or two hundred years from now, reading about the caribou in storybooks and about how we used to live."

Historical and current status

The first reliable population estimate was done in 1972 when 102,000 caribou were counted. The herd increased at a relatively slow rate until the herd size peaked at 178,000 in 1989. Following the peak the herd declined to its most recent population low of 123,000 in 2001. The cause of the decline between 1989 and 2001 is not well understood; however, biologists have a couple of theories. Population size is very dependant on calf birth rate and survival, and adult cow survival. In the early 1990s, the snow was deep and melted later than normal, resulting in a large number of calves dying early in the year. Again in 2000 and 2001, deep snow that stayed late into the spring resulted in very low calf survival. Studies during this time showed that adult cow survival was lower than it was when the herd was growing in the late 1980s. Although both of these factors appear to be responsible for the herd declining, biologists believe that the decline in adult female survival was the most important element driving the decline.

More recently adult female survival has increased and as a result the herd has grown. After many unsuccessful attempts in the 2000s biologists were able to get new population estimates in 2010 and again in 2013. The estimate of 169,000 in 2010 showed that the herd had increased while the most recent estimate of 197,000 shows that the herd is continuing to grow. The 2013 estimate is the highest ever recorded for the herd and is in contrast with the status of most other barren-ground caribou herds in North America which continue to decline.

Current and future threats

The PCH faces a possible threat on its calving grounds. The desire to exploit oil and gas reserves on the coastal plain has led to debate about opening up the Arctic National Wildlife Refuge to exploration and development. Most of the Refuge is designated as "wilderness"; however, a section of the coastal plain known as the "1002 Lands" was left out of the wilderness designation. It is up to the U.S. Congress to decide the fate of the 1002 Lands. It is not known what effects exploration and development would have on this herd or on the 7,000 northern Indigenous people who depend on it.

The PCH is not only sensitive to human activity on its calving grounds; development on the herd's winter range or migration routes could also affect the health of the herd. Such development would fragment the herd's range, possibly limiting the animals' access to good food areas during the cold winters.

Hunting pressure is another possible stress on the herd. Indigenous Peoples in 17 communities hunt this herd. Non-Indigenous hunters from these communities and from larger cities such as Whitehorse also hunt the caribou. Before the construction of the Dempster Highway, there was no road access for hunters. The Dempster Highway cuts through part of the winter range of the herd, allowing easier hunting access for both local and outside hunters. Managers of the herd and those who depend on completed a Harvest Management Plan for the herd in 2010. Although harvest probably accounts for only a small portion of the mortality of caribou, harvest is the only factor that managers can control. Managers must adjust how the herd is used in response to factors that they have no control over such as predation and bad weather.

There are several possible threats to the PCH due to events that are occurring on a global scale. Activities of people on the other side of the country and the world may affect this northern caribou herd. Pollution from large industrial centres can travel great distances. Lichens gathered in Canada's far north show traces of contamination caused by pollution. Because caribou eat lichens in such quantity, there is the possibility that contaminants could harm the caribou and those who eat them. For example, in the years following the 1986 explosion of the Chernobyl nuclear reactor, levels of radioactive cesium rose in the herd. More recent studies have found the levels of other contaminants to be relatively low and stable. Radioactive cesium fallout from the nuclear disaster in Fukushima, Japan, following the devastating tsunami in 2011 did not appear to affect PCH caribou or its habitats. However, cadmium levels were found to exceed World Health Organization standards and an advisory was issued for people to limit their consumption of caribou liver and kidneys. The recommended number of liver and kidneys is very high and it is important to know that the health risk is low and caribou remains a good food source for people.

Another change that may affect the PCH is global warming. Researchers and northern peoples are keeping close track of changes, such as temperature, snow depth, and vegetation changes to gauge the effects of global warming. If global warming continues, it may affect weather patterns, snow depth, habitat, insect numbers and the spread of diseases, all of which could have an impact on the PCH.

Management and study

Wild animals like caribou take little notice of political boundaries. Because the PCH ranges internationally, it presents a challenge to managers and others interested in the welfare of the herd. The International Porcupine Caribou Board was established to provide advice and recommendations to improve cooperation and coordination between Canada and the US. in managing the PCH. This Board consists of four members from Canada and four members from the US.

In Canada, efforts to protect the herd resulted in the creation of the Porcupine Caribou Management Board, which represents Indigenous groups and the Yukon, NWT and federal governments. The objective of this board is to ensure the conservation of the herd and its habitat, making sure that the herd will always be able to provide for the subsistence needs of the traditional users who depend on it.

Many studies of the PCH are conducted jointly by Canadian and American wildlife agencies, First Nation organizations and co-management agencies. There are several ongoing studies of the PCH. Aerial photographs of the herd are attempted in most years in late June or

early July, when the caribou are gathered in large groups. Satellite GPS transmitters attached to a sample of caribou help the researchers locate the various groups. The caribou are then counted from the photographs to obtain a population estimate. Researchers also attempt to make a composition count of the herd, estimating the numbers of cows, calves and bulls.

Satellite-collared caribou allow researchers to see what habitats the herd is using throughout the year and allows them to track their movements. During certain times of the year, researchers use the collar signals to locate the herd. For example, each spring they go to see where calving is occurring and to determine the number of cows having calves. Determining the location of major calving grounds helps managers identify the herd's critical habitat. Researchers also locate the cows one month after calving to estimate the survival of the calves during their critical early days.

There are numerous ways that harvest information is collected across the herd's range. Agencies, First Nation and Inuvialuit governments, and co-management bodies coordinate harvest reporting projects in the communities. Questionnaires and interviews with hunters are set up in an attempt to monitor the number of caribou taken by hunters each year. In years when the herd is accessible, harvest has ranged between 3,000 and 5,000 animals per year. This harvest rate is less than 3% of the total herd, an acceptable harvest. The body condition of caribou is monitored by hunters submitting samples from their harvested caribou. This information is used to see if caribou are getting enough food from their range.

Information collected from harvesters and through all of the other monitoring projects is pulled together each year in a summary report to help managers determine the health of the herd. Each February all the parties involved in managing and using the PCH come together to discuss the information, assess the status of the herd, and recommend management actions for the following harvest year.

The PCH is truly one of the last of the great herds of animals that once roamed this continent. It is a vital part of the northern environment.

For further information:

Porcupine Caribou Management Board
Box 31723
Whitehorse, Yukon
Y1A 6L3
Phone: (867) 667-7500
Website: http://pcmb.ca

Case study

The Qamanirjuaq caribou herd: An Arctic enigma

Prepared by Leslie Wakelyn

Range and ecosystem

Every year for thousands of years, Qamanirjuaq caribou (QCH) have migrated from calving and post-calving areas on the tundra, south to the wintering ground, and back north for the next calving season. The distribution of this barren-ground caribou herd has been described by government surveys conducted sporadically since the 1940s, and by tracking collared caribou cows (adult females) using telemetry since 1993. QCH caribou do not use all of their range in any one year, as their movements and range use patterns vary according to population size, weather and other factors. The total area known to be used by the herd since the 1940s extends from the west coast of Hudson Bay inland across the southern Kivalliq region of Nunavut, northern Manitoba, northeastern Saskatchewan and southeastern Northwest Territories (NWT). Telemetry information from collared caribou cows indicates that the herd's range from 1993 to 2012 extended at least 1,100 km from its southeastern limit near Split Lake, Manitoba to its northwestern edge near Lutsel K'e, NWT, and about 1,000 km from south to north, with its northern extent near Baker Lake, Nunavut. There has been substantial overlap of Qamanirjuaq and Beverly caribou range, especially winter range in the NWT and Saskatchewan.

The QCH returns to the same general area for calving each year, although not to the same specific location. As a result, the traditional calving ground, which is the total area known to be used for calving over many years, is much larger than the area used in any particular year. The QCH's traditional calving ground as described by government surveys conducted between 1963 and 2014, is about 200 km by 350 km in size, extending from near the west coast of Hudson Bay to about 250 km inland. It is located in the Qamanirjuaq Lake area of Nunavut's Kivalliq region, between the coastal communities of Arviat, Whale Cove and Rankin Inlet, and the inland community of Baker Lake.

Information from tracking collared cows since 1994 has been used to document seasonal range use during other periods as well, including spring (April-June) and fall (September-November). QCH caribou spring migration range includes a relatively heavily-used corridor within 50-125 km of the Hudson Bay coast between Arviat and Rankin Inlet. Several high use areas have been documented during fall migration within 50-175 km of the coast between Arviat and northern Manitoba, and farther inland in the southern Kivalliq and northeastern Saskatchewan-northwestern Manitoba.

The QCH historical winter range consists primarily of forested lands in southeastern NWT, northeastern Saskatchewan and northern Manitoba, as well as tundra in northern Manitoba and the southern Kivalliq region of Nunavut. In some years, portions of the herd have wintered on the tundra while other groups have wintered in the forest. In most years in the 1970s and 1980s, the majority of the QCH wintered on the tundra in coastal regions of Hudson Bay. In other years, much of the herd wintered in forested areas closer to communities in northern Manitoba and northeastern Saskatchewan.

Limited protection for scattered fragments of QCH habitat in the northern provinces is provided by various protected and conservation area designations with some restrictions on land use, but no such designations currently exist on the territorial portions of the range. Fairly large pieces of QCH winter range in northern Manitoba are included in Wapusk National Park and several provincial parks and special interest parks. Various smaller parts of the caribou winter range in northern Saskatchewan are designated as special management areas, provincial parks and representative areas.

Unique characteristics

Variability in QCH range use has caused much concern for hunters, biologists and wildlife management agencies over the years, and has frequently resulted in limited access to caribou for hunters from different parts of the range. Substantial changes in seasonal caribou distribution between years have caused much hardship in the past for Indigenous people dependent on QCH caribou as their primary food source. Before people moved to communities and used snow machines for hunting, famine resulted when the herd did not return to areas in which people had hunted caribou for many years. Even in modern times, hardship can result when

caribou do not winter near communities. For instance, in 1998, it was necessary for hunters from northern Manitoba communities to travel long distances (10 to 22 hours by snow machine) to harvest only a few caribou. In winter 2015 – 2016 there were no caribou accessible to hunters from northern Saskatchewan communities in areas where they traditionally harvested (in northern Saskatchewan and southern NWT), so they travelled long distances by road and snow machine to harvest caribou wintering in northern Manitoba.

One mystery that has never been solved concerns the large fluctuations in the numbers of calving QCH caribou that were observed during surveys conducted in the early 1980s. Government surveys from the 1960s to 1980 suggested that the population was declining, but in 1982 and 1983 biologists found an unexpectedly large number of calving caribou, which indicated that the herd size was much larger than previously believed, and that it was increasing. Biologists had explained the apparent decline as a consequence of over-harvesting, but hunters did not agree with this interpretation. No simple explanation for the confusing survey results has been established, although it is likely that the answer has something to do with changes in QCH caribou distribution.

Cultural and social significance

Many Dene and Inuit historically depended on QCH caribou for much of their food, clothing and shelter. Caribou were used so much by some groups of Inuit in the Kivalliq region that the people were given the name "Caribou Eskimo" by Europeans. The people known as the Ahiarmiut lived inland year-round, subsisting almost entirely on caribou and fish, unlike most other Inuit groups that depended at least partially on harvest of animals from the sea. When the Dene joined the fur trade, and consequently stopped following caribou onto the tundra each summer, the Ahiarmiut moved farther inland, pushing southwest to the tree line near Ennadai and Nueltin lakes by about 1850. During spring they intercepted caribou travelling north, and had summer camps on the calving ground and at river crossings used by caribou.

The Pallirmiut, neighbours of the Ahiarmiut, lived inland during winter and travelled to the coast for the summer. In the early fall, they returned inland to hunt caribou and make caches for the winter. Groups of families hunted caribou at water crossings during their southward fall migration, and cached caribou and fish under large rock piles, often on high points of land, so they could be found easily. These Inuit groups relied primarily on caribou during the winter months, and winter food supplies that they cached saved many people from starvation when caribou were scarce. These people were successful inland hunters, although they were subject to famine in years when caribou wintered primarily in the southern forest, rather than on the tundra, or when they were unable to cache sufficient food supplies in the fall.

Regular trade between Caribou Inuit and Europeans began in the early 1900s, after which time Inuit lifestyles began to change. White fox trapping became popular in the Kivalliq region, as it was easy and profitable to check traplines while hunting caribou. The Inuit maintained a lifestyle of hunting and trapping while living in family groups on the land, and continued to rely heavily on harvesting QCH caribou. However, following years of hardship in the late 1940s and 1950s, many people started moving into communities, and were encouraged by government to do so to allow their children to attend school and to have access to medical care at nursing stations.

In spite of the changes associated with community living, the use of QCH caribou continues to be very important for sustaining the culture and traditional lifestyles of Dene, Cree, Métis and Inuit across the caribou range. Caribou are still a significant source of food for families, and they also provide materials for traditional clothing and special tools. The herd is harvested regularly by residents of at least 13 communities in Nunavut, northern Manitoba, and northern Saskatchewan. An economic analysis estimated the net economic value of the herd to be more than $15 million each year (based on values for 2005 – 2006), including more than $10 million for subsistence harvest. Both the subsistence and commercial harvest of QCH caribou are important to some communities, although most of the harvest has historically been for Indigenous domestic use (87 per cent in 2007 – 2008). There is limited harvest of the herd by resident hunters across the range, and outfitters continue to harvest QCH caribou in Manitoba.

An Inuit legend about the origin of caribou

(Told by Kibkarjuk, from "Observations on the Intellectual Culture of the Caribou Eskimos" by Knud Rasmussen)

Once upon a time there were no caribou on the earth. But then there was a man who wished for caribou, and he cut a great hole deep into the ground, and up through this hole came caribou, many caribou. The caribou came pouring out, till the earth was almost covered with them. And when the man thought there were caribou enough for mankind, he closed up the hole again. Thus, the caribou came up on earth.

Historical and current status

The population size of the QCH was estimated to be well over 100,000 on the basis of surveys conducted in the late 1940s and mid-1950s. Calving ground surveys in the 1970s indicated a population decline, with estimates of fewer than 50,000 adult animals in the herd. By the late 1970s, biologists were concerned that the population decline could drive caribou numbers so low that harvesting would no longer be possible, which would have serious consequences for the many hunters and families that depended on QCH caribou as their main source of meat.

Hunters did not agree that the herd was declining, however, and believed instead that it was actually increasing. We know now that herd size was likely much higher than surveys in the 1970s indicated. Surveys in 1982 and subsequent years confirmed larger herd sizes and an increasing trend, with more than 200,000 adult caribou in the mid to late 1980s, and almost 500,000 by 1994.

Surveys in 2008 produced a population estimate of about 344,000, suggesting that the herd may have decreased by about 30 per cent since 1994. Following another population survey in June 2014, the size of the herd was estimated to be about 265,000, indicating a further decline of about 23 per cent compared to 2008 numbers. Therefore, although the QCH is still one of the largest in North America, there is increasing concern about its status and declining trend. The results of that survey are expected to confirm that the herd is experiencing a serious ongoing decline, in which case possible management actions will need to be considered. Although current survey techniques, including photographic surveys, provide better estimates of herd size than earlier methods, population estimates still contain a degree of uncertainty.

Current and future threats

The cumulative impacts from mineral exploration and development, roads, increasing harvest, and the effects of climate change are the greatest threats to QCH caribou. These impacts will accumulate over time in combination with the effects of other factors, such as disease, parasites, predation and environmental contaminants.

Mineral exploration activities increased on the caribou range, including the calving and post-calving areas, over about 20 years starting in the early 1990s. For example, between 1991 and 1998, five mining companies submitted applications to the federal government for mineral exploration on the QCH's traditional calving ground. Between 2005 and 2010, there were at least 125 active mineral tenures (prospecting permits, mineral claims and mineral leases) on the QCH calving ground each year, with more than 250 active tenures during most years. As well, land use permits were issued for more advanced exploration on the southwestern side of the QCH traditional calving ground, including construction of an airstrip. With the creation of the Territory of Nunavut in 1999, the Nunavut Impact Review Board (NIRB) took over responsibility for screening applications for land use permits and leases from the federal government, including activities on QCH caribou range. However, in the absence of any co-ordinated strategy or policy for protection of caribou calving and post-calving areas in Nunavut, exploration activities have continued in these and other areas on the caribou range.

A proposal for uranium mine development at the edge of the QCH range northwest of Baker Lake was submitted to the NIRB late in 2008, and an environmental review of the proposal began two years later. All phases of the mineral extraction process (including exploration, construction, operation and abandonment) and associated transportation issues (including a proposed access road from Baker Lake to the mine site) were of potential concern, although it is difficult to predict and accurately assess the possible negative impacts of these activities on QCH caribou. In May 2015, following their detailed environmental review,

the NIRB recommended that the project "not proceed at this time" and over a year later the four responsible federal ministers accepted this recommendation. However, they also invited the project proponent to resubmit the proposal in future, so the potential threat of the project to the QCH may reappear.

Feasibility studies were proposed in 1999 for transmission lines and an all-weather road from northern Manitoba to communities on the west coast of Hudson Bay, and for hydro generation facilities just north of the Manitoba border. These proposed facilities are all located within QCH range and could have significant consequences for the herd, but the proposed roads are the greatest concern to the BQCMB. The proposed Manitoba-Nunavut all-weather road along the Hudson Bay coast could affect caribou movements during spring and fall migration as well as calving success, as the proposed road corridor would run along the edge of the herd's primary migration corridor between winter range and the calving ground, and could also cross the traditional calving ground and the core calving and post-calving areas used in recent years. However, the greatest concern would be with the "spur" roads that would likely develop from the coastal road to access mineral exploration and mining projects farther inland. New roads may act as barriers to seasonal migration and other caribou movements, result in frequent disturbance from traffic, and reduce habitat availability and forage quality. There is also a high potential for significantly greater harvest levels resulting from the increased access to caribou range that these roads would provide, for both Nunavummiut and people from northern Manitoba and Saskatchewan, including hunters from south of the caribou range. The proposed hydroelectric development could also affect movements of QCH caribou during spring and fall migration. The herd may need to make long detours if traditional water-crossing sites become impassable because of changes to water levels and stream flow characteristics that result from hydro dams.

There is significant concern about QCH caribou harvest levels, which are likely increasing at the same time the herd size is decreasing. Harvest may threaten the QCH if it occurs at an unsustainable level, as it could accelerate the herd's decline, reducing herd size to such a low level that it cannot recover or continue to provide for the subsistence needs of traditional caribou harvesters. Adequate monitoring of both caribou and harvest levels is required for clarifying the status of the QCH and the sustainability of ongoing harvest. Careful sharing of the caribou resource may be necessary at some time in the near future to ensure that the QCH continues to be abundant and productive, so that caribou are available for present and future generations.

At least four new major factors are contributing to the apparent increase in harvest of QCH caribou:

1. The decreased availability of the Beverly, Ahiak and Bathurst herds to communities who traditionally hunted those herds has increased harvest pressure on the QCH from within the Beverly and QCH ranges. For example, Saskatchewan communities have been harvesting primarily from the QCH in recent years, and hunters from communities as far west as Ft. Smith and Lutsel K'e now harvest QCH caribou in years when they are accessible.
2. Very limited availability of caribou on Baffin Island has increased the demand for inter-regional sharing of country foods, particularly caribou, within Nunavut. This has resulted in caribou meat being sent from Kivalliq to Baffin communities.
3. Sharing of meat is being facilitated by use of social media and also by subsidized rates offered by northern airline companies for shipping country foods.
4. Commercial harvest appears to be increasing in Nunavut. In the past, commercial harvest was limited to meat sales to the Rankin Inlet meat plant. However, a new market has emerged and a few individuals are taking advantage of the demand and ease of using social media to make arrangements for selling caribou meat. This situation is likely increasing the harvest of QCH caribou, but the extent of the problem is difficult to determine for several reasons:
    - harvest data have not been obtained from Indigenous hunters and reliable estimates of subsistence harvest by communities have not been available in recent years;
    - "Internet sales" of caribou meat are not tracked systematically; and

- it is not known what proportion of caribou meat shipped elsewhere from Kivalliq communities is new additional harvest.

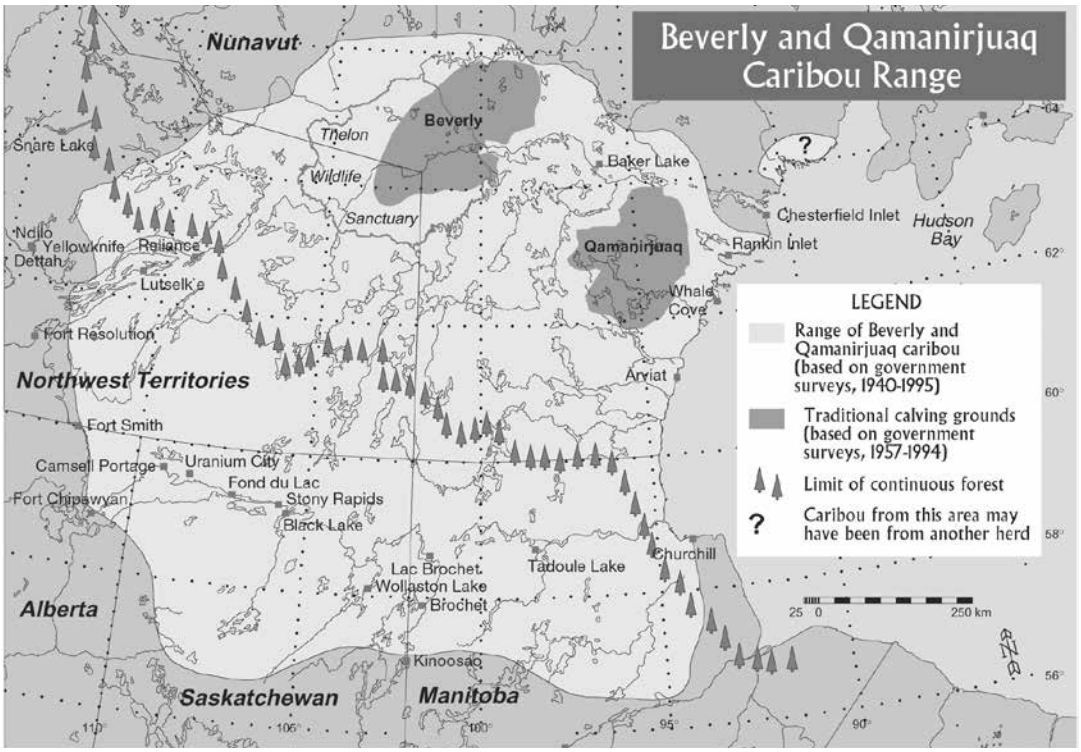
Sharing country food with family and friends is a traditional practice that is intended to address food scarcity, a serious problem for many Inuit families and an historical issue for Inuit generally.

Climate change over the next several decades has significant potential to affect QCH caribou and their habitat. Global warming may result in changes in snow depth and hardness, timing of spring melt, summer temperatures, and abundance of insects and parasites, all of which may have effects on the nutrition and survival of individuals and on productivity of the herd. These changes in turn will likely affect herd size, migration patterns and seasonal distribution of caribou.

Management and study

The Beverly and Qamanirjuaq Caribou Management Board (BQCMB) was established in 1982 to try to assist with issues associated with the multi-jurisdictional nature of the caribou herds. In the late 1970s, a confrontational situation existed among the several governments and many communities that had vested interests in management of Beverly and Qamanirjuaq caribou, and Indigenous peoples were not included in decision-making processes. The BQCMB was created and has continued through agreement by all governments with responsibility for the Beverly and QCH and their habitat, with representation from these governments and communities from across the ranges of both herds. Over the years, the Board has successfully brought people from these different governments, communities and cultures together to discuss issues and make recommendations for conservation and management of the caribou herds. The BQCMB has worked as a co-management board to foster multi-jurisdictional and multi-cultural co-operation as a result of greater understanding and respect for diverse values and points of view, which has had positive ramifications far beyond caribou management issues.

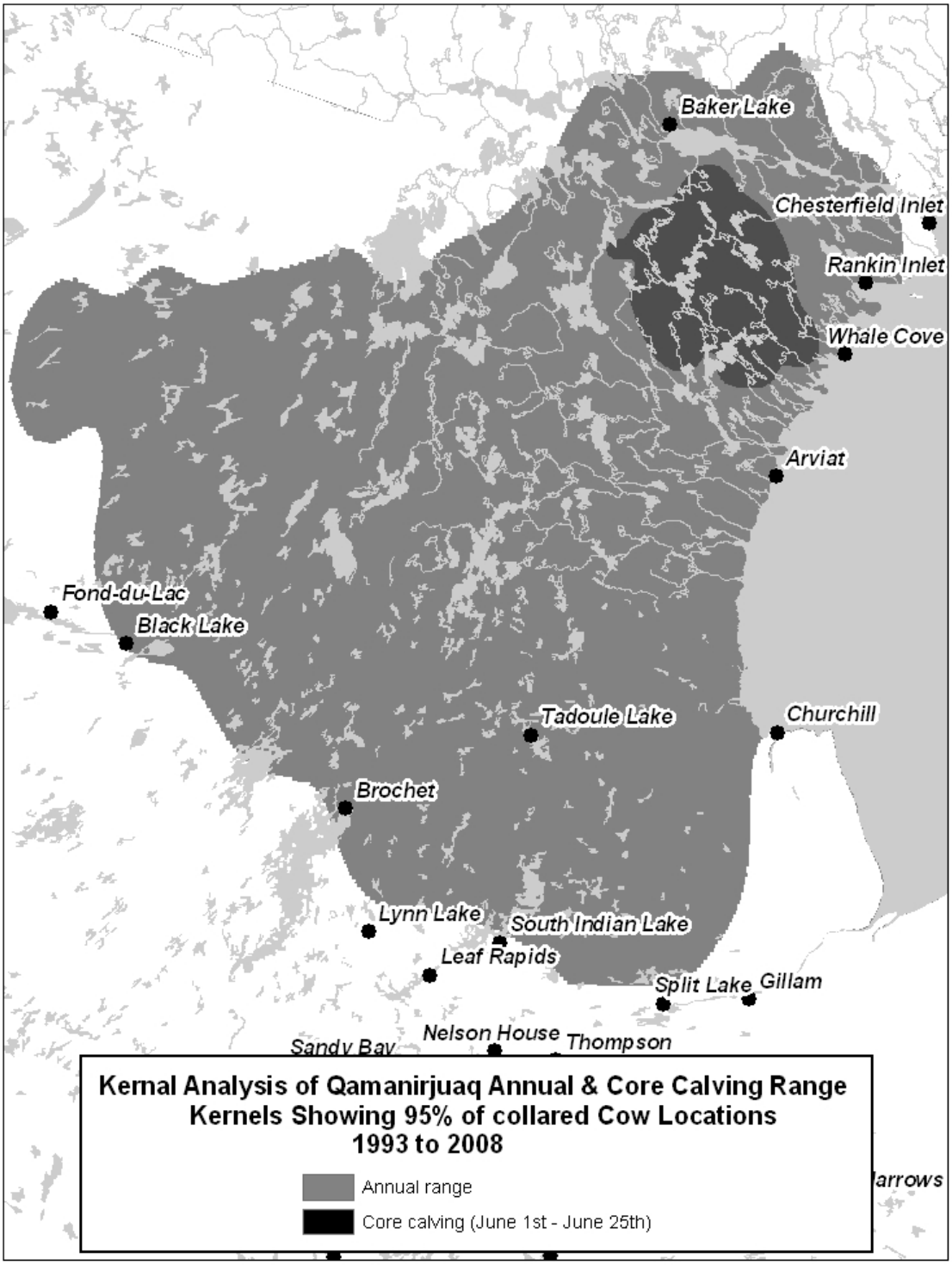
The BQCMB published the first management plan for the Beverly and QCH in 1987, and has since reviewed and revised the plan three times. The current Beverly and Qamanirjuaq Caribou Management Plan 2013 – 2022 was developed by Board members to outline the ways the Board will work co-operatively with governments, communities and other organizations to



safeguard the herds In the mid 1990s, the BQCMB released two reports reviewing and making recommendations to governments about fire management on forested winter range of the Beverly and QCHA report and map atlas on CD, published by the BQCMB in 1999 with assistance from the NWT government and the Nunavut Wildlife Management Board, provide information on seasonal range use by the caribou herds and recommendations for impact assessment and land use planning on the QCH and Beverly caribou ranges A new set of maps was created by the Board as part of the current management plan. In 2004, the BQCMB submitted recommendations to governments for protecting important caribou habitats in a position paper, including a recommendation for establishing legislated protected areas for calving and post-calving areas. This work formed the basis for subsequent recommendations by the BQCMB to the NIRB and the NPC for protecting calving and post-calving areas and key water crossings for both the Beverly and Qamanirjuaq herds. Responsibility for management of QCH caribou and their habitat is shared by two territorial and two provincial governments, as well as the federal government. The agencies responsible are the Nunavut Department of Environment, NWT Department of Environment and Natural Resources, Manitoba Sustainable Development, Saskatchewan Ministry of Environment and Indigenous and Northern Affairs Canada. The Government of Nunavut produced a Draft Nunavut Caribou Strategy Framework and began public consultations for developing a caribou strategy in 2010, and the following year drafted a Nunavut Caribou Co-management Monitoring Plan for 201 – 2016. The Government of the NWT has to date developed two five-year strategies (for 2006 – 2010 and 2011 – 2015) to guide management actions for barren-ground caribou in the NWT, and a new strategy for 2016-2020 is under development.

The distribution and movements of adult female QCH caribou were tracked for a few years in the 1980s using radio-collars which were periodically located by airplane. QCH cows have been monitored since 1993 using radio-collars that are tracked by satellites, recently employing GPS technology. The results of this monitoring have added much to our knowledge about the herd's recent distribution and seasonal movement patterns and the overlap between the QCH, Beverly and Ahiak caribou ranges. They also provided valuable information for planning the 1994, 2008 and 2014 calving ground surveys. The Government of Nunavut produced a digital map product on CD (*Journey of the Caribou*) that shows movements of collared caribou from the QCH and two other herds from the Kivalliq region, based on data from 1993 to 2006. Tracking QCH caribou using satellite technology is ongoing, although alternatives to collaring are being investigated, due to concerns raised by Inuit and Dene elders about the capture and collaring of animals.

Biologists with the federal government (Canadian Wildlife Service) and the Government of the NWT conducted numerous surveys of the QCH from the 1940s to the late 1990s, including surveys that were used to develop the 1994 population estimate. The Government of Nunavut (GN) has conducted many surveys and studies of the QCH and its habitat since the Territory was created in 1999, often with assistance from the Government of Manitoba. The largest undertakings by the GN to date have been a series of surveys that produced a long-awaited QCH population estimate for 2008 (the first since 1994) and the latest estimate in 2014. These were based on reconnaissance surveys and calving ground photo surveys conducted in June and fall composition surveys. Spring classification counts were also conducted in most years since 2003 to estimate over-winter survival of calves. Other studies spear-headed by the GN include work on caribou health, disease and contaminant monitoring; research on predation, habitat selection and diet; and a vegetation mapping project for the Kivalliq region which resulted in a detailed ecological land classification map atlas published in 2012. The Government of Manitoba has focused primarily on monitoring fall and winter harvest of QCH caribou on the winter range, conducting patrols for enforcement purposes, and assisting with Nunavut-led surveys and tissue sampling.



Annual range of the Qamanirjuaq barren-ground caribou herd from 1993 to 2008, based on locations of collared caribou cows. *Provided by Nunavut Department of Environment.*

For further information:

Beverly and Qamanirjuaq Caribou Management Board
Secretariat
P.O. Box 629
Stonewall, Manitoba R0C 2Z0
Phone: (204) 467-2438
E-mail: info@arctic-caribou.com
Web: www.arctic-caribou.com

Regional Biologist, Kivalliq Region
Department of Environment
Government of Nunavut
P.O. Box 120
Arviat, Nunavut X0C 0E0
Phone: (867) 857-3171
Fax: (867) 857-2986
E-mail: MCampbell1@gov.nu.ca

Draft Nunavut Caribou Strategy Framework (see www.gov.nu.ca/environment/documents/draft-caribou-strategy-framework-march-2010)

Wildlife Manager, Northeast Region
Manitoba Sustainable Development
P.O. Box 28, 59 Elizabeth Drive
Thompson, Manitoba R8N 1X4
Phone: (204) 677-6643
Fax: (204) 677-6359
E-mail: Daryll.Hedman@gov.mb.ca

Wildlife Ecologist, Shield Region
Saskatchewan Ministry of Environment
P. O. Box 5000
La Ronge, Saskatchewan S0J 1L0
Phone: (306) 425-4237
Fax: (306) 425-2580
E-mail: Tim.Trottier@gov.sk.ca

Manager, Wildlife Research and Monitoring
South Slave Regional Office
Department of Environment and Natural Resources
Government of the Northwest Territories
P.O. Box 900
Fort Smith, Northwest Territories X0E 0P0
Phone: (867) 872-6408
Fax: (867) 872-4250
E-mail: Allicia_Kelly@gov.nt.ca
http://www.enr.gov.nt.ca/node/2980

Case study

The Telkwa caribou herd: BC's hinterland herd

Prepared by Ian Hatter and Kerrie Post

Range and ecosystem

The Telkwa caribou herd (TCH) is a herd of woodland caribou of the northern ecotype. Its range is found 15 km from the major transportation corridor of Highway 16 near Smithers, Telkwa and Houston, BC Historically, caribou were widely distributed throughout most of the mountainous areas surrounding the Bulkley Valley. Evidence of antlers, reports from elders of the Wet'suwet'en First Nation and historical sightings of caribou are consistent with reports that caribou were once found throughout the area. Frequent sightings of caribou in the Telkwa Mountains support the suggestion that the Telkwa Mountains represent an important area of caribou habitat.

Based primarily on behaviour and habitat use characteristics, including distribution and migration patterns, the woodland caribou of British Columbia are classified into three ecotypes: mountain, northern and boreal. Telkwa herd caribou are considered to be of the northern ecotype, which live primarily in the mountainous part of northern and western central BC. Telkwa herd caribou spend most of their time at or above tree line. These caribou frequently winter either on windswept alpine slopes, where they feed primarily on terrestrial lichens, or in pine forests at low elevations where they feed on both arboreal and terrestrial lichens.

Unique characteristics

The three ecotypes of woodland caribou look similar but behave differently. The ecotypes differ by occupying different parts of the province, utilizing different habitats, and having different feeding habits and migration patterns. The differences are also thought to relate to the interactions of a variety of environmental conditions, including the amount and duration of snow cover, food types and availability, topography/terrain and predation. Genetic differences are possible as well.

Cultural and social significance

The TCH represents a particularly valuable resource to the people of British Columbia due to its proximity to the urban centres of Smithers, Telkwa and Houston and because of the importance of maintaining genetically viable populations of caribou in the face of increasing urban developments and habitat fragmentation.

While caribou aren't easily found, there are some viewing opportunities in the Telkwa Mountains. Snowmobiling is a popular recreational activity that can promote use and appreciation of wilderness areas, but its practice within caribou range is of major concern. While caribou may tolerate low levels of snowmobile use, high levels of snowmobile activity have been shown to cause caribou to abandon preferred winter habitats, which may ultimately lead to increased mortality and population declines. Many other forms of recreation, including hiking, quadding, and backcountry skiing, also occur in the Telkwa Range and have an influence on caribou.

Caribou are hunted by most northern First Nations, except during the rutting season, when the meat acquires an unpleasant strong taste. Because of its high insulative quality, caribou provide one of the warmest hides available. Besides clothing, tanned hides were also used to make containers for storage and transportation. Sinews were sometimes used as thread for sewing and as twine, and strands of caribou hide were used in snares. Caribou antlers and some bones were used to make arrow points, knives, scrapers, digging sticks and tool handles.

Caribou have less capacity for sustaining high hunting levels than do other members of the deer family largely because caribou produce only a single calf. This low productivity combined with a greater vulnerability of caribou to wolf predation means that caribou are not able to sustain the same levels of hunting pressure as moose, elk or deer. In the past, liberal hunting of both cows and bulls combined with predation resulted in caribou population declines. Current management goals are to restore and maintain viable populations throughout the current distribution of woodland caribou. Management activities including protecting caribou habitat, monitoring the size, sex ratio and recruitment of

herds and managing a conservative bulls-only harvest by requiring that all animals be inspected.

Historical and current status

Of all the woodland caribou in British Columbia, the northern ecotype, which includes the TCH, continues to be threatened by a combination of impacts from human activities. Under the *Species at Risk Act* (SARA) the Telkwa caribou population is currently (2017) listed in the Southern Mountain National Ecological Area (SMNEA), which includes the southern two-thirds of British Columbia, and the west-central portion of Alberta. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), however, has recommended that they be listed as northern mountain caribou. While all caribou in the SMNEA were listed as Threatened by COSEWIC in 2000 (and reaffirmed in 2002) the Telkwa and other northern caribou are blue-listed in British Columbia, meaning they are not immediately threatened, but of concern because of characteristics that make them particularly sensitive to human activities or natural events

Estimates of the size of the Telkwa caribou herd

The earliest population estimate of the Telkwa herd was in 1949 when a two-week horseback survey provided the basis for an estimate of 60 caribou. However, it is difficult to compare ground inventory to aerial surveys that cover larger areas over shorter periods of time.

There were a number of counts between 1956 and 1980. In 1984 an aerial survey provided a minimum count of 68 caribou. In 1984 it was thought that the TCH had increased at an annual rate of 3% after being nearly extirpated in 1966 and 1967. However, when the herd was next counted in 1993, only 11 caribou were found. Monitoring flights in June 1994 and March 1996 resulted in total counts of 10 and 13 caribou respectively. In 1997 the total count was 6 adults and no calves. To avoid imminent extinction of the herd, the BC Ministry of Environment translocated 12 caribou from the Chase-Sustut Herd to the Telkwa Mountains in November 1997 and 20 caribou in November 1998. The TCH increased from 2003 to 2006 when a fall survey led to an estimate of 114 animals (including calves) in the herd. By 2010 the population had dropped to less than 10 animals. Based on the number of animals and tracks seen during a survey conducted in October 2016 there were at least 18 animals estimated to be in the herd. The long-term viability of the population is unknown.

Current and future threats

Population declines in the past were probably the result of habitat loss, liberal hunting seasons and high predation rates. Until 1971 it was legal to use helicopters to place hunters near wildlife and to transport wildlife with helicopters. Additional causes for population decline of the TCH may include high mortality rates due to predation, movements of caribou out of the area, and/or range abandonment due to disturbance from human activities. The greatest threats to herd growth in the near future are low population size, continuing loss of habitat, continuing high predation rates by wolves and bears, and the effects of increasing motorized and non-motorized recreational access.

Predation of caribou by wolves has the potential to extirpate the TCH given that current wolf numbers may be largely determined by densities of moose, elk, deer and goats within the Telkwa herd range, and that the TCH is currently at a very low population level. Caribou calves are extremely vulnerable to both wolf and bear predation throughout the summer, and all age and sex classes of caribou are vulnerable to wolf predation throughout the year. Wolverine, golden eagles, coyotes and lynx have also been documented as predators on caribou. All are present in the Telkwa Mountains at low densities.

There has been a complete closure on caribou hunting in the Telkwa Mountains since 1973. However, there are unconfirmed reports of some poaching (illegal hunting) occurring in the Telkwa Mountains right into the 1990s. Poaching is unlikely to result in a significant degree of adult mortality unless access to alpine areas improves and the level of human activity increases, but given the current population level of caribou, any poaching could seriously jeopardize the recovery effort.

The recreational use of snow machines in the Telkwa Mountains represents a serious impact on the TCH and may result in winter range abandonment. Causing caribou to move out of areas of preferred winter range could lead to increases in predation rates and reduced

food intake given that not all areas of winter range have the same availability of terrestrial lichens.

Hikers and their dogs may cause both direct disturbance to caribou and range abandonment, particularly if dogs are taken to areas where they can be seen by cows, at a time when caribou are most sensitive to the presence of predators. Three areas within the Telkwa recovery zone that are both important for caribou calving and popular for summer hiking activities include: Hunter Basin/Camel Humps, Webster Plateau and Hankin Plateau. Skiers have the potential to cause many of the impacts described above for motorized access, but generally skiers cover less area, skiing occurs at a time when caribou are less sensitive to the presence of predators relative to hikers, and there is less potential for direct disturbance to animals.

Land alienation from urban development and agricultural encroachment has fragmented forested areas of the TCH range. Forest harvesting practices contribute significantly to habitat fragmentation unless carefully planned and conducted in accordance with a sustainable watershed-based perspective. Timber extraction and associated road developments can lead to further habitat fragmentation and increased public access. Forest harvest also leads to more moose and deer, and subsequently an increase in predator populations. This then has a negative influence on caribou populations. Support by the forest industry for access management measures and for incorporating caribou protection measures into harvesting reforestation and silviculture plans is required to reduce the relative liability associated with forest harvesting.

Other threats include loss of habitat and increased disturbance and access associated with potential mining developments (coal claims in the northeastern portion of the range, and coalbed methane in the Bulkley Valley) and oil and gas pipeline construction. Recent forest harvesting practices, the aggressive targeting of Mountain Pine Beetle infested stands of timber, and the policy of extinguishing all natural fires, with minimal consideration to mimicking natural disturbance patterns and rates, have all impacted the long-term availability of caribou winter range habitat.

Potential impacts of aerial harassment associated with low-level overflights for ecotourism, access to winter skiing areas, helicopter pilot training in the Telkwa Mountains, and survey and radio-collaring programs are similar to those described for activities associated with motorized access. Aerial harassment from low-level overflights, notably from helicopters (which are more intrusive than fixed-wing aircraft) can cause direct harassment leading to increased energy expenditure. As well, there is the potential for injury and range abandonment. Although the potential for aerial harassment to impact large areas of the Telkwa Mountains is great, the current low level of aircraft activity reduces the relative liability below that of activities associated with winter motorized and summer non-motorized recreational activities.

Finally, with increasing habitat fragmentation, degradation and alienation, the potential for interchange between the TCH and the nearest population of caribou in Tweedsmuir Park is reduced. Therefore, the potential for genetic effects to reduce the long-term viability of the TCH is increased. In general, the long-term impacts on genetic viability of small, isolated populations of caribou throughout British Columbia are poorly understood. However, studies elsewhere have documented that the likelihood that small, isolated populations of vertebrates will persist over the long-term is reduced as a function of the size of the gene pool and distance from other populations.

Although climate change is not expected to result in major habitat shifts in the short term, climate-related changes in habitat in the long term are expected to favour deer and other prey species, thereby increasing predator populations and predation on caribou, and facilitating the spread of diseases and parasites. However, impacts of climate change on caribou in the short term are expected to be low compared to other immediate threats that they face.

Management and study

Protecting the TCH is important to the residents of the Bulkley Valley. Direction on how to protect the herd was provided through public planning processes and consultation associated with the Telkwa Caribou Recovery Plan, and reflects the value people place on maintaining wildlife populations in the face of increasing pressures on natural resources in the Bulkley Valley and throughout British Columbia.

The Telkwa Caribou Recovery Plan has guided management actions that have:

1. Reversed recent declines in the size of the TCH by augmenting the population with caribou from other populations.
2. Increased understanding of factors influencing population growth rates by frequent monitoring of radio-collared caribou.
3. Protected caribou habitat by modifying industrial activities and managing potential disturbance to caribou arising from increased human access into and recreational use of the Telkwa Mountains.

Environment Canada's *Recovery Strategy for the Woodland Caribou, Southern Mountain population,* identifies the need to develop recovery action plans to identify and protect both current and recovery habitat requirements. Recent research has resulted in a better understanding of habitat use/distribution of the TCH, the influence of human activities on caribou, and the long-term impacts of forest practices on the TCH. These results will be used to inform future management actions for this herd.

For further information:

Ecosystems Branch Regional Office
Ministry of Environment
3726 Alfred Ave
Smithers BC V0J 2N0
Ph: 250-847-7260
Fax: 250-847-7591

Ecosystems Branch
Ministry of Environment
2080 Labieux Rd
Nanaimo BC V9T 6J9
www.env.gov.bc.ca/wld

Case study

The Western Arctic caribou herd: the largest herd in Alaska

Prepared by Meghan Nedwick and Jim Dau (2001), updated by Kyle Joly (2017)

Range and ecosystem

The Western Arctic caribou herd (WAH) is a barren ground caribou herd that ranges throughout northwestern Alaska. This vast herd ranges over a 140,000 square-mile (363,000 km^2) area bounded by the Arctic Ocean, the lower Yukon River and the trans-Alaska pipeline. About 40 communities and 13,000 people are located within the range of the herd. For the people of these communities, the herd is a vital link to cultural traditions, as well as a food staple for many families. The WAH herd moves seasonally over this large area, which has important implications on the ecology and subsistence patterns throughout the region from harvest to nutrient cycling.

In the spring, pregnant female caribou lead the migration to calving grounds located north of the Brooks Range. Calving then takes place in early June. The calving grounds offer a location where females encounter relatively few predators and which is close to insect relief terrain. The calves begin walking just hours after birth and quickly learn to follow their mothers during the herd's migration. Although precocious after birth, newborn calves still face many challenges. The survival rate of WAH calves through their first year varies annually and has ranged from roughly 23-68%. Sources of calf mortality include sickness, predators, becoming separated from their mother, and accidents.

The herd's summer range encompasses the calving grounds and consists of the Brooks Range and its foothills west of the trans-Alaska pipeline. For a short time during early summer WAH caribou form huge aggregations to help find relief from mosquitoes and other insects. The aggregation takes place in areas with winds that help keep the insects at bay. In the summer, the diet for these caribou includes grasses, sedges, and shrubs. Calves continue to grow on their mother's rich milk as well as from diverse and abundant vegetation.

Fall migration begins when temperatures cool and day length begins to change. Studies indicate that both temperature and day length play an important role in the timing of both fall and spring migration. Bulls compete fiercely with one another for females during mid-October. The mating season for caribou is brief and the "rut" for this herd is over by the end of October. Most of the herd migrates south in the fall across the Noatak and Kobuk Rivers to wintering grounds that include the Nulato Hills, the Seward Peninsula, and the upper Kobuk and Koyukuk drainages.

In most years, some WAH caribou do not migrate and winter on the North Slope between Point Lay and Wainwright. The herd winters on ridge tops or on the tundra where the landscape has shallow snow depths allowing the caribou to dig down, using their hooves like shovels to find lichen to eat. Winter can be harsh on caribou, especially if freeze thaw cycles cause heavy crusts or ice to form on the ground which makes digging difficult. Fortunately, caribou are resilient creatures well adapted to life in the north thanks to their many physiological and behavioral adaptations. Their hooves allow for efficient digging in the snow yet enable them to traverse steep, mountainous terrain or cross soft, swampy tundra. Their fur consists of hollow hair that effectively retains body heat. Barren-ground caribou also have sleek, compact bodies and small ears that reduce surface area and thus minimize heat loss.

Unique characteristics

The WAH was the largest caribou herd in Alaska and one of the largest in the world. This herd last peaked around 2003 when it reached 490,000 caribou. At last count in 2016 this herd numbered approximately 201,000 caribou. Because of its tremendous size, the ecological importance of the WAH to Northwest Alaska is incalculable. Although they are important prey for wolves and bears, these caribou directly and indirectly impact the entire food web through nutrient cycling affecting organisms from bacteria to moose. WAH caribou have the ability to survive under harsh conditions, travel long miles, inhabit an array of ecosystems from the coast to the mountains, and tolerate extremely cold temperatures as well as hot, insect-infested environments.

Cultural and social significance

The WAH herd is hunted by a variety of people throughout Northwest Alaska. The Inupaiq have relied on this herd for millennia to provide food, clothing, tools and shelter. Subsistence harvest patterns are primarily affected by seasonal movements and availability of caribou and also by traveling conditions for hunting. For example, Point Hope and North Slope villages harvest WAH caribou mainly during July and August while the WAH is on its summer range. In contrast, Shaktoolik and Unalakleet hunters primarily take WAH caribou during September through March. Harvest levels for villages along the Noatak and Kobuk Rivers are typically high during fall and spring migration periods, and also when caribou winter near those communities. Even so, caribou harvests all but cease during periods of freeze-up and breakup, when travel by boat or snow machine is difficult. Unlike many subsistence activities that are seasonally specific, subsistence hunting of caribou occurs whenever caribou are available and accessible.

People's reliance on WAH caribou has changed in relation to their availability. During times of abundance, people were able to survive quite well on the meat, hide, bones, and sinew of the caribou. During times of shortage, people relied more heavily on other game and fish, and had to travel much further to find caribou. When caribou became scarce, many communities were almost wiped out from exposure and starvation. Currently, caribou are still one of the main protein sources for people living in the range of the herd. In addition to their importance as a source of food, WAH caribou are also an important link between the Indigenous Peoples' past and present.

Historical and current status

Caribou abundance in northwest Alaska has varied substantially over the past 150 years. Although biologists have only been able to count caribou herds during the last 40 years, we know from historical records of early explorers that caribou almost disappeared from large portions of this area by the mid 19th century. Biologists first counted the WAH in 1970; at that time it, numbered about 242,000 caribou. The herd declined rapidly from 1970 to 1976 when it numbered only about 75,000 caribou. From 1976 through 1990 this herd grew about 13% annually to reach a population size of 416,000 caribou. From 1990 to 2003 the herd grew only 1-3% annually and peaked around 490,000 caribou. Since 2003 the WAH has declined and, as of 2016, numbered about 201,000 caribou.

Current and future concerns

The future of the WAH caribou depends largely on the land and the people who make decisions regarding large-scale resource development and access to the herds range. Caribou are facing many changes. Climate change brings melting permafrost, expanding shrubs, decreasing lichen, increasing wildfires, and changes in temperature. Oil, gas, and mineral developments may bring roads, pipelines, powers lines, construction, and possible spills and contamination. The warming climate is also opening the arctic to an even greater expansion of resource exploration and development. Changes impacting the caribou, also impact the people who value and use caribou as a resource.

Management and study

The foundation for management of the WAH depends largely on photocensus estimates of herd size. These censuses are conducted every two to three years. Additionally, composition surveys are conducted annually during the June calving period to determine how many calves are born and to delineate the calving area. Spring composition surveys are conducted to monitor calf survival through their first year of life. Fall sex and age composition surveys are conducted biennially to monitor proportions of bulls, cows and calves in the herd. Adult mortality is estimated annually.

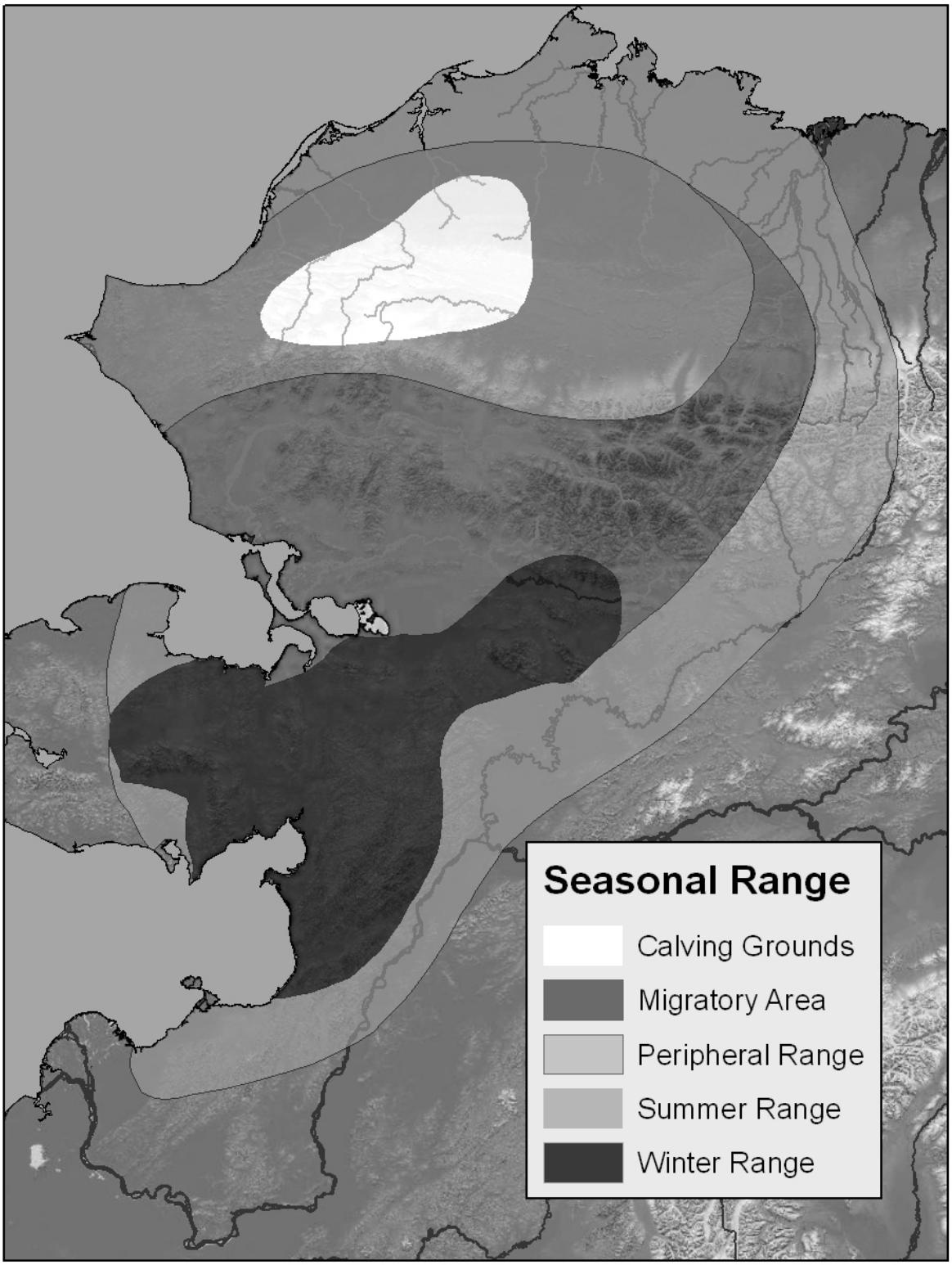
Distribution and movements of this herd are monitored through conventional and satellite telemetry. All of these activities are based on radio telemetry data. For the past thirty years, the Alaska Department of Fish and Game biologists have gone to a world-famous caribou crossing location on the Kobuk River (Onion Portage in Kobuk Valley National Park) to radio collar caribou. Since the early 1990s, federal agency staff and students from schools within the range of the WAH have accompanied department biologists to assist with caribou collaring. As caribou swim the river, a boat drives alongside a chosen group where biologists and students catch and hold an adult caribou and adorn it

with a collar. Besides deploying collars, biologists gather information regarding calf weights, body condition, and collects blood samples to detect antibodies that indicate exposure to disease. If the chosen caribou is a female with a calf, a second boat captures the calf to weigh it, assess sex and body condition and then release it near its mother. A third boat ensures that those caribou not being handled swim to the south side of the river to continue their migration. Using boats to capture caribou is quick, efficient, and safer for caribou as it uses no immobilization drugs. In-depth health assessments are conducted every two to three years to monitor the overall health of the animals.

Because the WAH traverse such a large area and impacts a variety of user groups, the need for co-management is important for the future of this herd. The Western Arctic Caribou Herd Working Group (WG) was established in 2003 as a way to help manage the herd. The WG includes subsistence users, other Alaska hunters, reindeer herders, hunting guides, transporters, conservationists, biologists, and natural resource managers. The group meets once a year, with additional subcommittee meetings throughout the year, as specific needs arise.

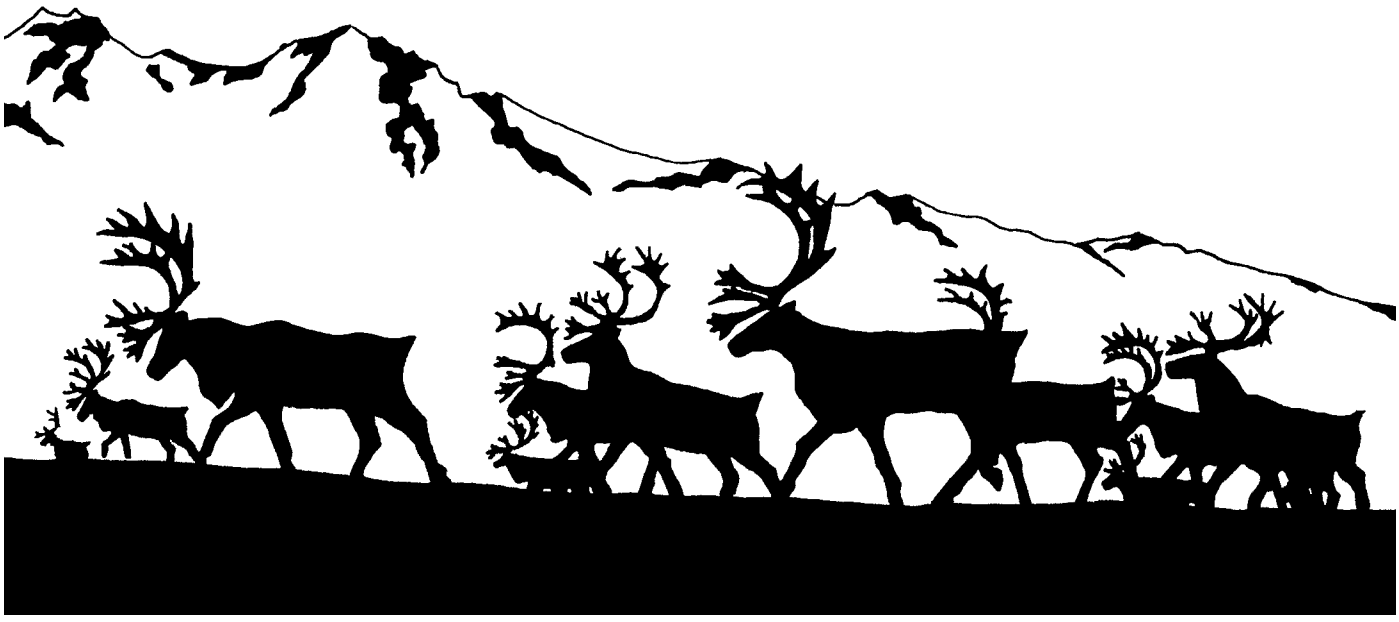
During meetings, biologists report on the current health and population status, range conditions, and other biological factors affecting the herd. Invited speakers present information on topics that may impact the herd, such as climate, transportation, and public land use planning. Elders address the group, sharing knowledge passed down for generations. The group identifies concerns, requests information and advocates for actions that will conserve and benefit the herd, including habitat studies or protections from the impacts of development. The group provides public information through its newsletter, *Caribou Trails*, and through its website: westernarcticcaribou.net.

Conservation of this herd and its habitat is critical in maintaining the traditional practices of Northern people as well as for the health and productivity of the habitat in which they roam.



Seasonal range of the Western Arctic caribou herd.

Appendices



Appendix 1

Conceptual framework

Concept A: *Caribou are culturally and socially important to human beings.*

Curriculum concept links: people and their environments, Canada studies, wilderness, pollution, circumpolar issues, cultural history, current events, global environment

Many Indigenous Peoples in North America have evolved cultural, spiritual and social relationships with caribou.

Caribou are found in many elements of the dominant North American society, and are considered to be a symbol of the North and wilderness, e.g., Santa's reindeer, the Canadian 25¢ piece, Newfoundland coat of arms.

People value caribou and their continued existence for both intrinsic and aesthetic reasons.

Caribou are valued by humans for both consumptive and non-consumptive uses such as tourism, hunting and wildlife viewing.

Concept B: *Caribou are part of global and local ecosystems that have evolved over time.*

Curriculum concept links: adaptation, evolution, Chordata-Subphylum Vertebrata, food webs, population dynamics, ecosystems, extinction, Beringia, predator-prey systems, wilderness, anatomy, parasite life cycles, biodiversity.

The caribou is a member of the deer family, which includes moose and elk.

The caribou is one of the most ancient forms of deer and has evolved from mammals bearing similar characteristics that existed during the last great Ice Age (up to 400,000 years ago in Europe and 10,000 years ago in North America).

Modern caribou are classified as caribou because they have evolved common physical and behavioural characteristics, or adaptations, which allow them to survive in the cold, northern circumpolar regions of the planet, e.g., thick blunt muzzle to minimize heat and water loss during breathing, thick and hollow hair, etc.

North American caribou are further classified into five major subspecies (barren-ground, woodland, Grant's, Peary and reindeer) each of which has specific behavioural and physical adaptations to its habitat.

Each subspecies has specific habitat needs. For example, barren-ground caribou migrate extensively in well-defined herds in response to environmental conditions, biting insects, etc.

Caribou have co-evolved with a multitude of other species and are a vital component of circumpolar food chains and food webs (including parasitic insects and humans).

Caribou populations continually fluctuate in response to a number of factors.

Caribou can be considered an "indicator species" of ecosystem health.

Concept C: *Humans and caribou interact, and human decisions and actions affect caribou and our joint environments.*

Curriculum concept links: how human activity affects local and global environments, climate change, analysis of the cost and benefits of making alternative choices that affect a global problem, Indigenous culture, valuations, habitat, habitat threats, urbanization, industrialization, recreation, agriculture, scientific research and tourism.

Human beings and caribou share a common global ecosystem, and the actions of each affect the other in some way.

The caribou's range has been reduced significantly over the last 200 years because of human activity.

Caribou can be affected, both positively and negatively, by human activities that take place far from the caribou's home range, e.g., contaminants and pollutants that are carried by air and water currents over long distances (nuclear, acid rain, etc.), political advocacy, consumer choices, etc.

Caribou can be affected, both positively and negatively, by human activities that take place within the caribou's home range, e.g., resource exploration and development, road and pipeline construction, forestry, agriculture, hunting, tourism, scientific research, etc.

Governments can take actions that affect caribou and their habitat by regulating human activities on the land. There is a growing trend to consider all living species in making decisions about how the land is used by humans (ecosystem-based management).

Caribou migrate across political boundaries, and therefore decisions about caribou must be made cooperatively by different governments. Co-management of caribou by different governments is taking place in many jurisdictions. Individuals can take actions that will help preserve caribou and their habitats.

Appendix 2

Glossary

abomasum A ruminant's fourth and final stomach chamber, where food nutrients begin to be absorbed into the blood.

Artiodactyl An order of ungulates with an even number of toes, usually either a "cloven" hoof with two toes or a spreading foot with four. Deer, cows, giraffes and camels are examples.

babiche Strips of tough, dried or untanned animal hide.

barren-ground caribou (*Rangifer tarandus groenlandicus*) Caribou that undertake the longest seasonal migrations from winter to summer ranges. Barren-ground caribou often travel in large herds.

Beringia The land known as Beringia existed as a refugium during the last ice age. The ice caps locked up much of the earth's water, causing sea levels to rise and a land bridge to form between North America and Asia. Beringia was comprised of this "Bering Strait Land Bridge" as well as parts of what is now Alaska and Yukon.

bioaccumulation The building up of contaminants in bodily tissues over time.

biomagnification The process by which contaminants collect in animal tissue in progressively higher concentrations towards the top of the food chain.

brucellosis A disease, caused by bacteria, that causes spontaneous abortion in animals.

calving grounds A traditional location to which the caribou return each year to give birth to their calves.

Cervidae A family of mammals, including deer species, elk, moose and caribou.

chionophile Species that has adapted for winter survival, from a Latin word that means "snow-loving."

co-management A process that brings local resource users and government representatives together to share the management responsibility for local or regional resources.

cratering The act of caribou digging in the snow with their hollow hooves in search of food.

crustose Forming or resembling a crust.

cud Half-digested food returned from the first stomach of a ruminant for further chewing.

dew claw A rudimentary toe. Caribou have two large, flat dew claws, which help support and balance them in deep snow.

filamentous Threadlike, having filaments.

foliose Having a leaf-like form.

fruticose Growing in a shrub-like or tufted form.

habitat The natural environment characteristically occupied by an organism.

harem A group of female animals sharing a mate.

heat The receptive period of the sexual cycle in female mammals.

herbivore An animal that feeds on plants.

indicator species A species of plant or animal found in a particular environment whose condition reflects conditions in that environment.

Inukshuk A human-like figure made from stones, used to scare caribou into an ambush, and now sometimes used as a marker to guide travellers.

key habitat A particularly important part of an animal's habitat.

larvae Insects in an early form of development, between egg and pupa.

lichen A plant composed of a fungus and an alga in symbiotic relationship.

macrohabitat A large-scale, comprehensive habitat.

maternity bands Groups of pregnant female caribou that gather together before calving time.

microhabitat A habitat which is small or limited in extent and which differs in character from surrounding, more extensive habitat.

nursery bands Groups of female caribou and their calves that gather together.

omasum A ruminant's third stomach.

omnivore An animal that feeds on many kinds of food, including both plants and flesh.

organochlorines Organic compounds with chlorine substituted for a hydrogen atom on one of the carbon atoms in the basic structure. Organochlorines include dioxins, PCBs, pesticides such as DDT, and solvents such as chloroethylene.

parasite An organism living in or on another and benefiting at the expense of the other.

pedicles Permanent bony stumps on a caribou's head, from which the antlers grow.

pelage The fur, hair or wool of a mammal. Caribou have fine underfur, as well as a thick coat of hollow guard hairs.

pemmican Meat that is pounded into berries and grease and dried to form a long-lasting food.

Perissodactyl An order of ungulate mammals with an odd number of toes, usually one main central toe, or a single toe, on each foot. Horses and rhinoceroses are examples.

protozoa Unicellular and microscopic organisms. Amoebae are examples.

Rangifer tarandus The species name for caribou.

refugium An area in which a population of organisms can survive through a period of unfavourable conditions, such as a glaciation.

regurgitate To bring swallowed food back up again to the mouth.

"reindeer lichen" (*Cladina rangiferina*) A lichen commonly eaten by caribou.

reticulum A ruminant's second stomach.

rumen The first stomach of a caribou or other ruminant, in which food is partially digested by bacteria.

ruminate The act of chewing cud regurgitated from the rumen.

sedge A grass-like plant with a triangular stem. It usually grows in wet areas.

stress syndrome A syndrome caused when snow machines, automobiles or aircraft frighten caribou into running long distances. This violent exertion causes chemicals to build up in muscles faster than the blood can remove them. The resulting muscle changes can lead to injury or death for the caribou.

symbiotic An interaction between two different organisms living in close physical association, usually to the advantage of both.

tarsal gland A gland found between the caribou's toes.

trophic level Successive levels of nourishment in a food chain.

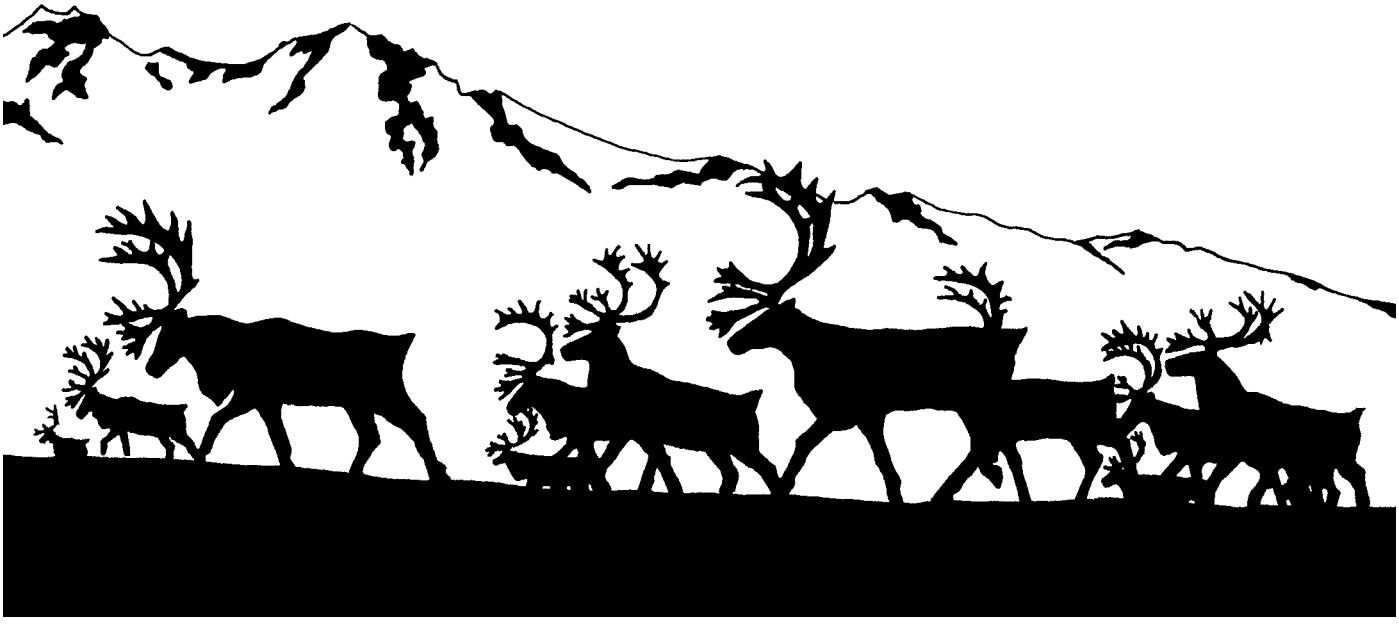
understory A variety of different bushes, ferns, flowers and leaf litter found underneath a forest canopy.

ungulate A hoofed mammal.

velvet The layer of fuzzy skin that covers an animal's growing antler.

woodland caribou (*Rangifer tarandus caribou*) A generally heavier and larger caribou than the barren-ground caribou, sometimes called 'mountain' caribou, found south of the Arctic Circle. Woodland caribou tend to stay in small groups and do not migrate large distances.

Cross-referencing index



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