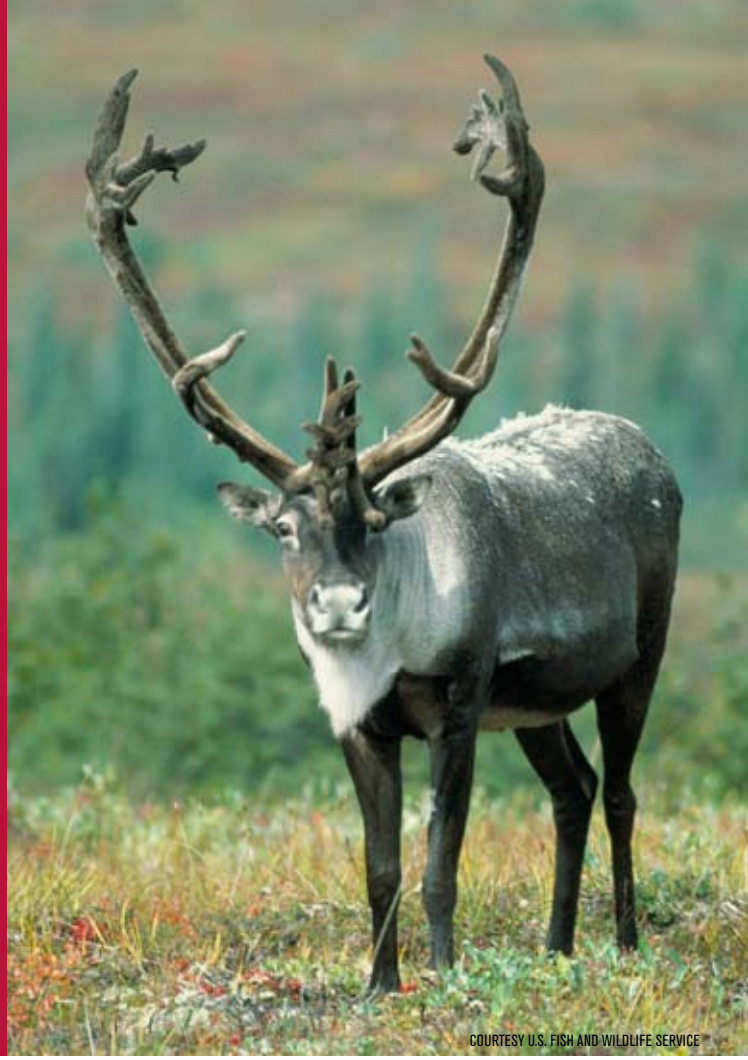
WILDLIFE AND GLOBAL WARMING

Navigating the Arctic Meltdown



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CARIBOU

In both fable and fact, caribou—or reindeer, as they are known in Europe and Asia—are renowned for their long-distance travels. In Christmas lore, an intrepid team of these hooved animals pulls Santa Claus and his sleigh full of presents around the world in a single night. In real life, caribou cover hundreds or thousands of miles along their annual migration routes, in search of lichens, moss, shrubs and grasses to eat. Survival in the harsh Arctic, where the ecosystem is fragile and plant growth slow, requires this almost constant movement. The food and habitat resources of the Arctic ecosystem on which caribou depend are easily destroyed by human disturbance. Unfortunately, such disturbances are widespread and include oil and gas exploration, roads and infrastructure, and, increasingly, the impacts of a changing climate.

While most caribou populations are relatively healthy, a recent catastrophic decline of one North American group serves as a stark warning. The Peary caribou is a subspecies found in Canada's high Arctic. Peary caribou are smaller than their mainland cousins and have snow-colored fur. In June 2007, Canada's environment minister proposed listing the Peary caribou as an endangered species because its population dropped from 50,000 to 8,000 in the past 30 years. The decline has been even steeper on certain islands. In 1961, scientists estimated more than 24,000 of these caribou inhabited the western Queen Elizabeth Islands. By 1993, only 2,400 were counted in the region, and searchers in 1998 spotted only 43 animals. The cause of this cataclysmic die-off? Research points to climate change due to global warming as the likely culprit. Although the word "warming" connotes milder winters through much

Caribou, such as these members of the Porcupine herd in Alaska, travel long distances every year and are vulnerable to human disturbances.

of North America, in the high Arctic winters are becoming icier and snowier, hampering the Peary caribou's ability to find food. The story of these caribou serves as a reminder that climate change can take many forms that threaten wild animals, especially creatures living in the harshest and most extreme habitats.

ARCTIC NOMAD AT RISK

Caribou live farther north than any other member of the deer family, inhabiting the Arctic tundra and boreal forests in Alaska, Canada, Scandinavia and Russia. In Europe and Asia, reindeer are semi-domesticated; the animals follow their traditional migration routes and breed naturally, but they are closely guarded by herders. North American caribou are wild and live in about 100 different groups that alternately merge and disperse. Subpopulations or herds come together for spring migration and calving, and then disperse in summer. They merge for fall migration, but go their separate ways again in winter. Depending on their summer habitat preferences, herds are described as either "woodland" or "barren-land" caribou. Small herds of woodland caribou are found as far south as the northern tip of Idaho, but the largest herds are barren-land caribou, summering on the tundra. The very largest herd, in northern Quebec and Labrador, numbers roughly half a million individuals.

Two herds, the Porcupine and the Central Alaska, converge on the coastal plain of Alaska's Arctic National Wildlife Refuge in early summer. There, they feed on the rich grass-like plants called sedges, which are common on the tundra, and give birth. Calves are born in May or June, each weighing about 10 to 20 pounds. The young can walk within an hour of birth; after their first day of life, they can outrun a person. As summer progresses, caribou switch their diet to low-growing tundra shrubs such as the dwarf birch, bog blueberry, Arctic heather and Arctic willow. Caribou also move around in summer to seek respite from biting mosquitoes and flies.

In autumn, caribou that summer on the tundra move south toward the taiga or boreal forest. Mating occurs in the fall, with males fighting each other for the right to mate with a group of females. Caribou feed throughout the fall and winter on lichens. Although they resemble tiny plants, lichens are actually the result of a symbiotic relationship between an algae and a fungus, with the algae providing energy via photosynthesis, while the fungus captures minerals and water directly from the air. Because of this unique relationship, lichens are extremely hardy and grow in conditions too harsh for true plants: frozen ground, bare rock and tree trunks. On the other hand, this vital food source grows very slowly and takes years to establish or recover from disturbance.

Caribou have several behavioral and physical adaptations that help the animals exploit the scarce vegetation and survive in extreme northern habitats. They have large, broad hooves that vary in hardness through the year: in summer the base of the hoof is softer to provide traction on the spongy ground, and in winter it grows a tough, sharp-edged rim for "cratering" through the ice to reach food. Their thick fur has two layers: a woolly undercoat and a thick outer coat of hollow guard hairs that trap air for insulation. Their muzzles are specialized to warm and moisten the air before it reaches their lungs.

Caribou of Alaska and the Yukon have the longest migration of any land mammal—more than 3,000 miles every year. These long, energy-intensive travels and the caribou's specialized, seasonal diet requirements render the animals vulnerable to human disturbances. Oil and gas drilling, air pollution, helicopters, roads and recreation all disturb caribou and damage their habitats. Unsustainable levels of hunting have also led to caribou declines in the past.

WARMING TRENDS

Climatic changes due to global warming are making life more difficult for caribou in a variety of ways. Paradoxically, warming is bringing harsher winter conditions to portions of the far north. The Arctic historically received little precipitation because extremely cold air holds little moisture. Warmer temperatures increase the amount of moisture the air can hold, so the region now sees more snow and freezing rain, which cover the ground with a thick, icy crust. Since caribou survive the winter by digging through this crust to reach the lichens below, any increase of snow and ice means more work to reach food. When caribou expend more energy cratering through deep ice and snow, they deplete critical fat reserves. This, in turn, affects their ability to survive and to successfully produce healthy calves. Researchers in Sweden and Canada have found that thicker winter snow and ice increase calf mortality and reduce the rate of population growth.

While climate changes are bringing more moisture to the high Arctic during winter, they are also increasing

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Climate change is likely causing the catastrophic decline in numbers of Peary caribou (left), a subspecies of the high Arctic. Caribou depend on lichen for sustenance, but global warming is making lichen (like that covering the ground in the boreal forest, below) less plentiful and harder to reach.

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summertime droughts. This leads to more forest fires. The state of Alaska suffered a record fire season in 2004, with 6.6 million acres burned, and an additional 4.6 million acres burned in 2005. More frequent fires are bad news for caribou, because the animals prefer to graze in older spruce woodlands where slow-growing lichens have had a long time to develop. Caribou avoid sites that have burned within the past 50 to 60 years, because there simply isn't enough lichen in these places. Devastating fires could mean less winter habitat with plentiful lichen. "Predicted changes in fire regime due to climate warming…could substantially alter the winter habitat of caribou in interior Alaska and lead to change in winter range use and/or population dynamics," according to T. Scott Rupp and his colleagues working in Alaska.

Climate change may also hurt caribou because as summer temperatures increase, conditions become more favorable for insects. Mosquitoes, black flies, bot flies, warble flies and other insects swarm caribou during the brief Arctic summer. Insect harassment interferes with feeding, and caribou move to higher elevations or seek remnant patches of snow to avoid insects. Temperature has a major impact on insect physiology, reproduction and survival. From the insect's perspective, "warmer is better," according to biologists from the University of Washington. Of course, from the perspective of the animals that these insects harass, warmer isn't better at all.

Better conditions for insects also spell more bad news for the spruce-lichen forests. Outbreaks of spruce bark beetles have reached epidemic proportions in Alaska recently. Spruce bark beetles kill spruce trees by tunneling into the part of the tree's bark where the sap and nutrients flow, eventually starving the tree. Trees are more susceptible to attack by the beetles in hot summers when the trees are stressed by drought. In addition to weakening the tree, several other aspects of climate change tilt the scales in favor of the insects. Cold winter temperatures kill the beetles, so warmer winters reduce beetle die-offs. The beetles also fly better in warmer weather, so warm springs allow the insects to disperse to new host trees more easily. "Warmer is better" for the beetles in another way: the beetles are now maturing faster, reaching breeding age in one year rather than two. The result has been millions of acres of dead spruce forests, which are highly flammable. If the beetles spread farther north in Alaska, more fires and less caribou habitat will follow in their wake.

PREPARING FOR THE MELTDOWN

To keep climate changes from ruining the caribou's food sources, we must act now to reduce the emission of greenhouse gases. In addition, we should take other important steps to help the caribou navigate the complex threats posed by climate change:

- **Permanently ban oil drilling in the Arctic National Wildlife Refuge.** The Arctic refuge's coastal plain—where drilling has been proposed—is a vitally important calving ground for the Porcupine herd and the Central Alaska herd of caribou. Calf production is lower in years when caribou breed outside the coastal plain. In nearby Prudhoe Bay, females calve more frequently in undisturbed areas than in areas where drilling is occurring. Females with calves tend to avoid roads, buildings and other infrastructure. Drilling activity and equipment in the Arctic refuge would also likely disrupt caribou migration between seasonal feeding grounds.
- **Reduce air pollution.** Lichens capture minerals and water directly from the air, so they are sensitive to some forms of pollution. Air and wind currents send sulfur dioxide, heavy metals and even radioactive elements to the Arctic. Because lichens get their nutrients directly from the air, they also take up pollution, which reindeer then ingest.
- **Carefully monitor caribou populations and manage hunting sustainably.** For Arctic peoples of both North America and Eurasia, caribou are an important source of meat, hides and antlers. But caribou populations must be monitored carefully for their response to hunting pressures and climate change, and managed accordingly. For instance, some research of Peary caribou suggests that harvest should be limited to a few males. Other management approaches may be warranted in the near future as our ability to predict the impacts of climate change on caribou improves. Adaptive management and research will be required to help these wild populations survive into the next century.

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