

# Changing Arctic Ecosystems

## Resilience of Caribou to Climatic Shifts in the Arctic

### Why Study Caribou?

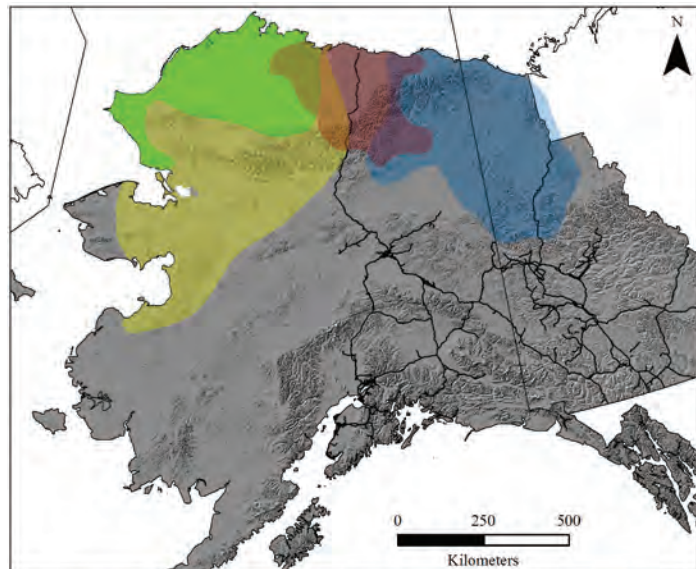
The U.S. Geological Survey (USGS) Changing Arctic Ecosystems (CAE) initiative strives to inform key resource management decisions for Arctic Alaska by providing scientific information and forecasts for current and future ecosystem response to a warming climate. Over the past 5 years, a focal area for the USGS CAE initiative has been the North Slope of Alaska. This region has experienced a warming trend over the past 60 years, yet the rate of change has been varied across the North Slope, leading scientists to question the future response and resilience of wildlife populations, such as caribou (*Rangifer tarandus*), that rely on tundra habitats for forage. Future changes in temperature and precipitation to coastal wet sedge and upland low shrub tundra are expected, with unknown consequences for caribou that rely on these plant communities for food. Understanding how future environmental change may affect caribou migration, nutrition, and reproduction is a focal question being addressed by the USGS CAE research. Results will inform management agencies in Alaska and people that rely on caribou for food.



Summer ranges for caribou are areas important for calving, replenishing resources lost during winter, and finding relief from biting insects.

### Where Are the Caribou in Northern Alaska?

Four migratory herds of caribou (Western Arctic, Teshekpuk, Central Arctic, and the Porcupine) spend summers on the North Slope of Alaska. These herds differ in total number, distribution, and population trend. Population dynamics of these caribou herds primarily are driven by “bottom up” factors, such as the influence of the environment on the plants they eat. Thus, forage availability, nutritional content, and digestibility exhibit a strong influence on



— Major roads    Western Arctic    Teshekpuk    Central Arctic    Porcupine

Annual range map for the four migratory caribou herds in northern Alaska.

annual reproduction and survival. Given the increased temperature in the Arctic, the ability of caribou populations to persist will depend on the capacity of individuals and populations to endure and reproduce in a changing ecosystem.

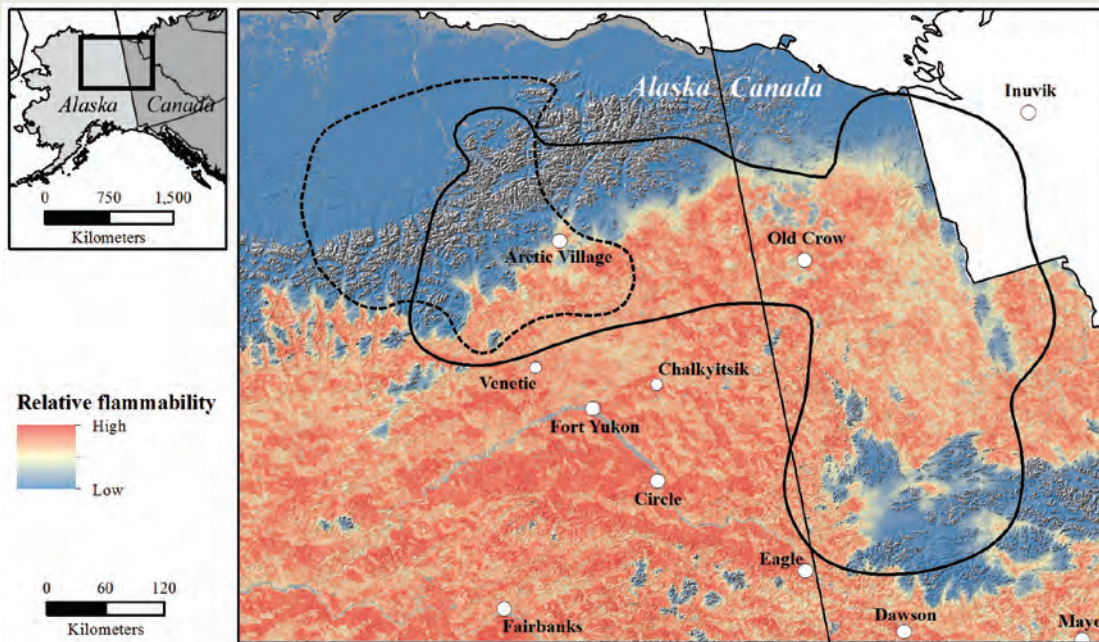
### How Do Changes in Plants Affect Nutrition?

USGS CAE research on caribou in the Alaskan Arctic has examined how changes in the growing season and air temperature since the 1970s have affected phenology, quality, and abundance of forage plants. We have established relationships among temperature, satellite-derived indices of plant greenness, and forage characteristics that will provide the basis for understanding how caribou habitats will be affected by climate change. Integrated with the current USGS CAE research is work at the University of Alaska Fairbanks on the foraging dynamics of captive-raised caribou. Measuring how forage on different plants (shrubs, forbs, and sedges) may influence body mass and reproduction of captive caribou will allow us to develop models that can be used to forecast the nutritional implications of future habitat conditions.

### What Does the Future Hold for Caribou?

Other future changes to northern tundra habitats include the potential for more wildfires that can alter plant composition and successional patterns. These shifts in vegetation types and characteristics alter the distribution and abundance of northern herbivores in different ways. Wildfires may benefit some species, such as moose (*Alces alces*) by rejuvenating habitats and increasing habitat value. However, wildfire may have negative effects on species dependent on late successional forests, such as caribou. A recent model by USGS determined that increased wildfires could reduce the production of lichens, an important winter food for caribou.





Warming temperatures will increase the flammability of lichen-producing boreal forests, which are important winter habitat for caribou herds. Simulated relative flammability of vegetation is shown for the ECHAM5 global circulation model in the winter ranges of the Central Arctic (dashed line) and Porcupine (solid line) caribou herds, Alaska and Yukon, 2010–2100.

## What is Next?

Next steps for USGS CAE research on caribou will include the monitoring of adult females in the Central Arctic herd with high-resolution GPS collars to measure habitat use relative to temperature, forage characteristics, nutrient demands, reproduction, and seasonal changes in body mass. Additionally, an evolving GPS locational dataset from the National Park Service will be used to contrast how temperature and forage characteristics affect movements and habitat use of a rapidly declining herd in the Western Arctic and stable to declining herd in the Central Arctic.

The USGS CAE research on caribou in Alaska has assisted land management agencies by projecting how climate-driven changes to vegetation may affect wildlife habitat and subsistence resources. This research is summarizing how vegetation change and anthropogenic activities cumulatively affect caribou, by fulfilling inventory and monitoring mandates of agencies such as the National Park Service, and by providing information useful for conservation plans in the Arctic National Wildlife Refuge.



Joe Welch (University of Alaska Fairbanks) collecting habitat data on the North Slope of Alaska for the Central Arctic caribou herd, September 2012.

## Publications

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- Tape, K.D., and Gustine, D.D., 2014, Capturing migration phenology of terrestrial wildlife using camera traps: *BioScience*, v. 64, p. 117–124, doi:10.1093/biosci/bit018.

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