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Climate change will endanger caribou habitat

by Staff Writers
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Reindeer, from Northern Europe or Asia, are often thought of as a domesticated animal, one that may pull Santa's sled. Caribou, similar in appearance but living in the wilderness of North America, are thought of as conducting an untamed and adventurous life.

Woodland caribou, already an endangered species in southern Canada and the United States, will feel the effects of global warming as one of the most northern species. Photo by Mark Bradley.

However, new research published in the journal Nature Climate Change suggests that there are more similarities about these two animals than previously thought and change in climate played a role in their evolution.

A group of 21 researchers from two continents, including Marco Musiani of the University of Calgary, looked closely at the DNA of reindeer in Scandinavia and Asia as well as tundra and woodland caribou in North America to find out more about how their environments were affected in the past and will be influenced in the future by climate change.

As one of the most northern species, caribou will feel the effects of global warming, says Musiani, a professor in the faculties of Environmental Design and Veterinary Medicine and co-author of the study.

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French customs

"The woodland caribou is already an endangered species in southern Canada and the United States. The warming of the planet means the disappearance of their critical habitat in these regions. Caribou need undisturbed lichen-rich environments and these types of habitats are disappearing," said Musiani, noting that the study projected how the environment will change by the year 2080.

Musiani said the research demonstrates that the animals are not as different from a genetic point of view as some might think given the geographic spread of reindeer and caribou. The two sister groups occur throughout Europe, Asia and North America, from Norway to Eastern Canada.

Researchers found that caribou living in North America, but just south of the continental ice became isolated and evolved their unique characteristics during the last glaciation. At that point, Europe, Asia and Alaska were connected by a land bridge; reindeer occurred there and also evolved separately.

"Then, at meltdown the two groups, reindeer from the North and caribou from the South, reunited and interbred in areas previously glaciated such as the southern Canadian Rockies," says Musiani.

The researchers looked at how the animals were distributed over 21,000 years as the climate changed and at present and found that caribou in Alaska and northern Canada are strikingly similar to reindeer. More typical North American caribou occur only in the lowland forested regions further south.

"Animals more closely related to reindeer occur in North America, throughout its northern and western regions, with some transitional zones, such as the one remarkably placed in the southern Canadian Rockies," said Musiani.

Climate change threatens genetic diversity, future of world's caribou
Caribou in southern and eastern Canada may disappear from most of their current range in 60 years if climate change takes the toll on their habitat that scientists predict in a paper appearing online Dec. 15 in the journal Nature Climate Change.

Scientists looked at reservoirs of genetic diversity in caribou and whether that diversity was linked to stable habitats. They found that caribou populations in the most climatically stable areas had the greatest genetic diversity and note that future climate forecasts bode ill for both caribou habitat and their genes.

"Caribou can respond to habitat change in three ways," said Kris Hundertmark, co-author and wildlife biologist-geneticist at the Institute of Arctic Biology at the University of Alaska Fairbanks. "They can move to new, suitable habitat, adapt to the changed habitat or die."

Caribou populations are predicted to become more isolated and fragmented as climate change shrinks habitat and as caribou have fewer opportunities for genes to flow between individuals and herds, explained Hundertmark.

"When a population loses genetic diversity, they lose the ability to adapt to change," Hundertmark said, adding that although Alaska herds are expected to fair slightly better at least in the near future, they are still facing significant challenges.

"Climate change in Alaska means we're going to see more fires and while that's good for moose, it's really bad for caribou," said Hundertmark, "because it's going to burn lichen beds that can take at least 50 years to recover and reduce viable caribou habitat."

Hundertmark and then-graduate student Karen Mager who collected 655 tissues samples from 20 of Alaska's 32 herds developed genetic profiles of Alaska's caribou. The two credit a successful collaboration with state and federal fish and game biologists and hunters over several years with making sample collection possible.

The scientists, part of a team headed by researchers at Laval University in Quebec, used climate reconstructions from 21,000 years ago to the present to predict where caribou habitat would likely exist and they matched reservoirs of high genetic diversity to areas with the most stable habitat over time.

Bolstered by the success of their retrospective analysis the scientists forecast caribou habitat to the year 2080 using a 'business-as-usual' climate model - the Intergovernmental Panel on Climate Change's A1B model. The outcome is grim.

"Those caribou herds that shift their range to remain within their habitat and those herds that are reduced in size and become isolated from neighboring herds are those most threatened with loss of genetic diversity," said Hundertmark. "That is why it is important to know what areas will be have the most habitat stability in the future."

The team predicts that viable caribou habitat will shift north, the southernmost herds will disappear and herds in northeastern North America will become more threatened with extinction, losing up to 89% of their current habitat.

Caribou in western North America will also be affected, although to a lesser extent, and have a better chance of retaining what remains of genetic diversity and therefore adaptability to change.

"This study gives us strong evidence from a widespread species that the stability of the climate makes a difference in the amount of genetic diversity retained within a species," said Mager.

The paper, Genetic diversity in caribou linked to past and future climate change (DOI: 10.1038/nclimate2074), is scheduled for advanced online publication on Nature Climate Change's website.

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