

# Climate change and species distributions

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Scientists have long pointed to physical changes in the Earth and its atmosphere, such as melting polar ice caps, sea level rise and violent storms, as indicators of global climate change. But changes in climate can wreak havoc in more subtle ways, such as the loss of habitat for plant and animal species. In a series of talks at the Ecological Society of America (ESA) 93rd Annual Meeting, climate change scientists will discuss how temperature-induced habitat loss can spell disaster for many living things.

Climate models project that rising temperatures over time can lead to an increase in dry, desert-like conditions, which will affect not only the survivorship of particular species, but also the natural resources they have adapted to use in their natural environment. Species are thus forced to move elsewhere to find places to live and food to eat.

"Impacts on individual species indicate wider changes at the biome level that will potentially change conditions for many plant and animal species, in addition to ecosystem services to humans," says Patrick Gonzalez, a researcher at The Nature Conservancy and a member of the Intergovernmental Panel on Climate Change (IPCC).

One species whose habitat may be in danger is the Canada lynx, which is listed as threatened in the United States. The feline's main prey, the snowshoe hare, lives in deep snow cover in boreal forest. Because they rely so heavily on hares for food, lynx are adapted to live in areas with snow cover at least four months out of the year. The cats are so specialized to life on snow that their paws are much wider than is

required to support their weight; the large paws help them stalk hares over deep snow without falling in.

Gonzalez, who has worked with USDA Forest Service scientists to analyze lynx habitat, projects that a temperature increase of 2.5 to 4 degrees Celsius in the coming century across the U.S. and Canada—the range of warming under the scenarios reported by the IPCC—may diminish snow cover suitable for lynx by 10 to 20 percent and reduce boreal forest cover by half in the contiguous U.S. Together, these changes could shift lynx habitat northward and decrease the area of habitat in the lower 48 states by two-thirds. This potentially extensive loss of habitat signals serious changes in boreal and alpine ecosystems, says Gonzalez.

Climate change can result in animals and plants migrating northward to escape the heat, but in many cases suitable habitat becomes scarce or unavailable farther away from the species' natural range. The *Propertius* duskywing butterfly lives throughout the West Coast of the U.S., and during its caterpillar stage is specialized to live on oak trees. Shannon Pelini, a graduate student at the University of Notre Dame, conducted experiments revealing that warmer temperatures increased the survivorship and body size of caterpillars in its most northern habitats. A lack of oak trees in more northern climes, however, would preclude them from moving further north. The range shift of oak trees will happen much slower than the shift for the butterflies, leading to a contracted range, says Pelini.

As if the direct effects of rising temperatures weren't enough, climate change also has impacts that could make climate patterns less consistent over time. Michael Notaro, a scientist at the University of Wisconsin-Madison, used climate data from the past century to model vegetation changes over time. He found that large variability in climate causes an increasing number and intensity of fires and droughts, as well as extreme

weather events that could kill long-lived trees and allow short-lived grasses to colonize the leftover space. His models predict that year-to-year variability in precipitation and temperature reduces the Earth's total vegetation cover, expanding its relative grass cover and diminishing its relative tree cover.

"The central U.S. is characterized by an ecotone that's the intersection of forest in the East and grassland in the West," says Notaro. "The border between these ecosystems is largely determined by climate variability and it is likely that climate change will shift the location of this and other ecological boundaries worldwide."

Gonzalez agrees that the research results presented at the ESA Annual Meeting indicate serious vulnerabilities of both individual species and global biomes to climate change.

"Climate change threatens to alter extensive areas of habitat," says Gonzalez. "Lynx is one species that is vulnerable, but the potential impacts of climate change on entire ecosystems are even more alarming."

Source: Ecological Society of America

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