

Climate change puts ecosystems on the run, researchers say

December 27 2009



Scientists Chris Field and Scott Loarie. Image: L.A. Cicero

(PhysOrg.com) -- Global warming is causing habitats to move across the landscape. Can the creatures living there keep up? If they can't, some species may die out, researchers say.

To keep up with global warming, the average ecosystem will need to shift its physical boundaries about a quarter mile each year, says a new study led by scientists at Stanford University and the Carnegie Institution. For some habitats, especially in low-lying areas, climate belts are moving even faster, putting many species at risk of being left behind, especially where human development has blocked migration paths.

"Expressed as velocities, [climate-change](#) projections connect directly to survival prospects for plants and [animals](#). These are the conditions that

will set the stage, whether species move or cope in place," says study co-author Chris Field, professor of biology and of environmental Earth system science.

The research team, which included researchers from Stanford, the Carnegie Institution, the California Academy of Sciences, and the University of California, Berkeley, combined data on current climate and temperature gradients worldwide with climate model projections for the next century to calculate the "temperature velocity" for different regions of the world. This velocity is a measure of how fast temperature zones are moving across the landscape, either to higher elevations or higher latitudes, as the planet warms - and how fast plants and animals will need to migrate to keep up.

The researchers found that as a global average, the expected temperature velocity for the 21st century is 0.42 kilometers (0.26 miles) per year. But this figure varies widely according to topography and habitat.

In areas of high topographic relief, where species can find cooler temperatures by climbing a nearby mountain, velocities are relatively low. In flatter regions, such as deserts, grasslands, and coastal areas, species will have to travel farther to stay in their comfort zone and velocities may exceed a kilometer per year.

Can the planet's ecosystems keep up? [Plants](#) and animals that can tolerate a wide range of temperatures may not need to move. But for the others, survival becomes a race. After the glaciers of the last Ice Age retreated, forests may have spread northward as quickly as a kilometer a year. But current ecosystems are unlikely to match that feat, the researchers say.

Nearly a third of the habitats in the study have velocities projected to be higher than even the most optimistic plant migration estimates.

Even more problematic is the extensive fragmentation of natural habitats by human development, which will leave many species with nowhere to go, regardless of whether their migration rates are fast enough to let them keep up with the geographical shifting of their habitats.

Protected areas such as nature reserves are generally too small to accommodate the expected habitat shifts. According to the study, less than 10 percent of protected areas globally will maintain current climate conditions within their boundaries 100 years from now. This will be a challenge for many species adapted to highly specific conditions, especially if migration to new habitats is blocked.

Scott Loarie, a postdoctoral fellow at the Carnegie Institution and lead author of the paper, pointed out that an appreciation of climate velocities could stimulate discussions about sound management for climate change, from the design of nature reserves to the planning of assisted migrations for affected species. He added that it should also stimulate discussion about strategies for minimizing the amount of warming to help put the brake on climate velocity.

In addition to his professorships in biology and environmental Earth system science, Chris Field is a senior fellow at Stanford's Woods Institute for the Environment and director of the Carnegie Institution's Department of Global Ecology.

The paper was published in the journal *Nature* on 24 December.

Provided by Stanford University

Citation: Climate change puts ecosystems on the run, researchers say (2009, December 27) retrieved 15 June 2024 from <https://phys.org/news/2009-12-climate-ecosystems.html>

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