

Stanford researchers say climate change will significantly increase impending bird extinctions

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Where do you go when you've reached the top of a mountain and you can't go back down? It's a question increasingly relevant to plants and animals, as their habitats slowly shift to higher elevations, driven by rising temperatures worldwide. The answer, unfortunately, is you can't go anywhere. Habitats shrink to the vanishing point, and species go extinct.

That scenario is likely to be played out repeatedly and at an accelerating rate as the world continues to warm, Stanford researchers say.

By 2100, climate change could cause up to 30 percent of land-bird species to go extinct worldwide, if the worst-case scenario comes to pass. Land birds constitute the vast majority of all bird species.

"Of the land-bird species predicted to go extinct, 79 percent of them are not currently considered threatened with extinction, but many will be if we cannot stop climate change," said Cagan Sekercioglu, a senior research scientist at Stanford and the lead author of a paper detailing the research, which is scheduled to be published online this week in *Conservation Biology*.

The study is one of the first analyses of extinction rates to incorporate the most recent climate change scenarios set forth earlier this year in the reports of the Intergovernmental Panel on Climate Change (IPCC), which shared the Nobel Peace Prize with Al Gore.

The researchers modeled changes to the elevational limits of the ranges of more than 8,400 species of land birds using 60 scenarios. The scenarios consisted of various combinations of surface warming projections from the 2007 IPCC report, habitat loss estimates from the 2005

Millennium Ecosystem Assessment (an evaluation of the planet's ecosystems by 1,360 experts around the world), and several possibilities of shifts in elevational range limits.

The worst-case scenario of 6.4 degrees Celsius surface warming combined with extensive habitat loss produced the estimate of 30 percent of land bird species going extinct by 2100. Increasing habitat loss exacerbates the effects of climate change because organisms seeking more suitable conditions will be less likely to find intact habitats. Even with an intermediate 2.8 C warming, 400 to 550 land-bird extinctions are expected.

"Vegetational shift is the key issue here," Sekercioglu said. "Birds will follow the shift in habitat."

All plants have certain temperature and precipitation requirements they need to flourish. As lowlands become too warm for some species, higher slopes that were formerly too cool become better suited to their needs, and the distributions of plants slowly move upward. That shifting of populations renders bird species vulnerable to a host of complications.

Topography itself is a major issue. Each bird species is only found between specific elevations, limits based mainly on the temperatures at which it can survive and the presence of the plants, insects and other animals on which it feeds. Temperature decreases as one goes up a mountain, so as the lowlands become warmer, plant and animal communities need to move higher in order to remain in their required microclimates. Most bird species live in the tropics, mostly in lowland environments. In many of these areas, there may be no significantly higher slopes to which they can retreat. But even the presence of hills or mountains

does not guarantee the survival of a species.

As one moves upslope, the extent of the area encompassed by a given elevational range almost always decreases. It's a matter of simple geometry. The circumference of a mountain is typically smaller near the summit than at its base, so a range of, say, a hundred vertical meters occupies a far smaller band of area near the top than it does down at the base.

And once the summit of a mountain becomes too hot for a species or its preferred vegetation type, the habitable area is reduced to nothing.

"It's like an escalator to extinction. As a species is forced upwards and its elevational range narrows, the species moves closer to extinction," Sekercioglu said.

In some instances, species can expand their ranges, which the authors also considered in their models. If warming is limited and a species adapts, only the upper limit of a species' elevational range might rise. As warming continues, however, the lower bound is likely to rise, as well.

Additional threats include interactions between the rising temperatures and other environmental factors. For example, as Hawaiian mountains get warmer, mosquitoes carrying avian malaria, to which most native bird species have no immunity, are moving upslope, invading the last refuges of birds already on the brink of extinction. In Costa Rica, toucans normally confined to lower elevations are colonizing mountain forests, where they compete with resident species for food and nesting holes, and prey on the eggs and nestlings of other bird species.

In addition, plant species that currently share a habitat may not all react the same way to temperature and moisture changes. Some species may be forced upslope while others are able to linger behind, tearing apart plant and animal communities even if all the species survive. Differences in soil composition can further disrupt plant communities. If soils at higher elevations are inhospitable to some plant species, those species will be wedged between a fixed upper bound and a

rising lower bound until they are squeezed out of existence.

Until now, highland species have been less threatened by habitat loss and hunting, simply because most people live in flat lowlands instead of the steeper highlands. Compared to lowland birds, however, highland species are not only more sensitive to temperature changes, but their populations also are more isolated from each other, as mountains effectively constitute habitat islands surrounded by a sea of hotter lowlands.

The study also has shown that sedentary birds, which comprise over 80 percent of all bird species, are much more likely to go extinct from climate change than are migratory birds. That suggests that many sedentary mountain species currently thought to be safe are actually jeopardized by global warming. All in all, climate change is likely to be especially hard on the hundreds of bird species endemic to tropical mountains.

But in part because of the remoteness of the mountains and in part due to a lack of funding for ornithological studies in most tropical countries, there are few data on these birds' responses to climate change. Crucial remote sensing data are also becoming less available, as government satellites like Landsat age and as image distribution moves increasingly to the relatively expensive private sector.

"To effectively monitor the rate of change as warming progresses, especially in the species-rich tropics, we need a lot more data on birds' distributions and on the speed and extent of birds' elevational shifts in response to climate change," Sekercioglu said.

Perhaps the most worrisome finding is that each additional degree of warming will have increasingly devastating effects. The authors estimate that an increase of 1 C from present temperatures will trigger roughly 100 bird extinctions. But if the global average temperature were to rise 5 C, from that point on an additional degree of warming, to 6 C, would be expected to cause 300 to 500 more bird extinctions.

"This emphasizes the importance of any measure that reduces surface warming, even if we cannot stop it altogether," Sekercioglu said. "Even a reduction of 1 degree can make a huge difference."

"Giving up the fight against global warming would be the true disaster," he added.

Source: Stanford University

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