

Tropical lowland frogs at greater risk from climate warming than high-elevation species, study shows

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Bryophryne hanssaueri is one of the 22 species included in the Peruvian frog study. Individuals of this species have a bright orange throat and belly. Adults typically range in size from 0.47 to 1.13 inches (1.20 - 2.87 centimeters) in length. These frogs live under mosses and leaf litter in the high-elevation cloud forest between 10,480 and 11,250 feet, just below the treeline. Like other *Bryophryne* species, females attend clutches of direct-developing embryos until

they hatch into tiny froglets. Credit: Alessandro Catenazzi

A new study of Peruvian frogs living at a wide variety of elevations—from the Amazon floodplain to high Andes peaks—lends support to the idea that lowland amphibians are at higher risk from future climate warming.

That's because the lowland creatures already live near the maximum temperatures they can tolerate, while high-elevation amphibians might be more buffered from increased temperatures, according to a study by University of Michigan ecologist Rudolf von May and his colleagues published online April 6 in the journal *Ecology and Evolution*.

Previous studies have suggested that lowland reptiles and amphibians are especially vulnerable to climate warming. But in most cases, those conclusions were based on computer modeling work that incorporated a limited amount of field data.

"Understanding how species respond to climatic variation is critical for conserving species in future climatic conditions. Yet for most groups of organisms distributed in tropical areas, data about species' critical thermal limits are limited," said von May, a postdoctoral researcher in the U-M Department of Ecology and Evolutionary Biology.

"I think the contribution of our study is that it focuses on a group of closely related [frog species](#) distributed along a single montane gradient and that it includes empirical data on species' tolerance to heat and cold, as well as air temperatures measured along the same gradient."

In the process of conducting the study, which involved more than two years of fieldwork, von May and his colleagues identified three

previously unknown [frog](#) species. Those newly discovered species will be described separately in a series of journal articles.

The elevational-gradient study focused on the thermal ecology and evolution of 22 species of land-breeding frogs, which are also known as terrestrial-breeding frogs, in southern Peru's Manu National Park and surrounding areas. Sampled elevations ranged from the Amazon River floodplain, at 820 feet above sea level, to 12,000-foot Andes Mountains peaks.

The region in and around Manu National Park is known for long-held records of biodiversity including more than 1,000 species of birds—about 10 percent of the world's bird species—and more than 1,200 species of butterflies. In addition, the park contains an estimated 2.2 percent of the world's amphibians and 1.5 percent of its reptiles.

While most frogs lay eggs in water, terrestrial-breeding frogs use a specialized reproductive mode called direct development: A clutch of embryos hatch directly into froglets; there are no free-living tadpoles. Terrestrial-breeding frogs form a diverse group that can exploit a wide variety of habitats, as long as those locations contain sufficient moisture.

In the study, the researchers looked at how closely related frog species differ in their elevational distribution and their tolerance to heat and cold in a region of the tropical Andes where temperature increase is predicted to be detrimental for most species.

"These measurements were taken in order to determine whether tropical frogs could take the heat—or cold—predicted for tropical regions as a result of climate change," von May said.

The researchers found that the frogs' tolerance to heat varied from 77 degrees Fahrenheit to 95 degrees and that, as expected, highland species

tolerated much lower temperatures than lowland species.

Frogs living in high-elevation grasslands tolerated near-freezing temperatures, which they experience during the dry season, as well as moderately high temperatures, which they may experience during sunny days.

When considering the temperature of the microhabitats in which the frogs live, the results suggest tropical lowland [species](#) live close to their thermal limit. Amphibians living at high elevation might be more buffered from future [temperature](#) increases because the highest temperatures they can tolerate are farther away from the maximum temperatures that they regularly experience in the wild.

Von May is the first author of the Ecology and Evolution paper, "Divergence of thermal physiological traits in terrestrial breeding frogs along a tropical elevational gradient."

More information: Rudolf von May et al. Divergence of thermal physiological traits in terrestrial breeding frogs along a tropical elevational gradient, *Ecology and Evolution* (2017). [DOI: 10.1002/ece3.2929](#)

Provided by University of Michigan

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