Disease, not climate change, fueling frog declines in the Andes, study finds

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Researchers placed frogs and a thin layer of water into plastic cups, which were then placed in the orange bucket, to measure the frogs' critical thermal maxima. The temperature of the water bath was increased by approximately 1 degree Celsius every two minutes by adding hot water to the bucket. The critical thermal maximum was defined as the temperature at which a frog placed belly-up could no longer righten itself. Frogs were then slowly cooled to ambient temperature to prevent harm. Credit: Alessandro Catenazzi

A deadly fungus, and not climate change as is widely believed, is the

primary culprit behind the rapid decline of frog populations in the Andes mountains, according to a new study published today in the journal *Conservation Biology*.

Frogs living at higher elevations can tolerate increasing temperatures, researchers found, but their habitats fall within the optimal temperature range for *Batrachochytrium dendrobatidis*, or Bd, a harmful pathogen they have only encountered relatively recently. The disease caused by Bd, chytridiomycosis, has led to the recent decline or extinction of 200 frog species worldwide.

The results have implications both for researchers trying to understand the rapid decline in frog populations across the globe and for conservationists looking to save the animals, said Vance Vredenburg, associate professor of biology at San Francisco State University and co-author of the study.

"Our research shows that we can't just automatically point our finger at climate change," he said. "We need to look carefully at what is causing these outbreaks."

The research was conducted at Wayqecha Biological Station on the eastern slopes of the Andes, located near Manu National Park in southern Peru. To measure frogs' tolerance to the changing climate, researchers placed them in water baths of varying temperatures, then flipped them on their backs. If a frog quickly flipped itself back over, that meant it was able to tolerate the warmer water. If not, researchers knew the frog had become overwhelmed and unable to deal with the change.

Researchers also measured the temperatures at which conditions are optimal for the growth and spread of Bd and found that the highland frogs' habitats lay right within that range.

A female *Bryophryne cophites*, one of the frog species used in the study, attending her eggs. The species lives at the very top of the Andes mountains, elevations from 3,200 to 3,800 meters, and is considered endangered by the International Union for Conservation of Nature (IUCN) Red List. Credit: Alessandro Catenazzi

"This really suggests that the fungus is driving a lot of the declines in this place," said Alessandro Catenazzi, assistant professor of zoology at Southern Illinois University and the lead author of the study. He was recently a post-doctoral fellow at SF State when much of the research took place.

Climate change, however, isn't let completely off the hook. Although Bd poses less of a threat to frogs in the lowlands, this study suggests that species at lower elevations are more susceptible to climate changes, putting them at risk if they are unable to adapt or move to higher altitudes.

"It's terrible news," Vredenburg said. "The frogs at the top of the mountain are in trouble because they are experiencing a novel pathogen. The guys at the lower elevations are not in trouble from the fungus, but they're really susceptible to changes in climate."

Vredenburg said Bd was likely introduced into this area of the Andes by human activity, and the results of the study indicate research and conservation efforts should focus on understanding and stopping the spread of the disease. Methods of doing so could include stopping the transport of live amphibians across borders, he said. But understanding the disease also has important implications for human health.

A female *Bryophryne nubilosus*, one of the frog species used in the study, attending her eggs. The species lives in the cloud forest of the Andes, at elevations from 2,400 to 3,200 meters. Credit: Alessandro Catenazzi

"This pathogen is like no other in the history of the world. Bd outbreaks make bubonic plague look like a slight cough," he said. "We need to understand the basic biology that's driving this terrible pathogen because it's the same biology that drives diseases that affect humans."

Vredenburg has studied the impact of Bd for more than a decade. His research has tracked the spread of the disease through the Sierra Nevada and beyond and shown that some species of frogs are relatively immune to its effects while others are highly susceptible. Future research will focus on those species to learn how they are able to escape Bd's harmful effects and see how that knowledge can be used to save other amphibians.

"Thermal Phsyiology, Disease and Amphibian Declines on the Eastern Slopes of the Andes" was published online in *Conservation Biology* on Dec. 13. Vredenburg co-authored the study with Catenazzi and Illinois Wesleyan University Assistant Professor of Biology Edgar Lehr. The research was funded by the Amazon Conservation Association, the Rufford Small Grants Foundation and a grant from the National Science Foundation.

Vance T. Vredenburg is an associate professor of biology at San Francisco State University. He is also a Research Associate at the Museum of Vertebrate Zoology at the University of California, Berkeley and California Academy of Sciences. Vredenburg is the co-founder of AmphibiaWeb.org, an online bioinformatics project promoting science

and conservation of the world's amphibians.

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