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Frog populations once decimated by disease mount a major comeback

A remote lakeshore deep inside Yosemite National Park teems with life: coyotes, snakes, birds, tadpoles, frogs. The frogs are at the heart of this scene, which a decade ago was much different. It was quiet — and not in a good way. The frogs that are so central to this ecosystem were absent, extirpated by a deadly fungal disease known as amphibian chytrid fungus.

Now, thanks to the consistent and focused efforts of researchers and conservationists to save, then reintroduce, mountain yellow-legged frogs to this and numerous other lakes in Yosemite, their populations are again thriving.

A new landscape-scale study led by UC Santa Barbara (UCSB) biologist Roland Knapp, with colleagues from UCSB, University of Colorado, Boulder, University of Tennessee, and Yosemite National Park, details the long-term endeavor comprising 24 reintroductions across 12 different sites in Yosemite over 17 years. In that time, remarkably, the frogs have developed some resistance to the chytrid fungus, *Batrachochytrium dendrobatidis (Bd)*, allowing them to persist in its presence. The paper is published in the journal Nature Communications.

“Going back to some of these lakes where frogs are now recovering, and just sitting and watching, reminds you of what has been accomplished,” said Knapp, based at UCSB’s Sierra Nevada Aquatic Research Laboratory. “You sit on the bank and you have tadpoles all around you in the water and adult frogs sitting next to you on the shore. You have birds flying in and feeding on them, and snakes that are feeding on

them. You have a lake that’s alive again.”

As it’s done to amphibians worldwide, *Bd* has devastated native frog populations in Yosemite. Once the most common amphibian in the high elevation portion of California’s Sierra Nevada mountains, during the past century the Sierra Nevada yellow-legged frog (*Rana sierrae*) has disappeared from more than 90% of its historical range. It is currently listed as “endangered” under the Endangered Species Act. But in their long-term study, Knapp and co-researchers were able to successfully reestablish breeding populations by translocating *Bd*-resistant frogs to sites where the species had been wiped out. The success of their recovery efforts is a beacon of hope for amphibian conservation.

“In our study, results from viability modeling suggest that many reintroduced populations have a high probability of persisting over 50 years,” Knapp said. “These results provide a rare example of how reintroduction of resistant individuals can allow the landscape-scale recovery of disease-impacted species, and have broad implications for amphibians and many other taxa that are threatened with extinction by novel pathogens.”

Amphibians are the most threatened vertebrate class, with more than 40% of species threatened with extinction. In less than a generation, the human-driven emergence of the amphibian chytrid fungus (Bd) has devastated global amphibian biodiversity, with thousands of populations in decline or extirpated, and dozens of species now extinct in the wild. Even amphibians in the most protected habitats have fallen victim to what Knapp calls an “invisible killer.”

All of which makes the success of this study even more “mind-blowing,” he said. “It’s mind-blowing considering where we were 10 or 15 years ago, when we weren’t sure if we were going to have this frog on the landscape anymore, to see how things are turning around. It’s incredible to see.”

It’s taken some seriously painstaking work to get here. The reintroductions require careful planning; when identifying the best locations for reintroduction, team members must factor site elevation, winter severity and predation risk. And monitoring the translocated frogs is an intensive, long-term effort, often requiring researchers to hike in and capture every frog at a site multiple times per year.

Monitoring those translocated populations over several years, the team observed the recruitment of new adult frogs, indicating successful recovery. Conducted within the protected confines of a national park, their efforts, Knapp noted, demonstrate the importance of maintaining and restoring natural processes in these ecosystems.

What about the prospect of scaling up this approach across the entire Sierra Nevada range — even serving as a proof of concept, and potentially as a model, for similar conservation efforts elsewhere across the globe?

“It’s really important to have that broader perspective,” said Knapp. “We now have a proven strategy that is working in Sierra Nevada yellow legged frogs and is allowing us to recover the frog at a scale of Yosemite National Park. This frog that has been pushed to the verge of extinction by this pathogen is now becoming an example of how we might recover amphibians all around the world.”

Knapp’s co-authors on the study are Mark Wilber at the University of Tennessee Institute of Agriculture; Maxwell Joseph, of CU Boulder and Planet; Thomas Smith, also of UC Santa Barbara; and Robert Grasso at Yosemite. Funding for the project was provided by the Yosemite Conservancy, National Park Service and National Science Foundation.

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