

## CASE STUDY

# Bathing Buddies

Antifungal slurries could be key to protecting amphibians from an insidious threat

TEXT AND PHOTOS BY RYAN WAGNER

**F**rogs are in trouble. A 2023 study in *Nature* found amphibians are the most endangered class of vertebrates on the planet, with roughly 40 percent of species worldwide at risk of extinction. Habitat loss, climate change and pollution are significant threats, but disease is also a notable concern. Since the late 20th century, a chytrid fungus has ravaged amphibian populations worldwide, contributing to the loss of hundreds of frog species. In Northern California, however, biologists are testing a clever solution that could give these creatures a fighting chance: antifungal frog baths.

The fungus is thought to have originated in Southeast Asia and has spread through the pet and food trades, as well as on the boots of unsuspecting hikers and researchers. Once chytrid establishes itself in an ecosystem, eradication is nearly impossible, and entire frog populations can be decimated in a matter of months. In Northern California, the Cascades frog has been suffering from chytrid since the 1980s. Designated as a candidate for listing under the California Endangered Species Act, the Cascades frog has disappeared from more than 95 percent of its range in the state. But there is hope, thanks to the pioneering work of Jonah Piovia-Scott, a disease ecologist at Washington State University who has been using antifungal frog baths to treat chytrid infection.

Piovia-Scott began experimenting with antifungals in 2012 by treating frogs when they are recently metamorphosed and most vulnerable to chytrid. In a recent study, he found treated frogs had survival rates between four and five times greater than untreated frogs. He plans to continue treating frogs in California for at least two more years and hopes to expand his work into other states.



**Chytrid is not visible to the naked eye, so frogs must be tested to determine whether the fungus is present (inset). Chytrid has led to significant population declines among Cascades frogs (right), whose range stretches from California to British Columbia.**







**A PREVALENT PERIL** Chytrid has spread across all six continents where frogs are found. Iconic species such as the Panamanian golden frog, the gastric-brooding frog and Rabbs' fringe-limbed treefrog have disappeared due to the fungus, making effective treatments especially vital. Cascades frogs are most susceptible to chytrid when they are newly metamorphosed, usually in late summer or early fall. Each fall, Piovita-Scott heads into California's Lassen region alongside a team of U.S. Forest Service biologists, graduate students and private landowners to collect hundreds of tiny Cascades froglets (above). The subjects are then brought to a field lab (left), where they are tested to determine the prevalence of the fungus and given treatment to reduce infection.

**SOAKING IN THE SLURRY** When frogs are infected by the microscopic pathogen (below), it bores into their permeable skin, disrupting vital functions and often leading to death. For amphibians, skin is much more than a protective barrier. It is essential for respiration, hydration and regulating electrolytes. While some amphibian species are able to recover from the fungus, others have a 100 percent mortality rate and die rapidly once infected. Chytrid has led to large declines among Cascades frogs, and several populations have already disappeared. To treat chytrid, Piovia-Scott's team bathes hundreds of tiny froglets in an antifungal slurry (right) for five minutes every day for a week. The treatments are highly controlled, using a common antifungal called itraconazole diluted to less than 0.01 percent of the active ingredient, and designed to kill the fungus without harming the delicate amphibians.



“We treated frogs and tracked how well they survived their first winter. What we found were dramatic increases in survival.” –Jonah Piovia-Scott

**THE FUTURE OF THE FROGS** After finishing their course of medication, the frogs are released back into the environment by the researchers (right). While it is still too early to fully assess the treatment's long-term impacts, results so far are promising. Survival rates for treated frogs have been significantly higher than for untreated frogs, and models suggest that increasing the survival of metamorphs could stabilize or even boost frog populations. “By keeping these populations alive, we hope they will naturally develop resistance to this pathogen,” Piovia-Scott says. While he knows treating individual frogs is not a permanent solution, Piovia-Scott says evidence from similar frog species shows that, over time, populations can evolve resistance to chytrid, potentially leading to recovery. ■



.....  
 Ryan Wagner is a Ph.D. student in biology at Washington State University.