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Missing in Action

Once abundant in Southern California, the foothill yellow-legged frog inexplicably vanished from the region sometime between the late 1960s and early 1970s. The reasons behind its rapid extinction have been an ecological mystery.

Environmental scientist Andrea Adams set out to crack the case. While pursuing her Ph.D. at UC Santa Barbara, she spent six and a half years reconstructing the missing amphibian's story in an attempt to find out why it disappeared. Her dissertation — Adams earned her doctorate in 2017 — explored the importance of discovering a species' past to inform its future. Now, a paper summarizing her findings about Rana boylii appears in the journal Ecology and Evolution.

"As species disappearances from unknown causes go, this one occurred at breakneck speed," said Adams, now a lecturer in the Environmental Studies Program. "The global trend of amphibian declines points to habitat loss, ultraviolet radiation and pesticides as potential culprits, yet most of these act gradually, slowly chipping away at populations over time. One of the only threats that can cause rapid extirpation — like that of Rana boylii in Southern California — is disease."

Chytridiomycosis — caused by the fungal pathogen Batrachochytrium dendrobatidis (Bd) — has devastated frog populations all over the world. Adams wanted to know if Bd could have done the same to the foothill yellow-legged frog in Southern California.

As a first step, Adams sampled more than 1,300 historical, archived amphibian specimens from natural history museums. Then she tested an improved protocol to better detect Bd DNA in those specimens. In addition, she looked for Bd DNA in amphibian species that occurred in the Southern California locations common to foothill yellow-legged frogs before, during and after their decline.

Adams also interviewed people who visited Southern California streams before the foothill yellow-legged frog disappeared. “The information I sought didn’t exist anywhere but in people’s memories and sometimes in field notes stashed away in their garages,” she explained. “I used that archived material to determine when foothill yellow-legged frogs were observed and how their population size diminished through time.”

Although Bd arrived in the region long before the foothill yellow-legged frog began to decline, Adams found that the pathogen widely advanced as the frogs began to disappear. Many factors could have contributed to the spread: the pressure of a rapidly expanding metropolitan region; increased recreational use of streams; roads extending deeper into natural areas; and the appearance of exotic species. Take the American bullfrog as an example. Brought to Topanga Canyon in big numbers in the early 1900s, the species today is widespread in California and known to harbor and spread Bd via international amphibian trade.

“When I overlaid the historical information with the incidence and prevalence of the chytrid fungus, I found that when the foothill yellow-legged frog started to go extinct corresponded to a spike in the spread of the pathogen in Southern California,” Adams said.

“Because this is a retrospective study, we can’t say for certain that amphibian chytrid fungus is the cause,” said co-author Cherie Briggs, a professor in the Department of Ecology, Evolution, and Marine Biology. “However, Andrea’s doctoral thesis and this paper provide sound supporting evidence for this hypothesis.”

About UC Santa Barbara

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