

# THE SACRAMENTO BEE

This colorful frog's survival is at risk in California's streams. Here's how the state could save it

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Shy of 3 inches with skin in muddy shades of red, green or brown, the foothill yellow-legged frog is unremarkable at first glance. Flipping it over, however, reveals the signature gold shading of its legs and lower abdomen that leads some to exclaim its beauty.

The amphibians used to be common in the foothill streams of mountain ranges across California, including the Sierra Nevada and Coast ranges. Now they're gone from over half of their historical habitat in California, and scientists and wildlife advocates are worried about their survival.

In 2012, the Center for Biological Diversity petitioned the U.S. government to protect the frog under the Endangered Species Act. But after a settlement last year pushed the decision to 2020, they decided to try listing it in California first.

On July 7, the California Fish and Game Commission named it a candidate species for protection under the California Endangered Species Act. Over the next year, the frog will be protected as though it were listed while the commission reviews its status.



“These frogs are really at the nexus of all the different ways in which we use water. ... They are sort of iconic and emblematic,” said Sarah Kupferberg, a visiting scholar at UC Berkeley and an independent consultant at Questa Engineering who has studied the frogs for about 20 years.

A look past their pebbly skin reveals how the frogs evolved to thrive in California. The snowmelt-fed streams they inhabit can be torrents in the early spring, but later can dry up altogether. The frogs have accumulated adaptations to help them survive in this environment including timing their life cycles with the seasonal changes in the river.

Mature males have to compete with a roaring river that would drown out their calls to potential mates. They get around this by calling underwater with a frequency that can only be heard with a hydrophone, said Kupferberg.

The tadpoles have developed a strategy to chow down on the algae by using their six rows of teeth to scrape it off of the rocks. The teeth also act like suction cups that keep the tadpoles from being swept away in the fast-moving stream.

The frog is an important link in the river food web. Some of the tadpoles are gobbled up by aquatic insects and dragonfly nymphs. Birds and garter snakes also feast on the tadpoles and young frogs. “They are a very important step in converting the algae that grows on the rocks into all other kinds of wildlife,” Kupferberg said.

“As a species they’ve been around for millions of years, so they’ve endured all kinds of megadroughts, megafloods,” Kupferberg said.

But now they’re in trouble. They have disappeared from the southern half of the state and face threats in the north. Like other amphibians around the world, their fate is tied to the influence humans have had on their habitats.

“Because this species is strictly a riverine species and because it was so widely distributed all over California, its fate is sort of a story of how we use water in our state,” said Kupferberg.

## Survival in California’s streams

Over the course of their lives, these frogs use the whole length of the stream.

Dams and reservoirs effectively build walls that restrict their movements and break up populations. Smaller populations are more vulnerable to randomly occurring threats, such as the recent drought.

Many dams release water from the bottom of their reservoir, lowering the water temperature. Colder temperatures can slow the frog’s growth and delay tadpoles from metamorphosis.

Pulse flows from dams may not be timed to line up with the life cycle that the frogs evolved. Frogs lay their eggs on rocks in the stream when the flow is tapering off, so when dams change the flows it changes the odds that eggs will survive. If the flows are too low, the eggs can be “stranded” and dry out, but if the flow is too fast, the eggs can wash away.

And then there’s pollution and water diversion.

With the rush to grow more marijuana in the state, trespass grows hidden away in national forests divert water from streams and use toxic chemicals. The U.S. Forest Service is studying whether they imperil frogs and other aquatic animals.

Because frogs have thin, water permeable skin, they are especially vulnerable to pollutants.

“All frogs are really indicators of the aquatic habitat and the reason that should be important to humans is water quality.

This is the source of the water we drink ... the water that goes to water our crops,” said Diane McFarlane, leader of the Threatened, Endangered & Sensitive Species Program of the Pacific Southwest Region of the U.S. Forest Service. “When frogs start disappearing in whole areas, you know you’ve got problems with the water quality.”

The Forest Service has been trying to save the frogs on National Forest land for the past two decades. Some of their efforts include moving stranded egg masses or tadpoles to more suitable parts of the stream.

The frogs are also facing threats from the chytrid fungus that has ravaged amphibian populations across the globe. The origin of chytrid fungus is not clear, but scientists think it was introduced to the U.S. and it’s now prevalent in much of the Sierra Nevada.

The fungus attacks keratin, the protein that makes up our hair and nails and also forms the teeth of the tadpoles. In adult frogs, in which keratin is one of the main components in their skin, chytrid fungus is particularly virulent. The fungus interferes with their immune system. It also depletes their electrolytes, making them prone to heart attacks.

Chytrid fungus can be treated with antifungal agents in frogs that are captured and released and scientists are working to develop methods to inoculate populations against the disease.

McFarlane is hopeful. “The species remains imperiled by pretty much the same threats. We may be getting a handle on some of them and can start to take positive action. We do have the ability to turn this species around,” she said.

## Protecting the foothill yellow-legged frog

If the frogs are listed under the California Endangered Species Act, they will need to be considered whenever dams or other water projects might impact their habitat, and more effort will be put towards their recovery.

Andrea Adams, a lecturer and research associate at UC Santa Barbara, studied the frogs’ decline in Southern California for her dissertation. She had been working for the U.S. Fish and Wildlife service in the region when she learned that the frogs used to live there. “It was almost like this frog had been forgotten in that region,” she said.

Frogs are “explosive breeders” that reproduce prolifically some years while not breeding at all during others, so ecologists in the 1970s when the frogs started to disappear thought nothing of their lack of frog sightings. When they retired, they took their knowledge of the frogs with them.

Adams’ work pointed to the chytrid fungus as a contributor to their rapid demise since most other threats kill off frog populations more gradually.

“That was just really profound — this idea that the environment is changing so quickly that we don’t really know ... (how) what we record about the natural environment today is going to be extremely valuable to some study later,” Adams said.

Adams hopes her work can help inform conservation efforts for foothill yellow-legged frogs in the places where they still live, like in Central and Northern California.

Other frogs, including some red-legged frogs, have been reared in captivity and released to bolster wild populations. Scientists are looking into that strategy to help yellow-legged frogs too although they need whole reaches of streams during their life cycle.

“It remains to be seen whether or not zoo rearing and release of frogs will work at re-establishing populations that are either about to blink out or have been missing for many years,” Kupferberg said.

That means if they do disappear from California, it’s not clear if we’d be able to bring them back.