

Signs from Salamanders

BY JEFF CRANE



Photo courtesy James Jancovich

Since 1979 in South America, biologists have monitored the decline of amphibians in Columbia, Peru, Ecuador, Brazil and Venezuela. In Central America's Costa Rica, one researcher noted "We were finding eight or nine animals where once we were finding hundreds."

In an isolated region of Oregon's Cascade Mountains, the population of the Western toad—*Bufo boreas*—has declined sharply. In just 15 years, the population has dropped from approximately 800 to 300 animals, nearly a 65 percent attrition rate.

THE DEATHS ARE OBVIOUS in the Hvaler Islands of Oslofjord. And in Costa Rica. And in the Amazon. And in the American Southwest. Dying are the Earth's amphibians—the salamanders, the frogs, the toads, and the newts. These creatures appear to be locked on the mortal end of an irrefutable global battle. They have many enemies and no apparent defenses. The population of frogs, toads, salamanders, and newts dwindled only slightly during most of the last half of the 20th century. But in 1989, researchers began to recognize a frightening decline. They concluded that the demise was far from a typical statistical fluctuation or down-cycle of biological diversity.

In late 1999, as the 21st century rapidly approaches, scientists around the world—many who look to the amphibians as a divining rod of environmental health—are sounding what amounts to an ecological alarm. They are working hard to unravel the mystery of dying amphibians.

Why the unmistakable deaths? What, if anything can be done?

The enigma magnified when scientists—many who hold conflicting theories and possess healthy egos—connected, teamed up, and realized that amphibian deaths had become commonplace in the Earth's isolated pristine valleys, lakes, ponds, and mountain habitats. An environmental buzzer went off. These regions are preserves that normally protect the land and its inhabitants. The answer, researchers realized, could no longer be blamed solely on human encroachment.

"These organisms are dying in areas that we've set aside as havens to protect them," says Jim Collins, chair of the Biology Department at Arizona State University. "We now have to rethink this and realize that human influence is everywhere, no matter how isolated or pristine some of these areas may be."

During the late 1980s biologists began reporting declines in amphibian populations in such diverse habitats as the Pacific Northwest's Cascade Mountains, in Arizona, in Australia, and in Panama. There are clues to the declines. Researchers have identified candidates such as the increase in ultraviolet-B rays, chemical contamination, fungi, introduction of competitors and predators, habitat destruction, and new diseases or pollutants.

ASU scientists also identified a virus that may be killing amphibians in southern Canada and in the San Rafael Valley of Arizona.

"This is really taking detective work. Luckily, a lot of personal egos haven't got in the way. The normal territoriality of scientists hasn't existed," says James Jancovich, an ASU graduate student. "Scientists are working together."

The persistent Jancovich took months to uncover *Ambystoma tigrinum*, the virus that may be responsible for the deaths of many amphibians.

Some of the researchers study whiteflies, others study Sonoran toads, tiger salamanders, or leopard frogs. The global teamwork has stacked up a bigger pile of questions than it has provided definitive answers.

Who are the culprits? They could be hunters or fishermen traveling from state to state. Perhaps new species of amphibians introduced into non-native waters. Or maybe the culprits are scientists themselves, who unwittingly transport a virus or bacteria into the field where they conduct their studies.

Ominous Warnings from Nature?

The variables are many. And, as Collins says, what may kill one species may not even tickle another.

“An analogy would be allergies in humans,” the ASU scientist explains. “For example, my brother has horrible allergies and I don’t. In a similar way, one organism lives in the same region where another is dying,” he says. “But one thing is certain, we all are struck by how quickly and how widespread the deaths among amphibians are occurring.”

Can it be a combination of factors, a singular cause, or perhaps something yet undiscovered?

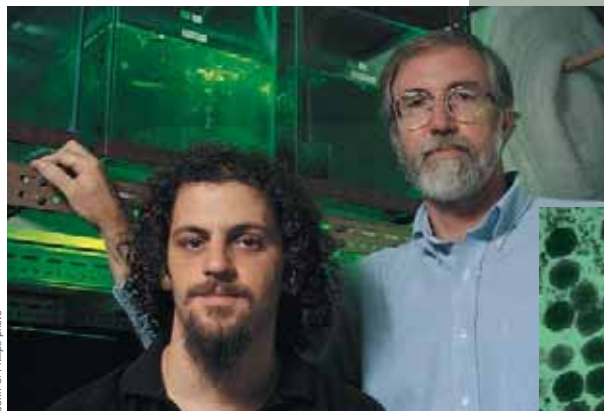
In California’s Sierra Nevada mountain range, the population of foothill yellow-legged frogs and mountain yellow-legged frogs is declining rapidly. Scientists pin the blame for the deaths partly on pesticides and herbicides

The Declining Amphibian Populations Task Force (DAPTF) has found that:

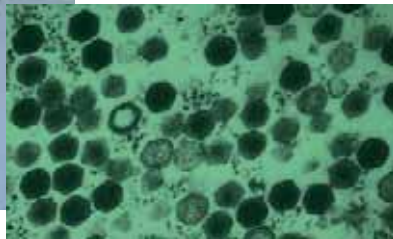
- 1 Amphibian populations naturally show large fluctuations.
 - 2 Allowing for those fluctuations, many amphibian species are in severe decline.
 - 3 Not all amphibian species are in decline.
 - 4 Within a single location, some species may be in decline, while others are stable.
 - 5 Although amphibian declines are spread across the world, no single global factor has been identified as the responsible culprit.
- Other scientists and ecological study groups suggest declining biodiversity may be attributed to:
- 1 Habitat loss—as human population grows and resources dwindle, undisturbed ecosystems are shrinking. Almost 98 percent of the tropical dry forest in Central America’s Pacific Coast has disappeared. Thailand has lost 22 percent of its mangrove forest.
 - 2 New species introduced into isolated ecosystems can imperil native species. Invader species can be viruses, bacteria, insects, plants, or new predators.
 - 3 Over-exploitation of animals and plants. Poaching for ivory, or exotic pets, for example, directly impacts animal populations

- 4 The pollution of soil, water, and atmosphere contaminates animal populations and can kill sensitive species. Acid rain, for example, has killed off life in thousands of lakes, ponds, and pools. Pesticides and herbicides damage animal populations worldwide.
- 5 Global climate change may increase the carnage in the coming decades. Human-caused “greenhouse” effects might increase global temperatures. As the average temperature rises, scientists believe that many animal species will be unable to migrate or redistribute themselves fast enough to survive.

—JEFF CRANE



John C. Phillips photo



James Jancovich

James Jancovich and Jim Collins. At right, particles of the *Ambystoma tigrinum* virus are revealed in a transmission electron microscope image. Virus particles are too small to be seen with an optical microscope. Researchers can deduce the presence of a virus by filtration experiments. The image directly confirmed the presence of virus in Arizona salamanders.

that have drifted airborne from Central California’s agricultural region.

Gary Fellers is a biologist at the U.S. Geological Survey. In an article published in Washington, D.C.-based *Chronicle of Higher Education*, Fellers noted that “in the Yosemite area, we found statistical declines in every single frog species we looked at. Pesticides and herbicides are the real problem.”

In Central America and Australia, amphibian declines are linked to a new-found fungus—chytrid—that has infected 27 species of frogs or toads. A fungus also was found on a species of toad in Southern California.

Karen Lips, an assistant professor from St. Lawrence University, discovered the link in a Panama forest reserve after she found 56 dead frogs. The fungus is believed to grow on the underside of amphibians. It suffocates them through their gills.

Is this a biological disaster? Is it a bad 1950s science fiction movie turned reality?

“We’ve looked at the obvious stuff,” says

Betty Davidson, an associate professor of entomology at ASU. “We’ve looked at all kinds of details. We’ve studied the chytrid fungus. We (scientists) are talking to one another. Who is spreading the fungus? Is it fly fishermen who travel up and down the region? Is it the scientists themselves who carry a virus from pond to pond? We still don’t know.”

“I’m not into frightening anyone, but this situation certainly should alert people to the implications,” Collins says. “We do have to ask ourselves if there is something in the air that is killing the amphibians. Shouldn’t we be worried about what’s in the air or the dust being blown around us?”

Collins specializes in amphibian biology. He is an expert on the tiger salamander. In June 1998, he organized a groundbreaking global conference at the National Science Foundation. The goal was to analyze and review the world’s declining amphibian populations. The hope was to share evidence and to develop a strategy for future research and analysis.

A scientist who has studied the tiger salamander for 20 years began finding the amphibian floating, dead, on the water’s surface instead of in his net, alive, trying to escape.

His work reflected that of others, such as the Declining Amphibian Populations Task Force (DAPTF) and World Resources Institute, both of which are focusing on the amphibian decline. A newsletter, *FROGLOG*, has created a forum for concerned scientists and researchers. Chinese scientists are hollering for answers with questions. In Honduras, researchers want the same answers.

For all, one question remains constant. What, or who, is the culprit?

Scientists look at the vulnerability of all the species involved. Because amphibians have a two-stage life cycle, one under water and one above, they are more sensitive and more vulnerable to culprits such as environmental change and pollution.

Amphibians lay their eggs in water. They then go through a complete metamorphosis to become above-ground dwellers. Scientists are searching for the stage where the death knell occurs. Does it occur before metamorphosis or after? The search for answers continues.

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