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Could a single, planet-wide phenomenon be killing frogs? Probably not

CROAK

The trouble with Kermit

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"The frogs died out of the houses and courtyards and out of the fields. And they gathered them together in heaps, and the land stank."
Exodus 8:14.

TWO years ago, scientists presented an updated version of the Bible's most famous frog story. Instead of Egyptians afflicted by a plague of frogs, herpetologists – people who study amphibians and other reptiles – held out the possibility that mankind was inflicting a plague *on* the frogs.

At a conference in Irvine, Calif., researchers from around the world reported that for at least a decade they had witnessed serious declines in the numbers of frogs, toads and salamanders. What particularly worried them was that a number of the "population crashes" had been observed in pristine or isolated areas where it was difficult to explain the decreases.

To some people, the reports raised the spectre of global environmental decay. Specifically, researchers feared that global warming or increased ultraviolet radiation associated with thinning of the ozone layer was silently mowing down the planet's frogs.

More than one scientist pointed out that frog biology might make frogs uniquely sensitive to a variety of global blights: They live in water and on land; airborne gases are able to pass through their skin; and they eat both plants and meat during their lifetime.

Since the initial burst of concern, scientists have been struggling to answer the two questions that dominated discussions from the beginning: Was the largely anecdotal evidence of a plague being visited on frogs, toads and salamanders genuine in any statistically significant sense? And could a single, planet-wide phenomenon explain the putative amphibian holocaust?

The early answers seem to be probably Yes and probably No.

Forty working groups in 30 countries are attempting to devise procedures that might answer these questions more conclusively. But the early struggles of the task force on Declining Amphibian Populations (DAP), organized by the International Union for the Conservation of Nature, an umbrella group of conservation agencies, is already showing how difficult it is to tease larger truths out of inherently unstable biological systems.

First, simply enumerating the estimated 4,500 frog species is a nightmarish task: "Frogs are not as obvious as trees or birds," remarks Roy McDiarmid, a research zoologist with the U.S. Fish and Wildlife Service in Washington, D.C. He is the co-author of a soon-to-be published book outlining principles that should govern a standardized census of the world's amphibians.

Dr. McDiarmid says that many frogs are nocternal and reclusive. And if the most profound declines are occurring in inaccessible locales, counting these creatures will be particularly troublesome. Moreover, weather compounds the problem. Frogs' skins need to be kept moist, so warm, wet nights will almost always produce census bonanzas. "If you are sampling on a dry Monday, Tuesday, Wednesday, you are going to get very different numbers than if you go out on a wet Thursday, Friday, Saturday."

Then there are the mysteries of the reproductive cycle. Many species of frogs gather at a pond to breed for only three or four days a year. After that they may scatter into the surrounding forest. "If you show up three weeks after they have bred you may think they are not there at all," comments Dr. McDiarmid.

Overriding all this confusion are the natural swings in population numbers. One of the longest continuous enumerations of frogs has been a 12-year count at a pond in South Carolina's Rainbow Bay. Breeding female populations in the pond ranged in one species from three frogs one year to more than 2,500 five years later. Collections of tadpoles ranged from zero one year to 3,000 another. Similar erratic swings were noted in three other frog groups and, to add to the scientific muddle, one species' boom years could be another's bust.

In general, the best indicator of a dearth of frogs was a dry year. However, scientists reporting on their work in the U.S. journal *Science* last year suggested that if you looked at only a two- or three-year cycle you might easily have imagined nefarious human factors at work.

It is also clear to many zoologists that if they want to separate natural swings from human-induced population declines, a given population must be surveyed over decades. "It could take 25-plus years to arrive at any definitive answer," says Robert Johnson, curator of amphibians and reptiles at the Metropolitan Toronto Zoo.

However, feeling political pressure to produce answers more quickly, DAP has set a three- to five-year limit on its deliberations. "This operation is really a SWAT team," says DAP co-ordinator James Vial in Corvallis, Ore. "If we cannot come up with answers quickly we will probably discontinue our efforts."

One reason for a fast and dirty appraisal is that biologists, accustomed to short, specific research efforts, fear that such a census would turn into a money morass. "The potential for wasting money is great where everyone writes in and says 'I want to monitor my local pond for 10 years and get paid for it'", remarks biologist David Wake of the University of California at Berkeley.

None of these institutional toings and froings answers the question of whether a single phenomenon is provoking the supposed decline. What now seems clear is that amphibian numbers are *not* declining everywhere. In particular, there is no good evidence that salamanders are in any trouble. It also seems likely that many of the declines of two years ago result from localized phenomena.

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Reductions in frog numbers in California could stem from an over-zealous stocking of frog-devouring trout in lakes and streams. Agricultural encroachment and a volcanic eruption in Central America have been associated with disappearing frog populations. And in Japan, conversions of rice paddies to golf courses have been associated with a reduction in frog numbers. A deep frost in Brazil is seen as a likely explanation for reported troubles there. Pesticide poisonings, toxic mine tailings, swamp drainings, regionalized droughts and maybe acidified rain are other culprits.

Indeed the variety of localized frog-killing conditions is such that some observers suggest the single-cause scenario was always mainly hype. "The media desperately wanted a single answer, they wanted a headline," says University of Virginia biologist Henry Wilbur.

A few scientists may have played upon this. "There was a lot of deliberate stirring up of interest, of sounding the bell and making a big public splash. That was

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the objective of a lot of people there [at the meeting in Irvine]," remarks Peter Smouse of Rutgers University.

Frog biologists suggest that the vision of a single but inexplicable global cause of amphibian deaths galvanizes public interest in a way that more prosaic explanations don't. "People will think habitat destruction is regrettable, but at least it is not mystical," says Dalhousie University zoologist Richard Wassersug.

Yet concerned biologists still aren't backing away from the fear that, for whatever the reasons, the world's frog populations are suffering. "I don't think there is a Death Star out there," says Prof. Wake. "The simple [reason] is just human reproduction, and it is doing us in with general environmental degradation."

The article EM9216 reprinted overleaf and above is used in Figure 12.4 of the STAT 221 Course Materials,

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