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Letter From the Desk Of David Challinor
October 1997

Frogs have been featured in songs and stories since the beginning of western culture. Aristophanes wrote his celebrated Greek drama, "The Frogs," at the end of the IV century BC, and "The Frog Prince" is a well-known fairy tale. Children still enjoy the frog and toad characters in Beatrice Potter's tales, especially The Tale of Jeremy Fisher, and in Kenneth Grahame's "The Wind in the Willows."

It is no wonder that these remarkable amphibians have attracted our attention, for different frog species lead varied and, to the biologist, fascinating lives. Some tree frogs, for example, are so arboreal that they never descend to the ground. Their eggs are laid in tiny pockets of water stored at the base of bromeliad leaves of epiphytic plants growing on branches in the forest canopy; they find all their nutrients from rain and dust in the air. Other frogs live underground in the desert where they stay cool and damp, whereas still others almost never leave the water. There are species that live in mountain streams and ponds where they successfully spawn in water as cold as 5°C (about 34°F), and other species that live in the warm, wet tropics where they lay their eggs and hatch them in water as hot as 34°C (about 90°F).

For those who dissected frogs in biology class, you may remember that true frogs have no ribs and that their skin is unusually thin and smooth. Growth from egg to tadpole to adult varies between species. Some adults carry fertilized eggs in "pockets" on their backs; others hold them in their mouths; and some even carry tadpoles stuck to their bodies until the young are ready to fend for themselves. The time needed for a tadpole to metamorphose into a frog varies from a few days for those that lay their eggs in temporary puddles, to four or five years for the North American bullfrog.

The above information is probably more than most of you ever want to know about frogs, but despite the research of generations of herpetologists, there are still many unanswered questions about their elaborate life cycles. The most crucial question today is why, globally, frog populations have been declining rapidly over the past 10 or 15 years. Although at first glance their disappearance seemed related to human-caused loss of habitat and environmental pollution, these are apparently not the only causes, for many frog species are disappearing even in habitats that still appear to be pristine.

The initial evidence for the decline was anecdotal, but recent scientific data is supporting what was previously only surmised. Although many factors must be involved in this biological catastrophe, one possible cause has recently been isolated by Dr. Karen Lips of St. Lawrence University. She was studying tree frogs in western Panama near the Costa Rican border in December 1996. Along a mountain stream where she had previously found her study frogs in quantity, she discovered scores of small frogs of several species all dead on the ground. She collected about 50 of them, preserved them frozen or in formalin (a common preservative for animal specimens), and sent them for analysis to Dr. Earl Green, an animal pathologist at the University of Maryland. Her discovery marked the first time a herpetologist had ever come upon such a mass frog mortality. The animals she collected had died only recently; had she visited this site a few days later, it is likely the dead frogs would have been eaten by scavengers.

Although these Panamanian frogs were thought to be living in an ideal environment free from evident human stress, the pathologist reported that all had died from an attack by a microscopic protozoan on their skin. A frog's skin is particularly sensitive and crucial to its health; it allows bodily fluids to emerge directly through it and it absorbs oxygen and water directly. Its skin is a primary defense against the ever-present danger of dehydration; furthermore, in a few species of Dendrobates and Phyllobates frogs the skin is the source of a potent toxin for protection against predators.

The as-yet unidentified protozoan attacked these frogs in one of their most vulnerable parts, for some still unknown reason. Protozoans are hard to find in the blood stream of an animal and even more difficult to identify. As a victim of a protozoan attack that resulted in retinal damage (see my letter of December 1995), I can appreciate their dangerous nature. In Dr. Lips' frogs, the pathologist reported that the protozoan infection caused a mild skin swelling in the toes and in the "drink patch" located on the pelvis where the frogs absorb water. The protozoans evidently multiplied at the infection site and formed a discharge tube through which a score of spores entered the water on their way to infect other victims. The protozoan, moreover, seemed very similar to one that infects oysters in the Chesapeake Bay; it is the principal cause of their mortality. Even more amazing is that a similar die-off of frogs in the rain forests of northern Queensland in Australia seemed to have been caused by a protozoan almost identical to that found in the Panamanian frogs.

Another microscopic pathogen is attacking menhaden, a small schooling planktivore in the Chesapeake watershed. Frightened fish buyers have caused the fresh fish market in Maryland to decline by 50% even though menhaden are not eaten by people; instead, they are used for their oil or as bait for crabs, lobster, bluefish, etc. Commercially valuable fish species seem unaffected by the pathogen.

So far outbreaks of frog and fish mortality seem to be relatively isolated incidents, scattered widely over the globe. However, with rapid and ubiquitous communication, global events are instantaneously disseminated. Thus reports of school children discovering frogs with missing or extra legs in Minnesota and adjacent Ontario appeared in a British journal (New Scientist, 13 Sept. 1997). Early evidence suggests that these malformations may be caused by a photochemical reaction triggered by UV sunlight shining on certain commonly used insecticides. The photochemical reaction creates a toxic substance harmful to tadpole development. Similarly, the latest issue of ECOLOGY (78(6), 1736-51) contained an account of the rapid decline of local yellow-legged frogs in northern California streams. In this case, the local frogs were being displaced by introduced bullfrogs. The native tadpoles were unable to compete with the larger, more aggressive invaders.

As yet no one cause accounts for the decline in frog populations. It is no longer a local phenomenon, but seems to be global. Although there have always been peaks and depressions in frog populations, scientists do not recall such a widespread extinction pattern. The most publicized loss was that of the golden toad in the Monteverde cloud forest of Costa Rica. In 1987 the population was normal and the forest held hundreds of thousands of these gleaming animals. Only five toads were found two years later and not one since then. Furthermore, 20 other species of frogs and toads have disappeared from this area.

It may take years to learn why the protozoa began to attack frogs in what appeared to be an ideal frog habitat. Protozoa, like other organisms, can mutate for reasons still unclear. What is surprising, however, is that the parasite would wipe out a whole host population. Thanks to organizations like Chicago's Brookfield Zoo, which has supported Dr. Lips' research, the answers may be found. In the meantime, it is incumbent on us all to protect our wetlands as frog habitats and to be cautious about introducing alien fish and frogs into streams where they often out-compete native species to the point of extinction.

David Challinor
202/673-4705
202/673-4607 FAX