Environmental Case Study

What's Happening to Frogs?

Around the world, scientists are finding increasing evidence of striking deformities in frogs, toads, salamanders, and their amphibian kin. How can we evaluate the causes of a widespread environmental problem such as this?

The first report of frog abnormalities to attract widespread attention came from Minnesota schoolchildren on a summer fieldtrip to a marsh in 1995. Of the 22 frogs they caught that day, more than half had either too few or too many legs. The students' questions about these deformities led to discovery that similar problems also occurred in places throughout North America. Investigators report that as much as 80 percent of frog or salamander species in some local populations have abnormal or missing limbs, digits, or eyes. When dissected, many of these animals are found to have internal problems as well, including defective digestive systems and abnormal reproductive organs. Altogether more than 60 species in 46 states have been found to have some or all of these anomalies.

An alarming number of deformed frogs have been found in recent years. What causes these abnormalities is not yet known. Are they a warning of pollution or other serious environmental problems?
Courtesy of the Minnesota Pollution Control Agency.

Several hypotheses have been proposed to explain amphibian malformations. Chemical contamination, ultraviolet (UV) solar radiation, and parasite infection are among the leading candidates. To test the proposal that pesticides, industrial chemicals, or other environmental contaminants might be responsible, frogs were grown in the laboratory in the presence of a variety of toxic substances. Many different developmental abnormalities occurred. Field studies, however, have failed to show a clear correlation between any of these contaminants and frog abnormalities in wild populations. It's possible that high toxin levels at a crucial developmental stage—just as frog eggs are hatching, for example—might cause permanent physical deformities even though pollutants may be degraded or diluted to lower levels by the time researchers collect water samples.

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Similarly, lab studies demonstrate that high levels of UV exposure can result in many of the same deformities observed in nature. We know that UV radiation has increased because of stratospheric ozone depletion, but it's difficult to determine how much UV exposure wild frogs are getting. Both tadpoles and adults take shelter under debris or aquatic vegetation. In exposed areas, they may be more active at night than during the day. In addition, UV is absorbed by organic material, so that the exposure to animals in the water may be much less than that at the surface.

Currently, the leading candidate for amphibian malformalities seems to be parasite infections. Deformed animals often have cysts of a invasive trematode fluke named *Ribeiroia ondatrae.* The fluke burrows into tadpoles and can cause formation of either extra, absent, or deformed limbs. Infecting tadpoles with living trematodes resulted in many of the same defects found in nature. Although first observed in California, *Ribeiroia* has also been found in Wisconsin, Illinois, Pennsylvania, New York, and Minnesota, and appears to be spreading rapidly.

Fertilizer runoff and other water pollutants may play a role in *Ribeiroia* infections. Extra nutrients stimulate algal blooms and aquatic vegetation growth that provide food for snails, the intermediate host for the parasite. Endocrine disrupters can weaken immune systems and make amphibians more susceptible to infection. Still, like other suspected causes of amphibian problems, *Ribeiroia* field studies have produced mixed results. Parasites aren't always found in sites with frog abnormalities, and they haven't been shown to produce all the types of defects found in nature.

It seems likely that different combinations of chemical, biological, and physical factors are probably responsible for causing the deformities observed in wild amphibian populations. Malformations undoubtedly play a role in the widespread decline of many species of frogs, toads, salamanders, and newts from wetlands around the world. It's important for us to continue this research to understand what's happening to species that serve as indicators of more widespread environmental problems.