Environmental Case Study
West
The Deformed Frogs of California

Introduction

Amphibians are among the oldest surviving vertebrates on Earth. For as long as they lived undisturbed by natural events they are now being threatened by human activities. Starting in the 1950s there has been a global decline in the populations of many species of amphibians including frogs, toads, newts, and salamanders. Unfortunately, many species have become extinct or threatened. Much of this population decline is associated with habitat degradation due to deforestation, draining of wetlands, pollution, and urbanization. Few biologists believe this decline is a natural fluctuation. In 1988, it was discovered that amphibians are even disappearing from supposedly undisturbed environments. This suggests that large global changes are affecting amphibian survival. Many biologists believe that global climate change, acid rains, and increase in infectious animal disease may be the culprit for this decline.

One unusual factor that may be contributing to the amphibian decline is an increase in deformities. Animal deformities come in various types each having its particular cause. Some of these deformities are shown in Figure 1. The large numbers of frog eggs produced during mating means that there is a good chance of genetic defects showing up in the population. Genetic defects can be caused by mutations that take place naturally during cell division. However, exposure to certain chemicals and ultraviolet radiation can produce an abnormal number of mutations. Some defects do not alter the DNA, but do affect the development of the frog. These deformations can be rather severe and can be caused by certain chemicals and parasites.

Figure 1 – Deformed Frogs
(Photo courtesy of Dr. Joseph Kiesecker, Penn State University)
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Background

Many scientists believe that the widespread increase in deformed frogs may be contributing to the general decrease in frog populations. Developmental biologists, including David Gardiner of the University of California in Irvine, believe this is true. However, he hesitates to confirm what is causing the increase in developmental defects. Some of these defects affect limb development, making it difficult for the frogs to get around. Other deformities affect the reproductive system, in effect making the frog infertile.

Initial press coverage of frog deformities appeared after some Minnesota high school students reported ponds full of defective frogs in 1995. Researchers at first concluded that the deformities were very likely caused by pollutants. Agricultural runoff was particularly put to blame. Laboratory experiments then confirmed that a variety of agricultural chemicals could cause developmental defects in frogs. This just confirmed studies in other animals and clinical studies on human birth defects.

The most persuasive studies on chemical effects on frog development came out the laboratory of Tyrone Hayes at the University of California – Berkeley. He found that the agricultural herbicide atrazine caused reproductive abnormalities in frogs. Frogs exposed to atrazine had defective gonads incapable of producing the normal amounts of gametes needed for successful reproduction. Hayes argued that trace amounts of atrazine in California ponds was responsible for the reproductive defects. The atrazine acts like an endocrine disruptor which interferes with the function of hormones. Atrazine stimulates an enzyme called aromatase in frogs which promotes the conversion of testosterone to estrogen. This disruption is the probable explanation for emasculating male frogs. It may also decrease fertility in female frogs and alter the proportion of frog eggs developing into males.

The Issues

It appears obvious that the higher than normal frog deformations would be caused by environmental pollutants in the frog’s habitats. However, agricultural chemical companies, many farmers, and some scientists refute the claims and findings of Gardiner, Hayes, and other researchers. This disagreement made the news after the National Institutes for Environmental Health Sciences’ press release stating that water from sites where malformed frogs was potent in deforming frogs in laboratory experiments. Their report implied that a man-made chemical pollutant was at fault.

Some researchers discovered that some of the water being tested where the deformed frogs were unusually soft and simply lacked key minerals critical for proper development of the frogs. Other researchers discovered that a parasitic worm called a trematode could induce anatomical deformities in frogs. So, these scientists and supporters of these claims believe the findings were just quirks of nature. Hayes research is more difficult to refute even though atrazine’s maker, Syngenta hotly, disputes the validity of the research. They state that Hayes’ research was not conducted properly and they have no evidence of atrazine behaving as an endocrine disruptor.
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References

Literature


Web Sites

1. Center for Global Food Issues
   http://www.cgfi.org/
2. e.Hormone – Center for Bioenvironmental Research
   http://e.hormone.tulane.edu/
3. Environmental Protection Agency
   http://www.epa.gov/
4. Information on Amphibians – UC Berkeley
   http://www.ucmp.berkeley.edu/vertebrates/tetrapods/amphibintro.html
5. Mindfully Yours – Hayes versus Syngenta story
   http://www.mindfully.org/Pesticide/2003/Syngenta-Tyrone-Hayes31oct03.htm

Key Principles

1. Amphibians
2. Atrazine
3. Endocrine disruptors
4. Frog deformities
5. Pesticides
6. Pollution

Ethical Considerations

1. How should politicians use scientific findings in making policy about human impacts on the environment?
2. How should society deal with observations about environmental problems based on refuted scientific findings?
3. Who should carry the responsibility for determining the regulation of agricultural practices that may cause the decline of wild animal populations?
4. Should governments err on the side of caution when some scientific data shows that certain human activities can damage the environment?

Civic Engagement & Service Opportunities

1. Volunteer for a local community group involved in protecting wildlife in your area.
2. Write or e-mail your local politicians about factors leading to declining wildlife in your area.
3. Form a student group having an environmental preservation mission.
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4. Set up a public forum at your school discussing any human activities in your area that may contribute to amphibian declines.

Learn more about community service as part of your educational enrichment by visiting the following websites: http://www.learnandserve.org/, http://www.servicelearning.org/, http://www.aahe.org/service/srv-links.htm.

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