WHERE HAVE ALL THE FROGS GONE?

Unit Overview

In this unit, we will examine the recent population declines of certain species of frogs and toads. We will also look at reasons for accelerated rates of deformities and even extinction among Amphibian species. This problem might possibly be an indication of additional problems yet to come which could affect other animal species including humans.

Where Have All the Frogs Gone?

Research May Solve the Puzzle

An entire species of golden toad, observed breeding on a Costa Rican mountainside, vanished two years after individuals from the species had been observed breeding on a Costa Rican mountainside, and has not been seen since. Frogs examined during a middle-school science outing in Minnesota are found to have astonishingly high rates of physical deformities. At least three species of amphibians have apparently vanished from their former range in Yosemite National Park. What is happening to amphibians? Why?

QuickTime What Are Amphibians? (02:01)

Why should we care about these dramatic declines, deformities, and disappearances plaguing many amphibian populations around the world?

Amphibians are good indicators of significant environmental changes. Amphibians, unlike people, breathe at least partly through their skin, which is constantly exposed to everything in their environment. Consequently, their bodies are much more sensitive to environmental factors such as disease, pollution, toxic chemicals, ultraviolet radiation, and habitat destruction. The worldwide occurrences of amphibian declines and deformities could be an early warning that some of our ecosystems— even seemingly pristine ones—are seriously out of balance.

What kinds of malformations have been noticed, and how widespread is the problem?

Multiple limbs, missing limbs, and facial abnormalities are the main developmental malformations seen. Malformed amphibians are now documented in 44 states, in 38 species of frogs and 19 species of toads, with estimates of deformities as high as 60 percent in some local populations. Scientists now agree that current numbers of reported malformations significantly exceed the normal statistical variation.

Where have amphibian declines been noted?

Scientists have documented four major "hot spots" for amphibian declines: western North America, Central America, northeast Australia, and Puerto Rico. Researchers believe that all of these declines, most in seemingly pristine areas, have occurred since around 1980. Other areas of the world may also be affected by such declines, but until research is conducted on other continents and in other regions, the extent of possible problems is unknown.

In the United States and its territories, major declines of frog populations have been noted in California, in the Rocky Mountains, in Puerto Rico, and in areas of the Southwest. Some of these declines have occurred in some of our nation's largest parks and wilderness areas, where we would expect wildlife to be most protected. Northern leopard frogs, for example, have disappeared or become rare over much of their known range in western North America. Boreal toads have undergone an 80 percent decline in the southern Rocky Mountains. In parts of the Sierra Nevada and adjacent foothills, several amphibian species— including mountain and foothill yellow-legged frogs and red-legged frogs—have declined over areas of 100 square miles or so. And in Puerto Rico, almost two-thirds of the native amphibians are declining; some species have not been found for several years.

Are there any worldwide patterns of amphibian declines?

The worldwide pattern of amphibian declines includes both loss of populations from parts of species' ranges, such as the pattern seen in Australia and Central American tropics with stream frogs. Also, noted have been declines of entire species, such as the Ranid frogs in California and the Southwest, and the "poster frogs" for amphibian declines, the golden toad in Costa Rica and an Australian frog that broods its young in its stomach.

How many amphibian species are there in the United States?

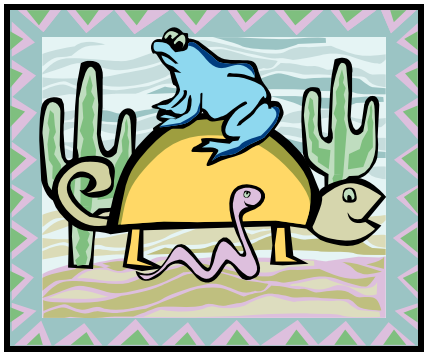
There are about 230 species of amphibians, including about 140 species of salamanders and 90 species of frogs and toads that occur in the continental United States. Amphibians have two major patterns of distribution: confined to one location, that is, endemic or widespread. Scientists estimate that the number of endemic species that have suffered losses has increased from 33 species in 1980 to 52 species in 1994.

QuickTime Salamanders (02:28)

What are the leading causes of frog declines and deformities?

There does not appear to be one "smoking gun cause," but numerous environmental factors are probably responsible for the declines and deformities. Limited research findings and anecdotal information suggest several possible causes, including habitat loss, introduction of non-native predators such as fishes and bullfrogs, disease, and possibly airborne contaminants. Scientists, who have studied amphibian declines and deformities, agree that the deformities are unlikely to have caused the extensive, well-documented declines of many amphibian species worldwide. Deformities in different localities probably have different causes. Recent USGS research indicates that some malformations may have both site-specific and time-dependent causes.

What is the United States doing about these issues?



The Department of the Interior has begun a nationwide program of amphibian monitoring, research, and conservation to ensure a sound scientific foundation for better informed decision-making on amphibian issues. At DOI's science bureau, the USGS has developed a framework for amphibian studies in cooperation with a network of federal and state agencies. The study will consider habitat loss and degradation, invasive species, contaminants, disease outbreaks, climate change and altered patterns of disturbance.

Where can I go for more information?

Click on the PDF File: Frog Web PDF File

Click on the following PDF File: Where Have All the Frogs Gone? PDF File

Fertilizers and Amphibian Deaths

All over the world, frogs, toads and newts seem to be under threat, some of them in polluted areas, and some of them in pristine environments. Pesticides, acid rain, predators, habitat destruction, pollutants, detergents and wetting agents, bacteria and fungi, increased ultraviolet radiation from the sun, are just some of the causes that have been suggested, but a report in the journal Environmental Toxicology and Chemistry points to yet another possible cause. The authors say they have discovered that a level of nitrogen-based compounds, low enough to meet EPA standards as safe for human drinking water, a level often found in agricultural areas as a result of using crop fertilizers, is enough to kill some species of amphibians.

The study showed that five species of amphibians, including the Oregon spotted frog, red-legged frog, western toad, Pacific tree frog and northwestern salamander, can be highly susceptible to fairly low levels of nitrate and nitrite exposure, especially in their more vulnerable tadpole stages. When exposed to only moderate amounts of nitrates and nitrites, some of the tadpoles, and also young frogs, swam less vigorously, showed signs of disequilibrium, developed physical abnormalities, suffered paralysis and eventually died. Others, in control tanks with normal water, survived quite happily.

In other words, nitrate and nitrite exposure at levels considered safe for humans or fish is able to inflict considerable damage on amphibians. Agriculture depends heavily on the use of artificial fertilizers, rich in nitrogen, to produce the world's food supply, and has done for more than a century. These fertilizers came originally from deposits in the Atacama Desert, and later from the Haber process. Much of the nitrate added to soil is leached down to the water table, and ends up in waterways, flowing down to the sea. More nitrate may come from natural sources.

The Oregon spotted frog has largely disappeared from most of its known historical range, which happens to be in an area of lowlands with intensive

agricultural use. In the study, three environmental levels of nitrates and nitrites were used, and the Oregon spotted frog was the most sensitive. Overall, it was three to four times more vulnerable to nitrates and nitrites than red-legged frogs and Pacific tree frogs, and they suggest that this could well account for its disappearance.

In just 15 days, nitrite levels considered safe for humans were high enough to kill over half of the exposed Oregon spotted frog tadpoles. All five species were affected by nitrite levels which were within the EPA "safe" limits for warm water fish. This is probably the key finding: nitrates themselves are relatively harmless, but reduced to nitrites, they cause health problems. Shore sites with high contents of organic matter are usually high in nitrites, as are other areas high in animal manure, while nitrate can also be reduced to nitrite in the gut, especially in younger animals.
In all probability, the decline of amphibians has happened for a number of reasons in different places, so that there is no one single cause. In some places, there may be a synergy operating, where two or three different effects, each relatively harmless, work together to take out a population.

The increased numbers of frogs with extra legs, for example, has been blamed on a trematode parasite, but this parasite has been around for a long time. Perhaps the nitrate and nitrite levels are interacting with the trematode in some way. After all, the trematode lives part of its life cycle in a snail, snails eat algae, and higher levels of nitrogen-based fertilizers can cause increased algae growth, increasing the snail populations.

So there is a logical chain to be studied here, to be teased out, and tested for flaws. But while scientists work to identify the cause or causes, the amphibians continue to drop away. We will have to wait to see who wins this potentially deadly race.

Amphibian deaths in the USA

Around the world, amphibians are dying off in large numbers, or suffering other problems. In some parts of the world, the deaths in Panama and Australia at least, seem to be caused by a chytrid fungus. The US Geological Survey (USGS) announced in early August that a little understood, emerging iridovirus disease associated with large die-offs of frogs and salamanders in the Midwest and the East has caused another recent die-off, this time in North Dakota.

A USGS wildlife pathologist D. Earl Green said in an Internet announcement that an iridovirus infection is the culprit in most of the deaths of the U.S. western tiger salamanders at the U.S. Fish and Wildlife Service's Cottonwood Lake Study Area near Jamestown, North Dakota. Wildlife health scientists at the USGS National Wildlife Health Center in Madison, Wisconsin, also are investigating numerous other amphibian die-offs that recently occurred or are continuing to occur in several locations across the United States. The die-offs, which involve multiple species of frogs, toads, salamanders and one species of newt, are occurring on private, state, and federal lands including several national parks.

As yet, it is not clear if some of the ongoing die-offs are related to recent local or regional amphibian declines across the United States, or if they are sustained long-term events that have only recently been discovered. It is clear that the die-offs are happening all over the world, so the findings of the USGS are potentially of global significance. However, at the same time, these mortality 'events' may be partly the result of increased surveillance of amphibian populations. Amphibian researchers and land managers worldwide, however, are concerned about the often severe and mostly unexplained declines of amphibian populations on many continents, including in remote and pristine areas.

Scientists are actively investigating hypotheses other than chytrid fungi and viruses that could help explain these worldwide declines, including increased exposure to ultraviolet radiation due to ozone thinning, the spread of nonnative predators, and contamination from pesticides and other chemicals, and rising temperatures. Many biologists suspect a combination of factors may be responsible.

At the Cottonwood Lake Study Area, in July 2000, when salamanders in a study area typically reach their yearly peak in numbers, researchers were able to trap only eight salamanders in the three traps they had set. In July 1999 in the same wetlands, the researchers had caught between 100 and 150 salamanders per trap. Records back to 1967 have never shown drops like this, and because the salamanders trapped this year also exhibit unusual skin abnormalities, USGS is conducting additional testing to rule out a concurrent infection or toxin.

USGS has identified iridovirus as the likely suspect in several other recent amphibian die-offs. In June 2000, USGS scientists isolated iridovirus from mink frogs found dead in Minnesota; from wood frogs, bullfrogs and spotted salamanders found dead in North Carolina; and from wood frog tadpoles and spotted salamanders found dead and dying at a Massachusetts site where several hundred to a thousand amphibians were reported to have died. For the second consecutive year, numerous frogs and salamanders at the Great Smoky Mountains National Park in Tennessee experienced a spring die-off associated with iridovirus.

Spraying cannot be entirely ruled out. It is now thought that the recent mysterious death of 95 per cent of the lobster population off the coast of New York could be a result of pesticides being sprayed in the surrounding area in an attempt to prevent another outbreak of West Nile virus.

While the world's naturalists have been fascinated by the loss of amphibian populations around the world, at the same time, reptiles are suffering similar losses of populations and whole species. However, it is difficult to notice the loss of reptiles unless they have shells

According to an article in the August 11th issue of the journal *BioScience*, the world's reptiles are in even greater distress than their better known cousins, the amphibians and the Chelonia. The Amphibia and the reptiles are collectively referred to as the herpetofauna, but the focus of general concern has been almost exclusively on amphibians. This needs to change and scientists hope that the general public will begin to recognize what they have long known, that reptiles all across the globe are affected by many of the same forces as the amphibians, but with even greater impact.

The problem has a number of aspects, but habitat loss and degradation may be the largest single factor in reptile loss. Even if an apparently endangered habitat such as a wetland is protected, all too often, the surrounding terrestrial habitat needed by semiaquatic reptiles is not given the same level of protection.

A major part of habitat degradation comes from introduced species: the Galapagos tortoise is now nearing extinction, due largely to introduced rats, which destroy the tortoise eggs. In Australia, cats and dogs, but particularly cats, both feral and domesticated, are major killers of skinks. The problem has been made worse by 'humane' cat owners who put bells on their cats to stop them from killing birds, forcing the cats to concentrate on reptiles instead.

In some parts of the world, the harvesting of reptiles for pets, food and for use in folk medicines can result in over-collection, and this affects reptiles more than amphibians. While this sort of use is not universally bad, harvesting should be 'sustainable,' which means the population from which individuals are harvested should be able to rebound to at least the same population level. In the case of some long-lived species, which may take years to reach maturity, this recovery is simply not happening.

Global climate changes may also present problems for reptiles, according to the Bioscience article. Some population declines have been noted for which a cause has not been identified. The biggest problem may be the clandestine nature of many reptiles and their large home ranges, which may allow a population to decline without anybody noticing. For the moment, scientists working on reptiles believe that it would be well to assume the worst, and work from there.

Now answer questions 1 through 25.