

# The Silence of the Frogs

Imagine a silent pond. No croaks, no peeps, no “ribbits,” no noisy frogs. If the number of amphibians like frogs continues to decline, you will not need to use your imagination. All ponds will be silent. Biologists have recently become aware of the gradual disappearance of frogs, toads, and salamanders, which seem to be dying at unprecedented rates. About 30% of North America’s frogs and toads are in trouble.

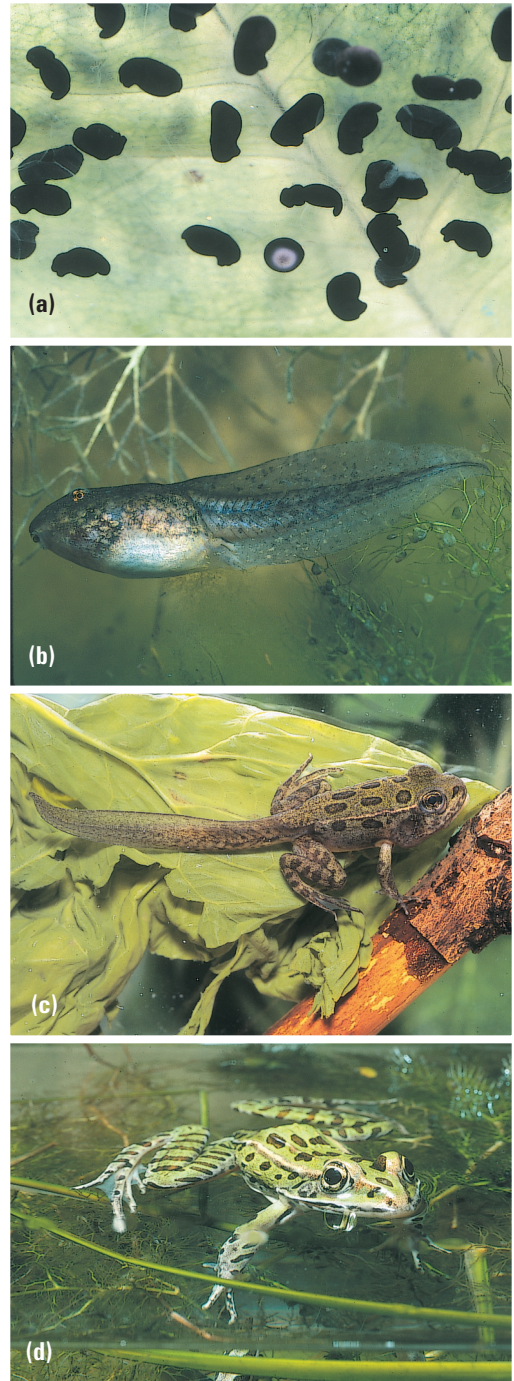
Amphibians have been around for more than 400 million years. When most animals and plants died out about 250 million years ago, amphibians survived. Frogs skipped right by the catastrophe that killed all the dinosaurs 65 million years ago. Frogs and their relatives have adapted to ice ages and extended periods of global warming without missing a beat. These timid amphibians can withstand drought, flood, and winter ice. They can be found in most ecosystems that include water. (**Ecosystem** is a term used to describe the relationships among the many species living in an environment and the relationships among those organisms and the non-living components of the environment.) Amphibians live on the peaks of the Canadian Rockies, in the city parks of Toronto, and in the swamps of Newfoundland. They have even done well dealing with the growth of the human population — at least until recently.

## Why Are Scientists Concerned?

Other than those who enjoy eating frogs’ legs, why would scientists care about amphibians? Many believe that the health of amphibians indicates the health of the ecosystems they live in.

The word amphibian is a clue as to why frogs and toads can be used to diagnose the health of ecosystems. The word comes from two Greek words, *amphi* (“on both sides”) and *bios* (“life”). Amphibians literally have two lives (**Figure 1**). Frogs begin as eggs and grow to tadpoles in ponds, and then enter their second life as adults in forest and grassland areas. This means they are exposed to hazards in both ecosystems, instead of only one. Any decline in the health of either of the two ecosystems in which they live will have an impact on frogs.

Not only do frogs occupy two different ecosystems, they are also parts of two very different food chains. A **food chain** is a step-by-step sequence linking organisms that feed on each other, starting with a food source such as plants (**producers**), and continuing with animals and other living things that feed on the plants and on each other (**consumers**).



**Figure 1**

The northern leopard frog, native to Ontario, is one of the threatened amphibian species. **(a)** Leopard frogs lay their eggs in ponds. **(b)** Tadpoles develop. **(c)** Tadpoles grow into immature frogs. **(d)** Adult leopard frogs live in fields and around ponds.

## Frogs in Their Ecosystems

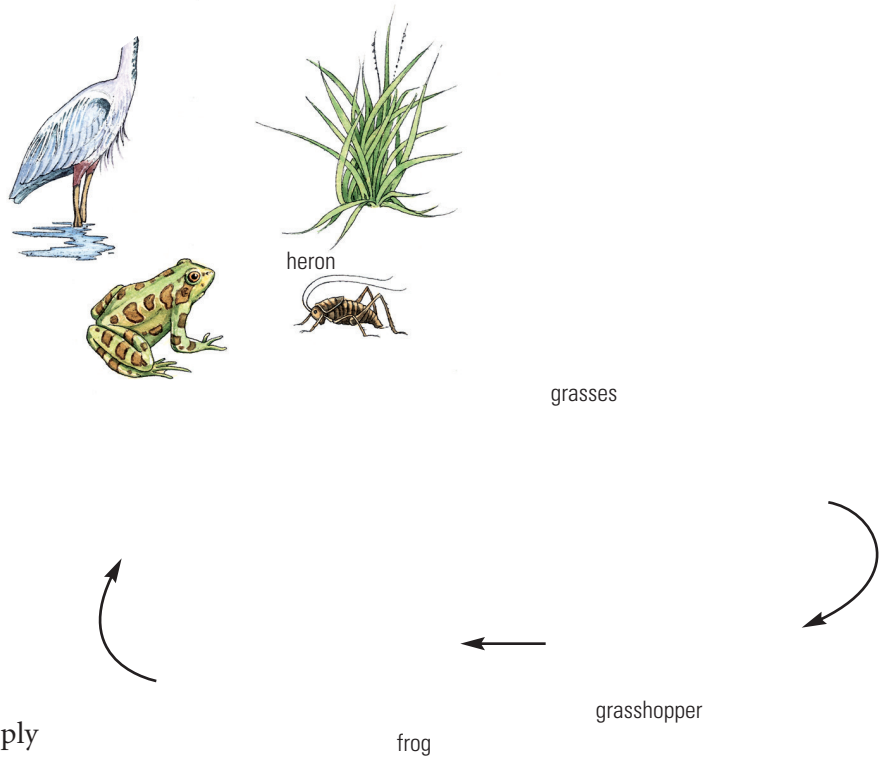
Adult frogs eat mostly insects, although they may also eat some small fish. In turn, large fish, predatory birds, reptiles, and small mammals eat frogs. This makes the adult frog a member of a food chain (Figure 2) that includes producers (plants), **herbivores** (animals that eat plants) and **carnivores** (animals, like the frog, that feed on other animals). Animals that eat both plants and animals, such as humans, raccoons, and bears, are called **omnivores**.

If frogs were completely wiped out, insect populations would most certainly soar. This has already happened in Bangladesh, where frog populations have been decimated to supply restaurants with delicacies. The result is a rise in the number of mosquitoes, and a dramatic rise in cases of malaria among humans. Malaria is a disease that is transmitted by mosquitoes, which are eaten by frogs. The increase in malaria can be traced back to the disappearance of frogs from the local ecosystems.

Tadpoles eat large amounts of algae (small plant-like organisms), both living and dead. The tadpole is a herbivore, not a carnivore, and is part of a much different food chain (Figure 3). In this food chain there are two food sources — producers (the algae) and **detritus** (waste from plants and animals, including their dead remains). Detritus food chains are critical in the recycling of matter in ecosystems. They include **decomposers**, organisms that break down detritus to get nutrients for their own use, but in the process also release nutrients to the soil and water. Plants and algae use those nutrients to grow.

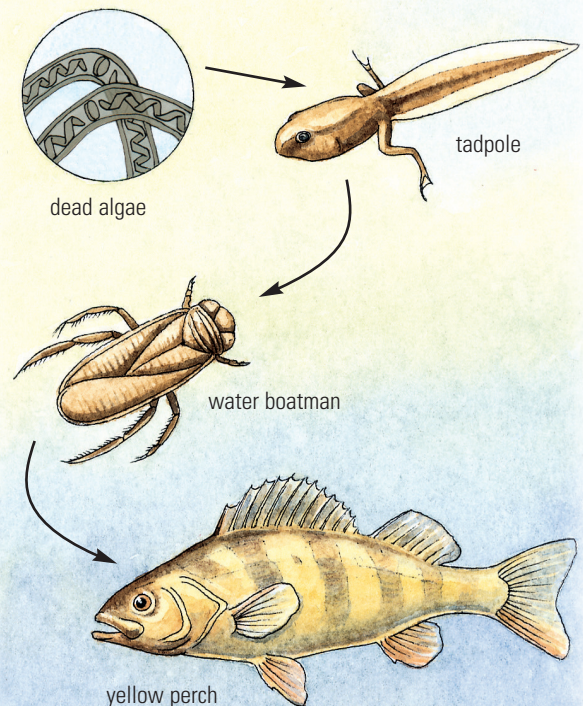
**Figure 3**

Waste is recycled within a detritus food chain. Organisms in the chain include fungi, bacteria, insects and other invertebrates, and, in ponds, tadpoles.



**Figure 2**

The adult frog is part of a food chain that includes producers (plants) that make the food and consumers (animals and fungi) that feed either directly or indirectly on the plants.



## Why Are Frogs Disappearing?

The worldwide disappearance of frogs is a bit of a puzzle. In some areas, scientists don't really know what is causing the problem. In other areas, they have identified some probable causes.

### Loss of Habitat

In Canada, frogs in more heavily populated areas, such as southern Ontario, seem to be in great danger. The loss of **habitat**, places where a species can live, is most often mentioned as the main cause. Frogs need wetlands, ponds, or lakes with clean water so they can breed and lay their eggs. As adults they need a place such as a forest or a field, where they can catch insects. They also need a safe path between the two. The growth of cities and other human activities, such as farming and industry, takes away all of these things. Humans drain wetlands, cut down trees, build on fields, and build roads between ponds and woods.

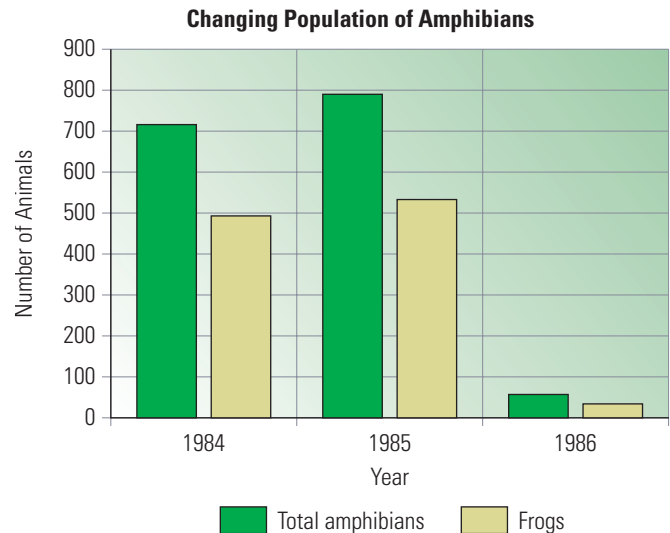
A highway separating a woodlot from a pond or lake can claim the lives of many frogs as they move between their feeding and breeding areas. Cutting down some of the trees that surround a lake creates problems for amphibians by exposing them to predators as they make their way between the water and the denser trees farther from the lake.

From 1984 to 1986 scientists studied an area where a swamp and a forest were separated by a road (Figure 4). When trees bordering the road were cut in 1986, researchers noticed a huge decline in the number of frogs and other amphibians.

### Air and Water Quality

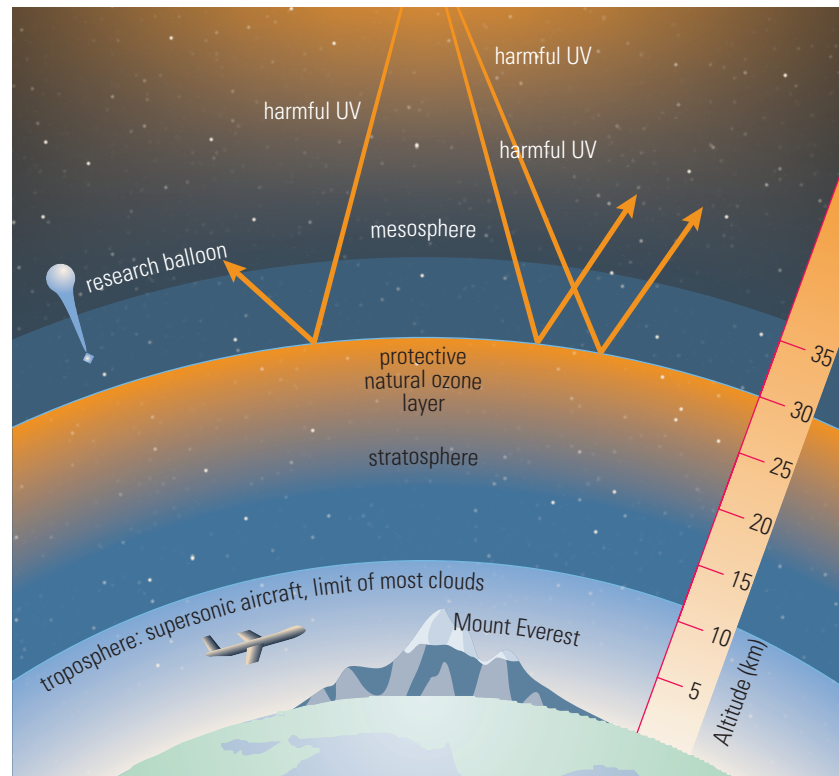
A second cause for the decline in frog numbers is pollution. This is because frog skin is thin and it is not protected by feathers, fur, or scales. Frogs have lungs, but they also breathe through their skin, which must be thin to allow oxygen through. Pollutants can also pass through their thin, moist skin. Acid rain, caused mostly by pollutants released by vehicles and industry, is just one example.

Acidity also affects frogs' ability to reproduce. Researchers have noted that if the water is even slightly acidic, it reduces the mobility of frog sperm cells. This makes it less likely that eggs will be fertilized. Even if



**Figure 4**

In the first year of the study, researchers counted 716 amphibians, of which 493 were frogs. After the trees were cut in 1986, they found very few.



**Figure 5**

A thin layer of ozone ( $O_3$ ) blocks harmful solar radiation. The layer is getting thinner. Atmospheric scientists believe that chlorofluorocarbons (CFCs), which were widely used in spray cans and refrigerators, are at least partly responsible for the thinning.

mating is successful, acid affects the frog's development. Embryos, if they develop at all, grow slowly in acidic water. In some locations, this means that the pond they are in will dry up before tadpoles can become adult frogs, and the tadpoles die. Acidic water can cause other problems. For example, embryos may develop deformed limbs. Tadpoles with such limbs do not survive for very long.

## Ultraviolet Radiation

The thin skin of the frog is also susceptible to ultraviolet (UV) radiation. This invisible radiation from the Sun causes sunburns, but it has also been linked with more serious cell damage. The amount of UV radiation reaching Earth's surface is increasing because of damage to the protective ozone layer surrounding our planet (Figure 5).

Frogs at higher altitudes, where the problem of UV is greater, seem to be the ones that are most endangered. Many highland species are used to dealing with UV radiation (they lay black eggs and have developed a black covering that lines their internal organs for protection), but biologists speculate that these adaptations cannot keep pace with changes in the ozone layer.

The frog is not the only animal whose skin is exposed to UV radiation. Humans also have a delicate skin and are affected by the increase in UV rays. The fact that the rate of human skin cancer is rising all over the world underscores the importance of studying the frog as a "bioindicator" of the health of the planet.

## Climate Change

Human activities that are causing a change in climate have also been linked to the disappearance of frogs. There is evidence of a global warming trend. One hypothesis links increasing global temperatures with the increased use of fossil fuels such as coal, oil, and gasoline. Climate changes can cause important changes in local ecosystems. For example, if the climate becomes drier, frogs will suffer. No frog can stay in the sun too long or completely separate itself from fresh water.

## Challenge

- 1,2 Frogs can be used as indicator species for the health of ecosystems. What other plants and animals could be used as indicators in your Challenge? Record your thoughts as you progress through this unit.

## Understanding Concepts

1. A decline in the number of frogs would affect other species. Using the term food chain, explain how the decline would affect
  - (a) insects
  - (b) algae
2. Classify each of the organisms in **Figures 2** and **3** as herbivore, carnivore, or omnivore. Explain your classifications.
3. In a paragraph, explain the difference between the two food chains to which the frog belongs. Explain the role of the frog in each chain.
4.
  - (a) Explain why the life cycle and skin of the frog make it a good indicator animal if you want to determine the health of local ecosystems.
  - (b) Construct a concept map that links the decline in the **Y** number of frogs to factors that may cause the decline.
  - (c) Choose one of the possible causes and, using your own words, explain how it affects frogs.

## Making Connections

5. Make a list of things that you could do, or avoid doing, that might help frogs to survive.

## Exploring

6.
  - (a) Design a scientific experiment that would assess the impact of acid rain on one species of frog.
  - (b) If you actually carried out such an experiment, what **K** would happen to the animals you experimented on? From an ethical perspective, discuss your experimental design.

## Reflecting

7. In question 5 you made a list of things you could do or avoid doing to help frogs. Identify the things that would be easy for you, and those that would demand sacrifices. Would you be willing to do the hard things to save frogs? Explain your answer.

## Work the Web

Research the disappearance of the northern cricket frog (*Acris crepitani*) from southwestern Ontario and produce a report. Visit [www.science.nelson.com](http://www.science.nelson.com) and follow the links from Science 10, 1.1 to help in your research.