Biodiversity

CHAPTER 10

READING WARM-UP

Before you read this chapter, take a few minutes to answer the following questions in your ***EcoLog.***

1. What are the main reasons that species are currently becoming extinct?
2. Do you think humans should try to prevent the loss of other species? Explain your reasons.

How many species are in this photo? Scientists know that this region of Central Texas is home to an unusual number of unique species. However, many more species remain unknown to science, both in faraway jungles and in our own backyards.

SECTION 1

What Is Biodiversity?

Every day, somewhere on Earth, a unique species of organism becomes *extinct* as the last member of that species dies—often because of human actions. Scientists are not sure how many species are becoming extinct or even how many species there are on Earth. How much extinction is natural? Can we—or should we—prevent extinctions? The study of biodiversity helps us think about these questions, but does not give us all the answers.

Objectives

- Describe the diversity of species types on Earth, relating the difference between known numbers and estimated numbers.
- List and describe three levels of biodiversity.
- Explain four ways in which biodiversity is important to ecosystems and humans.
- Analyze the potential value of a single species.

Key Terms

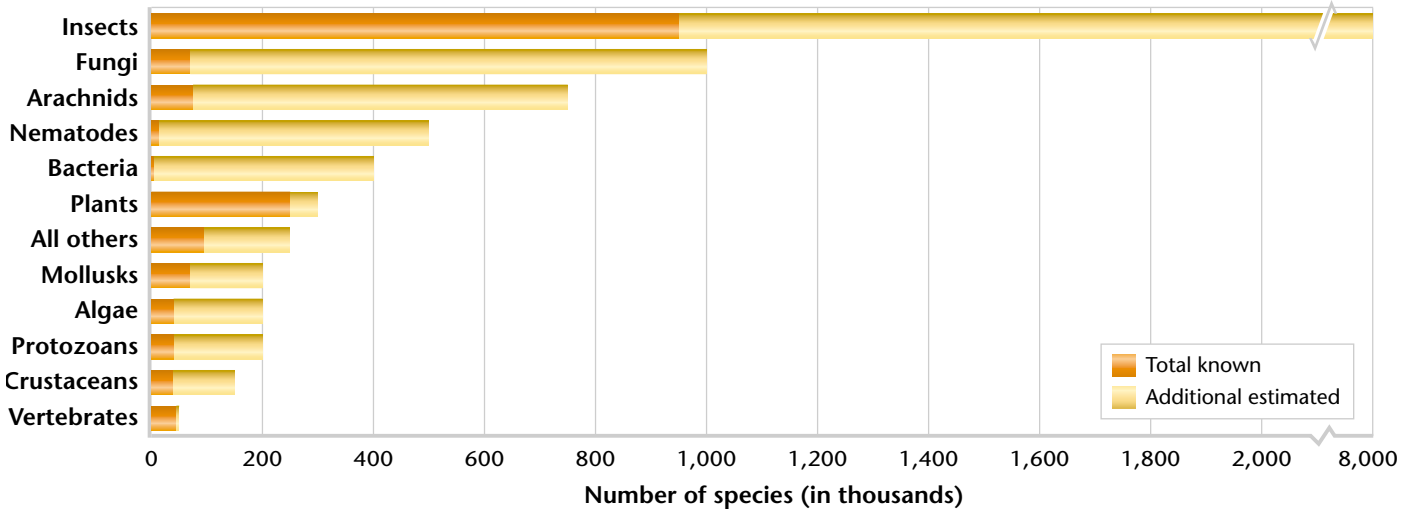
biodiversity
gene
keystone species
ecotourism

A World Rich in Biodiversity

The term **biodiversity,** short for "biological diversity," usually refers to the number and variety of different species in a given area. Certain areas of the planet, such as tropical rain forests, contain an extraordinary variety of species. The complex relationships between so many species are hard to study, but humans may need to understand and preserve biodiversity for our own survival.

Unknown Diversity The study of biodiversity starts with the unfinished task of cataloging all the species that exist on Earth. As shown in **Figure 1,** the number of species known to science is about 1.7 million, most of which are insects. However, the actual number of species on Earth is unknown. Most scientists agree that we have not studied Earth's species adequately, but they accept an estimate of greater than 10 million for the total number of species. New species are considered *known* when they are collected and described scientifically. Unknown species exist in remote wildernesses, deep in the oceans, and even in cities. Some types of species are harder to study and receive less attention than large, familiar species. For example, less is known about insects and fungi than is known about trees and mammals.

Figure 1 ▶ Number of Species on Earth About 1.7 million species on Earth are known to science. Many more species are *estimated* to exist, especially species of smaller organisms. Scientists continue to revise these estimates.



Source: World Conservation Monitoring Center.

Figure 2 ▶ Scientists continue to find and describe new species. Specimens may be stored in collections such as this one, with a small tag that says where and when the specimen was found.

Levels of Diversity Biodiversity can be studied and described at three levels. *Species diversity* refers to all the differences between populations of species, as well as between different species. This kind of diversity has received the most attention and is most often what is meant by *biodiversity*. *Ecosystem diversity* refers to the variety of habitats, communities, and ecological processes within and between ecosystems. *Genetic diversity* refers to all the different *genes* contained within all members of a population. A **gene** is a piece of DNA that codes for a specific trait that can be inherited by an organism's offspring.

Benefits of Biodiversity

Biodiversity can affect the stability of ecosystems and the sustainability of populations. In addition, there are many ways that humans clearly use and benefit from the variety of life-forms on Earth. Biodiversity may be more important than we realize.

Species Are Connected to Ecosystems We depend on healthy ecosystems to ensure a healthy biosphere that has balanced cycles of energy and nutrients. Species are part of these cycles. When scientists study any species closely, they find that it plays an important role in an ecosystem. Every species is probably either dependent on or depended upon by at least one other species in ways that are not always obvious. When one species disappears from an ecosystem, a strand in a food web is removed. How many threads can be pulled from the web before it collapses? We often do not know the answer until it is too late.

Some species are so clearly critical to the functioning of an ecosystem that they are called **keystone species.** One example of a keystone species is the sea otter. **Figure 3** shows how the loss of sea otter populations led to the loss of the kelp beds along the U.S. Pacific coast and how the recovery of otter populations led to the recovery of the kelp communities.

Figure 3 ▶ The sea otters of North America are an example of a keystone species, upon which a whole ecosystem depends.

❶ In the 1800s, sea otters were hunted for their fur. They disappeared from the Pacific coast of the U.S.

❷ Sea urchins, with no more predators, multiplied and ate all of the kelp. The kelp beds began to disappear from the area.

❸ In 1937, a small group of surviving otters was discovered. With protection and scientific efforts, the otter populations grew.

❹ The otters once again preyed on the sea urchins. The kelp beds regenerated.

Species and Population Survival The level of genetic diversity within populations is a critical factor in species survival. Genetic variation increases the chances that some members of a population may survive environmental pressures or changes. Small and isolated populations are less likely to survive such pressures. When a population shrinks, its genetic diversity decreases as though it is passing through a *bottleneck*, represented in **Figure 4.** Even if such a population is able to increase again, there will be inbreeding within a smaller variety of genes. Then, members of the population may become more likely to inherit genetic diseases.

Medical, Industrial, and Agricultural Uses People throughout history have used the variety of organisms on Earth for food, clothing, shelter, and medicine. About one quarter of the drugs prescribed in the United States are derived from plants. Almost all antibiotics are derived from chemicals found in fungi. **Table 1** lists some plants from which medicines are derived.

For some industries, undiscovered and poorly studied species represent a source of potential products. New chemicals and industrial materials may be developed from chemicals discovered in all kinds of species. The scientific community continues to find new uses for biological material and genetic diversity, from combating diseases to understanding the origins of life.

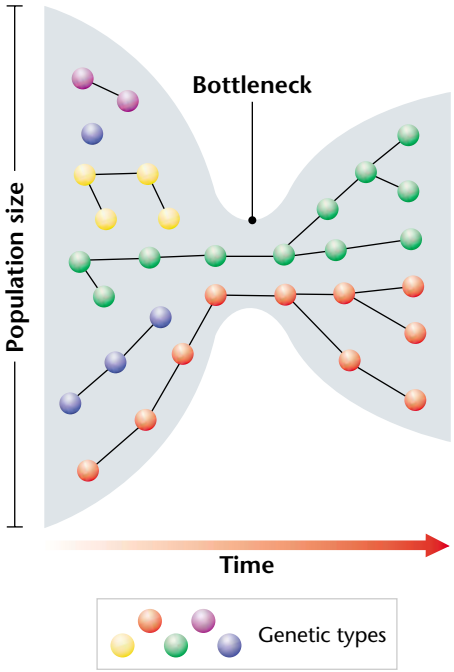


Figure 4 ▶ When a population is reduced to a few members, this creates a *bottleneck* of reduced genetic variation. Even if the population grows again, its chances of long-term survival are lower.

Table 1 ▼

Common Medicines Derived from Plants		
Medicine	**Origin**	**Use**
Neostigmine	calabar bean (Africa)	treatment of glaucoma and basis for synthetic insecticides
Turbocurarine	curare vine (South America)	surgical muscle relaxant; treatment of muscle disorders; and poison for arrow tips
Vincristine, vinblastine	rosy periwinkle (Madagascar)	treatment of pediatric leukemia and Hodgkin's disease
Bromelain	pineapple (South America)	treatment to control tissue inflammation
Taxol	Pacific yew (North America)	anticancer agent
Novacaine, cocaine	coca plant (South America)	local anesthetic and basis for many other anesthetics
Cortisone	wild yam (Central America)	hormone used in many drugs
L-dopa (levodopa)	velvet bean (tropical Asia)	treatment of Parkinson's disease
Reserpine	Indian snakeroot (Malaysia)	treatment to reduce high blood pressure

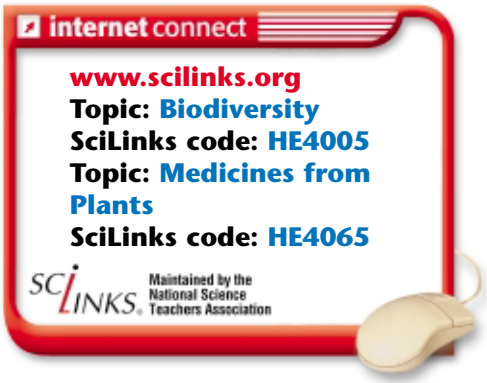


Figure 5 ▶ A produce market in Bolivia shows a diversity of native foods. Food crops that originated in the American tropics include corn, tomatoes, squash, and many types of beans and peppers.

Table 2 ▼

Origins of Some Foods
North America, Central America, and South America
• corn (maize), tomato, bean (pinto, green, and lima), peanut, potato, sweet potato, avocado, pumpkin, pineapple, cocoa, vanilla, and pepper (green, red, and chile)
Northeastern Africa, Central Asia, and Near East
• wheat (several types), sesame, chickpea, fig, lentil, carrot, pea, okra, date, walnut, coffee, cow, goat, pig, and sheep
India, East Asia, and Pacific Islands
• soybean, rice, banana, coconut, lemon, lime, orange, cucumber, eggplant, turnip, tea, black pepper, and chicken

Humans benefit from biodiversity every time they eat. Most of the crops produced around the world originated from a few areas of high biodiversity. Some examples of crop origins are shown in **Figure 5** and **Table 2.** Most new crop varieties are *hybrids*, crops developed by combining genetic material from other populations. History has shown that depending on too few plants for food is risky. For example, famines have resulted when an important crop was wiped out by disease. But some crops have been saved from diseases by being crossbred with wild plant relatives. In the future, new crop varieties may come from species not yet discovered.

Ethics, Aesthetics, and Recreation Some people believe that we should preserve biodiversity for ethical reasons. They believe that species and ecosystems have a right to exist whether or not they have any other value. To people of some cultures and religions, each organism on Earth is a gift with a higher purpose.

People also value biodiversity for aesthetic or personal enjoyment—keeping pets, camping, picking wildflowers, or watching wildlife. Some regions earn the majority of their income from **ecotourism,** a form of tourism that supports the conservation and sustainable development of ecologically unique areas.

SECTION 1 Review

1. **Describe** the general diversity of species on Earth in terms of relative numbers and types of organisms. Compare known numbers to estimates.
2. **Describe** the three levels of biodiversity. Which level is most commonly meant by *biodiversity?*
3. **Explain** how biodiversity is important to ecosystems, and give examples of how it is important to humans.

CRITICAL THINKING

4. **Analyzing a Viewpoint** Is it possible to put a price on a single species? Explain your answer.
5. **Predicting Consequences** What is your favorite type of organism? If this organism were to go extinct, how would you feel? What would you be willing to do to try to save it from extinction? Write a short essay describing your reaction. WRITING SKILLS