# Chapter 9

# Sustaining Biodiversity: The Species Approach

### Summary

1. Biologists estimate extinction rates in one of three levels. Local extinction occurs when a species in a specific area is lost but the species is still found in other places. Ecological extinction describes a species that is so small it cannot play out its ecological role where it is found. Biological extinction means that the species is gone from the earth. Scientists use measurement and models to estimate extinction rates: studying past records, identifying species-area relationships, examining lists of threatened species. Extinction rates are increasing because of human activities. Our growing population, degrading and eliminating biological environments and biological hot spots all contribute to growing extinction rates.

2. Biodiversity and species extinction are important because species provide enormous economic and ecological services we need to survive. In 100 years, mankind will destroy species that it would take five million years to rebuild. These species may provide genetic information, medicines, and information about natural processes we need to discover. These wild plants and animals are economic, recreational, and health resources.

3. Many human activities endanger wildlife, such as degradation/loss of habitat; capture of wild animals, which prevents their breeding; overfishing, oil spills, and exposure to pesticides; and extinction from nonnative species, which we introduce.

4. To prevent premature extinction of species, we must reduce threats from nonnative species; end illegal poaching and hunting; provide means for people to survive economically without killing native animals for food; maintain predator species, not destroy them; reduce greenhouse emissions and deforestation throughout the world; develop governmental policies to support biodiversity; and protect wild species in sanctuaries.

### Outline

* 1. **What role do humans play in the premature extinction of species?**

**CORE CASE STUDY**: Passenger pigeons were once one of the most numerous bird species on earth. Uncontrolled hunting and habitat loss led to their extinction by the year 1900. There have been five mass extinctions on earth, and it appears we are currently entering the sixth. Human activities, it is predicted, will lead to the premature extinction of one-fourth to one-half of plant and animal species.

A. Background extinction is an historic, continuous, low level of extinction.

B. Extinction rate is the percentage or number of species that go extinct each year.

C. Mass extinction is the loss of many species in a short period of time.

D. Local extinction occurs when a species disappears from one of many areas it once inhabited.

E. Ecological extinction: the number of individuals is so low that they cannot fulfill their ecological roles.

F. Biological extinction: a species has disappeared from the earth.

G. Human activities increase the pace of extinction.

 1. Current rate is 100—1,000 times the background rate (0.01–.1% per year).

 2. Extinction estimates are likely conservative.

 a. Rates will likely increase with the growing human population.

 b. Rates tend to be much higher in biodiversity hotspots.

 c. Habitat fragmentation limits the potential for speciation to occur.

H. Species heading toward biological extinction are either endangered or threatened.

1. Endangered species are so few in number that the species could soon become extinct.

2. Threatened/vulnerable: still abundant but likely to become endangered in the near future.

a. The World Conservation Union has kept *Red Lists* that are the world standard for listing all threatened species throughout the world.

 **SCIENCE FOCUS**: Estimating rates of extinction is problematic because extinction takes a long time, we are uncertain of how many species there are on earth, and we know little about the species that have been identified. There are several methods for estimating extinction rates, such as studying fossil records and rates of mutation, applying a species-area relationship to habitat destruction, and building mathematical models. Scientists acknowledge the shortcomings of estimates of extinction rates, but are certain that humans have caused an increase in the rate of extinction.

**9-2 Why should we care about preventing premature species extinction?**

 A. Wild species have instrumental value.

 1. Use values: Economic goods and services, ecotourism, and genetic information.

 a. Medicinal properties are found in many plants and some animals.

 b. Genetic information in species helps them adapt and produce new species. This information can be used to develop food and medicines for people. Wild species provide a bank of genetic information.

 c. Recreational value is provided by plants and animals.

 2. Non-use values: existence value and aesthetic value.

 B. Ecological value: each species is a vital component to ecosystem function.

 **SCIENCE FOCUS**: Poachers slaughter about 25,000 elephants per year for their ivory. Since 2007, scientists have used a DNA map of elephant populations to trace the origin of ivory sold on the black market. This helps them to identify regions where poaching is occurring so they can focus efforts on eliminating it.

 C. Intrinsic or existence value: species have an inherent right to exist, regardless of their utility to humans.

 1. Biophilia: belief that humans have an inherent genetic kinship with the natural world.

 a. Many people have a preference for natural scenes over urban environments.

 b. Some believe that certain organisms have more of a right to life than others.

 2. Biophobia: Fear of certain forms of wildlife.

 **SCIENCE FOCUS**: There are about 950 species of bats. They reproduce slowly and live in large colonies, which makes them vulnerable to extinction. Bats are important for controlling insect populations, pollinating crops, and distributing fruit and seeds. Currently one-fourth of bat species are listed as endangered or threatened.

* 1. **How do humans accelerate species extinction?**

 There are several causes of depletion and premature extinction of wild plants and animals. The acronym HIPPCO describes these causes.

A. The loss, degradation, and fragmentation of habitat are the greatest threat to a species.

1. Deforestation in tropical forests is the greatest species eliminator followed by loss of wetlands and plowing of grasslands.

2. Island species are especially vulnerable to extinction. Many are endemic.

3. Habitat islands are isolated and surrounded by other habitats.

4. Habitat fragmentation occurs when large contiguous habitats are divided into isolated patches.

 a. Certain species are more vulnerable to habitat fragmentation. These tend to be those that are rare, require a large range, or have low reproductive capacity.

**SCIENCE FOCUS**: Tropical forests are generally very diverse. As these forests are fragmented, there is growing concern over the loss of biodiversity. Research illustrates that within 100 meters of the edge of the fragment, up to 36 percent of the biomass of old-growth trees is lost in 10–17 years. This information can help scientists estimate how large a fragment must be to prevent the loss of biodiversity.

**CASE STUDY**: About 70% of the world’s bird species are declining in number, and about 12 % is threatened with extinction. The primary cause of decline is habitat loss and fragmentation. Birds are seen as indicator species, signaling environmental change in their habitats. Birds play a number of important economic and ecological roles. Their loss could trigger a cascade of extinctions.

**SCIENCE FOCUS**: Three species of vulture in India and South Asia were driven nearly to extinction in a few years beginning in the 1990s. The cause was poisoning from a pharmaceutical given to the cows they often fed on. The ecological ramifications of this population decline led to an increase in rabies amongst humans. The loss of vultures led to a greater food supply for wild dogs, and an increase in the number of dogs carrying rabies. Conservation biologists believe that the fates of wildlife and humans are often interconnected.

B. After habitat loss, introduced species are the biggest cause of extinction.

1. The alien species can be introduced accidentally or deliberately.

2. Some of these species threaten and endanger native species.

a. They have no natural predators, competitors, or pathogens in their new habitat.

b. They can trigger ecological disruptions.

c. There are an estimated 7,100 invasive species that have caused ecological or economic harm in the U.S.

**CASE STUDY**: The Kudzu Vine was deliberately introduced in the 1930s to control erosion, but got out of hand. It is prolific and difficult to control, engulfing hillsides, gardens, and trees, among other things.

1. Invasive species are often introduced accidentally.

 a. Argentine ants aggressively attack native ant populations.

4. The best control is to prevent the nonnative species from being introduced.

 C. Population growth, overconsumption, pollution, and climate change.

 1. Overpopulation and excessive consumption of resources eliminate habitat.

 2. Pollution from chemicals like pesticides can have unintended effects on species.

 3. Human activities induce rapid climate changes, increasing extinction rates.

 **CASE STUDY**: The populations of many vital pollinators are currently in decline. Honeybees, in particular, are important pollinators of commercially grown crops. Since the 1980s there has been a decline in bee populations, and in the last few years the situation has become more severe. Colony Collapse Disorder describes the sharp declines in some species of bees and could lead to agricultural collapse in the regions where the pollinators are lost.

 **CASE STUDY**: Polar bears are distributed in 19 populations across the polar arctic. They are dependent on the ice that expands every winter for their feeding behaviors. As the climate warms, their summer fasting period becomes longer. Also, ice shrinkage is forcing them to swim longer distances in search of food. According to the IUCN, polar bears may decline by 35% by mid-century, and may be confined only to zoos by the end of the century. The IUCN now lists polar bears as a threatened species.

 D. Poaching—illegal killing of protected species.

 1. Some protected species are killed for their valuable parts or are sold live to collectors.

 2. Earns smugglers $10 billion peryear.

 3. Low-risk, because smugglers are rarely caught and punished.

 4. The internet is the main tool in this trade, and education is the key to combating it.

E. Global legal and illegal trade in wild species for pets is a very profitable business.

1. More than 60 bird species, mostly parrots, are endangered or threatened because of the wild bird trade.

2. Amphibians, reptiles, mammals, and tropical fish are also being depleted because of pet trade.

3. Ex-poachers in Thailand are now making more money taking eco-tourists into the forest than they did by poaching hornbills. They also protect these birds from poachers.

4. Collecting exotic pets and plants (such as orchids and cacti) kill large numbers of them and endanger these species and others that depend on them.

F. Bushmeat supplies indigenous people with food and has been harvested sustainably, but as demand has gone up illegal hunting has skyrocketed.

1. There has been an eightfold increase in Africa’s population, increasing demand.

2. Logging roads allowed ranchers, miners, and settlers into areas once too remote/inaccessible.

3. These hunting practices have resulted in negative ecological impacts and have driven at least one species to extinction.

**9-4 How can we protect wild species from premature extinction?**

A. Treaties help protect endangered and threatened species, but enforcement is difficult and punishment inadequate.

B. The 1975 Convention on International Trade in Endangered Species (CITES) protects 900 species from being commercially traded and restricts international trade for 29,000 species that may become threatened.

1. Enforcement is difficult and varies from country to country.

2. Many countries are not signatories and still trade in animals.

3. The Convention on Biological Diversity (CBD) binds governments to reverse the global decline in biological biodiversity. The United States has not ratified this treaty. There are no severe penalties or other enforcement mechanisms in place.

**CASE STUDY**: The Endangered Species Act of 1973 (ESA) identifies and legally protects endangered species in the U.S. and abroad.

1. Identification of endangered, threatened ocean species is made by the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service is responsible for identifying and listing all other endangered and threatened species.

a. Biological facts form the basis of inclusion on the endangered list.

b. Habitats of endangered species must be protected.

2. Efforts have been made to repeal/weaken the Endangered Species Act by:

a. Some developers, timber companies, and other private landowners avoid government regulations and loss of economic value by managing land to reduce its use by endangered species.

b. Habitat conservation plans (HCPs) are designed to reach a compromise between interests of private landowners and endangered/threatened species.

c. The HCP allows destruction of some critical habitat or killing of a population if the developer or landowner takes steps to protect that species using a series of steps such as protecting critical nesting sites, setting aside part of the habitat as protected land, maintaining travel corridors, or moving the species to another suitable habitat.

 3. Conservation biologists believe that the ESA should be strengthened and modified to correct deficiencies.

 C. The sanctuary approach is being used to protect wild species.

 1. 547 federal refuges protect wildlife but the habitats are deteriorating due to invasive species, pollutants, and little operational or maintenance funding.

 2. More than three-fourths of the refuges are concentrated along major bird migration corridors.

 3. About one-fifth of U.S. endangered and threatened species have habitats in the refuge system.

 **SCIENCE FOCUS**: The Endangered Species Act is often criticized because only 37 species have been removed from it. Biologists claim that the ESA has not been a failure because species are only listed when they face serious danger of extinction, it takes years for a species to become endangered and a long time for them to recover as well, conditions for more than half the species are stable or improving, and the ESA operates on a small budget. Some recommended changes include a larger budget, more rapid development of recovery plans, and a provision calling for the immediate establishment of a core area of survival habitat.

D. Gene banks, botanical gardens, and farms can be used to raise threatened species and help protect species from extinction; but funding is inadequate.

E. The world’s 1600 Botanical Gardens and Arboreta contain almost one-third of the world’s known plant species, but only 3% of the world’s rare and threatened species.

F. Raising some threatened or endangered species on farms can take some of the pressure off them and perhaps offer some for commercial sale.

G. Zoos and aquariums can help protect some endangered animal species as well, but they are both notoriously underfunded.

1. Egg pulling collects wild eggs laid by endangered bird species and hatches them in zoos/research centers.

2. Captive breeding takes wild individuals into captivity for breeding with the commitment to reintroduce the offspring back into the wild.

3. Artificial insemination, use of surrogate mothers, use of incubators, and cross-fostering by a similar species are other ways to increase populations of rare species.

4. The ultimate goal is to reintroduce these species into the wild.

 5. Reintroductions of endangered species to the wild fail because:

 a. There is not suitable habitat.

 b. Individuals bred in captivity are not able to survive in the wild.

 c. There is renewed overhunting/capture of the returned species.

**CASE STUDY**: The California Condor was nearly extinct, with only 22 birds in the wild. The remaining birds were captured and bred in captivity. As of 2007, there were 135 birds in the wild. A major threat remains from lead used in ammunition. When the birds eat carcasses, lead poisoning can make them very weak.

H. Precautionary Principle: When substantial preliminary evidence indicates that an activity can harm human health or the environment, we should take precautionary measures to reduce or prevent such harm.

### Objectives

1. Describe the economic, medical, scientific, ecological, and aesthetic, recreational, and ethical significance of wild species. Define *biophilia.* Summarize your position toward protection of different species.

2. Describe the general process of extinction. Compare past extinctions to present extinctions. Start with E. O. Wilson's estimates for habitat destruction and loss of biodiversity. Calculate a range of estimations of biodiversity loss based on high and low assumptions.

3. Distinguish among *local extinction, ecological extinction,* and *biological extinction.* Distinguish between threatened and endangered species. List nine characteristics that make species extinction prone.

4. List three root causes of extinction of wildlife. List eight human activities that directly increase the wildlife extinction rate. Summarize the condition of the world's fisheries and the causes of those conditions.

5. Explain how bioinformatics is being used to help protect wild species.

6. State and briefly describe the most far-reaching international treaty to protect wildlife. List four strategies that have been used recently to weaken the Endangered Species Act. List three recommendations for strengthening the Endangered Species Act. State three guidelines that conservation biologists would use to determine "priority species."

7. Assess the advantages and disadvantages of using wildlife refuges, gene banks, botanical gardens, and zoos to protect wildlife.

8. Describe how wildlife populations can be managed by manipulating the successional stage of the habitat and by sport hunting. Evaluate whose interests are generally the most influential in determining wildlife management priorities.

9. Describe freshwater and marine fishery management and how it can be improved. Analyze the lessons to be learned from the decline of the whaling industry.

### Key Terms

**endangered species** (p. 186)

**HIPPCO** (p. 193)

**threatened** (**vulnerable**) **species** (p. 186)