

Extinction in the Modern World

In the 1850s, flocks of passenger pigeons (Figure 1) would darken the sky as they migrated south for the winter. Alexander Wilson, a scientist who studied birds, once saw a flock that he estimated contained nearly 2 billion birds. By 1914, there wasn't a single passenger pigeon anywhere on Earth. The species was extinct.

How could such a successful species suddenly become extinct? Massive commercial hunting and the clearing of forests, which destroyed habitat and food for the pigeons, were both part of the reason. Passenger pigeons were curious animals, and easy to kill. A common practice was to tie a captured bird to a perch. As other pigeons flew by during their migration, they would stop to see what was going on. When a flock landed, they were slaughtered. The perch was known as a “stool,” and the practice has given us the name “stool pigeon.”



Figure 1

The extinction of the passenger pigeon is just one example of the growing influence of humans.

Humans and the Rate of Extinction

The extinction of the passenger pigeon was sudden, but it is not an isolated event. Humans, a recent addition to the planet, have had a profound effect on other organisms. Species extinction rates are increasing dramatically as the human population grows. Between 8000 B.C. and A.D. 1600 the species extinction rate is estimated at one species every 1000 years. Between 1600 and 1900 the estimate is that one species went extinct every four years. In modern times, the rate is soaring (Figure 2). In the early years of the 21st century, the projection is that one species will become extinct every 30 minutes. Although the majority of threatened species can be found in tropical rainforests, the problem also exists in Canada. The number of species at risk of extinction is growing, at the rate of about 80 species per year.

Estimated Extinction Rate

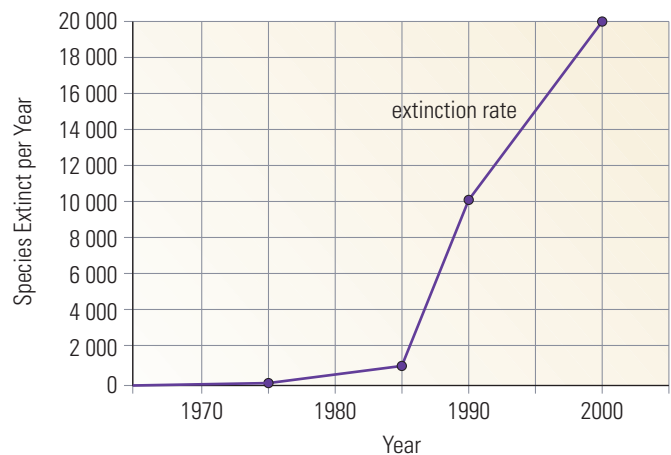


Figure 2

The rate of extinction is increasing rapidly. Human activities are the major cause.

A Brief History of Extinction

The history of our planet, recorded in rocks and fossils, reveals several large-scale disasters that have destroyed huge numbers of species (Figure 3). Approximately 438 million years ago the first mass extinction of marine organisms took place. Another mass extinction of marine organisms happened nearly 360 million years ago. Possibly the largest mass extinction occurred about 245 million years ago. That catastrophe, in which about 80% of all species perished, was followed by another mass extinction 208 million years ago. This event marked the beginning of the age of dinosaurs. It may well have removed the competition, ensuring the success of the early reptiles, which were then no larger than a small dog. The most famous mass extinction, even though it was not as disastrous as

some of the earlier ones, happened about 65 million years ago, and it marked the end of the age of dinosaurs.

Mass extinctions occurred before humans existed, but scientists believe the causes were much different from those of the modern era. The most promising theories involve asteroids crashing into Earth (Figure 4). A collision would raise tremendous amounts of dust, blocking light from the Sun, and set off many volcanoes, quickly altering environmental conditions. There is evidence that an asteroid hit Earth about 65 million years ago. The crater, just off the Yucatan Peninsula of Mexico, is 9.6 km deep and 300 km wide.

Other Causes of Extinction

It is estimated that nearly 500 million different species have inhabited the planet. Of these, more than 90% have either become extinct or have evolved into new species. The mass extinctions, probably caused by single catastrophes, are not the only reasons for these losses.

Climate changes and the pressure of competition from other species force organisms to adapt or die. If a new species enters an area, species that eat the same food must compete with it. A species that is better at finding food, reproducing, or defending its territory could force competing species into extinction. If one species disappears, even if only from part of its range, it can affect other species that rely on it for food.

Over the long term, hundreds of millions of years, all species eventually encounter conditions to which they cannot adapt, and they become extinct.

In modern times, however, human activities are the major causes of extinction.

The Banff longnose dace (Figure 5), a small minnow, was recently declared extinct. It was unable to compete with the guppies, swordtails, and other tropical fish released accidentally into warm marsh waters below the hot springs in Banff National Park.



Figure 4
This large circular lake in Manicouagan, Quebec, is actually a crater formed when an object from space collided with Earth.

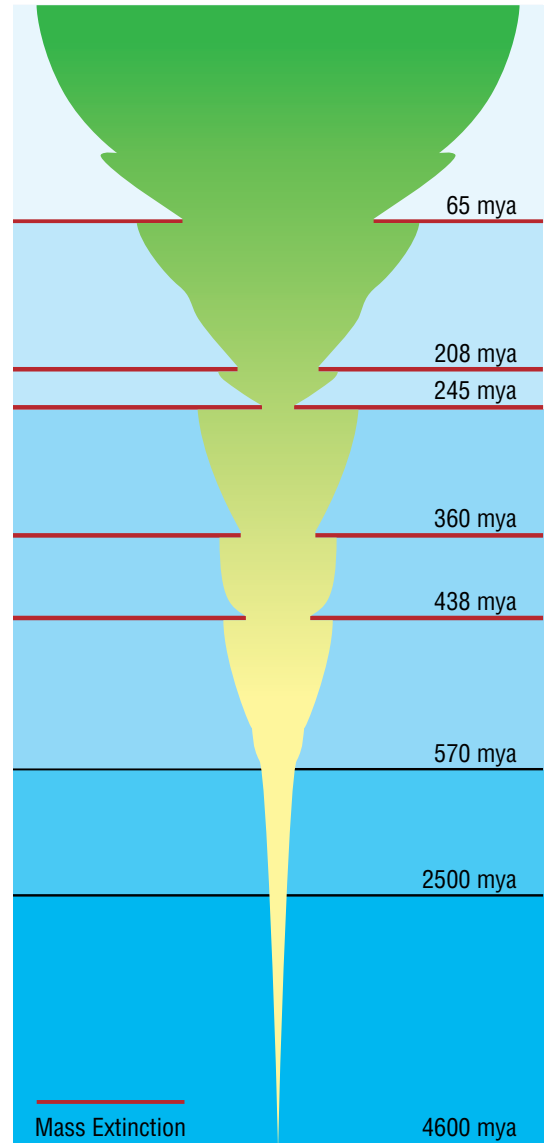


Figure 3
Fossil evidence shows that many species suddenly disappeared in several episodes over the last 500 million years.



Figure 5
The Banff longnose dace lost a competition with exotic fish.

In Canada's Arctic, climate change has been blamed for the demise of the Peary caribou (Figure 6). Changes in snow cover, caused by global warming, have caused changes in local plant communities. Lichens and mosses, the preferred food of the caribou, are being replaced by plants that previously grew farther south.

In fir, pine, and spruce forests from British Columbia to Newfoundland, logging, oil exploration, and expanding cities have reduced the size of ecosystems, endangering forest-dwelling species such as spotted owls, woodland bison, and woodland caribou.

The expansion of agriculture has also been identified as a major contributing factor in extinction. The decline of the monarch butterfly has been linked to the use of herbicides used to control milkweed, the monarch caterpillar's only source of food.

The burrowing owl (Figure 7), which lives on the prairies, is threatened because the burrows it nests in have been plowed under and rodents, its food, have been exterminated.

Effects of Extinction

The number of species in an ecosystem is described as the biological diversity or **biodiversity** of the ecosystem. Because every organism in an ecosystem is connected to all the other organisms, the reduction in biodiversity caused by the extinction of a single species can cause a "domino effect." The removal of one part from an ecosystem, like the removal of a moving part from a car, can cause the collapse of an entire food chain. When the threatened species acts as a predator, it keeps the population of its prey in check; when it acts as prey, it provides an important food source.

For example, overhunting of sea otters (Figure 8) along the Pacific coasts of Asia and North America removed the main predator of the sea urchin. Predictably, the number of sea urchins grew rapidly. Sea urchins eat kelp, a form of seaweed. As the number of sea urchins grew, the amount of kelp declined, and so did the fish that relied on the kelp bed ecosystem for habitat and food.

Sea otters very nearly became extinct due to hunting pressure. From the point of view of humans, killing sea otters for their fur resulted in the decline of a valuable fishery. Where the sea otter has been reintroduced, sea urchin populations have fallen, kelp beds are being re-established, and the number of fish is increasing.

Restoring the Balance

The reintroduction of the sea otter to the Pacific northwest is an example of an attempt to restore a natural balance. It is not always easy to do.

The whooping crane (Figure 9) may be a success story — or it may not. In spring, whooping cranes fly north to live in the marshes and swamps of the prairies and the Canadian north, where they eat crayfish, fish, small mammals, insects, roots, and berries. Efforts by Canadian and U.S. conservationists over the past three decades have helped increase the population from a low of 14 individuals in 1940 to 183 in 1999. Chemical pesticides were the original human threat to the crane, but it was already



Figure 6

The Peary caribou was a victim of climate change.



Figure 7

The burrowing owl is at risk of extinction due to pressures created by agricultural practices.

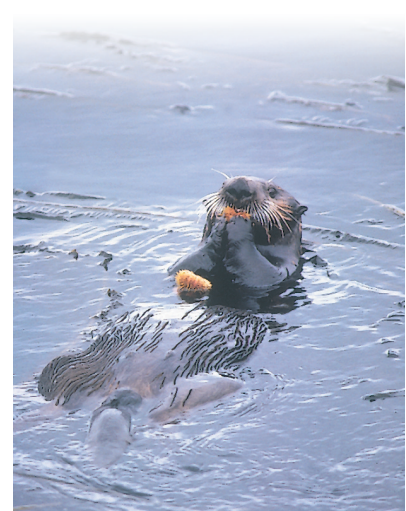


Figure 8

A sea otter eats a sea urchin. The removal of the sea otter caused a major change in the ocean ecosystems of the Pacific coast.



Figure 9

The efforts of wildlife biologists are preventing the whooping crane from becoming extinct. Some young birds are being hand-raised but, to prevent the chicks from associating humans with safety, the caregivers disguise themselves as adult cranes!

struggling. Cranes must fly a long way between their summer homes in the north and their winter homes on the Gulf of Mexico. Along the way they are vulnerable to hunting and accidents. In addition, the whooping crane reproduces very slowly. Each year females produce two eggs; however, only one will mature. The first fledgling to emerge from its egg kills its brother or sister. This ensures there will be enough food for the survivor, but it also means that once the number of whooping cranes is small, it is very difficult for the species to increase its numbers.

We do not fully understand all the relationships between species in many ecosystems, so we cannot predict reliably what will happen to an ecosystem if its biodiversity is reduced, even by one species. Allowing or forcing just one species to become extinct could possibly be disastrous, and we would not know the extent of the disaster until later.

Challenge

- 1 Why would a golf course have less biodiversity than a natural ecosystem? How might the lower biodiversity affect surrounding ecosystems?

Understanding Concepts

1. (a) Explain why the passenger pigeon became extinct.
(b) Speculate about which animals might benefit if the passenger pigeon had not become extinct.
(c) Compare the extinction of the passenger pigeon to the near extinction of the sea otter.
2. Explain how each of the following factors could lead to the extinction of a species. With each explanation include an example of a threatened species.
 - (a) Poor reproductive success
 - (b) Competition from a species newly introduced into an ecosystem
 - (c) Change in climate
 - (d) Hunting by humans
3. (a) In your own words define the term “biodiversity.”
(b) Explain why diversity is important for ecosystems.
(c) Give two examples of ecosystems that have high biodiversity, and two that have low biodiversity. Explain your classification.

Making Connections

4. The common cockroach is not at risk of extinction. In fact, it is one of the species that have benefited from human activities.
 - (a) Hypothesize about which human activities benefit the cockroach.
 - (b) If a chemical company invented a spray that could kill all cockroaches, would it be acceptable to use the spray to make the cockroach extinct? Explain your position in a letter to the chemical company.

Exploring

5. The passenger pigeon is not the only bird that has become extinct due to human hunting. Research and prepare a report on the great auk or the dodo.

Work the Web

Canadian wildlife biologists have been attempting to preserve the whooping crane. Are they succeeding? In a short essay, evaluate the success of their program. To research the whooping crane program, visit www.science.nelson.com and follow the links from Science 10, 1.3.