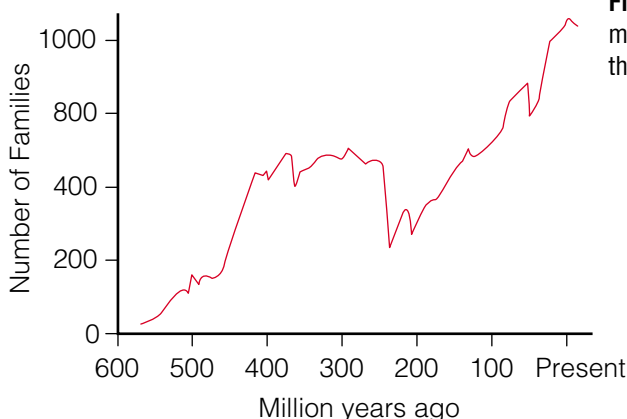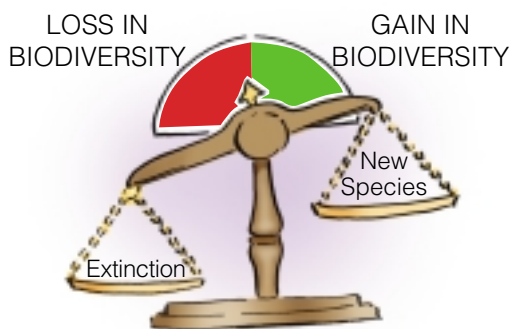# The Sixth Extinction?

Figure 1.58 There have been five major declines in Earth's biodiversity in the past. Has another decline begun?

In the last 600 million years there have been five major declines in Earth's biodiversity. Even so, for the last 65 million years the rate at which new species were formed has been greater than the rate of extinction. Many scientists agree that the rate of extinction has been about one species per year over the history of life on the planet. Today that rate may be closer to 70 extinctions per *day*! As the rate of extinction increases, the scales are tipped toward an overall trend of decreasing biodiversity.
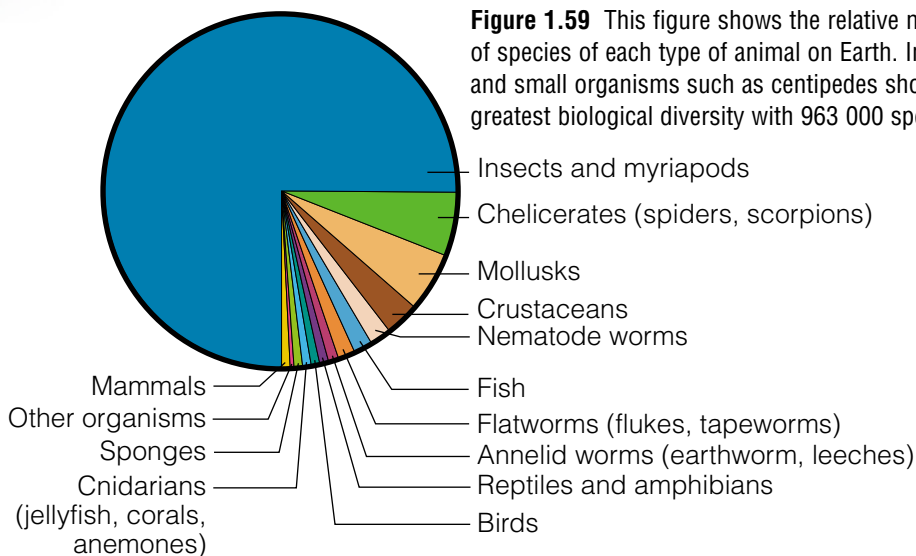

LOSS IN BIODIVERSITY   GAIN IN BIODIVERSITY
New Species
Extinction

Figure 1.59 This figure shows the relative numbers of species of each type of animal on Earth. Insects and small organisms such as centipedes show the greatest biological diversity with 963 000 species!

Insects and myriapods
Chelicerates (spiders, scorpions)
Mollusks
Crustaceans
Nematode worms
Fish
Flatworms (flukes, tapeworms)
Annelid worms (earthworm, leeches)
Reptiles and amphibians
Birds

Mammals
Other organisms
Sponges
Cnidarians
(jellyfish, corals, anemones)

Word CONNECT

The sao la, or *Pseudoryx nghetinhensis,* is a newly discovered mammal species. It lives in a forested region on the border of Laos and Vietnam. This shy relative of goats and cattle was unknown to Western scientists until the 1990s. However, locals are very familiar with the sao la. The sao la looks like an oryx, although these animals are unrelated. Write a note explaining why you think the sao la was given the scientific name *Pseudoryx.*

DidYouKnow?

Sixty-five million years ago dinosaurs dominated Earth. Evidence from fossils points to a complex world with many different life forms. Scientists continue to debate the cause of the dinosaurs' abrupt extinction, but the current "best guess" is that a large meteorite hit Earth off the coast of the Yucatán peninsula, Mexico. The resulting explosion hurled a massive amount of debris into the atmosphere, blocking the rays of the Sun. Without light, photosynthesis came to a halt and food chains collapsed. Other theories involve massive volcanoes or periodic changes in the world's climate. Some scientists think that the extinctions were not caused by a single event but occurred over a period of time.

These scientists are studying one of Earth's biodiversity "hot spots," a tropical rain forest. There are a number of ways to measure the biological diversity of an area. In one method, a smoke bomb is used to get a sample of the insects present in the forest canopy. A biodegradable insecticide is sprayed into the upper tree canopy and the affected insects fall into plastic sheets set out below.

When scientists used this technique in the rain forests of Peru, they obtained over 43 species of ants from one application of insecticide and only one tree! This is equal to the entire ant fauna of the British Isles! Using this method, scientists have also estimated that 1 ha of Panamanian rain forest may have over 18 000 species of beetles, most of which were previously unknown to science. To date only 24 000 beetle species have been identified in all of Canada and the United States.

Human Impacts on Biodiversity

Some areas of the world support greater biological diversity than others. Heat, light, and rainfall promote the growth of plants, which leads to more complex food chains and greater biodiversity. This trend can be seen in Figure 1.60. However, the trend is not consistent. What other factors influence biological diversity?
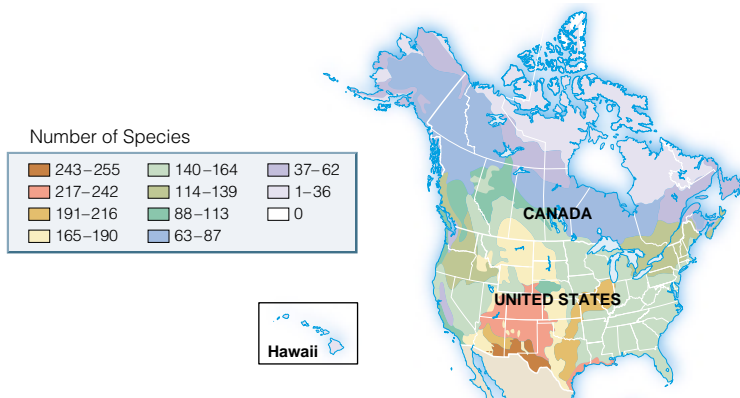
Number of Species

243–255	140–164	37–62
217–242	114–139	1–36
191–216	88–113	0
165–190	63–87	

CANADA

UNITED STATES

Hawaii

Figure 1.60 This map shows the distribution of the diversity of butterflies across Canada and the United States.
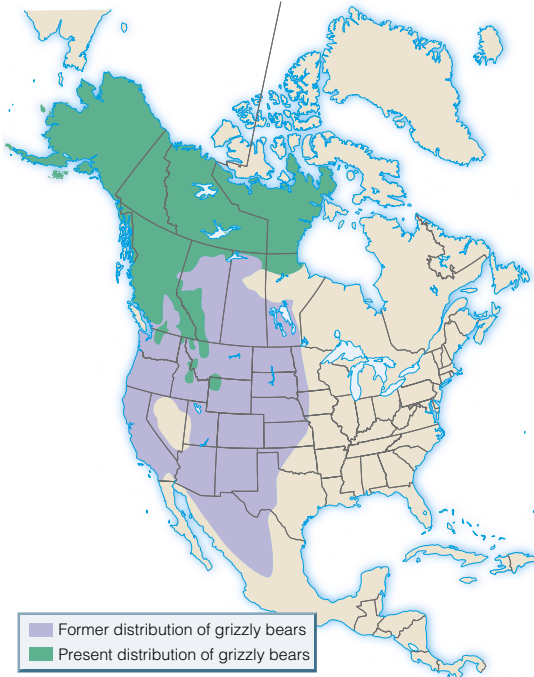
Pause & Reflect

Over time, climates change and natural disasters occur. The complex interactions between plants, animals, and their changing environments result in successful and unsuccessful species. Natural selection chooses "winners," which have adapted. As for the others, scientists estimate that 99% of all species in the history of Earth no longer exist. Today, changes in the environment caused by human activity occur so rapidly that many species do not have time to evolve and adapt. What are some changes that certain species may have trouble adapting to? Write your thoughts in your Science Log.

Did You Know?

Arctic animals such as the caribou are threatened by increasing temperatures in the region. As it becomes warmer, the caribou migrate farther north. Many scientists believe that increasing greenhouse gas concentrations from human activities are causing the warmer temperatures.

INVESTIGATION 1-K
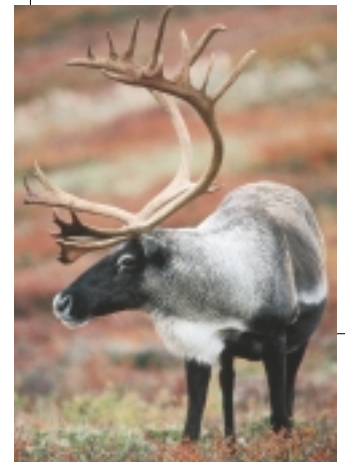
Where Have the Grizzlies Gone?

Former distribution of grizzly bears
Present distribution of grizzly bears

Think About It

Just 150 years ago, between 50 000 and 100 000 grizzly bears roamed western North America, from the grasslands of Saskatchewan to the coast of the Pacific Ocean and as far south as Mexico. Today, grizzlies occupy less than 2% of their original range. The disappearance of the grizzly from all of Mexico and most of the United States is an example of **extirpation**, the extinction of a species in certain locales. As settlers moved from east to west, the bear disappeared. Although many grizzly bears were killed by hunters, the reasons for the bear's rapid decline are complex. In Alberta, prior to European settlers, there were probably 6000 grizzlies spread across the province. As of 1990, there were an estimated 200 grizzly bears in the national parks and 600 on other provincial lands.

What to Do

With a partner, examine the map, and brainstorm some possible reasons to explain why grizzly bear populations have decreased.

Analyze

1. In parts of Canada and the United States it is still possible to get a licence to hunt grizzly bears. Hunters will pay $10 000 or more just for the possibility of shooting one of these bears. What are some of the reasons that grizzly bears continue to be hunted?

2. How might farming and ranching affect grizzly bear populations? (Keep in mind that grizzlies need large tracts of wilderness.) How would farmers be affected if grizzly populations increased?

3. Are there any "islands" of isolated populations of grizzlies at present? What are some possible problems for such isolated populations?

4. What do you think are some measures that could be taken to protect grizzly bears?

Extension

5. Some people feel that grizzly bears should be removed from areas where they might interfere with people's enjoyment of the wilderness. Argue for or against this statement.

Disappearing Habitats

Many people feel that the grizzly bear is a **bioindicator species**. The ability of this large carnivore to survive in an area is a measurement of human impact on the environment. Historically, one of the first effects of human interference in an ecosystem is loss of the large carnivores such as bears and wolves. Like the grizzly bear's range, that of the wolf, cougar, and wolverine have also shrunk. For this reason many people believe that the preservation of these animals goes hand in hand with the preservation of their habitats.

Figure 1.61 The range of the wolverine has shrunk significantly over time. In 1999, there were thought to be fewer than 1000 breeding wolverines in Alberta. Wolverines live in wild and remote areas and avoid human settlements.

Human Impact on Rain Forest Ecosystems

Our global population is increasing faster than ever before. New methods of farming to produce more food and better ways of preventing and treating diseases have reduced infant deaths and allowed people to live longer in many countries. The result is a larger human population that has put increased demands on the environment. In place of natural habitats, more land is being cleared for farming. The call for housing and consumer products has produced an increase in logging and mining. Altogether, these human activities have also contributed to increasing pollution.

Figure 1.62 How large a supply of materials and energy would a city such as Vancouver, British Columbia use daily? How much waste would it produce?

Math CONNECT

Tropical rain forests are being cut down at a rate of about 1% per year. Assuming this rate remains constant, if a given rain forest were 2050 km^2, how long would it take for the forest to be cut down completely?

Pause & Reflect

If global temperatures were to rise high enough to turn lush, tropical regions into dry regions, how do you think local wildlife would be affected? Record your thoughts in your Science Log.

How High Can It Go?

How fast is the global human population increasing?

Procedure • Performing and Recording

Draw a line graph showing the change in the human population over time using the data from the chart. Be sure to include a title and label both the horizontal (year) and vertical (population) axes.

Analyze • Analyzing and Interpreting

1. What relationship between time and population is illustrated by your graph?

2. How can you determine what the population will be in the year 2050?

3. What factors would cause this estimate to be too low? Too high?

Year	Population (in millions)
5000 B.C.E.	50
800 B.C.E.	100
200 B.C.E.	200
1200	400
1700	800
1900	1600
1965	3200
1990	5300
2002	6100
2050	?

Skill
F O C U S

For tips on extrapolating data from graphs, turn to Skill Focus 10.

Figure 1.63 This tropical rainforest is being cleared for agriculture.

Pause&
Reflect

Is the rate of population growth in Canada increasing, decreasing, or staying the same? Do Canadians have an impact on what happens to biodiversity in other countries? From where do Canadians get their pineapple and coffee? Record your thoughts on these questions in your Science Log.

The Population Explosion

The impact of population growth is not shared equally. Developing nations are often hardest hit by the population explosion, and it is in these regions that biological diversity is the most threatened. Areas in tropical rain forests are often cleared to make small farms. Some trees are used for firewood, an inexpensive source of fuel for local people. Land is also cleared to make way for cattle ranches or large pineapple or coffee plantations. The loss of even a single area of rain forest can mean the extinction of specialist organisms that depend on the forest for food or protection. The destruction of the rain forests is made more difficult to repair because the forest soil has few nutrients. In general, the nutrients accumulate in the fast-growing plants. This means that farms and plantations are usually successful for only a very short time. The lack of soil nutrients also prevents regrowth of the forest. At least for the foreseeable future, the damage already done to the rain forests is permanent. Many species have already been lost.

DidYou**Know**?

Orangutans are tree-dwelling primates that live in the rain forests of Sumatra and Borneo. These fascinating animals are endangered and face a number of threats, such as the destruction of their habitat. Hunting and trapping have also reduced their numbers.

The Suffield Horses

Think About It

The National Wildlife Area at the Canadian Forces Base Suffield is home to numerous native species of plants and animals, some of which are endangered. Last century, feral horses also inhabited the Suffield prairie grasslands. The horses were a unique breed, descended from domestic horses that had been released into the wild. However, the rapidly growing population was damaging the grasslands. The fragile ecosystem was at risk, and in 1993, the horses were rounded up and adopted. This decision caused a great deal of controversy. There were good arguments on both sides.

Pros

- A unique ecosystem would be preserved.
- The horses would be well taken care of by their adopted owners.

Cons

- The horses would lose their identity as a unique group.
- The horses would lose their freedom.
- People would no longer be able to view the horses in a natural setting.

How Can Science Help?

When animal populations grow too high, many problems can result. Scientists must investigate effects on human communities as well as natural ecosystems. In the case of the Suffield grasslands, scientists studying the ecology of the area came to realize it was one of few remaining habitats for endangered local species. Scientific observations of the landscape were key in order to assess the impact of the Suffield horses on the grasslands. The effects of the horses were easy to see: vegetation was being over-grazed and the landscape was eroding. Today, scientists continue to observe wildlife in the area and monitor it for changes in species populations.

Procedure

1 Suppose a unique population of animals lives near your area. Scientists would like to know more about this group. However, the animal population is too high and is damaging the environment. Perhaps the animals carry disease, and some people have become sick. Consider what should be done in this situation.

2 One alternative is to remove the animals from the area. As a class, come up with points you could make in favour of and against this decision.

3 Take a class vote to decide which side has the most convincing points.

Analyze

1. What was the most important factor in making your choice?

2. What else would you need to know in order to evaluate your decision.

3. Were there any alternatives to the issue that were overlooked? Would you have preferred one of these alternatives? Why?
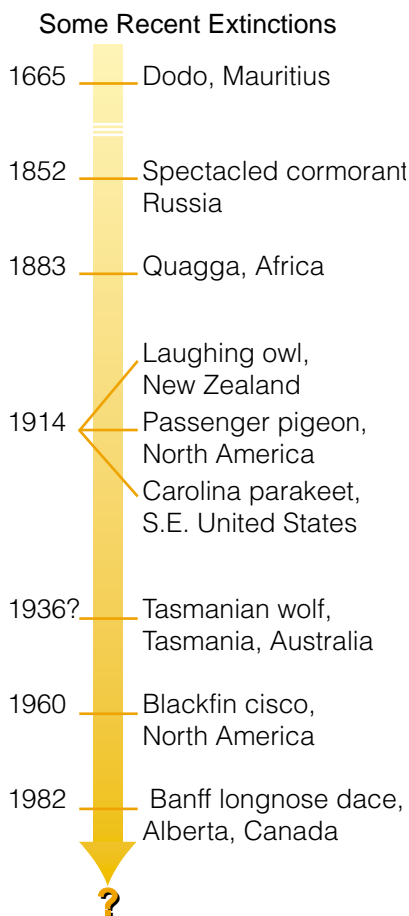
Extension

4. Did the removal of the Suffield horses from the grasslands have the desired effect on the ecosystem? Research this question on the Internet.

Skill
FOCUS

For tips on societal decision making, turn to Skill Focus 8.

Human Activities and Extinction

People have not always been as aware of their impact on species survival as they are today. It is thought that the woolly mammoth was hunted to extinction some 10 000 years ago. Around 500 C.E., humans killed off most of the large animals on the island of Madagascar. The same story was repeated in Australia and New Zealand. Perhaps the most dramatic example of humans hunting an animal into extinction was recorded in eastern North America in the late nineteenth century. Hunters killed about 5 billion passenger pigeons. The passenger pigeon went from being the world's most abundant bird to extinction in less than 100 years. Today many people are concerned about conservation efforts and are trying to find ways to prevent overhunting and overfishing. On the one hand, technology can help us preseve biodiversity, as we shall see in Topic 8. On the other hand, technology has increased our ability to affect biodiversity by using up natural resources and damaging the environment.
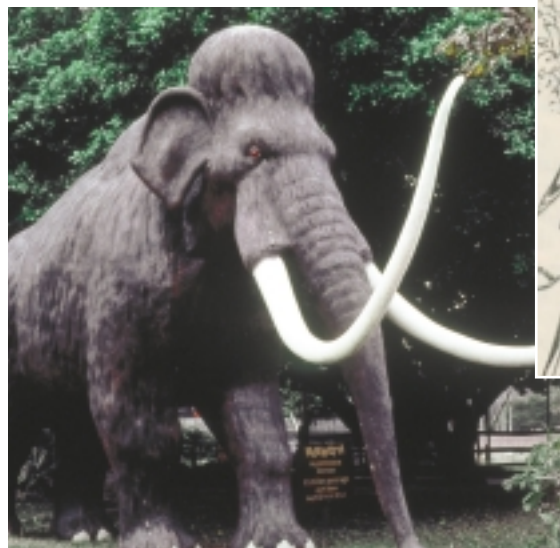
Figure 1.64 The woolly mammoth and passenger pigeon were both hunted to extinction.

TOPIC 7 **Review**

1. Name five ways in which humans have had an impact on biodiversity in your location.

2. In general, there is more biodiversity in the bird life in the tropics than in the North. Why has Hawaii lost at least 50 species of birds in the last several years? Suggest a possible explanation

3. There are more species on Earth than ever before. Why do scientists say that biological diversity is decreasing?

4. Does your daily life affect biodiversity on the planet? Explain your answer.