Extinction of Species

Just as birth and death are natural events in the life of an individual, the rise and fall of species are natural processes of evolution. The elimination of a species from Earth is called extinction. Extinction often occurs when a species as a whole cannot adapt to a change in its environment.

FIGURE 10: The northern spotted owl is native to the Pacific Northwest region of the United States.

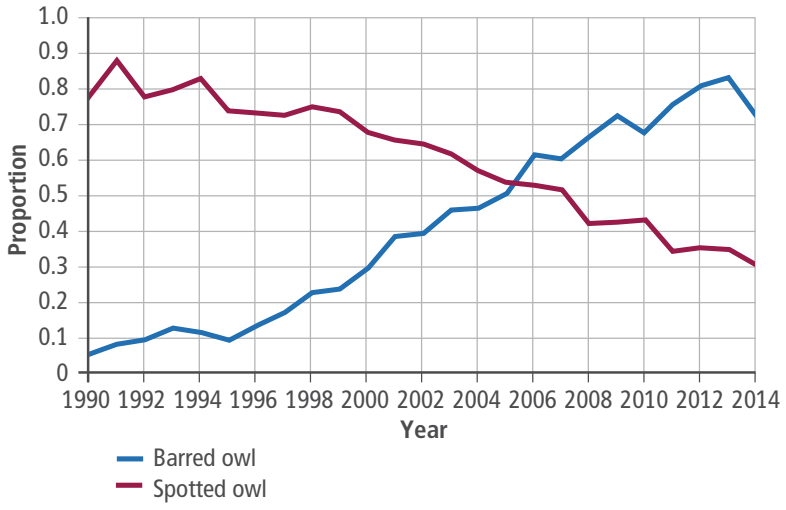
Causes of Extinction

Let's return to the example of the barred owl territory expansion. The expansion has been good for the barred owl, as seen by its increasing success and growing population numbers. Unfortunately, the appearance of the barred owl in the forests of the Pacific Northwest has negatively impacted a closely related species, the northern spotted owl. This bird is listed as a threatened species under the Endangered Species Act. Historically, the northern spotted owl has been most threatened by habitat loss due to logging, land development, and natural disasters. Now, the small amount of northern spotted owl habitat that remains is being invaded by the barred owl.

Barred owls and northern spotted owls use the same habitat in many of the same ways. Both species use old growth forests for food and nesting. Advantages of the barred owl over the northern spotted owl include a larger body, more aggressive behavior, smaller overall territory needs, the hunting of a wider range of prey, and more breeding success. In short, the barred owl is outcompeting the northern spotted owl. If the northern spotted owl is driven from its entire range, then the species could become extinct.

Comparing Owl Populations

FIGURE 11: The northern spotted owl is being displaced by the larger barred owl.



Source: Forsman, Eric D. et al. Demographic characteristics of spotted owls in the Oregon Coast Ranges, 1990-2014.

Source: Smithsonian Magazine, 2009

Collaborate Discuss with a partner how the expansion of a species into a new habitat might affect the native species that are already living there.

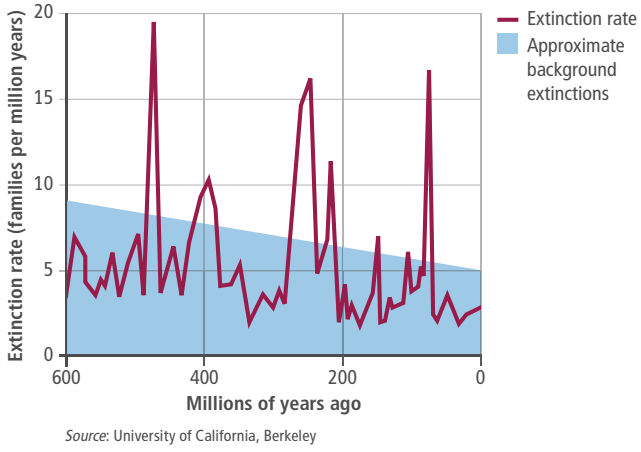
Extirpation, or local extinction, occurs when a species no longer exist in a specific portion of their range but still can be found elsewhere. For example, wolves have been extirpated from much of their historic range due to overhunting and habitat loss. Extinctions have occurred throughout time as shown in the fossil record. Natural events such as droughts, volcanic eruptions, and floods can cause extinctions if species cannot adapt to the new environment.

Background Extinctions and Mass Extinctions

Extinctions that occur continuously but at a very low rate are called background extinctions. These extinctions occur at roughly the same rate as speciation. This type of extinction typically affects one or a few species in relatively small areas. Background extinction is common and occurs due to factors such as disease, loss of habitat, or loss of a competitive advantage. Mass extinctions are more rare, but have a larger impact on Earth's biodiversity. Entire orders or families may be wiped out by mass extinction events. Mass extinctions are thought to occur suddenly in geologic time, usually because of a catastrophic event such as an ice age or asteroid impact. An example of a mass extinction is the K-T event that occurred at the end of the Cretaceous period 65 million year ago. A large meteor that crashed on Earth triggered this mass extinction. The aftermath of the meteor strike caused the extinction of 70 percent of Earth's species. The fossil record confirms that there have been at least five mass extinctions in the past 600 million years.

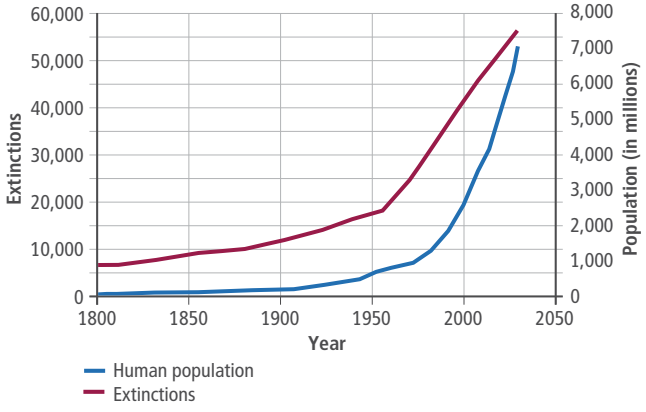
Cause and Effect

FIGURE 12: Comparing Extinction Rates



Source: University of California, Berkeley

a Extinction Rates Through Time



Source: Scott, J.M. 2008. *Threats to Biological Diversity: Global, Continental, Local*. U.S. Geological Survey, Idaho Cooperative Fish and Wildlife, Research Unit, University of Idaho.

b Human Population Growth and Extinction Rates

Analyze Use the graphs in Figure 12 to answer the following questions:

1. What patterns or trends are shown in the first graph (a)? What is the cause of these patterns?
2. What patterns or trends are shown in the second graph (b)? What is the cause of these patterns?
3. Is there a relationship between the two graphs? Explain your answer.

Climate Change and Extinction

Many scientists think that Earth is currently experiencing a sixth mass extinction. The sixth mass extinction is characterized by extinction rates that are 1000 to 10,000 times the background rate. The current extinction event is caused almost entirely by human behaviors such as the burning of fossil fuels, destruction of habitat, and introduction of invasive species.

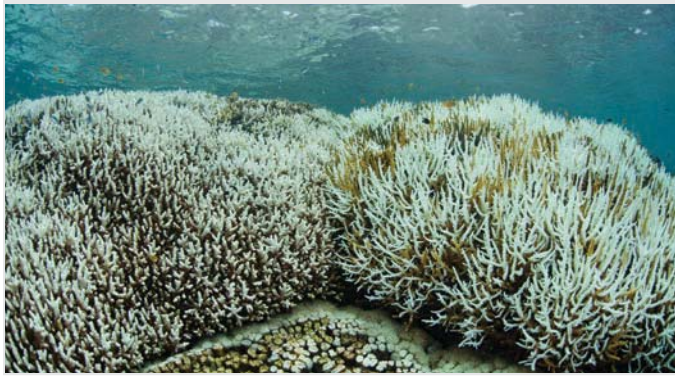
Analyze What is the cause-and-effect relationship between humans and the sixth mass extinction? Describe the relationship in terms of the growing human population and the causes and effects of climate change.

Climate change is caused by the release of large amounts of greenhouse gases—such as carbon dioxide—into the air, mostly from the burning of fossil fuels. Climate change is causing rapid changes to environments, from increasing temperatures to rising sea levels. Some species may find an increase in suitable habitat due to climate change. Other species may go extinct if their populations cannot adapt quickly enough to the changing environmental conditions. Corals are an example of a group of species that are being negatively affected by climate change.

Increasing Sea Temperature

Coral bleaching is a stress response in corals. When conditions are poor, the corals lose the symbiotic algae living inside of them. The photosynthetic algae are the corals' main source of food. Without the algae, the corals weaken and turn white. Rising sea temperatures are the leading cause of bleaching events on coral reefs. Other causes include pollution, increased intensity of sunlight, and extremely low tides.

FIGURE 13: Coral Bleaching



Ocean Acidification

Ocean acidification occurs when carbon dioxide is absorbed by seawater. The reaction between carbon dioxide and seawater also uses dissolved carbonate ions, which results in a decreased concentration of carbonate ions in the water. Many corals need carbonate in the form of calcium carbonate to build their skeletons. Coral reef growth will decline without enough carbonate for skeleton formation. If reef growth is slower than reef erosion, the reef could eventually stop functioning.

Extreme Weather Events

Many coral reefs are located in areas with extreme weather events such as hurricanes. The reef structure and species have adapted to recover after storms, though the recovery period can take a long time. It is predicted that climate change will increase the frequency and intensity of severe storms in some areas. Corals affected by more frequent storms may be unable to maintain reef structures. The increasing effects of coral bleaching, ocean acidification, and extreme weather present a bleak outlook for coral reefs in the future.

Explain What might happen if a species that is well adapted to lower pH and higher temperatures was introduced to coral reefs in the Hawaiian Islands?