CONSERVATION OF SPECIES

How a Species Becomes Endangered and Extinct

Endangered Species: Current Status

When we say that we want to save a species, what is it that we really want to save? There are four possible answers:

- A wild creature in a wild habitat, as a symbol to us of wilderness.
- A wild creature in a managed habitat, so the species can feed and reproduce with little interference and so we can see it in a naturalistic habitat.
- A population in a zoo, so the genetic characteristics are maintained in live individuals.
- Genetic material only—frozen cells containing DNA from a species for future scientific research.

The number of species of animals listed as threatened or endangered rose from about 1,700 in 1988 to 3,800 in 1996 and 5,188 in 2004, the most recent assessment by the International Union for the Conservation of Nature (IUCN).

The IUCN's Red List of Threatened Species reports that about 20% of all known species of mammals are at risk of extinction, as are 12% of known birds, 4% of known reptiles, 31% of amphibians, and 3% of fish, primarily freshwater fish.

The Red List also estimates that 33,798 species of vascular plants or 12.5% of those known, have recently become extinct or endangered. It lists more than 8,000 plants that are threatened, approximately 3% of all plants.

What does it mean to call a species “threatened” or “endangered”?

The terms can have strictly biological meanings, or they can have legal meanings.

The U.S. Endangered Species Act of 1973 defines endangered species as “any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man.” In other words, if certain insect species are pests, we want to be rid of them. It is interesting that insect pests can be excluded from protection by this legal definition, but there is no mention of disease-causing bacteria or other microorganisms.

Threatened species, according to the Act, “**means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range**.”

How a Species Becomes Endangered and Extinct

Extinction is the rule of nature.

Local extinction means that a species disappears from a part of its range but persists elsewhere.

Global extinction means a species can no longer be found anywhere.

Although extinction is the ultimate fate of all species, the rate of extinctions has varied greatly over geologic time and has accelerated since the Industrial Revolution.

From 580 million years ago until the beginning of the Industrial Revolution, about one species per year, on average, became extinct. Over much of the history of life on Earth, the rate of evolution of new species equaled or slightly exceeded the rate of extinction. The average longevity of a species has been about 10 million years. However, the fossil record suggests that there have been periods of catastrophic losses of species and other periods of rapid evolution of new species, which some refer to as “punctuated extinctions.” About 250 million years ago, a mass extinction occurred in which approximately 53% of marine animal species disappeared; and about 65 million years ago, most of the dinosaurs became extinct. Interspersed with the episodes of mass extinctions, there seem to have been periods of hundreds of thousands of years with comparatively low rates of extinction.

Causes of Extinction

Causes of extinction are usually grouped into four risk categories: population risk, environmental risk, natural catastrophe, and genetic risk. Risk here means the chance that a species or population will become extinct owing to one of these causes.

Population Risk

Random variations in population rates (birth rates and death rates) can cause a species in low abundance to become extinct. This is termed population risk.

For example, blue whales swim over vast areas of ocean. Because whaling once reduced their total population to only several hundred individuals, the success of individual blue whales in finding mates probably varied from year to year. If in one year most whales were unsuccessful in finding mates, then births could be dangerously low.

Environmental Risk

Population size can be affected by changes in the environment that occur from day to day, month to month, and year to year, even though the changes are not severe enough to be considered environmental catastrophes. Environmental risk involves variation in the physical or biological environment, including variations in predator, prey, symbiotic species, or competitor species. Some species are so rare and isolated that such normal variations can lead to their extinction.

For example, Paul and Anne Ehrlich described the local extinction of a population of butterflies in the Colorado mountains. These butterflies lay their eggs in the unopened buds of a single species of lupine (a member of the legume family), and the hatched caterpillars feed on the flowers. One year, however, a very late snow and freeze killed all the lupine buds, leaving the caterpillars without food and causing local extinction of the butterflies. Had this been the only population of that butterfly, the entire species would have become extinct.

Natural Catastrophe

A sudden change in the environment that is not caused by human action is a natural catastrophe. Fires, major storms, earthquakes, and floods are natural catastrophes on land; changes in currents and upwellings are ocean catastrophes.

For example, the explosion of a volcano on the island of Krakatoa in Indonesia in 1883 caused one of recent history's worst natural catastrophes. Most of the island was blown to bits, bringing about local extinction of most life-forms there.

Genetic Risk

Detrimental change in genetic characteristics, not caused by external environmental changes, is called genetic risk. Genetic changes can occur in small populations from reduced genetic variation and from genetic drift and mutation. In a small population, only some of the possible inherited characteristics will be found. The species is vulnerable to extinction because it lacks variety or because a mutation can become fixed in the population.

Consider the last 20 condors in the wild in California. It stands to reason that this small number was likely to have less genetic variability than the much larger population that existed several centuries ago. This increased the condors' vulnerability. Suppose that the last 20 condors, by chance, had inherited characteristics that made them less able to withstand lack of water. If left in the wild, these condors would have been more vulnerable to extinction than a larger, more genetically varied population.

The Good News: We Have Improved the Status of Some Species

- Thanks to the efforts of many people, a number of previously endangered species, such as the Aleutian goose, have recovered. Other recovered species include the following:
- The elephant seal, which had dwindled to about a dozen animals around 1900 and now numbers in the hundreds of thousands.
- The sea otter, reduced in the 19th century to several hundred and now numbering approximately 10,000.

- Many species of birds endangered because the insecticide DDT caused thinning of eggshells and failure of reproduction. With the elimination of DDT in the United States, many bird species recovered, including the bald eagle, brown pelican, white pelican, osprey, and peregrine falcon.

- The blue whale, thought to have been reduced to about 400 when whaling was still actively pursued by a number of nations. Today, 400 blue whales are sighted annually in the Santa Barbara Channel along the California coast, a sizable fraction of the total population.
- The gray whale, which was hunted to near-extinction but is now abundant along the California coast and in its annual migration to Alaska

How People Cause Extinctions and Affect Biological Diversity

People have become an important factor in causing species to become threatened, endangered, and finally extinct. We do this in several ways:

- By intentional hunting or harvesting (for commercial purposes, for sport, or to control a species that is considered a pest).
- By disrupting or eliminating habitats.
- By introducing exotic species, including new parasites, predators, or competitors of a native species.
- By creating pollution.

People have caused extinctions over a long time, not just in recent years. The earliest people probably caused extinctions through hunting.

Ecological Islands and Endangered Species

The history of the Kirtland's warbler illustrates that a species may inhabit "ecological islands," which the isolated jack-pine stands of the right age range are for that bird.

An **ecological island** is an area that is biologically isolated, so that a species living there cannot mix (or only rarely mixes) with any other population of the same species.

Mountaintops and isolated ponds are ecological islands. Real geographic islands may also be ecological islands. Insights gained from studies of the biogeography of islands have important implications for the conservation of endangered species and for the design of parks and preserves for biological conservation.

Surrogate Species

Surrogate species are used to represent other species or aspects of the environment.

Keystone species: A plant or animal species that plays an unique and crucial role in the ecosystem.

Umbrella species: Where the conservation goal is to protect a habitat or community or species, an umbrella species may be employed as a surrogate to delineate the size of area or type of habitat over which protection should occur (Caro & O'Doherty, 1999).

Flagship species: Used to attract the attention of the public (Western 1987).

Indicator species: an organism whose characteristics (e.g. Presence or absence, population density, dispersion) are used as an index of attributes too difficult, inconvenient, or expensive to measure for other species or environmental conditions of interest (Landers et al. 1988).