

Keystone species

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The jaguar has a varied diet in Central and South America. It acts as a keystone predator by helping to balance the animals in the jungle ecosystem by consuming 87 different species of prey. Photo from the public domain.

A keystone species is an organism that helps define an entire ecosystem.



If the keystone species were to disappear from the ecosystem, no other species would be able to fill its environmental role. The ecosystem would be forced to radically change, allowing new and possibly invasive species to take over the habitat.

Any organism, from plants to fungi, may be a keystone species. They are not always the largest or most abundant species in an ecosystem. However, almost all examples of keystone species are animals that have a huge influence on food webs. The way these animals influence food webs varies from habitat to habitat.

Carnivores, Herbivores And Mutualists

Predators

A keystone species is often, but not always, a predator. Just a few predators can control the distribution and population of large numbers of prey species.

The entire concept of keystone species started with a study of predators. American zoology professor Robert T. Paine was researching Tatoosh Island in Washington state. He found that removing a single species, the *Pisaster ochraceus* sea star, from a tidal plain there had a huge effect on the ecosystem. These creatures, commonly known as purple sea stars, are a major predator of mussels and barnacles on Tatoosh Island. With the sea stars gone, mussels took over the area and crowded out other species, including benthic algae that supported communities of sea snails, limpets and bivalves. Lacking a keystone species, the tidal plain's biodiversity, or variety of creatures, was cut in half within a year.



In the Greater Yellowstone Ecosystem (GYE), gray wolves are a keystone species. The GYE stretches across the U.S. states of Montana, Wyoming and Idaho. It includes active geysers, mountains, forests, meadows and freshwater habitats.

The elk, bison, rabbit and bird species in the Greater Yellowstone Ecosystem are at least partly controlled by the presence of wolves. The feeding behavior of these prey species, as well as where they choose to make their nests and burrows, are largely a reaction to wolf activity. Scavenger species, such as vultures, are also controlled by the wolf activity.

When the U.S. government designated land for Yellowstone National Park in the late 19th century, hundreds of wolves roamed the GYE. They preyed primarily on abundant herds of elk and bison. The government feared that wolves would too heavily hunt these animals, as well as local livestock, like cows. So it worked to remove wolves from the GYE. The last wolf pups in Yellowstone were killed in 1924.

This started a top-down trophic cascade in the Greater Yellowstone Ecosystem. This is when an ecosystem changes due to the addition or removal of a predator. A top-down trophic cascade describes changes that result from the removal of an ecosystem's top predator.

Lacking a top predator, elk populations in Yellowstone exploded. Elk herds competed for food resources, and plants such as grasses, sedges and reeds did not have time or space to grow back. This hurt populations of other species, such as fish, beaver and songbirds. These animals rely on plants and their roots, flowers, wood and seeds for survival.

It wasn't just animals who were affected. Stream banks eroded as wetland plants failed to anchor valuable soil and sediments. Lake and river temperatures increased as trees and shrubs failed to provide shaded areas.

Starting in the 1990s, the U.S. government began reintroducing wolves to the Greater Yellowstone Ecosystem. The results have been noteworthy. Elk populations have shrunk, willow heights have increased and beaver and songbird populations have recovered.

Herbivores

Herbivores can also be keystone species. By eating plants, they help control the physical and biological aspects of an ecosystem.



In African savannas such as the Serengeti plains in Tanzania, elephants are a keystone species. Elephants eat shrubs and small trees that grow on the savanna. Even if the acacia tree grows to a height of a yard or more, elephants are able to knock it over and uproot it. This feeding behavior keeps the savanna a grassland, rather than a forest.

With elephants to control the tree population, grasses thrive and sustain grazing animals such as antelopes, wildebeests and zebras. Smaller animals such as mice and shrews are able to burrow in the warm, dry soil of a savanna. Predators such as lions and hyenas depend on the savanna for finding prey.

Keystone Mutualists

Keystone mutualists are two or more species that work like a team. A change in one species would impact the other, and change the entire ecosystem. These are often pollinators, such as bees.



In the woody grasslands of Patagonia, a region of South America, a species of hummingbird and native plants work together. Local trees, shrubs and flowering plants have evolved to only be pollinated by a hummingbird called the green-backed firecrown. Green-backed firecrowns pollinate 20 percent of local plant species. In turn, these plants provide the sugary nectar that makes up most of the hummingbird's diet.

Pockets of the existing Patagonian habitat would collapse without green-backed firecrowns. No other pollinator has adapted to pollinate these plants.

Other Organisms Crucial To Ecosystems

In addition to keystone species, there are other categories of organisms crucial to their ecosystems' survival.

Umbrella Species

Umbrella species are often confused with keystone species. Both terms describe a single organism on which many other species depend. The main difference between the two is that an umbrella species travels widely so it has an effect on a larger area.

Umbrella species have large habitat needs, and the requirements of that habitat impact many other species living there. Most umbrella species are migratory — that is, they move from place to place.

For conservation — it's often important to identify umbrella species in specific areas. If an area is about to be protected, its measurements may be determined by how far a key umbrella species travels.

The Siberian tiger, an endangered species, is an umbrella species with a range of more than 620 miles in Russia's far east, with territory stretching into China and North Korea. Populations of deer, boar and moose are under the snowy "umbrella" of the Siberian tiger range.

Foundation Species

Foundation species play a major role in creating or maintaining a habitat.

Corals are a key example of a foundation species across many islands in the South Pacific Ocean. These tiny animals grow as a colony of thousands and even millions of individual polyps. The rocky outer layers of these polyps create enormous structures around islands: coral reefs.



Coral reefs are one of the most biologically diverse ecosystems on the planet. Microscopic plankton, as well as crustaceans, mollusks, sponges, fish and marine reptiles are all part of healthy coral reef ecosystems.

Coral reef ecosystems also contribute to the human geography of a region. Pummeled by waves and ocean currents, coral exoskeletons can experience erosion. These worn-away fragments of coral, along with bony fragments of organisms such as mollusk and crustaceans, create a soft sand known as coral sand. Coral sand beaches are among the most popular tourist destinations in the world.

Ecosystem Engineers

Like foundation species, ecosystem engineers contribute to the physical geography of their habitat. Ecosystem engineers modify, create and maintain habitats.

Some engineers modify their environment by modifying their own biology. These are called autogenic engineers. Corals and trees are autogenic engineers. As they grow, they are a living part of the environment, providing food and shelter to other organisms. The hard outer shells left behind as corals die continue to define and modify the ecosystem.



Allogenic engineers physically change their environment from one state to another. Beavers are a classic example. They help maintain woodland ecosystems by thinning out older trees and allowing young saplings to grow. Converting these trees into timber for dams radically alters woodland meadows and streams, changing them into wetland habitats.

Invasive species are often ecosystem engineers. Lacking natural predators or other factors to constrain them, these introduced species change the existing environment in ways that hold back the growth of the native ecosystem.

Kudzu, the so-called “vine that ate the South,” is an invasive species of plant that modified the environment of the southeastern United States. Kudzu regularly fights native species for space and nutrients. As it crowds out native species, kudzu limits the pollinators, insects and bird species that inhabit an area.

Indicator Species

An indicator species describes an organism that is very sensitive to environmental changes in its ecosystem. Indicator species are almost immediately affected by changes to the ecosystem and can give early warning that a habitat is suffering.

Changes associated with outside influences such as water pollution, air pollution or climate change first appear in indicator species.

In Chesapeake Bay, in the northeastern U.S., oysters are an indicator species. Oysters filter water as they strain it for food particles. Oysters filter nutrients, sediments and pollutants that enter the bay. Oyster beds help protect fisheries and coastal habitats. The health of oyster

populations in the Chesapeake, therefore, is used to help understand the health of the entire ecosystem.



Flagship Species

A flagship species acts as a symbol for an environmental habitat, movement, campaign or issue. They can be mascots for entire ecosystems.

Identifying a flagship species relies heavily on the social, cultural and economic value of a species. They are often large animals with popular appeal due to how they look, or when they appear in popular culture, like movies, TV or books.

Flagship species can sometimes be symbols of general ideas about conservation. Polar bears are the unchallenged flagship species associated with climate change.

The giant panda is perhaps the most familiar flagship species. Pandas are the global symbol of endangered species.

Quiz

- 1 Read the selection from the section "Predators."

Lacking a top predator, elk populations in Yellowstone exploded. Elk herds competed for food resources, and plants such as grasses, sedges and reeds did not have time or space to grow back.

Why does the author use the word "exploded"?

- (A) to suggest the violence with which predators hunt
 - (B) to suggest the shock of scientists at the lost predators
 - (C) to convey the speed with which elk populations grew
 - (D) to convey the excitement of elk at having no predators
- 2 Read the section "Keystone Mutualists." Then, fill in the blank.
- The word "mutualists" is used to describe these species because _____
- (A) the plants need special pollination to survive.
 - (B) the species rely on each other for survival.
 - (C) the grasslands have many rare species.
 - (D) the pollinators will need to find other species.
- 3 What is the MAIN reason the author includes the section "Herbivores"?
- (A) to illustrate how plant-eaters affect the physical and biological traits of an ecosystem
 - (B) to demonstrate what causes certain areas to become forests rather than grasslands
 - (C) to emphasize the reliance of predators on other keystone species in the savanna
 - (D) to provide a contrast between the feeding behaviors of carnivores and herbivores

- 4 Why does the author include information about indicator and flagship species?
- (A) to describe species that have an impact on people's understanding of the environment's needs
 - (B) to explain how certain species can be affected by pollutants in their environment
 - (C) to demonstrate what is being done to help protect keystone species from negative effects
 - (D) to emphasize people's reactions to the loss of animals such as pandas and oysters