

Encyclopedic Entry

keystone species

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A **keystone species** is a **plant** or **animal** that plays a **unique** and **crucial** role in the way an **ecosystem** functions. Without keystone species, the ecosystem would be dramatically different or **cease** to exist **altogether**.

All species in an ecosystem, or **habitat**, rely on each other. The contributions of a keystone species are large compared to the species' prevalence in the habitat. A small number of keystone species can have a huge impact on the environment.

A keystone species is often, but not always, a **predator**. A few predators can control the **distribution** and **population** of large numbers of **prey** species. A single **mountain lion** near the Mackenzie Mountains in Canada, for example, can **roam** an area of hundreds of kilometers. The **deer**, rabbits, and **bird** species in the ecosystem are at least partly controlled by the presence of the **mountain lion**. Their **feeding behavior**, or where they choose to make their nests and burrows, are largely a reaction to the mountain lion's activity. **Scavenger** species, such as vultures, are also controlled by the activity of the mountain lion.

A keystone species' disappearance would start a **domino effect**. Other species in the habitat would also **disappear** and become **extinct**. The keystone species' disappearance could affect other species that rely on it for survival. For example, the population of deer or rabbits would explode without the presence of a predator. The ecosystem cannot support an unlimited number of animals, and the deer soon compete with each other for food and water resources. Their population usually declines without a predator such as a mountain lion.

Without the keystone species, new plants or animals could also come into the habitat and push out the **native species**. Some species of hummingbirds are keystone species in the Sonoran Desert of North America. Hummingbirds **pollinate** many varieties of native **cactus** and other plants. In areas of the Sonoran Desert with few hummingbirds, **invasive species** such as **buffelgrass** have taken over the ecosystem.

The theory that the balance of ecosystems can rely on one keystone species was first established in 1969 by American **zoology professor** Robert T. Paine. Paine's research showed that removing one species, the *Pisaster ochraceus* **sea star**, from a **tidal plain** on Tatoosh **Island** in the U.S. state of Washington, had a huge effect on the surrounding ecosystem. The sea stars are a major predator for mussels on Tatoosh Island. With the sea stars gone, mussels took over the area and crowded out other species. In this ecosystem, the sea star was the keystone species.

The **sea otter** is another example of a keystone species in the **Pacific Northwest**. These mammals feed on sea urchins, controlling their population. If the otters didn't eat the urchins, the urchins would eat up the habitat's **kelp**. Kelp, or giant **seaweed**, is a major source of food and **shelter** for the ecosystem. Some species of crabs, snails, and geese depend on kelp for food. Many types of **fish** use the huge kelp forests to hide from predators. Without

sea otters to control the urchin population, the entire ecosystem would **collapse**.

Herbivores can also be keystone species. In African savannas such as the **Serengeti plains** in Tanzania, elephants are a keystone species. Elephants eat small trees, such as **acacia**, that grow on the **savanna**. Even if an acacia tree grows to a height of several feet, elephants are able to **knock over** the tree and **uproot** it. This feeding behavior keeps the savanna a **grassland** and not a forest or **woodland**. 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 prey. Elephants are the keystone species that maintain the entire savanna ecosystem.

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

Foundation Species

Foundation species play a major role in creating or maintaining a habitat that supports other species. Corals are one example of a foundation species in many islands in the South Pacific Ocean. Corals produce the **reef** structures on which countless other organisms, including human beings, live.

Umbrella Species

An umbrella species is a large animal or other organism on which many other species depend. Umbrella species are very similar to keystone species, but umbrella species are usually **migratory** and need a large habitat.

Protection of umbrella species is thought to automatically protect a host of other species. Tigers are an example of an umbrella species. Efforts to save wild tigers in forests in the Indian state of Rajasthan also accomplish the goal of saving other species there, such as leopards, boars, hares, antelopes, and monkeys.

Indicator Species

An indicator species is a plant or animal that is very sensitive to environmental changes in its ecosystem. This means it is affected almost **immediately** by **damage** to the ecosystem and can give early warning that a habitat is suffering. Damage from external influences such as **water pollution**, **air pollution**, or **climate change** first appear in indicator species.

In the United States, the Environmental Protection Agency (EPA) studies the population and health of fish in the Chesapeake **Bay** to evaluate the quality of water in the ecosystem. The EPA uses the fish as indicator species of the bay.

VOCABULARY

| Term | Part of Speech | Definition |
|----------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| acacia | <i>noun</i> | tree or shrub that is often thorny. |
| air pollution | <i>noun</i> | harmful chemicals in the atmosphere. |
| altogether | <i>adverb</i> | entirely or completely. |
| animal | <i>noun</i> | organisms that have a well-defined shape and limited growth, can move voluntarily, acquire food and digest it internally, and can respond rapidly to stimuli. |
| antelope | <i>noun</i> | grazing mammal. |
| bay | <i>noun</i> | body of water partially surrounded by land, usually with a wide mouth to a larger body of water. |

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| bird | <i>noun</i> | egg-laying animal with feathers, wings, and a beak. |
| boar | <i>noun</i> | mammal, related to a pig, native to Europe and Asia. |
| buffelgrass | <i>noun</i> | grass native to Africa and Asia. |
| burrow | <i>noun</i> | small hole or tunnel used for shelter. |
| cactus | <i>noun</i> | type of plant native to dry regions. |
| cease | <i>verb</i> | to stop or end. |
| climate change | <i>noun</i> | gradual changes in all the interconnected weather elements on our planet. |
| collapse | <i>verb</i> | to fall apart completely. |
| coral | <i>noun</i> | tiny ocean animal, some of which secrete calcium carbonate to form reefs. |
| crab | <i>noun</i> | type of marine animal (crustacean) with a flat body, hard shell, and pincers. |
| crucial | <i>adjective</i> | very important. |
| damage | <i>noun</i> | harm that reduces usefulness or value. |
| deer | <i>noun</i> | mammal whose male members have antlers. |
| disappear | <i>verb</i> | to vanish or leave without a trace. |
| distribution | <i>noun</i> | the way something is spread out over an area. |
| domino effect | <i>noun</i> | situation in which one event causes another, which causes yet another, until an entire system is changed. |
| dramatic | <i>adjective</i> | very expressive or emotional. |
| ecosystem | <i>noun</i> | community and interactions of living and nonliving things in an area. |
| elephant | <i>noun</i> | large mammal with a long trunk, native to Africa and Asia. |
| extinct | <i>adjective</i> | no longer existing. |
| feeding behavior | <i>noun</i> | methods by which an organism obtains food and eats. |
| fish | <i>verb</i> | to catch or harvest fish. |
| foundation species | <i>noun</i> | species that creates or maintains an ecosystem. |
| function | <i>verb</i> | to work or work correctly. |
| goose | <i>noun</i> | aquatic bird with a long neck. |
| grass | <i>noun</i> | type of plant with narrow leaves. |
| grassland | <i>noun</i> | ecosystem with large, flat areas of grasses. |
| grazing animal | <i>noun</i> | animal that feeds on grasses, trees, and shrubs. |
| habitat | <i>noun</i> | environment where an organism lives throughout the year or for shorter periods of time. |
| hare | <i>noun</i> | mammal, related to rabbits, with long ears and strong legs for hopping. |

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| herbivore | <i>noun</i> | organism that eats mainly plants. |
| hummingbird | <i>noun</i> | type of very small bird. |
| hyena | <i>noun</i> | predatory mammal native to Africa and Asia. |
| immediately | <i>adverb</i> | at once or quickly. |
| indicator species | <i>noun</i> | any species that determines a characteristic of its environment, such as range or ecological health. |
| invasive species | <i>noun</i> | type of plant or animal that is not indigenous to a particular area and causes economic or environmental harm. |
| island | <i>noun</i> | body of land surrounded by water. |
| kelp | <i>noun</i> | type of seaweed. |
| keystone species | <i>noun</i> | a species that has a major influence on the way an ecosystem works. |
| leopard | <i>noun</i> | large, spotted cat native to Africa and Asia. |
| lion | <i>noun</i> | large cat native to sub-Saharan Africa and Gir Forest National Park, India. |
| mammal | <i>noun</i> | animal with hair that gives birth to live offspring. Female mammals produce milk to feed their offspring. |
| migratory | <i>adjective</i> | organisms that travel from one place to another at predictable times of the year. |
| monkey | <i>noun</i> | mammal considered to be highly intelligent, with four limbs and, usually, a tail. |
| mountain lion | <i>noun</i> | large cat native to North and South America. Also called a cougar, puma, catamount, and panther. |
| mouse | <i>noun</i> | small mammal, usually with a pointed snout and long, hairless tail. |
| mussel | <i>noun</i> | aquatic animal with two shells that can open and close for food or defense. |
| native species | <i>noun</i> | species that occur naturally in an area or habitat. Also called indigenous species. |
| nest | <i>noun</i> | protected area built by birds to hatch their eggs and raise their young. |
| Pacific Northwest | <i>noun</i> | the area made of the U.S. states of Oregon and Washington, and the Canadian province of British Columbia. |
| plant | <i>noun</i> | organism that produces its own food through photosynthesis and whose cells have walls. |
| pollinate | <i>verb</i> | to transfer pollen from one part of a flower (the anther) to another (the stigma). |
| population | <i>noun</i> | total number of people or organisms in a particular area. |
| predator | <i>noun</i> | animal that hunts other animals for food. |
| prevalent | <i>adjective</i> | common or widespread. |
| prey | <i>noun</i> | animal that is hunted and eaten by other animals. |
| professor | <i>noun</i> | highest-ranking teacher at a college or university. |
| rabbit | <i>noun</i> | mammal with long ears that hops on strong hind legs. |
| reef | <i>noun</i> | a ridge of rocks, coral, or sand rising from the ocean floor all the way to or near the ocean's surface. |

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| resource | <i>noun</i> | available supply of materials, goods, or services. Resources can be natural or human. |
| roam | <i>verb</i> | to wander or travel over a wide area without a specific destination. |
| savanna | <i>noun</i> | type of tropical grassland with scattered trees. |
| scavenger | <i>noun</i> | organism that eats dead or rotting biomass, such as animal flesh or plant material. |
| sea otter | <i>noun</i> | marine mammal with thick fur native to the Pacific Ocean. |
| sea star | <i>noun</i> | marine animal (echinoderm) with many arms radiating from its body. Also called a starfish. |
| sea urchin | <i>noun</i> | marine animal (echinoderm) with a circular, spiny shell. |
| seaweed | <i>noun</i> | marine algae. Seaweed can be composed of brown, green, or red algae, as well as "blue-green algae," which is actually bacteria. |
| Serengeti plains | <i>noun</i> | grassland of the Serengeti ecosystem of Kenya and Tanzania. |
| shelter | <i>noun</i> | structure that protects people or other organisms from weather and other dangers. |
| shrew | <i>noun</i> | type of small mammal resembling a mouse with a long nose. |
| snail | <i>noun</i> | marine or terrestrial animal (mollusk) with a shell and one foot on which it glides. |
| soil | <i>noun</i> | top layer of the Earth's surface where plants can grow. |
| sustain | <i>verb</i> | to support. |
| thrive | <i>verb</i> | to develop and be successful. |
| tidal plain | <i>noun</i> | large, flat area where mud and sediment are deposited by ocean tides. Also called tidal flat or mudflat. |
| tiger | <i>noun</i> | large cat native to Asia. |
| umbrella species | <i>noun</i> | large, usually migratory species on which other species in an ecosystem depend. |
| unique | <i>adjective</i> | one of a kind. |
| uproot | <i>verb</i> | to tear or remove a tree or other plant by the roots. |
| vulture | <i>noun</i> | bird that mostly eats dead animals. |
| water pollution | <i>noun</i> | introduction of harmful materials into a body of water. |
| wildebeest | <i>noun</i> | type of antelope native to Africa. Also called a gnu. |
| woodland | <i>noun</i> | land covered with trees, usually less dense than a forest. |
| zebra | <i>noun</i> | mammal, related to a horse, native to Africa. |
| zoology | <i>noun</i> | the study of animals. |

For Further Exploration

Articles & Profiles

- Save the Prairie Dogs: About Prairie Dogs, a Keystone Species

Websites

- National Geographic Emerging Explorer: Shafqat Hussain



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