The Importance of Keystone Species

The *Oxford English Dictionary* defines *keystone* as “a central stone at the summit of an arch, locking the whole together.” From this definition, it is clear why Robert Paine, professor of zoology at Washington University, first used the term "keystone species" to describe a species with a strong influence on its ecosystem. In his 1969 paper, Paine described how a certain starfish species affected the rest of its tidal ecosystem. Since then, the term "keystone species" has become widely used in population science.

Gray Wolves as a Keystone Species

One of the most studied examples of a keystone species is the gray wolf (*Canis lupus*). Gray wolves had roamed much of midwestern North America for centuries. As carnivores, these wolves feed on many large animals. Their prey includes bison, deer, and moose. However, elk seems to be their first choice. Since their reintroduction in 1995, gray wolves are native to Yellowstone National Park.

The gray wolf is the dominant predator of Yellowstone National Park, an important aspect of its role as a keystone species.

In the late 1800s, populations of the gray wolf’s prey species greatly decreased in number in and near the park. This was mostly due to an increase in human settlements in the area. As a result, the gray wolves were forced to find other food sources. With the increase in the human population came an increase in the number of ranches and farms. These provided the new food source the wolves needed. Gray wolves feasted on cattle, sheep, and other livestock. This angered the ranchers and farmers.

A Decision with Far-Reaching Consequences

In 1872, the federal government established Yellowstone as the first national park. At the time, there were 300 to 400 gray wolves in the park. Due to their hunting of the park’s elk and bison populations and their attacks on local livestock, the federal government decided to destroy the park’s wolf population. Hunters trapped and shot as many wolves as they could. Others were pulled from their dens, hunted by dogs, or poisoned. In 1924 park rangers killed the last two remaining wolf pups. The park’s program and similar programs elsewhere

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had been a wild "success." Wolves had nearly disappeared from the United States and Mexico, remaining only in parts of Alaska.

However, in the absence of their main predator, elk populations skyrocketed. As these grazing animals ate up plants, other populations began to be affected. Many plant populations, including aspen and willow trees, decreased significantly. This caused a domino effect. The lack of aspens and willows affected other wildlife species that were dependent on the trees. For example, beavers and such songbirds as robins and warblers soon felt the effects of the wolves' removal, as their numbers declined due to habitat loss.

Plants and animals were not the only victims of the slaughter of the wolves. The whole ecosystem fell into a downward spiral. Without the anchoring roots of trees and other plants, stream banks became unstable. Soil easily broke away and washed downstream to clog streams and lakes. Water temperatures rose from a lack of nearby shade trees. The cycle of nutrients between the soil and living organisms slowed. The wolves' removal had created damage beyond what anyone had expected.

The increase in the gray wolf population quickly affected the elk population. It is another sign of the gray wolf's status as a keystone species.

Bringing Back the Wolves

By 1966, government policies regarding the gray wolf began to change with the passage of the Endangered Species Preservation Act. Seven years later, as part of the updated Endangered Species Act of 1973, Yellowstone National Park decided to restore the park's conditions to their natural state. This meant that gray wolves had to be brought back in a careful process called "reintroduction." Over the next several years, many gray wolves were slowly released back into the Yellowstone wild. Their reintroduction has been considered a true success. The gray wolf population has grown steadily. By the end of 2009, there were nearly 100 wolves in the park.

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The returning wolves again proved their role as a keystone species. They thrived on the overgrown elk population, which had suffered greatly from starvation in the winter months. Other species benefitted from the wolves' return, too. Carcasses left after a wolf kill also fed other carnivores. The elk not only provided food for the wolves, but also for coyotes, eagles, bears, and foxes. In fact, studies have established that up to 28 different species feed on an elk kill. This one keystone species provides a reliable and available food source for many others.

Other parts of the park ecosystem also recovered with the return of the wolves. The reduction of the elk population toward normal levels led to an increase in willow trees in the park. In turn, the songbird population showed strong growth, and the beaver population increased to 10 times its lowest level.

Evidence of the gray wolf as a keystone species at Yellowstone National Park is clear. Wolves play an exceptionally large part in the overall health of the park's ecosystem. Although they had been absent from the area for nearly a century, their return caused dramatic positive changes. Data collected from the gray wolf reintroduction project further demonstrated that keystone species are vital to the structure and function of ecosystems for both the short-term and long-term preservation of all species.