



Prize Winner

Science Writing Year 11-12

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STAGE 1 BIOLOGY

Science as a Human Endeavour Task

Keystone Species – Grey Wolves of Yellowstone National Park

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INTRODUCTION

In the 1920s, government predator control programs allowed the extermination of the grey wolf (*Canis lupus*) population from Yellowstone National Park located in the USA across the boundaries of Montana, Wyoming and Idaho, due to various complaints of wolf infestations on farmlands. This elimination of the *apex predator*, triggered an ecosystem collapse, known as a **trophic cascade**. *Trophic cascade* refers to the ecological phenomenon caused by the introduction or the removal of a species that changes the populations of predators and preys, ultimately decreasing the diversity of and affecting the way an ecosystem works.

However, in 1995, wolves were reintroduced to the park due to new policies (e.g. The Endangered Species Act of 1973), and the impact has been closely examined ever since (Gordon, 2017). As a result of intense conservation and restoration efforts, the grey wolf was finally fortunately taken off the endangered species list after four decades (U.S Fish and Wildlife Service, 2019). With numerous strategies to prevent the extinction of the wolf species, guided by both scientific knowledge and society, factors such as social, economic and ethical will be considered.



Figure 1: Grey Wolf (Sartore, 2017)

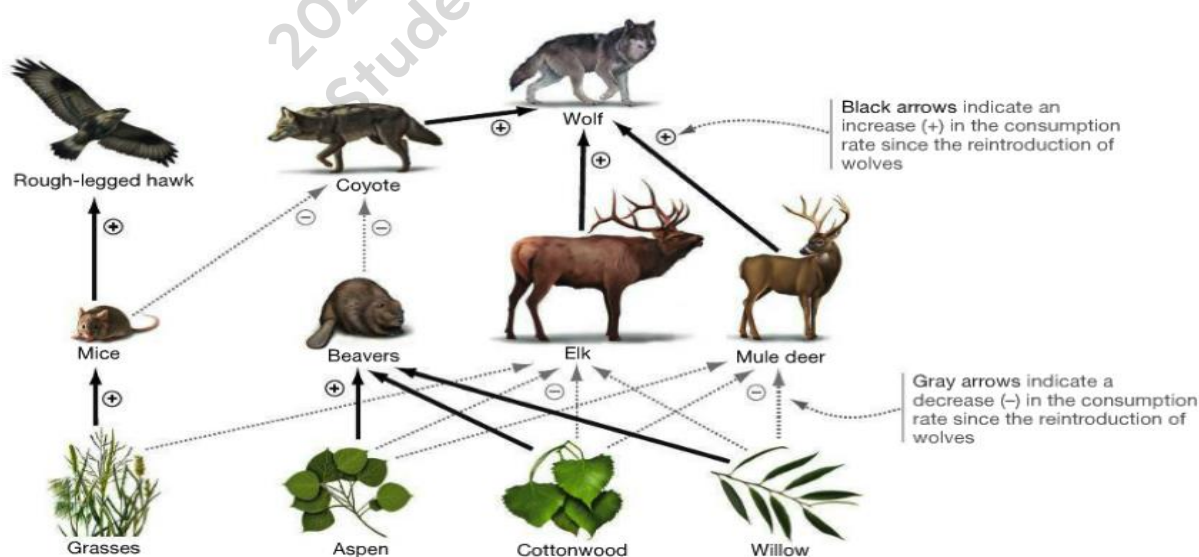


Figure 2: Food web showing effects of the reintroduction of grey wolves (Cohen, 2016).

KEYSTONE SPECIES: *The impact of the removal of grey wolves*

Grey wolves, sometimes referred to as grey wolves, are the **keystone species** of the Greater Yellowstone Ecosystem. The term *keystone species* refers to a species whose presence and role within an ecosystem has a dramatic effect on other organisms within the ecosystem. This means that the removal of the species, would result in the extinction of other organisms or in a decrease of the ecosystems overall diversity. Since the grey wolf is classified as a top-level predator, its food web consists of a variety of herbivores, scavengers and vegetation. Figure 2 displays the relationship between organisms in the Greater Yellowstone Ecosystem through a simple food web.

Studies on the reintroduction of the grey wolves have shown that they have a significant effect on organisms such as elk, beavers, deer, aspen, cottonwood, willow, grasses, rabbits, bison, birds, fish, vultures along with the way the rivers and streams work.

Since, **elk** are a very adaptable species, aware of their predator of grey wolves, they alter their behaviour according to wolves' presence (Farquhar, 2019). When wolves are present, elk behave *nomadically*, travelling from area to area for food. However, the absence of wolves caused them to become less cautious and prefer to stay and eat in one spot for a longer period of time. Instead of eating small portions of a variety of plants in different areas, they ate large portions of the same plants. This resulted in the overgrazing of plants such as **aspen** and **cottonwood trees**, and **riverside willows** of which **beavers**, **songbirds**, and **fish** depend on, causing them to decline. This is particularly important as beavers are also a keystone species. Hence, the extinction of beavers resulted in loss of quality of the habitat for various other organisms. Beavers have a significant role of building dams and creating wetlands of which many species depend on. In fact, 85% of wild animals in North America rely on wetlands (Do and Wildlife, 2020). Beaver's also:

- Moderate stream flow, reducing damage of flooding.
- Moderate temperature of stream, providing habitat for amphibians and insects.
- Purify and control water by filtering silt from the water bodies they live in.
- Contain forest fires by converting streams to large bodies of water, serving as a fire line or water supply to fire fighters.
- As velocity of water is slowed by the dams, sediment builds up on the bottom of the stream, repairing damage from erosion whole raising the water table.

Thus, the extinction of wolves leads to the extinction of beavers of which have detrimental effects on not only other animals, but also the way the bodies of water work. Furthermore, scavenger species, such as **vultures** were also found to be controlled by wolf activity in which the depredation by wolves, provides preferable food sources for vultures (Stoykov, 2018). The absence of wolves also heavily influences abiotic factors of the ecosystem particularly due to overgrazing. Stream banks eroded because wetland plants were unable to gain valuable soil and sediments. Lake and river temperatures increased due to the failure of trees and shrubs to provide shaded areas (Evers, 2019).

WHY WERE GREY WOLVES ENDANGERED?

Grey wolves were/are highly susceptible to disruption of human activities. As stated earlier, grey wolves were ultimately exterminated by government sponsored programs due to complaints from farmers regarding depredation of livestock. Additionally, grey wolves were also hunted for sport and for their skins.

SCIENCE AS A HUMAN ENDEVOUR: *Application and Limitation / Influence*

The Application and Limitation aspect of Science as a human endeavour will be explored through the application of solutions along with impacts of factors such as society, economics and ethics. The Influence aspect will also be explored regarding the acceptance and use of scientific knowledge influenced by social and ethical considerations.

Biological understandings and studies have highlighted the significance of the grey wolf regarding the ecosystem, resulting in the *Endangered Species Act of 1973* (Robinson, 2006). This act is one strategy implemented to prevent the extinction of the wolf species, particularly in Yellowstone. This law provides support for the conservation of endangered animals while prohibiting any actions that cause deaths of these animals, including the grey wolf. However, factors to consider with this solution are social, economic, and ethical.



Figure 3: On December 28, 1973, President Nixon signs into the law the Endangered Species Act of 1973 (Glass, 2012).

It is believed that this solution could affect the **economy** in both a positive and a negative way. Research has found an extreme increase in tourism since the law, and the reintroduction of grey wolves, impacting the economy positively. In fact, it has been reported that at least 150,000 more people come to the park each year just to observe the wolves, which brings in \$35 million to the local economy (Oregon Wild, 2017). Additionally, the repair of damaged streams caused by the absence of wolves, cost local governments millions of dollars. Furthermore, trying to limit wolf population is expensive as the wolf extermination services require high funds. However, some economic losses also occur due to the depredation of cattle.

Scientific knowledge allows this negative impact on the economy through depredation of farm/ranch animals to be minimised through various implementations of strategies for farmers/ranchers such as the following:

- Range riders to monitor animals.
- Use of guard animals such as dogs, llamas and donkeys. If highly trained, dogs can act as protection against wolves however, in most cases dogs feel intimidated by wolves. Llamas bond easily with any herd or flock, and when it sees a predator or a threat it immediately charges, kicks and spits. Donkeys can intimidate and challenge predators like wolves by kicking, biting and charging. They can also alert farmers of an intruder with their loud alerting noise, due to their territorial nature (Harlow, 2016).
- Keeping farm/ranch clear of carcasses and downed animals that would attract wolves to the area. Wolves like to prey on carcasses, and downed animals are vulnerable as they are easy to hunt.

It is also essential that there is no random hunting of wolves in which the loss of a wolf disrupts the pack resulting in an increase of depredation of livestock. This is because the disruption of their pack leads them to hunt for livestock, which are reasonably stationary animals, instead of mobile animals such as deer and elk. As a result of intense conservation and restoration efforts, the grey wolf was finally fortunately taken off the endangered species list after four decades (U.S Fish and Wildlife Service, 2019).

The **social** impact of the government solution, is both positive and negative. Some people (particularly farmers/ranchers) disagreed with the act due to the depredation of animals. However, most of the negative social impact came from people who were uneducated, and unable to see the benefit of the wolf species (lack scientific knowledge) due to the stigma surrounding the species. Wolves are one of the most misunderstood species and are seen as '*vicious, four-legged, killing machines*'. However, this is evidently not the case, as they indirectly protect various species, saving more lives than they kill. Regarding **ethical** impacts, the application of solutions, are ethical of which long-term effects consist of the protection of various species, and the biodiversity of the ecosystem. The wolves are strongly monitored and strategies for farmers and ranchers are able to be implemented to ensure the protection of their livestock.

This is a demonstration of application and limitation along with influence as a science as a human endeavour.

CONCLUSION

Overall, the information collected through various sources demonstrates the impacts of the removal of the grey wolf from an ecosystem, evidencing its classification of a keystone species. Hence, it is clear that the presence of the wolf within Yellowstone, substantially increases the biodiversity of the ecosystem as it impacts the survival of various organisms. The situations and solutions implemented for the purpose of preventing the extinction of the grey wolf species, illustrates how scientific knowledge and society can beneficially intertwine to develop solutions to larger issues. Furthermore, the application and limitation aspect along with the influence of Science as Human Endeavour were addressed and demonstrated through the solutions and their economic, ethical, and social impacts.

Word count: 1566

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