SUPPLEMENT 12

WOLF AND MOOSE INTERACTIONS ON ISLE ROYALE, MICHIGAN (USA) (SCIENCE)

CHAPTERS 7, 8

Isle Royale, Michigan (USA), is an isolated island in Lake Superior. For more than four decades, wildlife biologists, led by Rolf Peterson, have been studying the relationship between the moose and wolf populations on this island.

In the early 1900s, a small herd of moose wandered across the frozen ice of Lake Superior to this island. With an abundance of food and no predators, the moose population exploded. In 1928, a wildlife biologist visiting the island correctly predicted that the large moose population would crash as a result of stripping the island of most of its plant food resources.

In 1949, timber wolves (probably a single pair) wandered across the frozen lake from Canada and discovered abundant moose prey on the island. They stayed and slowly grew in numbers.

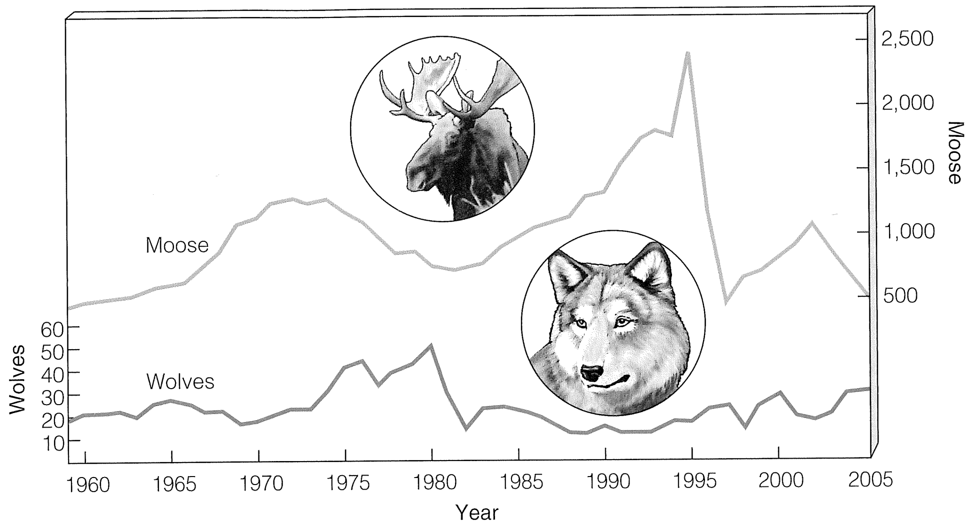

Figure 1 Predator–prey interactions between moose and wolf populations on Isle Royale, Michigan, from 1960 to 2005. (Data from Rolf O. Peterson)

Since 1958, wildlife biologists have been tracking the populations of the two species and found that they appear to be interacting in an oscillating predator–prey cycle (Figure 1). See Supplement 26 on pp. S73–80 for an article describing how scientists can track the movement of animals such as wolves.

The simple explanation is that between 1958 and 1970 there were not enough wolves to control the moose population so the number of moose increased. Then as the wolf population increased and preyed on moose the number of moose decreased. The decline in the moose population then led to a decrease in the wolf population because of fewer prey for the wolves. In turn, this allowed the moose population to increase and started the predator–prey cycle again.

But things are not that simple. Researchers have identified four other factors that affect this predator–prey interaction. *First,* warmer than normal *summers* increase tick populations that weaken moose and make them more vulnerable to their wolf predators. *Second,* warmer than normal *winters* reduce snow cover and allow moose to more readily escape capture by the wolves. *Third,* a canine virus introduced to wolves by dogs that migrated to the island may have weakened and killed some of the wolves. *Fourth,* the wolves may have a low reproduction rate because of a lack of genetic variability from inbreeding. Studying nature is fascinating!

Critical Thinking

What ecological lesson can we learn from studying the moose–wolf interaction on Isle Royale?

SUPPLEMENT 13

EFFECTS OF GENETIC VARIATIONS ON POPULATION SIZE (SCIENCE)
CHAPTER 8

Genetic Diversity and Population Size: Small Isolated Populations Are Vulnerable

Variations in genetic diversity can affect the survival of small, isolated populations.

In most large populations genetic diversity is fairly constant and the loss or addition of some individuals has little effect on the total gene pool. However, several genetic factors can play a role in the loss of genetic diversity and the survival of small, isolated populations. One called the *founder effect* can occur when a few individuals in a population colonize a new habitat that is geographically isolated from other members of the population (Figure 4-10, p. 92). In such cases, limited genetic diversity or variability may threaten the survival of the colonizing population.

Another factor is a *demographic bottleneck.* It occurs when only a few individuals in a population survive a catastrophe such as a fire or hurricane. Lack of genetic diversity may limit the ability of these individuals to rebuild the population.

A third factor is *genetic drift.* It involves random changes in the gene frequencies in a population that can lead to unequal reproductive success. For example, some individuals may breed more than others do and their genes may eventually dominate the gene pool of the population. This change in gene frequency could help or hinder the survival of the population. The founder effect is one cause of genetic drift.

A fourth factor is *inbreeding.* It occurs when individuals in a small population mate with one another. This can increase the frequency of defective genes within a population and affect its long-term survival.

Conservation biologists use the concepts of founder effects, demographic bottleneck, genetic drift, inbreeding, and island biogeography (Case Study, p. 146) to estimate the the *minimum viable population size* of rare and endangered species: the number of individuals such populations need for long-term survival.

Metapopulations: Exchanging Genes Now and Then

Separate subpopulations of mobile species can exchange genes regularly or occasionally if there are suitable corridors or migration routes.

Populations often live in areas where resources are found in patches. The individuals of a species that live in a habitat patch are called a **subpopulation.** Often areas of unsuitable habitat separate the subpopulations of a species located in suitable habitat patches. Most subpopulations are small and are thus vulnerable to being wiped out by diseases, invasions by predators, and local catastrophes such as fires, floods, or extreme weather. The smaller a subpopulation, the more likely it is to become locally extinct by such chance events.

This threat can be reduced if some individuals can move back and forth between different subpopulation patches. A set of subpopulations interconnected by occasional movement of individuals between them is called a *metapopulation.*

Some subpopulations where birth rates are higher than death rates produce excess individuals that can migrate to other local populations. Other subpopulations where death rates are greater than birth rates can accept individuals from other populations. Conservation biologists can map out the locations of metapopulations and use this information to provide corridors and migration routes to enhance the overall population size, genetic diversity, and survival of related local populations.