



Jacquelyn Fallon

# Island of Gray Wolves

*Using Isle Royale as a case study, students analyze predator-prey relationships with charts and a food web.*

## SECTION 2 Natural Systems

### Subjects:

*biology, geography,  
mathematics*



### Approximate lesson time:

*20 minutes*



### Materials:

*charts  
(make into  
overheads),  
data tables*

### STUDENT OBJECTIVES:

At the end of this unit, the student should be able to:

1. Describe an example of island biogeography.
2. Build a food web using Isle Royale animals.
3. Infer the effects of isolation on resident species.
4. Identify the impact that wolves have on moose population dynamics.

### VOCABULARY:

island biogeography •  
overbrowsing

### TEACHER BACKGROUND:

#### What is an island?

An island is an isolated body of land. Many types of islands exist on the earth. For example, an “island” could also be a forested area within a city, or an alpine meadow surrounded by mountains and forests on all sides. Island biogeography is the study of the distribution and population flux of animals and plants in any one of these isolated ecosystems.

#### What is Isle Royale?

Isle Royale is a group of islands located 15 miles from the north shore of Lake Superior. Isle Royale is also a national park. It consists of more than 400 islands totaling 133,782 acres of land, with 405,500 acres of water within park boundaries. Average Lake Superior water temperature is 40°F, bringing on hypothermia or death in a matter of minutes to those immersed in it. Crashing surf, rocky shores and cold water pose a formidable challenge to island access. More than 70 deaths in ten named shipwrecks have occurred on or near the island.

#### Wildlife on Isle Royale

In spite of all the challenges of survival, different forms of life have made it to the island. Many bird species have made the crossing to the island, although winds and strong air currents probably discourage any number of birds on any given day. Mammals comprise an interesting collection of creatures inhabiting the islands. There are at least 31 mammal species living on the north shore of Lake Superior, but only about 14 mammal species living on the Isle Royale islands.

Lynn and Donna Rogers /www.bearstudy.org



### **National Science Education Standards**

#### **Unifying Concepts and Processes**

*Systems, order,  
and organization*

*Evidence, models,  
and explanation*

*Change, constancy,  
and measurement*

*Evolution and  
equilibrium*

*Form and Function*

#### **Science as Inquiry**

*Abilities  
necessary to do  
scientific inquiry*

*Understanding about  
scientific inquiry*

#### **Life Science (5–8)**

*Structure and  
function in  
living systems*

*Regulation and  
behavior*

*Population and  
ecosystems*

*For more  
correlations,  
please see  
Appendix IV.*

These mammals include deer, mice, beavers, red foxes, four species of bats, mink, river otters, short-tailed weasels, snowshoe hare, red squirrels, moose, and wolves.

Wolves were first observed on the island in 1949, and moose arrived somewhere around 1900. At what point in history the other 12 mammal species arrived is still a mystery. Some animals used to live on Isle Royale but no longer do. These mammals include lynx (previous to 1930s), coyotes (arrived in the 1940s, gone by 1949), woodland caribou (last seen 1927), eastern chipmunks and striped skunks (both last seen in 1977), marten (disappeared early in 20th century), and red-backed voles (were reported in the 1800s). House mice and Norway rats were also present on the island at some point, introduced no doubt by humans, but did not persist.

#### **How did they get there?**

Perhaps many species wandered to the island from the mainland over frozen lake ice. Wolves, foxes, and otters have all been seen on Lake Superior ice. However, there is no reliable information as to exactly how the animals on Isle Royale did arrive. Full ice bridges connecting the island to the mainland require extremely cold, calm winters and are very rare.

It is believed that there are only two possible ways moose could have arrived on Isle Royale: walking over ice or swimming. In two documented cases of moose swimming in Lake Superior, one recorded a moose that was first spotted several miles off the shore of the island. The moose completed the swim but lay on the shoreline

for a long time afterwards. The other case was a moose seen by a boat captain swimming far into Lake Superior. It is not known for certain that moose swam to the islands, but moose seem to be very afraid of walking on ice, and thus it is highly unlikely that they would cross an ice bridge. Rumors of humans introducing moose to the island in the early 1900s remain unsubstantiated. The real truth remains a mystery.

#### **Which mammals never arrived and why?**

Most of the mainland mammals have not been successful in reaching the islands. Deer may have dispersed to the island by attempting the swim; however, many die of hypothermia and exhaustion, with their bones washing up on the shores of the islands. Likewise, porcupine skeletons have been found in beach detritus, perhaps also from an attempted swim. Even though black bears are good swimmers, they are also missing from the island.

Other common animals who have not colonized the islands include northern flying squirrels, woodchucks, three species of voles, five species of shrews, star-nosed moles, least weasels, fishers, lemmings, two species of mice, and raccoons.

#### **How hard is it to live there?**

Living in an island ecosystem puts a great deal of pressure on all species. Perhaps the most important pressure comes from overbrowsing by moose, which greatly affects the vegetative habitat of all the creatures. The isolation

also puts pressures on animals, as they must adapt to limited resources.

Moose and beavers inhabiting the same areas may be in conflict over food. Beavers often cut large diameter trees near their ponds. This may stimulate active regrowth of smaller trees, which moose will be attracted to. The intense browsing (eating) may prevent hardwoods from ever reaching the size preferred by beavers.

### ***Mammal Species on Isle Royale:***

*gray wolf*  
*moose*  
*beaver*  
*snowshoe hare*  
*red fox*  
*red squirrel*  
*deer mouse*  
*short-tailed weasel*  
*mink*  
*otter*  
*lynx*  
*muskkrat*  
*little brown bat*  
*Keen myotis (bat)*  
*big brown bat*  
*red bat*

### **How do moose impact Isle Royale's natural system?**

The effect that moose have on the ecosystem and its vegetation is enormous. When moose arrived on the islands, there were few or no predators and an abundance of food; thus, their population expanded rapidly (see enclosed chart and data table for actual numbers). Their food supply became over-browsed, and the

population went into a serious decline. Several large forest fires in 1936 and 1948 resulted in forest regeneration (especially in birch and aspen) in some areas, and the population began to recover.

### **How does vegetation impact moose survival?**

The amount of vegetation present determines how many moose survive (carrying capacity) and determines in part the moose's susceptibility to predation as well as their birth rates. Limited vegetation causes weak moose to become weaker and produce

smaller, weaker offspring. Vegetation studies measure the long-term effect moose may have on the plant communities. Researchers fence in plots of land to keep moose out and study how the vegetation differs. In these studies, it has been found that more than 89 percent of the vegetation is browsed adjacent to the control plots, demonstrating the heavy impact moose have on the vegetation.

### **How did the arrival of wolves impact moose population?**

Arrival of wolves in the 1940s appeared to stabilize the moose population numbers well below what the vegetation on the island could support. At first, it was thought that predators or pathogens were instrumental in limiting the moose population, but more recent research indicates that vegetation plays the biggest role in moose population dynamics. The amount of vegetation available in winter depends largely on snow depth; therefore, weather also plays a significant role in moose survival. Deep snow makes food inaccessible and travel difficult for moose, making them more susceptible to predation by wolves. Wolves tend to cull young and old moose from the population.

### **Humans on Isle Royale**

Humans have both visited and lived on Isle Royale for centuries. Native peoples used the island waters for fishing and mined copper from the hillsides. Early European settlers began visiting the island on steamships and eventually joined the fishing industry. Today the island is reserved for wilderness camping and biological research.

People are allowed to visit the island during the summer months only; winter is largely absent of human presence.

Biologists have been fortunate to use one of the greatest naturally isolated laboratories to study wolf and moose populations on Isle Royale. The wolf-moose study is the longest wolf-prey study anywhere in the world.

### **ACTIVITIES:**

Using Isle Royale as a case study, students will examine several aspects of the interrelationships existing there.

1. Conduct research on the types of mammals found on Isle Royale versus the north shore habitat of Lake Superior (the resources below are a good place to start).
2. Have students determine what species are available in each ecosystem, and construct a food web based on those animals.
3. Examine the enclosed charts. Begin with the moose population chart before the colonization of wolves on the island. Instruct students to analyze the chart and cite reasons for the tremendous spike in the moose population, and for a small rebound in moose population numbers later on.
4. Next, examine the chart of the moose population after the arrival of wolves. Direct students to come up with ways wolves may control a population of animals, such as by culling young and old (Note: Moose populations fluctuated before the arrival of wolves. The declining moose population from 1928–43 was probably due to a lack of

food, as moose overgrazed plants and trees on the island and then starved to death. Severe winters can also cause a drop in moose populations.)

5. Looking at the wolf population chart, have students determine possible factors for the rapid growth and rapid decrease of the wolf population. Answers may include an initial abundance of food, food scarcity and other factors such as disease.
6. Students may determine at least two factors in population control of a species based on the Isle Royale study.

### **ASSESSMENT:**

Each student should be able to list factors affecting the survival of populations of any given animal. These may include isolation, disease and food availability. A student should also be able to weave these factors together to form a more complex picture of predator impacts on prey and prey impacts on habitat.

### **EXTENSIONS:**

Students may use the data table of moose and wolf populations from Isle Royale to create graphs for discussion. Simple computer graphing programs may be helpful.



**Additional Resources:**

*Durward Allen. Wolves of Minong. Ann Arbor: University of Michigan Press, 1993.*

*Rolf Peterson. The Wolves of Isle Royale: A Broken Balance. Minoqua, WI: Willow Creek Press, Minoqua, 1995.*

*Napier Shelton. Superior Wilderness: Isle Royale National Park. Houghton, MI: Isle Royale Natural History Association, 1997.*

**Web sites:**

*Isle Royale National Park: [www.nps.gov/isro](http://www.nps.gov/isro)*

*Isle Royale Natural History Association: [www.irmha.org](http://www.irmha.org)*

**Background Information and Questions**

- In 1981–82, canine parvovirus entered the wolf population (probably carried onto the island by human visitors). Mark that spot with the word “virus” on your graph.
  - What effect did this virus, which affects wolf pups, have on the wolf population on the island?
- In 1996, Isle Royale experienced a severe winter. Mark that “severe winter” on your graph.
  - What effect did that winter have on moose populations?
  - Was the wolf population affected in the same way? Why or why not?
  - What long-term effect could the change in moose population have on the wolf population? Give reasons for your answers.
  - Identify at least two other severe winters based on your graph.
- Predict probable wolf and moose populations for the year 2010 and 2020. Give reasons for your answers.

### WOLF AND MOOSE POPULATIONS ON ISLE ROYALE

(data from 1960 on is from annual scientific monitoring;  
data from before 1960 is from sporadic monitoring and extrapolation)

Year	Wolves	Moose	Year	Wolves	Moose	Year	Wolves	Moose
(estimated data)			1971	20	1583	1990	14	1250
1915	0	200	1972	23	1507	1991	12	1313
1925	0	1900	1973	24	1634	1992	12	1590
1928	0	5000	1974	31	1478	1993	13	1879
1935	0	600	1975	41	1462	1994	17	1770
1945	0	500	1976	44	1277	1995	17	2422
1955	10	450	1977	34	1055	1996	22	1163
(actual data)			1978	40	1072	1997	24	500
1960	22	637	1979	43	939	1998	14	699
1961	22	639	1980	50	861	1999	20	750
1962	23	668	1981	30	797	2000	29	850
1963	20	717	1982	14	765	2001	19	900
1964	26	727	1983	23	783	2002	17	1100
1965	28	773	1984	24	813	2003	19	900
1966	26	898	1985	22	1100	2004	29	750
1967	22	1039	1986	20	1025	2005	30	540
1968	22	1299	1987	16	1380			
1969	17	1348	1988	12	1653			
1970	18	1522	1989	12	1397			

Source: Earthwatch Moose and Wolves Curriculum, and Dr. Rolf Peterson

