

Introduction to Our Class Case Study – Isle Royale

Background Information

Ecosystems are often difficult to understand because they usually include interactions among so many species. Isle Royale is different. It is a relatively simple island ecosystem, located 24 km from the shore of Canada in Lake Superior.



While there are many types of small animals on the island, and almost 20 types of mammals, only two species of the mammals that live on the island are relatively large. These are the wolves and the moose. On this island, wolves are the only predator of moose, and moose are essentially the only food for wolves.



It's important that some of our observations of nature include places like Island Royale where some of the relationships in the ecosystem are relatively simple.

How might studying an ecosystem with simple relationships between the organisms help us understand more complex places?

To understand nature it also helps to observe an ecosystem where human impact is limited. On Isle Royale, there are no towns and people do not hunt wolves or moose or cut the forest. It is a very rare place on the planet where wolves, their prey, and the plants that support the prey are all left unharvested by humans. Isle Royale is remarkable, because nature runs wild there.

Moreover, because the wolves and moose on Isle Royale are isolated from the mainland by the surrounding water, they are unable to leave.

Scientists have been taking measurements of the population of wolves and moose on the island since 1959. There was only one reported case of a single wolf migrating from mainland Canada in all the years since records were first kept. That single migration occurred in one extremely severe winter when the 24 km. of water between the island and the mainland froze over and the wolf walked across that ice shelf that winter to reach the island.

The population changes we might observe therefore are not the mere wanderings of wolves and moose to or from the island.

Since wolves can't typically migrate on or off the island, what other factors might cause the size of the wolf population to change from year to year?

Since moose can't typically migrate on or off the island, what other factors might cause the size of the moose population to change from year to year?

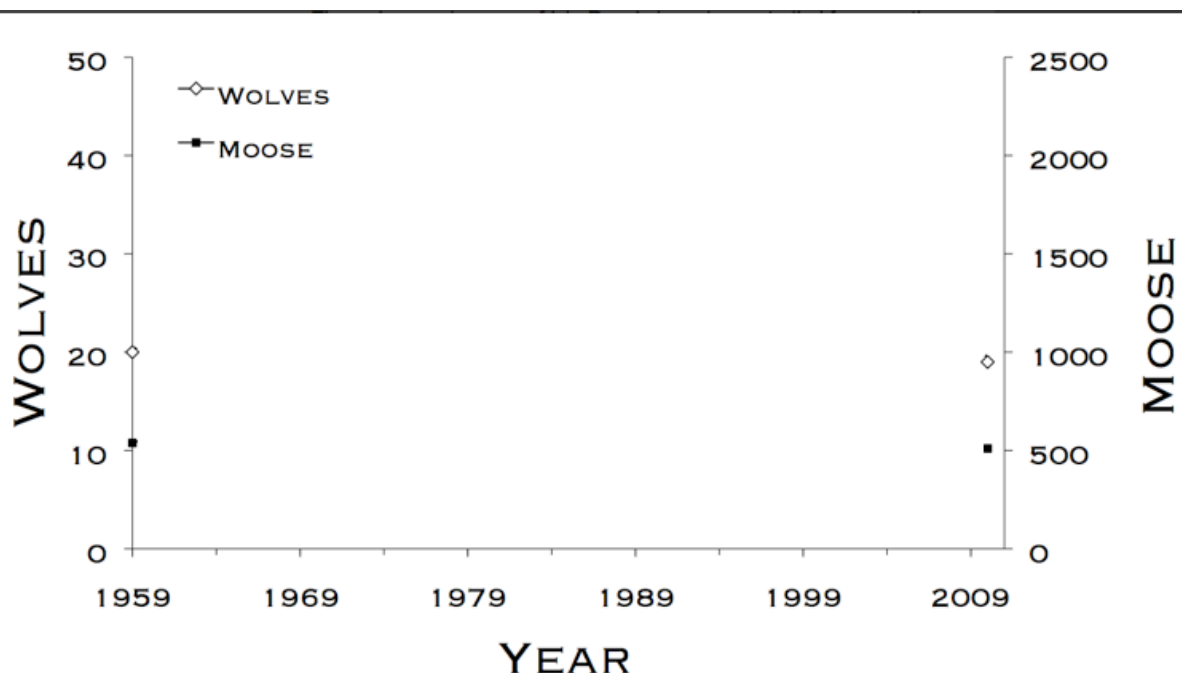
Predicting Population Sizes on Island Royale

Scientists counted the number of wolves and moose on Island Royale every year starting in 1959. Here is the data for 1959 and for 2010.

Year	Wolf Abundance	Moose Abundance
1959	20	538

2010	19	510
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In order to compare data from two populations, scientists plot the data using two different y-axes on the same graph. The y-axis on the left side of the graph below is the scale for the size of the wolf population. The y-axis on the right side of the graph below is the scale for the size of the moose population.



- 1) What is the maximum number of wolves that can be plotted on this graph according to the axis labels and intervals? _____
- 2) What is the maximum number of moose that can be plotted on this graph according to the axis labels and intervals? _____
- 3) Sketch the shape of the graph that you predict you will see for the size of the wolf population between 1959 and 2010. In a different color, sketch the shape of the graph that you predict you will see for the size of the moose population between 1959 and 2010

Your teacher will assign you to a team of four people to read the four pieces of background information on the wolves and moose.

- 4) Fill out the table below to record who will read, highlight, and summarize which packet of information.

Background Information Assigned	Who will read, highlight and summarize this packet
Packet A on the island wolves	
Packet B on the island wolves	
Packet C on the island moose	

Packet D on the island moose

5) After reading, highlighting, and summarizing what you discovered in packet individually, meet with the group members and share out the main discoveries you made from the data packet. Summarize each members discoveries in the chart below:

Background Information Assigned	Main Ideas / Discoveries
Packet A on the island wolves	
Packet B on the island wolves	
Packet C on the island moose	

Packet D on the island
moose

All about the island moose – Packet A

Selected text and images from <http://www.isleroyalewolf.org/overview/overview/moose.html>



Cows give birth to calves in late May when it is still cold and spring has not yet really arrived in the boreal forest. At this time cow moose are malnourished and not yet recovered from the past winter's ticks. It seems too early, but an early start is essential so that calves are prepared to survive winter.

At birth calves weigh only 30 pounds, but can walk within hours of birth. For the first two months of life, much of the calf's nourishment comes from the mother's milk. Calves begin testing different foods within a couple of weeks, and by late July calves eat large amounts of vegetation. By late fall, calves are fully weaned. At this time, healthy calves weigh 300 pounds, almost ten times their birth weight.

Typically, eight of every ten cows are pregnant each fall. By the following spring, twenty months later, only one or two of every ten cows still have a surviving calf. By some standards the survival of a calf is miraculous; by any standard it is against the odds.

During summer, moose consume thirty to forty pounds of vegetation a day. That would be like you or me eating 7 pounds of salad every day. Because each bite may contain

only a few grams of food, moose bite and chew several thousand times every day. Moose patiently feed for about eight hours every day.

Moose forage is voluminous, but not very rich in nutrition. To accommodate this kind of food moose possess one of the most complicated digestive systems in mammals. To get the most out of their food, moose digest it a bit, regurgitate it, chew on the cud, and re-swallow it for a second round of digestion. Moose patiently chew their cud about eight hours every day.

In preparation for winter, moose increase their body weight by as much as twenty-five percent, due to the extra food they store in their bodies. Imagine gaining twenty-five percent of your body weight by eating only vegetable salads – no salad dressing, just the salad.

All this extra food is stored in their bodies in the form of fat. This fat is used up over the course of the winter to provide the moose energy when they can't find enough vegetation to eat during the winter due to snow cover or loss of leaves from plants in the fall.

You may have noticed in the area where you live that some winters are more severe than others and some are milder. The amount of snow cover in the winter, the amount of rainfall in the spring and summer, and the temperature extremes over each season may vary from year to year.

What are some important factors you discovered in this reading that may affect the size of the moose population from year to year?

Notes on the reading:

All about the island moose – Packet B

Selected text and image from <http://www.isleroyalewolf.org/overview/overview/moose.html>

More than any other member of the deer family, moose spend time in the water. The moose's association with water is so distinctive that moose may appropriately be considered the hippopotamus of the north country.

Moose are well suited for spending time in water. They have long, strong legs allow moose to walk easily in shallow waters and swim in deeper waters. Moose also have large, complex noses that include massive cartilage, specialized muscles, folded and recessed skin, and fatty pads.



All these features may represent a complex, nostril-closing system, that allow moose to forage underwater without breathing in any water. Aquatic environments offer much to moose. Water brings coolness. In the water, moose reduce their respiration rate by almost 30%, and their overall energy expenditure by about 10%. Water also brings nutrition. Of all the food that moose consume, aquatic plants are the richest in protein and sodium. Water also brings safety. Even a weak, vulnerable moose is considerably safer from an attacking wolf when standing in just a few feet of water.

For moose, winter is full of suffering and triumph over that suffering, but not because of the cold. Moose are hardly bothered by cold. It is the difficulty of getting food. During winter, moose mostly eat twigs from deciduous trees and shrubs and the twigs and needles of balsam fir and cedar. Each bite of food is a mere gram – just 1/28th of an ounce – of nutritious material. Moreover, twigs and needles contain only one third the nutrition of leaves that moose eat during summer.

The fare is not only meager, but also difficult to gather. The snow is deep and moving from tree to tree is difficult and energy consuming. Imagine yourself walking through chest or knee deep snow from tree to tree collecting about nine thousand twigs – one twig at a time – every day. This is how moose – an 800 or 1000 pound creature – survive the winter.

When snow is deep and foods sparse, moose restrict their intake of food because the costs of eating exceed the gains. Moose pass much of the winter resting and ruminating, in solitude and hunger. Ultimately, moose lose weight every single day, for about five months of every year. Nevertheless, most moose live to see the spring that follows each winter.

What are some important factors you discovered in this reading that may affect the size of the moose population from year to year?

Notes on the reading:

All about the island wolves – Packet C

Selected text and image from <http://www.isleroyalewolf.org/overview/overview/wolves.html>



Wolves develop from pups at an incredible rate. Pups are born, in late April, after just a two-month pregnancy. They are born deaf, blind, and weigh no more than a can of soda pop. At this time, pups can do basically just one thing – suckle their mother’s milk. Within a month, pups can hear and see, weigh ten pounds, and explore and play around the den site. The parents and sometimes one- or two- year old siblings bring food back to the den site. The older wolves regurgitate the food for the pups. By about two months of age (late June), pups are fully weaned and eat only meat. By three months of age (late July), pups travel as much as a few miles to rendezvous sites, where pups wait for adults to return from hunts.

Pups surviving to six or seven months of age (late September) have adult teeth, are eighty percent their full size, and travel with the pack for many miles as they hunt and patrol their territory. When food is plentiful, most pups survive to their first birthday. But often, food is scarce and no pups survive. The life of a wolf is difficult and, typically, short. The chances of pup survival are highly variable. In some years and for some packs, most or all pups die. In other years, most or all survive.

Of the wolves that survive their first six to nine months, most are dead by three or four years of age. Every year, one in four or five adult wolves dies in a healthy wolf population.

A wolf may disperse from its natal pack when it is as young as 12 months old. In some cases a wolf might disperse and breed when it is 22 months old – the second February of its life. In any event, from 12 months of age onward, wolves look for a chance to disperse and mate with a wolf from another pack. In the meantime, they bide their time in the safety of their natal pack. Most wolves die in the process of dispersing. Dispersal is a tremendous risk, but one worth taking. Ultimately, the only thing that matters is reproducing. Reproduction is very unlikely within the pack to which a wolf is born. It is better to risk death for some chance of finding a mate and a territory, rather than live safely, but have virtually no chance of reproduction.

From birth until his or her last day, a wolf is linked to other wolves in a complex web of social relationships. The ultimate basis for these relationships is sharing food with some, depriving it from others, reproducing with another, and suppressing reproduction among others. Most wolves live in packs, a community sharing daily life with three to eleven other wolves. Core pack members are an alpha pair and their pups. Other members commonly include offspring from previous years, and occasionally other less closely related wolves.

Because territories are a pack's hunting grounds, giving up territory to other wolves is like giving away the family's much-needed food. Territories are large enough to contain all the prey that a pack needs.

The life of a wolf is largely occupied with walking. Wolves are tremendous walkers. Day after day, wolves commonly walk for eight hours a day, averaging five miles per hour. They commonly travel thirty miles a day, and may walk 4,000 miles a year.

Wolves living in packs walk for two basic reasons - to capture food and to defend their territories. Isle Royale wolf territories average about 75 square miles. This is small compared to some wolf populations, where territories can be as large as 500 square miles. To patrol and defend even a small territory, involves a never-ending amount of walking. Week after week, wolves cover the same trails. It must seem very ordinary.

What are some important factors you discovered in this reading that may affect the size of the wolf population from year to year?

Notes on the reading:

All about the island wolves – Packet D

Selected text and image from <http://www.isleroyalewolf.org/overview/overview/wolves.html>

For most North American and European humans eating a meal is a pretty simple affair: get some food from the cupboard, heat it up, and eat. What if every meal required exerting yourself to the point of exhaustion, holding nothing back? What if every meal meant risking serious injury or death? Under these circumstances, you might be happy to eat only once a week or so – like Isle Royale wolves.

Isle Royale wolves capture and kill, with their teeth, moose that are ten times their size. Think about it for a moment – it is difficult to comprehend. A successful alpha wolf will have done this more than one hundred times in its life.

Wolves minimize the risk of severe injury and death by attacking the most vulnerable moose. Wolves are incredible judges of what they can handle. Wolves encounter and chase down many moose. Chases typically continue for less than $\frac{1}{2}$ a mile.



During chase and confrontation wolves test their prey. Wolves attack only about 1 out of every ten moose that they chase down. They kill 8 or 9 of every ten moose that they decide to attack. The decision whether to attack is a vicious tension between intense hunger and not wanting to be killed by your food.

Typically, wolves consume impressive portions of their prey, eating all but the rumen contents, larger bones, and some hair. They routinely eat what you and I would not dream of eating – the stomach muscles, tendons, marrow, bones, hair and hide. They typically consume 80 to 100% of all that is edible.



But these eating habits make sense: starvation is a very common cause of death for wolves; killing prey requires a tremendous amount of energy and is a life-threatening prospect for a wolf.

While chasing and attacking a moose a wolf may burn calories at ten to twenty times the rate they do while resting – a wolf's heart beats at five times its resting rate. In comparison, a world-class human athlete can burn calories at no more than about five times the calories they burn at rest.

While burning all of this stored food to release and convert energy, wolves may eat only once every five to ten days. During the time between kills a wolf may lose as much as 10% of its body weight. However, a wolf can regain all of this lost weight in just two days of just eating and resting.

What are some important factors you discovered in this reading that may affect the size of the wolf population from year to year?

Notes on the reading: