

Name \_\_\_\_\_

Period \_\_\_\_\_

Regents Biology

Date \_\_\_\_\_

### LAB \_\_\_\_\_. NATURAL CONTROLS OF POPULATIONS

The size of populations in a community are regulated in many ways. Some of the controls acting on populations are:

- the amount of food and water available to feed the population
- the amount of nesting sites available to support raising young
- the size of the predator population
- the amount of disease and parasites infecting the population

Because of these limitations a certain area can only support a certain size population of each type of organism. The population size of each creature that the environment can support is called the **carrying capacity** of that community. This limit represents how many of a certain species that can survive in that area.

In this lab we will study two real life examples of populations, their natural controls, and the carrying capacity of their community.

#### THE KAIBAB DEER

In the early 1900s, the Kaibab plateau, north of the Grand Canyon in Arizona, supported a population of about 4000 deer on over 700,000 acres. Predators, such as coyotes, wolves, and pumas, helped to keep the deer population in check. It was estimated at the time that the plateau had a carrying capacity of about 30,000 deer, so that there seemed to be plenty of food for the population that existed.

Ranchers who moved into the area lost many sheep and cattle to the predators. Then on November 28th, 1906, President Theodore Roosevelt created the Grand Canyon National Game Preserve to protect the "finest deer herd in America." In an effort to save livestock and increase the deer population for tourists, the Forest Service tried to exterminate the predators of the deer. Between 1907 and 1939, 816 mountain lions, 20 wolves, 7388 coyotes and more than 500 bobcats were killed.

With the successful removal of many of the predators, the deer herd increased dramatically. But signs that the deer population was out of control began to appear as early as 1920 and the range (the deer habitat) was beginning to deteriorate rapidly. The food supply was being over-grazed by the high population of deer. Trees and grass were being damaged to the point they couldn't recover for next year's growing season. Soon there wasn't enough food to feed the growing population. By 1923, the deer were reported to be on the verge of starvation and the range conditions were described as "deplorable."

The Kaibab Deer Investigating Committee recommended that the number of deer be cut in half as quickly as possible. Hunting was allowed, and during the fall of 1924, 675 deer were killed by hunters. However, these deer represented only one-tenth the number of deer that had been born that spring. Over the next two winters, it is estimated that 60,000 deer starved to death.

Today, the Arizona Game Commission carefully manages the Kaibab area. Hunting permits are issued to keep the deer in balance with their range. Predators were re-introduced and are now protected to help keep herds in balance with food supplies. Tragic winter losses are now reduced by keeping the number of deer near the carrying capacity of the range.



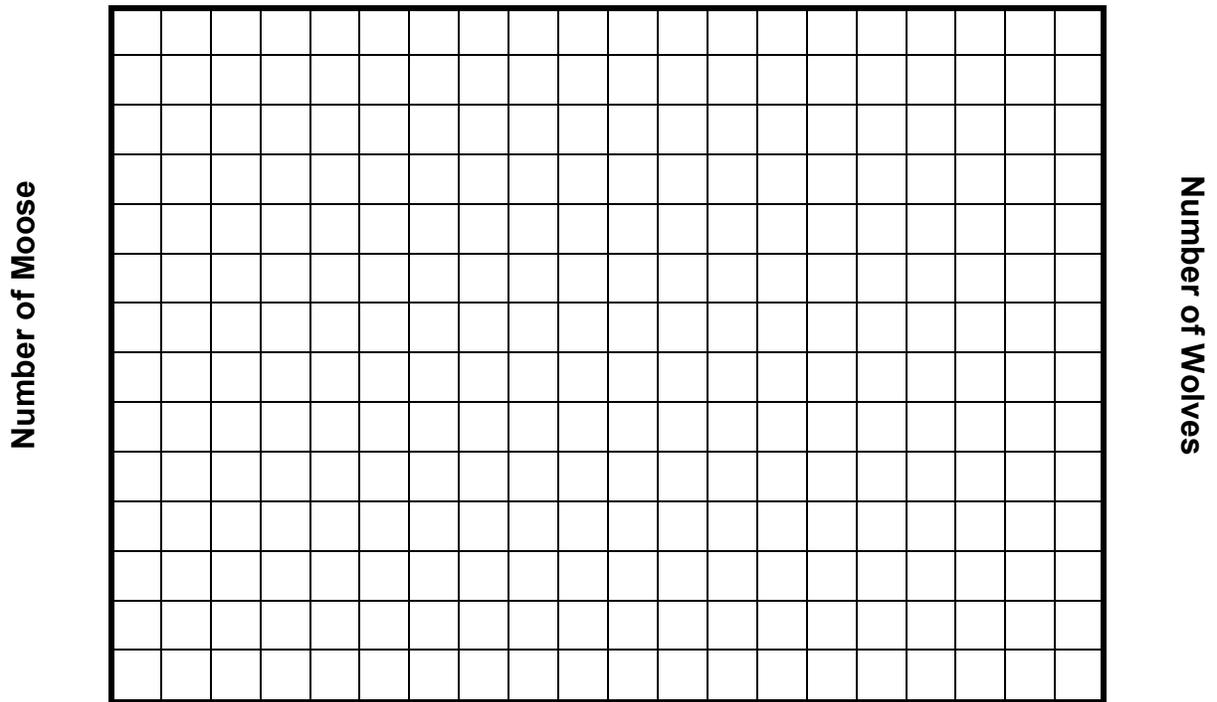
**THE MOOSE OF ISLE ROYALE**

Isle Royale is a forested island in the middle of Lake Superior in Michigan. The island is about 50 miles long and about 8 miles wide and is a protected forest reserve. A herd of moose lives on the island, but there were no moose-predators, like wolves, living on the island with them. In 1970 the moose population of the island was about 2000 animals. Although the island had excellent vegetation for feeding, the food supply obviously had limits. Thus the forest management personnel feared that overgrazing might lead to mass starvation. Since the area was too remote for hunters, the wildlife service decided to bring in natural predators to control the moose population. It was hoped that natural predation would keep the moose population from becoming too large and also increase the moose quality (or health), as predators often eliminate the weaker members of the herd. In 1971, ten wolves were flown into the island.

The results of this program are shown in the following table. The Population Change is the number of moose born minus the number of moose that died during that year. Fill out the last column for each year (the first has been calculated for you).

Year	Wolf Population	Moose Population	Moose Offspring	Predation	Starvation	Moose Population Change
1971	10	2,000	800	400	100	<b>+300</b>
1972	12	2,300	920	480	240	
1973	16	2,500	1,000	640	500	
1974	22	2,360	944	880	180	
1975	28	2,244	996	1,120	26	
1976	24	2,094	836	960	2	
1977	21	1,968	788	840	0	
1978	18	1,916	766	720	0	
1979	19	1,952	780	760	0	
1980	19	1,972	790	760	0	

1. Calculate the population change for each year and enter it into the last column in Table 2. The population change is equal to the number of moose that were born minus the number of moose that dies during the year.
2. Graph the moose and wolf populations on the graph below. Use the left axis for the moose population and the right axis for the wolf population. Plot each line using a different color.



**SUMMARY QUESTIONS**

**THE KAIBAB DEER**

1. During 1906 and 1907, what methods did the Forest Service use to protect the Kaibab deer?

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2. Were these methods successful? Use the data from your graph to support your answer.

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3. Why did the population of deer start to increase in 1905?

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4. Why did the population of deer decline drastically in 1925, even though their predators were eliminated?

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5. Why do you think the deer population size in 1900 was 4,000 when it is estimated that the plateau has a carrying capacity of 30,000?

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6. Based on these lessons, suggest what YOU would have done in the following years to manage deer herds.

a. 1915: \_\_\_\_\_

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b. 1923: \_\_\_\_\_

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7. What happens to populations as they reach or exceed the carrying capacity of their ecosystem?

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8. It is a criticism of many population ecologists that the pattern of population increase and subsequent crash of the deer population would have occurred even if the bounty had not been placed on the predators. Do you agree or disagree with this statement. Explain your reasoning.

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**THE MOOSE OF ISLE ROYALE**

9. Describe what happened to the moose and wolf populations between 1971 and 1980.

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10. What do you think would have happened to the moose on the island had wolves NOT been introduced?

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11. Most biology textbooks describe that predators and prey exist in a balance. This "balance of nature" hypothesis has been criticized by some scientists because it suggests a relationship between predators and prey that is good and necessary. Opponents of this hypothesis propose the following questions:

- a. Why is death by predators more natural or "right" than death by starvation?

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b. How does one determine when an ecosystem is in "balance"?

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c. Do predators really kill only the old and sick prey? What evidence is there for this statement?

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d. What is your opinion of the balance of nature hypothesis? Would the deer on the island be better off, worse off, or about the same without the wolves. Defend your position.

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