Name:

Lab: Population and Limiting Factors

BACKGROUND:

In nature, populations of organisms rarely grow uncontrolled. Each ecosystem has a carrying capacity or number of organisms it can sustain. Limiting factors are biotic and abiotic factors that prevent the continuous growth of a population. If the limiting factor plays a large enough role, the number of organisms in a population may be kept below carrying capacity. This activity will look at how different limiting factors impact population.

PROCEDURES:

1. Tape a 1 meter by 1 meter square on your lab table. This will be your population's environment.
2. Your initial mouse population consists of 100 mice. Scatter 100 beans randomly over the area. Each bean represents a mouse in the environment.
3. Your initial population consists of 4 hunting owls. Each of you will represent one of these owls
4. Using the ring provided to represent the owls. One at a time, each owl stands 1 meter from the glade area, tosses the "hunting" ring (to model the owl feeding), collects all beans (mice) located inside the ring and records it in the data table.
5. Each owl should take a turn feeding and recording how many mice they eat.
6. ***In order to stay alive, each owl must eat at least 4 mice in each three day period! (i.e. day 1-3, day 2-4 etc)*** If fewer than 4 mice are eaten in any three-day period, the owl grows too weak to hunt and dies.
7. Follow the specific instructions for each of the 3 investigations.

EXPERIMENT:

Investigation #1: Normal, rainy season (usually a favorable mouse population)
Starting with 100 mice, follow the procedure as written above. As each owl hunts **any mice caught MUST be removed BEFORE the next owl hunts**. Enter the numbers in Table #1. Continue as long as there is a surviving owl. Enter an X in the appropriate box on the table indicating the date of death (if it occurs).

Table #1:

Owl #	Number of Mice Eaten									
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
1										
2										
3										
4										
Total Mice Left										
Total Owls Left										

Investigation #1 questions:

1. Describe the "success" of the owl population (i.e. how many survived, how long did it take for any to die, etc.)

2. Describe the "success" of the mouse population.

Investigation #2: Dry Season

Lack of rain has led to drought-like conditions in the glade. 25% of the mice die (25 total). **Start with only 75 "mice"** in your environment.

Complete Table #2 for 10 days as in Investigation #1.

Table #2:

Owl #	Number of Mice Eaten									
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
1										
2										
3										
4										
Total Mice Left										
Total Owls Left										

Investigation #2 questions:

1. How did the dry conditions affect the hunting success of the owls as compared with Investigation #1? ***(Use data from data table as part of your response to compare).***

2. How did the dry conditions affect the success of the mouse population as compared with Investigation #1? ***(Use data from data table as part of your response to compare).***

3. What do you think would happen if the drought-like conditions had killed 50% of the mice?

4. Is this an example of a density dependent or independent factor? ***Explain***.

Investigation #3: Competitors Introduced

The spring season this year has been a successful one for the Eastern Garter Snake. Its numbers have increased by 25% and the owls are in direct competition with the snakes for mice. Begin with 100 mice; **remove 2 mice (beans) each day <u>BEFORE</u> each of the owls hunt (8 removed total each day)**.

Complete Table #3 for 10 days as in Investigation #1 and #2.

Table #3:

Owl #	Number of Mice Eaten									
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
1										
2										
3										
4										
Total Mice Left (after snakes and owls eat)										
Total Owls Left										

Investigation #3 questions:

1. How did the addition of competitors affect the survival rate of the owls?

2. Is this an example of a density dependent or independent factor? ***Explain***.

<u>ANALYSIS</u>:

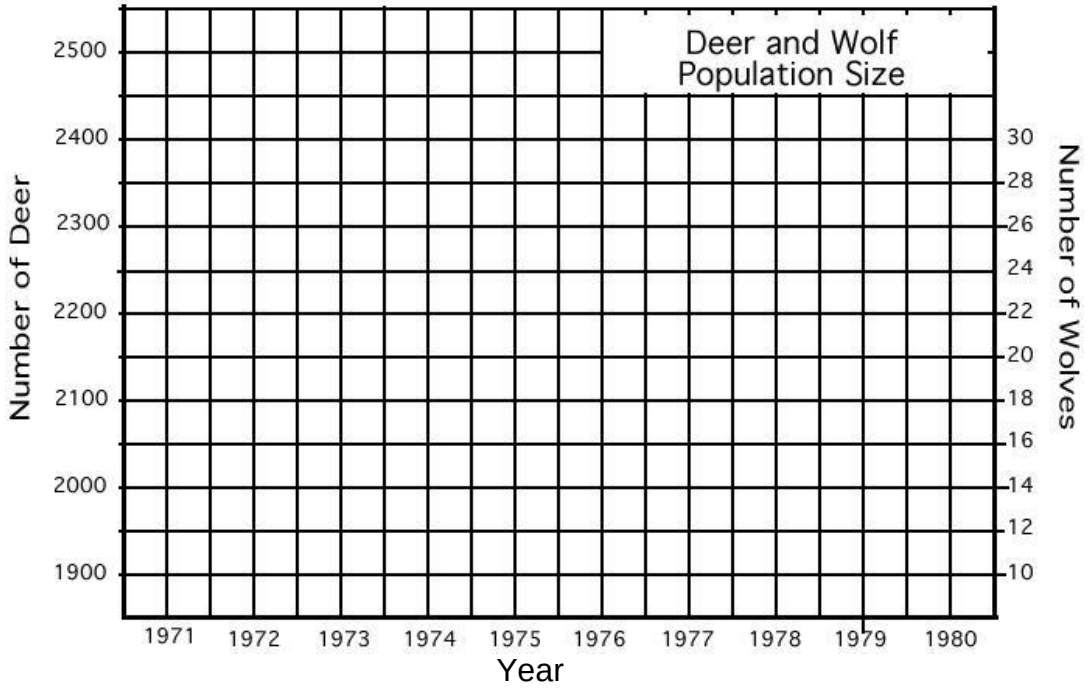
1. Read each situation in the chart below. Then, state if it is a density-independent (D.I.) limiting factor or a density-dependent (D.D) limiting factor. Then state the specific limiting factor that is occurring.

Situation	D.I. or D.D.?	Specific Limiting Factor
Northern pike (it's a fish) feed on another fish, the yellow perch. An increase in the yellow perch population causes an increase in the northern pike population		
The BP oil spill in the gulf of Mexico has harmed many aquatic organisms that live in the gulf region.		
A new strain of influenza (the flu) breaks out in New York City		
A population of rabbits and a population of deer are bot feeding off the same plants in the same habitat		
Hurricane Katrina forced thousands of people to leave New Orleans		
Due to humans putting increasing amount of greenhouse gases into the atmosphere and cutting down trees that would normally take up some of those gases, the Earth slowly gets warmer and changes climate around the globe. This effects the polar bear population.		

2. **Deer: Predation or Starvation**: Another type of limiting factor shown in the three investigations is the predator prey relationship. However, this limiting factor is better shown over longer periods of time. Read the following and answer the questions: In 1970 the deer population of an island forest reserve about 518 square kilometers in size was about 2000 animals. Although the island had excellent vegetation for feeding, the food supply obviously had limits. Thus the forest management feared that overgrazing might lead to mass starvation. The wildlife service decided to bring in natural predators to control the deer population. They hoped that natural predation would keep the deer population from becoming too large and increase the deer overall health), as predators often eliminate the weaker members of the herd. In 1971, ten wolves were introduced. The results are shown in the following table. The Population Change is the number of deer born minus the number of deer that died during that year. Fill out the last column for each year.

Year	Wolf Population	Deer Population	Deer Offspring	Death via Predation	Death via Starvation
1971	10	2,000	800	400	100
1972	12	2,300	920	480	240
1973	16	2,500	1,000	640	500
1974	22	2,360	944	880	180
1975	28	2,224	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

3. On the graph below, plot the deer and wolf populations as line graphs. Use one color to show the deer population and another color to show the wolf population.



4. Describe what happened to the deer and wolf populations between 1971 and 1980.

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

6. Is this an example of a density dependent or independent limiting factor? ***Explain***.