**Name:** **TOC#**

# 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.

## Pre-lab questions

1. Define the two types of limiting factors.

2. List at least 3 examples of density dependent limiting factors.

3. List at least 3 examples of density independent limiting factors.

## 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 80 mice. Scatter 80 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 pipe cleaners bent into 10 x 10 cm squares to represent the owls. One at a time, each owl stands 1 meter from the glade area, tosses the "hunting" square (to model the owl feeding), collects all beans (mice) located inside the square 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 a three day period!* 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 investigation

## Experiment

**Investigation 1: Normal season rainy season,** usually a favorable mouse population
Starting with 80 mice, follow the procedures for a normal season. 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 One

| 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, ect.)

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 (20 total). Add in only 60 “mice” to your environment.

Complete Table 2 for 10 days as in Investigation 1.

Table Two

| 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. 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.

3. How did the dry conditions affect the hunting success of the owls as compared with Investigation 1. (Use data to compare).

4. How did the dry conditions affect the success of the mouse population as compared with Investigation 1. (Use data to compare).

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

6. 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 80 mice; remove 2 mice (beans) each day before 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 (eaten by owl + 8 eaten by snake | | | | | | | | | | |
| Total owls left | | | | | | | | | | |

Investigation 3 questions:

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

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

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

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

**Analysis**

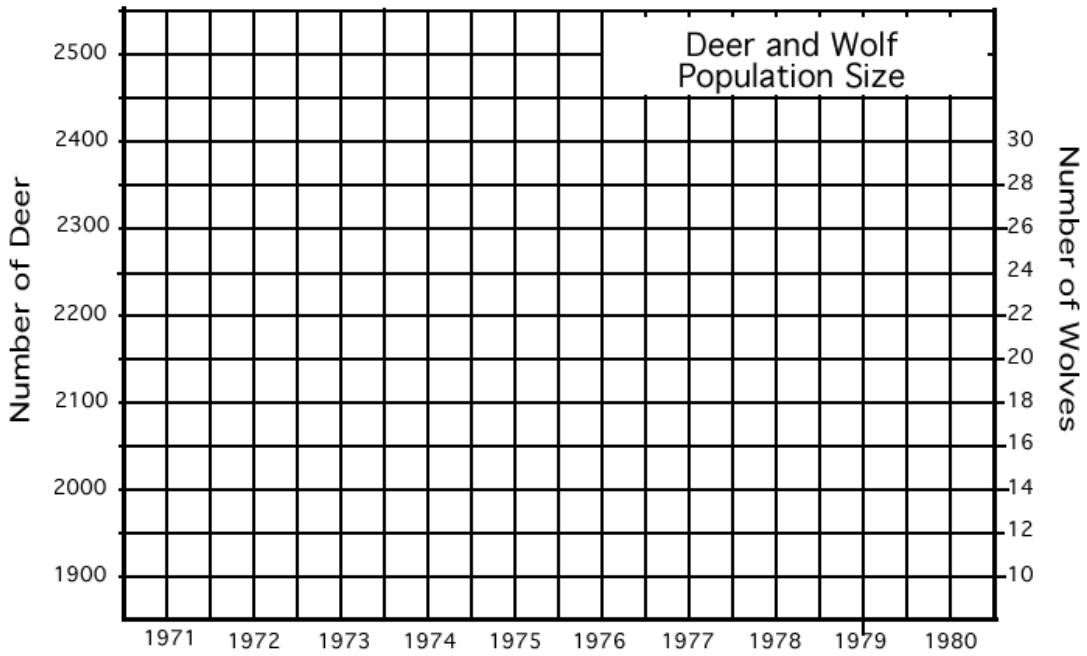
1. Read each situation in the chart below. Then, state if it is a density-independent (D.I.) limiting factor or a density-dependent (D.D) limiting factor. Then state the specific limiting factor that is occurring.

| 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 climates 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 | Predation | Starvation | Deer Population Change |
|---|---|---|---|---|---|---|
| 1971 | 10 | 2,000 | 800 | 400 | 100 | +300 |
| 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, graph the deer and wolf populations on the graph below. Use one color to show deer populations and another color to show wolf populations.




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.