Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Hour\_\_\_\_\_\_\_\_\_

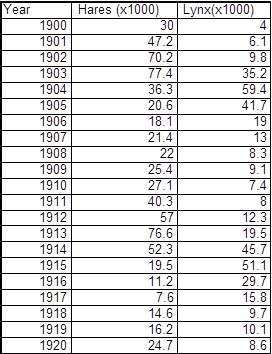
**Hare and Lynx Populations: Predator Prey Inquiry Lesson**

Populations are always changing. Sometimes changes are the result of humans interfering with food webs or habitats. But even when humans do not interfere, populations will still naturally shift up and down or fluctuate. As an example, we will look closely at the relationship between the Canada lynx and its primary prey, the snowshoe hare.

The *snowshoe hare* is a common species of rabbit found in North America, its range extending throughout Canada, Alaska, and into the northern United States. One distinctive quality is its 2 different coloration patterns – brown in the summer, and white in the winter to better camouflage with the snow. Its diet consists of grasses, berries, twigs, bark and leaves. The *Canada lynx* is a wild cat that resembles a large house cat with a short tail and prominent tufts on its ears. It is very secretive and even experienced hunters rarely see one in the wild. Its range overlaps with the snowshoe hare, on which it almost exclusively preys upon. Humans have been trapping the hare and lynx for over 300 years. Detailed records list the number of snowshoe hare pelts and the number of lynx pelts collected by hunters and trappers every year since the late 1700’s.

However, it is impossible to count the exact number of hare and lynx in Canada in any given year. Therefore, this information must be gained by capturing a small number of individuals and then estimating the actual number out in the wild.

Your job will be to identify the parts of a scientific investigation. Then graph the data making a double-line graph, one line representing the change in the hare population and the other representing the lynx population over a 20 year period. You will then pick out the patterns you see in the graph and come up with a logical theory of why these patterns exist.



1. Sample of data to graph

*On the graph paper provided*, use one color of pencil to graph the number of hares trapped each year between 1900 and 1920. Using another color graph the number of lynx trapped.

2. Make a problem statement for this investigation:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Make a hypothesis for this investigation:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. What is the independent variable?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. What is the dependent variable?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

6. What patterns do you notice? Describe 3 patterns:

a. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Scientists observe that as the hare population gradually increases, they eat more and more grass and seeds each year until the food supply becomes scarce. At that point, young hares have a difficult time finding enough food to survive and fewer babies are born.

7. ***On your graph, label these periods of hardship with arrows and a short description of what is happening in your own words.***

8. As the number of hares decreases, what do you think happens to the population of grass and seeds that the hares eat? Why?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9. After a few years, the hare population begins to increase. Why?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10. ***On your graph, label these periods of prosperity with arrows and a short description of what is happening in your own words.***

11. In general, are there more lynx or more hares? Why?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

12. Do the peaks in the lynx graph line up exactly with the peaks in the hares graph?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

13. When the hare population increases, what happens to the lynx population? Why?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

14***. On your graph, label these periods of prosperity with arrows and a short description of what is happening in your own words.***

15. Look at 1903 and 1904. Think about what is happening to the hares at this time. Is the presence of more lynx helping the hares or hurting them? Why?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

When the hare population declines, the lynx compensate by switching to other prey such as squirrels, gophers, mice and other rodents. However, while there are other prey around, there is not enough to support a large lynx population. When females are in poor condition, fewer will breed and not all of those bred will produce litters. Litters will be smaller, and most, if not all, of the few kittens born will die soon after birth.

16. ***On your graph, label these periods of hardship with arrows and a short description of what is happening in your own words.***

Check to see that your graph has 2 lines AND 8 arrows with labels.

Name ***ANSWER KEY*** Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Hour\_\_\_\_\_\_\_\_\_

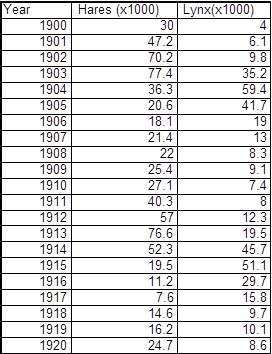
**Hare and Lynx Populations: Predator Prey Inquiry Lesson**

Populations are always changing. Sometimes changes are the result of humans interfering with food webs or habitats. But even when humans do not interfere, populations will still naturally shift up and down or fluctuate. As an example, we will look closely at the relationship between the Canada lynx and its primary prey, the snowshoe hare.

The *snowshoe hare* is a common species of rabbit found in North America, its range extending throughout Canada, Alaska, and into the northern United States. One distinctive quality is its 2 different coloration patterns – brown in the summer, and white in the winter to better camouflage with the snow. Its diet consists of grasses, berries, twigs, bark and leaves. The *Canada lynx* is a wild cat that resembles a large house cat with a short tail and prominent tufts on its ears. It is very secretive and even experienced hunters rarely see one in the wild. Its range overlaps with the snowshoe hare, on which it almost exclusively preys upon. Humans have been trapping the hare and lynx for over 300 years. Detailed records list the number of snowshoe hare pelts and the number of lynx pelts collected by hunters and trappers every year since the late 1700’s.

However, it is impossible to count the exact number of hare and lynx in Canada in any given year. Therefore, this information must be gained by capturing a small number of individuals and then estimating the actual number out in the wild.

Your job will be to identify the parts of a scientific investigation. Then graph the data making a double-line graph, one line representing the change in the hare population and the other representing the lynx population over a 20 year period. You will then pick out the patterns you see in the graph and come up with a logical theory of why these patterns exist.



1. Sample of data to graph (IN1D7a)

*On the graph paper provided*, use one color of pencil to graph the number of hares trapped each year between 1900 and 1920. Using another color graph the number of lynx trapped.

2. Make a testable question for this investigation: (IN1A7a)

***How does the amount of time in years affect the number of lynx and hares?***

3. Make a hypothesis for this investigation: (IN1A7a)

***If the amount of time in years changes, then the number of hares will increase as the number of lynx decrease***

4. What is the independent variable? (IN1A7b)

***Amount of time in years***

5. What is the dependent variable? (IN1A7b)

***Number of hare and lynx***

Red – Lynx

Blue - Hare

The Effect of the Amount of Time in Years on the Number of Hare and Lynx

100

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | Time of Prosperity more food available for hare |  |  |  |  |  |  |  |  |  | Time of prosperity  More food available for hare |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  | Prosperity for lynx  Hare population increase more food available |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Prosperity for lynx  Hare population increases more food available |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  | Lynx hardship |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Period of Hardship  Low food supply for hare |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  | Period of Hardship  Low food supply for hare |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | 1905 |  |  |  |  |  |  |  |  |  |  |  |  | Lynx hardship |  |  |

The Number of Hare and Lynx (x 1000)

75

50

25

0

1920

1915

1910

1900

Time in years

6. What patterns do you notice? Describe 3 patterns: (IN1D7a)

a. **Increase in hare population 1901-1903, followed by an increase in lynx population (but not as great an increase)**

b. **Decrease in hare population 1904-1910, followed by a decrease in lynx population (population very low)**

c**. Increase in hare population 1911-1913, followed soon by a lynx population increase (but not as great an increase as hare)**

Scientists observe that as the hare population gradually increases, they eat more and more grass and seeds each year until the food supply becomes scarce. At that point, young hares have a difficult time finding enough food to survive and fewer babies are born.

***More information: During peak years the hares devour all the available vegetation and quite literally breed like rabbits until the environment can no longer support their increasing population. As the hares become weaker by starvation, the lynx are better able to find and capture them, adding to the decline. The population does not reestablish itself immediately because it takes time for the vegetation to grow back. Also the lynx population determines the hare population. As the number of hares increases, so does the numbers of lynx that survive to eat them. Soon, there are too many lynx for the number of hare and the lynx eat away their favorite food until they also suffer a population decline, until the hare population also increases. Lastly, there is evidence that as the hare population peaks, stress caused by the increase of predators cause a decrease in the reproduction rate of hares.***

7. ***On your graph, label these periods of hardship with arrows and a short description of what is happening in your own words.* (IN1D7a)**

8. As the number of hares decreases, what do you think happens to the population of grass and seeds that the hares eat? Why? **(EC1B6c)**

**The number of grass and seeds population will start to increase due to less demand from the hares that have now decreased in population**

9. After a few years, the hare population begins to increase. Why? (**EC1B6c)**

**The vegetation has now increased in numbers, so there is more food available for the hare population. They will eat more and increase in population**

10. ***On your graph, label these periods of prosperity with arrows and a short description of what is happening in your own words.* (IN1D7a)**

11. In general, are there more lynx or more hares? Why? **(EC2A6b)**

**There will be more hare than lynx, lynx are higher level consumers and it will take more hare (prey) to supply enough energy to supply the lynx (predator) with the amount of energy it will need to survive. It takes many more lower level consumers to supply the energy needed to higher level consumers. Too many lynx and the lynx will starve**

12. **Do the peaks in the lynx graph line up exactly with the peaks in the hare graph? No the lynx peaks follow a few years later and they do not increase as much as the hares. The hare population must increase before the lynx population can.**

13. When the hare population increases, what happens to the lynx population? Why? **(EC1B6c**)

**When the hare population increases, the lynx population will also increase, but not as much as the hare population. (it takes more lower level consumers to support the higher level consumers) This happens because there is more food available for the lynx, they become healthier and more lynx are able to survive and breed**

14***. On your graph, label these periods of prosperity with arrows and a short description of what is happening in your own words.*  (IND7a)**

15. Look at 1903 and 1904. Think about what is happening to the hares at this time. Is the presence of more lynx helping the hares or hurting them? Why? **(EC1B6c)**

**Hare population is going down, lynx population went up which means more lynx are over-hunting and eating the hare. This is causing the hare population to also go down. This hunting will eventually cause the hare population to decrease putting less stress on the vegetation. This will allow the grass and seeds to grow and increase the food supply available for the hare population again allowing the hare population to increase with the increase of food supply.**

When the hare population declines, the lynx compensate by switching to other prey such as squirrels, gophers, mice and other rodents. However, while there are other prey around, there is not enough to support a large lynx population. When females are in poor condition, fewer will breed and not all of those bred will produce litters. Litters will be smaller, and most, if not all, of the few kittens born will die soon after birth.

16. ***On your graph, label these periods of hardship with arrows and a short description of what is happening in your own words.* (IND7a)**

Check to see that your graph has 2 lines AND 8 arrows with labels.