AP Environmental Science

Population Cycles

Part One- Oh Deer! - Population Simulation

Graphing Data- Using the data collected in the Oh Deer! Population Simulation (data table in your notebook) and the graph paper provided, plot the data for both the deer population change over 20 years time and the habitat abundance over 20 years time (2 lines, connect the data points). Use different colors or data points to distinguish between the deer and habitat lines. Be sure to include: evenly spaced intervals, a title, labeled axes, and a key.
→ Draw a line across your graph that symbolizes the carrying capacity.

Discussion Question (Answer this on a separate piece of paper and staple it to your graphs.)
Discuss the relationship between deer population and habitat as it is shown in your data. Include as many of the following terms and phrases as you can and underline them: carrying capacity, exponential growth, logistic growth, overshoot, population crash, cyclic population change, top-down population regulation or bottom-up population regulation, environmental resistance, and limiting factors.

Part Two- Hare and Lynx Populations

Populations are always changing, naturally shifting up and down; fluctuating. 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.

For over 300 years, the Hudson Bay Company has been involved in the fur trade in Canada. Detailed company 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. The data shows a 200-year history of cyclical population booms and busts in the snowshoe hare population and a slightly delayed population boom and bust in the lynx population. Native Americans observed this cycle long before Europeans began trapping the hares and lynx for their pelts. Yet there are many competing theories to explain why the populations cycle in so dramatic a fashion. These theories include:

An emerging and increasingly more widely accepted theory explains: during peak years, the hares devour all the available vegetation and quite literally breed like rabbits until the environment can no longer support their blossoming population. As the hares become weakened by starvation, the lynx are better able to find and kill them, adding to their decline. The population does not reestablish itself immediately because it takes time for the vegetation to grow back.

The traditional theory is that 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 hares and the lynx eat away their favorite food until they too suffer a population decline until the hare population can start growing again. Lastly, another theory provides evidence that at the peak population levels, the hares become so stressed by the increasing numbers of predators that they no longer reproduce at the same rate. Their population falls both as a result of the lowered reproductive success and the sheer number of lynx that are out to eat them.

Graphing Data

Using the graph paper provided, graph the number of hares trapped each year between 1900 and 1919. Then graph the number of lynx trapped each year between 1900 and 1919. Then graph the number of lynx trapped. (2 lines, connect the data points). Use different colors or data points to distinguish between the hare and lynx lines. Be sure to include: evenly spaced intervals, a title, labeled axes, and a key.

Year	Hares (x1000)	Lynx(x1000)
1900	30	4
1901	47	6
1902	70	10
1903	77	35
1904	36	59
1905	20	42
1906	18	19
1907	21	13
1908	22	8
1909	25	9
1910	27	7
1911	40	8
1912	57	12
1913	77	20
1914	52	46
1915	19	51
1916	11	30
1917	8	16
1918	15	10
1919	16	10
1920	18	8

Analysis Questions (Answer these on a separate piece of paper and staple it to your graphs.)

1. What patterns do you notice in the graph? (Describe the trends shown on the graph.)
2. As the number of hares *increases*, what do you think happens to the population of grass and seeds that the hares eat? **Why?**
2. As the number of hares *decreases*, what do you think happens to the population of grass and seeds that the hares eat? **Why?**
3. After a few years, the hare population begins to *increase*. **Why?** On your graph point out these periods with arrows and label them either "hardship or prosperity" and include short description of what is happening in your own words, next to the arrow.
4. Are there usually more lynx or more hares? **Why?** (Explain in terms of the trophic pyramid: primary, secondary, and tertiary consumers)**?**
5. When the hare population increases, what happens to the lynx population? **Why?** On your graph, point out these periods with arrows and label them "hardship or prosperity" and include short description of what is happening in your own words, next to the arrow.
6. 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?**
7. On your graph point out these periods with arrows and label them "hardship or prosperity" and include short description of what is happening in your own words, next to the arrow.

Discussion Question

Explain how these population cycles show both top-down population regulation and bottom-up population regulation. Distinguish between the emerging, more widely accepted theory and the traditional model, in which the predator and prey populations regulate one another. Which theory do you believe best explains the relationship between the snowshoe hare and Canada lynx population cycles? Why?