Population Growth

Background

In ecosystems, populations interact with each other and the abiotic environment. Therefore a change in size of a specific population in a community may have numerous effects on other populations in the community. Biologists consider that studying populations is one way of monitoring the health of ecosystems. Investigation of selected population changes in the natural environment and the laboratory enables biologists to develop generalizations that may be applied to all populations, including the human population.

Procedure

Part 1. A population simulation.

Population studies usually take time and often involve complex and expensive apparatus. Simulations, based on actual studies of open (individuals can move into and out of the population) and closed (individuals cannot move into or out of the population) populations, are frequently used to model populations and predict trends. The deermouse *(Peromyscus maniculatus),* one of a number of small, mouse-like species of mammals found across Canada, will be studied in the following simulation.

1 . Souris Island, located in a large lake, has an area of 1.0 km^2. Its habitat is ideally suited for deermice, but is too far from the mainland to allow them or other small mammals to migrate to it. However, natural predators of the deermouse do live on the island.

a) Name a natural predator of the deermouse likely to be found on the island and how it got there?

b) Under what naturally occurring conditions could deermice actually get to Souris Island?

2. A biologist released 20 breeding pairs of deermice on the island. They were left alone for two years to establish a population. Each year, for the next seven years, the deermouse population was measured and recorded.

3. Rather than measuring an entire population of animals, biologists obtain random samples and then estimate the total population size.

c) Why is this technique used in field studies?

4. An estimate of this kind was obtained on Souris Island by live trapping the deermice at random locations over a 5 d period. Animals were captured, marked and then released. Marked animals were counted only once. Each year the traps were set from July 10 to 14 in the same locations. The 3 lines of traps were assumed to capture deermice in an area equivalent to 500 m^2 (This is considered a valid sampling of a population.)

d) Why were the trapped animals marked?

e) Why were the traps set at the same time and location each year?

5. To make the estimate as accurate as possible, three separate trap lines were randomly located; the trapping results were combined each year and then averaged.

f) Why would this be a better technique than using a single line?

6. The trapping results over the seven-year period are listed in Table 1.

Table 1 - Trapping results for *P. maniculatus* over a seven year period on Souris Island

Year	Line 1	Line 2	Line 3
1	7	1	4
2	7	5	6
3	12	8	7
4	12	18	30
5	48	61	47
6	57	55	50
7	29	27	22

g) Determine the total number of animals trapped annually. Calculate the average catch for each year of the investigation. Tabulate your results.

7. Population patterns can best be examined by plotting population numbers on a graph, then joining the points to form a population curve.

h) Construct a graph of the population changes during the seven years of trapping. Plot the average population (responding variable; y-axis) against the time in years (manipulated variable; x-axis). *Leave sufficient room on your graph to extend the time axis over ten years.*

8. Examine the graph closely, noting the shape of the population curve you drew.

i) How would you describe the rate of growth during years one to three? What might account for this growth rate?

j) During what time span was growth the most rapid? How could you account for this population "explosion"?

k) What happened to the population between years five and seven? What might have been responsible for this growth pattern?

1) Based on the data, predict what might happen to the deermouse population over the next three or four years.

m) Is the growth curve characteristic of an open or a closed population? Explain.

n) If other mouse species had been living on Souris Island when the deermice were introduced, how might the population growth of the deermice have been affected?

9. The biologist decided to monitor the deerrnouse population for an additional three years. The results appear in Table 2.

Table 2. Trapping results for *P. maniculatus* over an additional three-years on Souris Island.

Year	Line 1	Line 2	Line 3	Total
8	30	26	25	81
9	26	29	20	75
10	26	24	28	78

o) Plot the average population number for each of the additional years on your original graph.

p) How does the additional data compare with your prediction in question (l)?

q) Based on the total data, make a long-term prediction about the fate of the deermice on Souris Island.

Questions for Application and Further Thought

1. Is it necessary to know the exact population of a species in order to follow its population changes?
2. Although a wide variety of *small* mammal species is found across the rest of Canada, the meadow vole (or field mouse) *Microtus pennsylvanicus* is the only species that naturally inhabits Newfoundland.

i) Suggest reasons for the lack of small mammals in Newfoundland.

ii) Suggest a possible explanation for the presence of the meadow vole in Newfoundland.

iii) Discuss the effects of introducing the deermouse to Newfoundland - on population growth, the ecosystem, and humans.

3. Compare a graph of global human population growth with your graph of the deermouse population.

i) Are there any similarities? Differences?

ii) Do we, as humans, live in a closed or open population? Comment.

iii) What do you think may happen to the human growth curve? Why?

iv) Based on your answer in (iii) above, how might your prediction affect individual humans?