

Ecological Sampling - How do Predator and Prey Populations Change?

Introduction

Predation is the interaction in which one organism consumes all or part of another. This includes predator-prey, herbivore-plant, and parasite-host interactions. These relationships are the prime movers of energy through food chains. They are an important factor in the ecology of populations, determining mortality of prey and birth of new predators.

In order to determine a population size, ecologists have to count individual organisms. In reality, a biologist cannot count each and every organism in an environment. Instead, they take a sample. This means they count capture and count some of the target organisms and then mathematically determine an approximate population size

Populations can change due to a variety of pressures (change in food supply, habitat destruction, etc.) Predators and prey have a unique relationship in that a change in predator population will have a direct effect on a prey population. The following is a model of this relationship.

Goal

1. Set up a model of predator and prey relationships
2. Observe changes in the populations due to various pressures or limiting factors
3. Construct a graph that shows the result of your population sampling.

Materials

101 – black beans, paper bag, 13 white beans

Procedure:

The James Hyde farm has not had people living on it since 1974. An interstate highway was put through the middle of the farm. Now there are only 100 acres of land left on this farm. In April of 1982, two biologists wanted to find out how the fox and rabbit populations were changing on the farm. They counted rabbits by trapping and releasing them. They counted foxes by looking for them with binoculars because the foxes would not go near the traps. They trapped and released 92 rabbits and saw 8 foxes.

1. Use the DATA TABLE – SAMPLING POPULATIONS table to record your findings.
2. Put **92 black beans** and **8 white beans** into a paper bag. The black beans represent rabbits and the white beans represent foxes. **This is the starting population for April 1982.**
3. To sample, shake the beans in the bag. Reach into the bag and remove one bean without looking into the bag. Put a strike mark in the table in the rabbit column if the bean is black. Put a strike mark in the fox column if the bean is white. **RETURN THE BEAN TO THE BAG AFTER COUNTING!!!!!!!!!!!!**
4. Repeat step 3 until you have a total of 25 marks.
5. Total up the strike marks for the rabbits and record it in the RABBIT TOTAL column for April 1982
6. Total up the strike marks for the foxes and record it in the FOX TOTAL column for April 1982.

7. Examine Table 2 – SAMPLING DATE AND POPULATION CHANGES. This table explains how to change your number of beans to reflect how the fox and rabbit populations at the Hyde farm have changed over a four year period of time.
8. After each date change in population, take a sampling like in step 3. Do this AFTER EACH CHANGE IN POPULATION.
9. Record your data in the DATA TABLE – SAMPLING OF POPULATIONS

TABLE 2 - SAMPLING DATE AND POPULATION CHANGES

Sampling Date	Rabbit population change	Fox population change
October 1982	Remove 10 black beans (Winter was harsh and food was low. Many rabbits died)	Add 2 white beans (Foxes ate pheasants. Fox numbers increased)
April 1983	Add 15 black beans (Food was plentiful, so more rabbits moved into the area)	Add 2 white beans (Foxes had larger litters of kits than usual)
October 1983	Remove 8 black beans (disease devastated the rabbit population)	Remove 3 white beans (Food was low so some foxes left the area)
April 1984	Add 12 black beans (Spring came early, so rabbits bred earlier)	Remove 4 white beans (less rabbits from disease, so some foxes starved)
October 1984	Add 4 black beans (fewer foxes means more rabbits survive to reproduce)	Add 8 white beans (there were lots of rabbits from the spring, so more foxes moved into the area)
April 1985	Remove 14 black beans (hunters killed the pheasants, so foxes had to eat more rabbits)	Remove 2 white beans (hunters also killed some foxes)
October 1985	Add 3 black beans (with less foxes, more rabbits survived to reproduce)	Add 4 white beans (more baby bunnies means more baby foxes were born)
April 1986	Remove 7 black beans (all those baby foxes ate the rabbits)	Remove 6 white beans (pollution from a sewage plant upstream killed many foxes)
October 1986	Add 19 black beans (with so few foxes, the rabbits multiplied rapidly)	Add 10 white beans (the large increase in rabbits provided a lot of food for the foxes.

Graphing Data:

1. On a sheet of graph paper construct a double line graph showing the population totals for both rabbits and foxes from the data recorded on the Data Table – Sampling of Populations. MAKE THE LINE FOR RABBITS ONE COLOR AND THE LINE FOR FOXES A DIFFERENT COLOR.
2. Be certain that you label all axes, give the graph a title, and create a legend.

Conclusions Questions

1. How did your sampling method (pulling beans from a bag) compare to the sampling method the biologists used for the rabbits? (think about what method the biologists used)
2. How did the sampling method (pulling beans for a bag) compare to the sampling method for the foxes?
3. List 2 factors (not mentioned in table 2) which could cause an increase in the rabbit population.
4. List 2 factors (not mentioned in table 2) which could increase the fox population.
5. List 2 factors (not mentioned in table 2) which could DECREASE the rabbit population.
6. List 2 factors (not mentioned in table 2) which could DECREASE the fox population.
7. Does the presence of the pheasants affect the rabbit population? Why or why not?
8. How can hunting foxes (a human activity) have an effect on the rabbit population? Use the data from your graph to support your answer?

Data table: Sampling of Populations

DATA	Rabbits (black beans)	Rabbits	Foxes (white beans)	Foxes
	Count	TOTAL	Count	TOTAL
April 1982				
Oct 1982				
April 1983				
October 1983				
April 1984				
October 1984				
April 1985				
October 1985				
April 1986				
October 1986				