Mark-Recaputure Population Sampling

Teacher Information

science take·out
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Summary

Students use the mark-recapture technique to determine the number of organisms in a simulated spider population.

Core Concepts

Analysis of data involves drawing conclusions and recognizing the limitations and possible improvements for experiments.

Time Required

One 40-minute class periods + homework.

Kit contains

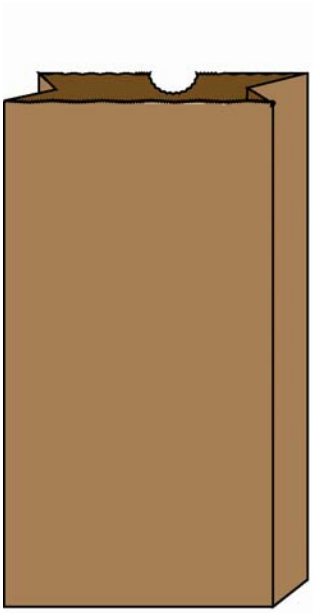
- Sheet of dot stickers
- Bag containing small plastic spiders and paper shreds
- Clip

Teacher Provides

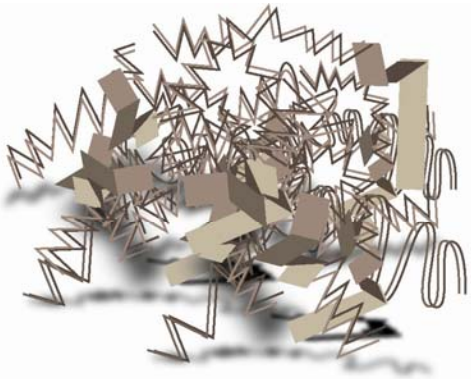
No additional material required

Warning: Choking Hazard
This Science Take-Out kit contains small parts. Do not allow children under the age of seven to have access to any kit components.

Kit Contents Quick Guide

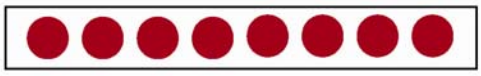


Bag



"Leaf Litter" (paper shreds)

Spiders



Stickers

Clip

Mark-Recapture Population Sampling

Mark-recapture is a population sampling technique commonly used by wildlife biologists who want to estimate the size of animal populations.

Using the mark-recapture method, a scientist will estimate population size by making two visits to the study area.

- During the first visit, the scientist will capture an initial random sample of the animals. These animals are then marked in some way and released.
- During the second visit, the scientist recaptures a second random sample of the animals. Some of these recaptured animals will be marked animals and others will not.

The scientist will then use a mathematical equation to determine an estimate of the total number of animals in the population.

$$N = \frac{MC}{R}$$

N = Estimate of total population size

M = Total number of animals captured and marked on the first visit ("Marked" animals)

C = Total number of animals captured on the second visit ("Captured" animals)

R = Number marked animals recaptured on the second visit ("Recaptured" animals)

Your Task:

In this activity, you will use the mark-recapture technique to determine the size of a spider population in sample of leaf litter. Leaf litter is dead plant material that has fallen to the ground and accumulated to form a layer on the ground. Leaf litter is a habitat for many small animals such as spiders, centipedes, and worms.

This activity is a simulation using plastic spiders and simulated leaf litter (paper shreds).

The bag in your kit contains a "population of spiders" (plastic spiders) in "leaf litter" (paper shreds).

1. Shake and turn the bag upside down several times to mix the plastic spiders and paper shreds. Then, open the bag but do not empty the contents of the bag.

2. Put your hand inside the bag and "capture" 10 spiders.

3. Mark each of the spiders that you captured by firmly attaching a small dot sticker to the center of each spider.

4. Record the number of spiders that you captured and marked (M) in the data table below. (Enter this number in the box on the first row of the data table.)

Data Table

Symbol in the equation	What the symbol stands for	Data from your experiment
M	**Marked** - The number of animals captured and marked during the first visit to the site.	
C	**Captured** – The number of animals (both marked and unmarked) captured during the second visit to the site.	
R	**Recaptured** – The number of recaptured animals that were marked.	
N	**Number** – The estimated number of animals in the population.	

5. Release all of the marked spiders back into the bag. Close the bag by folding the top and securing it with the clip.

6. Shake and turn the bag upside down at least 5 times to simulate movement of the animals in the environment.

7. Stick you hand in the bag and capture 10 spiders. These spiders will be both marked and unmarked spiders. Record the number of captured spiders (C) in the data table. (Enter this number in the box on the second row of the data table).

8. Count how many of the spiders in your recaptured sample are marked. Record the number of recaptured spiders that were marked (R) in the data table. (Enter this number in the box on the third row of the data table.)

9. Use the equation below to calculate the estimated number of spiders in the population (N). Show your work.

$$N = \frac{MC}{R}$$

10. Record the estimated number of spiders in the population (N) in the data table. (Enter this number in the box on the forth row of the data table.)

11. You used the mark-recapture technique to estimate the number (N) of spiders in the leaf litter population. Now let's see how accurate this estimate of the spider population size (N) is.

Empty the contents of the bag. Count the number of spiders that were in the "leaf litter" (bag). This is the actual number of spiders in the "leaf litter."

Estimated number of spiders in the "leaf litter" =

Actual (counted) number of spiders in the "leaf litter" =

12. Percent error calculation can be used to determine how accurate your estimate of the spider population is. The percent error for your spider population estimate is calculated using the following equation:

$$\textbf{Percent Error} = \frac{\textbf{(Estimated number of animals – Actual number of animals) X 100}}{\textbf{Actual number of animals}}$$

13. Calculate the percent error for your mark-recapture experiment. Show your work.

NOTE: *it is OK to have a negative number. A negative number for percent error indicates that your estimated number of spiders is less than the actual number of spiders in the population.*

14. If your estimate of the population size is accurate, the percent error would be 0. A high percent error indicates that your population estimate is not accurate. Complete the following statement:

As the percent error increases, the accuracy __(increases ***or*** decreases)__

15. Many things can affect the accuracy of the mark-recapture technique. Complete the chart below by indicating whether each of the following events will increase or decrease the percent error and accuracy of the experiment.

Event	Will the percent error increase or decrease?	Will the accuracy of the estimate increase or decrease?
Some of the marks (dots) fall off the spiders.		
You mark 15 instead of 10 spiders in the first visit to the site.		
Some new spiders move into the leaf litter between the first visit (when you marked the spiders) and the second visit (when you recaptured the spiders).		
You carefully look for and catch only marked spiders on the second visit.		
Marking harms the spiders.		

Applying what you learned about mark-recapture population sampling

An ecologist wants to estimate the size of a population of snapping turtles in a lake. She captures 20 turtles on her first visit to the lake, and marks their backs with paint. A week later she returns to the lake and captures 15 turtles. Five of these 15 turtles have paint on their backs, indicating that they are recaptured animals.

16. Complete the chart below.

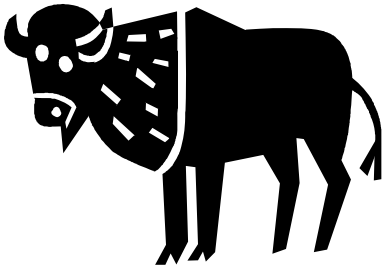
Symbol in the equation	What the symbol stands for	Data from your experiment
M	**Marked** - The number of animals captured and marked during the first visit to the site.	
C	**Captured** – The number of animals (both marked and unmarked) captured during the second visit to the site.	
R	**Recaptured** – The number of recaptured animals that were marked.	
N	**Number** – The estimated number of animals in the population.	

17. Use the equation to calculate the size of the snapping turtle population in the lake.

$$N = \frac{MC}{R}$$

In the early 1800's, an estimated 65 million bison roamed throughout the continent of North America. Hunting and poaching had a devastating effect on the bison population, and by 1890, fewer than 1,000 bison remained.

Laws were passed to protect the bison and the bison population began to increase. By 1997, there were approximately 3,500 bison in Yellowstone National Park.



18. Yellowstone National Park rangers have captured 100 bison. They would like you to design a mark-recapture experiment to estimate the size of the bison population. Describe how you would use the mark-recapture technique to estimate the size of the bison population in Yellowstone National Park.

19. A famous rock band has offered to do a free concert in your community. You are a news reporter who has been asked to estimate the number of people who attend the concert. You have 100 autographed concert tee shirts that you can use to "mark" people attending the concert. Describe how you would use the tee shirts and the mark-recapture technique to estimate the number of people who attend the concert.