SCIENTIFIC AMERICAN
FRONTIERS

TEACHING GUIDE

Alien Invaders

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Activity 3: Grades 5-8
Estimating a Snake Population

As you saw in the segment "The Silence of the Birds," alien brown tree snakes have destroyed the fragile balance of life on the island of Guam. To best understand this invasion, biologists must estimate the number of snakes in various land sectors. A successful method of estimation involves capture and recapture ratios. To identify a captured snake, an ID tag is implanted on the animal. This device is then used to identify recaptured individuals, a procedure which also helps to illustrate the dynamics of the tagged population.

In this activity, you will use the same technique employed by Guam researchers to estimate the population size of a tagged species. You will then critically analyze your data using a mathematical model.

OBJECTIVE
This activity page will offer:

- An introduction to estimating populations using capture/recapture statistics
- An opportunity to calculate estimated population
- An opportunity to critically analyze sampling techniques

MATERIALS

- Paper
- Pencil

The Scenario
You are part of an international project that is studying the population of
brown tree snakes in isolated sectors of a Pacific Island. The target animals are
captured in traps without injury. A tag is then implanted into each animal to
help identify the individual snake when released back in the wild.

Your responsibility is to uncover the total population of brown tree snakes in
the capture and release sector. Since the tagging began, there have been 750
captured snakes in a 20,000 m2 sector. You have been a part of two tagging
events that occurred three weeks apart.

Here is the data from each of those events:

9/01/01

      Total # tagged in population = 750 snakes
      # of snakes in this capture = 50 snakes
      # of snakes that are recaptured during this event = 30

9/22/01

      Total # tagged in population = 770 snakes
      # of snakes in this capture = 40 snakes
      # of snakes that are recaptured during this event = 30

Population Estimation
Use the following equation to estimate the total population of brown tree
snakes on both dates.

Equation for Estimating Population:

Total population = (# tagged in population) x (# of captures)
                                (# of recaptures)

QUESTIONS

1. What seems to have happened to the snake population during this three-
   week period?
2. Did the population really change as this calculation suggests?
3. If the results of this calculation are not guaranteed, why bother using it?
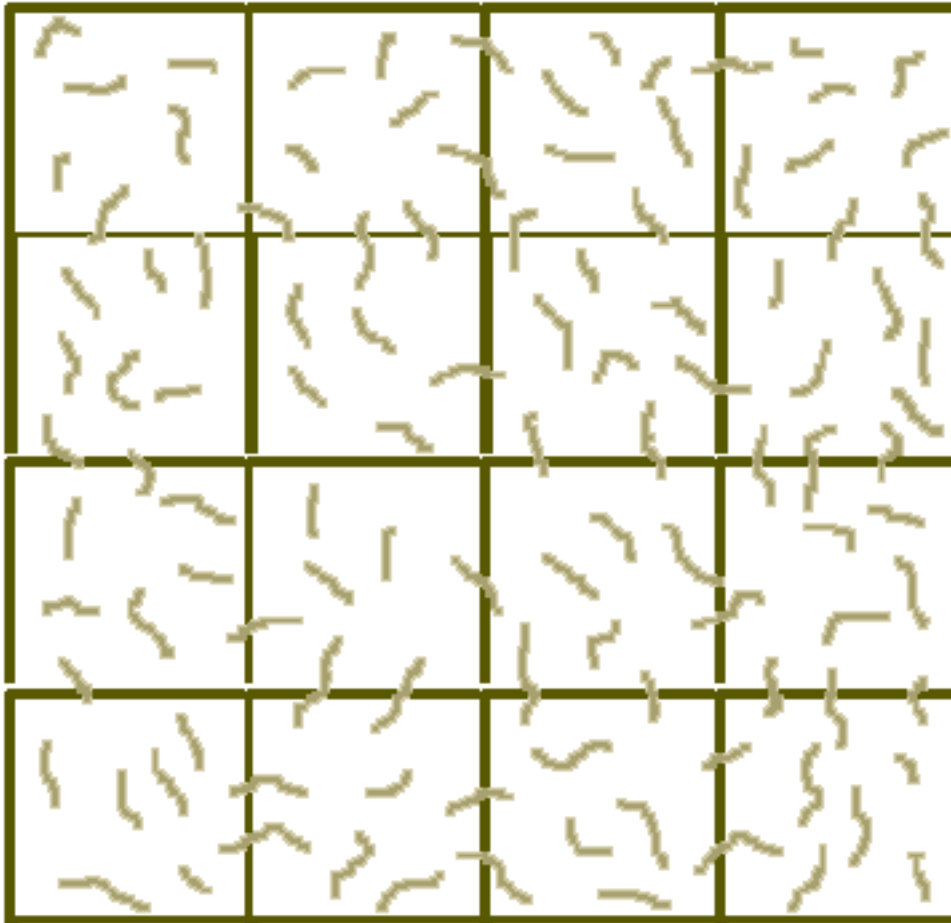4. What factors in the real world might compromise the accuracy of this
   method?

EXTENSIONS

Perimeter Trapping

The sampling techniques used by the Guam researchers uses perimeter trapping. Since the traps are set along the perimeter of a sensitive region (such as a bird nesting ground), the snakes must travel a greater distance to the trap. What are the advantages of this type of trapping as opposed to setting traps throughout the sector? What are its disadvantages?

Count the Boxes

An alternate method for estimating population involves random sampling of blocks within a larger grid matrix.

It represents a sector that is divided into 16 smaller blocks. Select any 4 random blocks. Count the number of "snakes" in each block. You will need to develop a set of counting rules that addresses snakes that span two or more boxes. To estimate the number of individuals in this entire grid, multiply the total number you counted by four. Discuss the advantages and disadvantages of this population estimation technique. Is this technique foolproof? Explain. What assumptions do you need to make when using this method?

WEB CONNECTION

Brown Tree Snake Trapping

http://members.tripod.com/allan_searle/snake/trappingbrowntreesnake.html
An extensive overview of the impact of the brown tree snake on Guam.

Policy Statement on Invasive Alien Species

http://www.fhwa.dot.gov/environment/inv_dot.htm
A US policy statement designed to impact the introduction of alien species.

Population Ecology

http://www.gypsymoth.ento.vt.edu/~sharov/popechome/welcome.html
A rich-resource site on population biology hosted by Virginia Tech.

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ANSWERS

Population Estimation

Use the following equation to estimate the total population of brown tree snakes on both dates.

Equation for Estimating Population:

Total population = (# tagged in population) x (# of captures)
                          (# of recaptures)

Calculations for 9/01/01:

Total population = (# tagged in population) x (# of captures)
                          (# of recaptures)

Total population = (750) x (50)
                          (30)

Total population = 1250 snakes

Calculations for 9/22/01:

Total population = (# tagged in population) x (# of captures)
                          (# of recaptures)

Total population = (770) x (40)
                              (30)

Total population = 1027 snakes

QUESTIONS

1. What seems to have happened to the snake population during this three-week period?
    (According to these calculations, the population decreased by about 223 snakes)
2. Did the population really change as this calculation suggests?
    (No one knows for certain. The only absolute way of finding out is to count each snake in the sector.)
3. If the results of this calculation are not guaranteed, why bother using it?
    (It is impractical to do an actual "headcount" of the snakes. Although this may not be 100% accurate, it is a good approximation of the snake population.)
4. What factors in the real world might compromise the accuracy of this method?
    (All sorts of factors such as animals learning to avoid traps, clustered distribution patterns, workers accidentally releasing captures, traps placed in regions that do not fairly sample the population, etc.)

EXTENSIONS

Perimeter Trapping
The sampling techniques used by the Guam researchers uses perimeter trapping. Since the traps are set along the perimeter of a sensitive region (such as a bird nesting ground), the snakes must travel a greater distance to the trap. What are the advantages of this type of trapping as opposed to setting traps throughout the sector? What are its disadvantages?
(Since you set the traps at the perimeter, you don't have to disturb the sensitive environment within the sector. It may be easier to check out traps that are placed along the sides of a square perimeter than following curved trails within the sector. The disadvantage is that it may take a while for the snake to travel to the trap. If the snakes don't move great distances, you may not collect a fair sample upon which to calculate the population.)

Count the Boxes
An alternate method for estimating population involves random sampling of blocks within a larger grid matrix. It represents a sector that is divided into 16 smaller blocks. Select any 4 random blocks. Count the number of "snakes" in

each block. You will need to develop a set of counting rules that addresses snakes that span two or more boxes. To estimate the number of individuals in this entire grid, multiply the total number you counted by four. Discuss the advantages and disadvantages of this population estimation technique. Is this technique foolproof? Explain. What assumptions do you need to make when using this method?

(Although answers will depend upon which boxes were selected and exact counting method, the answer should be about 120)