Name _____ Class _____ Date _____

Skills Practice Lab

MODELING

Estimating Wild Animal Populations

One popular and simple technique for estimating a wild population of animals is called the mark-recapture method. It works like this: Suppose that you want to estimate the population of goldfish in a pond. You catch, tag, and release 40 fish. A few days later, you catch 40 fish and notice that 10 of the fish were tagged from the first catch—in other words, they were recaptured. To estimate the population of fish in the pond you can use a mathematical model. Multiply the number of fish in the first sample *(M)* by the number in the second sample *(n)*, and divide the product by the number of "recaptures" *(R)* to get the population of fish in the pond *(N):*

$$\boxed{N = \frac{Mn}{R}} = \frac{\text{(first sample)} \times \text{(second sample)}}{\text{number recaptured}} = \text{estimated population}$$

To estimate the fish population,

$$\frac{40 \times 40}{10} = \frac{1600}{10} = 160$$

Therefore, the estimated number of goldfish in the pond is 160. For this model to give accurate estimates, you need to sample a fairly large population, and at least one animal must be captured in each sample. In general, the bigger your samples, the more accurate your estimate.

In this lab, you will practice the skill of estimating wild animal populations by setting up a model wild animal population in the lab. You will analyze the results of your lab and evaluate the use of the mark-recapture method as a good way to estimate a population.

OBJECTIVES

Construct a model of a wild animal population survey in the lab.

Survey and **estimate** wild animal populations using a pebble mark-recapture method laboratory model.

Analyze estimation data and evaluate the use of this method to estimate a population.

MATERIALS

- jar, 1-quart, plastic
- markers, 2 shades
- pebbles to fill jar

Procedure

PRACTICE USING THE MATHEMATICAL MODEL

1. You are an entomologist (a scientist who studies insects) trying to determine the population of Japanese beetles in your backyard. Two weeks ago you captured, marked, and released 100 beetles. Yesterday, you caught 40 beetles; 20 were recaptured from the first sample. Estimate the Japanese beetle population in your backyard. Show your work.

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TRIAL 1—USING THE MARK-RECAPTURE METHOD

2. Fill a jar halfway with pebbles. These pebbles represent a population of wild animals. Do not count the pebbles.

3. Remove a handful of pebbles from the jar. The handful represents your first sample of animals. Count the pebbles, and write the total on the line below. Mark each pebble in your sample with one of the markers. Return the pebbles to the jar and thoroughly mix them with the others.

_____

4. Remove another handful of pebbles from the jar, and record the total below.

_____

5. Count and record the number of pebbles that were "recaptured."

_____

TRIAL 2—USING THE MARK-RECAPTURE METHOD

6. Repeat steps 2–5 with the same jar of pebbles, but use a different marker. Record your data below.

Number in first sample = _____

Number in second sample = _____

Number recaptured = _____

7. Count the total number of pebbles in the jar. Record the number below.

_____

Analysis

1. Organizing Data Use Equation 1 to estimate the number of pebbles in the jar for both trial 1 and trial 2 data. Write your estimations on the line below.

_____

2. Analyzing Data Compare the actual number of pebbles recorded in step 7 of the Procedure with the estimates above.

3. Analyzing Data Analyze the following data examples and determine which would reflect the largest population and which would reflect the smallest. Explain your answer.

a. large first sample, large second sample, large recapture

b. large first sample, large second sample, small recapture

c. small first sample, large second sample, large recapture

d. small first sample, small second sample, large recapture

4. Analyzing Data Analyze the following situation. You are surveying two ponds, one large and one small, for goldfish. You catch, tag, and release 20 goldfish from each pond. The next day, you catch 20 goldfish from each pond and count 8 recaptures from the small pond and 2 from the large pond.

a. Estimate the population of goldfish in the small pond.

b. Estimate the population of goldfish in the large pond.

c. Why would a large pond tend to have fewer recaptures than a small pond?

5. **Analyzing Data** Analyze the following situation. You captured, marked, and released 5 turtles from a pond, and caught 10 unmarked turtles the next day. Would you have enough information to estimate the population using the mark-recapture method?

6. **Analyzing Results** Distinguish the following situation from the previous situation. If you captured and marked one turtle from a pond and captured the same turtle the next day, can you conclude that only one turtle lives in the pond? Explain your answer.

Conclusions

7. **Drawing Conclusions** Draw your conclusion on the use of the mark-recapture method for estimating a population. Is it a good way of estimating populations? Explain your answer.

8. **Applying Conclusions** Imagine that you are studying birds that are flying south for the winter. How might their migration affect the results of a mark-recapture study? Can you accurately estimate the migrating bird population using the mark-recapture method? Explain your answer.