

Names: \_\_\_\_\_

# Investigation: How do Biologists Estimate Population Size?



**Objective:** You will be expected to estimate the size of a sample population using the mark-recapture technique and compare the mark and recapture technique to other methods of population estimating.

1. You are given the responsibility of determining the number of fish in Horseshoe Lake. Discuss with your partner how would you accomplish this task and describe in detail below.

## Random Sampling Technique

A technique called **sampling** can be used to estimate population size. In this procedure, the organisms in a few small areas are counted and projected to the entire area. For instance, if a biologist counts 10 squirrels living in a 200-square foot area, she could predict that there are 100 squirrels living in a 2000 square foot area. This is a simple ratio.



2. A biologist collected 50 liters of pond water and counted 10 mosquito larvae. How many larvae would you estimate to be in that pond if the total volume of water in the pond was 80,000 liters? Show work.

3. What are some problems with this technique? What could affect its accuracy?

## Mark and Recapture Technique

In this procedure, biologists use traps to capture animals and mark them in some way. The animals are then returned unharmed to their environment. Over a period of time, the animals are trapped again, with researchers recording how many of the original tagged individuals are recaptured. The **ratio** of animals trapped with the tags and the animals trapped that were not tagged is used to estimate the overall population number.

### Procedure:

- Obtain a bag that represents your population (beans, pennies)
- Capture 10 “animals” by removing them randomly from the bag.
- Place a mark on them using tape or string
- Return the 10 marked “animals” to the container
- Without looking, use a scoop to **recapture** animals in the population. Record the number of “animals” recaptured in total and the number that have a mark on them on the data table
- Return the “animals” to the bag and repeat ten times.

## DATA

| Trial Number | Number Captured | Number Recaptured with mark |
|--------------|-----------------|-----------------------------|
| 1            |                 |                             |
| 2            |                 |                             |
| 3            |                 |                             |
| 4            |                 |                             |
| 5            |                 |                             |
| 6            |                 |                             |
| 7            |                 |                             |
| 8            |                 |                             |
| 9            |                 |                             |
| 10           |                 |                             |
| Total:       |                 |                             |

4. Calculations = Find your Population Estimate

$$\text{Population Estimate} = \frac{(\text{Total number captured}) \times (\text{Number marked})}{(\text{Total Number Captured with Mark})}$$

Estimated Size: \_\_\_\_\_

5. Use the code-name on your bag to check with the teacher about how many “animals” are really in your population.

Name on Bag \_\_\_\_\_ Actual Size \_\_\_\_\_

**Analysis**

6. Compare the actual size to the estimated size. Did you overestimate or underestimate?

7. **Continue** the experiment by filling out the data table.

Recalculate your estimate using the formula. (**Show below**)

a. Is the second estimate closer than the first one? \_\_\_\_\_

b. To get the most accurate results, you would generally do [ more / less ] trials . (circle)

8. Given the following data, what would be the estimated size of a butterfly population in Wilson Park.

A biologist originally marked 40 butterflies in Wilson Park. Over a month-long period butterfly traps caught 200 butterflies. Of those 200, 80 were found to have tags. Based on this information, what is the estimated population size of the butterflies in Wilson Park? **SHOW WORK.**

| Trial Number  | Number Captured                | Number Recaptured with mark    |
|---------------|--------------------------------|--------------------------------|
| 11            |                                |                                |
| 12            |                                |                                |
| 13            |                                |                                |
| 14            |                                |                                |
| 15            |                                |                                |
| 16            |                                |                                |
| 17            |                                |                                |
| 18            |                                |                                |
| 19            |                                |                                |
| 20            |                                |                                |
| <b>Total:</b> | (add original data + new data) | (add original data + new data) |

**Remove all the tags from your population before turning in your bag.**

9. He later does another capture exercise at the community garden near the high school. In this area, he captured and marked 40 butterflies. The traps in this location found 100 butterflies where 50 of them had tags. What is the population size of the butterflies at the school? **SHOW WORK.**

10. In what situations would sampling work best for estimating population size, in what situations would mark & recapture work best. You’ll probably have to think about this one. Justify your answer.