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

**Estimating Population Size**

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

1. If you were in charge of a team given the responsibility to determine the number of sunfish in Horseshoe Lake, discuss with your partner how would you accomplish this task and describe in detail here:

**Technique 1: Random Sampling**

The technique called random sampling is sometimes used to estimate population size. This is the method we used in yesterday’s lab. 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.

2. A biologist collected 1 gallon of pond water and counted 50 paramecium (unicellular microorganisms). Based on the sampling technique, how many paramecium could be found in the pond if the pond were 28,000 gallons? Show work here:

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

**Technique 2: Mark and Recapture**

In this procedure, biologists use traps to capture the animals alive and mark them in some way. The animals are returned unharmed to their environment. Over a long time period, the animals from the population are continued to be trapped and data is taken on how many are captured with tags. A mathematical formula is then used to estimate population size.

**Procedure:**

1. You will receive a bag that represents your population.
2. Capture 10 “animals” randomly from the bag. (DO NOT RECORD ANYTHING YET!)
3. Place a mark on each of the captured “animals” using a marker, pen, or highlighter.
4. Return the 10 marked “animals” to the bag. Give the bag a little shake to mix it up.
5. Without looking, select 10 “animals” from the bag one at a time. *This is the recapture step, or trial 1.* Record only the number of “animals” recaptured that have a mark in the data table besides the appropriate trial number.
6. Return the “animals” to the bag and repeat. Complete 10 recaptures.

**Data Table**

|  |  |  |
| --- | --- | --- |
| **Trial** | **Number Captured**  **This Trial** | **Number Recaptured with Mark This Trial** |
| 1 | 10 |  |
| 2 | 10 |  |
| 3 | 10 |  |
| 4 | 10 |  |
| 5 | 10 |  |
| 6 | 10 |  |
| 7 | 10 |  |
| 8 | 10 |  |
| 9 | 10 |  |
| 10 | 10 |  |
| **Total (add up all the trials):** | 100 |  |

**Calculations:**

In order to estimate your population size, follow this formula:

**Estimate\* of Total Population =**

***\* This formula is a modified model.***

4. What is the estimation of your population? Show work here:

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

Name of Bag \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Actual Size \_\_\_\_\_\_\_\_\_\_\_

**Analysis:**

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

7. *Continue* the experiment, adding another 10 trials to the trials you already have. (MAKE SURE YOU ADD THE AMOUNT CAUGHT W/MARK FROM THE FIRST TABLE ON THE PREVIOUS PAGE!)

|  |  |  |
| --- | --- | --- |
| **Trial** | **Number Captured**  **This Trial** | **Number Recaptured with Mark This Trial** |
| 11 | 10 |  |
| 12 | 10 |  |
| 13 | 10 |  |
| 14 | 10 |  |
| 15 | 10 |  |
| 16 | 10 |  |
| 17 | 10 |  |
| 18 | 10 |  |
| 19 | 10 |  |
| 20 | 10 |  |
| **Total (add up all the trials):** | 200 |  |

8. Recalculate your estimate using the formula and the added data. Show work here:

9. What does this say about the number of trials that should be conducted in a real mark & recapture?

10. 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 your work here:

11. In what situations would random sampling work best for estimating population size? In what situations would mark & recapture work best? **Explain your answer**.