Lab: Capture - Mark - Recapture

INTRODUCTION

Ecologists often spend time out in the field studying the various biotic and abiotic components that make up the ecosystems that they are interested in researching. Such factors may include things like water quality, soil type, and various species of plants and animals. One important element of an ecosystem that scientists may be interested in is **animal populations**. They may want to know how many individuals of a particular species reside in a specific habitat.

Researchers may find such information important to understanding an ecosystem's food web, or the scientists may want to use population data to determine whether or not a threatened species is declining. Observed population fluctuations may be normal or they may indicate that the ecosystem is out of balance.

Unfortunately there is no easy way to count all the members of an animal population in an ecosystem. Animals move from place to place; they hide, they hibernate, and they camouflage themselves. Surveying a large tract of land trying to count all the members of a species would be extremely time consuming and expensive. In other words, conducting a census, which is the counting of every single individual in a population, is simply impractical if not impossible. So researchers have developed a more efficient method.

This method is called the **capture-mark-recapture technique** and is used to make a meaningful estimate of an area's animal population. With the capture-mark-recapture method, instead of trying to count every animal in an ecosystem, you randomly capture a sample group of the population, mark it, release it, and then do a series of recaptures that will allow you to estimate the entire population under study. The ratio between the marked and unmarked animals is the key to estimating the species population for the entire ecosystem. Watch this video on YouTube to see how this technique can be used to estimate the number of bees in a hive.

Scientists must capture animals carefully in an effort to avoid injury and trauma. A wide variety of techniques are used to mark animals that have been captured. Birds will have small bands put around their legs, fish will have one of their small fins clipped, mice and rats will have their tails painted, tortoises will have their shells tagged, and larger mammals may have collars attached.

The accuracy of this method rests on a number of assumptions, including the following:

1. During the interval between the preliminary marking period and the subsequent recapture period, nothing has happened to upset the proportion of marked to unmarked animals (that is, no new individuals were born or immigrated into the population, and none died or emigrated out of the area beyond natural rates).
2. Chances for each individual in the population to be caught are equal and constant for both the initial marking period and the recapture period. That is, marked individuals must not become either easier or more difficult to catch.
3. Sufficient time must be allowed between the initial marking period and the recapture period for all marked individuals to be randomly dispersed throughout the population (so that

assumption 2 above holds). However, the time period must not be so long that assumption 1 breaks down.

4. Animals are not affected by their marks (i.e., their survival, catchability, ability to migrate, reproductive ability in the time interval are all unaffected by the marks).

5. Animals do not lose their marks.

OBJECTIVE

The purpose of this activity is to have students participate in a simulation that demonstrates the capture-mark-recapture method of population assessment used by ecologists in the field. Furthermore, students should discover that using a scientifically based formula for determining ecosystem populations is more accurate than a non-scientific visual estimation. In addition, students will learn how to calculate the percent error between the actual population and their scientific and non-scientific estimates.

MATERIALS

- ➔ Two medium-size plastic cups for each table
- ➔ White, quarter inch plastic beads (in container – 8 oz)
- ➔ Red, quarter inch plastic beads (in container – 4 oz)
- ➔ Data table spreadsheet (found on Canvas)

PROCEDURE

A. Take a close look at the white beads in the cup and do a visual estimate of how many beads you think are in the cup. You and your group should do separate estimates. Write your visual estimate in step 1 below. This estimate will be compared to your population estimate and to the actual count.

   - ★ **Visual estimate** of the number of beads in the cup: #

B. Now dig your hand into your cup of beads and "capture" a medium-sized handful of "animals" (beads). Carefully count each bead. Record this number in Step 2 below. Replace your captured beads (white) with the same number of plastic beads of a different color (red) – these red beads now become your marked animals. (this is the only time that you will replace white beads with red beads)

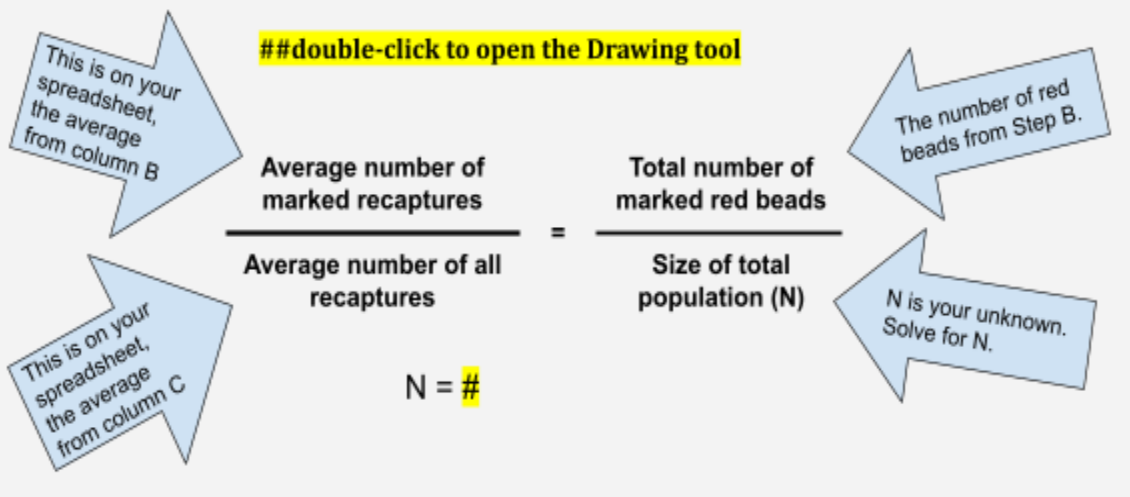
   - ★ **Number of marked red beads** from your first capture: #

C. Put this marked group back into the cup and thoroughly mix up the beads.

D. Now it is time to do a series of recaptures. Dig your hand back into the cup to grab a medium-sized handful of beads. First, count the total number of beads in your recapture *(count both red and white beads*) and then make a count of all the ones out of that recapture that were marked *(red beads)*. Use the spreadsheet data table to collect your data. You can find this on the Canvas page for this assignment, the same place you found this Doc. Once you are done, put all of these beads back into the cup. Repeat this recapture procedure 19 more times recording all your data in the spreadsheet.

E. Once you are done with 20 recaptures, use your spreadsheet to find the average number of beads for all recaptures and then the average number of marked recaptures.

F. Put these two averages along with the number in the first sample count into the formula below. Solve for N and calculate the population estimate of beads in the cup.

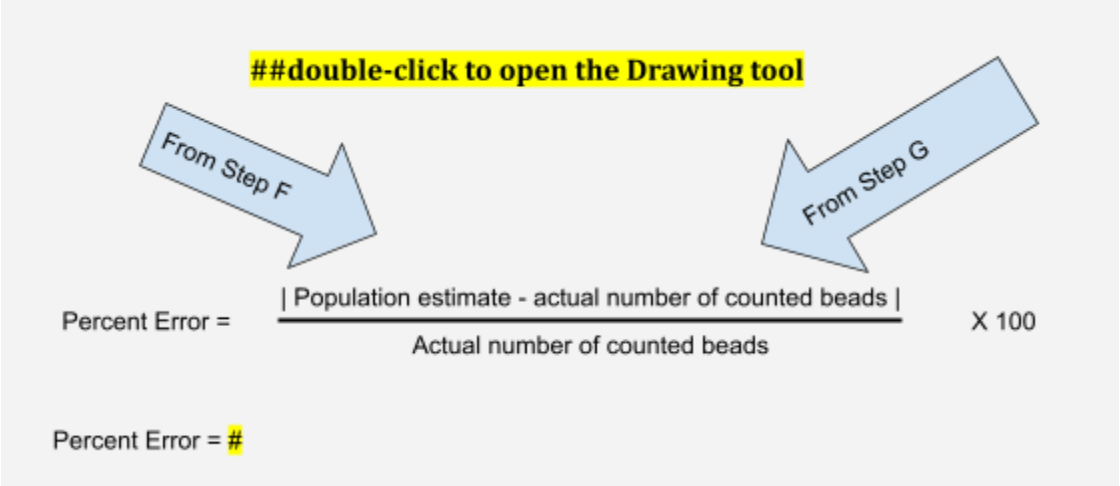


★ **Population estimate** of the number of beads in the cup: #

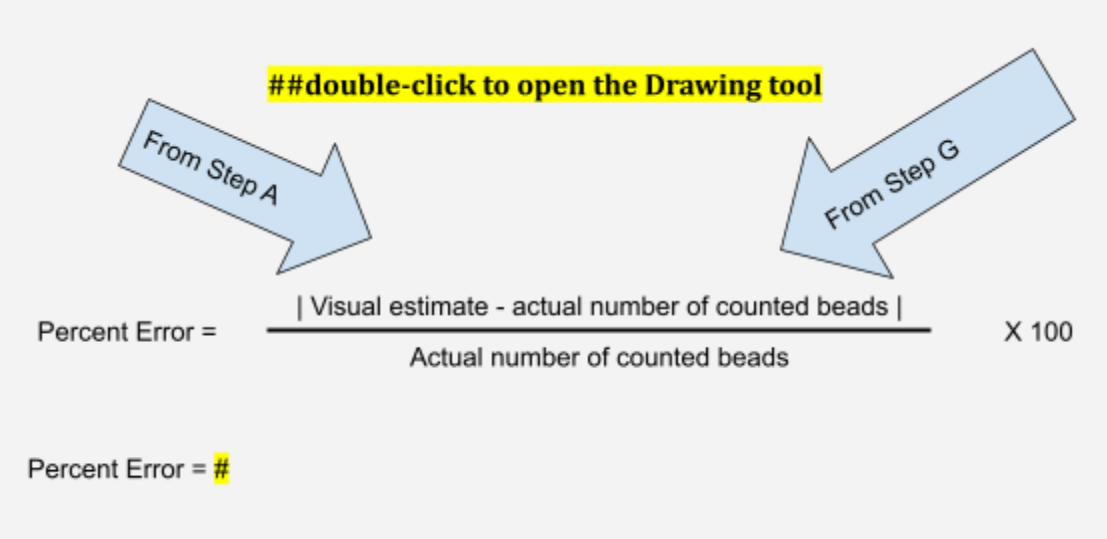
G. Now dump the beads out of the cup and carefully count each and every bead to determine the actual count. Record the actual number of beads in the "population."

★ **Actual number of beads** in the cup: #

H. Determine the percent error between your population estimate and the actual count for Step 6. An error rate of less than 5% would indicate that your population estimate is a reliable indicator of the actual total population. An error rate of more than 10% is an indication that your population estimate is flawed.



I. Determine the percent error between your visual estimate and the actual count for Step 7.



QUESTIONS

1. Make a claim! Which is more accurate, your visual estimate or your population estimate? ***Support with data!*** Why do you think this is so?
    a. #
2. Why might an ecologist need to know an estimate of a population's size?
    a. #
3. Why might migration affect the population size estimates you might make in the field?
    a. #
4. Please identify two reasons why ecologists would want to use a scientific technique of determining ecosystem populations as opposed to doing an actual count of all the animals in an area.
    a. #
5. What are some of the behaviors and characteristics of animals that make it difficult for scientists to get an accurate count of their populations in the wild?
    a. #
6. What are a few reasons why the capture-mark-recapture technique is not accurate?
    a. #

//END