ESTIMATING ANIMAL POPULATIONS ACTIVITY

VOCABULARY

mark
capture/recapture
ecologist
percent error
ecosystem
population
species
census

MATERIALS

- Two medium-size plastic or paper cups for each pair of students
- One-half of a cup of white beans (pinto will work if you use black marker) or one-half a cup of quarter inch plastic beads (all the same color)
- Marking pen or additional quarter inch plastic beads of the same shape but a different color from the one's just mentioned
- Data recording sheet

PROCEDURE

1. Fill your plastic cup one-half the way with beans

2. Take a close look at the beans in the cup and do a visual estimate of how many beans you think are in the cup. You and you partner should do separate estimates. Write your ***visual estimate*** on the space provided on your data recording sheet. This estimate will be compared to your ***scientific estimate*** and to the ***actual count***.

3. Now dig your hand into your cup of beans and "capture" a medium-sized handful of "animals" (beans or beads). Carefully count and mark both sides of each bean with your marker. Record this information on your data sheet. If you are using plastic beads, replace your captured beads with the same number of plastic beads of a different color – these now become your marked animals.

4. Put this marked group back into the cup and thoroughly mix up the beans by pouring your beans or beads back and forth between two cups. It is important that the beans or beads get thoroughly mixed up.

5. Now it is time to do a series of recaptures. Dig your hand back into the cup to grab a medium-sized handful of beans. First, count the total number of beans in your recapture and then make a count of all the ones out of that recapture that were marked from your first capture. Record both of these pieces of data onto your data sheet. **Then put all of these beans or beads back into the cup**. Repeat this procedure nine more times recording all your data onto your data sheet.

6. Once you are done with ten recaptures, find the average number of beans for the recaptures and then the average number marked in the recaptures.

7. Put these two averages along with the number in the first sample count into the formula on the data sheet. Calculate the *scientific estimate* of the population of beans in the cup.

8. Now dump the beans out of the cup and carefully count each and every bean to determine the *actual count*.

9. Determine the percent error between your *scientific estimate* and the *actual count*. Use the percent error formula on your data collection sheet to calculate the percent error. An error rate of less than five percent would indicate that your *scientific estimate* is a reliable indicator of the actual total population. An error rate of more than ten percent is an indication that your *scientific estimate* is flawed.

DATA ANALYSIS

Part 1: *Visual estimate* of the number of beans or beads in the cup: _____

Part 2: Number of beans or beads in your first capture all of which you marked: _____

Part 3: Fill in the following chart with your recapture data and then add up the two columns and divide by 10 to get the average.

DATA TABLE

Recapture Sample Number	Number of Recaptured Beans	Number of Recaptured Beans Marked
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
SUM		
AVERAGE		

Part 4: Calculate your *scientific estimate* using the following formula:

$$\left(\frac{\text{Number of beans in your first capture}}{\frac{\text{Average number of marked beans from recapture samples}}{\text{Average number of beans from recapture samples}}}\right) = \text{Scientific Estimate}$$

Example:

$$\frac{86}{\left(\frac{22}{88}\right)} = \frac{86}{.25} = 344$$

$$\frac{\qquad\qquad}{\left(\qquad\qquad\right)} = \qquad\qquad$$

Part 5: Count the *actual number* of beans in the cup: _____

Part 6: Determine the percent error of your *scientific estimate* using the following formula:

$$\frac{\text{Scientific estimate - actual number}}{\text{Actual number}} = \%\ \text{Error}$$

$$\frac{\qquad\qquad\qquad}{\qquad\qquad\qquad} = \qquad\%\ \text{Error}$$

Part 7: Determine the percent error of your *visual estimate* using the following formula:

$$\frac{\text{Visual estimate - actual number}}{\text{Actual number}} = \%\ \text{Error}$$

$$\underline{\qquad\qquad\qquad\qquad} = \underline{\qquad}\ \%\ \text{Error}$$

Part 8: Which is more accurate, your *visual estimate* or your *scientific estimate*? Why do you think this is so?

_____

_____

_____

_____

_____

_____.

QUESTIONS

1. 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.

2. In what situations might ecologists choose to do an actual count of every individual in a population (census) rather than use the *capture-mark-recapture* method.

3. 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?

4. How does the time interval between the first capture and the subsequent recaptures affect the reliability of the *capture-mark-recapture* method? What are the advantages and disadvantages of increasing or decreasing that time interval?

5. In the field, how can the time of the year affect the results of a population study?

6. In using the *capture-mark-recapture* method, why would it be important for scientists to be familiar with the territorial range and migratory behavior of the species being studied?

7. The capture-mark-recapture technique is primarily used with vertebrate animals. Could it be as effectively used with invertebrate animals? Please explain.

8. How does the lifespan of the animal being studied affect how quickly scientists do a recapture after the initial capture?

9. What advantage does the *capture-mark-recapture* technique have over simple sampling and extrapolation? For example, a scientist may want to know what the gopher population is for a 100,000 square foot habitat. She sections off a 1,000 square foot area and carefully counts all the gophers in this small area and then multiples the results by 100, thus extrapolating to the entire area under study. Explain to her why she might want to use the *capture-mark-recapture* instead.

10. In using the capture-mark-recapture technique, why is it important to take an average of several recaptures rather than doing just a single recapture?

11. In the United States, the Federal government requires that human populations be determined through the use of a census in which every person is supposed to be counted instead of using an estimating technique such as *capture-mark-recapture*. What would the advantages and disadvantages be for using some sort of sampling technique to ascertain human populations instead of attempting to count every individual?

12. The *capture-mark-recapture* method is designed to be used with animals. Can you think of scientific techniques that could be used to estimate the number of ***plants*** in an ecosystem without having to count all of them?