Name: _____ Date: _____ Period: _____

APES Mark & Recapture Lab: Something's Fishy

Biological Sampling

How do biologists determine the population of a species in a particular area? There are a variety of ways that it can be done; however, the most common method involves tagging. In this method, biologists first capture and tag a sample of the animals. Then, after some time has passed for the animals to return to their environment and to "redistribute themselves", the scientists take repeated random samples and calculate the percentage of the sample that is tagged. We would expect that these sample percentages should vary around the true population's percentage. Using this assumption, one can calculate the approximate population size given that they know the original number tagged and the mean percent tagged from the samples.

Some important assumptions have to be made:

1. That each individual member of the population has an equal chance of being captured at each sampling. (They don't learn to be caught or learn not to be caught!)

2. Except for the effects of sampling, the population is not changing during the sampling period.

Question:

Can I use the Mark and Recapture Method to estimate the size of a population of beanfish?

Materials (per group): 1 bag of brown beans (approx. 200), 1 bag of white beans (approx 40)

Fishing Exercise:

Each of the teams in class have a population of "beanfish" (brown beans) in front of them. Your goal is to approximate the size of your population using the same tagging and sampling methods that biologists use in their field research. The directions are as follows:

1) Remove a sample (a large handful of the "beanfish", approximately 40). Replace this sample with the equivalent number of tagged beanfish (white beans). Record in the table below how many you "tagged". *Now put the remaining white beans & the removed brown beans aside. You will not use them again!*

2) Mix the population thoroughly to get the tagged beanfish "redistributed" among the population.

3) Without looking (to prevent your personal bias) remove a sample of beanfish from the "pond". Count the number of tagged (white) and total number of beanfish in your sample, recording these numbers. Also calculate the percent tagged in the sample, using several decimal places for accuracy.

4) Mix the population thoroughly and repeat the sampling for a total of 20 samples. The sample sizes do not have to remain the same, but you do want to get fairly large handful of beanfish each time.

5) When you are finished, find the mean percent tagged from your set of samples.

6) Now, count your entire population to get the total actual count.

DataTable:

Original Number of "Beanfish" Tagged: _____

Sample #	# Tagged Beanfish in Sample	Total Sample Size	% Tagged in Sample
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
		Average Percent Tagged:	

Inferential Statistics

Now, how do we predict our population size? Well, we expect that the sample percent tagged should vary fairly closely around the true population proportion of originally tagged beanfish. Using ratios from algebra, we can do the following:

mean of the 20 sample percentages = number originally tagged / population size

Rearranging the equation above, one gets the following results:

*Population size = [number originally tagged / the mean of the 20 sample %ages] * 100*

Using your information, find the predicted population size for your pond: _____

Now, count your entire population and determine how close your estimate was:

Actual Population: _____

Difference between predicted & actual count: _____

Problems and Discussion

I am sure that you did not predict your actual population exactly. Even if you did, consider the following questions as you think about your results.

1. a. What could cause your results to be off from the actual population?

b. How would sample size and population size affect these results?

c. How would the number of samples affect these results?

d. If you were predicting a large population (as in a real pond), would the number you were off really have been that bad - relatively speaking?

2. a. What concerns should a biologist have about a species' life history (habits) before he/she uses this method to approximate the size of a population?

b. Even with these concerns, does this mean that tagging should not be used by biologists?

c. Tagging is used for lots of other research purposes besides estimates of population size. Describe at least one other use.

Future Thoughts:

As we continue to develop our working knowledge of statistics, wouldn't it be nice to be able to put some measure of accuracy or "margin of error" on this estimate? Since we wouldn't know what the actual population size is, maybe we could statistically determine the margin of error of our answer that would contain the true population? Suppose in this example we determined statistically that our answer was going to be in error up to ± 5%. Would this additional knowledge of the margin of error affect how you would interpret or use your results above and how accurate you would consider them to be?