

Mark-Recapture Problems and Questions

Conservation Biology
Spring 2009

Problem: Suppose that you capture 10 individuals of a rare subspecies of brook trout from an impounded watershed. You place a pit tag (a very small radio activated tag) in the body cavity of each individual and then release these fish. You come back a month later and capture 20 fish and find that four of these are individuals that you had previously captured and released. What is your best estimate of the population size, N ?

The percentage of the sample should equal the percentage of marked in the entire population.

Sample % marked = $4/20=0.2$

There were 10 fish captured and then released back into the watershed. Thus, they should have dispersed until they made up 20% of the population. Thus:

$$0.2 = 10 / N$$

$$N = 50$$

Reverse engineering this answer: Let's now suppose that there are 50 fish, ten of which are marked and we capture 20 fish at random (and all at once). We have captured 0.4 of the entire fish population and we already know that 10/50 or 0.2 are marked – thus the expected number of marked fish would be $20 \cdot 0.2 = 4$, as given in the original problem.

Question: List two likely means that would bias your estimate. Which direction (high, low or possibly either way) would these biases act? Explain your answer.

a. Disproportionate mortality of marked individuals – result would be a bias towards a larger population size than actually existed.

Let's see what would happen if half of the 10 fish we marked died while none of the other, unmarked, fish died. For our purposes we will assume that the population had 50 individuals including the 10 marked ones. Then five die and so the population is now 45 individuals with 5 marked ones.

If we get an unbiased sample, we would see $5/45 = 11\%$ marked (instead of 20% if none had died).

Let's compare the calculated value with the actual population size:

$$0.11 = 10 / N$$

$$N = 90.9$$

Again, the real population is 45 – we have obtained a 100+% overestimate!

b. Incomplete diffusion (mixing) of marked and unmarked individuals and/or trap happy/trap shyness of captured /released fish. How this will affect our estimate will depend on whether we are more likely to recapture the fish than we are to capture the unmarked fish others (for example, because they all hang out together and not with the other unmarked fish – we get all of them or none – or they like to go into fish traps – or avoid the traps – as compared to the unmarked fish).

For example, trap happy fish:

Assume that the population size is 50 individuals and that I capture a sample of 20 – but this includes 8 of the marked fish. I would underestimate the population size:

$$0.4 = 10 / N ; N = 25$$