20.7: Estimating population size

[under construction]

Approaches to finding out how many individuals are present in a particular geographic area.

Census methods

If the population is closed, and all individual can be discovered, then counting every individual is the best way to estimate the population size.

Simple random and systematic sampling

Random sampling would be to divide an area into a grid then randomly select grids to be counted. Systematic sampling would be to identify areas ahead of time which are likely to have the individuals, then proceed to count individuals in all areas where the individuals are likely to be.

Capture-recapture methods

$$\frac{m}{n} = \frac{M}{N}$$

then solve for $N = n \cdot \frac{M}{m}$

This is called the Lincoln Index, where N is the estimated population size, M is the number of individuals caught the first time (and all marked, then released), n is the number of individuals captured a second time, of which m were marked. Assumptions of this method include:

1. closed population (i.e., no loss or gain of individuals during the capture intervals);
2. every individual in the population has an equal chance of being caught;
3. marks are always recognizable.

Removal methods

Using intensive methods (e.g., netting), capture animals, prevent immigration into the area. Assumption is that the captures per unit time yield decreasing numbers of caught individuals. Then, change in population size may be estimated by

$$\frac{dN}{dt} = -\alpha N$$

where α is the removal rate. The solution to this equation is the differential \(N = N_{0} e^{\alpha t\)

where e is the natural logarithm, N_0 is the initial population size, and t is time intervals. If A is the number of individuals captured at time t_i, then a plot of A on the Y-axis versus t_i describes this differential. α could be estimated by getting the slope of the non-linear regression (N_0 would be the intercept).

As an approximation, you could take the based on the analysis of 2 first time intervals only. For example, if captures in the first 2 time intervals were 23 and 14 fish, then

$$N_0 = \frac{232}{23 - 15} = 66.125$$

$$\alpha = \frac{23 - 15}{23} = 0.3478$$

Capture effort

x

Additional reading

http://www.sbs.utexas.edu/jcabbott/courses/bio208web/labs/populations/populations.htm