IB 153L

Lab 3: Population estimates using a mark-recapture technique

Background: Quadrat counts are a typical method for estimating the abundance of a sessile organism, but many ecologists study organisms that move. To estimate the population size of mobile organisms, one commonly used method is the mark-recapture technique. This involves first capturing and marking a sample of organisms and then recapturing them and counting the number that have been marked. As discussed in lecture, there are many variations on the basic technique as well as many assumptions involved in each specific method. In this lab, we will use the Petersen method to estimate the population size of the common water strider, *Gerris remigis*, at two locations along a small stream in Tilden Park.

     G. remigis (Order: Hemiptera; Suborder: Heteroptera (true bugs)) is semi-aquatic, living on the surfaces of ponds, slow-moving streams, marshes, and other quiet waters. The front legs of water striders are short, modified for grasping and used strictly for capturing prey. The middle and hind legs are long and thin, allowing the water strider's weight to be supported by surface tension. It skates across the water by synchronous, oar-like movements of the middle legs, which are longer than the others, while steering with its hind legs.   A water strider's legs are covered with thousands of hairs that render them effectively non-wetting. This property allows it to freely remove its legs from the surface to row. A water strider's weight is balanced by a surface tension force more than ten times its weight. This large margin of safety allows the strider to freely lift its legs from the surface during rowing or to support the weight of a companion without falling through the surface.

Gerrids are predaceous, feeding mainly on insects and other organisms that fall on the water, but they can also catch aquatic insects (e.g. mosquito larvae) that swim near the surface. Adult *G. remigis* are 14-18 mm long; females are approximately 50% larger than males. In breeding season, water striders communicate by sending ripples to each other on the surface of the water. Females lay eggs at the water's edge, usually on plant stems. When eggs hatch, nymphs must grow for over a month before molting to the adult stage. In central and northern California, gerrids overwinter as adults in leaf litter or protected vegetation along shores. Certain species exhibit wing dimorphism, with shorter-winged morphs occurring in more permanent aquatic habitats.

Field instructions: The goal is to mark and recapture as many water striders as possible.
To facilitate this, we will divide into two groups of four with each group performing the
same tasks, so as to increase our sample size.

Day 1: Marking

At each of the two study reaches, we will collect, mark, sex, measure and release a large
number of water striders. Use the following procedure:

1. Catch water striders with an aquarium dip net, and place them in a plastic box
   containing about an inch of stream water. To prevent the striders from escaping,
   be sure to keep the lid closed between captures.
2. When you have finished capturing the sample, transfer individuals to a second
   plastic box that is lined with paper towels. This will allow them to dry for
   marking.
3. First measure and then mark each individual, placing them in a second paper-
   lined box to insure that the marks dry. Measure the length of each individual (tip
   of rostrum to tip of abdomen), determine its sex (see handout), and then mark the
   dorsum with a small dot of "whiteout". It is critical to avoid getting whiteout on
   the ventral plastron, as this will kill the gerrid. The length and sex of each
   individual should be recorded.
4. When the entire sample has been marked, release the striders in the pool where
   they were collected.
5. Using quadrats, estimate the area of pools occupied by the sampled population of
   striders.

Day 2: Recapturing

1. Using the aquarium nets, capture as many striders as possible from the sampled
   pools, placing them in plastic boxes containing about an inch of stream water.
2. Examine each striders for a whiteout mark, determine its sex, and measure its
   length as above.
3. When sampling is completed, return the striders to the sampled pools.

Data analysis: In the computer lab, use Excel and the Peterson method equations to
answer the following questions:

1. What is the estimated density of striders in each study reach? Determine the 95%
   confidence intervals for these estimates following the procedures in Krebs.
2. What is the sex ratio of striders in each of the study reaches? Does is differ
   statistically from 50:50?
3. Plot a histogram of the size-distribution of strider at each site. What is the average
   and variance in length in each of the study reaches?   Using 2-way ANOVA,
   determine if strider gender and/or site significantly affect average strider size.
4. Using a chi-squared test, determine if males and females were recaptured with
   equal frequency?