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Adventures in Desktop Ecology

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Extended Abstract

One of the biggest challenges for biologists is to make sure that they are measuring things objectively. For ecologists and animal behaviorists this is especially difficult. In this exercise, we use simple tools (beans, gravel, nail polish, sow bugs or bean beetles, tape, meter sticks, candles, IR thermometers and the Image-J software package) to demonstrate the challenges associated with a) estimating population size, b) determining whether organisms are randomly distributed, clumped, or over-dispersed, and c) determining the thermal and moisture preference of an isopod. The importance of replication, sample size, and objectivity are both demonstrated and emphasized. In the past, we have wrapped up this exercise with a discussion of 'The Decline Effect' (Lehrer, 2010). This year, we are planning to replace the Lehrer article with a discussion of an interactive article from FiveThirtyEight.com (Aschwanden, 2015).

We use this activity in the Ecology/Evolution semester of our General Biology course. By the time students conduct this exercise, they are nominally familiar with both T-tests and X^2 tests. Two or three weeks after this exercise they will be expected to apply some of these methods to a research project at a local urban stream.

The first activity is a simple mark-recapture exercise using dried beans living in an aquarium gravel habitat. Students capture varying numbers of beans by reaching into cups of gravel. Beans are marked using cheap nail polish and returned to their habitat. A new set of beans is captured, and students use the Lincoln-Peterson equation (Lincoln, 1930; Petersen, 1896) to estimate the total number of beans in the habitat. We wrap up this activity with students counting all beans and by comparing results among student teams and a discussion of how increased sampling effort will lead to more reliable estimates.

In the second activity, students estimate densities and census sizes using a grid transect created with masking tape on their lab benches. Beans are scattered by the instructor, and students use random numbers to determine which quadrat(s) to survey. As in activity 1, we wrap up by comparing results among teams and discussing factors that will increase and decrease the reliability of the estimates. We also emphasize why random sampling is an important tool for maintaining objectivity.

In the third activity, we use either sow bugs (*Porcello* sp.) or bean beetles (*Callosobruchus maculatus*). Both are available from Carolina Biological Supply) to test how the creatures are distributed in space (clumped, random or aggregated per Clark and Evans (1954)). About ten animals are placed in a 15 cm petri dish and allowed to acclimate for five or ten minutes. Students then photograph the petri dish and estimate distances between animals using NIH's Image-J software (ImageJ.NIH.Gov). This seems to be the most challenging activity for our students. Often, this is their first experience with non-commercial software, and the distribution concepts are new to most of them. Although this part could be done without the software, we continue to use Image-J because researchers often must use software that isn't user friendly, and the program has many additional uses. We conclude this section with a discussion of the ecological explanations for the different kinds of distribution.

The fourth activity involves testing temperature preferences of either a bean beetle or sow bug by making a u-shaped channel out of aluminum foil (approximately 15 cm long). The bottom of the channel is marked every cm with a Sharpie. It's then arranged so that one end is over a candle other over an ice pack. The system is allowed to equilibrate for a few minutes before an IR thermometer is used to measure the temperature at each mark. Creatures are then gently placed in the part of the channel that is closest to room temperature and observed. In practice, this activity is problematic since it's difficult to get the cold end of the trough very cold. Creatures usually congregate on the cool end which is slightly below room temperature. This allows us to discuss whether this apparatus has really helped us achieve our goal.

Starting in the Spring-2016 semester, we will be adding the web-based interactive article by Aschwanden (2015) as our final activity. Among its strengths is a set of interactive tools that illustrate how easy it can be to reach different and contradictory conclusions by examining selected subsets of the available data.

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