Lab 3—Population Growth

Now that you know something about diversity and how organisms obtain resources in the environment, we now move on to some ecological theory—namely population growth. Lab 3 had several goals: 1) to give you some basic microscope skills—can you focus and measure an object using the micrometer? 2) to introduce you to hypothesis testing, which is at the heart of all scientific study, and 3) to apply what you know about population growth to a question of your own choosing.

The first part of the lab took you through using a dissecting microscope (some of you will use a similar microscope in your own careers). It also taught you how to measure an object using the micrometer. You were basically applying units to a ruler that had no units. You did this by creating a ratio. You will want to review how to do this as questions related to this may show up on the lab practical. It is not hard but does take some practice. For each level of magnification you would have to come up with a new calibration. Why might this be?

The majority of the lab dealt with hypothesis testing and applying that to population growth. As you think about population growth, you want to understand some of the basic factors that can affect growth. For example, one of the most obvious is birth rates compared to death rates. Also, what can control birth rates or death rates in a population? What are density independent and dependent factors that can influence population growth? How might emigration or immigration affect populations? The study of population growth can get complicated quickly, but for the lab we tried to keep it relatively simple.

For the lab we had different populations of *Blepharisma*, the single celled ciliate. We used a microorganism because we can get rather large populations quickly in a small space. How might using elephants affected the lab design? These populations were grown at different food levels: low, medium, and high. These populations were also at different ages, ranging from 4 days to 30 days for each food level. You were asked to come up with a testable hypothesis related to population growth, a null hypothesis, a mathematical prediction of that hypothesis, and methods to test those results. Much of the lab was left up to you and we just provided the framework.

Try these questions:

1. What is the difference between density independence and density dependence?

2. At high densities, the *Blepharisma* that you looked at in lab turns into a cannibalistic form. Is this a density dependant or independent event? What might drive this organism to start feeding on others of its kind?

3. In this lab you saw the formula $N_t=N_{t-1} + B - D$. In your own words describe what each term represents. What would happen to N_t if B is greater than D? If B is less than D? If B = D?

4. What is a testable hypothesis? What is a null hypothesis? What is a control in an experiment? What was an example of a control in any one of the labs?

5. Show mathematically how you would test the hypothesis that in a low nutrient medium, the population of *Blepharisma* should be smaller in number than the population size at medium nutrient levels. How would you test this hypothesis?

6. What is the finite rate of increase per day?

7. In your own words describe what the following mathematical prediction is stating: $N_7 > N_{10} > N_{14}$

8. Give a practical reason why understanding population growth is important. (hint: there are numerous examples in agriculture, medicine, conservation biology and many other fields)

ANSWERS:
1. Density dependent—the pop. size plays a role as to how the population is affected (competition is usually a density dependent factor). Density independent—it does not matter what the population size is in order for there to be an effect on the population (for example, a fire is a density independent event).

2. Density dependant. Maybe there is not enough food and so at high densities some forms turn into cannibals.

3. Population will grow. Population will shrink in size. Pop. size remains the same.

4. The very specific question you will test. The null is the statement of no change. In its most basic form, the control gives you a basis for comparison. That is, something to compare your experimental treatments to. One example of a control was in the algae ball experiment form lab 2. You had the vial covered with aluminum foil and the vial without photosynthetic organisms.

5. Show mathematically how you would test the hypothesis that in a low nutrient medium, the population of *Blepharisma* should be smaller in number than the population size at medium nutrient levels. How would you test this hypothesis?

6. How many individuals are added to the population per day.

7. Population size is greatest at day 7, second largest at day 10, and the smallest at day 14.

8. In agriculture, growers are interested in how fast a population of a pest insect might grow. They can then treat their crops if they feel a certain threshold has been reached.

9. The very specific question you will test. The null is the statement of no change.