Lab 17: Mechanisms of Evolution: Why Will the Characteristics of a Bug Population Change in Different Ways in Response to Different Types of Predation?

Introduction

The various components of an ecosystem are all connected. Plants depend on the abiotic resources of an ecosystem to produce the food they need to grow, herbivores eat these plants, and carnivores eat the herbivores. Thus, a change in the amount of abiotic resources available or a change in the size of any one of these populations of organisms can influence the size of the other populations found in that ecosystem. A drought, for example, could reduce the size of the plant population. A decrease in the size of the plant population results in less food for the herbivores. When herbivores do not have enough food to eat, the death rate of the population increases, which, in turn, results in fewer herbivores. The size of the carnivore population, as a result, begins to shrink because there is not enough food available.

In addition to influencing the size of a population, the interactions that take place between the organisms found within an ecosystem can actually change the characteristics of some populations. Some of the characteristics that can be influenced by these interactions include the ratio of males to females in a population or the ratio of juveniles to adults in the population. Other characteristics that can be influenced by population interactions include the proportion of individuals within a population that have a specific trait or the average height or weight of the members of that population. It is therefore important for biologists to understand how different types of interactions can result in a change in the characteristics of a population.

One type of interaction that can result in a change in the characteristics of a population is predation. Predation often has a strong influence on the characteristics of a prey population. For example, a population of herbivores that lives in an area with a lot of predators will often have different characteristics than a population of herbivores that lives in an area with few or no predators. The hunting strategy used by the predator will also have an influence on the characteristics of a prey population. For example, a herbivore population that is eaten by a predator that chases its prey and a herbivore population that is eaten by a predator that hunts by sitting and waiting for its prey will often have different characteristics. Biologists often study how the characteristics of a specific prey population change in response to a specific type of predation, to understand how different types of interactions can result in a change in the characteristics of a population.

Your Task

Use a computer simulation called Bug Hunt Speeds to explore how a population of a "bug" responds to the influence of two different types of predators. You will then develop an explanation for the changes you observe in the bug population. Your explanation must outline a mechanism that will cause the characteristics of a prey population to change in different ways in response to different types of predation.

The guiding question of this investigation is: **Why will the characteristics of a bug population change in different ways in response to different types of predation?**

Materials

You will use an online simulation called **Bug Hunt Speed** to conduct your investigation. You can access the simulation by going to the following website: *https://ccl.northwestern.edu/netlogo/*.

Getting Started
Bug Hunt Speed simulates a population of bugs that all belong to the same species. All the bugs in this population, however, are different, even though they belong to the same species. The bugs vary in terms of color, how fast they move, if they wiggle or not, and if they flee from predators when one is nearby.

In this simulation, you will act as the predator. You are able to eat the bugs (your prey) by clicking on them. You can act as a "hunting" predator by moving the mouse around to catch the bugs, or you can act as a "sit and wait" predator by keeping the mouse in one place and then catching the bugs that come to you. When a bug is eaten, it is replaced through reproduction by a bug in the simulated ecosystem. The new bug, therefore, will have the same characteristics as a bug that has not been eaten yet. Remember, all of the bugs in the ecosystem are from the same species.

The simulation also allows you to adjust the characteristics of the bugs. You can use the menus on the left of the screen to determine the color scheme for the bugs, the initial number of bugs in the habitat, if the bugs wiggle or not, and if they "flee" from a predator or not (see figure below).

A screen shot from the Bug Hunt Speed simulation
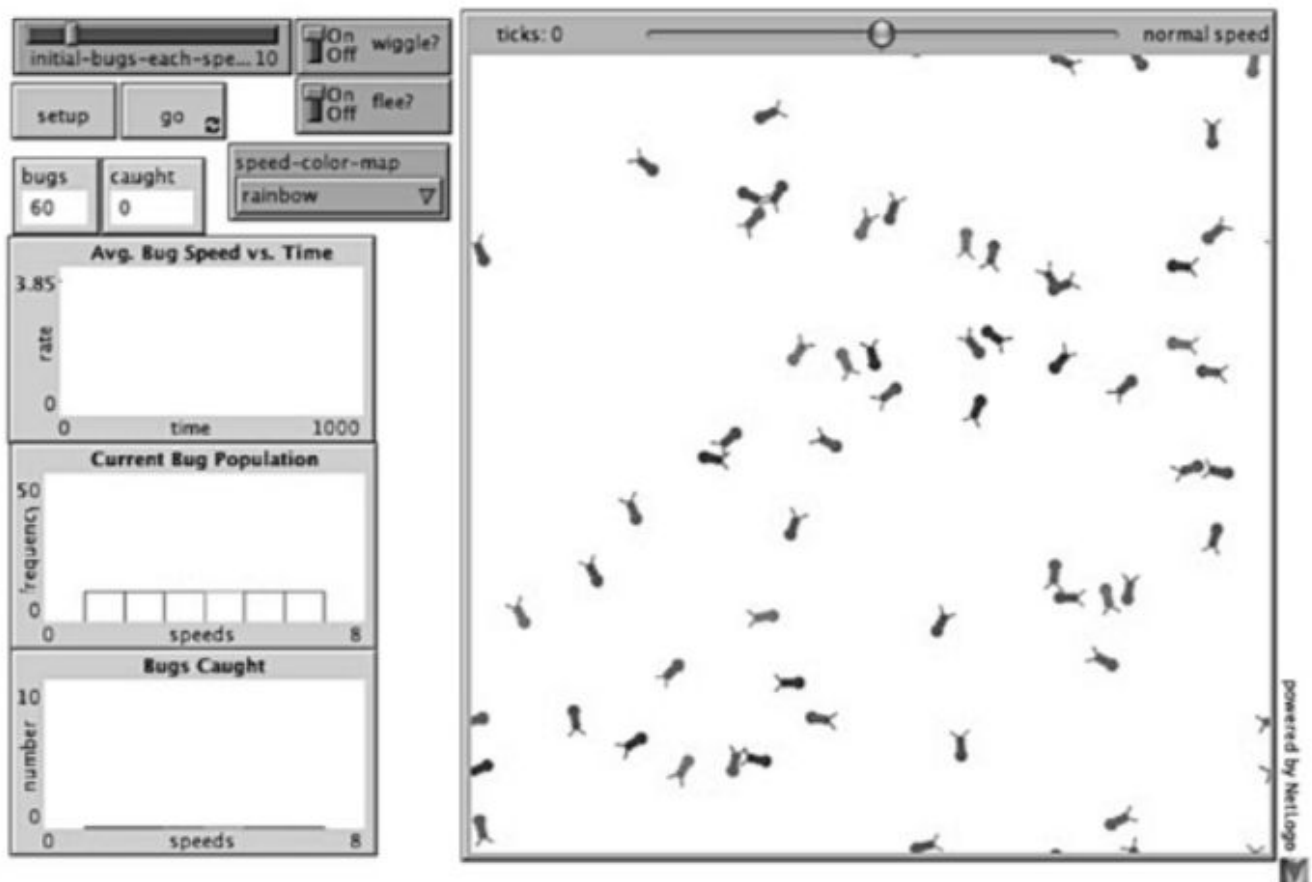
To answer the guiding question, you must determine what type of data you will need to collect, how you will collect it, and how you will analyze it.
To determine *what type of data you will need to collect,* think about the following questions:
- How will you determine if the characteristics of the bug population change over time?
- How will you test your explanation for the changes you observe in the population of bugs?
- What will serve as your dependent variable (e.g., color, speed, number of bugs caught)?
- What type of measurements or observations will you need to record during your investigation?

To determine *how you will collect your data,* think about the following questions:
- What will serve as a control condition (e.g., no predation)?
- What types of treatment conditions will you need to set up and how will you do it?
- How many trials will you need to conduct?
- How long will you need to run the simulation during each trial (e.g., for three minutes or until 60 bugs are caught)?
- How often will you collect data and when will you do it?
- How will you keep track of the data you collect and how will you organize the data?

To determine *how you will analyze your data,* think about the following questions:
- How will you determine if there is a difference between the different treatment conditions and the control condition?
- What type of calculations will you need to make?
- What type of graph could you create to help make sense of your data?

Report

Once you have completed your research, you will need to prepare an investigation report that consists of four sections (be sure to have section headings):

1. Introduction: Give some background information on the topic. Explain what question you were trying to answer and include a hypothesis. (Background info, research question and hypothesis)
2. Procedure: What did you do during your investigation and why did you conduct your investigation in this way? (How you collected and analyzed data)
3. Data: Include a data table and/or graph to show your results. Be sure to include a title for your table or graph with labels for the variables.
4. Conclusion: What is your argument? (Claim - Evidence - Reasoning)

Your report should answer these questions in two pages or less. The report must be typed, and any diagrams, figures, or tables should be embedded into the document. Type your report on Google Docs (12 point font, double-spaced) and share it with your teacher. Your report will be graded based on the rubric in the class syllabus.