

Lab 9: Population Growth: How Do Changes in the Amount and Nature of the Plant Life Available in an Ecosystem Influence Herbivore Population Growth Over Time?

Introduction

A population is a group of individuals that belong to the same species and live in the same region at the same time (the figure to the right shows an example of a rabbit population). Populations have unique attributes such as growth rate, age structure, sex ratio, birth rate, and death rate. The growth rate of population describes how the size of the population changes over a set time period. The age structure refers to the distribution of individuals based on age. The sex ratio is the proportion of males and females in the population. The birth rate is the frequency of births within a population over a set time period. The death rate is the frequency of deaths over a set time period. The characteristics of a population can change over time because of births, deaths, and the dispersal of individuals from one population to another.

The population of rabbits at the Myxomatosis Trial Enclosure on Wardang Island, Australia



Populations of animals interact with each other and their environment in a variety of ways. One of the primary ways a population interacts with the environment and with other populations is through feeding. Animals can eat plants, other animals, or both. Animals that feed on plants are called herbivores. The plants that herbivores eat, however, are not all the same. Some plants grow quickly and are plentiful, which makes them easy to find, whereas others grow slowly and are sparse. Some plants are drought resistant, whereas others do not grow well unless there is plenty of water available. Finally, and perhaps most important, some plants are loaded with nutrients (vitamins and minerals) but low in calories, some are high in calories but have fewer nutrients, and some are high in both calories and nutrients.

There are a number of factors that might influence the size of a herbivore population in an ecosystem. These factors include, but are not limited to, the amount of food available to eat, the type of plants available to eat, and the nutritional value of these plants. In this investigation, you will explore how the size of a herbivore population changes over time in response to changes in the nature and type of plants available for it to eat.

Your Task

Explain how the size of a population of rabbits (herbivores) changes over time in response to changes in the amounts and characteristics of the plants available in an ecosystem.

The guiding question of this investigation is: ***How do changes in the amount and nature of the plant life available in an ecosystem influence herbivore population growth over time?***

Materials

You will use an online simulation called **Rabbits Grass Weeds** to conduct your investigation. You can access the simulation by going to the following website:

<http://ccl.northwestern.edu/netlogo/models/RabbitsGrassWeeds>

Getting Started

The *Rabbits Grass Weeds* simulation allows you to explore a simple ecosystem made up of rabbits, grass, and weeds. The rabbits wander around randomly, and the grass and weeds grow randomly. When a rabbit bumps into some grass or weeds, it eats the grass and gains energy. If the rabbit gains enough energy, it reproduces. If it doesn't gain enough energy, it dies. The grass and weeds can be adjusted to grow at different rates and give the rabbits differing amounts of energy.

This simulation is easy to use. Click the SETUP button to set up the ecosystem with rabbits and grass, then click the GO button to start the simulation. It is also easy to adjust the characteristics of the simulated ecosystem. The NUMBER slider controls the initial number of rabbits (0–500). The BIRTH-THRESHOLD slider sets the energy level at which the rabbits reproduce (0–20). Rabbits can reproduce at any time when the threshold is set at zero. When the threshold is set at 20, a rabbit must eat enough food to have an energy level of 20 before it can reproduce. The GRASS-GROWTH-RATE slider controls the rate at which the grass grows (0–20). When the grass growth rate is set to 0, no grass will grow in the simulated ecosystem. The WEEDS-GROWTH-RATE slider controls the rate at which the weeds grow (0–20). The GRASS-ENERGY slider and the WEED-ENERGY slider allow you to set the amount of energy a rabbit can get from a plant when it is eaten (0–10).

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 need to collect, think about the following questions:

- What will serve as your independent variables (presence of grass, presence of weeds, grass growth rate, amount of energy obtained from grass, weed growth rate, and so on)?
- What will serve as your dependent variable (population size of rabbits, population size of weeds, population size of grass, and so on)?
- 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 (or comparison) condition?
- What types of treatment conditions will you need to setup and how will you do it?
- How long will you need to run each simulation?
- How often will you collect data and when will you do it?
- How will you make sure that your data are of high quality (i.e., how will you reduce measurement error)?
- 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 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 were you 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.