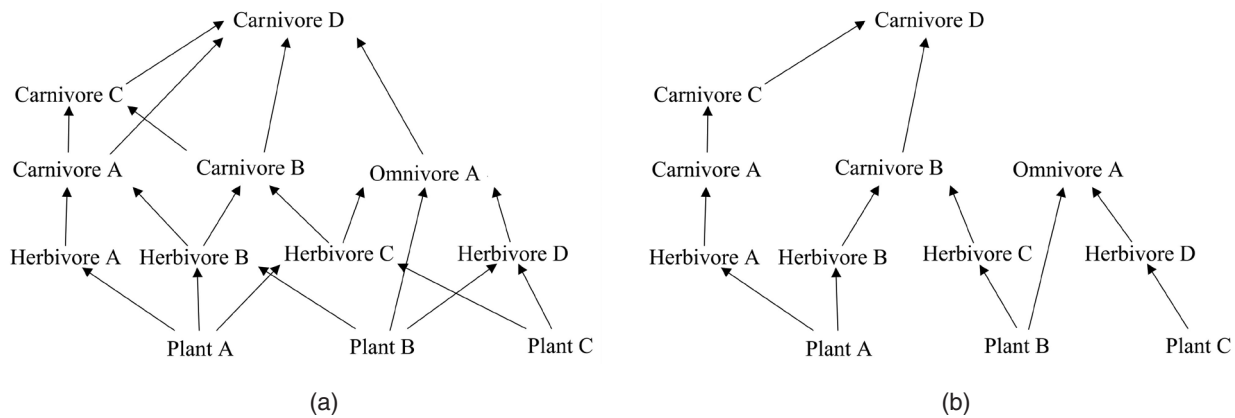


Lab 11. Ecosystems and Biodiversity: How Does Food Web Complexity Affect the Biodiversity of an Ecosystem?

Introduction

An ecosystem is a community of living organisms and the nonliving components of the environment. Energy flows in an ecosystem in one direction through food chains, and a food web is made up of all the food chains within a community of organisms. Food chains and food webs consist of the producers (the autotrophs of an ecosystem), the primary consumers (the herbivores and omnivores of the ecosystem), the secondary consumers (the carnivores and omnivores of the ecosystem), and the top predator. Some ecosystems have complex food webs and some do not. In ecosystems with a complex food web, herbivores and omnivores eat many different types of plants and the carnivores eat many different types of animals. The consumers in this type of ecosystem are described as generalists. Ecosystems that support consumers that rely on a single food source, in contrast, have simple food webs, because the consumers are specialists. An example of a complex food web is provided in panel (a) of the figure below, and an example of a simple food web is provided in panel (b) of that figure.

Example of (a) a complex food web and (b) a simple food web



Biodiversity refers to the variation in species found within an ecosystem, and it is measured in two ways: (1) species richness, which is the total number of different species in an ecosystem; and (2) relative abundance, which is a measure of how common each species is within the ecosystem. Regions that are home to many different species with a high relative abundance of those different species have high levels of biodiversity, whereas regions with only a few different types of species or that have moderate species richness but a low relative abundance of several species have a low level of biodiversity.

Notice that the food webs illustrated on the opposite page have the same amount of species richness even though the feeding relationships are different. Some of the feeding relationships illustrated in these two ecosystems, however, may or may not be sustainable over time and may result in a net decrease in biodiversity. The relative abundance of each species, for example, may change if one or more of the populations within the ecosystem grows or declines over time. The species richness of the ecosystems could also change if some of the populations disappear because of too much predation or too little access to natural resources. Given the role that biodiversity plays in ecosystem health and tolerance to ecological disturbances, it is important to understand how food web complexity is related to the biodiversity of an ecosystem.

Your Task

Use the online simulation *Ecology Lab* (see the figure on the next page), to explore the relationship between food web complexity and biodiversity in an ecosystem.

The guiding question of this investigation is, **How does food web complexity affect the biodiversity of an ecosystem?**

Materials

You will use an online simulation called *Ecology Lab* to conduct your investigation. You can access the simulation by going to the following website: www.learner.org/courses/enovsci/interactives/ecology.

Safety Precautions

1. Use caution when working with electrical equipment. Keep away from water sources in that they can cause shorts, fires, and shock hazards. Use only GFI-protected circuits.
2. Wash hands with soap and water after completing this lab.
3. Follow all normal lab safety rules.

Getting Started

The *Ecology Lab* simulation allows you to create different food chains and webs within a model ecosystem. Once you establish the food chains and webs in the model ecosystem, you can run the simulation to determine the effect on the population of each organism (see the figure to the right).

To answer the guiding question, you will need to design and conduct several experiments using the online simulation. To accomplish this task, you must determine what type of data you will need to collect during each experiment, 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:

- What will serve as your dependent variable (population size, number of different populations, relative abundance, and so on)?
- What type of data will you need to keep a record of 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 during each experiment?
- What types of treatment conditions will you need to set up for each experiment?
- What variables will you need to control during each experiment?
- 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 conditions during each experiment?
- What type of calculations will you need to make?
- What type of table or graph could you create to help make sense of your data?

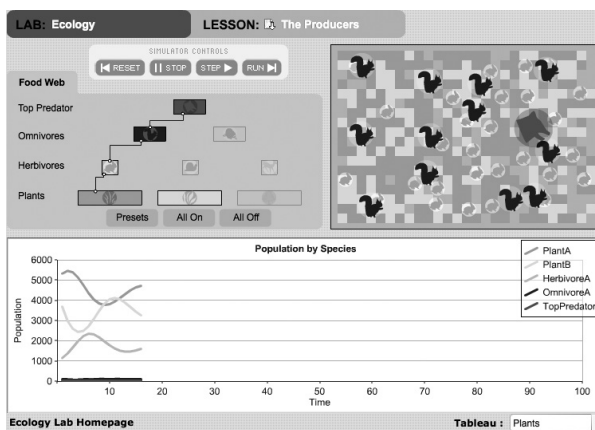
Investigation Proposal Required? Yes No

Connections to Crosscutting Concepts and to the Nature of Science and the Nature of Scientific Inquiry

As you work through your investigation, be sure to think about

- the importance of identifying patterns,
- the importance of identifying the underlying cause for observations,
- how models are used to study natural phenomena,
- how systems go through periods of stability and change,
- the importance of creativity and imagination in science, and
- the factors that influence observations and inferences in science.

A screen shot of the *Ecology Lab* simulation



Argumentation Session

Once your group has finished collecting and analyzing your data, prepare a whiteboard that you can use to share your initial argument. Your whiteboard should include all the information shown in the figure to the right.

To share your argument with others, we will be using a round-robin format. This means that one member of your group will stay at your lab station to share your group's argument while the other members of your group go to the other lab stations one at a time to listen to and critique the arguments developed by your classmates.

The goal of the argumentation session is not to convince others that your argument is the best one; rather, the goal is to identify errors or instances of faulty reasoning in the arguments so these mistakes can be fixed. You will therefore need to evaluate the content of the claim, the quality of the evidence used to support the claim, and the strength of the justification of the evidence included in each argument that you see. In order to critique an argument, you will need more information than what is included on the whiteboard. You might, therefore, need to ask the presenter one or more follow-up questions such as:

- How did you use the simulation to collect your data?
- What did you do to analyze your data? Why did you decide to do it that way? Did you check your calculations?
- Is that the only way to interpret the results of your analysis? How do you know that your interpretation of your analysis is appropriate?
- Why did your group decide to present your evidence in that manner?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those alternative ideas?
- How confident are you that your claim is valid? What could you do to increase your confidence?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your original argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the most valid or acceptable answer to the research question!

Report

Once you have completed your research, you will need to prepare an investigation report that consists of three sections that provide answers to the following questions:

1. What question were you trying to answer and why?
2. What did you do during your investigation and why did you conduct your investigation in this way?
3. What is your argument?

Your report should answer these questions in two pages or less. This report must be typed, and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid!

Argument presentation on a whiteboard

The Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence: