From Ants to Grizzlies: A General Rule for Saving Biodiversity

hhmi | BioInteractive

Film Activity
Student Handout

INTRODUCTION

This activity explores research shown in the short film *From Ants to Grizzlies: A General Rule for Saving Biodiversity*. This film explores a general principle, or "rule," in ecology called the species-area relationship. You'll also see how this rule has been used to study a variety of wildlife: from ants on tropical islands and monkeys in the rainforest, to wolves and grizzly bears in national parks. The concepts you'll learn here could help protect species of all types around the world.

PROCEDURE

PART 1: Before the Film

Before you watch the film, answer the following questions based on your current knowledge.

1. The title of the film uses the phrase "saving biodiversity."
   a. Explain what biodiversity means in your own words.

   b. Why do you think saving biodiversity might be important? What are the benefits of biodiversity for wild ecosystems and human societies?

2. The start of the film will mention that, as human populations expand, habitats are shrinking and becoming more **fragmented**: broken into smaller, separated areas.
   a. Describe at least one specific way in which human activities or development are making habitats more fragmented.

   b. What do you think happens to wildlife when their habitats become more fragmented? How might these changes affect the biodiversity in a particular area?

PART 2: After the Film

After watching the film *From Ants to Grizzlies: A General Rule for Saving Biodiversity*, answer the following questions based on the information provided and what you learned from the film. You may use the film's transcript as a reference.

Figure 1, which is similar to a graph that appears in the film, shows the number of amphibian and reptile species found on islands of different sizes. From these data, scientists observed an important pattern called the species-area relationship.

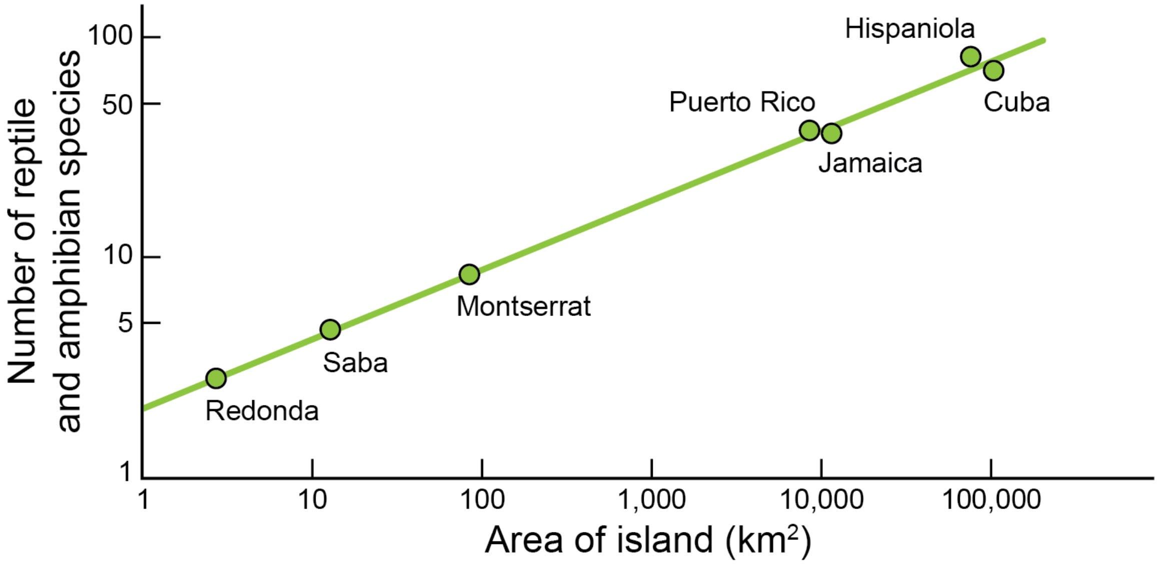

Figure 1. The number of reptile and amphibian species on islands in the West Indies, a region of the North Atlantic Ocean and Caribbean.

3. Figure 1 uses a **logarithmic scale** on both axes of the graph.
   a. Carefully examine the axes and then describe what a logarithmic scale is.

   b. Why do you think a logarithmic scale was chosen to show these data?

4. Fill in the following table with numerical values estimated from Figure 1.

Island	Area of island (km^2)	Number of reptile and amphibian species
Montserrat		
Puerto Rico		
Cuba		

5. Complete the following statements based on Figure 1. Briefly support each answer with a specific example from the figure.
   Statement: An island that is about **10** times larger has about _____ times as many species.
   Example:

   Statement: An island that is about **100** times larger has about _____ times as many species.
   Example:

6. Imagine that 90% of Cuba's area became unsuitable for wildlife due to human activities. How many reptile and amphibian species would you expect to find in Cuba then? Support your answer with evidence from Figure 1.

7. Wilson and his colleagues compared their mathematical model of the species-area relationship to real data. They used data from the *natural* removal of species from the island of Krakatoa and an *experimental* removal of species from islands in the Florida Keys.
    a. Think about why the scientists decided to use both natural and experimental data. What are some advantages of natural data? What are some advantages of experimental data?

    b. Complete the following statement based on what happened in both the Krakatoa and the Florida Keys examples.
    Although the ______ of species on an island tends to stay the same, the _____ of species can change over time.

8. In 1979, scientists started an experiment in the Amazon to determine whether habitat fragments on land behaved like the islands studied by Wilson and his colleagues.
    a. How is a habitat fragment on land similar to an island in the ocean?

    b. The scientists in the Amazon found that certain types of species were more likely to be lost from small habitat fragments. According to the film, which types of species were more likely to be lost, and why?

    c. Kellen Gilbert, one of the scientists in the film, and her colleagues have found that monkey species with a higher proportion of fruit in their diet are rarer in smaller fragments, possibly because it's harder to find enough fruit in smaller areas. Describe **two** other things that could be difficult for a species to find or do in a smaller area, which could cause the species to disappear from that area.

The Amazon experiment, and other research related to the species-area relationship, has helped conservationists design strategies for protecting wildlife areas. The last part of the film shows some protected areas in northwestern North America and strategies that conservationists are using to conserve species such as wolves and grizzly bears.

9. Fill in the following table to describe two of the strategies presented in the film.

Strategy	What is it?	How does it help conserve species?
wildlife corridor		
wildlife crossing structure		

10. Explain why the very large size of the Y2Y corridor is important. Support your answer using evidence from the research done in the Amazon.

11. Think of a habitat *not* mentioned in the film that is fragmented by human development, maybe one you have learned about or are personally familiar with. Propose a specific way to help conserve the species in this habitat, based on what you learned from the film.

EXTENSION: Half-Earth and the Species-Area Relationship

As shown in the film, the **species-area relationship** is a general relationship between the area of a habitat and the number of species that the habitat supports. This relationship can be described not only with a graph, like Figure 1 above, but also with a mathematical equation.

The equation for the species-area relationship has the form:

$$S = cA^z$$

where *S* is the number of species, *A* is the area of the island, and *c* and *z* are constants that affect how much the number of species increases as the area gets bigger. Both *c* and *z* depend on species type and location.

1. Why might it be useful to describe natural processes and patterns, such as the species-area relationship, using mathematical equations?

Edward Wilson, the first scientist in the film, used the species-area relationship to estimate what proportion of Earth's species could be supported by just half of Earth's area.

2. Without using the equation, what proportion of Earth's species would you expect to be supported by *half* of Earth's area?

Let's use the equation for the species-area relationship, as Wilson did, to estimate what proportion of Earth's species could be supported by half of Earth's area.

First, we'll rewrite the equation to represent the *total* number of species on Earth. If we let *A* represent the total area of Earth, then *S* is the total number of species on Earth. For many species, *z* is around 0.3. Substituting this into the equation above, we get:

$$\text{total number of species on Earth} = c(A)^{0.3}$$

3. Rewrite the right side of the equation to represent the number of species in *half* of Earth's area. (*Hint*: Remember that *A* represents the *total* area of Earth. How could you adjust *A* in the equation to represent *half* of Earth's area?)

$$\text{number of species in half of Earth's area} =$$

4. Calculate what proportion of species on Earth would be supported by half its area. Round your answer to two decimal places. (*Hint:* You can use the equation below as a starting point. Fill in the numerator "?" with your answer from Question 3, then simplify the fraction. Neither *A* nor *c* should appear in your final answer.)

$$\text{proportion of species} = \frac{\text{number of species in half of Earth's area}}{\text{total number of species on Earth}} = \frac{?}{c(A)^{0.3}}$$

5. Is your answer to Question 4 smaller, larger, or similar to what you expected in Question 2? Why do you think this is?

After Wilson made a similar estimate, he was inspired to create the Half-Earth Project, which aims to protect half of Earth's natural areas.

6. Why do you think Wilson proposed saving half of Earth's area and not more?