Some Things Will Always Change:

Land Use in a Dry Tropical Forest

Meet Dr. Lugo:

I like being a scientist because it brings me into contact with people who, like me, are fascinated by the *complexity* of nature and have an opportunity to try to figure it out. Then we can put the information to work for the benefit of people.

Dr. Lugo

Thinking About Science

Scientists observe natural areas using many different techniques. One way to observe natural areas is through photographs. In this article, the scientists wanted to learn about changes in

Glossary:

complexity (käm **plek** suh te): The state of being complicated or having many related parts.

latitude (**lat** uh tood): Distance north or south of the Equator.

diverse (di vürs): Differing from one another.

biome (**bi** om): An area of Earth with similar plants and animals because of its climate.

climate (**kli** met): The average condition of the weather at a place.

adapt (uh **dapt**): To change so as to fit new conditions.

dense (dens): Having its parts close together.

land use history (land us **hist** ür e): The story of how land has been used by people over time.

barren (**bear** en): Not producing crops, fruit, or many trees.

former (**fôr** mer): Earlier or in the past.

native (**na** tiv): Naturally occurring in an area.

habitat (**ha** ba tat): Environment where a plant or animal naturally grows and lives.

consensus (kän **sen** sus): Agreement of all or most.

Pronunciation Guide

a	as in ape	ô	as in for
ä	as in car	u	as in use
e	as in me	ü	as in fur
i	as in ice	oo	as in tool
o	as in go	*ng*	as in sing

Accented syllables are in **bold**.

an area of land over a long period of time. They wanted to know if trees were growing or had been cut down, or if roads or buildings had been built over the years. To do this, they used photographs of an area taken between 1936 and 1989. The photographs were taken from an airplane. Photographs taken from an airplane are called aerial (**air** e ul) photographs. The aerial photographs were compared with each other to show changes in how the land was being used. By comparing these photographs, the scientists were able to see the changes that had occurred on the land over a long period of time.

Thinking About the Environment

Tropical forests are very diverse. Although most people know about tropical rain forests, they may not know about tropical dry forests. Can you guess what makes dry forests different than rain forests? A rain forest receives more rain than a dry forest (Figure 1). A rain forest can get up to 400 inches or 1,000 centimeters of rain each year (What is the average number of inches or centimeters possible every week? What is the average number possible every day?). A dry forest receives about 20 inches or 50 centimeters of rainfall. The amount of rainfall is the most important factor limiting plant growth in an area. The plants growing in drier areas are *adapted* to lower rainfall. Drier areas often have fewer plants, and the plants do not grow as *densely* as plants in areas with a lot of rain. In this study, the scientists studied a dry tropical forest. The dry tropical forest is the result of the rain shadow effect (Figure 2). Over thousands of years, this forest has adapted to its dry conditions. Although it is still a forest, its trees are shorter and their leaves are not as large as trees in the nearby rain forest (Figure 3).

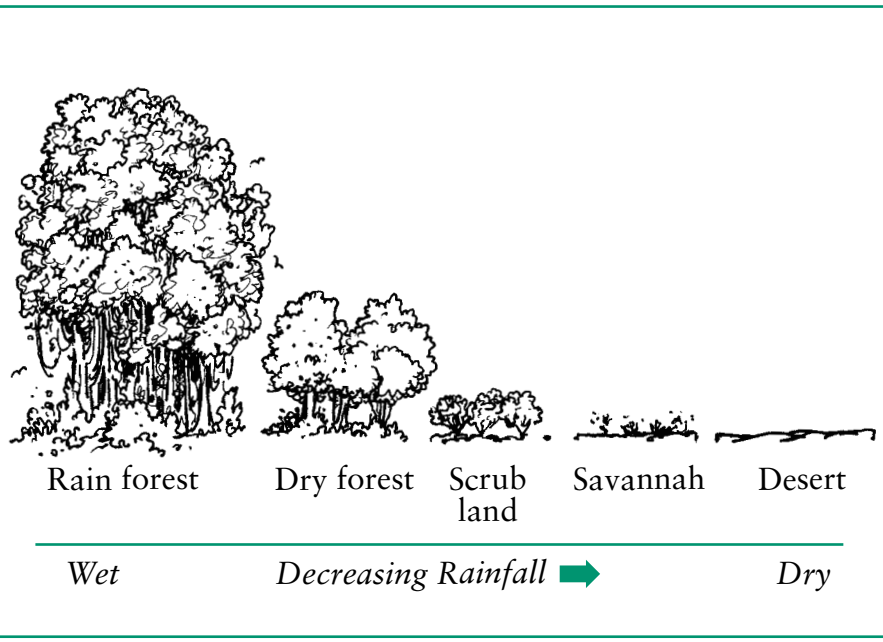

Figure 1. The type and amount of vegetation in the tropics is dependent upon the amount of rainfall received. The amount of rainfall also affects the type of vegetation growing at any latitude.

Thinking About Ecology

Think about the natural area that surrounds your community. Is it a forest, a prairie or grassland, or a desert? The Earth's surface is *diverse*. Besides having forests, grasslands, and deserts, there are also different types of forests, grasslands, and deserts! Have you ever thought about what determines these different types of *biomes* across the Earth's surface? The answer is that areas of the Earth have different *climates*. The climate of an area is determined mainly by its average temperature and average amount of

rain each year (What is the average number of inches or centimeters possible every week?). For this reason, the types of plants and animals living in dry forests are different from those living in rain forests. Trees and animals that are adapted to drier conditions live in tropical dry forests. In this article, you will learn about a dry forest in Puerto Rico. (Just for fun – What is the average amount of rainfall your town or area receives each year?)

Introduction

Guanica (**gwa** ne kä) Forest is a tropical dry forest in the southwest corner of Puerto Rico (Figure 4). In 1981, the United Nations recognized it for being one of the best examples of a dry tropical forest. Before 1919, Guanica Forest was used for agriculture and other human activities. In 1919, Guanica Forest became legally protected from most human development. Since 1919, more acres have been added to Guanica Forest. Land that had been used in the past for human activities is now inside the forest boundaries. It is mostly protected from development inside the boundaries. The land in and around Guanica Forest has been changing. The scientists in this study wanted to know how Guanica Forest and the land around it has changed over the years. For example, they wanted to know whether the trees have been growing back where crops used to be.

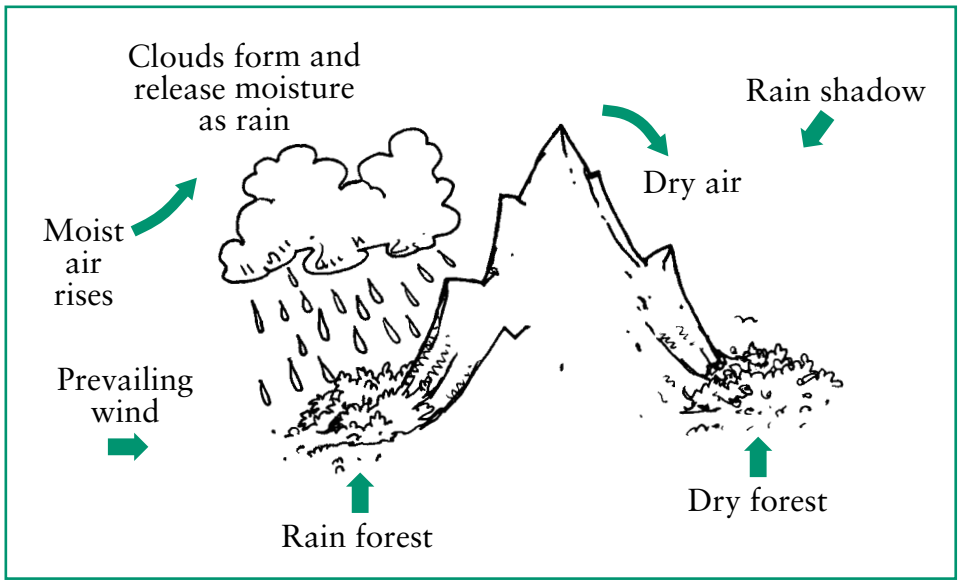

Figure 2. The rain shadow causes some areas to be drier than others.

Figure 3. Guanica Forest, a dry forest in Puerto Rico.

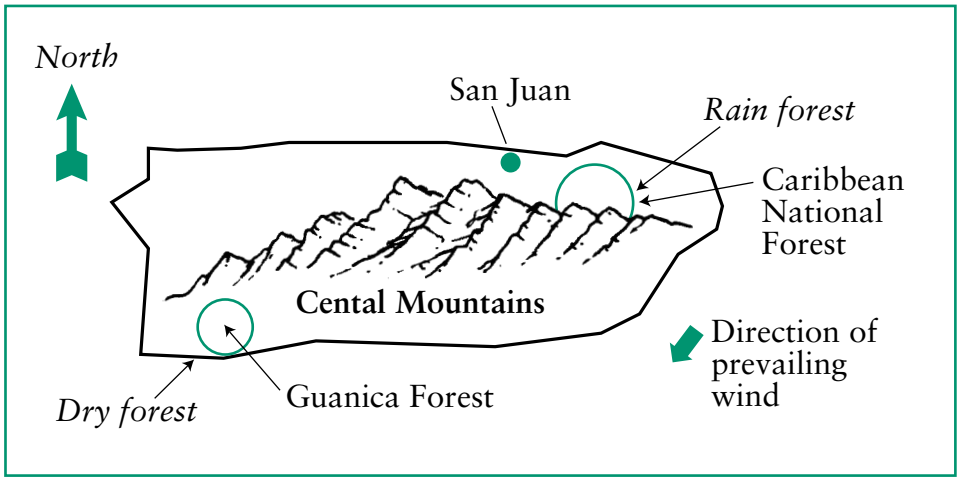

Figure 4 – Location of Guanica Forest in Puerto Rico.

They were interested in the *land use history* of Guanica Forest and the surrounding land. You have probably learned about the history of your country, state, or commonwealth. Land use history is like your country's, state's, or commonwealth's history, except that it is a history of how people used the land.

Reflection Section

- Why do you think it is important to learn the land use history of an area?

- Think about the land that your home or school was built on. What do you think the land was used for, or what it looked like, before your home or school was built there?

Methods

Based on aerial photographs taken in 1936, 1950, 1963, 1983, and 1989, the scientists determined how the land was being used over the years. They looked at the photographs of land within the Guanica Forest and outside of the forest boundaries. They saw that land had been used for buildings, roads, and agriculture. They also saw the natural areas of the forest, including trees, wetlands, and *barren* land. The scientists calculated the percentage of the forest that was in each category. The categories included:

- Urban land (with buildings, parking lots, roads, and other structures)
- Agricultural land
- Water
- Forests
- Wetlands
- Barren land

Reflection Section

- Why do you think the scientists created categories of land use?

- Do you think that the amount of agricultural land within Guanica Forest increased or decreased over the years? Why?

- Do you think that the amount of urban land outside Guanica Forest increased or decreased over the years? Why?

Results

The scientists found that land use had changed over the years. Although the portion of urban land within the forest increased much more than outside of the forest, there were many more hectares of urban land outside of the forest (See Figures 5 and 6). The amount of agricultural land within the forest decreased much more than outside of the forest. Overall, urban land increased and agricultural land decreased, while the amount of forested land stayed about the same. Figure 7 shows some of the actual photographs used by the scientists.

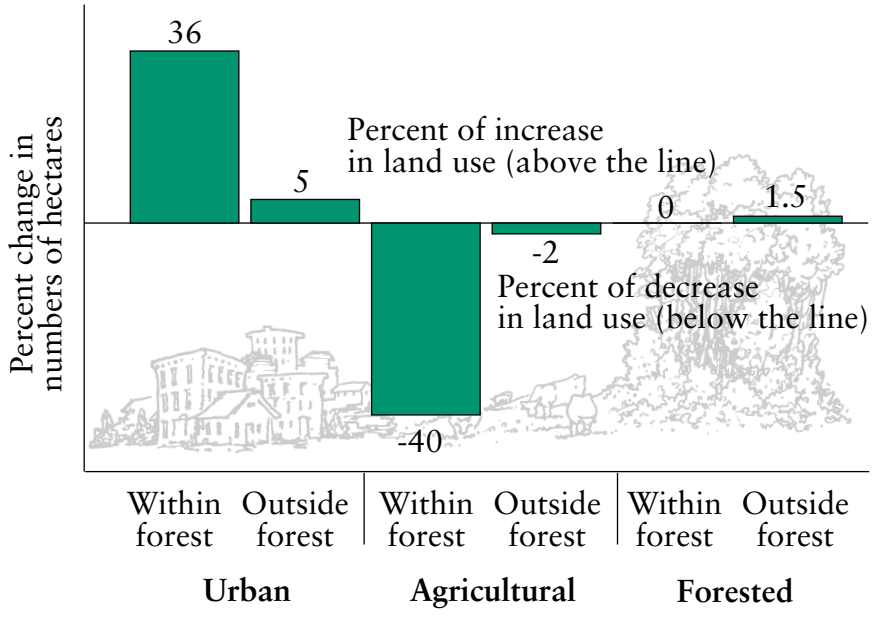

Figure 5. Relative amount of change in land use over time within and outside of Guanica Forest.

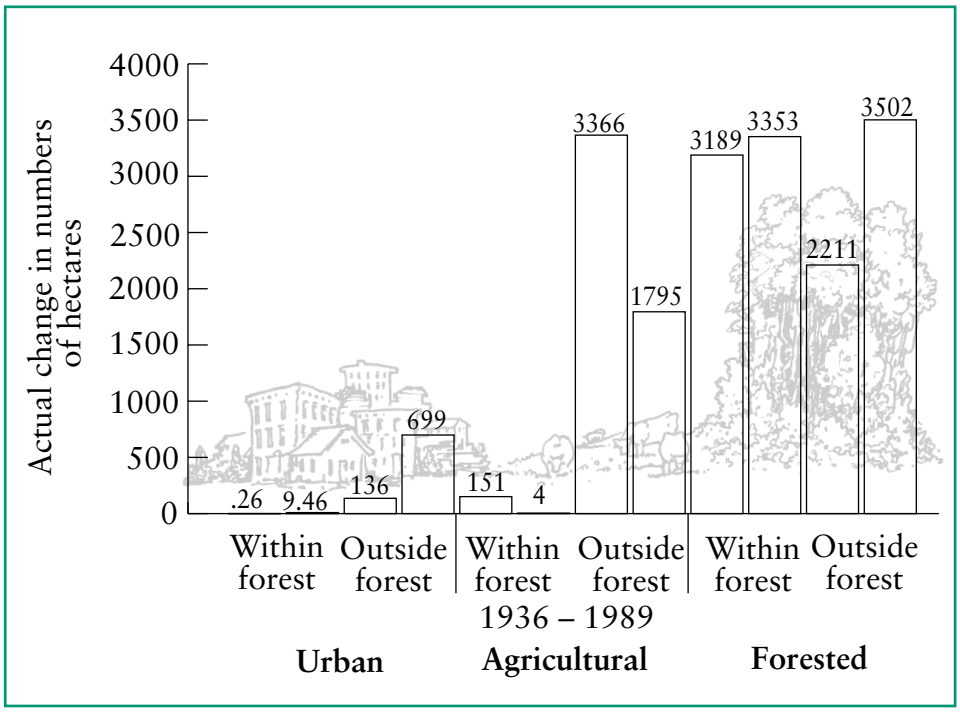

Figure 6. Actual change in number of hectares by land use type within and outside of Guanica Forest. A hectare is a metric measure equal to 2.47 acres.

Figure 7. Aerial photographs showing land use changes over time in an area outside of Guanica Forest.

Reflection Section

- Does the land around your home or school look more like a forest or is it an urban area? What land use changes, if any, are taking place around your home or school?

- Why do you think there is more urban land outside of the Guanica Forest boundary compared with inside the boundary?

Implications

The scientists found that land use outside of Guanica Forest was changing quickly. Urban uses, such as buildings and roads, were replacing the *native* forest. When native forests are removed, animals that do not naturally live in the forest can move into the area. These non-native animals might gradually move close to or over the boundary of Guanica Forest. Once they do that, they will compete with the native animals for food and *habitat*. An example in North America is the European starling, a bird that competes with native American songbirds. The scientists suggest that some of the land surrounding the forest should remain mostly forested with limited buildings or other construction (Figure 8). That way, non-native animals will not be as likely to move into Guanica Forest,

and the forest's native animals will be protected.

Reflection Section

- Do you think it is important to protect the native animals in Guanica Forest? Why or why not?

- How could the scientists find out if non-native animals are competing with native animals for food?

FACTivity

In this FACTivity, you will answer the question: Should an area of land outside of the Guanica Forest boundary be closed to land development? The method you will use to answer this question is by holding class discussions. Divide your class into three (or five) equal-sized groups of about 6 students each. One or two groups will take the position that land outside of the immediate forest boundary can and should be developed for human uses. Another group, or two other groups, will take the position that an area of land outside of the forest should be left undeveloped and natural. Each of these groups will develop three arguments in support of their position. You will need to discuss the issue within your group before developing your arguments. Take about 20 minutes to develop your arguments either for or against development. You should consider the advantages of development to people, as well as the disadvantages of development to the animals and plants within the forest. Remember that Guanica Forest has been recognized by the United Nations as one of the best examples of a dry tropical forest. Once you have developed your arguments, each group will present them orally to the remaining group while the whole class listens. The remaining group must decide whether to allow development close to the forest boundary, or whether to create an area around the forest that is closed to human development. The remaining group should spend time in advance planning how they will make their decision. Will they vote, or will they try to reach *consensus*? Once a decision is made, the remaining group must explain to the class how and why they made their decision.

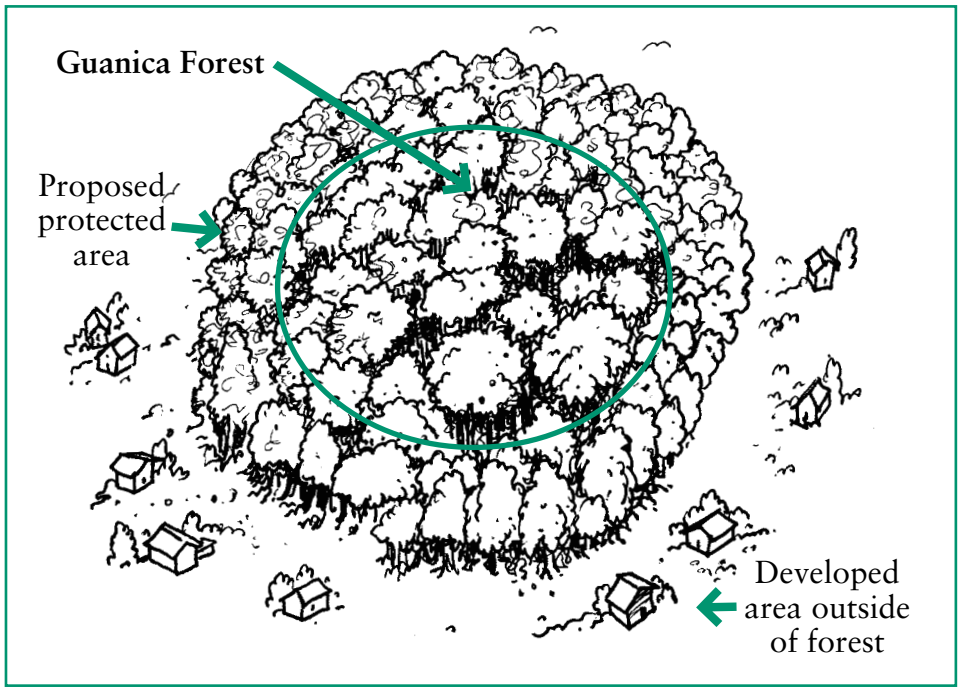

Figure 8. Example of the proposed protected area around Guanica forest.

From Lugo, Ariel E.; Ramos, Olga; Molina, Sandra; and Scatena, F. N. (1996). *A fifty-three year record of land use change in the Guanica Forest Biosphere Reserve and Its vicinity*. Rio Piedras, PR: Institute of Tropical Forestry: USDA Forest Service

For information on dry tropical forests, visit www.mobot.org/gradstudents/olson/drytropics.html