Stress Test:

The Current and Probable Future of Forests and Rangelands in the United States

Meet Dr. Hof:

I like being a scientist because I enjoy using both math and science to solve problems.

Dr. Hof

Meet Dr. Flather:

I like being a scientist because it is essentially problem solving—and in my case, the problems deal with the *conservation* of wildlife. Working on wildlife conservation problems can be very satisfying when their solution leads to better management of the *habitats* where *wildlife* live.

Dr. Flather

Thinking About Science

Scientists often work with things called *variables*. A variable can be anything, as long as it can be measured or placed into a category. Length of hair is a variable. The number of students in a class is a variable. Age, heart rate, and eye color are variables too! When scientists do their research, they often look for *relationships* between variables. Scientists find a relationship between variables when they discover a pattern of change between them.

For example, there is a general relationship between the height and weight of middle school students. As students get taller, they usually weigh more.

Scientists typically focus on the measurement of a special kind of variable, called a dependent variable. Dependent variables are called this because their value depends on the values of one or more other variables. The other variables are called independent variables. When you write a paper, you earn a particular grade (the dependent variable). Your grade depends on the values of many other independent variables, such as the accuracy of what you write, your grammar, sentence structure, spelling, neatness, and whether you turned your paper in on time.

Glossary

conservation (kän sür **va** shun): The care and protection of natural resources such as forests and water.

habitats (**hab** uh tats): Environments where a plant or animal naturally grow and live.

wildlife (**wild** lif): Animals that live in the wild.

species (**spe** sez): Groups of organisms that resemble one another in appearance, behavior, chemical processes, and genetic structure.

variables (**ver** e uh bulz): Things that can vary in number or amount.

relationships (re **la** shun ships): Connections in some fashion of two or more things.

rangelands (**ranj** lands): Open lands which are mostly covered with grasses or shrubs.

stressed (stresd): Strained, pressured, or placed under tension.

indicate (**in** di kat): To point out or point to.

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

threatened and endangered species (**threh** tend and en **dan** jürd **spe** shez): *Species* whose numbers are so low as to threaten or endanger its existence in the future.

cubic feet (**kyoo** bik fet): The summed volume of many cubes that are each 1 foot long, 1 foot high, and 1 foot wide.

sediment (**sed** uh ment): Matter set down by wind or water, such as sand or soil.

ratio (**ra** she o): The relation of one thing to another in size, amount, etc. Proportion.

breeding birds (**bred** ing bürds): Birds who are also breeding and raising their young in the area they are living.

climate (**kli** met): Average weather conditions of a place over a number of years.

elevation (el uh **va** shun): The height above sea level.

population (pop yoo **la** shun): The total number of individuals of separate types of plants or animals occupying an area.

publicly (**pub** lik le): By the government, on behalf of all citizens.

analysis (uh **now** luh sis): Separating something into its parts to examine it.

represent (rep re **zent**): To be an example of.

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**.

Thinking About the Environment

The scientists in this study were interested in identifying forest and *rangeland* areas of the United States where the natural environment might become more *stressed* in the future. They picked seven conditions that *indicate* how stressed the natural environment is. These conditions included things like the number of *native* birds living in an area and how much water was flowing in streams.

The scientists considered many changes that might affect these conditions. They assumed that the changes that would place the most stress on the environment are the ones caused by human activity. This included things like how many people are living in an area, how much of the land is built up with homes and businesses, and how much of the land is used for cattle grazing.

Change is a normal part of the natural environment, but natural change usually takes a long time to occur, and the environment has time to adapt to the changes. When people make changes to the natural environment, the change is usually faster. If the environment does not have time to adapt to changes, it might become more stressed.

Introduction

It is important to understand the condition of our forests and rangelands, now and into the future. Ideal forests and rangelands have clean water in their streams, a variety of native animals, and few *threatened and endangered species* (figure 1).

The scientists in this study were asked to identify which areas of forest and rangeland in the United States might become more stressed in the future. To do this, they decided to identify areas across the United States where human activity might cause stress on forests and rangelands.

Examples of human activities that might cause stress on forest and rangelands include using trees for wood products and mining the earth for minerals. These activities can affect the types and amount of wildlife, the cleanliness of the water, and whether there are a lot of different types of plants growing in an area.

Figure 1. The Mexican wolf is an endangered species.

Reflection Section

- What is the question the scientists were asked to answer?
- To determine what might happen in the future, what will they need to know about the human activities that might cause stress to the natural environment?

Method

The scientists identified seven dependent variables, which they called indicators. The scientists called these dependent variables indicators because they believed these variables would indicate how much stress a forest or rangeland was experiencing. The seven indicators were:

1. The number of threatened and endangered plant species per acre.
2. The number of threatened and endangered animal species per acre.
3. The amount of water flowing in streams, measured in *cubic feet* per second.
4. The amount of *sediment* flowing down waterways, measured in tons per day.
5. The *ratio* of the number of acres of undisturbed land to total number of acres.
6. The number of native *breeding birds* per acre.
7. The ratio of the number of nonnative breeding birds to the total number of birds (figure 2).

Figure 2. The European starling is a nonnative breeding bird that can be found across the United States.

The independent variables included measures of the *climate* of an area, its *elevation*, its *population*, how much money had been paid for trees to be used for wood products, how many cows were grazing on the land, how many mining sites were in the area, and whether the land was privately or *publicly* owned.

Using a computer program, the scientists did their *analysis* using two steps. First, they looked for current relationships between the indicators and the independent variables. For example, when human population grows in an area, is there a greater or lesser number of threatened and endangered plant species in that area? What happens to the amount of sediment flowing in streams when more cows are allowed to graze in an area?

The scientists entered numbers into the computer program that *represent* what might happen to the independent variables in the future. For example, is the climate expected to change? If so, how? Is the number of cows grazing on land expected to increase, decrease, or stay the same in the future?

Remember that the scientists already knew the relationship between the indicators and the independent variables. From the expected future changes in the independent variables, the scientists were able to predict how the indicators might change in the future.

Reflection Section

- Why were the scientists able to predict what might happen to the indicators in the future? Taken together, what do the indicators represent?
- You probably know the relationship between your grade on a school paper and how accurate your information was, the number of words you incorrectly spelled, your neatness, and whether you turned your paper in on time.

  If the number of incorrectly spelled words went down, your writing or typing got neater, and you turned your paper in early, how would you expect your grade to change from grades in the past? What if the number of incorrectly spelled words went up, your writing or typing got sloppier, and you turned your paper in late? How would you expect your grade to change? How is your experience with grades in school like this study?

Findings

The scientists developed maps that show areas of the United States where by the year 2020 there is likely to be the greatest concern for each of the seven indicators of forest and rangeland stress (figures 3-9, pgs. 52-54). Then, they combined the seven maps and created another map that shows areas where by the year 2020 there is likely to be the greatest concern for stress on forests and rangelands overall (figure 10, pg. 54).

The scientists predicted that by the year 2020, almost 24.6 percent of the United States will experience a high level of stress for at least one of the seven indicators. The scientists caution that this is only a prediction. What will actually happen in the future could be different. Their conclusions are similar to another study that showed the same general locations across the United States where stress on forests and rangelands may be the greatest.

Figure 3. Areas of the United States where there is likely to be the greatest increase in threatened and endangered plant species by the year 2020.

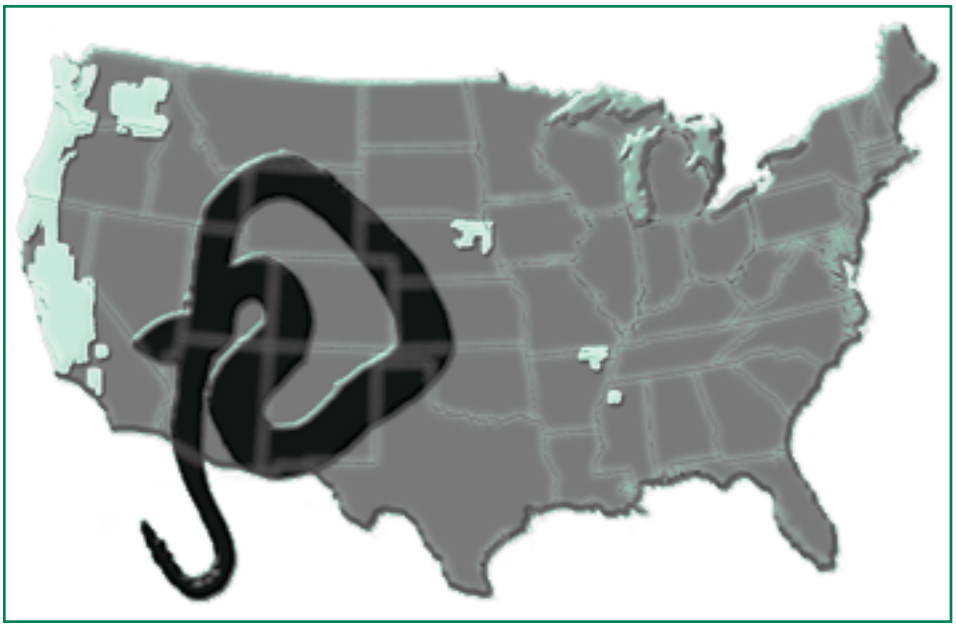

Figure 4. Areas of the United States where there is likely to be the greatest increase in threatened and endangered animal species by the year 2020.

Figure 5. Areas of the United States where there is likely to be the greatest decrease in stream flow by the year 2020.

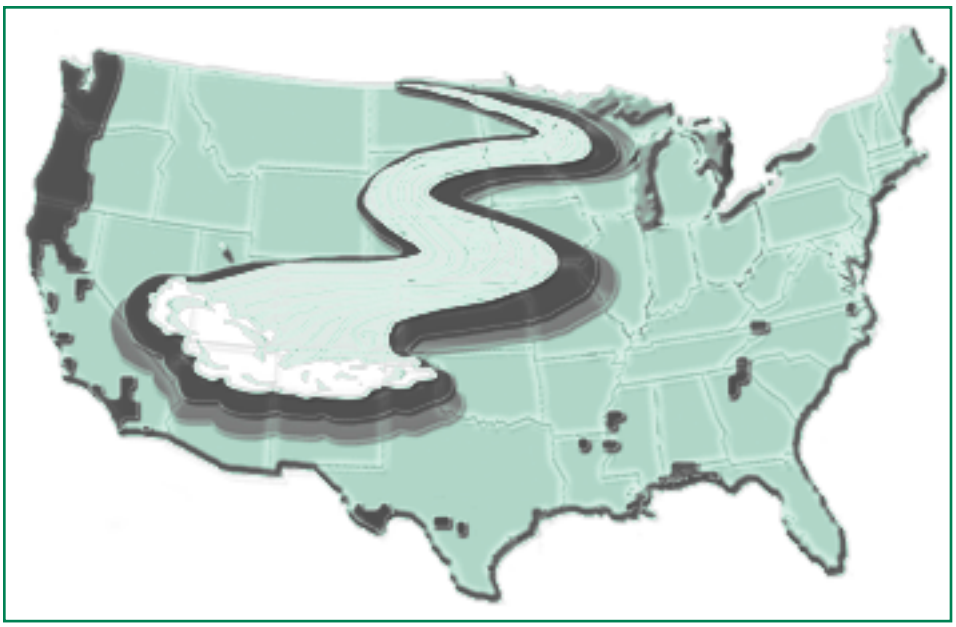

Figure 6. Areas of the United States where there is likely to be the greatest increase in sediment discharge by the year 2020.

Figure 7. Areas of the United States where there is likely to be the greatest decrease in undisturbed natural land by the year 2020.

Figure 8. Areas of the United States where there is likely to be the greatest decrease in native breeding birds by the year 2020.

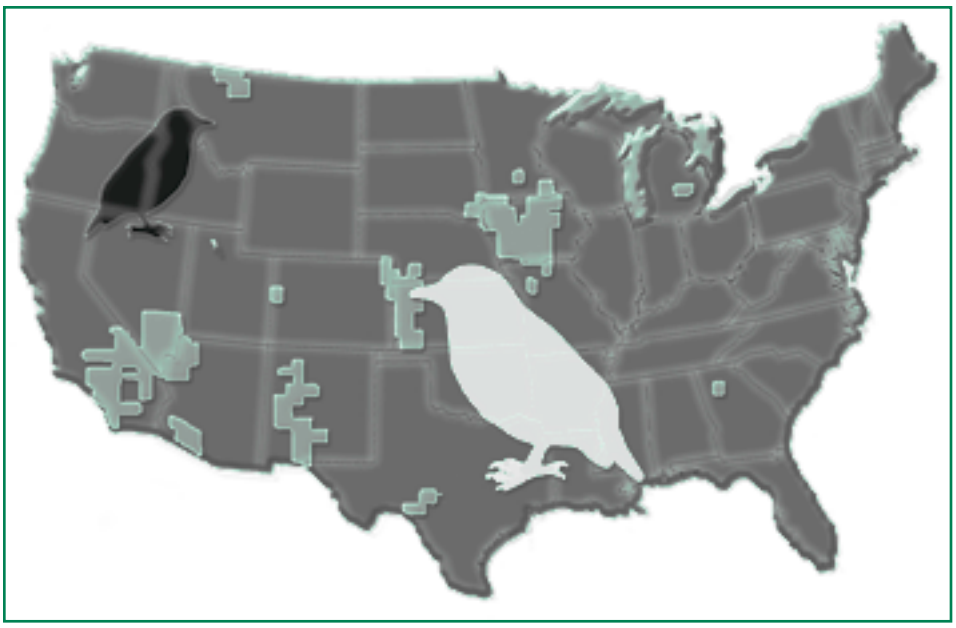

Figure 9. Areas of the United States where there is likely to be the greatest increase in nonnative birds by the year 2020.

Reflection Section

- Look at figures 3-9. Do you see any similarities in the location of the seven indicators? What are some of the areas across the United States where the most stress is predicted to occur?
- The scientists reported that the areas of the United States where they predicted a greater level of stress in forests and rangelands are similar to the results of another study. Does this give you more or less confidence in their results? Why?

Figure 10. Areas of the United States where there is likely to be the greatest increase in environmental stress by the year 2020.

Implications

Although this study identified areas in the United States where forests and rangelands may experience more stress by the year 2020, this is only a prediction. Scientific predictions are based on the best information that scientists have today. What happens in the future might be different. This study helps us to think ahead into the future, and to pay special attention to the areas that need it the most. By doing that, we might be able to keep those areas healthier, and possibly change what will happen in the future.

Reflection Section

- How old will you be in the year 2020? What kind of impact might a decline in stream flow have on your life in the year 2020? What kind of impact might an increase in the number of threatened and endangered animal species have on your life?
- Do you think that people should pay attention to the predictions made in this study? Why or why not?

From: Hof, John; Flather, Curtis; Baltic, Tony; Davies, Stephen. 1999. *National projections of forest and rangeland condition indicators: A supporting technical document for the 1999 RPA assessment.* Gen. Tech. Rep. PNW-GTR-442. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 57 p.

FACTivity

The question you will answer in this FACTivity is: What is the environmental condition of the land around your school? The method you will use to answer this question is: First, you have to decide what the best indicators are of the environmental condition of the land around your school. You also have to decide what the indicators mean. To do this, divide your class into groups of 4-5 students. Each group will hold a discussion and submit one indicator to the class. It is okay for more than one group to suggest the same indicator, but if your class does not have at least 5 indicators, assign the groups to develop more. Examples of indicators that you might use are:

1. The number of trees per acre. More trees indicate a better environmental condition.
2. Whether you have a bird bath, pond, or stream on the land surrounding your school. A source of water for birds and other animals indicates a better environmental condition.
3. The number of bird nests on the land surrounding your school. More bird nests indicate a better environmental condition.

After your class has developed five indicators, the class should determine the values of each of the indicators and what the values represent. Here are examples of the values and what they represent for the examples given above.

1. The number of trees per acre. (You will have to find out how many acres of land surround your school.) Less than 5 (<5) trees per acre = poor condition; 6-10 trees per acre = good condition; more than 10 (>10) trees per acre = very good condition.
2. A source of water available to birds and other animals. No = poor condition; Yes, we have a bird bath that is cleaned and filled daily = good condition; Yes, we have a pond or a stream on our school grounds = very good condition.
3. The number of bird nests on the land surrounding your school. None = poor condition; 1-5 = good condition; >5 = very good condition.

Select a student to write the indicators and their values on the board. Hold a class discussion over what the indicators indicate about the condition of the land surrounding your school. Do the indicators tell you clearly whether the condition of your school's land is good or poor? Why or why not? Hold a class discussion about how this FACTivity is similar to the method used by the scientist in this study. In what ways is it different?