Wild Ways

Assessing How Climate Change May Affect Certain Wildlife

Photo by Dave Menke and courtesy of U.S. Fish and Wildlife Service.

Meet the Scientists!

Dr. Sharon Coe,
wildlife ecologist

I have had wonderful experiences doing science outdoors. One of my favorite experiences was studying a bird. I studied mountain chickadees in a forest in the Sierra Nevada. The Sierra Nevada is a mountain range in California and Nevada. I was collecting data for my Ph.D. degree. People earning a Ph.D. degree become highly **specialized** in one research topic.

I spent many weeks each summer observing the nesting behavior of mountain chickadees. I was able to see eggs and nestlings close-up. I enjoyed learning my way around the woods and knowing where the birds were nesting. My study sites were on lands managed by the Forest Service. After a while, the area became so familiar to me that it felt like it was my backyard. It was a big adventure!

Dr. Deborah Finch,
biologist:

One of my favorite scientific experiences is mist-netting and banding songbirds. A mist-net looks like a large volleyball net. The netting is very fine and almost invisible. Birds fly into the netting and get caught. Birds are not injured by mist-nets. After I carefully take each bird from the mist-net, I measure it and put a little numbered metal band around its ankle to keep track of it over time. Then, I love to open up my hands and watch the bird fly away.

Dr. Megan Friggens, ecologist:

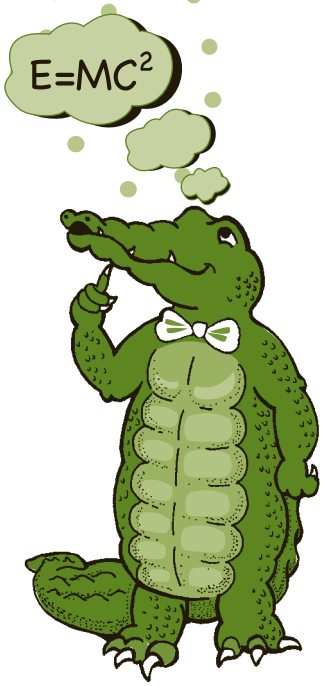
My first favorite science experience was taking a 10-day field trip to Belize (bə **lēz**) as part of a college tropical biology class. Belize is in Central America. This trip was my first opportunity to travel to and live in a tropical jungle. I also explored Belize's **cays** and **reefs**. I saw animals in the wild, such as howler monkeys and barracudas. I did a field study on a plant that eats insects. I also learned a lot about the local human populations. These people were often leading the efforts to **conserve** wild **habitats** and animal **species**. During this time I slept in a hammock, was attacked by tiny biting flies, and swam in crocodile-infested waters (the crocodiles were too small to hurt me). By the end of it all, I knew that I was going to be an ecologist.

What Kind of Scientist Did This Research?

biologist: This scientist studies living organisms and systems.

wildlife ecologist: This kind of scientist studies the relationship of different kinds of wildlife with each other and with their living and nonliving environment.

ecologist: This kind of scientist studies the relationship of living things with each other and with the nonliving environment.



Thinking About Science

Sometimes scientists study current problems. Scientists also study problems that may occur in the future. To study what may happen in the future, scientists look at current evidence and make predictions about what might happen.

In this study, the scientists were interested in how a changing climate may affect wildlife in the future. Scientists have tried to figure out the effects of climate change using several different methods. The method the scientists used in this study was to create a **vulnerability index**. A vulnerability index predicts how much a species might be affected by changes to their habitat. The scientists used this vulnerability index to predict which species of wildlife were likely to be the most **vulnerable** to climate change. This process enables people who work to **conserve** wildlife to make better decisions.

Thinking About the Environment

Have you heard the term "climate change?" Climate change refers to how Earth's climate may be changing over time. In the past few years, most scientists have agreed that measured and recorded changes in Earth's climate over the past 100 or more years point to a warming of Earth's surface.

Scientists are researching questions related to the possible effects of climate change. One question is: How do different plant and animal species respond to a changing climate? In this study, scientists were interested in how some **vertebrates** may respond to climate change **(figure 1)**.

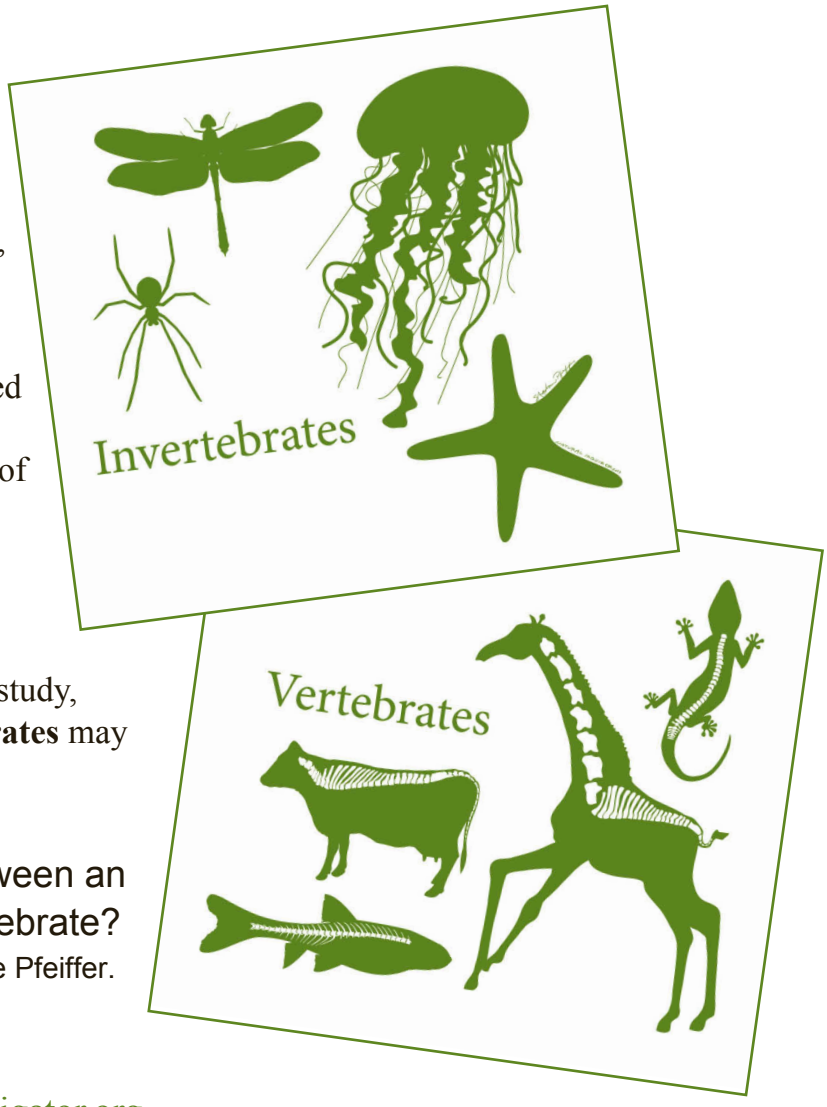


Figure 1. What is the difference between an invertebrate and a vertebrate?
Illustration by Stephanie Pfeiffer.

Introduction

Identifying which species may be the most vulnerable to a changing climate is important. This information can help people make decisions about how to best manage the land. It can also help make better decisions to support wildlife. In this study, the scientists wanted to learn more about species living in and around the Coronado National Forest (CNF) **(figure 2)**. The CNF is located in southeast Arizona and southwest New Mexico **(figure 3)**. The scientists identified 30 species to study.

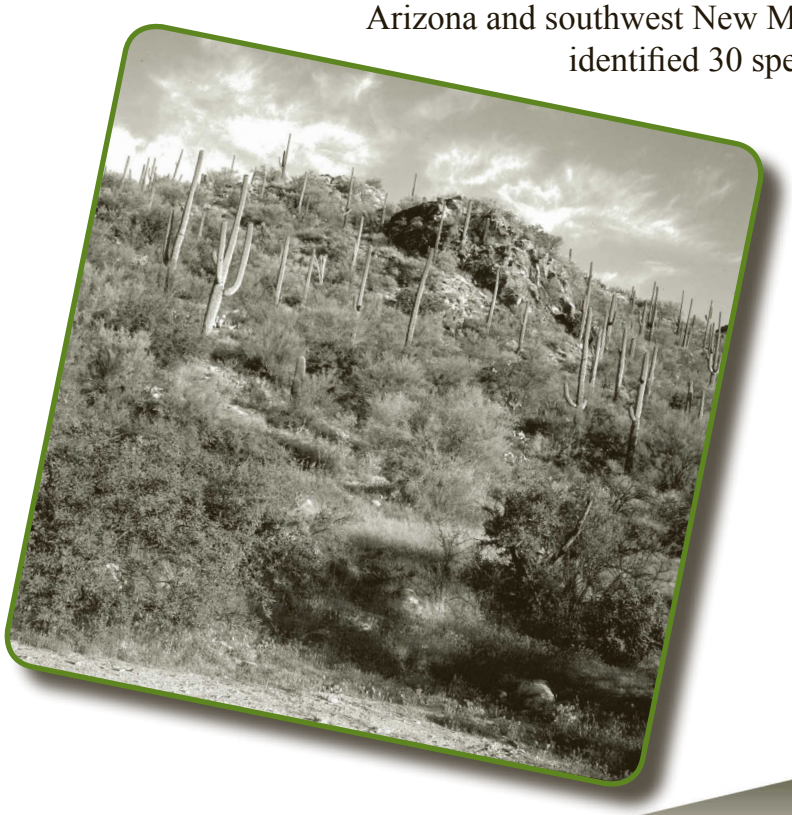


Figure 2. The Coronado National Forest covers 1,780,000 acres of southeastern Arizona and southwestern New Mexico. Photo by Rod Replogle, Forest Service.

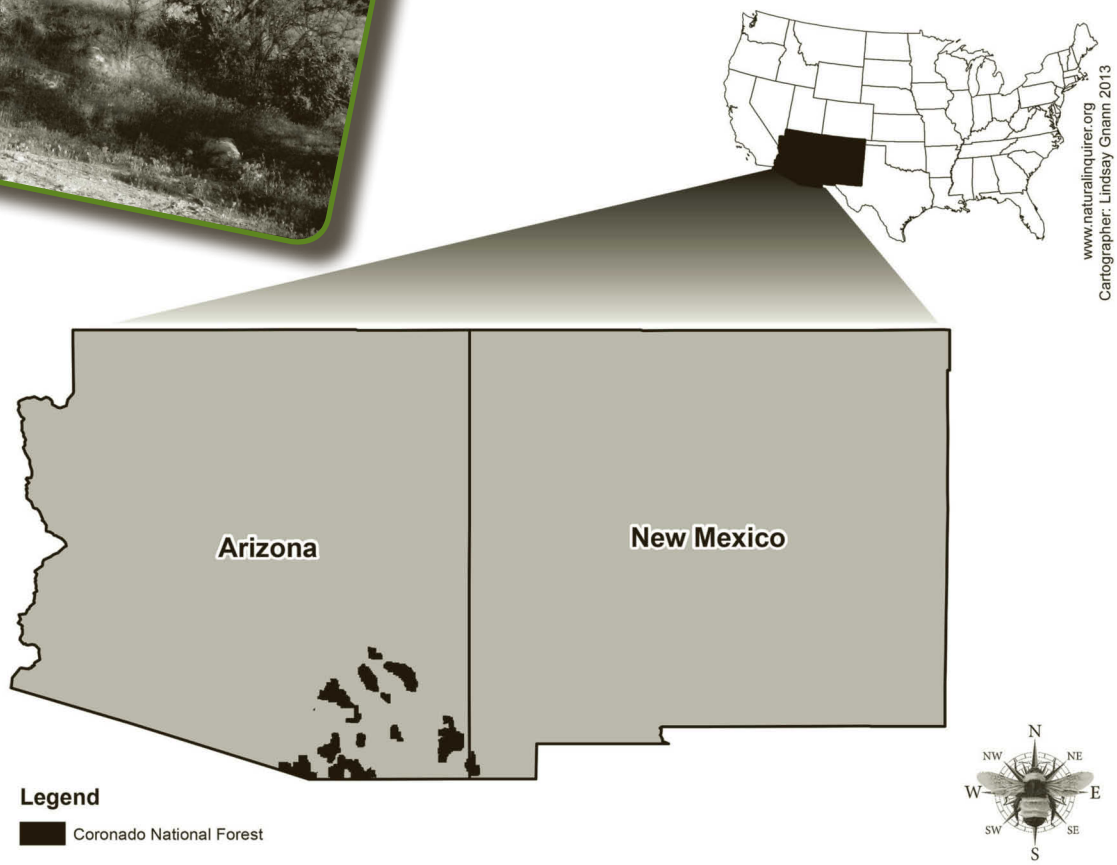


Figure 3. The Coronado National Forest is located in southeast Arizona and southwest New Mexico.

The 30 species the scientists studied included reptiles, amphibians, birds, and mammals **(figures 4, 5a, & 5b)**. Some of these 30 species were important to study because they were considered at risk of **extinction**. Some of the species were already listed as an **Endangered Species** or a **Federal Species of Concern**.

Figure 4. The 30 different species that the scientists studied included 8 birds, 13 mammals, 5 reptiles, and 4 amphibians.

Abert's squirrel	Arizona ridge-nosed rattlesnake	Desert tortoise	Mexican long-tongued bat	Northern gray hawk	Townsend's big-eared bat
Allen's lappet-browned bat	Chiricahua leopard frog	Elegant trogon	Montezuma quail	Northern Mexican gartnersnake	Western yellow bat
American bullfrog	Chiricahua fox squirrel	Giant spotted whiptail	Mount Graham red squirrel	Slevin's bunchgrass lizard	Western yellow-billed cuckoo
American peregrine falcon	Coues' white-tailed deer	Gould's wild turkey	Northern buff-breasted flycatcher	Sonoran tiger salamander	Western red bat
Arizona gray squirrel	Desert bighorn sheep	Mesquite mouse	Northern goshawk	Tarahumara frog	White-bellied long-tailed vole

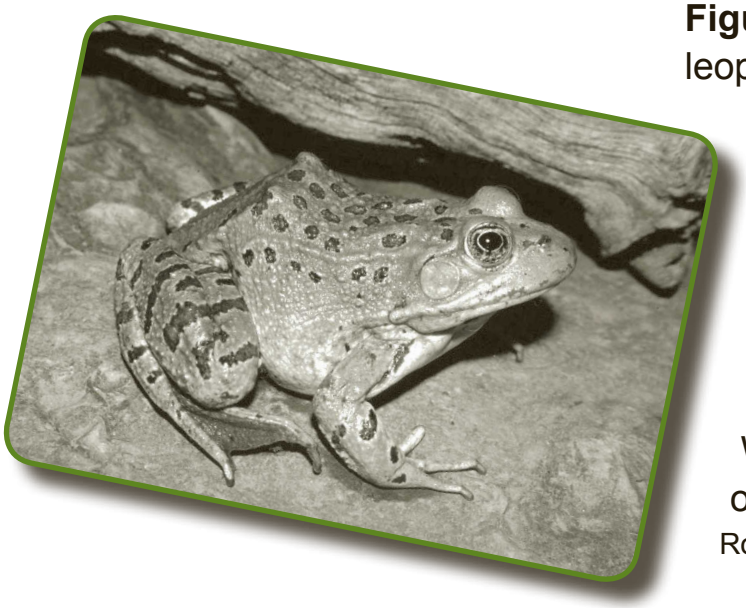


Figure 5a. The Chiricahua (chir ə **kä** wə) leopard frog is a threatened species. Under the Endangered Species Act of 1973, a threatened species means that the species is "likely to become endangered in the foreseeable future throughout all or a significant portion of its range." An endangered species is one in which the entire species is in danger of extinction. When a species is extinct, no individuals of that species are alive. Photo courtesy of Jim Rorabaugh, U.S. Fish and Wildlife Service.

Figure 5b. The American peregrine falcon is a fast flier. The falcon averages 25-34 miles per hour in traveling flight. The falcon can reach up to 69 miles per hour when pursuing prey. Photo courtesy of Andrew Kuhn, National Park Service.

The scientists in this study were interested in discovering how climate change may affect the 30 species they studied. The scientists wanted to figure out how **vulnerable** the species may be to climate change.

Methods

To figure out which species were likely to be the most vulnerable to the effects of climate change, the scientists used a vulnerability index. The scientists answered 25 questions for each species. The 25 questions were grouped into four categories.

The four categories were habitat, physiology (**fi** zē **ä** lə jē), phenology (fi **nä** lə jē), and biotic (bī **ä** tik) interactions. The habitat category covered topics about where an animal lives. The physiology category covered topics related to the function and activities of the animal.

Phenology is the study of the relationship between climate and events in the annual life cycle of plants and animals. Example topics in the phenology category are bird migration and

plant flowering. Migration is when an animal moves from one region or climate to another for feeding or breeding.

Biotic interactions are the ways that living things interact with each other. The questions in this category related to how these interactions might change due to a changing climate. Examples of the types of questions the scientists answered are shown in **figure 6**.

Habitat	Physiology
• Where is the breeding area? • What resources are needed in the habitat during the breeding season? • Where is the non-breeding area? • How well is the species able to make homes in new areas? • Does the species use migratory areas?	• How does the species respond to extreme weather? • Would climate change limit the daily active period for the species? • What is the species' life span? • What is the ability of the species to store energy?
Phenology	**Biotic Interactions**
• How does the species use temperature and moisture as cues for changes in behavior? • How many times does the species attempt to breed in a year?	• If the species has a specific diet, what are the impacts of climate change on the primary food sources? • Is there potential for changes in the amount that diseases are spread?

Figure 6. Examples of different types of questions the scientists asked in each category.

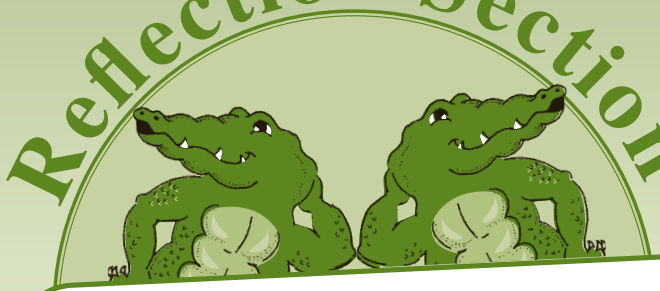
The scientists answered these types of questions for each of the species in their study. Each question was scored a point value depending on the answer to the question. The scientists calculated an overall score for each species using points from answers to all 25 questions.

The scientists also calculated a score for each species in each of the four categories (using points from only the questions within the category).

In addition, the scientists calculated a score for the four different **taxonomic** groups they studied. They calculated this score by taking the **average** of the overall score for each species in a taxonomic group. The four taxonomic groups that were studied were birds, mammals, amphibians, and reptiles.

In summary, the scientists calculated three scores: 1) an overall score for each species; 2) a score for each category for each species; and 3) a taxonomic group score.

Photo by Fernley and Dreamstime.



- Why do you think the scientists looked at an overall score for each species, category scores for each species, and taxonomic group scores?
- Look at figure 6 under biotic interactions. Why might it be important to know if there may be a change in the amount of diseases that are spread?

Figure 7. The elegant trogon's population is estimated to be around 200,000 birds. Photo courtesy of Dominic Sherony (Wikimedia Commons).

Findings

The scientists found that most of the species were vulnerable to climate change. The overall score ranged from -0.4 to 9.9. The larger the overall score, the more vulnerable the species was to a changing climate.

Sixty-seven percent of the species identified had a score over 5. These were the species most vulnerable to climate change. The two species with the largest scores were the elegant trogon (**trō** gän) and the Tarahumara (**ta** rə hü **mär** ə) frog **(figures 7 & 8)**. The lowest scoring species were the mesquite mouse, the desert bighorn sheep (see photo, upper right), and Slevin's bunchgrass lizard. These three species were predicted to be the least vulnerable to climate change.

Figure 8. The Tarahumara frog does not have vocal sacs like most male frogs. Vocal sacs are a thin piece of skin that, when filled with air, enables a male frog to call loudly. The Tarahumara frog still manages to make sounds, such as grunts and snores, above and below the water. Photo courtesy of Jim Rorabaugh, U.S. Fish and Wildlife Service.

Scientists calculated scores for each species within the four categories. The scores ranged from -2.3 to 5 for habitat, physiology, and phenology. The closer the score was to 5, the more vulnerable the species was predicted to be in that category **(figure 9)**.

Category	Species	Score
Habitat (highest score)	Chiricahua leopard frog	4.0
Habitat (lowest score)	Slevin's bunchgrass lizard	-2.3
Physiology (highest score)	Tarahumara frog and Chiricahua leopard frog	2.9 (for both)
Physiology (lowest score)	Townsend's big-eared bat	-0.8
Phenology (highest score)	Elegant trogon	5.0
Phenology (lowest score)	Mesquite mouse	-3.3

Figure 9. The highest and lowest scoring species for habitat, physiology, and phenology. The closer the score was to 5, the more vulnerable the species was predicted to be in each category.

When the scientists looked at the different taxonomic groups they studied, they found that the bird group had the highest average overall score and the reptile group had the lowest average overall score **(figure 10)**.

Figure 10. The scores for the taxonomic groups showed that all of the groups were vulnerable to climate change.

Taxonomic Group	Average Overall Score
Birds	7.4
Amphibians	6.9
Mammals	5.0
Reptiles	3.9

Look at figure 9. List one thing you notice when studying this table.

Look at figure 10. What do you notice about the scores for the four taxonomic groups?

Discussion

The scientists concluded that most of the 30 species are vulnerable to a changing climate. The scientists suggested that the scores for each species may be used as a guide. These scores may help guide which species should be studied more right now. Also, the scientists believe it is important to look at the individual characteristics of each species. These individual characteristics may have an impact on the vulnerability of a species.

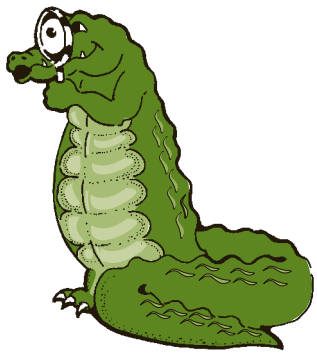
The scientists also said it was important to consider the overall score as well as the scores within the categories (habitat, phenology, physiology, and biotic interactions). For example, the elegant trogon and Tarahumara frog had the same overall score. However, they had different scores within the four categories. The scores within the categories may help scientists know which areas need more study.

Reflection Section

- Do you think it is useful to figure out how vulnerable a species is to climate change? Why or why not?
- Take a moment to think about all the members of your class. Write down three words to describe your entire class. For example, you could say energetic, smart, and fun-loving. Now take a moment to think about yourself. Write down three words to describe you. Did the three words that you wrote about the entire class and the three words you wrote about yourself match perfectly? How is this like what the scientists found out about the different species when they used the overall score, the category score, and the taxonomic group scores?

Adapted from Coe, Sharon J.; Finch, Deborah M.; Friggens, Megan M. 2012. An assessment of climate change and the vulnerability of wildlife in the Sky Islands of the Southwest. Gen. Tech. Rep. RMRS-GTR-273. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 208 p. http://www.fs.fed.us/rm/pubs/rmrs_gtr273.pdf.

If you are a trained Project Learning Tree educator, you may use Activity 86: Our Changing World or Activity 88: Life on the Edge.



Glossary

average (**a**v(ə-) rij): A value equal to the sum of a set of numbers divided by how many numbers are in the set.

cay (**kē**): Small, low-lying sandy island formed on the surface of a coral reef.

conserve (kən **sərv**): To avoid wasteful or destructive use of.

endangered species (in **dān** jər ed **spē** shēz): A species threatened with extinction.

extinction (ik **stiŋ(k)** shən): The state or situation that results when something (such as a plant or animal species) has died out completely.

Federal Species of Concern (**fe** d(ə-)rəl **spē** shēz əv kən **sərn**): Species which might need special help. Species of concern do not receive legal protection.

habitat (**ha** bə tat): The environment where a plant or animal naturally grows and lives.

reef (**rēf**): A chain of rocks or coral or a ridge of sand at or near the surface of the water.

specialized (**spe** shə līzd): Trained, or fitted for one particular purpose or occupation.

species (**spē** shēz): A class of individuals having common attributes and designated by a common name.

taxonomic (tak **sä** nə mik): Orderly classification of plants and animals according to their presumed natural relationships.

vertebrate (**vər** tə brət): Having a spinal column.

vulnerable (**vəl** n(ə-) rə bəl): Open to attack or damage.

vulnerability (**vəl** n(ə-) rə **bəl** ə tē): The state of being vulnerable.

vulnerability index (**vəl** n(ə-) rə **bəl** ə tē **in** deks): A system for generating a number that indicates how vulnerable something is to something harmful. In this study, scientists collected data about each species and then answered questions about how each species could be affected by climate change. The scientists then were able to calculate numbers, called scores. Higher scores indicated higher predicted vulnerability.

Accented syllables are in **bold**. Marks and definitions are from http://www.merriam-webster.com.

FACTivity

Time needed:
Two class periods.

The question you will answer in this FACTivity is:
How might climate change affect species in my state?

Materials

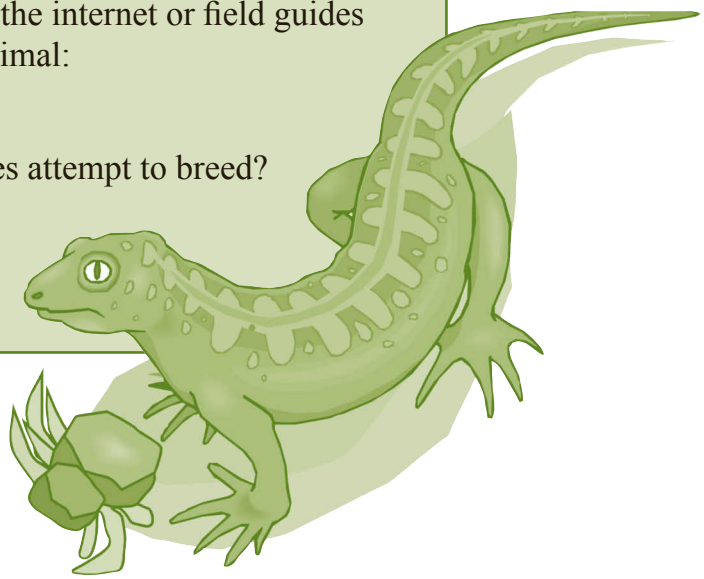
- *Investi-gator* Animals and Ecosystems of the Southwestern United States
- Computer with Internet access or hard copy field guides for birds, mammals, reptiles, and amphibians

The method you will use to answer this question is:

1. Divide into small groups of three to four students. You and your group will choose four animals that are found in your state. These animals can be birds, mammals, amphibians, or reptiles. One of these animals should be at risk of extinction. This species should be listed as a Federal Endangered Species or a Federal Species of Concern. To find endangered animals in your state, visit the U.S. Fish and Wildlife Service's Endangered Species Program Web site at http://www.fws.gov/endangered/.

   Once you have chosen four animals, you will answer a few questions to help determine the vulnerability of each animal. Use the internet or field guides to answer the following questions about each animal:

   a. Where is the species' breeding area?
   b. How many times a year does the species attempt to breed?
   c. What is the species' life span?
   d. Does the species have a specific diet?



FACTivity continued

2. After you and your group have answered the questions about each species, discuss the potential impacts climate change could have on these species. Some questions you may ask are:
    a. How might climate change affect the species' breeding habits? Will it shorten or lengthen the breeding period? Will the species have to travel further to reach its breeding area?
    b. Will climate change affect how many times a year the species breeds? For example, if it only breeds during the winter and winters become shorter, will the species be able to breed as often?
    c. How might climate change affect the species' life span? Will the species live for a longer or shorter amount of time?
    d. How will the species' diet change as a result of climate change? Will the food it eats still be available?
3. As a class, discuss the information you learned about climate change and animals in your state. Compare what you discover with the findings from this article. Now, answer the question posed at the beginning of the FACTivity.

Web Resources

Coronado National Forest
http://www.fs.usda.gov/main/coronado/home

Information about the Mexican Frog or Tarahumara Frog
http://www.azgfd.gov/w_c/edits/documents/Ranatara.fi.pdf

Teachers Guide for "Climate Change, Wildlife, and Wildlands Toolkit"
http://www.globalchange.gov/resources/educators/toolkit

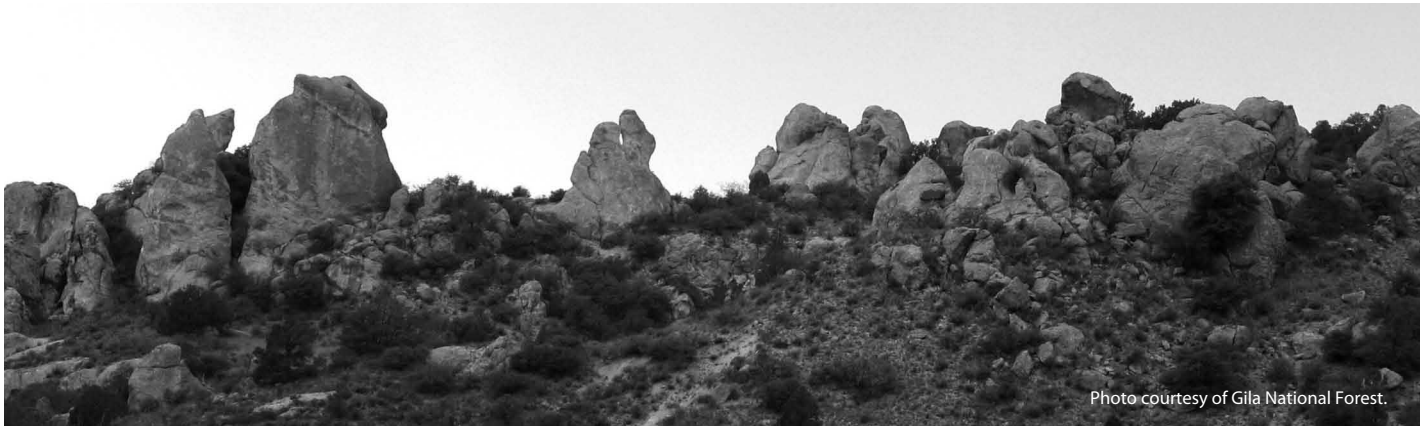


Photo courtesy of Gila National Forest.