

The Golden Egg

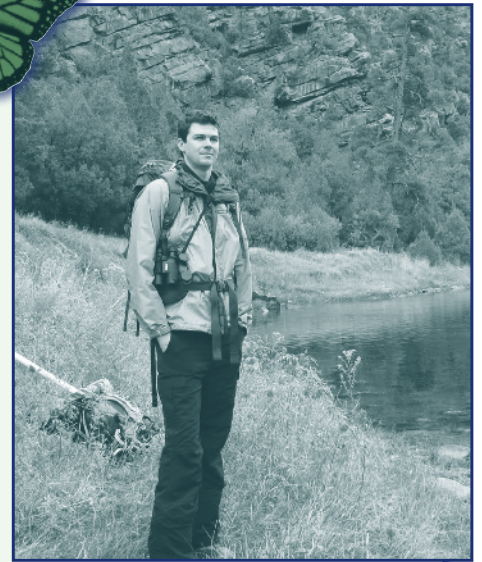
*Using Adaptive
Management To
Regulate Hiking Near
Golden Eagle Nests in
Denali National Park*

Photo courtesy of Kent Miller, National Park Service.

Meet the Scientists

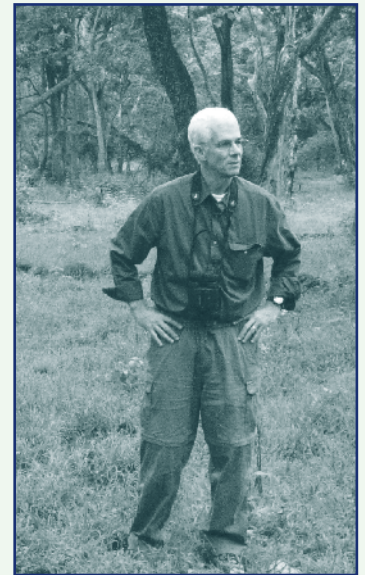


► **Dr. Julien Martin**, Research Scientist: The most satisfying moments in my job involve finding solutions to problems related to **conservation**. In the case of the golden eagle study, for example, our goal was to help park managers **regulate** recreation activities near golden eagle territories. Such regulation would help ensure a healthy population of eagles in Denali National Park. It is a nice example of the use of scientific knowledge to help make smart decisions for conservation.



◀ **Dr. Carol McIntyre**, Avian Bioecologist: Studying birds that nest at northern latitudes is exciting and one of the most interesting parts of my career. I also enjoy studying bird **migration**, particularly using technology such as **telemetry** that enables us to track the movements and migratory behavior of birds. Another exciting part of science is **collaborating** with other scientists on projects. Working with a diverse group of scientists always makes the project more interesting.

► **Dr. Jim Nichols**, Population Ecologist: One of my more interesting experiences occurred while working on a project on a big lake in central Florida that required collecting alligator eggs. I worked with a group of scientists with several airboats (two scientists per airboat) and a helicopter. The operation worked like this: The helicopter would fly over the marshland and swampland surrounding the lake. Whenever the people in the helicopter spotted an alligator nest, they would hover over the nest. One of the airboats would speed over to the nearest shoreline (riding on an airboat is a lot of fun!). After arriving on the shore, the people from the boat would look around for an alligator “run” (a small ditch leading from the lake to the alligator nest, used by the female alligator to go to and from the lake). The people from the boat would then walk up the run to the nest. (This method was a lot easier than trying to walk through all the dense marsh vegetation.)



While working on a two-person airboat team, I began walking behind my partner up an alligator run to the nest. Suddenly, my partner began moving through the water without moving his legs—he looked exactly like he was surfing! He yelled something and jumped off to the side of the ditch. It turns out that he had accidentally stepped right on the female alligator in the run, and she moved very quickly, taking him with her for a short ride! It was an experience that I will never forget because it was exciting and no one was hurt. We completed our mission, which was to collect a nest full of eggs for the purpose of studying alligator hatching and growth.

What Kinds of Scientists Did This Research?

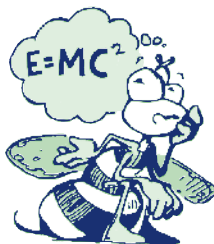
avian bioecologist: This scientist studies the relationship of birds with each other and with the nonliving environment.

population ecologist: This scientist studies the populations of different species and how each population interacts with its environment.

research scientist: This scientist has expert knowledge of one or more sciences, especially a natural or physical science.

Thinking About Science

Sometimes in science no clear-cut answers exist for a problem. When no clear-cut answers are available, scientists need to find a way to solve their problem the best way they can. Often scientists will design models of what they think is happening and then test these models. These models come as close to reality as possible. Models, however, give scientists a point of reference. This point of reference enables scientists to come up with possible answers to questions they are trying to answer. In this study, scientists made models of what might happen to golden eagles and their nests in areas with hiking activity. Specifically, the scientists used models to examine whether hiking activity would affect nesting success of golden eagles.



Thinking About the Environment

National parks attract many visitors throughout the year. These visitors come to see the beauty of the parks and take part in educational and recreational activities at the parks (**figure 1**). The number of people who visit a park can have an effect on the park in many ways. The effects of recreational activities such as hiking and biking, for example, are a concern for some parks. Some effects of these types of activities may be easy to see. Land erosion from too much foot or bike traffic in an area is one example. Other consequences of people hiking and biking in a park may not be as easy to see. The stress caused to animals by hiking and biking and changes in animal behavior because of the presence of humans are two examples of this kind of effect.

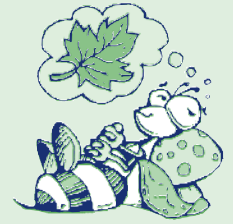


Figure 1. National parks provide many opportunities to enjoy the outdoors. Photo courtesy of Tim Rains, National Park Service.

National parks have multiple purposes that are mandated by the Organic Act of 1916. Managers of national parks, therefore, need to protect the environment, plants, and animals. Managers must also ensure that people, including future generations, can enjoy their visits to the park.

Glossary words are **bold** and are defined on page 18.

What Is the Organic Act?

President Woodrow Wilson signed the Organic Act of 1916, which created the National Park Service. The National Park Service's mission was clearly stated. The National Park Service's mission is to "... conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." To read the entire Organic Act, visit http://www.cr.nps.gov/history/online_books/anps/anps_1i.htm.

Introduction

Denali National Park in Alaska has one of the largest reported golden eagle nesting populations (**figures 2a and 2b**). The golden eagle is one of North America's largest birds of prey. These birds are very fast. They can dive from the air to catch their prey at speeds up to 150 miles per hour (241.4 kilometers per hour)! Golden eagles typically eat small animals such as rabbits, hares, and squirrels, but they have been known to attack larger prey. Pairs of

golden eagles maintain large territories. Some of these territories can be up to 60 square miles in size. (Complete the number crunch to see how big this territory is.) Golden eagles are legally protected to help the population survive. Three Federal laws protect the golden eagle (**figure 3**).

Because the golden eagle population is fragile, park managers want to protect nesting eagles from disturbance caused by hikers in the park. Managers also want hikers to have a good experience in the park. Park managers were not sure how much hiking activities would affect nesting golden eagles in Denali National Park (**figure 4a and 4b**). They asked scientists to help them study this question.

The scientists and managers formed a team to develop a way to make decisions about hiking in Denali National Park. The managers identified management **objectives** for protecting eagles while providing opportunities for hikers. The scientists knew a great deal about golden eagles and developed models to help make the best decisions for eagles and hikers. The models the scientists developed looked at how eagles might respond to hiking.

The question the scientists and managers wanted to answer with this research was: How much does hiking need to be restricted to maintain golden eagle populations at desired levels?



Figure 2a. Golden eagles are large birds of prey. Photo courtesy of Terry Sohl.

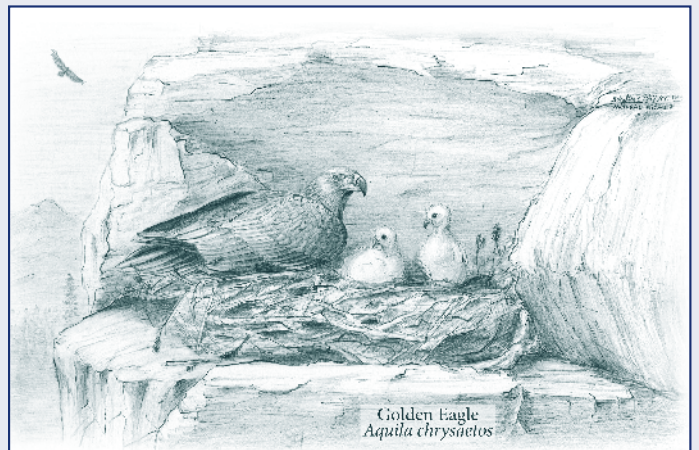
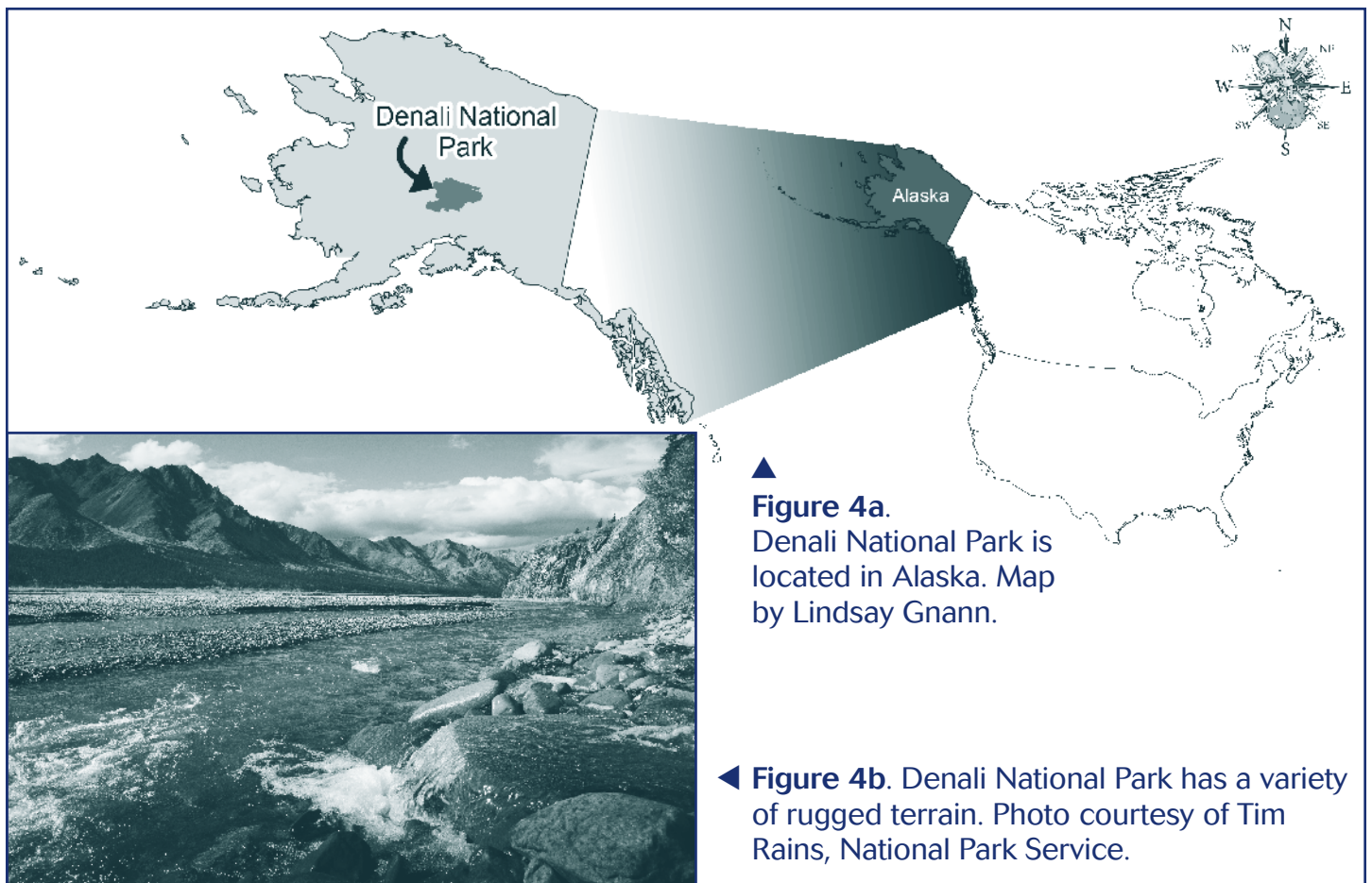


Figure 2b. A golden eagle nest. Illustration by Stephanie Pfeiffer.

Name of the law	How the law protects golden eagles
The Bald and Golden Eagle Protection Act of 1962	This act prohibits anyone, without a permit issued by the U.S. Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The act provides criminal penalties for persons who “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof.”
The Migratory Bird Treaty of 1918	This treaty established a Federal prohibition , unless permitted by regulations, to “pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention . . . for the protection of migratory birds . . . or any part, nest, or egg of any such bird.” (16 United States Code 703)
The Lacey Act of 1900	This act protects both plants and wildlife by prohibiting trade of illegally transported, sold, or taken plants and wildlife.

Figure 3. Three laws protect the golden eagle.





Number Crunches

- How many acres are in 60 square miles? (Hint: 1 square mile = 640 acres.) A football field in the United States is approximately 1 acre in size, so about how many football fields would be in 60 square miles?
- How many square kilometers are in 60 square miles? (Hint: 1 square mile = 2.59 square kilometers)

Reflection Section

- In your own words and in the form of a question, state the problem the scientists were trying to solve.
- Why do you think scientists were trying to maximize hiking and protection of the golden eagle nests?

What Is Adaptive Management?

Have you ever heard that experience is the best teacher? This idea is the foundation of adaptive management. Adaptive management is a way for land managers to deal with an unknown future and to learn from trying new things. When land managers try something new, the outcome is evaluated. Based on the evaluation, the managers try another approach to improve their management. The process continues, with managers continuing to learn and adapt.

Scientists often help managers by designing and implementing the evaluation process. As you can see, scientists are involved in some parts of the adaptive management process. Land managers, however, treat the entire adaptive management process as an experiment. What occurs when you do an experiment? Hopefully, you learn from your experience!

Number Crunch

- How many years ago was the National Park Service established? How many decades?

Methods

To identify the best way to manage hiking and still protect nesting golden eagles, the scientists used a formal decisionmaking framework as part of adaptive management (see page 4 for more information about adaptive management). First, the scientists had to gather information about the potential problem.

Since 1988, at least 93 eagle territory sites have been **monitored** in Denali. The scientists focused on 25 territories that they believed would be most affected by hiking. Golden eagle territories are areas of land in which eagles hunt and live. The scientists had to find out two main things. One thing they needed to know was the number of occupied and unoccupied eagle territories. The second thing they needed to know was the number of territories where golden eagles laid eggs and did not lay eggs (**figure 5**).

After scientists had this information, they created three mathematical models to help them understand the effect of hiking on golden eagle nests. Each model made an **assumption** that the scientists could test (**figure 6**). This process is similar to making a hypothesis and testing it. (For information about making assumptions in models, read “When Zombies Attack” on page 7.)

The scientists believed the population of golden eagles also depended on another important factor. This factor was the availability



Figure 5. Golden eagle nests are large and often found in high places. In this photo, a golden eagle is preparing to land at its nest. Photo courtesy of Kent Miller, National Park Service.

Model number	What the model assumed
1	Assumed no effect of hiking on whether the eagles lived and reproduced in the territory.
2	Assumed a moderate effect of hiking on whether the eagles lived and reproduced in the territory.
3	Assumed a large negative effect of hiking on whether the eagles lived and reproduced in the territory.

Figure 6. The models helped scientists study what may happen with different limits on hiking.

of snowshoe hares for food. Snowshoe hares are a primary prey for golden eagles in Denali (**figure 7**). The scientists believed that more eagles would nest when hares were plentiful. This information is important for understanding eagle nesting behavior.

Scientists do not know the exact population size of snowshoe hares from year to year. This lack of information is a source of uncertainty when trying to develop models of eagle nesting. The scientists have a hare **index** to help them



Figure 7. The snowshoe hare is adapted to cold climates. What is one adaptation you see? Photo courtesy of Jake Frank, National Park Service.

estimate the population size. This index does not give scientists exact numbers, but it does tell scientists when hares are in high and low phases of their population cycle.

The scientists used computer software to predict how different amounts of hiking would affect eagle nesting each year. Specifically, the scientists used the three models and the information they gathered about eagle reproduction and prey abundance to develop the software.

Adaptive Management in Your Life

Do you have bird boxes in your schoolyard? If you do not, pretend that you do. Your class has decided to use adaptive management to improve the situation for nesting birds. First, you must identify the problem and your objective. Let's say that no bird has ever nested in any of the bird boxes. A lack of nesting birds is the problem. Your objective is to have three successful bird boxes. A successful bird box is one in which eggs are laid and hatched, and baby birds are able to leave the nest and fly away (**figure 8**).

Your class does research in the media center. You decide that the bird boxes are placed too close to the playground. You move the bird boxes away from the playground. After 2 weeks, you observe and record bird activity. One pair of adult birds is observed carrying nesting material to one of the nests. After evaluating your results, your class does more research. You discover that one of the unsuccessful bird box holes is too small. You cut a bigger hole, wait 2 more weeks, and observe and record any nesting activity. A pair of birds is observed at the second bird box. After evaluating the results of your bird-box management, your class does more research. You discover that nesting birds like to have an



Figure 8. Bird boxes provide habitat for nesting birds. Photo by Babs McDonald.

open space in the front of the bird box. The last unsuccessful bird box faces a large bush. What steps will you take next?

Reflection Section



🍁 Why do you think the scientists chose to study only 25 territories instead of all 93 territories?

🍁 Why do you think scientists used three different models in their study?

Findings

Under model 2, closing some of the hiking areas had a small effect on golden eagle nesting (**figure 9**). Under model 3, however, closing fewer areas to hiking had a large negative effect on golden eagle nesting. The scientists found that more areas need to be closed to hiking as the number of unoccupied nests increased. The scientists also found that more areas need to be closed to hiking when fewer snowshoe hares were found in the area.

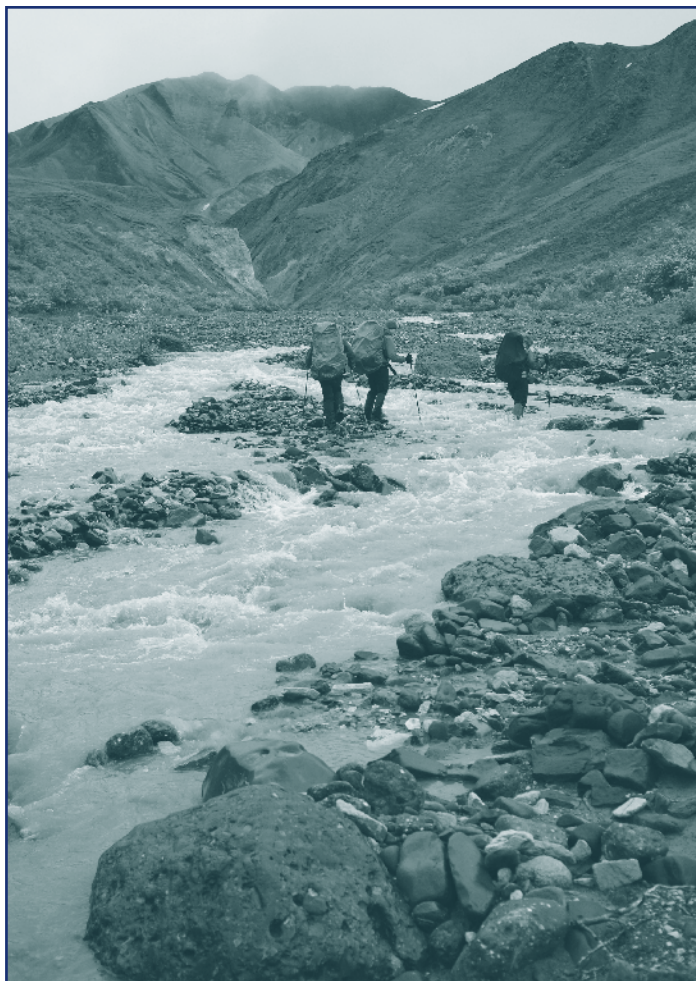


Figure 9. Hikers in Denali National Park. Photo courtesy of the National Park Service.

You Are the Adaptive Manager!

In this article, you are learning about research and evaluation as a part of the adaptive management process. One important feature of adaptive management is its focus on an uncertain future. Scientists help managers by doing research. Scientists provide information that can be used to predict what might happen in the future. Pretend you are the land manager of the area being studied in this research. How would you use the findings of this study? What management action would you take? After taking the action, what would you ask the scientists to monitor?

Reflection Section



- ❦ Why do you think that when snowshoe hare abundance is low, more hiking areas need to be closed?
- ❦ Based on the findings you read, do you think hiking has any effect on golden eagle nesting? Why or why not?

Discussion

The scientists said that it was important to consider the things in the models about which they were uncertain. This step is necessary before making any decisions about which model is best to use. For example, accurately accounting for the number of snowshoe hares may change model outcomes. The scientists believe that even with the limitations of these models, using the models to make management decisions is better than waiting to make decisions until more data are available.

Reflection Section



- ❦ Do you think that making management decisions based on the models in the paper is better than waiting until more data are available? Why or why not?
- ❦ Do you think scientists and managers need to take this much effort to protect golden eagles? Why or why not? (Hint: Review figure 3).

Adapted from Martin, J.; Fackler, P.L.; Nichols, J.D.; Runge, M.C.; McIntyre, C.L.; Lubow, B.L.; McCluskie, M.C.; Schmutz, J.A. 2011. An adaptive-management framework for optimal control of hiking near golden eagle nests in Denali National Park. *Conservation Biology*. 25(2): 316–323.

Glossary

assumption (ə səm(p) shən): A fact or statement taken for granted.

collaboration (kə lab ə rə shən): The act of working with others.

conservation (kän(t) sər vā shən): A careful preservation and protection of something.

index (in deks): A number (as a ratio) derived from a series of observations and used as an indicator or measure.

mandate (man dāt): To officially require something.

migration (mī grā shən): Passing, usually periodically, from one region or climate to another for feeding or breeding.

monitor (mä nə tər): To watch, keep track of, or check usually for a special purpose.

objective (əb jek tiv): An aim or goal.

prohibition (prō ə bi shən): An order forbidding something.

regulate (re gyə lāt): (1) To control according to a system. (2) To bring under control of law or some authority.

telemetry (tə le mə trē): The process of transmitting data by telemeter (tə le mə tər). A telemeter is a device that allows measurements to be made at a distance.

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

Note to Educators: If you are a Project Learning Tree trained educator, you may use “A Forest of Many Uses.”



The article title “Golden Egg” is an allusion to Aesop’s Fables classic “The Goose with the Golden Egg.” “The Goose with the Golden Egg” is a tale about a man who becomes too greedy and ends up with nothing. To see the text, visit <http://www.bartleby.com/17/1/57.html> and <http://www.umass.edu/aesop/content.php?n=14&i=1>.

Web Resources

Denali National Park
<http://www.nps.gov/dena/index.htm>

A Brief History of the National Park Service
http://www.cr.nps.gov/history/online_books/kieley/index.htm

National Geographic’s Golden Eagle page
<http://animals.nationalgeographic.com/animals/birds/golden-eagle/>

Cornell’s Lab of Ornithology—Golden Eagle page
http://www.allaboutbirds.org/guide/Golden_Eagle/id

Photo Gallery of Denali National Park
<http://www.flickr.com/photos/denalins/>

Photo Gallery of Denali National Park
<http://www.nps.gov/dena/photosmultimedia/photogallery.htm>



Time Needed

One class period

Materials

- Graph paper for each group of students (see graph paper provided on p. 20)
- Highlighters/colored pencils
- Pencils

In this FACTivity, you will become a park manager and examine where to place trails in a fictional park according to the location of eagles' nests.

Methods

1. Your teacher will divide the class into small groups of three to four students. Your teacher will also provide each group with two pieces of graph paper. Use one piece of graph paper for your draft and one piece of graph paper for presenting your final product.
2. The graph represents the area in the park. First, plot and label these points on your graph:
 - Waterfall (7, 5)
 - Park Welcome Center (1, 1)
 - Mountain Peak (2, 8)
3. Next, plot two eagle territories. Place the territories wherever you choose; however, take into account the following things:
 - Each block represents 10 square miles.
 - Golden eagles maintain an area up to 60 square miles in size. Therefore, you should give each eagle 60 square miles. You may give the eagle the land any way you choose as long as you give the eagle 60 square miles total for each nesting site.



- You will use highlighters or colored pencils to color in the 60 square miles allotted to each eagle.

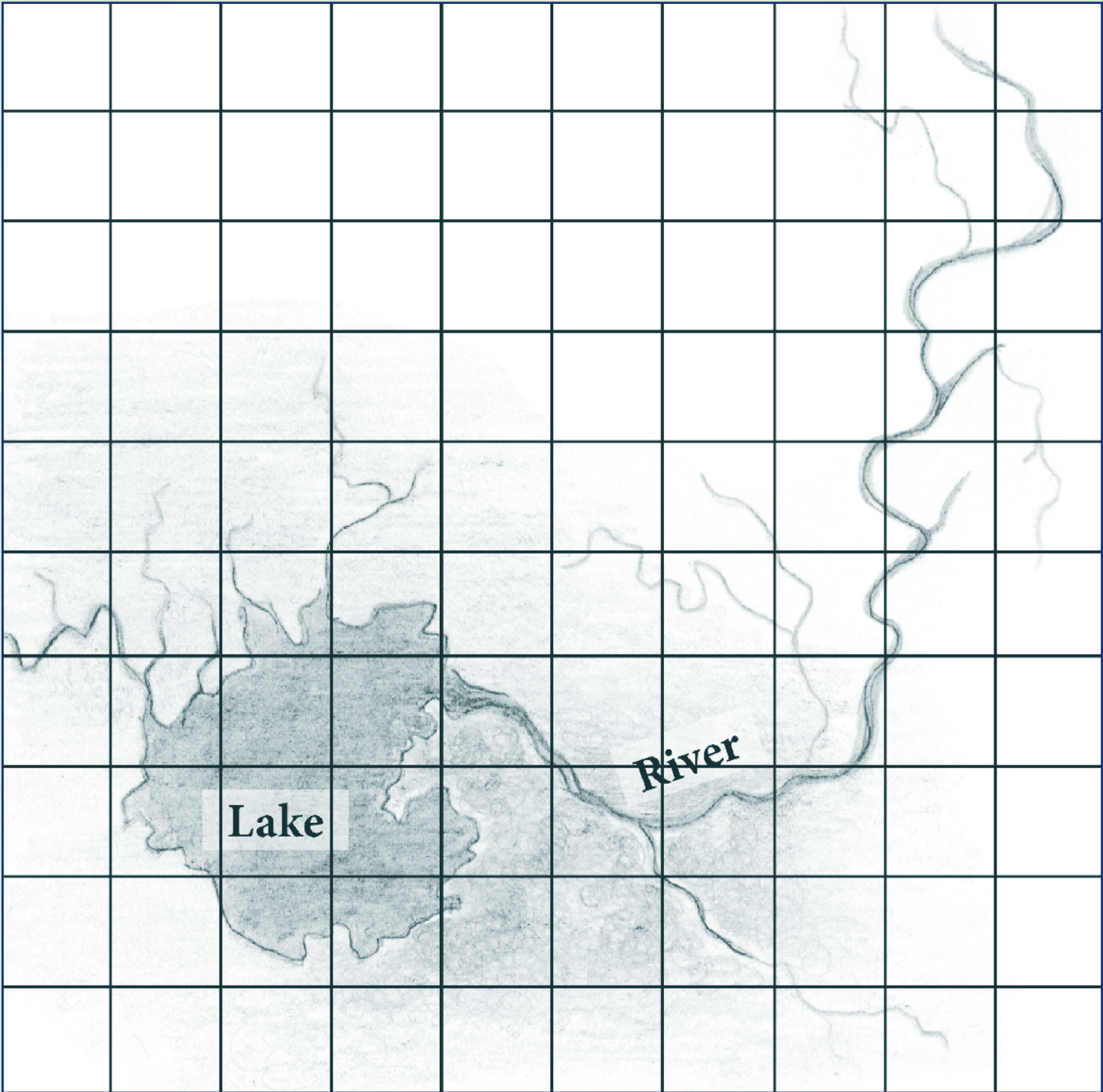
4. Next, place the following items on your grid.

- Potential scenic area 1: (9, 10)
- Potential scenic area 2: (6, 3)
- Potential scenic area 3: (1, 8)

Decide whether to use these potential areas as scenic areas for hikers based on the needs of the visitors and the eagles.

5. Decide how you will place two trails through the park. The trails should not interfere with the eagles' nests. Draw the trails on the map and then write a paragraph for each trail describing highlights of the trail and how the trail protects the eagles' nesting sites. Use complete sentences, correct spelling, and proper punctuation.

6. After your student group and all the others present their trail maps to the class, hold a class discussion about challenges that were encountered creating the trails and how this activity is similar and different from what would happen in an actual park. The following list has some questions to help start the discussion. (Note: These questions could also be used as part of an assessment.)
- How difficult did you find it to fit two eagle territories into the park?
 - In the real world, you would not be able to assign the territories because the eagles only choose a site they like. How would this difference make things more challenging for someone who is managing the park?
 - Were you able to make use of all possible scenic areas? Why or why not?



10 square miles

Each square in the grid is equal to 10 square miles.