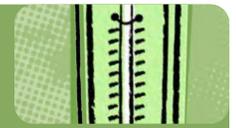


400-Acre Wood



In this activity, students will play the role of managers of a 400-acre (162 hectare) piece of public forest. Through this role, students will begin to understand the complex considerations that influence management decisions about forest lands.

Activity 50

Levels

Grades 7-8

Subjects

Science, Math, Social Studies

Concepts

- Resource management and technological systems help societies to meet, within limits, the needs of a growing human population. (3.6)
- Conservation technology enables humans to maintain and extend the productivity of vital resources. (3.7)
- Natural beauty, as experienced in forests and other habitats, enhances the quality of human life by providing artistic and spiritual inspiration, as well as recreational and intellectual opportunities. (1.10)

Skills

Identifying Main Ideas, Analyzing, Solving Problems



Technology Connections

Spreadsheet/Database Software

Materials

Copies of student pages; a yellow marker; chart paper; colored markers; calculators (optional); masking tape; transparencies and overhead projector (optional)

Time Considerations

Preparation: 60 minutes
Activity: Two to three 50-minute periods

Related Activities

Water Wonders, A Forest of Many Uses, Loving It Too Much, Forest Consequences, Forest for the Trees

OBJECTIVES

- Students will experience the analysis and decision-making involved in managing forest land.
- Students will understand that any land-use decision has a number of consequences for people, wildlife, and plants.

ASSESSMENT OPPORTUNITY

- Have student teams present their plan for 400-Acre Woods to a Community Council (made up of students). Give each team five minutes to explain why their plan should be accepted by the council. After all teams have presented their plans, give the council members time to choose the plan they believe is best. Use team presentations to assess how well students understand the pros and cons of their proposals.

BACKGROUND

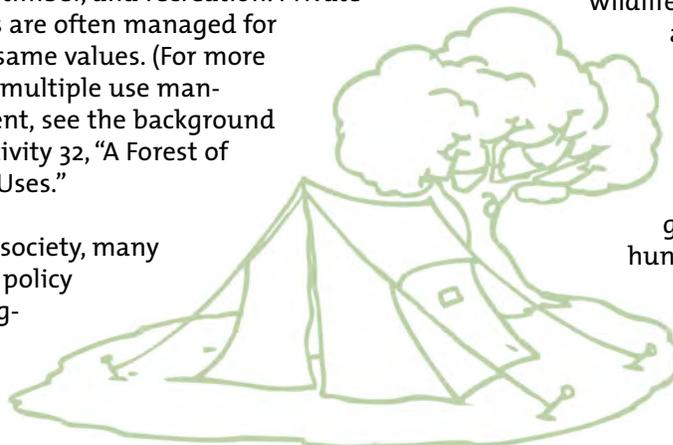
Public and private forests cover nearly one-third of our nation's land. More than just trees, forests are made up of a wide variety of species that interact to create a thriving ecosystem. They provide habitats for many species of plants and animals as well as vital resources for people. People use forests in many ways such as harvesting timber, camping, hiking, hunting, and fishing. Forests also provide clean water by anchoring the soil and preventing soil erosion.

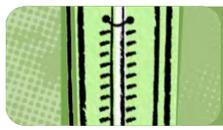
The Multiple Use and Sustained Yield Act of 1960 requires that national forests be managed "in a manner to provide the maximum benefit for the general public." Multiple use management of public lands means forest managers must consider values for fish and wildlife, soil, water, timber, and recreation. Private forests are often managed for those same values. (For more about multiple use management, see the background for Activity 32, "A Forest of Many Uses.")

In our society, many public policy and leg-

islative decisions are made in terms of costs, benefits, and environmental impacts. Forest managers must consider the economic effects of their decisions about forest lands. But they must also consider the forest's intangible elements such as recreation, water, soil, and wildlife values, even though those items are harder to evaluate. One way to consider the value of a forest for recreational use would be to compare costs and benefits, for example, the cost of developing a campground versus the income from fees charged. Another way is to calculate the number and type of visitors a specific attraction or activity will bring to the forest in a year.

One way to determine the value of wildlife is to measure its contribution to the forest's economic value. Calculate this value by finding out the species of wildlife that live in the forest and if those animals consist of game (hunted) species like deer, turkey, or quail. Then determine the income generated from hunters through licenses, guns, equipment, lodging, and travel.





Wildlife's economic value might include other uses that generate income such as wildlife photography and bird watching.

Another way to determine the importance of wildlife is to realize that it has intrinsic value, regardless of its economic value. With this approach, managers view the forest as a complex ecosystem in which every part of the system is important to every other part. If managers maintain each component of the ecosystem, the result will be healthy and assorted wildlife and plant communities, or biodiversity. To figure out how a specific action or non-action might impact biodiversity, forest managers look at the impact of an action on several wildlife species with different habitat needs.

One impact of human development can be **fragmentation**. Fragmentation is the process of dividing large, continuous ecosystems and habitats into smaller, isolated parcels. When humans develop a piece of land for homes, roads, businesses, agriculture, parking lots, and other developments, they change the biological community. As the size of a habitat becomes smaller and smaller, more and more animal and plant species are affected. Sometimes, the decline of a certain species can serve as an early indicator that a whole community or ecosystem is changing.

GETTING READY

Make copies of the student pages. Using a light-colored marker, draw a 20" x 20" (50.8 cm x 50.8 cm) grid map of 400-Acre Wood on a piece of chart paper for each team of four or five students. (Teams can also make their own.) The grid should have 400 1" x 1" (2.5 cm x 2.5 cm) squares, each representing 1 acre (0.4047 hectare). On another piece of chart paper, make an identical, but larger, grid to use in group discussion. If you have an overhead projector, you may want to prepare a transparency of the grid.



DOING THE ACTIVITY

1. Introduce the activity by explaining that students will look at several complex issues that face forest managers. Help students brainstorm a list of activities that take place on forest land. List their ideas on the board. Include uses like hiking, fishing, hunting, reading, taking pictures, camping, rock climbing, skiing, snowmobiling, logging, grazing, or mining. Ask the class to look at the list and decide if any activities would conflict with each other if done on the same piece of land.

2. Discuss these questions:
- Which activities would cost the most to provide on forest land?
 - Which would bring the most visitors?
 - Which would have the greatest impact on the forest ecosystem? On the wildlife there? Would this effect be permanent or temporary?
 - Which would cause fragmentation?
 - Which would provide for society's most critical needs?

3. Have students read the "If You Were the Boss" student pages. Divide the group into teams of four or five, and explain that each team will decide the

best use (or uses) of 400-Acre Wood, which has been donated to the community. Each team will develop a land management plan that will serve the best interests of the entire ecosystem. Make sure students understand that their team can use the entire 400 acres (162 ha) for one use, or can divide it up for multiple uses. For example, they may devote 200 acres (81 ha) to wilderness and hiking, 80 acres (32 ha) to a campground, and 120 acres (49 ha) for harvesting timber or hunting.

4. Before students begin, ask these questions:

- Which forest uses in "If You Were the Boss" are compatible with other uses? (for example, building a campground and hiking trail next to each other)
- Which might be incompatible with each other? (hunting near a campground)
- What could you learn by figuring out the costs, revenues, trees, wildlife populations, and number of visitors for each management plan? (how the plan affects different forest values)
- Are owls, wood rats, and salamanders the only wildlife in the forest? (no) What could you learn about the

forest ecosystem by analyzing the populations of these three species? (By looking at three animals with different habitat requirements, you get an idea of the general health of the forest ecosystem.)

5. Give each team a map (grid) of the 400-Acre Wood. Also give each team a copy of the “What’s the Score?” student pages. Each team should discuss various strategies for managing the forest. When the team arrives at a consensus on how the land should be managed, direct members to use “What’s the Score?” for a cost and benefit analysis of their plan. They should discuss what impact their plan would have in terms of visitors, wildlife, trees, and cost and revenue.

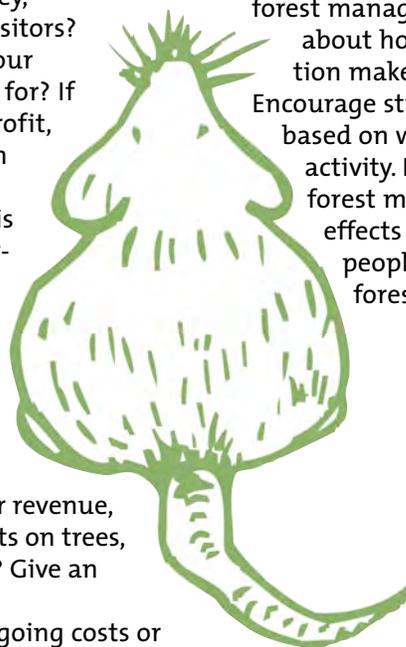
 See the PLT website, www.plt.org, for information about obtaining a spreadsheet or database to use in conjunction with the “What’s the Score?” student pages.

6. When the teams have completed their management plans, they should use crayons or colored markers to illustrate their plans on the grids. Remind them to include a key showing what different colors and symbols mean.

7. Ask teams to present their plans to the entire group, making clear how they decided on their plans. Have them also report the findings of their “What’s the Score?” student pages. Post the maps around the room.

8. Use the large grid map to lead a group discussion of different plans. Ask these questions:

- Which plan enables the most people to enjoy the forest? What is the monetary cost in attracting the most visitors? Are there any other costs besides money?
- Which plan does the most to preserve the forest in its original state? What are the costs of this plan?
- Which plan has the most impact on wildlife and fragmentation? Why should we care if one animal species leaves the forest?
- Which plan seems to provide the best balance of money, trees, wildlife, and visitors?
- How do you think your plan should be paid for? If your plan made a profit, what should happen with the money?
- Which do you think is most important: having the most trees, the most wildlife, or the most visitors? What makes you think so?
- Which do you think is most important—an activity’s cost or revenue, or the activity’s effects on trees, wildlife, and visitors? Give an example.
- Which items are on-going costs or revenues? Which are one-time costs or revenues?



- What will be the long-term effects of each plan? How will costs or revenue change in the next year? Will the numbers of trees, wildlife, or visitors change?

Enrichment

- Repeat the activity and have each team extend its management plan into the next year, and calculate the effect on money, trees, wildlife, and visitors for the second year.
- Contact the local Forest Service office or forestry agency, and invite a forest manager to talk to your class about how his or her organization makes land-use decisions. Encourage students to ask questions based on what they learned in the activity. For example, how do forest managers weigh the effects of an action on trees, people, and animals in a forested area?

READING CONNECTIONS

Bryan, Nichol. *Los Alamos Wildfires*. Gareth Stevens. 2003. Describes the events surrounding the wildfire that raged in New Mexico in 2000, and the resulting debate over the policy of prescribed burning, or purposely setting fires as a means of forest management. Grades 4+. ISBN: 0836855078.

Camp, William G. and Thomas B. Daugherty. *Managing Our Natural Resources*. Delmar Learning. 1995. Examines the nature, history, and management of natural resources

ranging from soil and water to forests, wildlife, and marine resources. Includes suggested activities and discussion of occupations in the field. Grades 6+. ISBN: 0827367163.

Foster, David R. and John F. O’Keefe. *New England Forests Through Time: Insights from the Harvard Forest Dioramas*. Harvard University Press. 2000. The historical and environmental lessons of New England’s landscape are told through the world-renowned dioramas in Harvard’s Fisher Museum. This first book based on the dioramas conveys the phenomenal history

of the land, the beauty of the models, and new insights into nature. Grades 6+. ISBN: 0674003446.

Heinrich, Bernd. *The Trees in My Forest*. HarperCollins Publishers. 1997. The author takes the readers on an eye-opening journey through the hidden life of a three hundred acre forest. Each of the 24 essays explores a different aspect of the relationships among plants, animals, and people of the forest. Grades 7+. ISBN: 0060174463.



If You Were the Boss



A magnificent forest, 400-Acre Wood, has just been donated to your community. You and your team have the job of deciding what to do with this forest.

As you might have guessed, 400-Acre Wood is 400 acres (162 hectares) in size. An acre is an area of land equal to a square that is 208.7 feet on each side, and 400 acres is a little less than 1 square mile. (A hectare [ha] is 10,000 square meters and is equal to about 2.47 acres. To convert acres to hectares, multiply by 0.4047).

400-Acre Wood is made up of pine forest, with about 150 mature pine trees per acre. In addition, it contains lots of wildlife such as owls, deer, bear, woodpeckers, turkey, quails, wood rats, fish, and woodland salamanders.

Wildlife biologists use something called management indicator species (MIS) to evaluate the impact of people's actions on the environment. For 400-Acre Wood, the indicator species are barred owls, wood rats, and woodland salamanders. Wildlife biologists estimate that 400-Acre Wood currently has two barred owls per 100 acres (40 ha) of forest, and one wood rat and 25 woodland salamanders per acre (0.40 ha). That means a total of 8 barred owls, 400 wood rats, and 10,000 salamanders currently live in 400-Acre Wood.

Because the forest currently has no roads or trails, few people use or visit it.

You and your team will make a map of 400-Acre Wood and develop a management plan for it. You may decide to do one thing with the entire forest. Or you may want to divide the forest and do different things in different areas. Your goal is to find what you think is the best balance between visitor enjoyment, trees, wildlife, and money.

Below are the different forest uses you can include in your plan. The "What's the Score?" student page will help you evaluate your plan's total effect on visitors, trees, wildlife, and money.

Wilderness Preserve

The purpose of a wilderness preserve is to allow wildlife and plants to exist without humans interfering. Typically a wilderness preserve has no roads, graded trails, or campsites. Wilderness preserve areas will have the following effects.

Visitors: About 5 people per acre per year will visit the preserve.

Trees: The number of trees per acre will remain the same.

Wildlife: The numbers of owls, wood rats, and salamanders per acre will remain the same.

Money: It will cost money to manage the preserve, and each visitor will pay an entrance fee.

Trails

Graded trails allow different types of visitors to enjoy a forest area, including walkers, cyclists, families with strollers, and wheelchair users. Trails areas will have the following effects.

Visitors: About 25 visitors per acre per year will use the trails.

Trees: Some trees must be cut to build a trail.

Wildlife: The increase in visitors will disturb the wildlife. Owls will leave areas with trails (they sleep during the day when people are about), and trails are dangerous for woodland salamanders as they migrate to pools of water during breeding season. There will be no effect on the wood rat population.

Money: It costs money to build and maintain trails. Trees removed to make the trail can be sold. Each visitor will pay an entrance fee.

(continued on next page)

If You Were the Boss (continued)

Campground

A campground allows visitors to enjoy a forest area overnight or over the weekend. It typically has a number of campsites, plus picnic tables, fire pits, parking spaces, and bathrooms. A campground also needs to have a road winding through it. A campground has about 4 sites per acre. Campground areas will have the following effects.

Visitors: About 12.5 campers per site per year will come to the campground, or 50 campers per acre per year.

Trees: Trees need to be removed to build the road and the campsites.

Wildlife: A campground and campers will cause all three indicator species—owls, wood rats, and salamanders—to disappear from the area.

Money: It costs money to build and maintain the road, to clear and level the campsites, and to build and maintain the restrooms. It also costs money to manage the campground. Trees removed for the road and campsites can be sold. Campers pay a camping fee.

Hunting

Some forest areas are managed to encourage game animals (deer, turkey, and quail) for hunters. These areas require a road for visitors. Hunting areas will have the following effects.

Visitors: About 1 hunter per acre per year will visit.

Trees: Trees will need to be removed to build the road.

Wildlife: With regulations to keep game populations constant, there should be no effect on the three indicator species—owls, wood rats, and salamanders.

Money: It will cost money to build and maintain the road. It will also cost money for management. Trees removed for the road can be sold. Hunters will pay a hunting fee.

Fishing

To encourage fish for anglers, a lake can be created by damming the forest stream. Fishing areas will have the following effects.

Visitors: About 2 anglers per acre per year will visit.



Trees: Trees will need to be removed to create the lake.

Wildlife: Creating the lake will cause all three indicator species—owls, wood rats, and salamanders—to disappear from the fishing area.

Money: It will cost money to build the dam to create the lake. It will also cost money for management. Trees removed for the lake can be sold. Anglers will pay a fishing fee.

Timber Harvest

Some forest areas are set aside for timber harvesting, which means cutting trees to sell the logs. Using a sustainable yield approach, only a portion of the trees are removed at any given time. This minimizes the effect on wildlife, while producing as many logs as possible over the long-term. For pine trees, which take 35 years to reach maturity, one-fifth of the trees are cut every 7 years. Timber harvest areas will have the following effects.

Visitors: About 5 people per acre per year will visit.

Trees: Trees will be removed to build the road, plus one-fifth of remaining mature trees will be removed.

Wildlife: The timber harvest will have a minimal impact on the three indicator species.

Money: It will cost money to build and maintain the road and for management. The harvested trees can be sold. Visitors will pay a fee.



What's the Score?

Step 1.

Determine how many acres you plan for each **land use**. The total should be 400 acres.

$$(\text{ ______ acres Wilderness}) + (\text{ ______ acres Trails}) + (\text{ ______ acres Campground}) + (\text{ ______ acres Hunting}) + (\text{ ______ acres Fishing}) + (\text{ ______ acres Timber Harvest}) = \text{ ______ Total Acres}$$

Step 2.

Calculate how many **visitors** per year this plan will attract to your community.

$$(\text{ ______ acres Wilderness} \times 5 \text{ visitors/acre}) + (\text{ ______ acres Trails} \times 25 \text{ visitors/acre}) + (\text{ ______ acres Campground} \times 50 \text{ campers/acre}) + (\text{ ______ acres Hunting} \times 1 \text{ hunters/acre}) + (\text{ ______ acres Fishing} \times 2 \text{ anglers/acre}) + (\text{ ______ acres Timber Harvest} \times 5 \text{ visitors/acre}) = \text{ ______ Total Visitors per Year}$$

Step 3.

Calculate how this plan will affect the **wildlife** management indicator species. Compare the totals you get to the original population of 8 owls, 400 wood rats, and 10,000 salamanders.

$$\text{Owls: } (\text{ ______ acres Wilderness}) + (\text{ ______ acres Hunting}) + (\text{ ______ acres Timber Harvest}) = \text{ ______ acres that will support owls} \times 0.02 \text{ owls/acre} = \text{ ______ Total Owls (Note: Round down to the nearest whole owl.)}$$

$$\text{Wood Rats: } (\text{ ______ acres Wilderness}) + (\text{ ______ acres Trails}) + (\text{ ______ acres Hunting}) + (\text{ ______ acres Timber Harvest}) = \text{ ______ acres that will support wood rats} \times 1 \text{ wood rat/acre} = \text{ ______ Total Wood Rats}$$

$$\text{Salamanders: } (\text{ ______ acres Wilderness}) + (\text{ ______ acres Hunting}) + (\text{ ______ acres Timber Harvest}) = \text{ ______ acres that will support salamanders} \times 25 \text{ salamanders/acre} = \text{ ______ Total Salamanders}$$

Step 4.

Calculate how many **miles of trail or road** are needed for your plan.

$$(\text{ ______ acres Trails}) \div 6 \text{ acres/mile} = \text{ ______ Total Miles of Trail}$$

$$(\text{ ______ acres Campground} \times 250 \text{ ft/acre}) \div 5,280 \text{ ft/mile} = \text{ ______ miles of road for Campground}$$

$$(\text{ ______ acres Hunting} \times 100 \text{ ft/acre}) \div 5,280 \text{ ft/mile} = \text{ ______ miles of road for Hunting}$$

$$(\text{ ______ acres Timber Harvest} \times 100 \text{ ft/acre}) \div 5,280 \text{ ft/mile} = \text{ ______ miles of road for Timber Harvest}$$

Step 5.

Calculate how many mature **trees** remain based on your plan.

$$(\text{ ______ miles of Trail} \times 0.36 \text{ acres/mile}) \times 150 \text{ trees/acre} = \text{ ______ }$$

$$(\text{ ______ miles Campground road} \times 1.45 \text{ acres/mile}) \times 150 \text{ trees/acre} = \text{ ______ }$$

$$(\text{ ______ miles Hunting road} \times 1.45 \text{ acres/mile}) \times 150 \text{ trees/acre} = \text{ ______ }$$

$$(\text{ ______ acres of Fishing}) \times 150 \text{ trees/acre} = \text{ ______ }$$

$$(\text{ ______ miles Timber Harvest road} \times 1.45 \text{ acres/mile}) \times 150 \text{ trees/acre} = \text{ ______ }$$

$$(\text{ ______ acres Timber Harvest} \times 1/35 \text{ harvested}) \times 150 \text{ trees/acre} = \text{ ______ }$$

$$\text{Total trees removed} \text{ ______ }$$

$$60,000 \text{ mature trees in 400-Acre Wood} - \text{trees removed} = \text{trees remaining} \text{ ______ }$$

(continued on next page)



What's the Score? (continued)

Step 6.

Calculate the **revenue and costs** associated with your plan, and determine the net profit or loss.

Revenue

Fees (per year)

_____ Wilderness visitors x \$2 fee per visitor = \$ _____
 _____ Trails visitors x \$2 fee per visitor = \$ _____
 _____ Campground campers x \$20 fee per site ÷ 2 campers per site = \$ _____
 _____ hunters x \$5 fee per hunter = \$ _____
 _____ anglers x \$2.50 fee per angler = \$ _____
 _____ Timber Harvest visitors x \$2 fee per visitor = \$ _____

Sale of Trees

_____ trees removed for Trails x \$50 per tree = \$ _____
 _____ trees removed for Campground road x \$50 per tree = \$ _____
 _____ trees removed for Hunting road x \$50 per tree = \$ _____
 _____ trees removed for Fishing x \$50 per tree = \$ _____
 _____ trees removed for Timber Harvest x \$50 per tree = \$ _____

Total Revenue \$ _____

Costs

Management Costs (per year)

_____ acres Wilderness x \$2.50 per acre = \$ _____
 _____ acres Trails x \$50 per acre = \$ _____
 _____ acres Campground x \$200 per acre = \$ _____
 _____ acres Hunting x \$5 per acre = \$ _____
 _____ acres Fishing x \$2.50 per acre = \$ _____
 _____ acres Timber Harvest x \$5 per acre = \$ _____

Construction Costs

_____ miles of Trail x \$100 per mile = \$ _____
 _____ miles Campground road x \$600 per mile = \$ _____
 _____ acres Campground x 4 sites per acre x \$1000 per site = \$ _____
 _____ miles Hunting road x \$600 per mile = \$ _____
 _____ acres Fishing x \$3000 per acre = \$ _____
 _____ miles Timber Harvest road x \$600 per mile = \$ _____

Total Costs \$ _____

Profit or Loss

(Total Revenue \$ _____) - (Total Costs \$ _____) = \$ _____ Net

If the Net amount is positive, it is a profit; if it is negative, it is a loss.