CHAPTER 11
SUSTAINING TERRESTRIAL BIODIVERSITY:
MANAGING AND PROTECTING ECOSYSTEMS

Objectives

1. List five types of public lands in the United States. Explain the mission and principles of management of each. Summarize the “takings issue” currently being used by the Wise-Use Movement.

2. Distinguish between old growth and second-growth forests, and give one example of each. Distinguish between a second-growth forest and a tree farm.

3. List five reasons why forests are commercially important. List five reasons forests are ecologically important.

4. Summarize the range of estimates of rates of tropical deforestation. Explain why there is so much variation among estimates. List five ways that tropical forests touch lives in the temperate zones. Summarize the impact of deforestation on some of the world’s indigenous cultures. Describe a plan to protect indigenous peoples.

5. List three factors underlying causes of tropical deforestation. List six human activities that actually destroy the tropical forests. Evaluate Japan’s environmental track record. Summarize the fuelwood crisis.

6. Distinguish between the goals of even-aged management and uneven-aged management. List four types of tree harvesting, indicating which type of management they are most likely to be used for.

7. Distinguish among surface fires, crown fires, and ground fires. Summarize threats to forests from fires, pathogens, and air pollution and strategies for dealing with each threat.

8. Distinguish among industrial forestry, “New Forestry,” and sustainable forestry. List eight ways to move toward sustainable forestry management. List at least five ways to reform federal forest management. List three ways to reduce demand for wood products. Explain the roles that straw and kenaf can play in reducing demand for wood.

9. List ways to help reduce the interlocking problems of tropical deforestation and the fuelwood crisis. Address scientific data collection, economic strategies, policy-making strategies, cultural strategies, and strategies to reduce demand for fuelwood.

10. Summarize Costa Rica’s efforts to protect and restore forests. Evaluate the “debt-for-nature” experiment in Bolivia. Describe one case where individual actions made a difference in helping to reduce forest destruction.


12. Explain the advantages and disadvantages of whole ecosystem and species-by-species approaches to increasing sustainability. Explain how gap analysis can be used as a tool to improve conservation efforts.

Key Terms (Terms are listed in the same font styles as they appear in the text.)

| **intrinsic (existence) value** (p. 196) | **National Forest System** (p. 197) | **second-growth forests** (p. 200) |
| **instrumental value** (p. 196)        | **National Resource Lands** (p. 197) | **tree plantations (farms)** (p. 200) |
| **use values** (p. 196)                | **National Wildlife Refuges** (p. 198) | **even-aged management** (p. 200) |
| **nonuse values** (p. 196)             | **National Park System** (p. 198)    | **uneven-aged management** (p. 200) |
| **existence value** (p. 196)           | **National Wilderness**              | **selective cutting** (p. 201)     |
| **aesthetic value** (p. 196)           | **Preservation System** (p. 199)     | **high-grading** (p. 201)           |
| **bequest value** (p. 196)             | **old-growth forests** (p. 199)      |                                   |
| **conservation biology** (p. 197)      |                                   |                                   |
| **hot spots** (p. 197)                 |                                   |                                   |
| **bioinfomatics** (p. 197)             |                                   |                                   |

Sustaining Terrestrial Biodiversity: Managing and Protecting Ecosystems
Chapter 11: Learning Log

Instructions: Answer the following questions on a separate piece of paper.

1. Define the boldfaced terms in this chapter. (OMIT)

2. Evaluate the reintroduction of the gray wolf as a keystone predator species in the Yellowstone ecosystem.

3. List factors that increase and decrease the earth’s biodiversity? Describe ways in which human activities have reduced the biodiversity of (a) the world and (b) the United States.

5. Distinguish between the intrinsic and instrumental value of the earth’s biodiversity? Distinguish between existence, aesthetic, and bequest values.

6. What is conservation biology? What is bioinformatics and why is it important?

7. What percentage of the land in the United States does the federal government own and manage as public lands? Describe the five major types of public lands in the United States and list the major uses allowed on each type.

8. List four principles that most biologists and some economists believe should govern the use of public land in the United States. Compare these principles with the views of users of mineral and other resources about the use, ownership, and management of the country’s public land.

9. List (a) eight important ecological services provided by forests and (b) seven important economic benefits of forests.

10. Distinguish among old-growth forests, second-growth forests, and tree plantations.

11. Describe the rotation cycle for harvesting and managing a forest. Distinguish between even-aged and uneven-aged management of a forest, and list the
advantages and disadvantages of each type.

12. Describe five major ways for harvesting trees. List the advantages and disadvantages of clear-cutting forests.

13. What is deforestation, and what are seven of its harmful environmental effects?

14. Why is it difficult to make estimates of change in forest cover? List two pieces of bad news and two pieces of good news about trends in the world’s forest cover.

15. What is the estimated economic value of the ecological services provided by the world’s forests? Why are these values not reflected in most economic decisions about how to use the world’s forests?

16. List eight ways to use forests more sustainably. Describe the benefits of certifying that timber has been produced sustainably.

17. Describe some good news and some bad news about the extent and condition of forests in the United States.

18. Describe Julia “Butterfly” Hill’s efforts to help protect an ancient redwood forest from being clear-cut.

19. List three insect pests that cause major damage to U.S. forests. List four ways to reduce the harmful impacts of tree diseases and of insects on forests.

20. Distinguish among surface, crown, and ground forest fires. List two approaches used to protect forest resources from fire. How do some plants and animals benefit from forest fires? List the advantages and disadvantages of reducing the chances of crown fires on public lands by (a) setting prescribed fires, (b) allowing most natural fires to burn, and (c) cutting trees to thin out forests.

21. What are the advantages and disadvantages of the Healthy Forests Initiative law passed to help reduce the threat of fire damages in U.S. national forests?

22. List three factors that promote timber harvesting from U.S. national Forests. Explain why timber harvesting in national forests usually loses money for the U.S. citizens who own these forests.

23. List the advantages and disadvantages of clear-cutting timber in U.S. national forests.

24. List the advantages and disadvantages of making paper from tree-free sources such as rice straw and kenaf fibers.
25. How rapidly are tropical forests being cleared and degraded and why is such cutting viewed as a serious global environmental problem?

26. List five basic and ten basic causes of tropical deforestation and degradation.

27. List nine ways to prevent or reduce tropical deforestation and degradation and three ways to restore degraded tropical forests. What are debt-for-nature swaps?

28. Describe the many uses of the tropical neem tree, and list the advantages and disadvantages of widespread planting of neem trees.

29. Describe (a) ways to achieve more sustainable farming and logging in tropical forests and (b) Kenya’s Green Belt Movement.

30. What are the major threats to national parks in the United States and in other countries? List 11 ways to improve national park management in the United States.

31. According to scientists, what is the minimum percentage of the earth’s land area that we should strictly protect from harmful human activities? What percentage has been strictly protected?

32. Describe efforts by Costa Rica to establish reserves to protect its biodiversity and (b) the role of the Nature Conservancy in establishing nature reserves in the United States and other parts of the world.

33. List the advantages and disadvantages of (a) large reserves and (b) establishing corridors between reserves.

34. What is a biosphere reserve? Describe the three zones of such a reserve.

35. List four goals of adaptive ecosystem management.

36. Explain the importance of protecting biodiversity in the world’s biodiversity hot spots.

37. What is wilderness, and why is it important? List the advantages and disadvantages of protecting more wilderness. What percentage of the land area of the United States has been set aside as wilderness?

38. Distinguish among ecosystem restoration, rehabilitation, remediation, and replacement. List five science-based principles for carrying out ecological restoration or rehabilitation. Describe some concerns about widespread use of ecological restoration.

39. Describe efforts to restore a degraded tropical dry forest in Costa Rica. What is biocultural restoration?
Outline

11-1 Human Impacts on Terrestrial Biodiversity

Human activities have negatively affected global biodiversity.

A. Humans have degraded from 50–83% of the earth’s land surface.
   1. We have cleared about 82% of temperate forests for crop fields and urban development.
   2. We have logged about 95% of virgin forests in 48 states; 98% of tallgrass prairie has disappeared; and California has lost 99% of its native grassland and 85% of its original redwood forests.
   3. Human use, waste, and destruction have affected 40% of the net primary productivity of earth’s terrestrial ecosystems.
   4. The species extinction rate is now probably between 100–10,000 times what it was prior to human existence.

B. Preservation of biodiversity is important for several reasons, such as intrinsic or existence value, and also because of its usefulness to humans.
   1. Instrumental value consists of use values that benefit people for goods and services, scientific information, recreation, and ecological services.
   2. Nonuse values are existence value, aesthetic value (the appreciation of wild species, or a view for beauty alone), and bequest value (the act of leaving natural capital for use by future generations).

11-2 Conservation Biology

A. Conservation biology uses rapid response strategies to curb loss and degradation of world biodiversity.

B. Hot spots of species-rich ecosystems are identified and Rapid Assessment Teams of biologists evaluate, make recommendations, and take emergency action against loss of biodiversity.

C. Bioinformatics is the applied science of managing, analyzing, and communicating biological information.
   1. Tools include high-resolution digitized images of specimens to analyze specimens and computer databases of these images.
   2. DNA sequences for identifying bacteria and other microorganisms are established.

11-3 Public Lands in the United States

Establishing public lands helps sustain biodiversity and lessen human impact on the planet.

A. The U.S. has set aside more public land than any other nation.
   1. The public land is in national forests, resource lands, parks, wildlife refuges, and protected wilderness areas.
   2. The national forests and the resource lands are used for logging, mining, grazing, oil and gas extraction, recreation, etc.
   3. The National Wildlife Refuges protect habitats and breeding areas for waterfowl and big game. One may hunt, trap, fish, mine, log, graze, and farm these lands.

B. Some federal public lands have more restricted use.
   1. The National Park Service allows camping, hiking, sport fishing, and boating but not hunting, mining, or oil/gas drilling.
   2. The National Wilderness Preservation System lands are even more restricted in use; they mostly support recreational activities.

C. There is a continuing controversy over management of public lands in reference to the resources the lands contain: oil, natural gas, timber, mineral, and biological resources. There are four principles that biologists and environmental economists advocate:
   1. The primary goal should be protecting biodiversity, wildlife habitats, and the ecological functioning of public land ecosystems.
   2. Subsidies/tax breaks should go to NO one who takes resources from public lands.
   3. Fair compensation should come to the American people from use of these lands.
   4. Users/extractors on public land should pay for the environmental damage they cause.

D. The federal government has given away $1 billion each year to privately owned interests.

E. Some developers and extractors want Congress to enact laws that would compromise public lands even further by:
1. actually selling the land/resources to corporations at less than market value,
2. slashing federal funding for regulatory administration of the land,
3. cutting all the old-growth forests to replace them with tree plantations,
4. opening all lands to oil drilling, mining, off-road vehicles, and commercial development,
5. dismantling the National Park Service and building commercial theme parks run by private investors,
6. continuing to give away mineral resources under the provisions of the 1872 Mining Law,
7. forgetting about preserving endangered species and repealing the Endangered Species Act,
8. decreasing the number of wetlands protected by about 50% (this is happening in 2004), and
9. preventing the public from legally challenging such private use of the public lands for private financial gain.

11-4 Managing and Sustaining Forests
Managing and sustaining forests is a long-term commitment.

A. Forests with at least 10% tree cover occupy about 30% of the earth’s surface, excluding Greenland and Antarctica.

B. Forests are classified according to their age and structure into three major types.
1. Old growth/frontier forests are those which have not been seriously disturbed by human activities/natural disasters for hundreds of years. These forests are storehouses of biodiversity because of the ecological niches they provide for wildlife species.
2. Second-growth forests develop in an area after human activities or natural forces have removed them.
3. Tree plantations/tree farms replant and clear-cut one species of trees in a regular cycle.
4. Logging threatens about 39% of the remaining old growth forests. The rest are so remote they are not threatened.

C. Major types of forest management:
1. Even-aged management maintains trees in a specific stand at about the same age and size. In such industrial forestry, a simplified tree plantation of fast-growing, commercially lucrative trees replaces a biologically diverse old-growth/second-growth forest.
2. Uneven-aged management maintains a variety of species of many ages and many sizes to foster natural regeneration. The goals in this type of management are:
   a. biological diversity,
   b. long-term sustainable production of high-quality timber,
   c. selective cutting of individual mature/intermediate-aged trees, and
   d. multiple uses of the forest: timber, wildlife, protect watersheds, recreation, etc.

D. The 2001 study by the World Wildlife Fund indicates intensive, sustainable management of one-fifth of the world’s forest would supply current and future demands for commercial wood and fiber, leaving the remaining old-growth forest untouched.

E. The presence of logging roads has many negative consequences.
1. Logging roads increase erosion and sediment runoff, fragment habitats, and contribute to loss of biological diversity.
2. They expose forest to invasion by nonnative pests, diseases, and wildlife species.
3. They provide access to the forest to all kinds of human pests.
4. Logging roads on public lands disqualify the land for protection as wilderness.

F. Different harvesting methods affect the continuing growth of forests.
1. In selective cutting, intermediate-aged/mature trees are cut singly or in small groups.
2. In high grading, selected trees of only the largest and best specimens of the most desirable trees are cut. This also removes other trees, and the forest floor becomes warmer, drier, and subject to erosion and fire.
3. Shelterwood cutting removes trees that grow best in full/moderate sunlight. There may be two or three cuttings over a period of time. (This is another method of clear-cutting.)
4. Seed-tree cutting removes all but a few evenly distributed trees whose seeds would begin a new generation. (This is a variation of clear-cutting.)
5. Clear-cutting removes every single tree in one cutting. Strip cutting removes a strip of trees along the contour of the land and spreads the cutting out over several decades.

G. Harmful effects of deforestation (temporary/permanently removing trees) are given below.
1. Deforestation reduces biodiversity and the ecological services that forests provide.
2. Deforestation can change regional climate, and forests will not regenerate.
3. Deforestation emits carbon dioxide, which affects global climate change.
4. Research indicates that at least 200 years are needed to accumulate the same amount of carbon stored in the original forest.

H. Deforestation is widespread across the planet and is continuing.
1. World Resources Institute surveys indicate that original forest cover has decreased by 20–50%.
2. Global deforestation is occurring by at least 0.2–0.5% per year, with 4/5ths of the losses occurring in the tropics.
3. If conditions don’t change within the next 10–20 years, 40% of the world’s remaining forests will have been logged or converted to other uses.

I. Some temperate forests have increased slightly from reforestation by secondary ecological succession on cleared forestland and abandoned croplands.

J. Some previously cut areas of tropical forest have been re-planted in tree plantations. This is not true forestland, however, because there is much lower biodiversity in these areas.

K. We must harvest trees no faster than they are replennished and have systems in place that manage forests sustainably.

L. The ecological services that forests provide are more valuable than the trees themselves.
1. The estimated economic value of income from earth’s ecological services is at least $36 trillion per year, close to the $42 trillion value of all goods and services produced worldwide in 2004.
2. Biodiversity is the world’s biggest financial asset. The estimates of the ecologists did not include the natural capital that generates these figures. It also did not include the value of nonrenewable minerals and fuels.
3. The accounting system has not changed to include these values because of short-term profits, and current government subsidies and tax incentives support destruction/degradation of forests for short-term economic gain.
4. Conservation biologists have four ways to estimate how much of the remaining forest to protect: include estimates of economic value of ecological services in decisions, protect enough so that the rate of loss/degradation is balanced by forest renewal, protect forest areas that are centers of biodiversity threatened by development, and establish use methods to evaluate timber grown sustainably.

M. Timber can be grown sustainably; standards certifying growing methods should be applied to all wood/wood products sold.
1. Scientific Certification Systems has standards to determine if a company has used sustainable methods in growing and harvesting timber.
2. It evaluates timber-growing lands in reference to forest regeneration, ecological effects, soil damage, and wildlife habitat areas.
3. Sustainable harvesting has been done successfully by several different groups.
4. Several wood distributors have agreed to sell only wood certified as being sustainably grown (to the degree that certified wood is available).

11-5 Forest Resources and Management in the United States

Forests in the United States cover about 30% of U.S. land area, provide habitat for >80% of wildlife species, and cover more area than was true in 1920.
A. More wood is grown each year in the U.S. than is cut and the total area planted with trees increases.
B. About 40% of U.S. forests are in protected lands, mostly in national forests.
C. On the other hand, the U.S. is losing its old growth and second-growth forests, which are being replaced by biologically simplified tree plantations.
1. As a result, forest biodiversity has been reduced.
2. Ecosystem processes have been disrupted.
3. Individuals like Julia Hill have protested this destruction, but the carnage continues.
D. Controversy of managing national forests is the same as that of managing public lands: Will big business interests continue to steal the wealth of the forests from the citizens of the country? Why is the government unwilling to discontinue such practices, and what can the individual do?
E. Three types of fires affect forest ecosystems.
1. Surface fires usually burn underbrush, burn leaf litter, and small seedlings, but most wild animals survive. They have benefits such as burning flammable ground material to prevent more destructive fires and releasing nutrients, stimulating germination of some seeds, and controlling pathogens and/or insects.

2. Crown fires are extremely hot and leap from treetop to treetop. Buildup of ground litter increases the likelihood of crown fires that result in greater destruction and soil erosion.

3. Ground fires are most common in northern peat bogs where they go underground and burn decaying matter. They are hard to detect and extinguish.

F. Protection of forest resources from fire includes fire prevention and prescribed burning.

G. An educational campaign to prevent forest fires has been successful, but now the public thinks all forest fires are bad.
   1. Prevention of all forest fires can increase chances of devastating fires from buildup of underbrush and small trees.
   2. Logging practices of the 1980s left logging debris.
   3. People now live in areas with high wildfire risk, and this increases chances of fires occurring.
   4. In parts of California, goats are used as an alternative to prescribed burns to avoid accidental large fires.
   5. Fires have been allowed to burn to help clear undergrowth in national parks and forests.
   6. A fire zone around homes of 150–200 feet and eliminating flammable building materials are advocated in fire-prone areas.
   7. Congress passed a law in 2003 that allows timber companies to cut down economically valuable medium and large trees in exchange for clearing smaller trees and underbrush.
   8. Biologists believe this will increase forest fires by (a) removing more fire-resistant trees and by (b) leaving fire-prone slash materials behind (as evidenced by some of the worst fires in the 1990s that burned through cleared forest areas with slash).

H. Forest thinning on public lands is needed but should focus on two goals: reducing ground-level fuel in dry forest types and leaving medium to large trees, and clearing flammable vegetation around individual homes/buildings in vulnerable communities.

I. This would cost less to taxpayers by having grants to communities for thinning forests and clearing around homes. This gives people a stake in the community.

J. There is controversy over the use of resources in national forests.
   1. Timber companies want to cut as much as possible at low prices.
   2. Biodiversity experts want reduction or elimination of tree cutting in national forests. They believe the forests should provide recreation and sustain biodiversity, water resources, and other ecological services.
   3. Incentives have been given to county governments and the Forest Service to increase timber sales.
   4. Cost of reforesting land by timber companies does not include the cost of road building, timber sale preparation, administration, and other overhead costs that are government subsidized. Timber sales have actually lost money for taxpayers in 97 of the last 100 years.
   5. Recreation, hunting, and fishing in national forests add 10 times more money to the economy than extracting timber and other resources.

K. Improving the efficiency of wood use would reduce pressure to harvest trees on public and private land.
   1. Up to 60% of wood consumed in the U.S. is wasted by:
      1. inefficient use of construction materials,
      2. excess packaging and overuse of junk mail,
      3. inadequate paper recycling, and
      4. failure to reuse wooden shipping containers.

L. Elimination of waste of wood by 4% would eliminate the need to use timber from the national forests.

M. Use of tree-free fibers for paper-making is another way to reduce pressure on tree harvest. Use of fibers from agricultural residues and fast-growing crops such as kenaf are good alternatives to tree fibers.
   1. Kenaf needs fewer herbicides/insecticides because it is able to outgrow most weeds.
   2. Kenaf is a nitrogen fixer, so it does not deplete nitrogen from the soil.
   3. Fiber production takes less energy and fewer chemicals resulting in less toxic wastewater.
   4. This may replace tree fibers within 10–20 years.
A. Most destruction of tropical forests has occurred since 1950.
   1. Brazil has about 40% of the world’s remaining tropical rainforest, but at the rate of destruction and
degradation practices, it may largely be gone in 40–50 years.
   2. Brazilian Atlantic rainforest once covered 12% of Brazil, and 93% of it has been cleared, a major
loss of biodiversity since there are 450 tree species in an area the size of two suburban house lots.
The U.S. has about 865 native tree species.
   3. It is very difficult to estimate the actual loss of rainforest due to political and economic reasons
and different ways of defining forest and deforestation/degradation.
   4. Loss of tropical forests is a loss of possible useful chemical products and also will contribute to
global warming as we lose this storehouse for carbon as biomass.

B. Four primary causes of tropical forest destruction:
   1. Population growth and poverty drive subsistence farmers to tropical forests where they attempt to
farm.
   2. Government subsidies make tropical forest resources cheap—relative to their full ecological value.
   3. The poor are given title to land they clear. It may reduce poverty but degrades land if settlers are
not taught to use forests sustainably
   4. International lending agencies encourage road building, mining, and drilling in tropical forests.
   5. Degradation begins when roads are cut into the forest for logging. Selective cutting removes the
best timber (high grade). Domestic use accounts for 80% of the trees cut in developing countries.
   6. Ranchers come in behind the timber cutters and overgraze land; they then move on and
subistence farmers come in and practice slash and burn farming to complete the destruction of the
land.
   7. Healthy rainforests do not burn, but logging, settlements, grazing, and farming have fragmented
the forest so they dry out, making it easier for lightning and people to start fires.

C. In order to reduce deforestation and degradation of tropical forests,
   1. we must help settlers learn methods to practice in small-scale sustainable agriculture and forestry.
   2. we must harvest sustainable fruits and nuts in the rainforests.
   3. we might use debt-for-nature swaps, which allow countries that owe foreign aid/foreign debt to act
as custodians of protected forest reserves in order for the debt to be forgiven.
   4. we must develop an international system for evaluating and certifying that tropical timber has been
produced by sustainable methods.
   5. loggers can harvest trees more gently: canopy vines’ being cut saves damage to
near-by trees; use the most open paths to remove felled trees.
   6. governments and individuals can reforest and rehabilitate degraded tropical forests and
watersheds.
   7. we must prevent illegal logging.

D. We need to develop programs like the Green Belt Movement in Kenya. Members of a women’s self-
help group established tree nurseries, raised seedlings, and are planting and protecting a tree for each
of Kenya’s people.

E. We must protect the plants of the tropical rain forest because, like the Neem tree of India, many
medicinal applications can improve health the world over.
   1. The neem tree is a broadleaf evergreen of the mahogany family.
   2. This tree can reforest degraded land quickly, supply fuelwood and lumber, provide natural
alternatives to pesticides, be used to treat various diseases, and help control population growth.
   a. It is a native of India and Burma.
   b. It is full-grown in 5–7 years, in poor soil and semiarid lands.
   c. Chemicals in its leaves and seed repel/kill insects.
   d. This tree is a “village pharmacy.”
   e. Its oil is an effective spermicide and may contribute to development of a male birth control
pill.
   f. Ecologists caution against widespread planting of the tree outside its native habitat; it could
become an invasive species elsewhere.
National parks, established by governments, are popular with people all over the world.

A. Several threats to national parks must have a sustainable response.
   1. Parks, especially in developing countries, need protection.
      a. People search for wood, game animals, etc.
      b. Loggers, miners, and poachers take all they want from the parks.
      c. Money must be available to protect parks from these rapists.
      d. Parks are too small to sustain many large animals.
   2. People illegally remove native species.
   3. Nonnative species invade parks.
      a. European wild boars threaten vegetation in parts of the Great Smoky Mountains National Park; Mountain goats in Washington’s Olympic National Park trample vegetation and hasten soil erosion.
   4. Cars are congesting the roads; trails are eroded, causing stress for visitors instead of solitude.
   5. Visitors often expect to have urban-type facilities in national and state parks.
   6. Parks have too many tourists and not enough staff members, and rangers spend more time on law enforcement than on conservation, management, and education.
   7. Human activities compromise the environment everywhere; parks are no exception. They are supporting mining, grazing, coal-burning power plants, polluted air, and urban development.
   8. All kinds of vehicles: dirt bikes, dune buggies, snowmobiles, and OVRs (off road vehicles) destroy vegetation and disturb wildlife and people.

B. To stabilize park conditions, the Gray wolf has been re-introduced to Yellowstone National Park.
   1. The wolves kept the populations of bison, elk, caribou, mule deer, and coyotes under control.
   2. Without the wolves, a keystone species, the environment was being undermined by expanding animal herds that devastated vegetation, increased erosion, and threatened the ecological niches of other types of wildlife.
   3. The re-introduced wolves have benefited the environment. Aspen and willow tree growth has expanded and in doing so has attracted beavers to new areas. Wolves killing elk have provided grizzlies another food source. The wolves have decreased the coyote population, which has helped grow smaller animals like ground squirrels and foxes.

C. Private concessionaires provide campgrounds, restaurants, hotels, and other services while paying 6–7% of gross receipts in franchise fees. Some analysts call for raising fees to 22% of gross receipts.

11-8 Nature Reserves

In order to sustain the earth’s biodiversity, we need to establish and manage more nature reserves.

A. Conservation biologists call for a strict protection of at least 20% of earth’s global system as biodiversity reserves that include multiple examples of all the earth’s biomes.
   1. Some progress is occurring with Brazil, Gabon, and Canada establishing more national parks.
   2. Developers and resource extractors generally oppose protecting any of the earth’s remaining undisturbed ecosystems.

B. The most impressive country in conserving its land and natural resources has been Costa Rica.
   1. It has established a system of reserves and national parks that included one-fourth of its land by 2003.
   2. It has consolidated its parks and reserves into eight megareserves, which sustain 80% of the country’s biodiversity. Almost two-thirds of its yearly tourism business comes from eco-tourism!
   3. Tourism may also undermine the protected areas without careful government control.

C. The Nature Conservancy, founded in 1951, has created the world’s largest system of private natural areas and wildlife sanctuaries in 30 countries.
   1. Private and corporate donations maintain a fund for buying ecologically important pieces of land or wetlands.
   2. Landowners who donate land to the Nature Conservancy in exchange for lifetime occupancy rights also receive sizable tax deductions.

C. Large reserves are usually the best way to protect biodiversity, but in some locales, several well-placed, medium-sized, isolated reserves may be a better way to protect a variety of habitats.

D. Establishment of habitat corridors helps to support more species and allows migration of vertebrates with large ranges.
   1. Migration of individuals can occur when environmental conditions deteriorate within a range.
2. They can also threaten isolated populations by allowing movement of pest species, disease, fire, and exotic species between reserves.
3. They may be costly to acquire, protect, and maintain.

E. Biosphere reserves have an inner protected core surrounded by two buffer zones that can be used by people for sustainable extraction of resources, food, and fuel.
1. UNECSO created the Man and the Biosphere Programme in 1971 to establish biosphere reserves in each of the 193 biogeographical zones.
2. The core area of the reserve is protected from all human activities except nondestructive research and monitoring.
3. A buffer zone surrounds the core zone and protects it.
4. A second buffer zone/transition zone surrounds the inner buffer and can be used by local people for sustainable forestry, grazing, hunting, fishing, agriculture, and recreation.
5. Presently most biosphere reserves are underfunded and fall short of the ideal.
6. A fund of about $100 million per year would help countries protect and manage biosphere reserves.

F. People with competing interests can work together to develop adaptable plans to manage and sustain nature reserves.
1. One way to do this is with adaptive ecosystem management, based on using the following four principles.
   a. Integrate ecological, economic, and social principles to maintain and restore diversity of reserves.
   b. Find a way to get diverse agencies, private conservation organizations, scientists, business interests, and landowners to reach a consensus on achievement of common conservation goals.
   c. Look at all decisions as experiments, learn from failures, and improve.
   d. Continually gather information, monitor, reassess, be flexible, adapt, and innovate when faced with uncertainty.
2. Conservation biologists use an emergency action strategy to identify and protect biodiversity hot spots. These are areas especially rich in biodiversity found nowhere else on Earth and are in danger of extinction.

G. Wilderness consists of undeveloped land affected primarily by forces of nature, and man is a visitor.
1. Wilderness areas should be at least 1,500 square miles so as not to be affected by air, water, and noise pollution.
2. People can enjoy nature’s beauty and observe the natural diversity. Wilderness areas can also help the mental and physical health of visitors.
3. These areas are centers for evolution and the preservation of biological diversity, a type of natural savings account.
4. Wild species that inhabit wilderness also have a right to exist without human interference.

H. The Wilderness Act was not passed in the U.S. until 1964. Only about 4.6% of U.S. land is protected as wilderness with almost three-fourths of it in Alaska.
1. Only about 1.8% of the lower 48 states are protected as wilderness.
2. Only 81 of the 233 distinct ecosystems are protected in wilderness, and most are smaller than the 1,500 square miles recommended.
3. About 150,000 square miles could qualify for wilderness status, and about 60% of it is in national forests.
4. Industries see these areas as sources of increased profits and short-term economic growth.
5. The Bush administration stopped protection of areas under consideration for wilderness status in 2003.
6. Wilderness advocates call for creating wilderness recovery areas where roads would be removed from public lands and wildlife habitats restored.
7. Strong opposition to these projects makes them unlikely to occur.

11-9 Ecological Restoration
A. Environmental degradation can be partially reversed through ecological restoration. These include restoring wetlands, replanting forests, reintroducing native species, removing invasive species, and removing dams on rivers.
B. Scientists study how natural systems recover and are learning to speed up repair operations by the following approaches.
   1. Return a degraded habitat to a condition as close to its natural state as possible. Changes in climate, soil, and species composition may make this impossible.
   2. Rehabilitation involves trying to restore an ecosystem to a functional state rather than is original state.
   3. Remediation involves cleaning up chemical contaminants from a site in order to use it again.
   4. Replacement is replacing a degraded ecosystem with a productive pasture or tree farm.
   5. Creating artificial ecosystems is another possibility.

C. Five basic principles are suggested for ecological restoration.
   1. Mimic nature and natural processes; let nature do most of the work.
   2. Recreate important ecological niches that may be lost.
   3. Rely on pioneer species, keystone species, foundation species, and natural succession.
   4. Control or remove nonnative species.
   5. Reconnect small patches to form larger ones with corridors.

D. Preventing ecological damage is cheaper and more effective than restoring degraded ones.

E. A restored ecosystem is better than a degraded one, and we have only been able to preserve about 7% of nature from harm.

F. Costa Rica is in the process of restoring a tropical dry deciduous forest degraded by cattle raising and farming. Making the local people a part of the project will give these people educational, economic, and environmental benefits. Eco-tourism in this area stimulates the local economy.
   1. This is a good training ground for scientists.
   2. Training today’s children will increase chances of future politicians protecting the area.
   3. It is thought that the best ways to restore degraded ecosystems is with education, awareness, and involvement.

11-10 What Can We Do?
Edward O. Wilson’s nine priorities for protecting the world’s ecosystems and species:
   A. Immediately take action to preserve the world’s biological hot spots.
   B. Keep the world’s remaining frontier forest intake, our last true wilderness areas.
   C. Cease all logging of old-growth forests everywhere.
   D. Protect and restore the world’s lakes and river systems.
   E. Identify the world’s marine hot spots and give them the same priority as land hot spots.
   F. Finish mapping the world’s terrestrial and aquatic biodiversity.
   G. Ensure that the earth’s terrestrial and aquatic ecosystems are in a global conservation strategy.
   H. Make conservation profitable.
   I. Start ecological restoration products worldwide to heal damage and increase the share of the earth allotted to the rest of nature. This could be funded by a 1 cent tax on a cup of coffee.
   J. Bottom-up political pressure is necessary from every individual citizen and all groups.

Summary

1. Mankind has depleted and degraded much of the earth’s biodiversity. This impact is expected to increase.

2. Conservation biology attempts to slow down the rate at which we are destroying and degrading the earth’s biodiversity through the use of rapid response strategies. Hot spots, the most endangered and species-rich ecosystems, receive emergency action to slow down/stop the loss of biodiversity in these systems. Bioinformatics manages, analyzes, and communicates basic biological and ecological information to help sustain biodiversity.

3. The major types of public lands in the United States are the national forests, resource lands, wildlife refuges, protected wilderness areas, and parks. The forests are used for logging, mining, livestock grazing, farming, oil and gas extraction, fishing, hunting, conservation, and recreation. The national resource lands are used for mining, oil and gas extraction, and livestock grazing. The national wildlife refuges protect habitats and breeding areas for waterfowl and big game. These areas also support hunting, trapping, oil and gas development, mining, military activities, and farming. The National Park System includes parks,
recreation areas, historic sites, monuments, battlefields, memorials, parkways, and seashores. They are primarily used for recreational activities. The National Wilderness Preservation System also supports recreational undertakings.

4. Forests provide important ecological and economic services, are storehouses of biodiversity, and affect weather and climate throughout the world. Forest resource management varies according to the type of forests. Some management systems maintain trees, cut them down, and replant them—all at the same time. In diverse forests, the ages and sizes of trees are preserved to foster natural regeneration. Government policies will primarily determine the future of forests, even the old-growth forests that are so important to us all.

5. Forests in the United States should be managed so as to retain as much of the forests as possible. Logging is an invasive action that undermines the health of any forest, so it should be undertaken as carefully as possible. Clear-cutting and seed-tree cutting methods of harvesting are scourges on the forest; selective cutting is the most reasonable way to harvest trees.

6. Deforestation is one of the most serious ecological problems of this century. The earth’s forests have been reduced by 20–50%, and the destruction continues to this day. Deforestation has many harmful environmental effects: reduces ecological services of forests, releases large amounts of carbon dioxide into the air, produces a drier and hotter climate, reduces the control of water movements, and increases soil erosion. We need to reduce the rate of forest loss and degradation and balance the loss by the renewal of forest areas. We need to include the value of forest ecological services in all decisions related to forests. We need to protect the forests that we have from destruction: fires, insect infestations, etc.

7. Tropical deforestation is one of the biggest threats to world economic health and climate. To help sustain tropical forests, nations of the world must unite to discourage deforestation and degradation. Such an effort would slow population growth, decrease/eliminate world poverty, provide environmentally supportive government subsidies, reduce/eliminate debts owed by the developing countries, and place a monetary value on ecological services provided by tropical forests. Other efforts include: practicing small-scale sustainable agriculture and forestry; harvesting renewable resources from rain forests, such as fruits and nuts; and certifying timber that is produced by sustainable methods.

8. Parks’ problems run from little/no protection from their governments to being too small to sustain large animal species, to being too popular and therefore being overused by people. Some methods for managing parks include: limiting the number of visitors, raising entry fees to provide funds for maintenance and management, managing parks in reference to nearby federal lands, discouraging development around already established parks, and providing more volunteers and better paid employees to maintain the parks.

9. Only about 7% of the world’s terrestrial areas are protected from potentially harmful human activities; these areas need to be expanded throughout the world. At least 20% of the earth’s land area should be protected in a global system of biodiversity. National governments and private cooperative ventures should be involved in setting aside land and sustaining it. Developers must be refused access to large areas of land; biodiversity must be preserved, despite the projected economic benefits. Costa Rica is one country that has preserved its biodiversity. In the 1970s, Costa Rica implemented a system of reserves and national parks, committed to biodiversity conservation. Their megareserve system includes a protected inner core with buffer zones that may be used by indigenous people for logging, food growing, cattle grazing, hunting, and fishing. This unique commitment has brought in millions of tourist dollars, a help to sustaining the country’s economy. Usually, the larger the land reserve, the better it is. Biosphere reserves have also proved effective. They have an inner protected core surrounded by two buffer zones.

10. Wilderness is an amount of land legally set aside to prevent/minimize harm from human activities. This is land affected by nature where human beings may visit but not remain. Wilderness areas are important for (1) their natural beauty, (2) their natural biological diversity, (3) their enhancement of the mental and physical health of visitors, and (4) their contributions to biodiversity and evolutionary possibilities.
11. Ecological restoration is the process of repairing damage caused by humans to the biodiversity and dynamics of natural ecosystems. It is important because mankind has so badly damaged the earth’s ecosystems. We may destroy the earth and ourselves unless we correct and then prevent this destruction.

12. To sustain the earth’s biodiversity, we need to:
   …immediately preserve the world’s biological *hot spots*.
   …protect the remaining old-growth forests and cease logging them.
   …map the world’s terrestrial and aquatic biodiversity.
   …identify and take action for the world’s marine hot spots, just as for the terrestrial hot spots.
   …protect and restore the world’s lakes and river systems.
   …develop a global conservation strategy that protects the earth’s terrestrial and aquatic ecosystems.
   …make conservation profitable.
   …initiate ecological restoration projects worldwide.