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Forests, Forest Management, and Protected Areas

Chapter Objectives

This chapter will help students:

Summarize the ecological and economic contributions of forests

Outline the history and current scale of deforestation

Assess aspects of forest management and describe methods of harvesting timber

Identify federal land management agencies and the lands they manage

Recognize types of parks and protected areas and evaluate issues involved in their design

Lecture Outline

I. Central Case Study: Certified Sustainable Paper in Your Textbook

- A. As you turn the pages of this book, you are handling paper made from trees that were grown, managed, harvested, and processed using certified sustainable practices.
- B. The trees cut to make this book's paper were selected for harvest based on a sustainable management plan designed to avoid depleting the forest of its mature trees or degrading the ecological functions the forest performs.
- C. Each stage in this process has been examined by independent third-party inspectors from the Forest Stewardship Council (FSC) to ensure that practices meet the FSC's strict criteria for sustainable forest management and paper production. The Forest Stewardship Council is an organization that officially certifies forests, companies, and products that meet sustainability standards.

- D. Only some of this paper is FSC-certified, but NewPage seeks out suppliers of wood from private land who are certified at least to the less-rigorous standards of the Sustainable Forestry Initiative®. NewPage states that it does not use wood from old-growth forests, rainforests, or forests of exceptional conservation value.
- E. FSC certification for the paper in your textbook was made possible because Pearson Education, the publisher of this book, is striving to follow sustainable practices.

II. Forest Ecosystems and Forest Resources

- 1. A **forest** is any ecosystem with a high density of trees.
- A. Many kinds of forests exist.
 - 1. Ecologists and forest managers find it useful to classify forests into **forest types**—categories defined by their predominant tree species.
 - 2. Altogether, forests currently cover 31% of Earth’s land surface.
- B. Forests are ecologically complex.
 - 1. Because of their structural complexity and their capacity to provide many niches for organisms, forests comprise some of the richest ecosystems for biodiversity.
 - 2. In a forest’s **canopy**—the upper level of leaves and branches in the treetops—beetles, caterpillars, and other leaf-eating insects abound, providing food for birds such as warblers and tanagers, while arboreal mammals from squirrels to sloths to monkeys consume fruit and leaves. Animals also live and feed in the **subcanopy** (the middle and lower portions of trees), in shrubs and small trees of the **understory**, and among groundcover plants on the forest floor.
 - 3. Forests with a greater diversity of plants tend to host a greater diversity of organisms overall.
- C. Forests provide ecosystem services.
- D. Carbon storage limits climate change.
- E. Forests provide us with valuable resources.
 - 1. Nations maintain and use forests for economic and ecological reasons.

III. Forest Loss

- 1. **Deforestation** is the clearing and loss of forests.
- A. Agriculture and demand for wood put pressure on forests.

1. Forest clearing has fed our civilization's growth, but unsustainable forest loss has negative consequences, especially as human population grows.
- B. We deforested much of North America.
1. Deforestation for timber and farmland propelled the expansion of the United States and Canada westward across the North American continent.
 2. As a farming economy shifted to an industrial one, wood was used to stoke the furnaces of industry.
 3. By the early 20th century, very little **primary forest**—natural forest uncut by people—remained in the lower 48 U.S. states, and today even less is left.
 - a. Nearly all of the largest oaks and maples found in eastern North America today, and even most redwoods of the California coast, are *second-growth* trees—trees that have sprouted and grown to partial maturity after old-growth trees were cut. Such second-growth trees characterize **secondary forest**.
 4. The fortunes of loggers have risen and fallen with the availability of big trees.
- C. Forests are being cleared most rapidly in developing nations.
1. Today's powerful industrial technology allows developing countries to exploit their resources even faster than occurred in North America. Deforestation is occurring rapidly in places such as Brazil, Indonesia, Central America, and West Africa.
 2. Developing nations in these regions are striving to expand settlement for their burgeoning populations and to boost their economies by extracting natural resources.
 3. Developing nations often are desperate enough for economic development and foreign capital that they impose few or no restrictions on logging.
 - a. Often they allow their timber to be extracted by foreign multinational corporations, which pay fees to the developing nation's government for a **concession**, or right to extract the resource.
- D. Solutions are emerging.
1. Some conservation proponents are pursuing community-based conservation projects that empower local people to act as stewards of their forest resources. In other cases, conservation organizations are buying concessions and using them to preserve forest rather than to cut it down.

2. Carbon offsets are central to emerging international plans to curb deforestation and climate change.

IV. Forest Management

1. *Foresters* are professionals who manage forests through the practice of **forestry**, and they must balance our society's demand for forest products against the central importance of forests as ecosystems.
- A. Forest management is one type of resource management.
1. **Resource management** describes our use of strategies to manage and regulate the harvest of renewable resources.
- B. Resource managers follow several strategies.
1. The maximum amount of resource extraction possible without depleting the resource from one harvest to the next is known as the **maximum sustainable yield**.
 2. More managers today espouse **ecosystem-based management**, which aims to minimize impact on the ecosystems and ecological processes that provide the resource.
 3. **Adaptive management** involves systematically testing different approaches and aiming to improve methods through time.
- C. Fear of a “timber famine” inspired national forests.
1. The depletion of the eastern forests spurred the formation of a system of forest reserves—the U.S. **national forest** system, managed by the U.S. Forest Service—that covers over 8% of the nation's land area.
- D. We extract timber from private and public lands.
1. The vast majority of timber harvesting in the United States today takes place on private land owned by the timber industry or by small landowners. Private timber companies also extract timber from the U.S. national forests and from publicly held state forests.
 2. Overall, timber harvesting in the United States and other developed nations has remained stable for the past 45 years, while it has more than doubled in developing countries.
 3. On timber industry land, companies manage their resources in accordance with maximum sustainable yield, so as to obtain maximal profits each year over many years. On public lands, rates of tree removal and growth reflect social and political factors as well as economic ones, and these evolve over time.

4. When regrowth outpaces removal, the character of forests may change. Once primary forest is replaced by younger secondary forest or by single-species plantations, the resulting community may be very different, and generally it is less ecologically valuable.
- E. Plantation forestry has grown.
1. Tree plantations with **even-aged** monocultures are planted and cut all at once, and then the land is replanted.
 2. Because there are few species and little age variation, plantations have little biodiversity in the organisms that live there.
 3. It is important that some harvesting methods maintain **uneven-aged** stands, with a mix of ages and species, to more closely resemble a natural forest.
- F. We harvest timber by several methods.
1. **Clear-cutting** is the easiest and most cost-efficient method in the short term, but it has the greatest impact on ecosystems.
 2. The **seed-tree** approach leaves small numbers of mature and vigorous seed-producing trees to reseed the logged area. In the **shelterwood** approach, small numbers of mature trees are left to provide shelter for new seedlings.
 3. **Selection systems** allow uneven-aged stand management, and cut only some trees at any one time.
 4. All timber-harvesting methods disturb soil, alter habitat, and affect plants and animals. All methods modify forest structure and composition.
- G. Forest management has evolved over time.
1. The Forest Service has nominally been guided by a policy of **multiple use**, meaning that the national forests are to be managed for recreation, wildlife habitat, mineral extraction, and other uses.
 2. In 1976, Congress passed the **National Forest Management Act**, mandating that renewable resource management plans be made for every national forest, based explicitly on the concepts of multiple use and sustained yield.
 3. Timber harvesting methods were brought more in line with ecosystem-based management goals. A set of approaches dubbed **new forestry** called for timber cuts that mimicked natural disturbances.

4. Another national policy milestone that accentuated a shift toward conservation occurred in 2001, when President Bill Clinton issued an executive order that became known as the **roadless rule**. The roadless rule put 23.7 million ha (58.5 million acres)—31% of national forest land and 2% of total U.S. land—off-limits to road construction or maintenance (and thus to logging).
- H. Fire can hurt or help forests.
1. For over a century, the Forest Service and other land management agencies have suppressed fire whenever and wherever it has broken out.
 2. Fire suppression increases the likelihood of catastrophic fires that damage forests, destroy human property, and threaten human lives. At the same time, increased residential development alongside forested land—in the **wildland-urban interface**—is placing more homes in fire-prone situations.
 3. To clear away fuel load, nourish the soil with ash, and encourage the vigorous growth of new vegetation, the Forest Service and other agencies have in recent years sponsored **prescribed burns**, or **controlled burns**—burning areas of forest under carefully controlled conditions.
 4. In the wake of the California fires in 2003, Congress passed the Healthy Forests Restoration Act, which encourages prescribed burns and **salvage logging**, the physical removal of small trees, underbrush, and dead trees by timber companies.
- I. Climate change and pest outbreaks are altering forests.
1. Global climate change (Chapter 18) is now worsening wildfire risk by bringing warmer weather to most of North America and drier weather to much of the American West.
 2. Climate change also is promoting certain pest insects that destroy forest trees.
 3. Climate change benefits some species while harming others, and as it interacts with pests, diseases, and management strategies, many of our forest ecosystems could be altered in profound ways.
- J. Sustainable forestry is gaining ground.
1. Several organizations examine timber company practices and offer **sustainable forest certification** to products made using sustainable methods.

2. Pursuing sustainable forestry practices is often more costly for producers in the short term, but producers recoup these costs when consumers are willing to pay more for certified products.

V. Parks and Protected Areas

A. Why create parks and reserves?

1. People establish parks and protected areas for several reasons.
 - a. Enormous or unusual scenic features such as the Grand Canyon, Mount Rainier, or Yosemite Valley inspire people to preserve them.
 - b. Protected areas offer recreational value for hiking, fishing, hunting, kayaking, bird-watching, and other pursuits.
 - c. Parks generate revenue from ecotourism.
 - d. Undeveloped land offers us peace of mind, health, exploration, wonder, and spiritual solace. Children in particular benefit from healthy exposure to the outdoors.
 - e. Protected areas offer utilitarian benefits through ecosystem services. For example, undeveloped watersheds provide cities with clean drinking water and a buffer against floods.
 - f. Reserves protect biodiversity. These islands of habitat help maintain species, communities, and ecosystems.

B. Federal parks and reserves began in the United States.

1. The striking scenery of the American West persuaded the U.S. government to create the world's first **national parks**, public lands protected from resource extraction and development but open to nature appreciation and recreation.
2. The National Park Service (NPS) was created in 1916 to administer the growing system of parks and monuments, which today comprises 401 sites totaling 34 million hectares.
3. A **national wildlife refuge** is another type of federal protected area.
4. The U.S. Fish and Wildlife Service administers the national wildlife refuges.

C. Wilderness areas are established on federal lands.

1. In response to the public's desire for undeveloped areas of land, in 1964 Congress passed the Wilderness Act, which allowed some areas of existing federal lands to be designated as **wilderness areas**.

These areas are off-limits to development but open to hiking, nature study, and other low-impact public recreation.

D. Not everyone supports land set-asides.

1. The restriction of activities in wilderness areas has generated some opposition to U.S. land protection policies, especially among citizens and policymakers in western states.
2. Parks and protected areas regularly bring substantial economic benefit to people who live nearby through ecotourism. However, individuals who do not have jobs related to parks and tourism may feel that a park restricts their economic opportunities.
3. Groups of indigenous people frequently oppose government actions to set aside land.
4. However, protected areas sometimes serve the interests of indigenous people.

E. Many agencies and groups protect land.

1. Private nonprofit groups also preserve land. **Land trusts** are local or regional organizations that purchase land to preserve in its natural condition.

F. Parks and reserves are increasing internationally.

1. Many nations have established systems of protected areas and are benefiting from ecotourism as a result.
2. Many of the world's protected areas are so-called *paper parks*—protected on paper but not in reality.
3. **Biosphere reserves** are tracts of land with exceptional biodiversity that couple preservation with sustainable development to benefit local people.
4. **World heritage sites** are another type of international protected area.
5. Some transboundary reserves (an area of protected land overlapping national borders) function as *peace parks*, helping to ease tensions by acting as buffers between nations that quarrel over boundary disputes.

G. Economic incentives can help preserve land.

H. Habitat fragmentation makes preserves more vital.

1. When forests are fragmented, many species suffer. For some, a fragment may simply not contain enough area. For other species,

the problem may lie with **edge effects**, impacts that result because the conditions along a fragment's edge differ from conditions in the interior.

- I. Insights from islands warn us of habitat fragmentation.
 1. The **island biogeography theory** explains how species come to be distributed among oceanic islands.
 2. Island biogeography theory explains how the number of species on an island results from a balance between the number added by immigration and the number lost through extirpation. It predicts an island's species richness based on the island's size and its distance from the mainland.
 - a. The farther an island lies from a continent, the fewer species tend to find and colonize it. Thus, remote islands host few species because of low immigration rates—this is the *distance effect*.
 - b. Larger islands have higher immigration rates because they present fatter targets for dispersing organisms to encounter.
 - c. Larger islands have lower extinction rates because more space allows for larger populations which are less likely to drop to zero by chance.
 3. Together, the latter two trends give large islands more species than small islands—a phenomenon called the *area effect*. Very roughly, the number of species on an island is expected to double as island size increases tenfold. This is illustrated by **species-area curves**.
 4. These patterns hold up for terrestrial habitat islands as well, such as forests fragmented by logging and road-building.
- J. Reserve design has consequences for biodiversity.
 1. Conservation biologists debate the **SLOSS dilemma** (single large or several small).
 2. A related issue is how effectively **corridors** of protected land allow animals to travel between islands of habitat.
- K. Climate change threatens protected areas.
 1. As temperatures become warmer, species ranges shift toward naturally cooler climates: toward the poles and upward in elevation.
 2. In a landscape of fragmented habitat, some organisms may be unable to move from one fragment to another.