

CHAPTER 12 BIODIVERSITY: PRESERVING LANDSCAPES

Chapter Overview

This chapter explains the nature of forests, grasslands and nature preserves. The importance of these vital ecosystems is stressed and the environmental damage result from anthropogenic uses of these lands. Nature preserves, both terrestrial and aquatic, are designated to protect these ecosystems and their inhabitants. Working in conjunction with the human inhabitants of an area, biosphere preserves are created. This, in turn, is beneficial as ecotourism becomes a boost to the local economy.

Topics and Key Concepts

The Living World

- Diagram a model biosphere reserve.

Land and Water Use

- Differentiate between continuous and deferred rotation grazing.
- Summarize the dangers to grazing lands throughout the world and outline steps taken by ranchers in the United States to preserve rangelands.
- Describe the various types and uses of the world's forests.
- Assess the extent of deforestation and loss of forest habitat, as well as evaluate various management and conservation systems.
- Explain the steps that have been taken to establish nature preserves in the United States.

Global Change

- Summarize the types of nature preserves that have been established in nations other than the United States.
- Discuss the role of indigenous people in the preservation of lands.

Key Terms

biosphere reserve	ecosystem management	overgrazing
closed-canopy forest	ecotourism	pastoralists
*continuous grazing	edge effects	primary forests
core habitat	forests	Roadless Rule
corridor	landscape ecology	rotational grazing
debt-for-nature swaps	Man and Biosphere (MAB) program	savannas
desertification	*monoculture forestry	world conservation strategy

Pacing Guide

The AP topic outline suggests 10-15 percent of the course include forestry and land management topics. Allow 3-4 days to cover the material presented in this chapter.

Approach and Tips

More than anything else, this chapter is about loss of biodiversity and the impact humans have had on the forest ecosystems around the world. Discuss how forested lands are being converted for agricultural uses. Then have students debate the rights of indigenous people to use their native lands as their cultures have done for many years. Ask the class to think about what unknown species or medical cures might be lost or already have been lost through human activities. Have students research the Yanomami tribe of Brazil as a case study for development destroying the culture of an indigenous people.

Students should know the different types of forests. Old-growth forests are not significantly modified by human activities and contain much of the world's biodiversity which is a result of their remote locations. Secondary forests have restored the complexity of the ecosystem through successional stages. Emphasize that tropical forests are the most diverse ecosystems on Earth even though they occupy less than 10% of the land and that tropical hardwoods are being cut at an unsustainable rate.

Types of forestry and lumber harvest methods are also important aspects of this chapter. Explain the concept of monoculture forestry using a cost/benefit analysis in both an environmental and economic sense. Monoculture forestry involves planting large plantations of one species of tree as a crop that can be easily clear-cut. This methodology may be preferred for conifer replanting but is devastating for hardwoods. Focus should remain on preservation of biodiversity regardless of dominant tree species. Mixed species planting can be used for a variety of purposes and can protect the ecosystem. Replanting of trees reduces flooding and erosion. Discuss different harvesting methods, including clear cutting, shelterwood cutting, creaming, and selective cutting and have the students describe the environmental effects of each. Emphasize that logging is not the only way to make a living from forest products, including extractive resources, include fruits, nuts, mushrooms, latex, and gum. In the northwestern United States and Canada, logging contributes significantly to the economy. Plans to protect endangered species and old-growth forests are the center of debate. Have students research U.S. forest management practices and debate the issue from the government's and the environmental groups' points of view.

People in highly developed countries use 80% of the wood harvested but produce less than 50%. Less-developed countries produce more than 50% of the wood, yet they use less than 20%. Discuss the imbalance and the impact on the long-term future of the people in these countries. You can introduce the concept for debt-for-nature swap so that students realize that developing nations do have options for preserving their natural ecosystems.

Grasslands are being lost at a faster rate than forested lands. Examine the difference between domestic livestock and wild and their interaction with grasslands. Specifically address how much damage cattle ranching does to a grassland. What factors contribute to the grassland degradation and eventual desertification? How do government subsidies impact land use? Explain that grasslands occur where there is enough rainfall to support drought-tolerant plants but not enough to support forests. Include a discussion of fire as a mechanism to cull any hardwoods that may exist outside of riparian zones. Stress that overgrazing, soil erosion, and degradation contribute to grassland losses. When animal herds are migratory, grasslands remain healthy. Explain that when plants are unable to recover and weedy invaders move in, desertification occurs. Using the North American bison as an example of native animals, illustrate that these species forage more efficiently than domestic livestock. In the United States, federal grazing permits are required to avoid exceeding the carrying capacity of federal rangelands. Overgrazing of federal lands can illustrate the concept of the tragedy of the commons. Rotational grazing helps keep weeds in check and encourages the growth of forage plant species. Pastures should be differentiated from rangelands.

Using a map of the world, illustrate that many nations have set aside some natural areas for ecological, cultural, or recreational purposes. Point out specific areas of the world where these natural areas are found. Currently, nearly 12% of land on Earth is protected in some sort of park, preserve, or wildlife management area. Brazil has the largest total area in protected status of any country. Make sure the students realize that even parks and preserves that are designed to have a high level of protection aren't always safe from exploitation. Commercial fisheries are being increasingly depleted, and biologists are calling for protected areas where marine organisms are sheltered. Reinforce the concept of biodiversity by explaining that coral reefs are among the most biodiverse and threatened marine ecosystems in the world. Explain that many nations are discovering ecotourism as a way to preserve their valuable assets. Ecotourism provides jobs for local residents, as well as provides recreation and aesthetics to visitors. A reserve should be large enough to support viable populations of endangered species. Many natural parks and preserves are increasingly isolated, remnant fragments of ecosystems. Stress the concepts of population density and the effects of fragmentation on population dynamics. Creating biological corridors where natural

habitat connects smaller habitat areas together is a solution when big preserves are not possible.

Common Mistakes and Misconceptions

Frequently students do not understand the concept of subsidies. Make sure you discuss this with students. In addition, be sure to explain that loss of biodiversity is not enough to answer a question. Students need to have supporting details. Students also do not easily understand how ecotourism and how jobs are linked. The AP exam often asks for an economic problem induced by a specific environmental action; ecotourism and jobs can answer that question, as long as the student links it specifically to money or revenue. Students should also avoid the term ‘fishermen’. Commercial vs recreational fisheries are very different in how they impact economics.

Activities

Learning Landscapes

The Bureau of Land Management (BLM) has an extensive catalogue of activities and information for classroom teachers. You can find these activities here: https://www.blm.gov/wo/st/en/res/Education_in_BLM/Learning_Landscapes/For_Teachers.html

Sustainability of Resources Activity

Obtain a copy of Jared Diamond’s “Easter Island’s End”. An Internet search will bring up many different websites that will have the article.

After reading the article, divide the class into groups of three having each group address the questions found in the worksheet provided at the end of this teacher manual’s chapter. After 10 minutes bring the class back together for a class discussion on what each smaller group decided.

Tragedy of the Commons Activity

Provide student groups with 10 goldfish crackers. Tell students that they will fish one at a time with straws. In order for students to survive each generation, they must consume at least 2 goldfish. Rules provided should be fairly limited. The goal is to simulate how society will exploit resources if not privately owned. Several rounds can be played so students can observe the changes in their behavior as they learn how to conserve resources for a common goal. An activity sheet has been provided at the end of this supplement.

As an extension, you can add red goldfish to provide a toxicology link. the red fish may contain mercury or another bioaccumulating toxin.

Habitat Fragmentation/Tree Harvesting Activity

As a follow-up to biodiversity and resources, the students can create their own habitat and illustrate clear-cutting and how habitat fragmentation can have a negative impact on the edges of an ecosystem.

To conduct the fragmenting of a habitat, provide a group of students with a small square of white board. Students will draw a line down the middle of the white board, measure, and record the size of each Habitat. Students place a large square in Habitat A and trace the square on the white board, then students will place 9 small squares in Habitat B and trace the square. Students should record the area of the clear cut represented by each squares, and record the new area of their habitat minus the clear cut. Once completed, then students should measure another 1 cm from the edge of each clear cut to represent the edge effect. Students can use dry-erase markers to shade in the areas affected by the edge effect. Students re-measure the area of their habitat. Students should recognize that multiple smaller cuts will have a greater effect on biodiversity of the habitat.

Questions for Review

1. How does preserving forest plant species help regulate the hydrologic cycle and provide clean drinking water?
The process of transpiration is part of the hydrologic cycle. Trees transpire and release water back into the atmosphere. When the water in the atmosphere condenses, precipitation occurs putting the water back into aquifers and reservoirs.
2. What are three benefits of subsidizing the logging industry? What is the environmental impact each has on the forest?
1) Jobs, 2) economic boost to the local economy, and 3) a plethora of products made from timber. The first two benefits, purely economic, would lead cause a population influx into an area with logging jobs. Therefore, all of the environmental issues that surround a higher population would be prevalent. Habitat alteration to make room for housing, and infrastructure would have a large impact. The third benefit would also lead to habitat alteration from cutting the forest down to make products from timber. In addition, this cutting, if done unsustainably could lead to soil erosion and other environmental problems.
3. How is GIS being used to protect forests?

Geographic Information Systems consists of spatial data, such as boundaries or road networks, and software to display and analyze data. GIS allows for powerful manipulation and measurement of variables that are hard to see on the ground—watershed boundaries, annual rainfall, landownership, or historical land use. This technique can be used to analyze areas and prioritize areas that need to be protected.

4. What is threatening the existence of temperate forests?

Logging in delicate areas surrounding old-growth forests, the construction of roads which fragment the habitat and provide a point of entry for hunters, recreational vehicles, and invasive species, climate change, insect infestations, drought, and wildfires,

5. What are the guiding principles that shape the U. S. Forest Service policies of ecosystem management?

The principles are 1) managing across whole landscapes, watersheds, or regions over ecological time scales, 2) considering human needs and promoting sustainable economic development and communities, 3) maintaining biological diversity and essential ecosystem processes, 4) utilizing cooperative institutional arrangements, 5) generating meaningful stakeholder and public involvement and facilitating collective decision making, and 6) adapting management over time, based on conscious experimentation and routine monitoring

6. How does desertification occur?

When grazing lands, particularly in arid climates, are abused by overgrazing they become compacted. When it rains, it runs off quickly before it can soak into the soil to nourish plants or replenish groundwater. Springs and wells dry up. Seeds can't germinate in the dry, overheated soil. The barren ground reflects more of the sun's heat, changing wind patterns, driving away moisture-laden clouds, and leading to further desiccation. The land becomes barren and desert like.

7. What is the rationale behind rotational grazing?

Letting the animals graze for only a few days simulates the effects of wild herds and allows for the return of nutrients to the soil from the manure.

8. What is the premise for ecotourism?

In developing countries their biological resources may be their most valuable assets, and that preserving those resources is vital for sustainable development. Ecotourism is both ecologically and socially sustainable.

Practice Questions

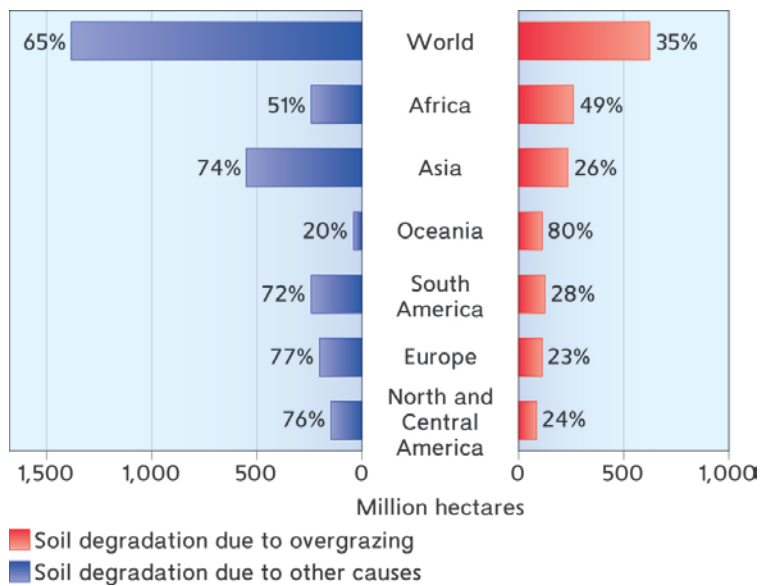
Multiple Choice:

Directions for questions 1-5: The lettered choices below correspond to the descriptions given in questions 1-5. Select the one lettered choice that best fits each statement. Each choice may be used once, more than once, or not at all.

- (A) desertification
- (B) overgrazing
- (C) deforestation
- (D) ecotourism
- (E) rotational grazing

1. much of the rangeland in the U.S. is subjected to this Tragedy of the Commons
2. clearing of land by subsistence farmers
3. benefits both humans and environment
4. a process exacerbated by arid climate
5. promotes healthier pastures
6. In temperate forests insect infestations are most likely a result of _____.
 - (A) clear cutting
 - (B) climate change
 - (C) wildfires
 - (D) selective cutting
 - (E) poor forestry practice
7. Criteria for sustainable forestry include all of the following except _____.
 - (A) conservation of biodiversity
 - (B) maintain soil and water resources
 - (C) maintain forest contribution to global carbon cycle
 - (D) clear cutting practices to provide timber for a growing population
 - (E) maintain productive capacity of forest ecosystems

Use the following graph for questions 8-10.



8. How many million hectares of soil are degraded worldwide?
 - (A) 3000
 - (B) 2500
 - (C) 500
 - (D) 1000
 - (E) 2000

9. In which continent(s) are the causes of soil degradation due to overgrazing equal to causes of soil degradation due to other causes?
 - (A) South America
 - (B) North and Central America
 - (C) Africa
 - (D) Asia
 - (E) Oceania

10. The two continents with the highest amount of soil degradation due to overgrazing are Africa and Oceania. What physical geographic features do they have in common?
 - (A) Desert and semiarid scrub make up most of the grazing land
 - (B) Both have extensive mountainous regions used for grazing
 - (C) Taiga biomes dominate the landscape
 - (D) Both continents have tropical moist land used for grazing
 - (E) The inhabitants of the continents are nomadic in nature

Free-Response Question:

Directions: Answer all parts of the following question. Where explanation or discussion is required, support your answers with relevant information and/or specific examples. When a calculation is required, be sure to show how you arrived at your answer.

1. The Bureau of Land Management (BLM) oversees western rangeland. Answer the following questions pertaining to rangeland.
 - (a) Identify and describe TWO environmental costs of grazing on western rangeland.
 - (b) Why is the BLM land a commons?
 - (c) Identify and describe TWO remedies to degradation of the rangeland.
 - (d) Describe one characteristic of the land that would make it more susceptible to soil degradation.

Answers to Practice Questions

Multiple Choice:

1. B
2. C
3. D
4. A
5. E
6. B
7. D
8. E
9. C
10. A

Free-Response Question:

This question is based on 10 points.

1. (a) 4 points total. One point for each identification and one point each for the description.

Identification	Description
Soil erosion	Overgrazing results in compaction of soil, loss of native plants, thereby reducing the ability of the roots of plants to hold the soil in place
Overgrazing	Too many cattle in too small of place or on marginal land
Desertification	Semiarid land that is subjected to overgrazing, thereby reducing vegetation, compacting soil, producing desert like land

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- (b) 1 point for correctly stating that the land is open to all for grazing, shared by the public.

- (c) 4 points total. One point for each identification and one point for each description.

Identification	Description
Rotational grazing	Only allowing grazing for a few days and then moving to another pasture
Set up fenced areas that need to recover from overgrazing	This will allow an area to be restored to prairie

- (d) 1 point total for correctly naming a characteristic of the land. Characteristics include: marginal land with scrub plants, semiarid land, and drought stricken land with compacted soil.

Answers to questions in the Student Edition:

Case Study AP Document-Based Question (p. 250)

- (A) One way of managing a rainforest is to only use existing degraded land for plantation or crop expansion while leaving currently forested, or recently deforested lands alone. Another method is a debt-for-nature or aid-for-nature swap where poorer countries accept debt forgiveness or aid from richer countries in exchange for working toward reduced deforestation, replanting trees, or otherwise restoring or protecting areas of biological importance.
- (B) A monoculture of trees is not as ecologically valuable as a primary forest because it does not provide the ecosystem services that a primary forest does. A planted monoculture of palm trees cannot support other animals like a primary forest does, so it does not act like the base of the ecosystem in the same way. A planted monoculture does not have the biodiversity that a primary forest does. It does not have the range of ages and sizes like a natural forest, so monocultures of palm forests do not have the structure and complexity of natural forests. Destroying primary forests also releases carbon emissions.

Use the Math (p. 254)

Figure 12.8 shows amount of standing forest in blue and change (increase or decrease) in red. The approximate percentage of world forests lost from 2000-2005 is -0.9%. Area lost (in millions of ha) can be calculated by multiplying amount of forest by percentage change: for example, Africa changed by about -0.05 percent (or -0.005) of 650 million ha = -3.25 million ha. Together the regions multiply as follows:

percentage change (rounded to nearest 0.1 percent)	total area (million ha)	area change (million ha)
-0.5	650	-3.25
0.4	600	2.4
0.1	1000	1
0	700	0
-0.5	850	-4.25
-0.4	200	-0.8

The sum of area change is -4.9 million ha. Reported increases in Asia and Europe result from reforestation efforts. Dividing -4.9 million ha by 5 years is 980,000 ha/year.

Use the Math (p. 264)

Terrestrial protected areas reached the current size of marine protected areas around 1991. In 2001, the average approximate size of a protected terrestrial area was 120 km² (around 15 million km²/125,000 terrestrial sites).

AP Connections Review Answers (pages 272-273)**Multiple-Choice Questions**

1. a. Most tropical forests are not subject to acid deposition whereas they typically are logged for timber, have mineral and oil extraction, and are used for agriculture and ranching.
2. d. Rotational grazing, moving the animals around, would help reduce environmental degradation. The grazing of multiple species would help by reducing all plant species equally.
3. d. National parks are not used for rangeland, because they are protected areas in the United States.
4. a. Boreal forests have a tremendous amount of protection compared to marine ecosystems, grasslands, and chaparral, or tropical rain forests.
5. e. Increased sunlight can allow native conifers to grow, eventually returning the ecosystem into a more natural state. Problems with monocultures include increased pests and disease, and decreased biodiversity. Monocultures can also interfere with the water cycle, resulting in more erosion and flooding as waters are not held in place by shade-loving understory growth.

6. d. A stable water cycle is an ecological benefit. The other benefits are aesthetic or utilitarian.
7. c. Overgrazing can lead to desertification of marginal lands, decreased riparian vegetation, sod, and topsoil, and increased erosion and soil compaction.
8. b. Prescribed burns can benefit a forested area by removing pest species. Snags and nutrients are beneficial and it is not the goal of the USFS to remove these. USFS would also not want to clear forested area for agriculture. Erosion may increase over the short term, before successional plants begin to establish themselves again.

Data Analysis & Free-Response Questions

1a The Condorito site has the greatest biodiversity.

1b Mean on-trail index = approximately 0.6167. Mean off-trail index = approximately 1.095. The off-trail sites are more diverse than those on-trail. If humans feed wild animals or leave trash behind, the on-trail biodiversity may appear higher (more diverse) as animals are attracted to the trail. If humans wander off-trail and disturb habitat, biodiversity may be lower (less diverse) than it would be otherwise off-trail.

2a Fire can increase nutrients in the soil and increase sunlight, encouraging new plant growth. Fire can also remove pests and disease.

2b Biodiversity in the newly-burned area would be low immediately after a fire. Then it would quickly be colonized by many plants that take advantage of the new influx of nutrients and light. Competition between plant species would ensue until the more competitive species begin to dominate the area. Eventually, the biodiversity in the newly-burned area would meet or exceed the biodiversity present before the fire.

Sustainability of Resources Activity Worksheet

Student: _____

1. Identify as many examples as possible from the article as to why the island suffered such severe deforestation.
2. What incentives did the individual clans have for destroying the forest?
3. How is this an example of the “tragedy of the commons”?
4. In the end of the article, Jared Diamond parallels Easter Island to Earth. Discuss how this comparison is both alarming and cause for hope.
5. Given their resources, promote a solution as to what the clans could have done differently to preserve the forest.

Environmental Music Activity Worksheet

Student: _____

1. How do the lyrics connect to the topic of biodiversity?

2. When did this song first hit the music charts?

3. What two environmental issues are contained in the lyrics of the song?

4. Why do you think these topics were part of a song? Is there any historical event that would have been inspiration for the song?

5. Challenge: Find an “environmental” song. Share the lyrics with the class. Make a similar worksheet for class discussion. Be sure to have the responses for all questions.