AP Environmental Science Ch. 10

**Sustaining Terrestrial Biodiversity: Saving Ecosystems and Ecosystem Services**

Core Case Study: Costa Rica – A Global Conservation Leader

* Suffered widespread deforestation
* Still harbors great biodiversity
	+ Microclimates provide variety of habitats
	+ More than 25% of its land is nature reserves and national parks
* Government pays landowners to restore forests

10-1 What Are the Major Threats to Forest Ecosystems?

* Forest ecosystems provide ecosystem services far greater in value than the value of raw materials obtained from forests
* Chief threats to forest ecosystems
	+ Unsustainable cutting and burning of forests
	+ Diseases and insects
* Projected climate change

Forests Vary in Their Age, Make-Up, and Origins

* Old-growth or primary forest (about 36%)
	+ Uncut not disturbed for several hundred years
	+ Reservoirs of biodiversity
* Second-growth forest
	+ Secondary ecological succession
* Tree plantation (tree farm, commercial forest)
	+ May supply most industrial wood in the future

Forests Provide Important Economic and Ecosystem Services

* Store atmospheric carbon
* Provide habitats
* Influence local and regional climate
* Provide raw materials
* Provide health benefits
	+ Medicines derived from plant species

There Are Several Ways to Harvest Trees

* One of the world’s largest industries
* Selective cutting
	+ Intermediate-age or mature trees are cut singly or in small groups
* Clear-cutting
	+ All trees in an area are removed
* Strip cutting
* Clear-cutting in strips

Fire, Insects, and Climate Change Can Threaten Forest Ecosystems

* Surface fires
	+ Usually burn leaf litter and undergrowth
	+ Provide many ecological benefits
* Crown fires
	+ Extremely hot – burns whole trees
	+ Kill wildlife
	+ Increase soil erosion
* Introduction of foreign diseases and insects
	+ Accidental or deliberate
* Global warming
	+ Rising temperatures
	+ Trees more susceptible to diseases and pests
	+ Drier forests – more fires
	+ More greenhouse gases

Almost Half of the World’s Forests Have Been Cut Down

* Deforestation
	+ Temporary or permanent removal of large expanses of forest for agriculture, settlements, or other uses
	+ Tropical forests
		- Especially in Latin America, Indonesia, and Africa
	+ Boreal forests
		- Especially in Alaska, Canada, Scandinavia, and Russia
* Encouraging news
	+ Recent increases in forest cover
	+ Due to:
		- Reforestation of cleared areas and abandoned croplands
		- Tree plantations

Case Study: Many Cleared Forests in the United States Have Grown Back

* Forests of the eastern United States decimated between 1620 and 1920
* Grown back naturally through secondary ecological succession in the eastern states
* Biologically simplified tree plantations
	+ Reduce biodiversity and deplete nutrients from soil

Tropical Forests are Disappearing Rapidly

* Majority of loss since 1950
	+ Mostly in Africa, Southeast Asia, South America
	+ Clearing trees can accelerate climate change
* Drier climate
	+ Risk of larger and more frequent forest fires
* Ecological tipping point
	+ Forest cannot grow back

Causes of Tropical Deforestation Are Varied and Complex

* Various causes
	+ Population growth
	+ Poverty of subsistence farmers
	+ Ranching
	+ Lumber
	+ Plantation farms – palm oil
* Begins with building of roads
* Many forests burned

10-2 How Should We Manage and Sustain Forests?

* We can sustain forests by:
	+ Emphasizing the economic value of their ecosystem services
	+ Removing government subsidies that hasten their destruction
	+ Protecting old-growth forests
	+ Harvesting trees no faster than they are replenished
* Planting trees

We Can Manage Forests More Sustainably

* Certify sustainably produced forest products
* Use more sustainable logging practices in tropical forests
* Phase out government subsidies

We Can Improve the Management of Forest Fires

* The U.S. Smokey Bear educational campaign
	+ What are the pros and cons?
* Prescribed fires
	+ Remove flammable material
* Allow fires on public lands to burn
* Protect structures in fire-prone areas
	+ Thin trees and vegetation within 60m of a structure
* Thin forests in fire-prone areas
	+ Clear away small trees and underbrush

We Can Reduce the Demand for Harvested Trees

* Improve the efficiency of wood use
	+ 60% of U.S. wood use is wasted
* Make tree-free paper
	+ Kenaf
* Hemp

Case Study: Deforestation and the Fuelwood Crisis

* How is Haiti an example of an ecological disaster?
* Possible solutions
	+ Establish small plantations of fast-growing fuelwood trees and shrubs
	+ Burn wood more efficiently
	+ Solar or wind-generated electricity
* Burn garden waste

There Are Several Ways to Reduce Tropical Deforestation

* Debt-for-nature swaps/conservation concessions
	+ Protect forests in return for aid
* Crack down on logging
* End subsidies
* Plant trees

10-3 How Should We Manage and Sustain Grasslands?

* We can sustain the productivity of grasslands by:
	+ Controlling the numbers and distribution of grazing livestock
* Restoring degraded grasslands

Some Rangelands Are Overgrazed

* Rangelands
	+ Unfenced grasslands in temperate and tropical climates that provide forage for animals
* Pastures
	+ Managed grasslands and fences meadows used for grazing livestock
* Overgrazing of rangelands
	+ Reduces grass cover
	+ Leads to erosion of soil by water and wind
	+ Soil becomes compacted
	+ Enhances invasion of plant species that cattle won’t eat

We Can Manage Rangelands More Sustainably

* Rotational grazing
	+ Cattle moved around
* Fence damaged areas
* Suppress growth of unwanted plants
	+ Herbicides
	+ Controlled burning

Case Study: Grazing and Urban Development in the American West

* American southwest population surge since 1980
* Land trust groups – conservation easements
* Reduce the harmful environmental impact of herds
	+ Operate ranch more economically and sustainably

10-4 How Should We Manage and Sustain Parks and Natural Reserves?

* Sustaining biodiversity will require:
	+ More effective protection of existing parks and nature reserves
	+ The protection of much more of the earth’s remaining undisturbed land area

National Parks Face Many Environmental Threats

* Worldwide – 6600 national parks
* Parks in developing countries
	+ Greatest biodiversity
	+ 1% protected against illegal:
		- Animal poaching
		- Logging and mining

Case Study: Stresses on U.S. Public Parks

* There are 58 major national parks in the U.S.
* The biggest problem may be popularity
* Other problems include:
	+ Nonnative species
	+ Poaching
	+ Commercial development
	+ Park maintenance

Nature Reserves Occupy Only a Small Part of the Earth’s Land

* Currently less than 13% is protected
* Conservationists’ goal – protect 20%
* Size and design of protected area is important
	+ Buffer zone
* Habitat corridor

Case Study: Identifying and Protecting Biodiversity in Costa Rica

* Megareserves – large conservation areas
	+ Designed to sustain about 80% of the country’s biodiversity
* Large eco-tourism industry

Protecting Wilderness Is an Important Way to Preserve Biodiversity

* Wilderness
	+ Land officially designated as having no serious disturbance from human activities
	+ Wilderness Act of 1964
* 5% of U.S. land protected as wilderness
* Why is wilderness protection being eroded today?

10-5 What is the Ecosystem Approach to Sustaining Terrestrial Biodiversity?

* We can help to sustain terrestrial biodiversity by:
	+ Identifying and protecting severely threatened areas (biodiversity hotspots), sustaining ecosystem services
	+ Restoring damaged ecosystems (using restoration ecology)
* Sharing with other species much of the land we dominate (using reconciliation ecology

The Ecosystems Approach: A Five-Point Strategy

* Map global ecosystems and identify species
* Identify resilient and fragile ecosystems
* Protect the most endangered
* Restore as many degraded ecosystems as possible
* Make development biodiversity friendly

Protecting Global Biodiversity Hot Spots Is an Urgent Priority

* 34 biodiversity hot spots are rich in plant species
	+ 2% of earth’s surface, but 50% of flowering plant species and 42% of terrestrial vertebrates
	+ 1.2 billion people

Case Study: Madagascar: An Endangered Center of Biodiversity

* The world’s fourth largest island
* Roughly 90% of the species found there are unique
* Severe habitat loss
* Population growth
* Less than 3% of the land area is officially protected

Protecting Ecosystem Services Is Also an Urgent Priority

* 2005 U.N. Millennium Ecosystem Assessment
	+ Identify key ecosystem services
	+ Human activities degrade or overuse 60% of the earth’s natural services
* Identify highly stressed life raft ecosystems
	+ Residents, public officials, and conservation scientists would work together

We Can Rehabilitate and Partially Restore Ecosystems That We Have Damaged

* Ecological restoration
	+ Repairing damage
	+ Succession processes
		- Restoration
		- Rehabilitation
		- Replacement
		- Creating artificial ecosystems
* Carrying out rehabilitation
	+ Identify what caused the degradation
	+ Stop the abuse
	+ Reintroduce species, if possible
	+ Protect from further degradation

We Can Share Areas We Dominate With Other Species

* Reconciliation ecology
	+ Invent and maintain habitats for species diversity where people live, work, and play
* Community-based conservation
	+ Protect vital insect pollinators

Three Big Ideas

* The economic values of the important ecological services provided by the world’s ecosystems are far greater than the value of the raw materials obtained from those systems
* We can manage forests, grasslands, and nature reserves more effectively by:
	+ Protecting more land
	+ Preventing overuse and degradation of these areas and the renewable resources they contain
* We can sustain terrestrial biodiversity and ecosystem services by:
	+ Protecting biodiversity hotspots and ecosystem services
	+ Restoring damaged ecosystems
	+ Sharing with other species much of the land we dominate

Tying It All Together: Sustaining Costa Rica’s Biodiversity

* Costa Rica protects a larger portion of its land than any other country
* Principles of biodiversity
	+ Respect biodiversity and understand the value of sustaining it
	+ Place an economic value on ecosystem services
	+ Encourage people to work together