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