10
Sustaining Terrestrial Biodiversity: Saving Ecosystems and Ecosystem Services
• 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
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
Seedlings planted

5 yrs

10 yrs

Years of growth

15 yrs

Clear cut

25 yrs

Weak trees removed

30 yrs
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
### Natural Capital

**Forests**

<table>
<thead>
<tr>
<th>Ecological Services</th>
<th>Economic Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support energy flow and chemical cycling</td>
<td>Fuelwood</td>
</tr>
<tr>
<td>Reduce soil erosion</td>
<td>Lumber</td>
</tr>
<tr>
<td>Absorb and release water</td>
<td>Pulp to make paper</td>
</tr>
<tr>
<td>Purify water and air</td>
<td>Mining</td>
</tr>
<tr>
<td>Influence local and regional climate</td>
<td>Livestock grazing</td>
</tr>
<tr>
<td>Store atmospheric carbon</td>
<td>Recreation</td>
</tr>
<tr>
<td>Provide numerous wildlife habitats</td>
<td>Jobs</td>
</tr>
</tbody>
</table>

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Fig. 10-4, p. 220
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
New highway

Old growth

Cleared plots for agriculture

Cleared plots for grazing

Highway

Fig. 10-5, p. 221
(a) Selective cutting

(b) Clear-cutting

(c) Strip cutting

Fig. 10-6, p. 222

Stepped Art

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Trade-Offs

Clear-Cutting Forests

Advantages

- Higher timber yields
- Maximum profits in shortest time
- Can reforest with fast-growing trees

Disadvantages

- Reduces biodiversity
- Destroys and fragments wildlife habitats
- Can lead to water pollution, flooding, and erosion, especially on steep slopes

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Fig. 10-8, p. 222
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
Natural Capital Degradation

Deforestation

- Water pollution and soil degradation from erosion
- Acceleration of flooding
- Local extinction of specialist species
- Habitat loss for native and migrating species
- Release of CO₂ and loss of CO₂ absorption
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
• 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 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
Solutions: Fast-Growing Plant: Kenaf
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
Solutions

Sustaining Tropical Forests

Prevention

Protect the most diverse and endangered areas

Educate settlers about sustainable agriculture and forestry

Subsidize only sustainable forest use

Protect forests through debt-for-nature swaps and conservation concessions

Certify sustainably grown timber

Reduce poverty and slow population growth

Restoration

Encourage regrowth through secondary succession

Rehabilitate degraded areas

Concentrate farming and ranching in already-cleared areas

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
Some Rangelands are Overgrazed (cont’d.)

• 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
Fig. 10-23, p. 232

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?
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
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
We Can Rehabilitate and Partially Restore Ecosystems That We HaveDamaged

• Ecological restoration
  – Repairing damage
  – Succession processes
    • Restoration
    • Rehabilitation
    • Replacement
    • Creating artificial ecosystems
We Can Rehabilitate and Partially Restore Ecosystems (cont’d.)

• Carrying out rehabilitation
  – Identify what caused the degradation
  – Stop the abuse
  – Reintroduce species, if possible
  – Protect from further degradation