

# **Sustaining Terrestrial Biodiversity: The Ecosystem Approach**

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## **Chapter 10**

# Core Case Study: Reintroducing Gray Wolves to Yellowstone

- Around 1800:
    - 350,000 gray wolves
  - 1850–1900: decline due to human activity
    - Most shot, trapped or poisoned
  - U.S. Endangered Species Act: 1973
    - Only a few hundred wolves left in 48 states
  - 1995–1996: relocation of gray wolves to Yellowstone Park to increase biodiversity and balance
    - Population exceeded carrying capacity
  - 2008: Gray wolf no longer protected
    - Removed from ESA list
-

# Natural Capital Restoration: the Gray Wolf



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

- **Concept 10-1A** *Forest ecosystems provide ecological services far greater in value than the value of raw materials obtained from forests.*
  - **Concept 10-1B** *Unsustainable cutting and burning of forests, along with diseases and insects, are the chief threats to forest ecosystems.*
-

# ***10-1 What Are the Major Threats to Forest Ecosystems? (2)***

- **Concept 10-1C** *Tropical deforestation is a potentially catastrophic problem because of the vital ecological services at risk, the high rate of tropical deforestation, and its growing contribution to global warming.*
-

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

- **Natural and planted forests = 30% of the Earth's surface.**
  - **Tropical Rainforests = 6%**
  - **Old-growth or primary forest**
    - 36% of world's forests
  - **Second-growth forest**
    - 60% of world's forests
  - **Tree plantation, tree farm or commercial forest**
    - 4% of world's forests
      - May supply most of the industrial wood in the future
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# Natural Capital: An Old-Growth Forest and an Old-Growth Tropical Forest



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# Forest Managers and ecologists classify forests into 2 major types

## Old - Growth

- Have not been seriously disturbed by human activity/natural disasters for hundreds of years
- Huge storehouses of biodiversity (niches!)



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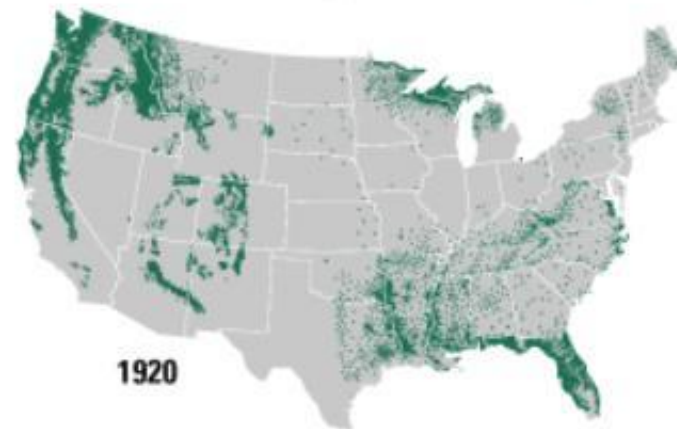
## Second-Growth

- Develop after humans or natural activities remove them



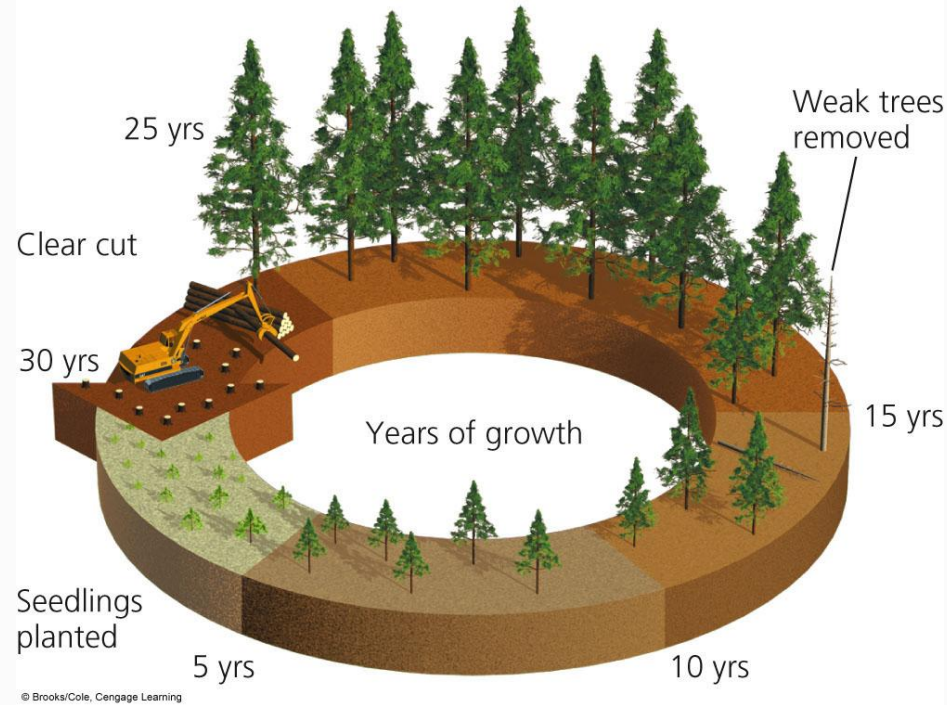


Approximate location  
of Virgin Old-Growth  
Forest in 1620, 1850,  
and 1920

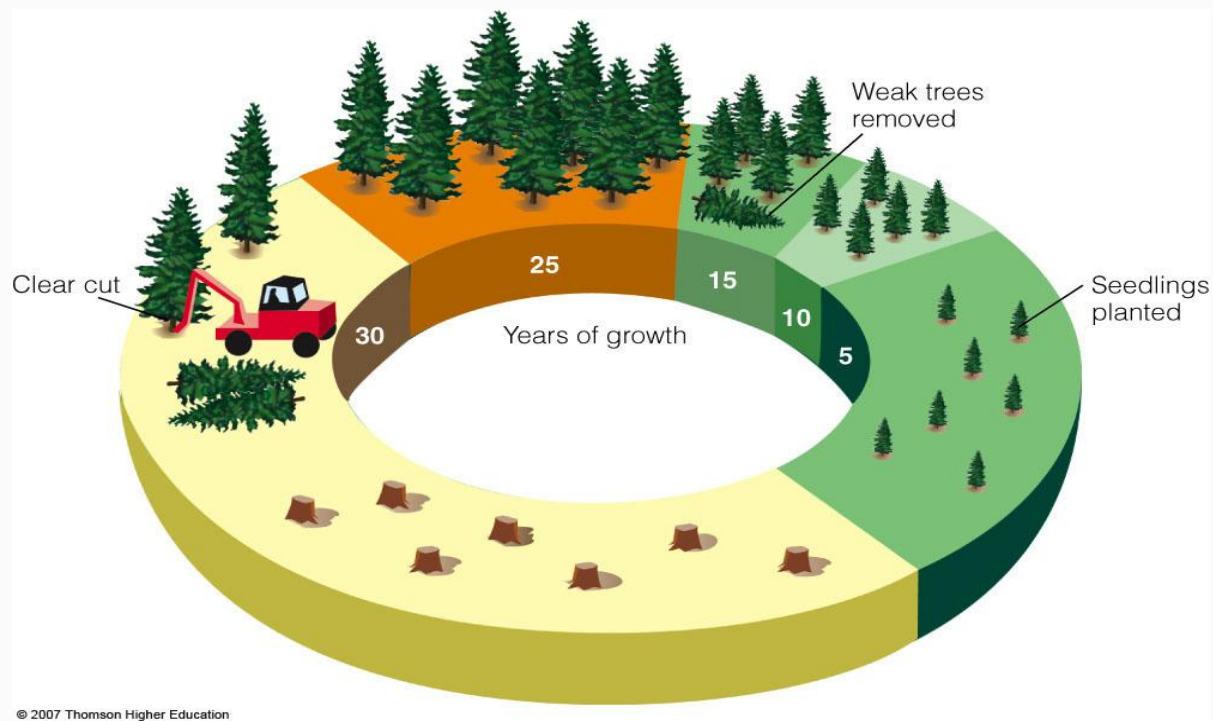


Meyer, 1995

# Rotation Cycle of Cutting and Regrowth of a Monoculture Tree Plantation



# Tree Farms – managed tract with uniformly aged trees of one species – harvested as soon as they become commercially viable



- **Second-growth forest:** a stand of trees resulting from natural secondary succession.
- **Tree plantation:** planted stands of a particular tree species.

# Tree plantations (commercial tree farms)

- A managed tract with uniformly aged trees of one species – harvested as soon as they become commercially viable.
  - Trees are replanted again in a regular cycle
  - 5% of world's forests = 20% world's commercial wood
  - **Repeated cycles**
    - Decreased soil fertility
    - Accelerated flooding
    - Increased runoff of eroded soil into aquatic systems
-

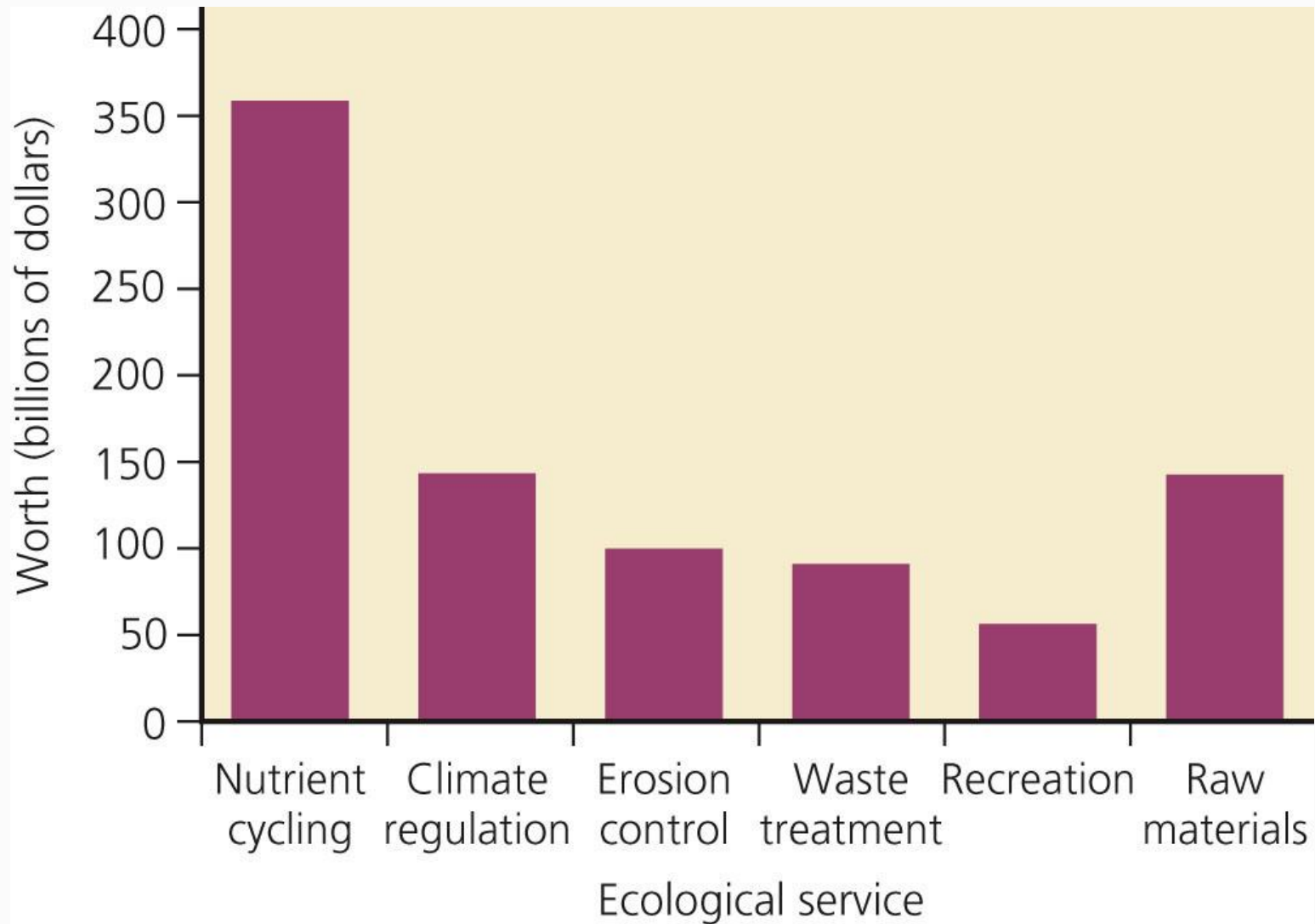
# Forests Provide Important Economic and Ecological Services (1)

- Support energy flow and chemical cycling
  - Reduce soil erosion
  - Absorb and release water
  - Purify water and air
  - Influence local and regional climate
  - Store atmospheric carbon
  - Habitats
-

# Forests Provide Important Economic and Ecological Services (2)

- Wood for fuel
  - Lumber
  - Pulp to make paper
  - Mining
  - Livestock grazing
  - Recreation
  - Employment
    - total services value \$4.7 Trillion per year
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# Estimated Annual Global Economic Values of Ecological Services Provided by Forests



# Unsustainable Logging is a Major Threat to Forest Ecosystems (1)

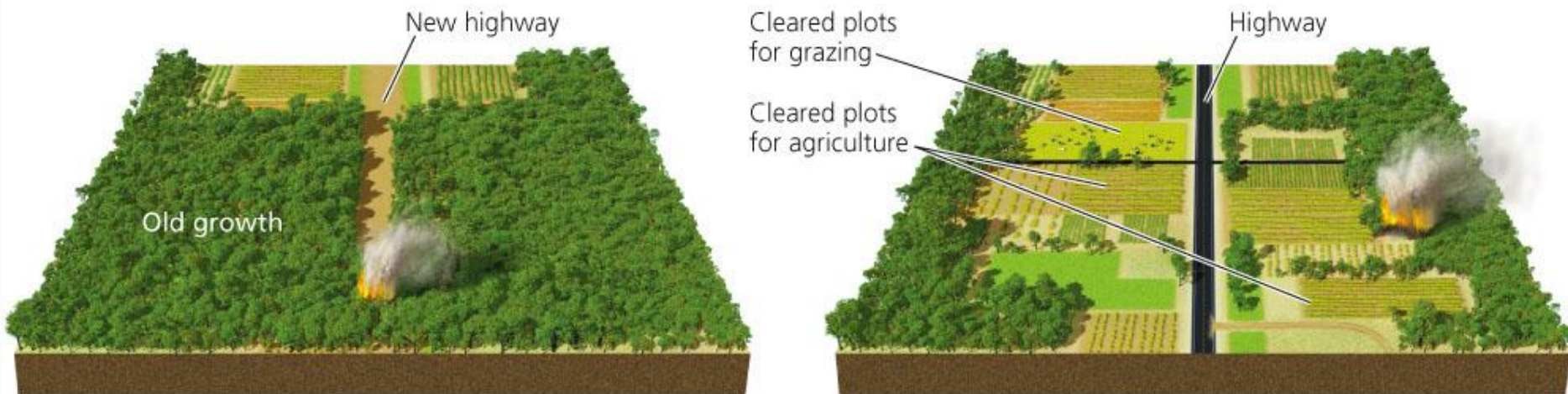
- Increased erosion
  - Sediment runoff into waterways
  - Habitat fragmentation
  - Loss of biodiversity
-



# Unsustainable Logging is a Major Threat to Forest Ecosystems (2)

- Invasion by
    - Nonnative pests
    - Disease
    - Wildlife species
  - Major tree harvesting methods:
    - **Selective cutting**
    - **Clear-cutting**
    - **Strip cutting**
-

# Natural Capital Degradation: Building Roads into Previously Inaccessible Forests

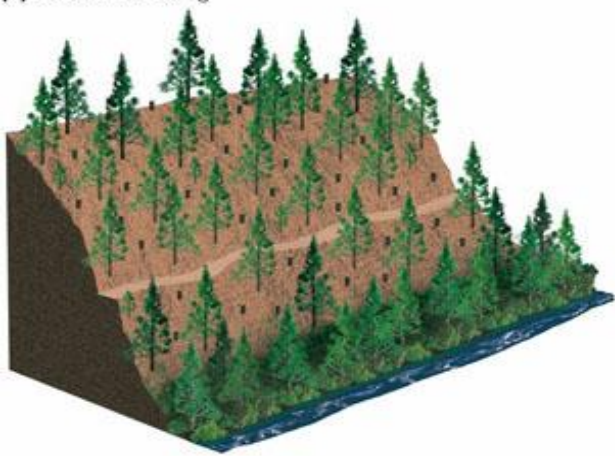


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# What's the harm of building roads?

- Increases erosion and sediment runoff into waterways
- Habitat fragmentation
- Loss of biodiversity
- Opens area to farmers, miners, ranchers, hunters and off road vehicles to forest degradation

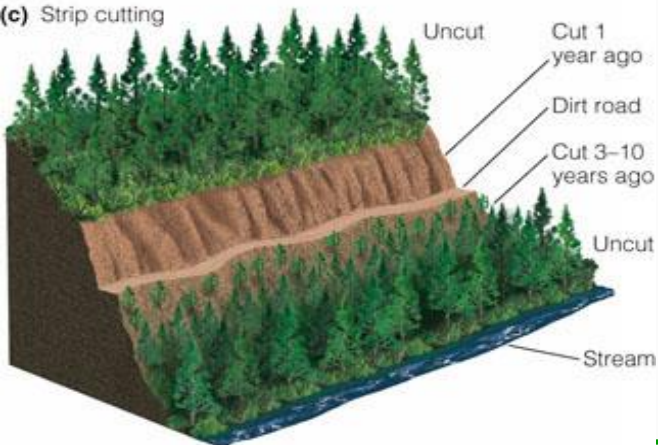




(b) Clear-cutting



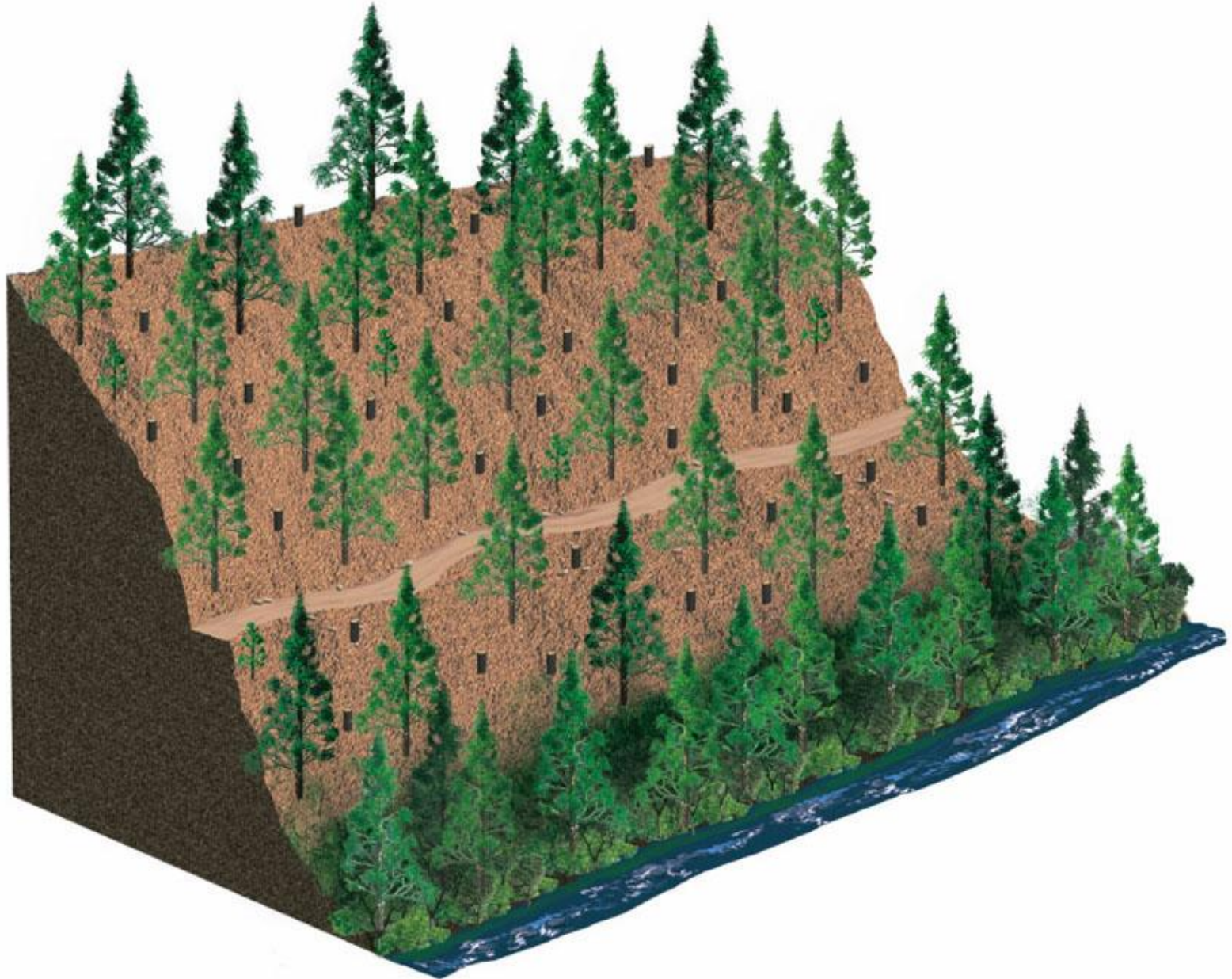
(c) Strip cutting



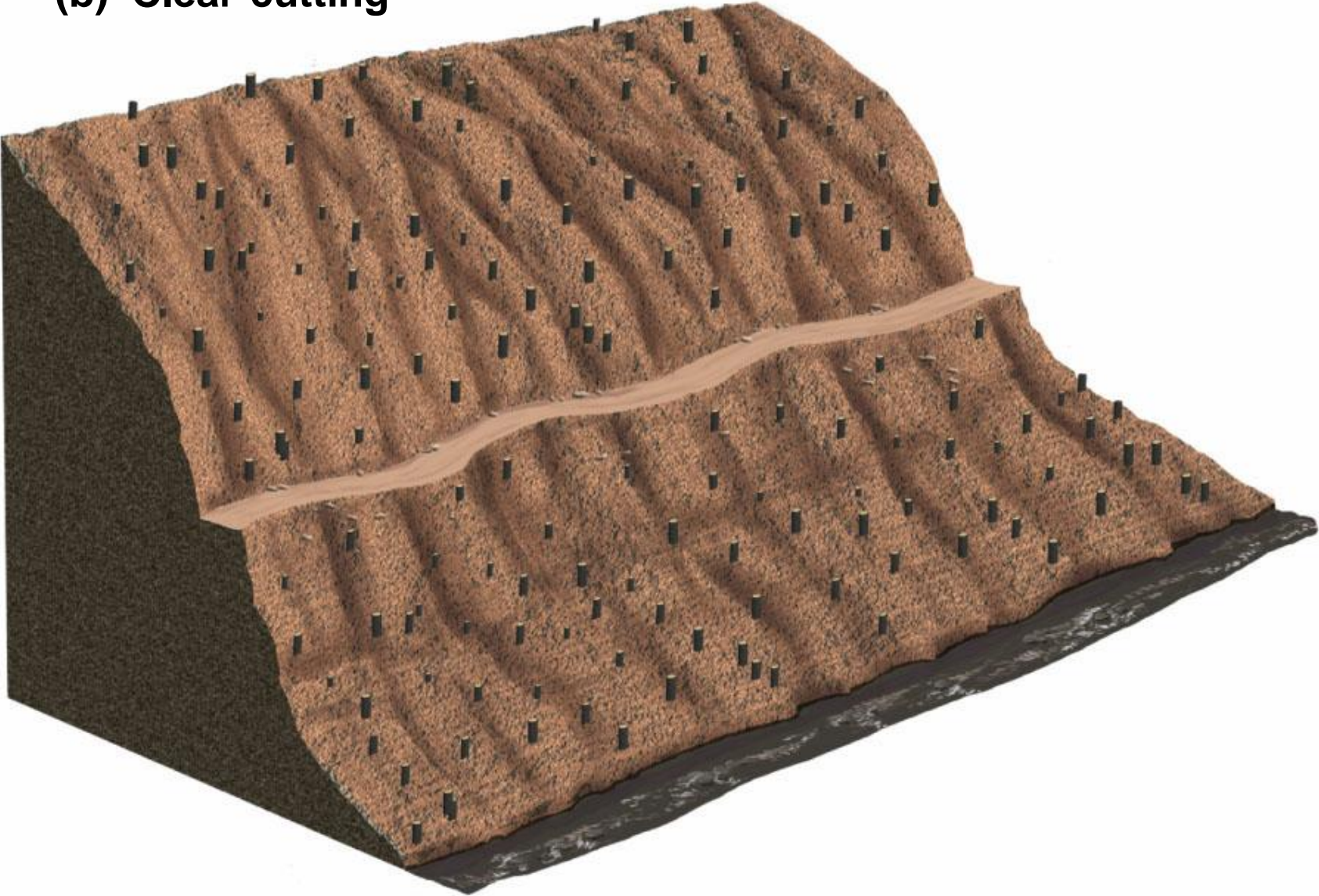
# Harvesting Trees

- Trees can be harvested individually from diverse forests (selective cutting), an entire forest can be cut down (clear cutting), or portions of the forest is harvested (e.g. strip cutting).

# (a) Selective cutting



**(b) Clear-cutting**



### (c) Strip cutting

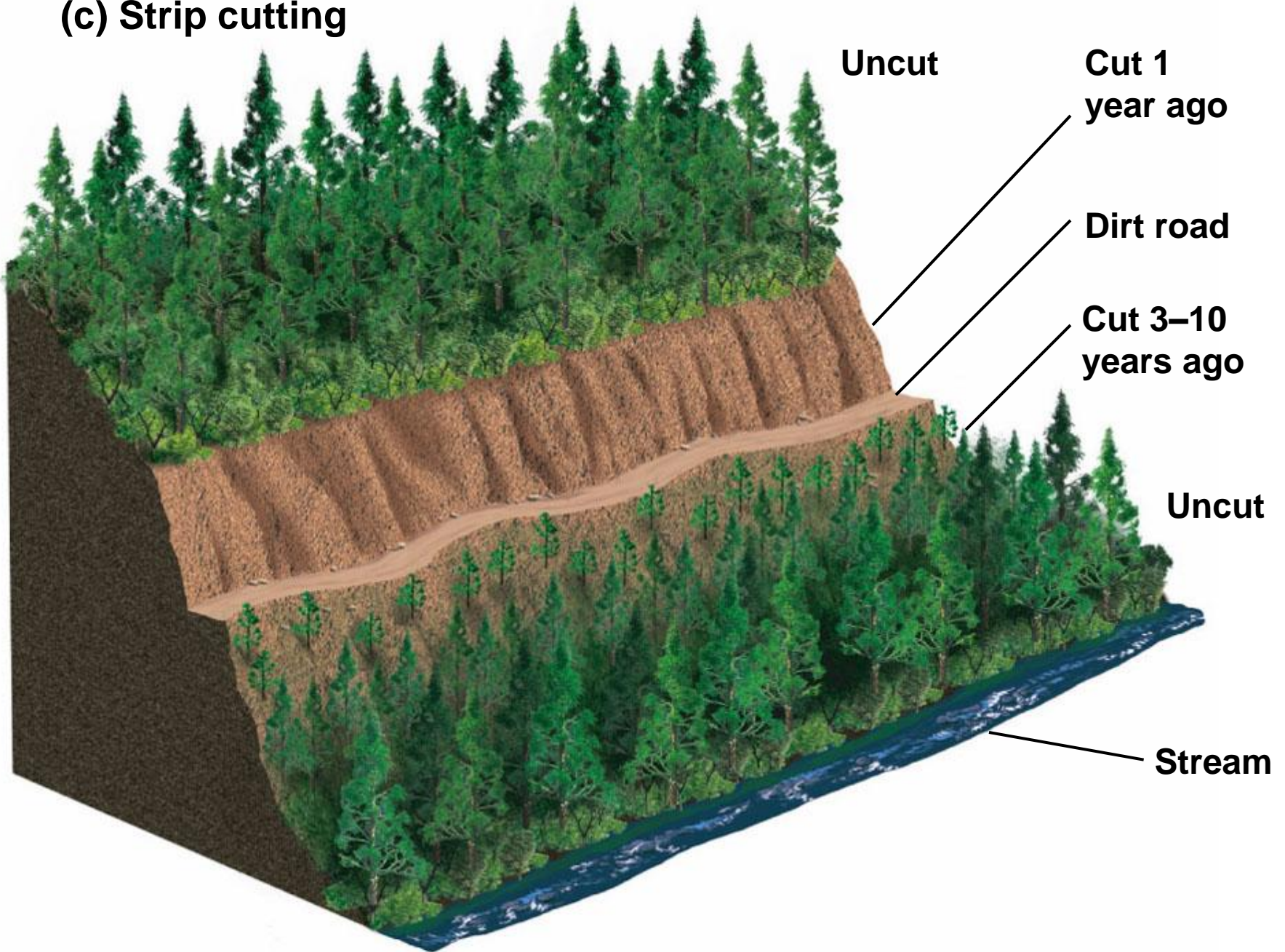
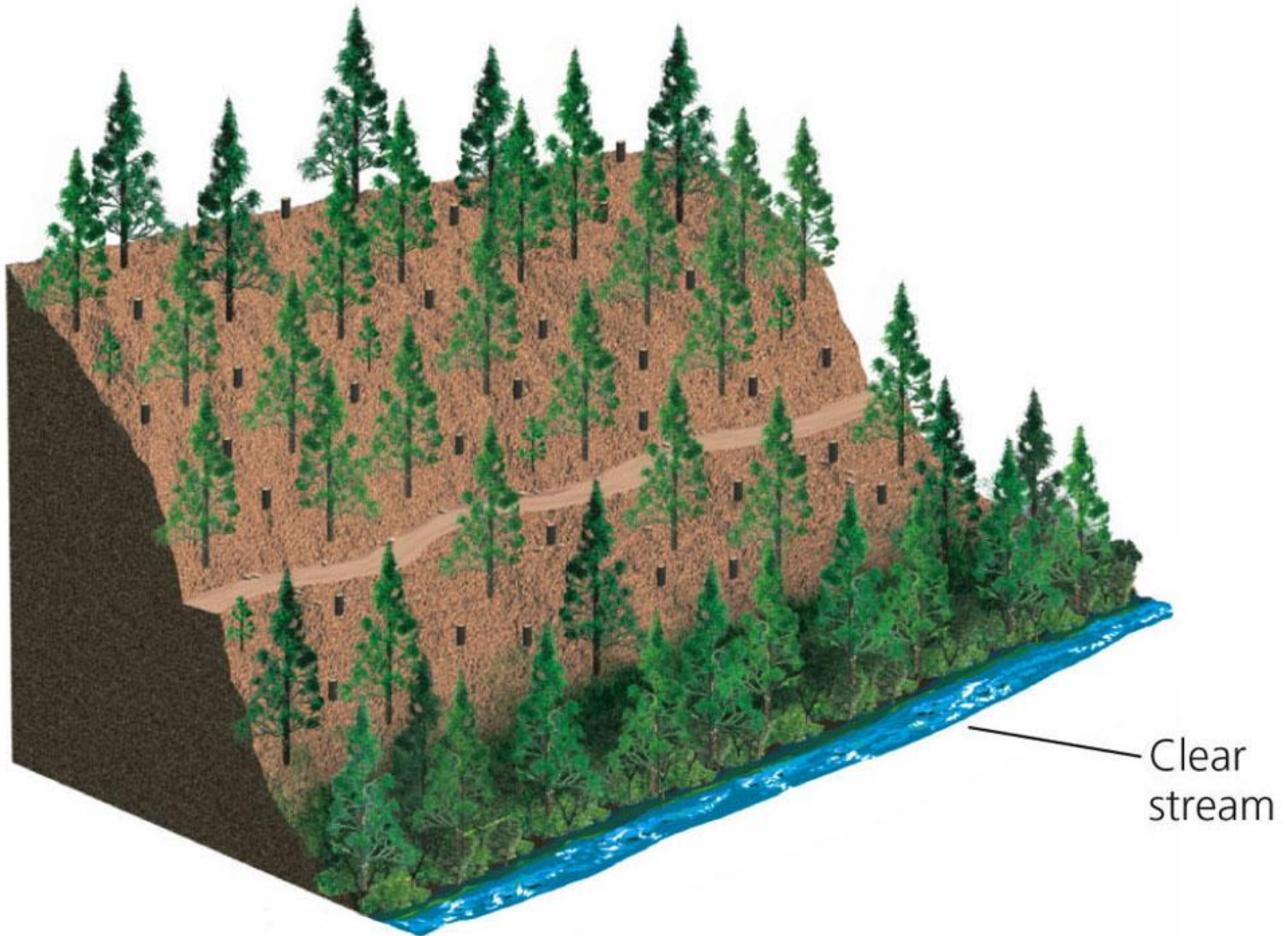


Fig. 10-9c, p. 198

**(a)** Selective cutting



Clear  
stream

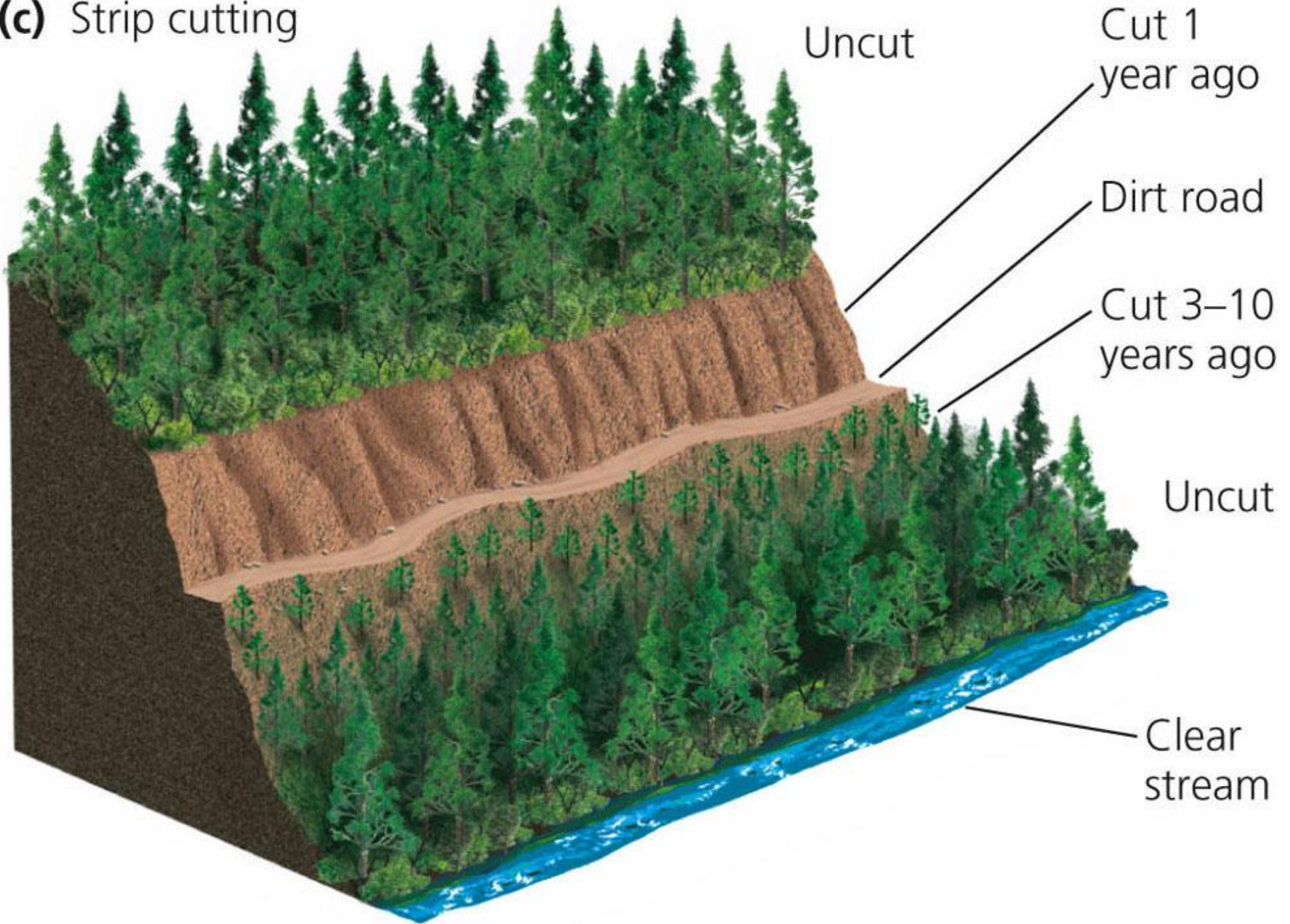


**(b)** Clear-cutting



Muddy stream

**(c)** Strip cutting



# Clear-Cut Logging in Washington State, U.S.



# TRADE-OFFS

## Clear-Cutting Forests

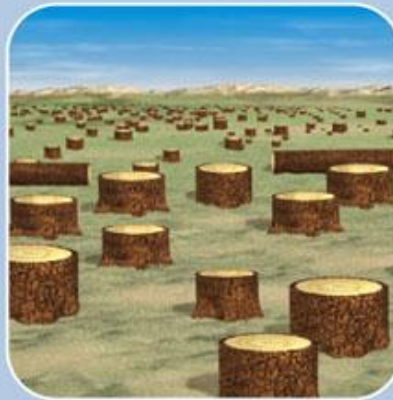
### Advantages

**Higher timber yields**

**Maximum profits in shortest time**

**Can reforest with fast-growing trees**

**Good for tree species needing full or moderate sunlight**



### Disadvantages

**Reduces biodiversity**

**Destroys and fragments wildlife habitats**

**Increases water pollution, flooding, and erosion on steep slopes**

**Eliminates most recreational value**

# Fire, Insects, and Climate Change Can Threaten Forest Ecosystems (1)

## ■ **Surface fires**

- Usually burn leaf litter and undergrowth
- May provide food in the form of vegetation that sprouts after fire

## ■ **Crown fires**

- Extremely hot: burns whole trees
  - Kill wildlife
  - Increase soil erosion
-

# Surface and Crown Fires



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# Fire, Insects, and Climate Change Can Threaten Forest Ecosystems (2)

- Introduction of foreign diseases and insects
    - Accidental
    - Deliberate
  - Climate Change
    - Rising temperatures
    - Trees more susceptible to diseases and pests
    - Drier forests: more fires
    - More greenhouse gases
-

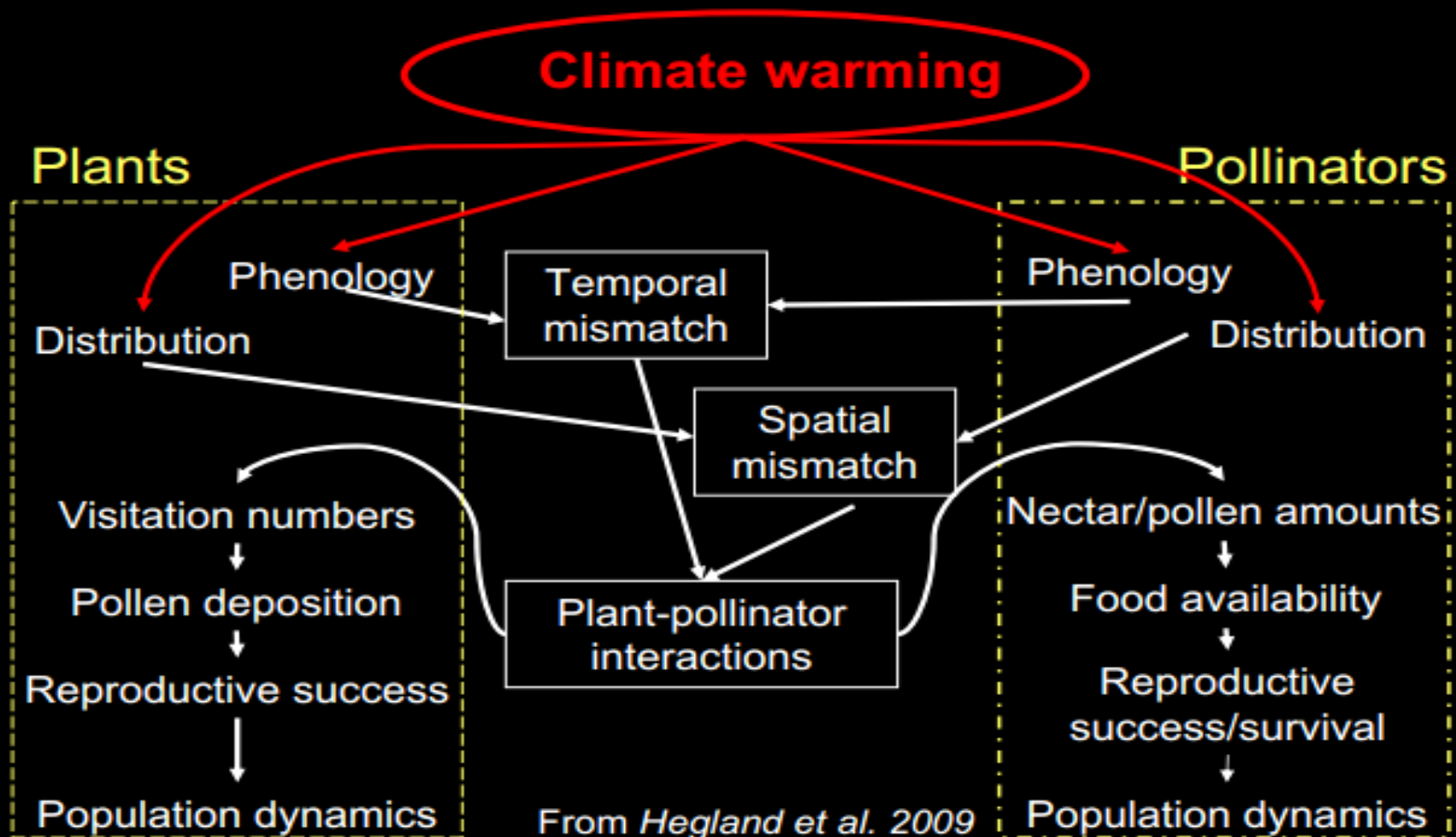
## A look at the damage:

- No fewer than 19 Mediterranean fruit fly infestations took hold in California, and the European grapevine moth triggered spraying and quarantines across wine country.
- The Asian citrus psyllid, which can carry a disease that has decimated Florida orange groves, crossed the border from Mexico, threatening California's \$1.8 billion citrus industry.
- New Zealand's light brown apple moth also emerged in California, prompting the government in 2008 to bombard the Monterey Bay area with 1,600 pounds of pesticides. The spraying drew complaints that it caused respiratory problems and killed birds. Officials spent \$110 million to eradicate the moth, but it didn't work.
- The sweet orange scab, a fungal disease that infects citrus, appeared in Florida, Texas, Louisiana and Mississippi, which all imposed quarantines.
- Chili thrips, rice cutworms and the plant disease gladiolus rust also got into Florida, which saw a 27 percent increase in new pests and pathogens between 2003 and 2007.



# Disruption of Plant/Pollinator Mutualism

## Consequences of mismatches



# Do mutualisms matter?

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- Which mutualist species are threatened by climate change impacts and in what systems?
- Which traits predict vulnerability?

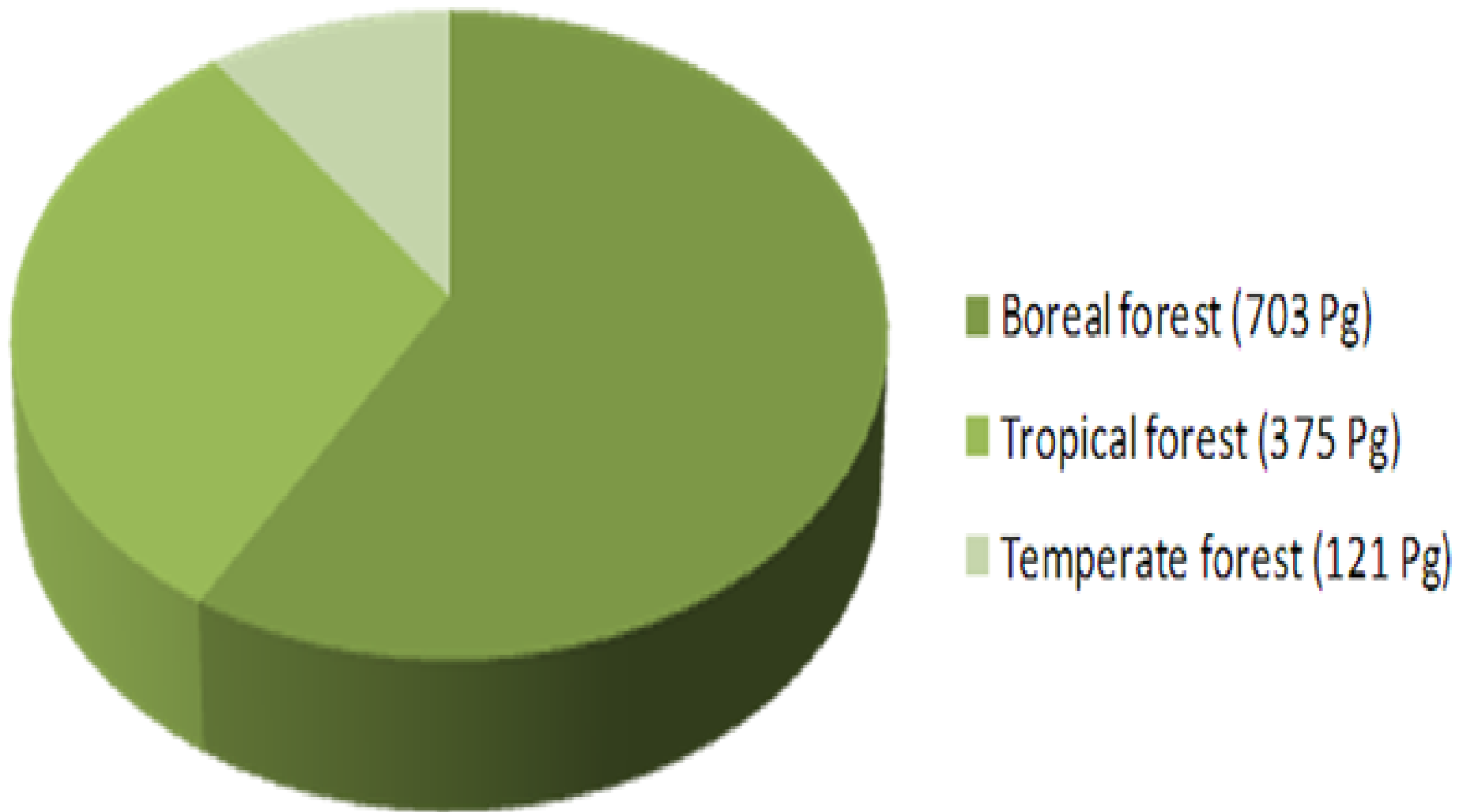


# We Have Cut Down Almost Half of the World's Forests

- **Deforestation – temporarily/permanently removing trees**
  - **Tropical forests**
    - Especially in Latin America, Indonesia, and Africa
  - **Boreal forests**
    - Especially in Alaska, Canada, Scandinavia, and Russia



# Carbon storage by global forest biomes



# Natural Capital Degradation: Extreme Tropical Deforestation in Thailand



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# Natural Capital Degradation: Harmful Environmental Effects of Deforestation

## NATURAL CAPITAL DEGRADATION

### Deforestation

- Decreased soil fertility from erosion
- Runoff of eroded soil into aquatic systems
- Premature extinction of species with specialized niches
- Loss of habitat for native species and migratory species such as birds and butterflies
- Regional climate change from extensive clearing
- Release of CO<sub>2</sub> into atmosphere
- Acceleration of flooding

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

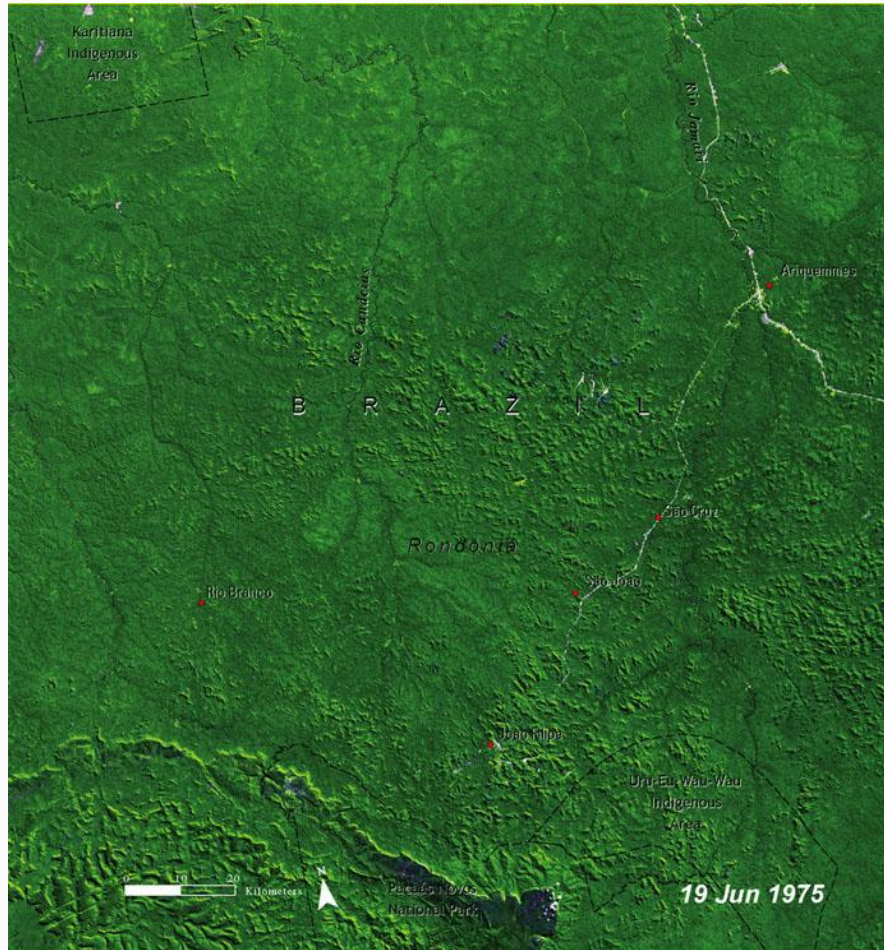
- Forests of the eastern United States decimated between 1620 and 1920
  - Grown back naturally through secondary ecological succession
  - Biologically simplified tree plantations reduce biodiversity
-

# Tropical Forests are Disappearing Rapidly

- Majority of loss since 1950
  - Brazil and Indonesia tropical forest loss
  - Role of deforestation in species' extinction
-



# Satellite Images of Amazon Deforestation between 1975 and 2001



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# Causes of Tropical Deforestation Are Varied and Complex

## ■ **Primary**

- Undervalued
- Crop/tinder export
- Government
- Poverty
- population

## ■ **Secondary**

- Roads
  - Logging/crops/ranching/farmers
  - Fire
  - monocultures
-

# Natural Capital Degradation: Large Areas of Brazil's Amazon Basin Are Burned



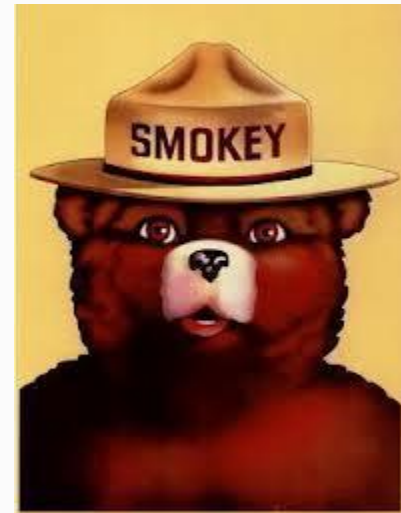
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## ***10-2 How Should We Manage and Sustain Forests?***

- **Concept 10-2** *We can sustain forests by emphasizing the economic value of their ecological services, protecting old-growth forests, harvesting trees no faster than they are replenished, and using sustainable substitute resources.*
-

# Smokey The Bear USFS public relations mascot

- The Forest Service says its campaign, together with modern fire-fighting equipment, has prevented 97 percent of small, natural fires.
- The Forest Service now encourages small, controlled burns to thin out the vegetation
- Environmental experts say the prevention of small fires has inhibited the natural thinning of forests.
  - There are other benefits of small fires. Many trees, including Ponderosa pine, depend on such fires for germination of their seeds (also nutrient cycling)



# We Can Improve the Management of Forest Fires (1)

- The Smokey Bear educational campaign
  - Prescribed fires
  - Allow fires on public lands to burn
  - Protect structures in fire-prone areas
  - Thin forests in fire-prone areas
  - 2003 Healthy Forest Restoration Act
    - Trade for logging of medium and large trees for clearing of small trees and brush
    - Instead of prescribed burns
-

# Solution: Sustainable Forestry

## SOLUTIONS

### Sustainable Forestry

- Identify and protect forest areas high in biodiversity
- Rely more on selective cutting and strip cutting
- No clear-cutting on steep slopes
- No logging of old-growth forests
- Sharply reduce road building into uncut forest areas
- Leave most standing dead trees and fallen timber for wildlife habitat and nutrient recycling
- Plant tree plantations primarily on deforested and degraded land
- Certify timber grown by sustainable methods
- Include ecological services of forests in estimating their economic value

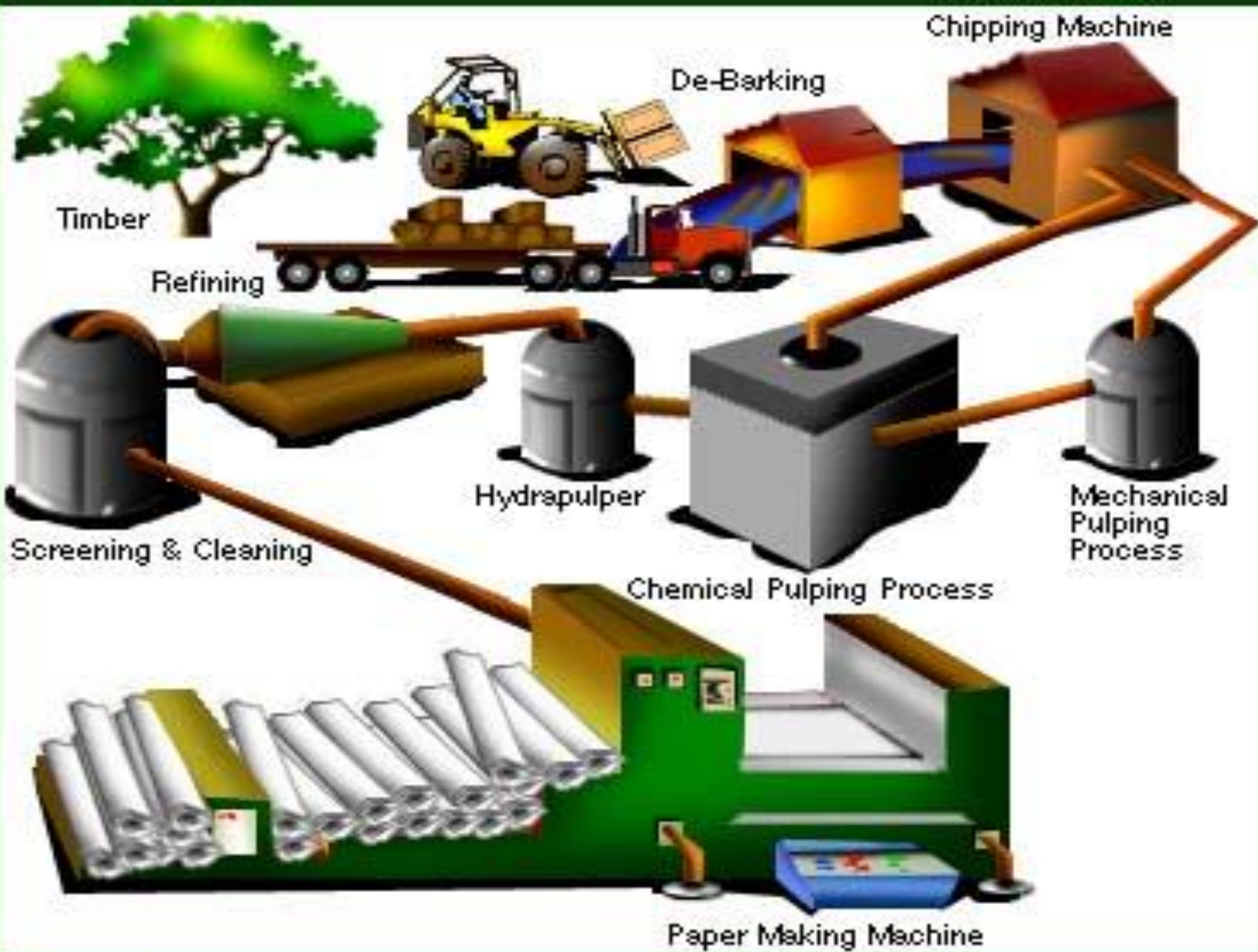
# Science Focus: Certifying Sustainably Grown Timber

- Collins Pine
    - Owns and manages protective timberland
  - Forest Stewardship Council
    - Nonprofit
    - Developed list of environmentally sound practices
    - Certifies timber and products
-



# We Can Reduce the Demand for Harvested Trees

- Improve the efficiency of wood use
    - Up to 60% of the wood consumed in the US is wasted!
      - Inefficient construction materials, junk mail, excess packaging, poor recycling habits and a failure to reuse wooden shipping containers.
  - Make tree-free paper
    - Kenaf
    - Hemp
    - Kudzu??
-



Chipping Machine

De-Barking

Timber

Refining

Hydrapulper

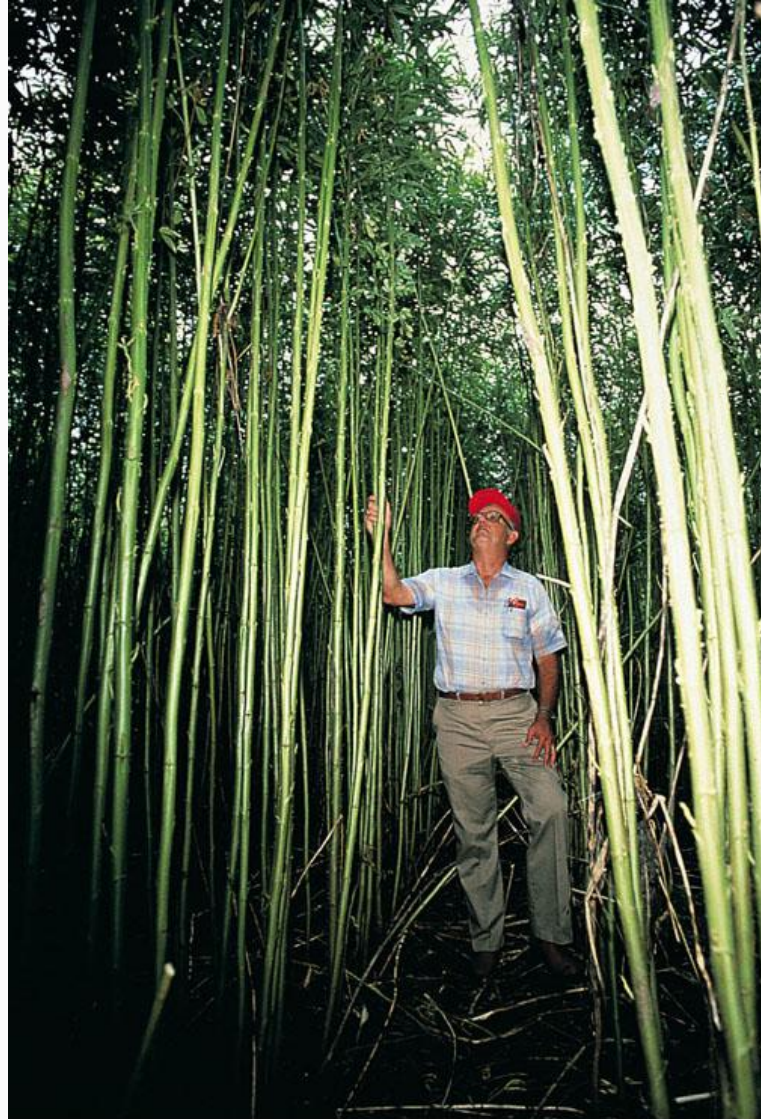
Mechanical Pulping Process

Screening & Cleaning

Chemical Pulping Process

Paper Making Machine

# Solutions: Fast-Growing Plant: Kenaf



# Case Study: Deforestation and the Fuelwood Crisis

- Possible solutions
    - Establish small plantations of fast-growing fuelwood trees and shrubs
    - Burn wood more efficiently
    - Solar or wind-generated electricity
  - Haiti: ecological disaster
    - <http://www.youtube.com/watch?v=XBXIKCQwAx0>
  - South Korea: model for successful reforestation
-

# Governments and Individuals Can Act to Reduce Tropical Deforestation

- Reduce fuelwood demand
  - Practice small-scale sustainable agriculture and forestry in tropical forest
  - Debt-for-nature swaps
  - Conservation concessions
  - Use gentler logging methods
  - Buy certified lumber and wood products
-

# Individuals Matter: Wangari Maathari and Kenya's Green Belt Movement

- Green Belt Movement: 1977
    - Self-help group of women in Kenya
    - Success of tree planting
    - <http://www.youtube.com/watch?v=p5GX6JktJZg>
  - Nobel Peace Prize: 2004
-

# Wangari Maathari and Kenya's Green Belt Movement

- Green Belt Movement: 1977
  - Self-help group of women in Kenya
  - Success of tree planting
  
- Nobel Peace Prize 2004



# How Should We Manage and Sustain Grasslands

- Important ecological services of grasslands
  - Soil formation
  - Erosion control
  - Nutrient cycling
  - Storage of atmospheric carbon dioxide in biomass
  - Maintenance of diversity
- Overgrazing of rangelands (unfenced grasslands)
  - 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
- Malapi Borderlands- Management success story
- Overgrazing and fire suppression degraded area, now  
Controlled burns and return of native grasses





# We Can Manage Rangelands More Sustainably

- Rotational grazing
  - Portable fencing
- Suppress growth of invasive species
  - Herbicides
  - Mechanical removal
  - Controlled burning
  - Controlled, short-term trampling



# *How Should We Manage and Sustain Parks and Natural Reserves*

- Worldwide: 1100 major national parks
- Parks in developing countries
  - Greatest biodiversity
    - 1% protected against
      - Illegal animal poaching
      - Illegal logging and mining



# 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 with debt-for-nature swaps and conservation concessions

Certify sustainably grown timber

Reduce poverty

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?***

- ***Concept 10-3*** *We can sustain the productivity of grasslands by controlling the number and distribution of grazing livestock and restoring degraded grasslands.*
-

# Some Rangelands Are Overgrazed (1)

- Important ecological services of grasslands
    - Soil formation
    - Erosion control
    - Nutrient cycling
    - Storage of atmospheric carbon dioxide in biomass
    - Maintenance of diversity
-

## Some Rangelands are Overgrazed (2)

- Rangelands are vast natural landscapes in the form of grasslands, shrublands, woodlands, and deserts.
  - Pasture - land covered with grass and other low plants suitable for grazing animals.
  - 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, loss of tender herbs
-

# Undergrazing

- Reduction of the net primary productivity of grassland vegetation and grass cover from absence of grazing for long periods (at least 5 years).



# Natural Capital Degradation: Overgrazed and Lightly Grazed Rangeland



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# We Can Manage Rangelands More Sustainably (1)

- Rotational grazing
  - Suppress growth of invasive species
    - Herbicides
    - Mechanical removal
    - Controlled burning
    - Controlled short-term trampling
-

# We Can Manage Rangelands More Sustainably (2)

- Replant barren areas
  - Apply fertilizer
  - Reduce soil erosion
-

# Conservation Easements

- A conservation easement is a restriction placed on a piece of property to protect its associated resources.
- The easement is either voluntarily donated or sold by the landowner and constitutes a legally binding agreement that limits certain types of uses or prevents development from taking place on the land while the land remains in private hands



# Case Study: Grazing and Urban Development the American West

- American southwest: population surge since 1980
  - Land trust groups: limit land development
  - Reduce the harmful environmental impact of herds
    - Rotate cattle away from riparian areas
    - Use less fertilizers and pesticides
    - Operate ranch more economically
-

# Restoration of Grazing Lands



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

- **Concept 10-4** *Sustaining biodiversity will require protecting much more of the earth's remaining undisturbed land area as parks and nature reserves.*
-

# National Parks Face Many Environmental Threats

- Worldwide: 1100 major national parks
  - Parks in developing countries
    - Greatest biodiversity
    - 1% protected against
      - Illegal animal poaching
      - Illegal logging and mining
-

# Several threats to national parks must have a sustainable response.

- 1. Parks, especially in developing countries, need protection.
    - a. People search for wood, game animals, etc.
    - b. Loggers, miners, and poachers take all they want from the parks.
    - d. Parks are too small to sustain many large animals.
  - 2. People illegally remove native species.
  - 3. Nonnative species invade parks.
    - a. European wild boars threaten vegetation in parts of the Great Smoky Mountains Nat Park
-



# Case Study: Stresses on U.S. Public Parks

- 58 Major national parks in the U.S.
  - Biggest problem may be popularity (stressors)
    - Noise
    - Congestion
    - Pollution
    - Damage or destruction to vegetation and wildlife
  - Repairs needed to trails and buildings
-

# Natural Capital Degradation: Damage From Off-Road Vehicles



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# Solutions: National Parks

## SOLUTIONS

### National Parks

- Integrate plans for managing parks and nearby federal lands
- Add new parkland near threatened parks
- Buy private land inside parks
- Locate visitor parking outside parks and provide shuttle buses for people touring heavily used parks
- Increase federal funds for park maintenance and repairs
- Raise entry fees for visitors and use resulting funds for park management and maintenance
- Seek private donations for park maintenance and repairs
- Limit the number of visitors in crowded park areas
- Increase the number of park rangers and their pay
- Encourage volunteers to give visitor lectures and tours

# Science Focus: Effects of Reintroducing the Gray Wolf to Yellowstone National Park

- Gray wolves prey on elk and push them to a higher elevation
    - Regrowth of aspen, cottonwoods, and willows
    - Increased population of riparian songbirds
  - Reduced the number of coyotes
    - Fewer attacks on cattle
  - Wolf pups susceptible to parvovirus carried by dogs
-

# Conservationists – preserve biodiversity through Nature Reserves

- Conservation biologists call for a strict protection of at least 20% of earth's global system as biodiversity reserves that include multiple examples of all the earth's biomes.

But the problem is .....

- Developers and resource extractors generally oppose protecting any of the earth's remaining undisturbed ecosystems.

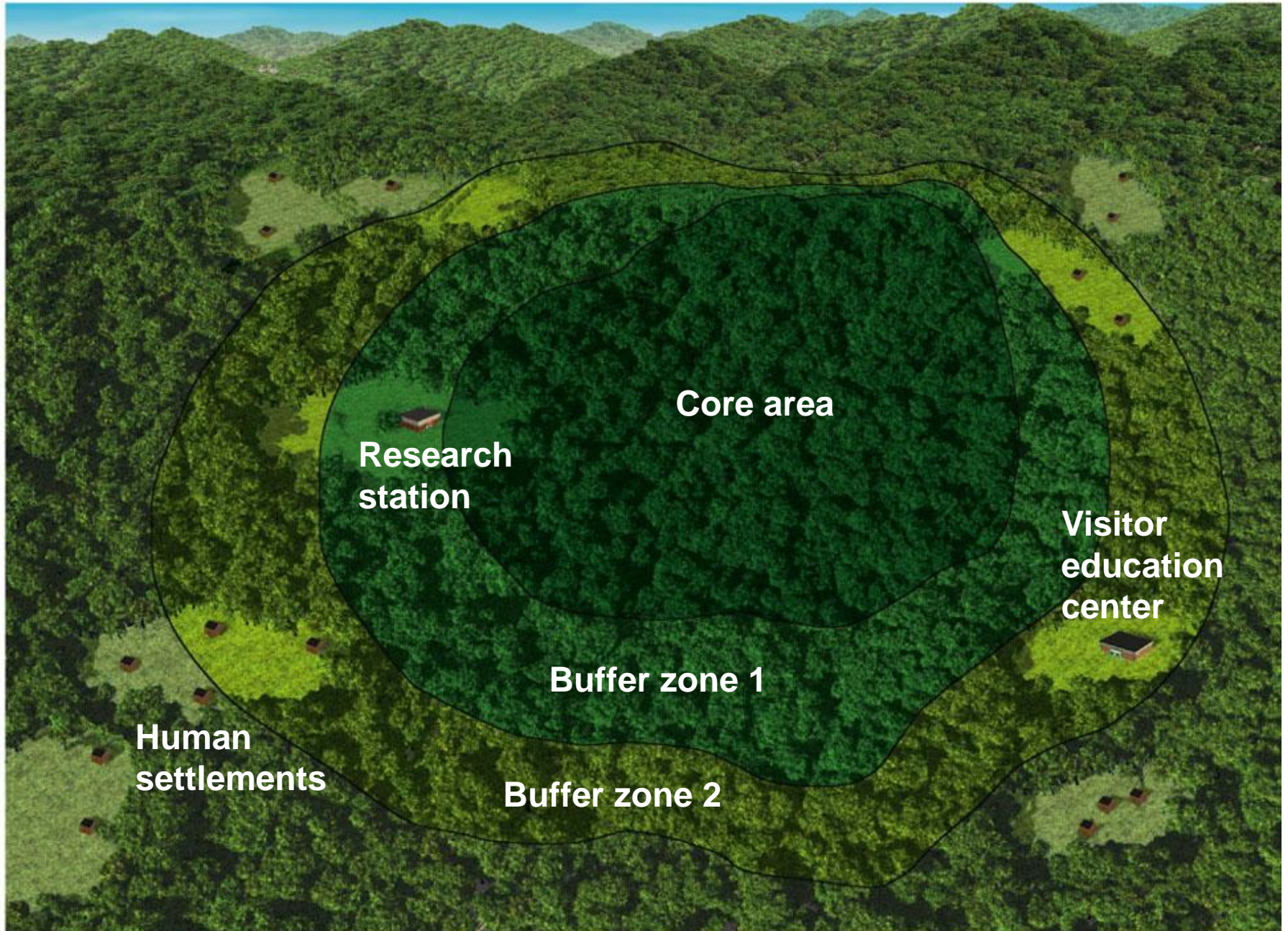


Piney Orchard Nature Preserve in Maryland

# Designing and Connecting Nature Reserves

- Large versus small reserves
  - The buffer zone concept
    - United Nations: 529 biosphere reserves in 105 countries
  - Habitat corridors between isolated reserves
    - Advantages
    - Disadvantages
-

# Biosphere Reserve



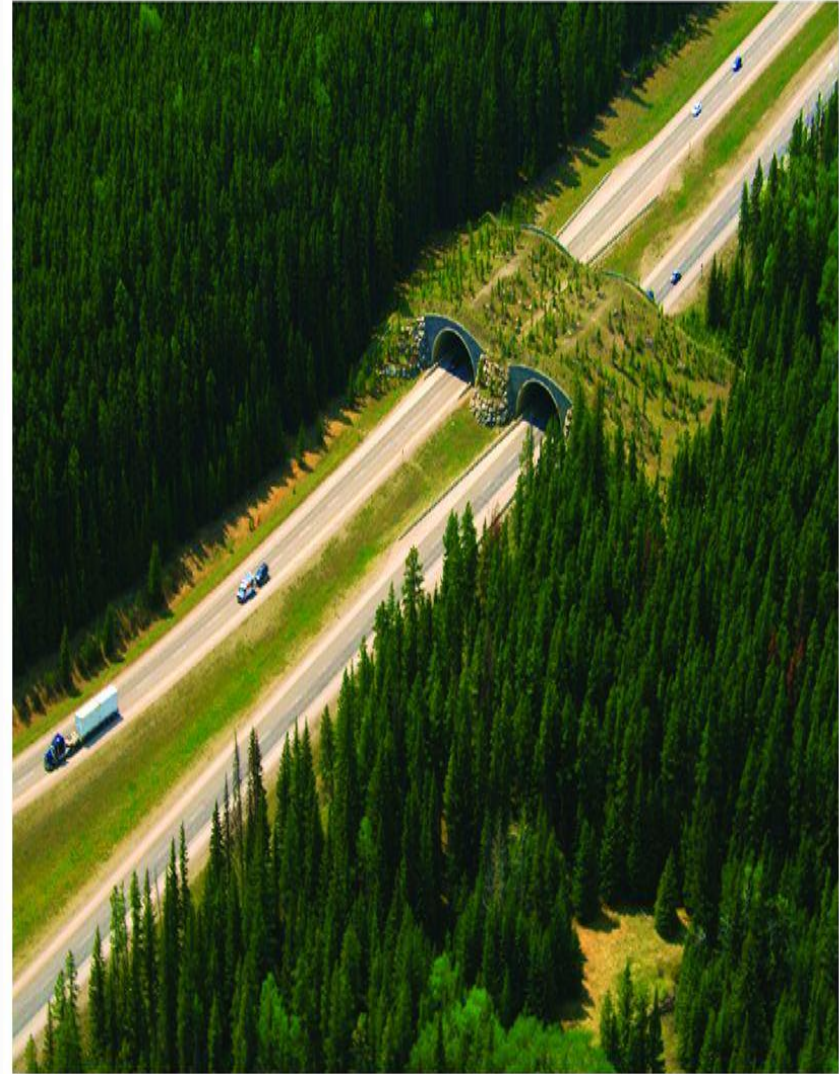
# Nature Reserves Occupy Only a Small Part of the Earth's Land

- Conservationists' goal: protect 20% of the earth's land
  - Cooperation between government and private groups
  - Nature Conservancy
  - Eco-philanthropists
  - Developers and resource extractors opposition
-



# Habitat Corridors

- Establishment of habitat corridors helps to support more species and allows migration of vertebrates with large ranges.
- Migration of individuals can occur when environmental conditions deteriorate within a range



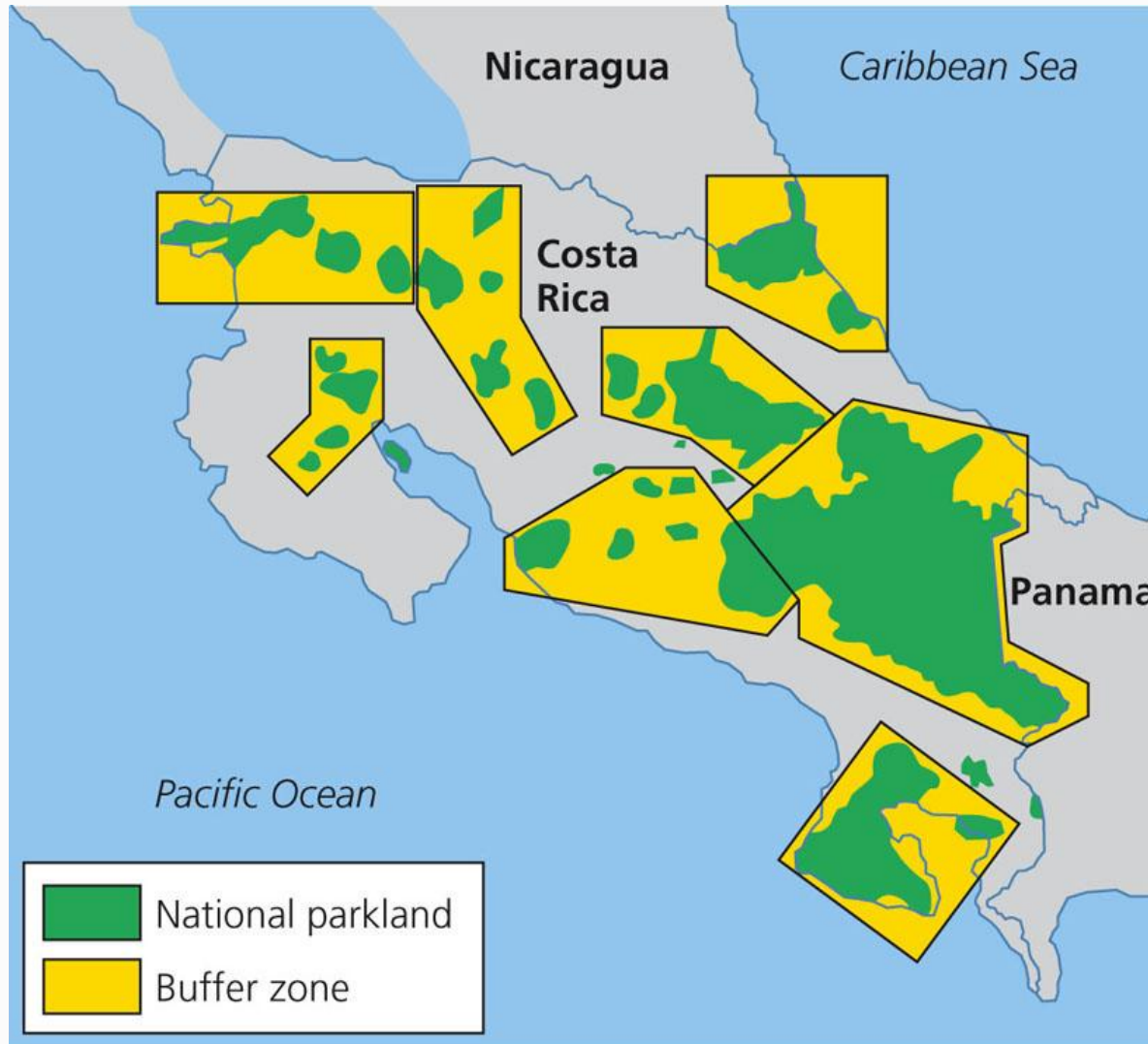
# Case Study: Costa Rica—A Global Conservation Leader

- 1963–1983: cleared much of the forest
  - 1986–2006: forests grew from 26% to 51%
    - Goal: to reduce net carbon dioxide emissions to zero by 2021
  - Eight zoned megareserves
    - Designed to sustain around 80% of Costa Rica's biodiversity
-

# F yeah Costa Rica!

- The most F'ing impressive country in conserving its land and natural resources has been Costa Rica.
  - 1. It has established a system of reserves and national parks that included  $\frac{1}{4}$  of its land by 2003.
  - 2. It has consolidated its parks and reserves into eight Megareserves, which sustain 80% of the country's biodiversity. Almost  $\frac{2}{3}$ s of its yearly tourism business comes from eco-tourism!
-

# Solutions: Costa Rica: Parks and Reserves—Megareserves



# Case Study: Controversy over Wilderness Protection in the United States

This is a quote from the United States Congress when they passed The Wilderness Act of 1964:

- "A **wilderness**, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as **an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.**"
-

# Theodore Roosevelt

- **"...short-sighted men who in their greed and selfishness will, if permitted, rob our country of half its charm by their reckless extermination of all useful and beautiful wild things..."**



# 10-5 What is the Ecosystem Approach to Sustaining Biodiversity? (1)

- **Concept 10-5A** *We can help sustain biodiversity by identifying severely threatened areas and protecting those with high plant diversity and those where ecosystem services are being impaired.*
  - **Concept 10-5B** *Sustaining biodiversity will require a global effort to rehabilitate and restore damaged ecosystems.*
-

## ***10-5 What is the Ecosystem Approach to Sustaining Biodiversity? (2)***

- **Concept 10-5C** *Humans dominate most of the earth's land, and preserving biodiversity will require sharing as much of it as possible with other species.*
-



# We Can Use a Four-Point Strategy to Protect Ecosystems

- Map global ecosystems; identify species. **Create an inventory of the species within them.**
  - Locate and protect most **endangered** plants and animals
  - Restore as many **degraded ecosystems as possible**
  - Development must be **biodiversity-friendly** by providing financial incentives
  - Are new laws needed?
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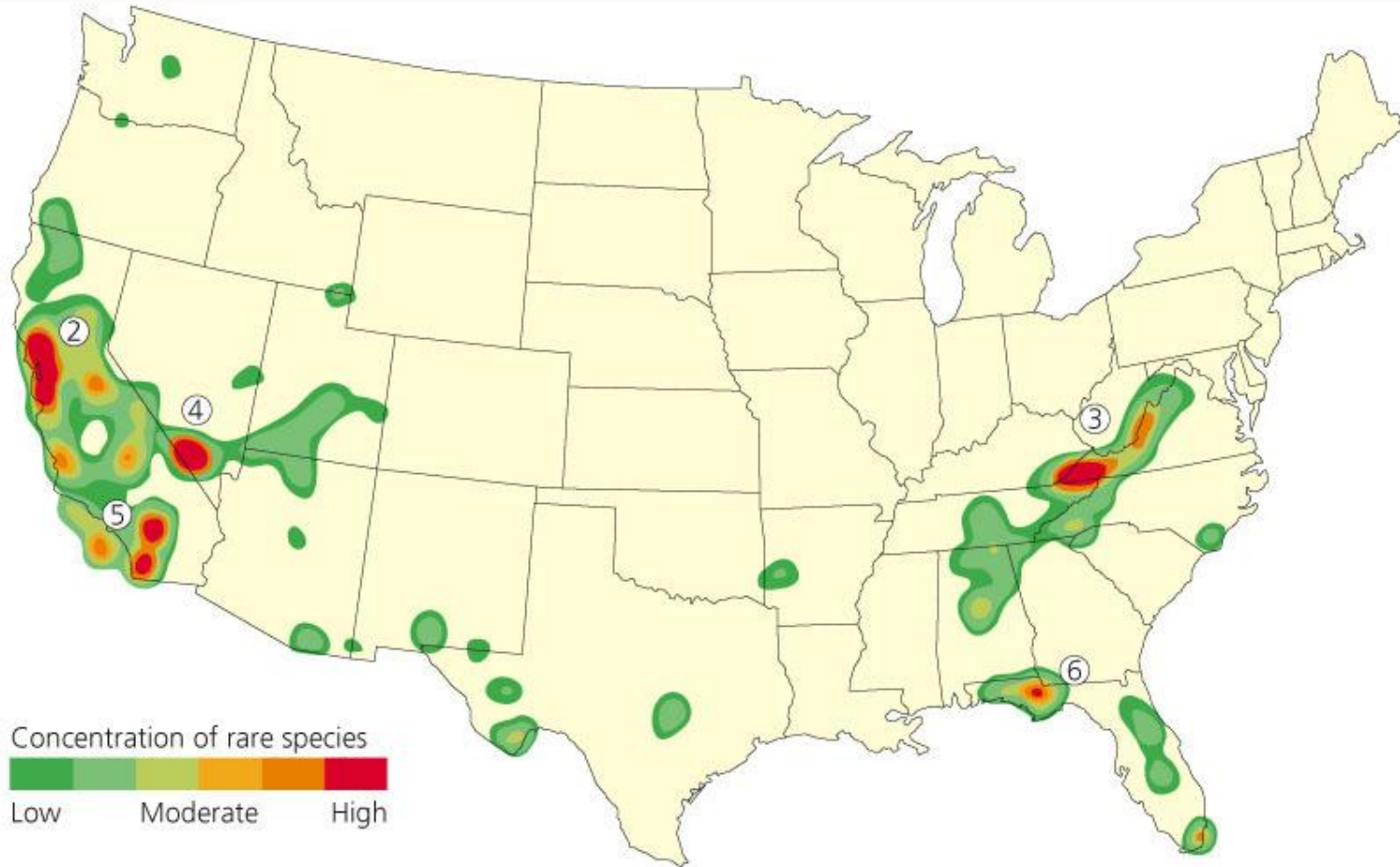
# Protecting Global Biodiversity Hot Spots Is an Urgent Priority

- 1988: Norman Myers
  - Identify biodiversity **hot spots** rich in plant species
  - A biodiversity hotspot is a biogeographic region with a significant reservoir of biodiversity that is under threat from humans.
- Not sufficient public support and funding
- Drawbacks of this approach
  - May not be rich in animal diversity
  - People may be displaced and/or lose access to important resources

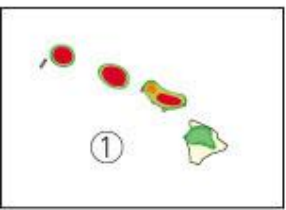
# Endangered Natural Capital: 34 Biodiversity Hotspots



# Endangered Natural Capital: Biodiversity Hotspots in the U.S.



- Top Six Hotspots**
- 1 Hawaii
  - 2 San Francisco Bay area
  - 3 Southern Appalachians
  - 4 Death Valley
  - 5 Southern California
  - 6 Florida Panhandle



# Case Study: A Biodiversity Hot Spot in East Africa

- Eastern Arc Mountains of Tanzania, Africa
    - Highest concentration of endangered species on earth
  - Threatened due to
    - Killing of forests by farmers and loggers
    - Hunting
    - Fires
-

# Protecting Ecosystem Services Is Also an Urgent Priority

- U.N. Millennium Ecosystem Assessment: 2005
    - Identify key ecosystem services
    - Human activities degrade or overuse 62% of the earth's natural services
  - Identify highly stressed **life raft ecosystems**
-

# We Can Rehabilitate and Restore Ecosystems That We Have Damaged (1)

- Study how natural ecosystems recover
    - **Restoration**
      - Repairing damages done by humans to 'close' to natural state
    - Rehabilitation
      - Repair degraded to improved and useful state, not original
    - Replacement
      - Turning a degraded ecosystem into a different one
    - Creating artificial ecosystems
      - Building ecosystems with unique materials to increase biodiversity
-

# We Can Rehabilitate and Restore Ecosystems That We Have Damaged (2)

- How to carry out most forms of ecological restoration and rehabilitation
    - Identify what caused the degradation
    - Stop the abuse
    - Reintroduce species, if possible
    - Protect from further degradation
-



# Science Focus: Ecological Restoration of a Tropical Dry Forest in Costa Rica

- Guanacaste National Park restoration project
    - Relinked to adjacent rain forest
    - Bring in cattle and horses – aid in seed dispersal
    - Local residents – actively involved
-

# Solutions: Curtis Prairie in Madison, WI (U.S.)



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# Will Restoration Encourage Further Destruction?

- Preventing ecosystem damage is cheaper than restoration
  - About 5% of the earth's land is preserved from the effects of human activities
-

# Case Study: The Blackfoot Challenge— Reconciliation Ecology in Action

- 1970s: Blackfoot River Valley in Montana threatened by
    - Poor mining, logging, and grazing practices
    - Water and air pollution
    - Unsustainable commercial and residential development
  - Community meetings led to
    - Weed-pulling parties
    - Nesting structures for waterfowl
    - Developed sustainable grazing systems
-

# What Can You Do? Sustaining Terrestrial Biodiversity

## WHAT CAN YOU DO?

### Sustaining Terrestrial Biodiversity

- Adopt a forest
- Plant trees and take care of them
- Recycle paper and buy recycled paper products
- Buy sustainably produced wood and wood products
- Choose wood substitutes such as bamboo furniture and recycled plastic outdoor furniture, decking, and fencing
- Help to restore a nearby degraded forest or grassland
- Landscape your yard with a diversity of plants natural to the area