5.2 FORESTRY ISSUES AND MANAGEMENT

College Board Topics 5.2 and 5.17

Ch12, Pages 306 - 323

From the Course Description

ENDURING UNDERSTANDING

EIN-2

When humans use natural resources, they alter natural systems.

LEARNING OBJECTIVE

EIN-2.B

Describe the effect of clearcutting on forests.

ESSENTIAL KNOWLEDGE

EIN-2.B.1

Clearcutting can be economically advantageous but leads to soil erosion, increased soil and stream temperatures, and flooding.

EIN-2.B.2

Forests contain trees that absorb pollutants and store carbon dioxide. The cutting and burning of trees releases carbon dioxide and contributes to climate change.

ENDURING UNDERSTANDING

STB-1

Humans can mitigate their impact on land and water resources through sustainable use.

LEARNING OBJECTIVE

STB-1.G

Describe methods for mitigating human impact on forests.

ESSENTIAL KNOWLEDGE

STB-1.G.1

Some of the methods for mitigating deforestation include reforestation, using and buying wood harvested by ecologically sustainable forestry techniques, and reusing wood.

STB-1.G.2

Methods to protect forests from pathogens and insects include integrated pest management (IPM) and the removal of affected trees.

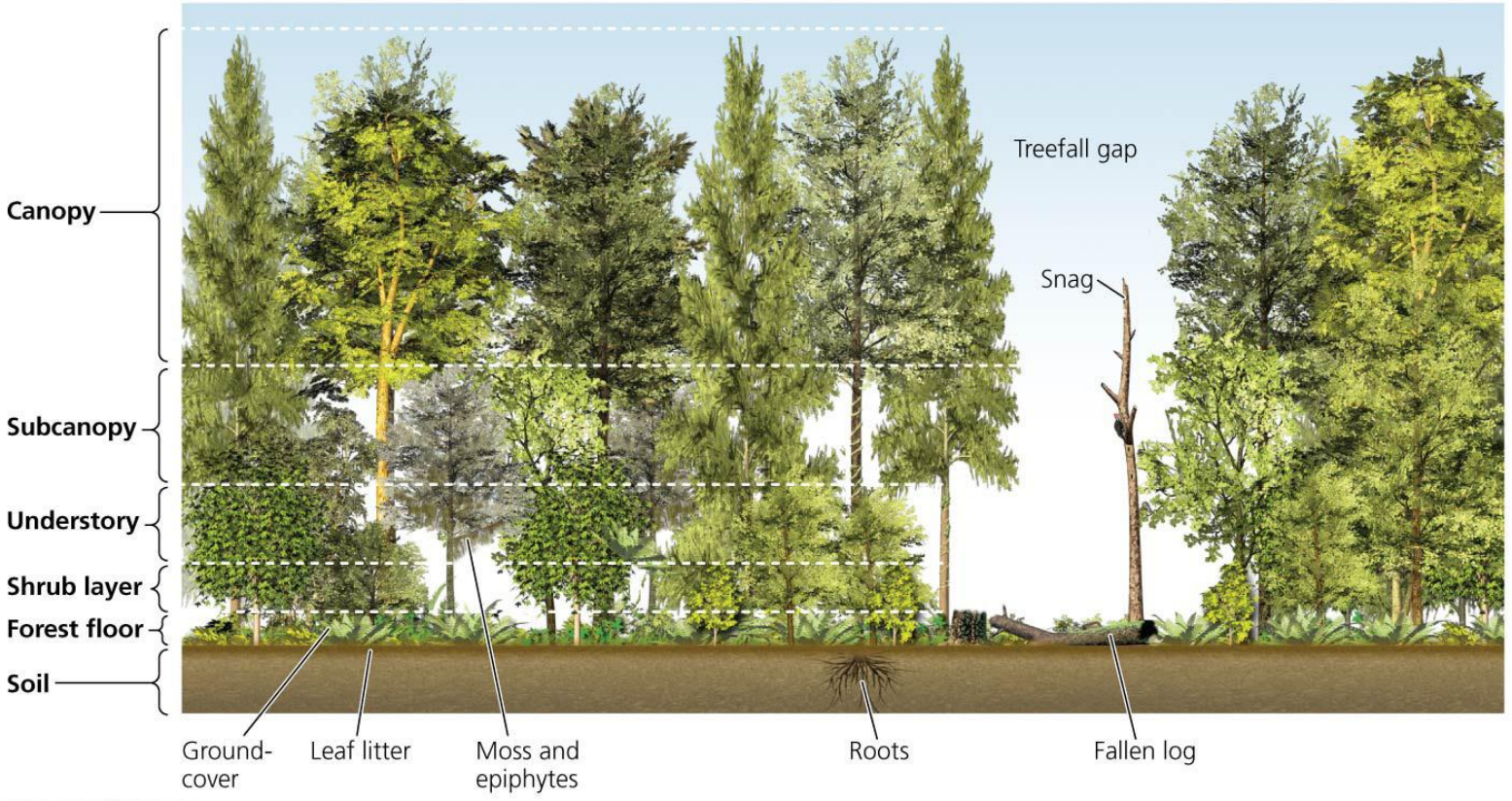
STB-1.G.3

Prescribed burn is a method by which forests are set on fire under controlled conditions in order to reduce the occurrence of natural fires.

Forest Types

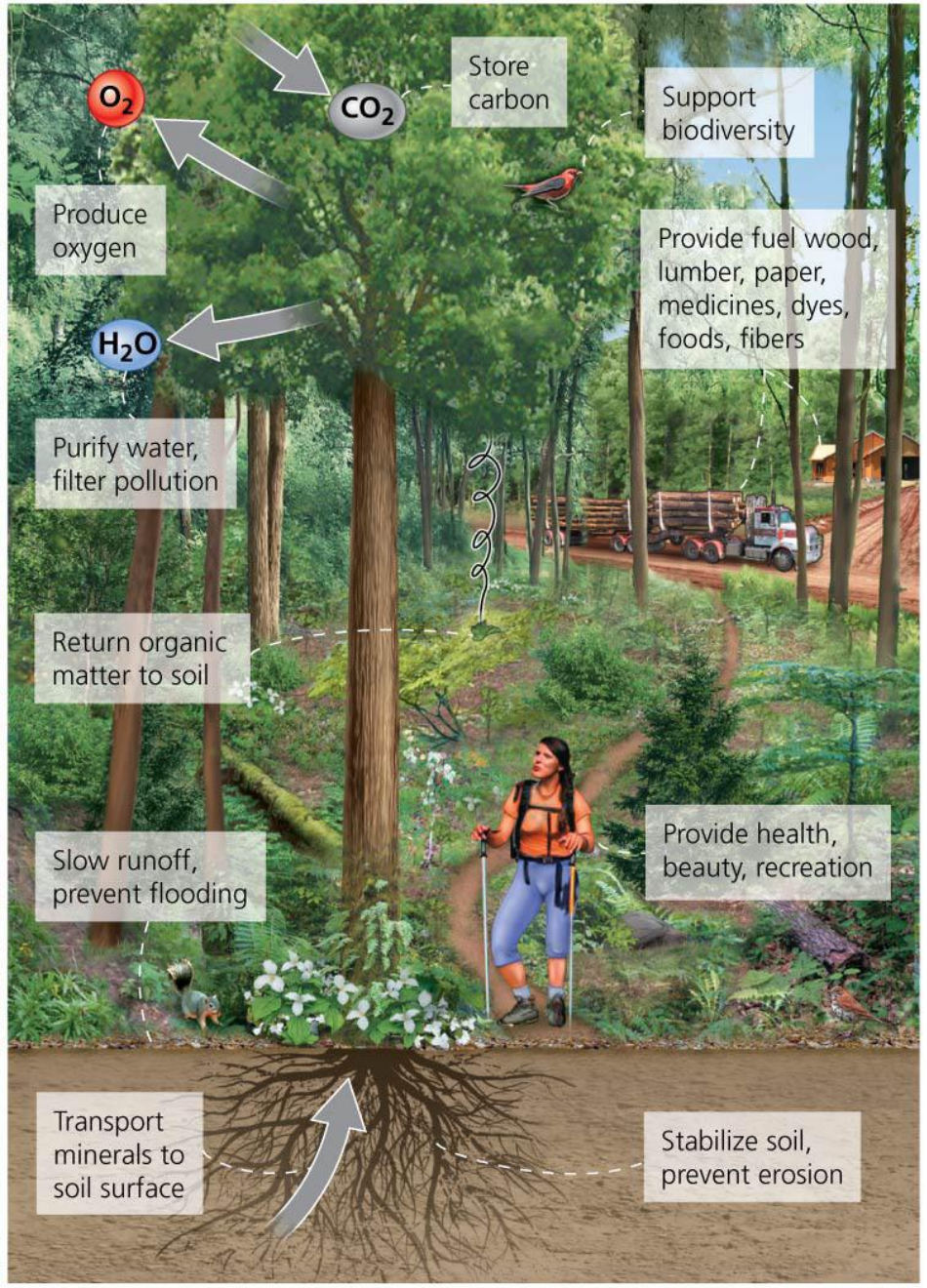
- **Forest communities differ due to soil and climate**
  - *Forest types* are defined by the dominant tree species (Deciduous, Coniferous (Boreal/Taiga), Tropical)

- **Forests are some of the richest ecosystems for biodiversity**
  - Structural complexity leads to a wider range of habitat and niches and greater overall organism diversity
    - **Canopy** = upper level of trees and branches in the treetop
    - **Subcanopy** = the middle and lower portions of trees
    - **Understory** = shrubs, small trees, and plants on the forest floor



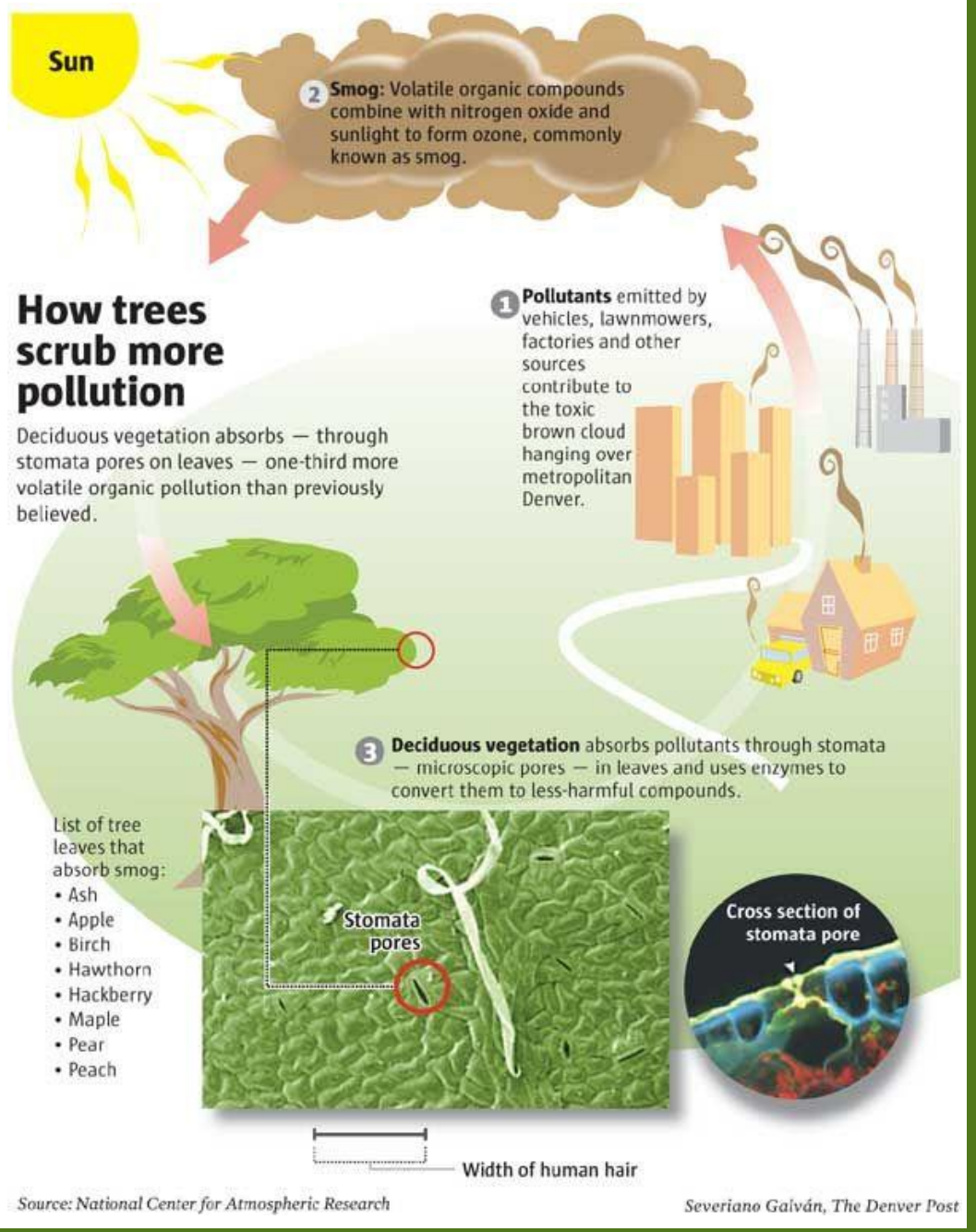
Forests provide ecosystem services

- Trees create habitat and support biodiversity
- Trees help build soil (return organic matter, transport minerals to the surface, slow erosion)
- Forests provide many economically valuable resources
  - Plants for medicines, dyes, and fibers
  - Animals, plants, and mushrooms for food
  - Wood from trees: fuel, lumber, and paper
- Forests provide inspiration, beauty, recreation and exercise (health)

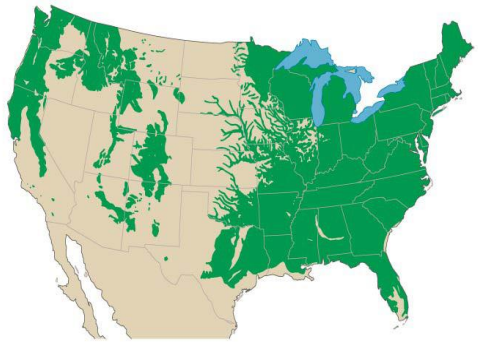


Forests provide ecosystem services

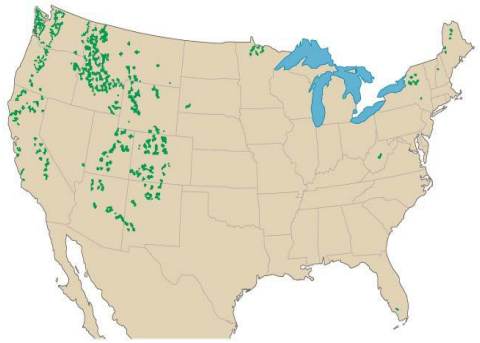
- Trees slow runoff, prevent flooding and erosion, and help purify water
- Trees filter pollutants from smog (VOC's, NO_x)
- Trees absorb carbon dioxide and store carbon
  - The world's forests store 280 billion metric tons of carbon
  - Cutting forests worsens climate change
    - Fewer trees soak up less carbon dioxide
    - Slash and burn agriculture amplifies the problems of forest loss and greenhouse gas emissions
    - Dead plants increase decomposition and release carbon dioxide
    - Deforestation accounts for as much carbon in the atmosphere as fuel combustion in vehicles.



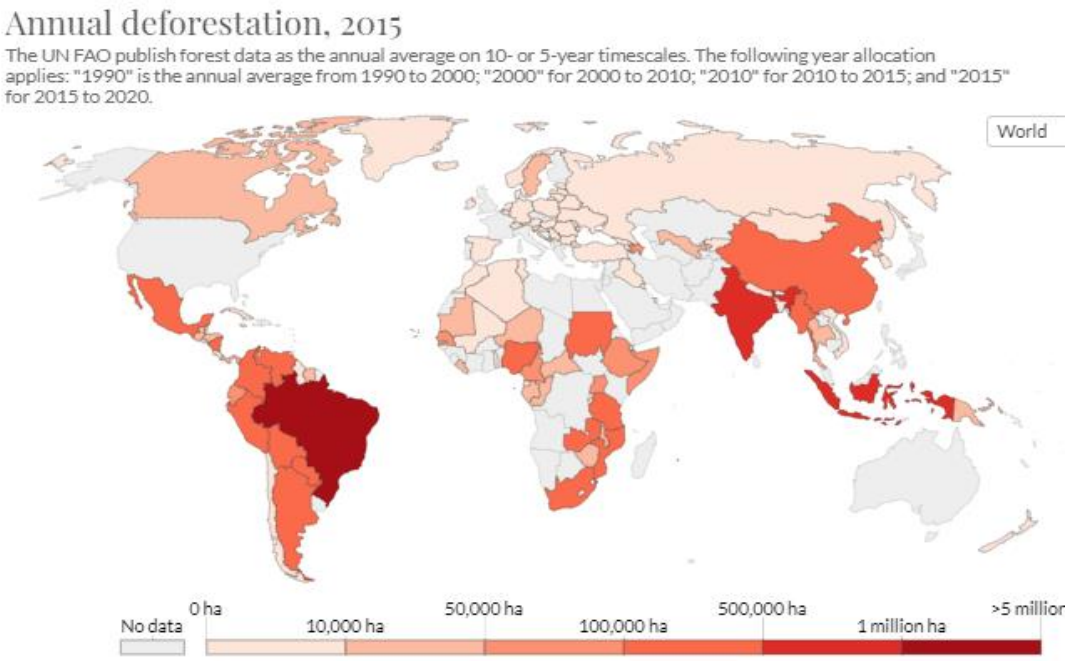
Deforestation



(a) 1620: Areas of primary (uncut) forest



(b) Today: Areas of primary (uncut) forest



- ***Deforestation*** propelled the expansion and growth of the United States and Canada
  - Little ***old growth*** forest remains in the United States.
  - Most existing forest is ***secondary growth*** with different species composition and structure.
  - Most logging in the U.S. is for commercial gain, and is now done more sustainably
- Uncut tropical forests still remain in many less developed countries (Brazil, Indonesia), but they are being cleared rapidly.
  - Clearing of land for agriculture to feed growing populations and grow economically (slash and burn)
  - Harvesting of firewood for heating and cooking
  - Harvesting of timber to develop economically

Tropical Deforestation

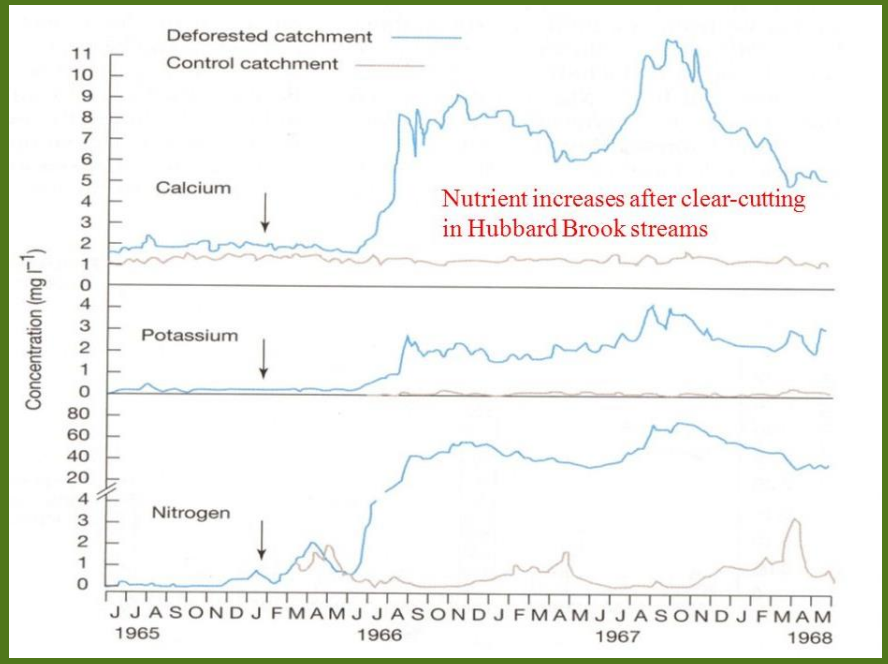
- Loss of tropical forests in developing nations has wider reaching global consequences
  - Tropical forests have greater biodiversity than the temperate forests of developed nations.
  - These forests have greater productivity and thus remove carbon from the atmosphere faster than temperate forests
- Palm Oil in Indonesia
  - Oil used in snack foods, soaps, cosmetics, and biofuels. Rapidly replacing corn oil / vegetable oil due to lower cost
  - Malaysia and Indonesia are the worlds largest producers.
- Cattle ranching in Brazil
  - 80% of deforestation in the Amazon Basin is attributed to cattle ranching
  - Brazil is home to 200 million cattle and is the largest exporter of beef, supplying a quarter of the world market.
  - Clearing land is a way to demonstrate ownership and claim title to the land in Brazil

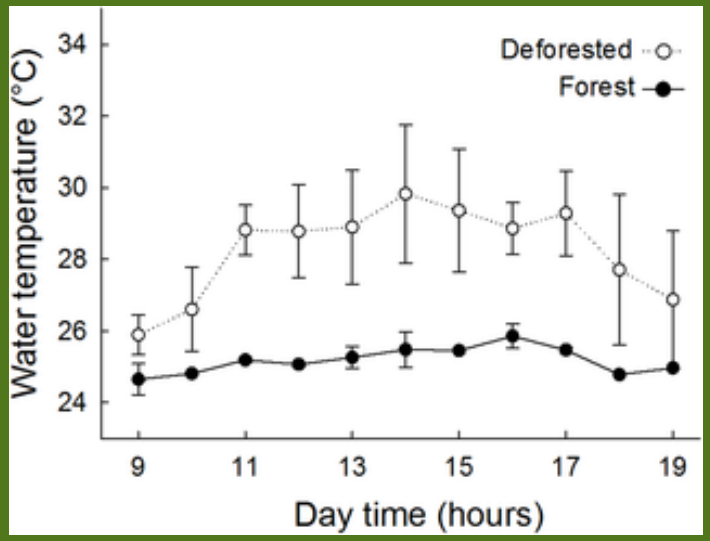
Deforestation

- ***Clear-cutting*** cuts all trees on a parcel of land.
  - Most cost-efficient
  - Greatest ecological impact
  - Most widely used harvesting method
    - But concerns and restrictions have caused companies to use other harvesting methods in the U.S.
- ***Slash and burn*** method of clearing land for agriculture by cutting trees & burning them
  - releases CO_2, N_2O and water vapor into the atmosphere (all GHGs)

Effects of Clearcutting

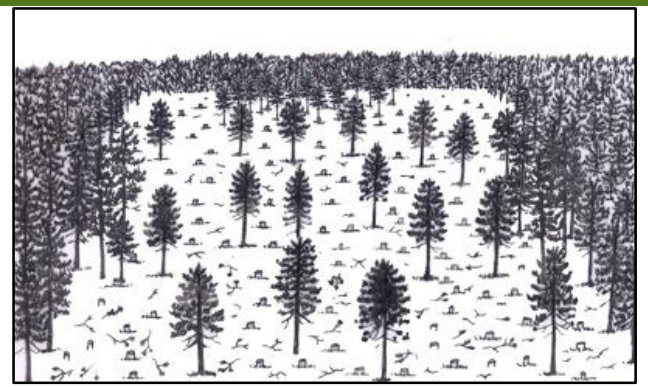
- Soil Erosion
  - Caused by loss of stabilizing root structure
  - Removes soil organic matter & nutrients from forest
  - Deposits sediments and excessive nutrients in local streams
- Loss of tree shade
  - increases soil temperature and evaporation rate from soil
  - Warms the water in streams & rivers
- Increases flooding and landslides
  - Logging machinery compacts soil
  - Loss of root structure = erosion of topsoil & O horizon
  - All of these factors decrease porosity and H_2O holding capacity of soil causing flooding & landslides



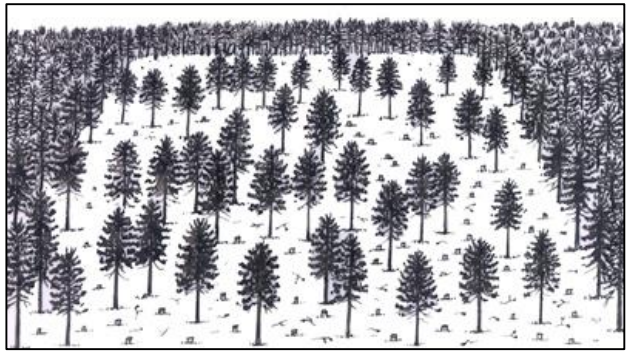


Sustainable Forestry

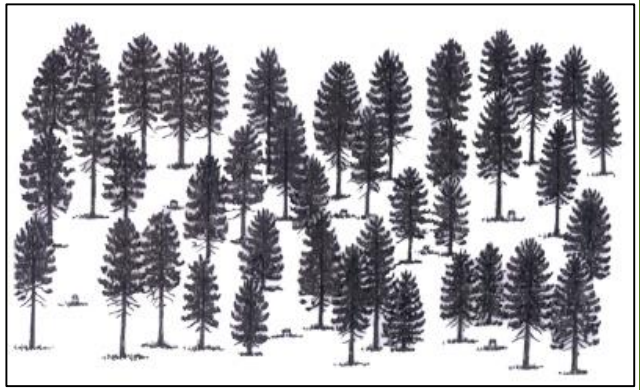
- ***Sustainable Forestry*** practices minimize the disturbance of forest ecosystems (soil erosion, stream pollution, habitat destruction)
- The impacts of any logging operation can be reduced by:
  - Avoiding clearing trees from the steepest slopes
  - Leaving undisturbed buffer zones of vegetation (including unharvested trees) along stream banks
  - Minimizing the amount of road construction and use of heavy machinery
- ***Seed-tree*** approach
  - a few larger, mature, seed-producing trees are left standing to reseed the logged area.
  - Tends to produce even-aged, single species stands of trees
- ***Shelterwood*** approach
  - some intermediate aged trees are left to provide shelter for seedlings as they grow.
  - The shelterwood is often logged at a later time as seedlings become larger and more sun tolerant
- ***Selection systems***: only select trees are cut
  - Single-tree selection = widely spaced trees are cut
  - Group tree selection = small patches of trees are cut
  - Can be used to meet a variety of forest management goals, including reducing fire danger from increased fuel loads
  - Results in uneven aged stands



Seed tree



Shelterwood



Single Tree Selection

Plantation Forestry

- The sustainability of forestry practices depends on forests regrowing as fast, or faster, than they are cleared.
  - Replanting seeds or seedlings on logged land can speed regeneration of forests
  - When replanting occurs, it is usually just the single species that is the most valuable or preferred species for logging.
  - Replanting with the full diversity of species that were originally removed helps to improve ecosystem diversity, and therefore stability.

- Plantation forestry relies on growing trees as crops
  - Trees of the same species, size, and age are grown together on a plantation and harvested together on regular intervals and then replanted.
  - Increases the yield of lumber and can be very efficient, reducing the amount of forested land that needs to be cleared.
  - But plantation forests lack the diversity and stability and level of ecosystem function found in natural forests.

Forest Certifications

- Products produced sustainably can be certified by various organizations
  - The Forest Stewardship Council (FSC) has the strictest standards
- Lumber suppliers, cabinet and furniture makers, hardwood flooring manufacturers must prioritize sustainably produced products
  - Choosing FSC products over similar, but uncertified products, adds value to certification and influences companies to seek certification through more sustainable logging practices
- Construction of certified green buildings requires use of FSC certified wood products
- Certification standards need to be kept strong

TABLE 12.2 Ten Principles of Forest Stewardship Council (FSC) Certification

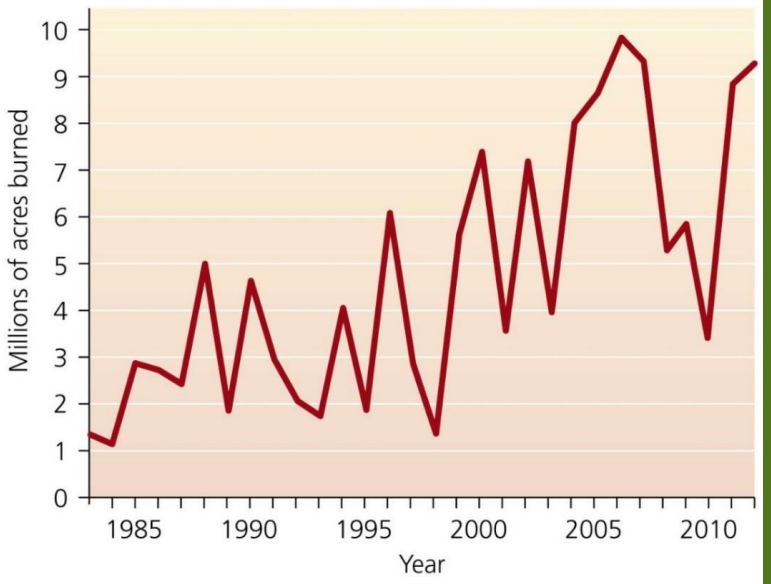
To receive FSC certification, forest product companies must:
• Comply with all laws and treaties.
• Show uncontested, clearly defined, long-term land rights.
• Recognize and respect indigenous peoples' rights.
• Maintain or enhance long-term social and economic well-being of forest workers and local communities, and respect workers' rights.
• Use and share benefits derived from the forest equitably.
• Reduce environmental impacts of logging and maintain the forest's ecological functions.
• Continuously update an appropriate management plan.
• Monitor and assess forest condition, management activities, and social and environmental impacts.
• Maintain forests of high conservation value.
• Promote restoration and conservation of natural forests.

Reduce, Reuse, Recycle minimizes demand for new forest products

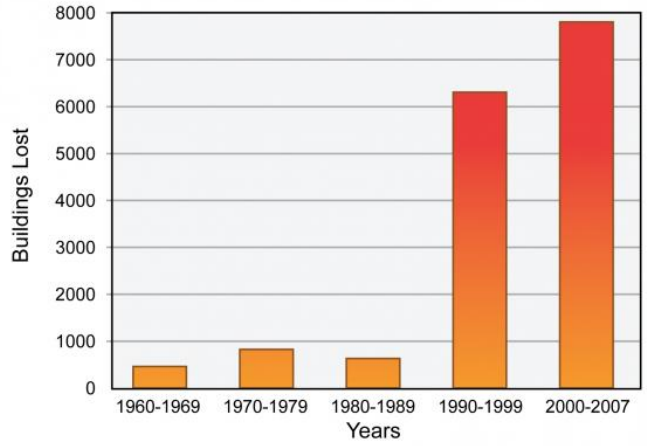
- Choosing alternative building materials reduces dependence on lumber (straw, hemp, bamboo)
- Electronic documents and communications can reduce the need for paper
- Applying the principles of industrial ecology can improve how efficiently we use forest products by reducing waste in manufacturing wood products.
- Reuse of building materials can limit the need for new lumber.
- Recycling used lumber into wood chips and mulch
- Recycling used paper products and choosing to purchase paper products made of recycled materials reduces need for

Managing disease, pests, fire and climate change can help sustain forests

- **For over 100 years, the Forest Service suppressed all fires**
- **Research shows that many forest ecosystems depend on fire**
  - Coniferous forests of the western U.S. are adapted to frequent, but with low intensity fire. (cones, bark, self-pruning)
  - Fires helped maintain diversity of forest ecosystems (disturbance regime and succession)
  - Fire helped prevent unnaturally high densities and increased rates of disease
- **Fire suppression has lead to a rise in catastrophic fires**
  - Excess vegetation increases fuel loads and ladder fuels for future fires
  - Severe fires have become more numerous.
  - Increased residential development has increased the ***wildland-urban interface*** and has placed more homes in danger, increasing the consequences of severe fires.

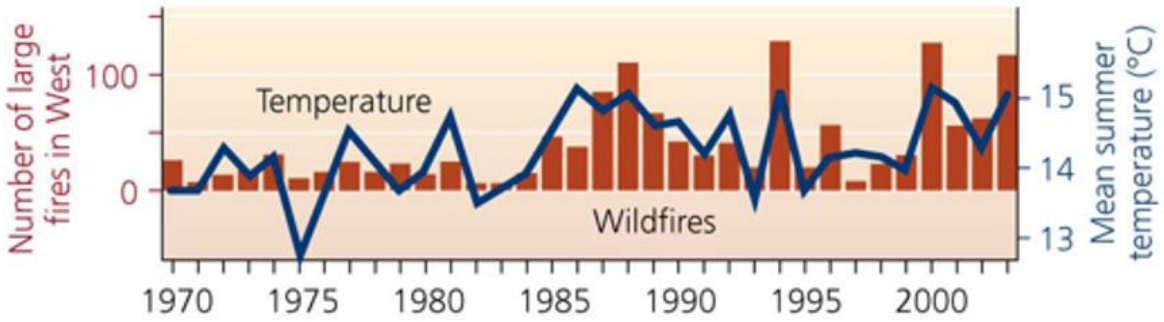


Building Loss by Fires at California Wildland-Urban Interfaces



Climate change and pest outbreaks are altering forests

- **North America is warming and the west is getting drier.**
  - Climate models predict this to continue.
  - Changed climate is resulting in more fires.



- **Climate change is promoting pest outbreaks (particularly bark beetles) that kill huge areas of forest.**
  - Milder winters allow more successful overwintering of beetle larvae.
  - Drier trees make it harder for trees to seal injuries to their bark with sap.
  - The even-aged forests of a single species commonly found in secondary growth forests are prime targets.

(b) Mountain pine beetles kill more trees in a warmer climate

- **Dead trees do not remove carbon dioxide, intensifying climate change, making forests drier and more prone to insect attack.**
  - Increased numbers of dead trees make large, catastrophic wildfires more likely.

Prescribed Burns and Selective cutting can help manage forests

- **Prescribed (controlled) burns**
  - burning areas of forests under carefully controlled conditions to clear away fuel loads, nourish soil, encourage growth of new vegetation
  - Are time-intensive and impeded by public misunderstanding and political interference
- **Selective Cutting**
  - Helps to reduce fuel loads by thinning the forest and removing dead dry trees, hopefully preventing catastrophic crown fires.

- Thinning can remove dead and/or diseased trees that still have some commercial value while reducing fire risk and slowing the spread of pests and disease.

Mitigating Forest Pests and Pathogens

- Diseased trees can threaten the health of the entire forest ecosystem.
- IPM techniques can help minimize the threat of infestations in an ecologically sustainable manner
  - IPM uses biological and physical means to control the spread of pests and disease. Chemical controls are used as a last resort.
  - Continual monitoring of forest health (early detection).
  - Knowledge of pest species.
  - Physical controls include thinning of underbrush and removal of vector species and setting pest traps
  - Biological controls using natural predators of the pest species
  - Chemical control with repellants, pesticides, herbicides, and fungicides