Human Impacts on Biodiversity

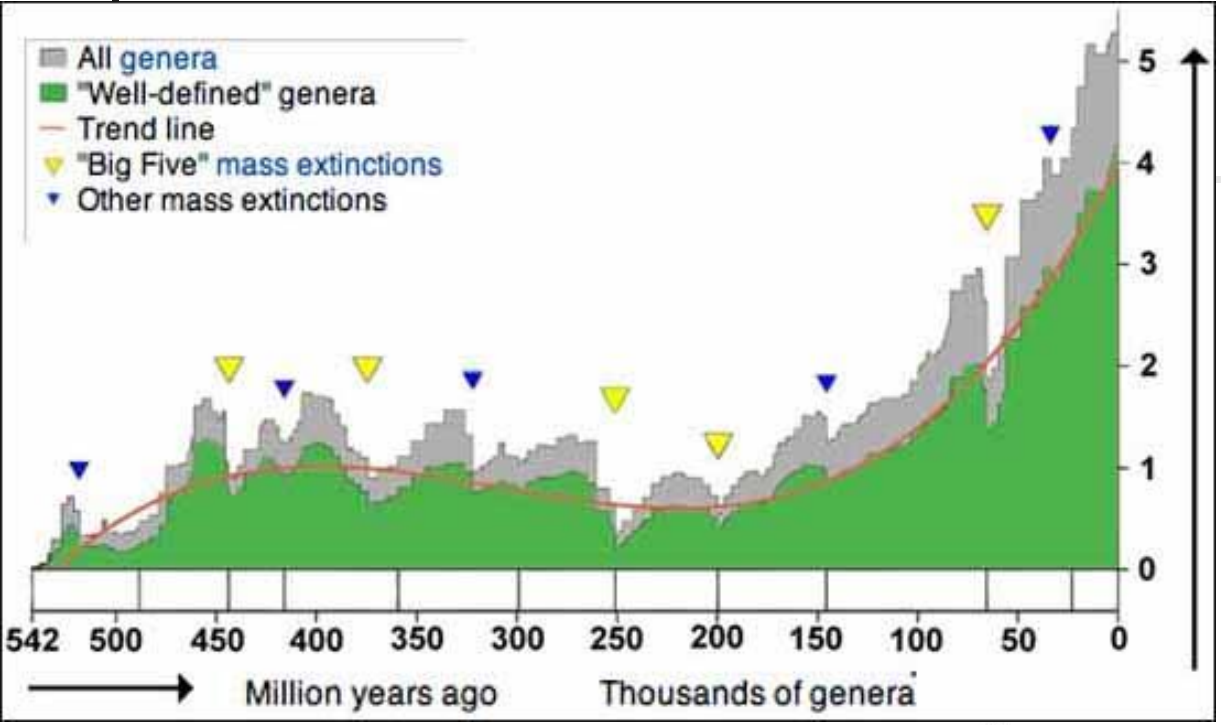
Learning Goals

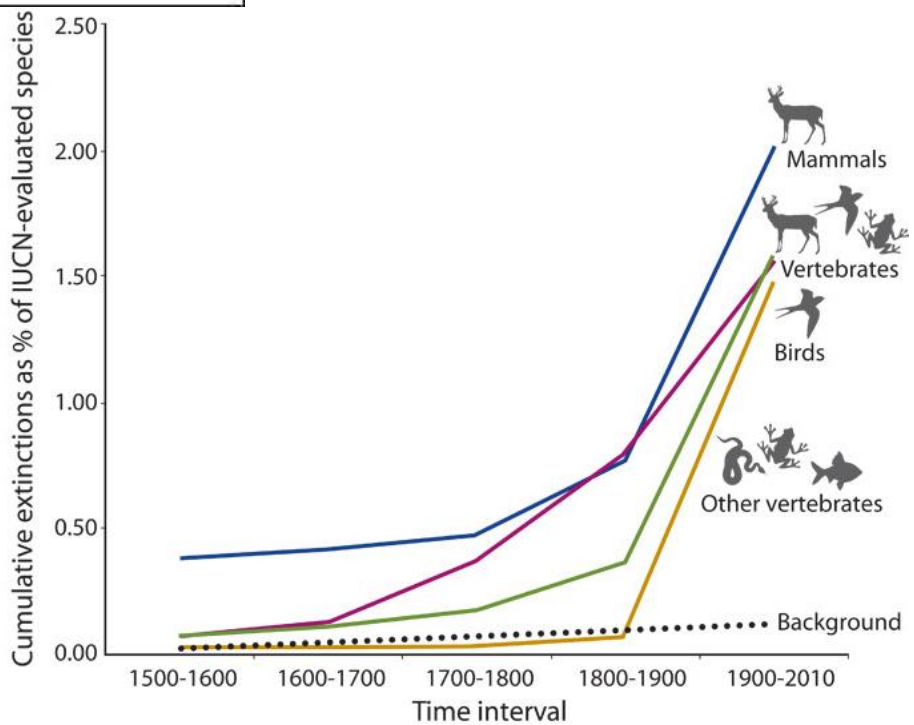
1) I know about the major human impacts on the environment
2) I can explain why the loss of biodiversity through extinction is a problem
3) I know the 4 ways humans influence terrestrial ecosystems through resource exploitation

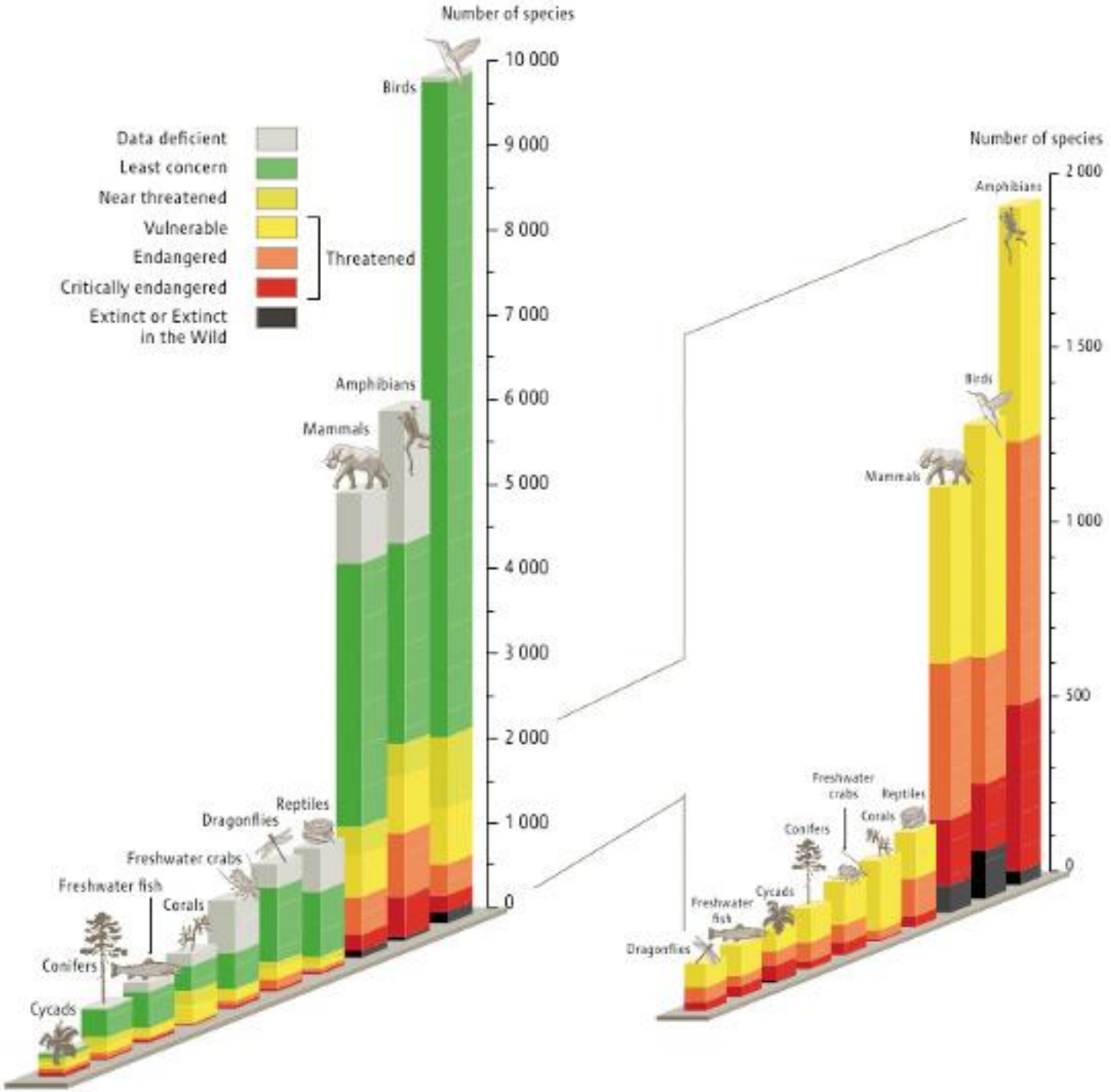

Biodiversity is Effected by Several Biotic and Abiotic Factors, but the Greatest Threat to Biodiversity is Human Impact

What caused the last great extinction?

What's causing this great extinction?


All genera
"Well-defined" genera
Trend line
"Big Five" mass extinctions
Other mass extinctions
5
4
3
2
1
0
542 500 450 400 350 300 250 200 150 100 50 0
Million years ago
Thousands of genera


Cumulative extinctions as % of IUCN-evaluated species
2.50
2.00
1.50
1.00
0.50
0.00
Mammals
Vertebrates
Birds
Other vertebrates
Background
1500-1600
1600-1700
1700-1800
1800-1900
1900-2010
Time interval


Number of species
10 000
9 000
8 000
7 000
6 000
5 000
4 000
3 000
2 000
1 000
0
Data deficient
Least concern
Near threatened
Vulnerable
Endangered
Critically endangered
Threatened
Extinct or Extinct in the Wild
Birds
Amphibians
Mammals
Reptiles
Dragonflies
Freshwater crabs
Freshwater fish
Corals
Conifers
Cycads
Number of species
2 000
1 500
1 000
500
0
Amphibians
Birds
Mammals
Freshwater crabs
Reptiles
Corals
Conifers
Cycads
Freshwater fish
Dragonflies

Threats to Biodiversity

write it down

- Threats:
  - Human Disreguard/Carelessness: Pollution, Overhunting, Invasive Species
  - Population Growth
- Biggest threats to biodiversity within an ecosystem deal with the elimination of a keystone species

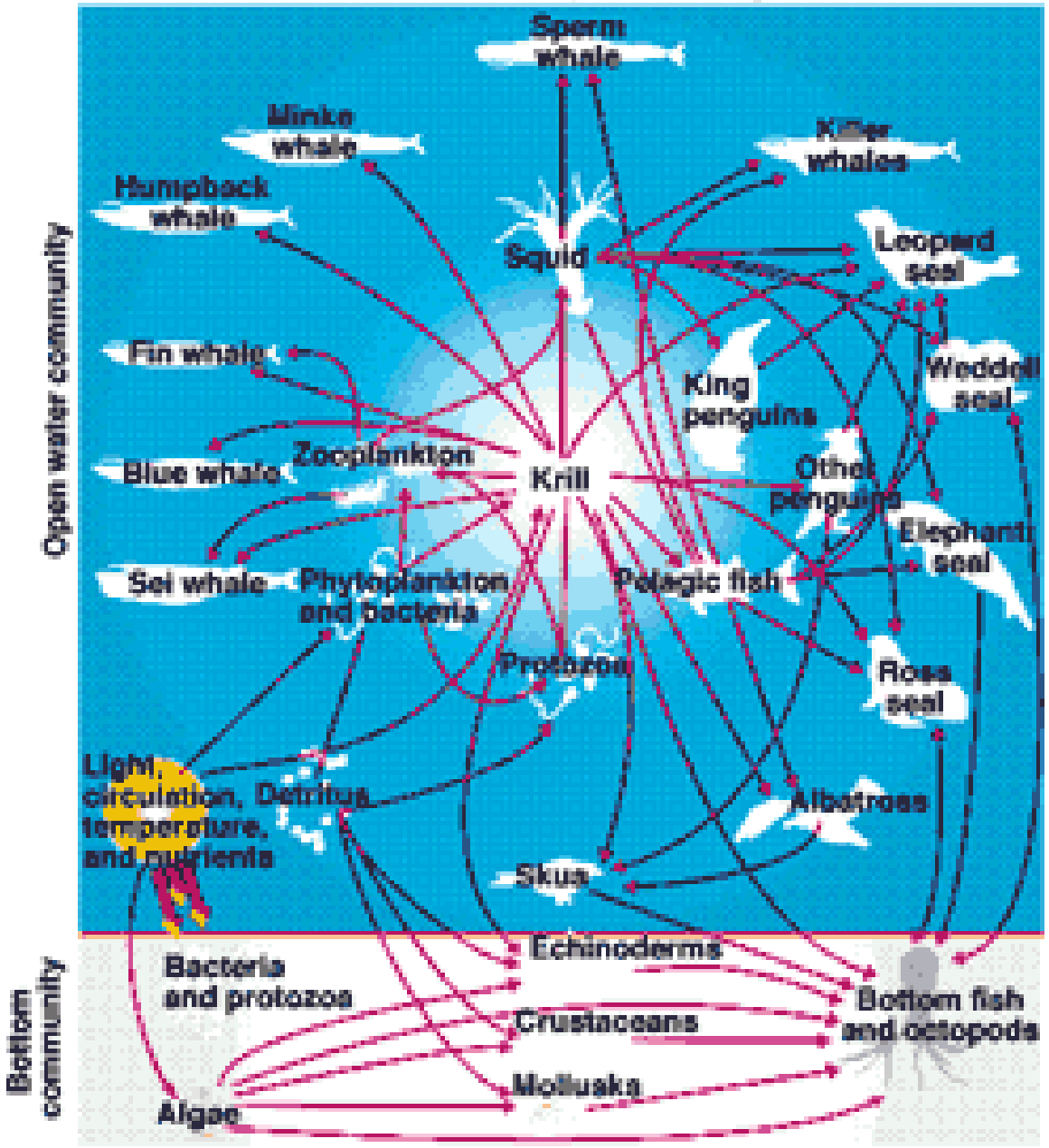
The biggest threat to biodiversity:

Loss of Keystone Species

A keystone species is a species that has a disproportionate effect on its environment relative to its abundance. Such species affect many other organisms in an ecosystem and help to determine the types and numbers of various others species in a community.

The prairie dog has long been hated by farmers and ranchers, but it is vital to many prairie species.

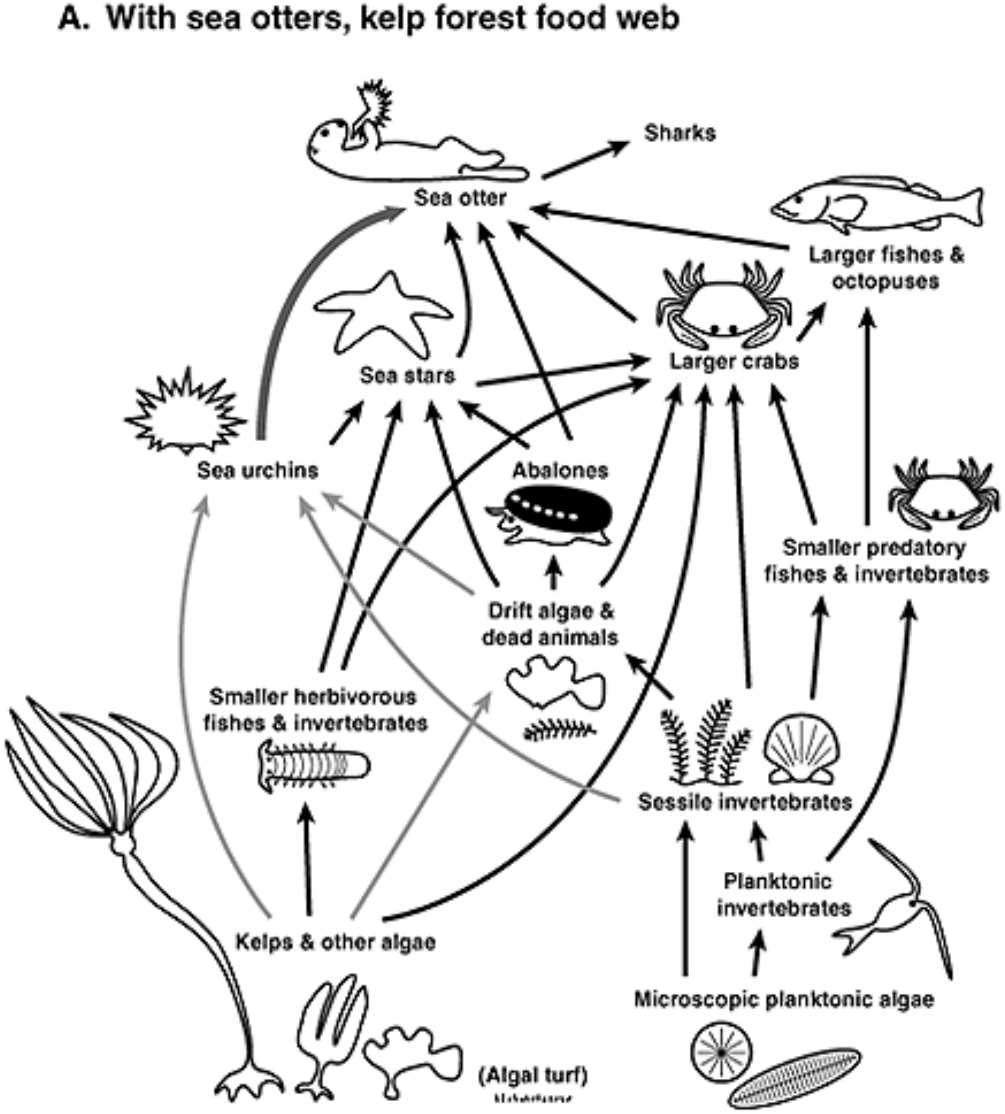
This gopher-tortoise is a an endangered keystone species, under protection in Mobile Country, AL.

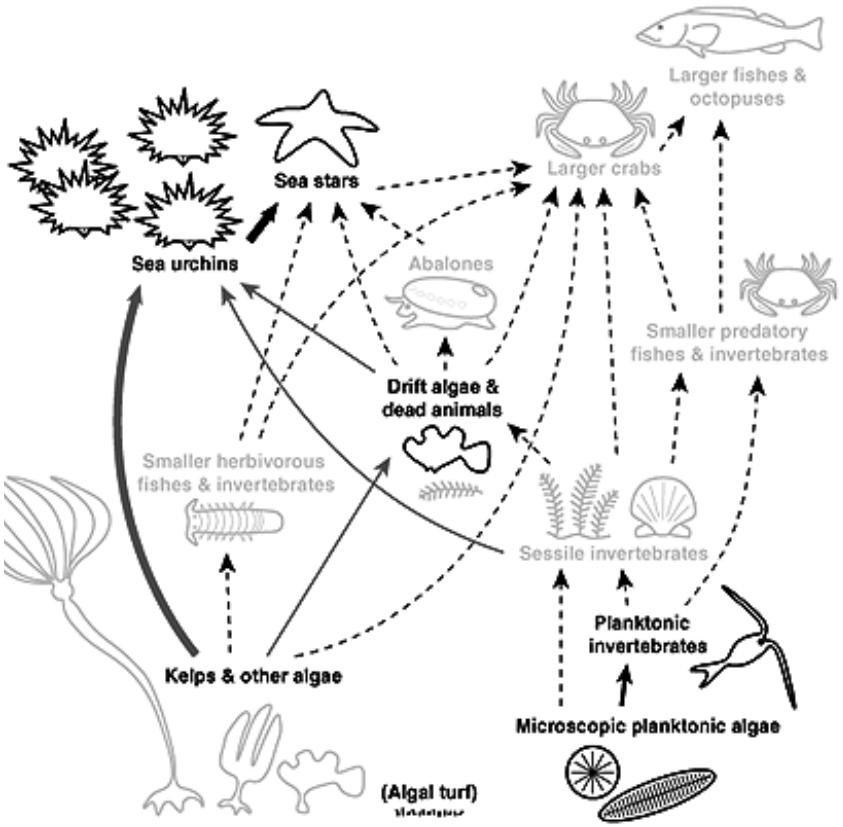


KRILL

Keystone species in the Antarctic

zoology.muohio.edu/oris/ZOO121/notes/Envs2003_07.htm





Otters are a keystone species on the Western Coasts of the US because they maintain the kelp beds; their predators are whales, sharks, and humans.

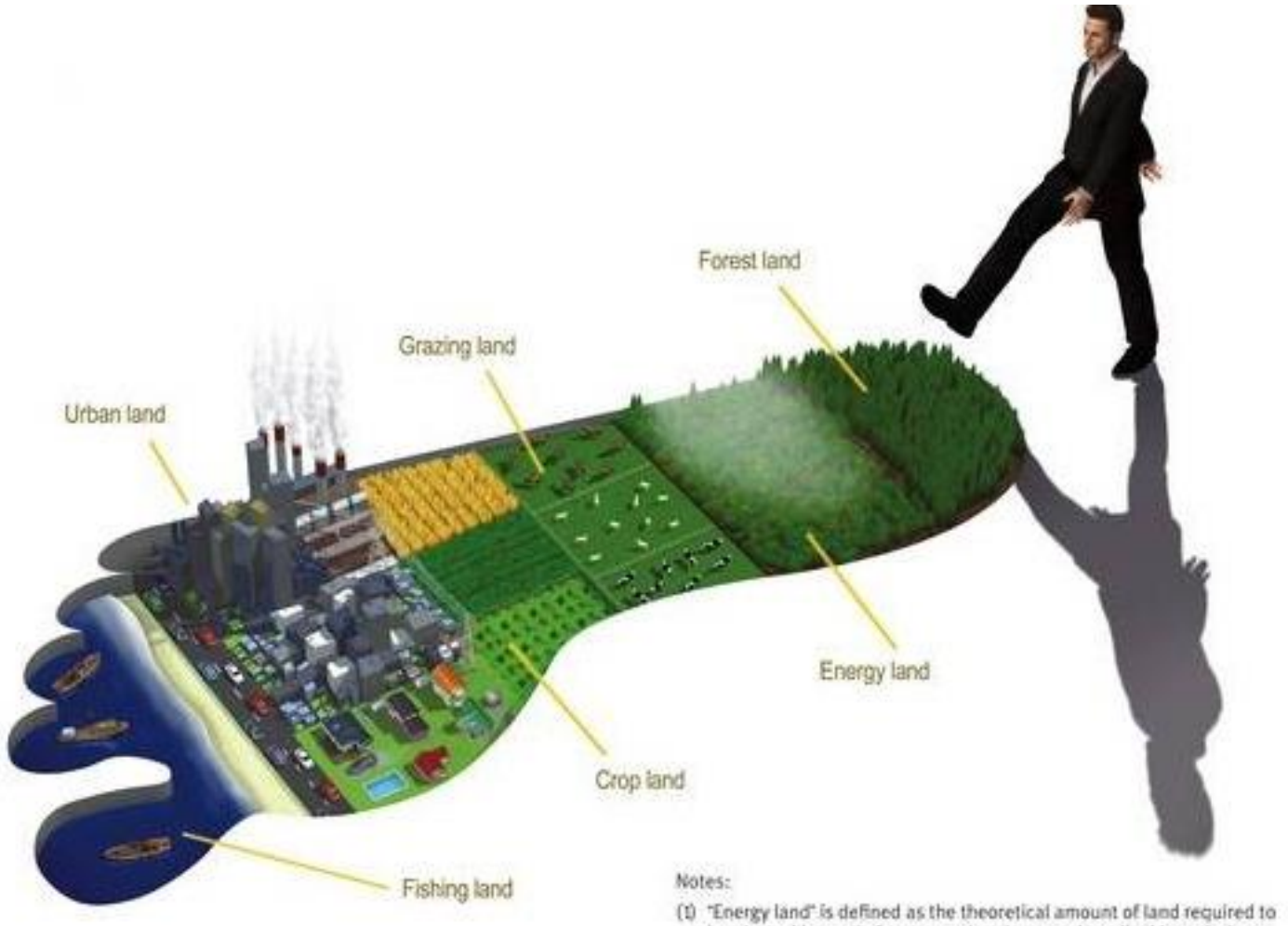
http://cbc.amnh.org/crisis/foodweb.html

Why care about BIODIVERSITY?

- The most major threats to biodiversity:
  - HUMANS!!! ☹
  - Human's Disregard and Carelessness
  - Population Growth: Estimated based on expected human population growth forecast a 7% increase in number of threatened species by 2020, and a 14% increase by 2050!

Isn’t this worth protecting?

Let's take a look at US now!



Notes:

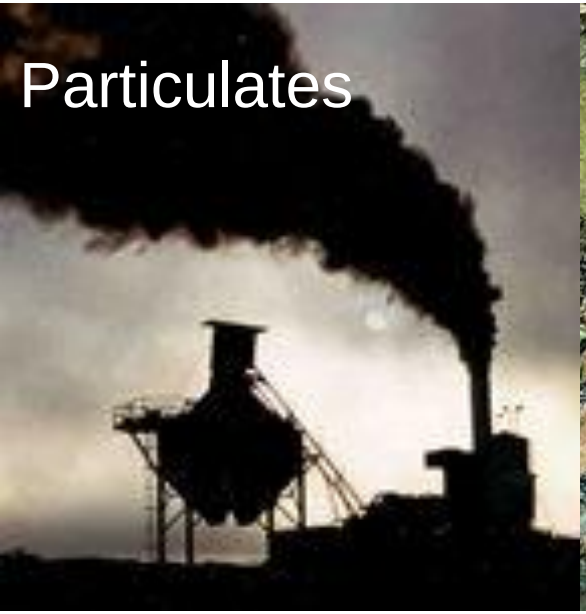
(1) "Energy land" is defined as the theoretical amount of land required to be planted in exotic forests to absorb our carbon dioxide emissions.

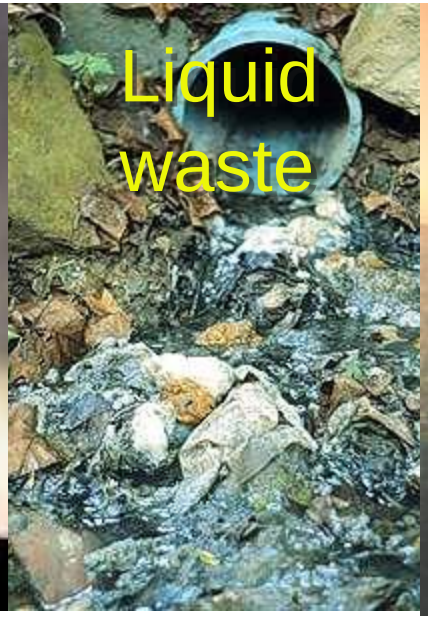
(2) "Fishing land" is the area required to support the fishing industry and the production of seafood.

Source: Ministry for the Environment.

One MAJOR impact…

Pollution - any addition of **matter** or **energy** that degrades the environment for humans and other organisms





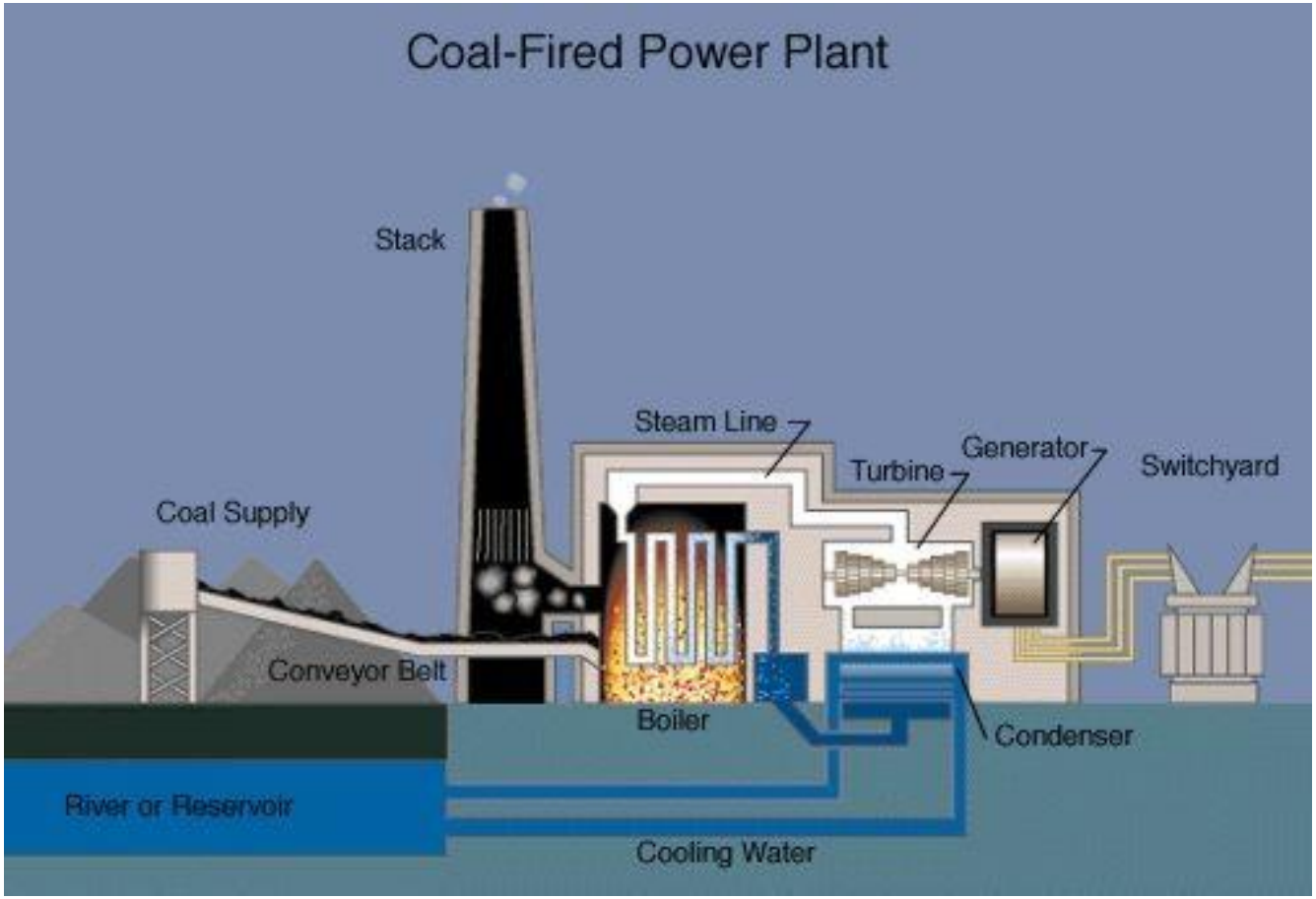
Function of population size and new technology

One major, pervasive impact…

Pollution - LIGHT

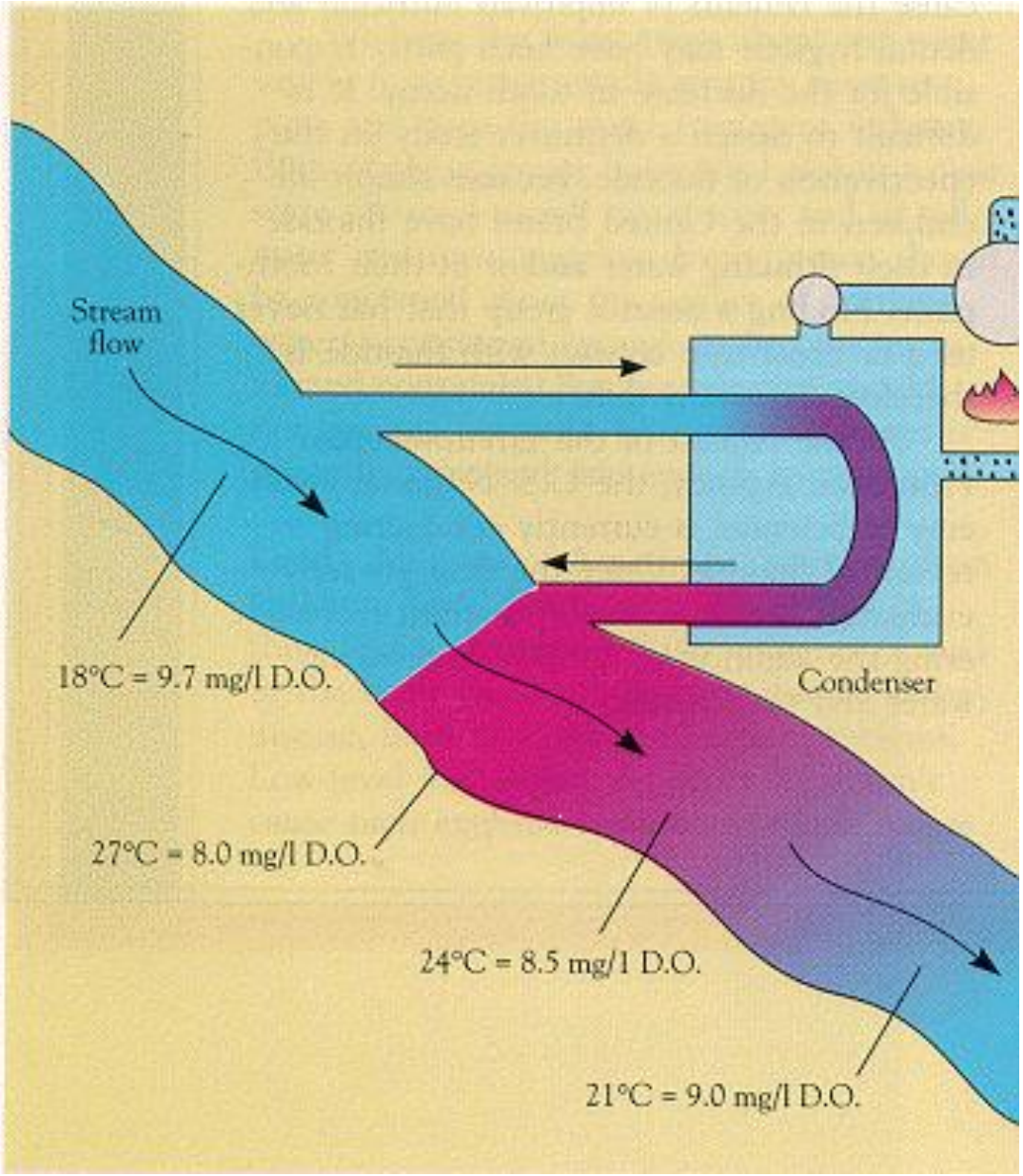
One major, pervasive impact…

Pollution - THERMAL



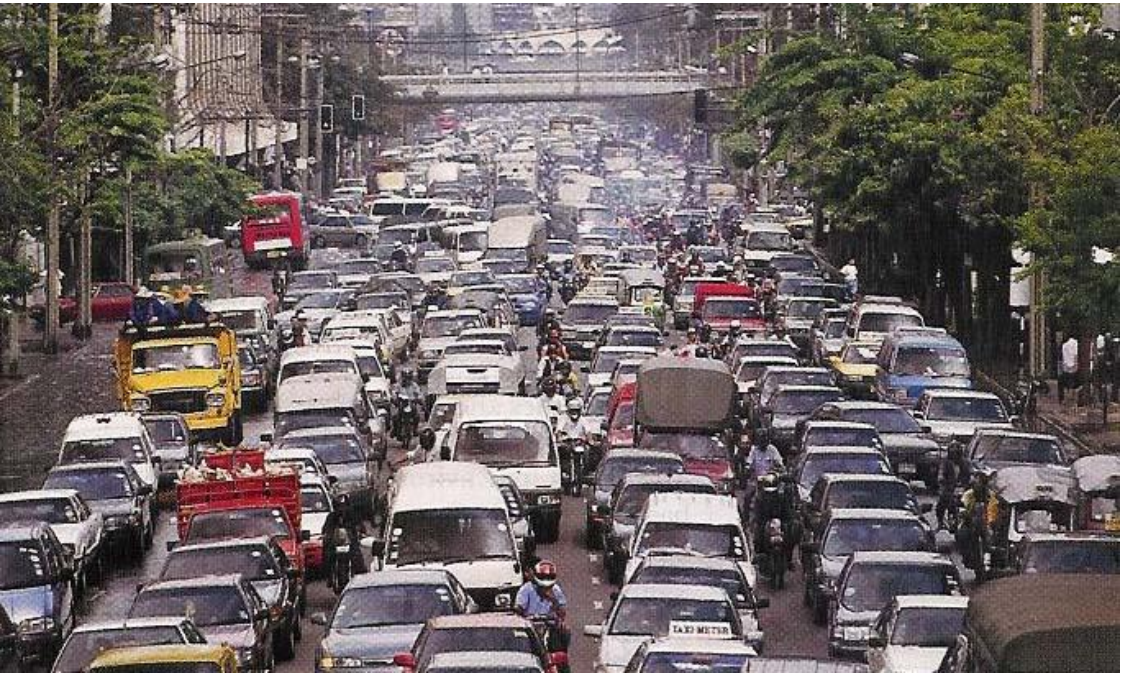
One major, pervasive impact…

Pollution - THERMAL



One major, pervasive impact…

Pollution - SOUND



One major, pervasive impact…

Pollution - SOUND

Pollution's effect on Biodiversity

Coral Reefs

- Coral Reefs cover 1% of the world's oceans
- 25% of all marine species live in coral reefs
  - And even more species use coral reefs as well, mostly as a nursery for larvae or juvenile stages.
  - Most commercially fished species have a connection to coral reefs

write it down

Youtube

- https://www.youtube.com/watch?v=kGRyNWrkG_w

Coral Reefs

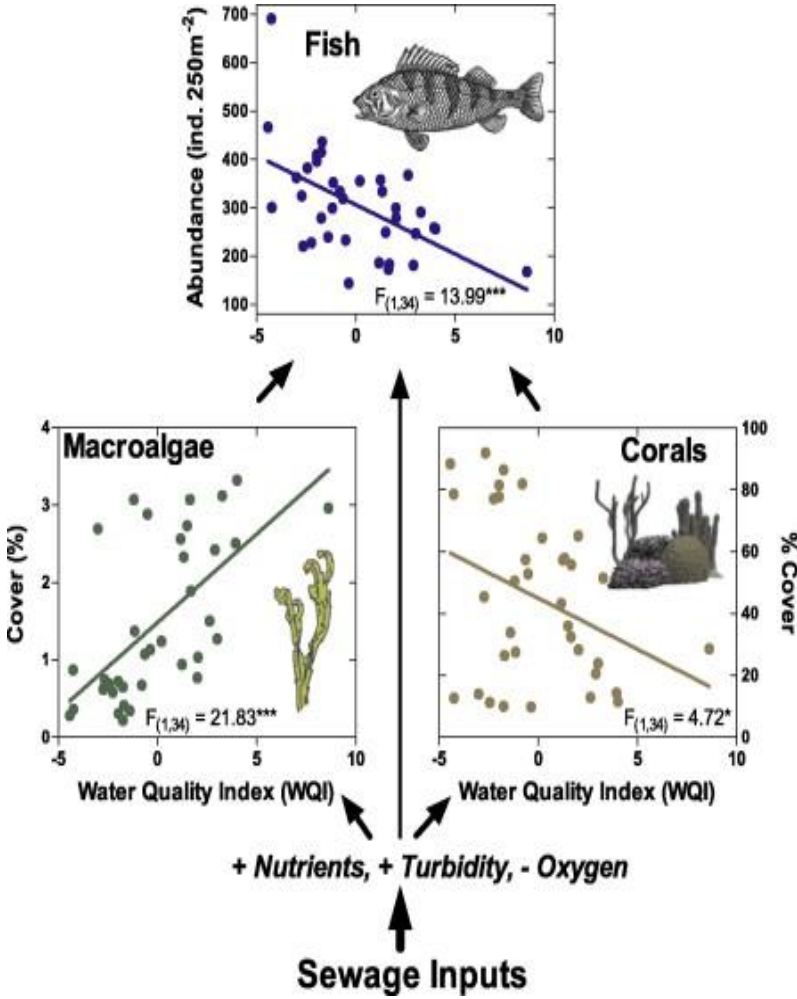
write it down

- Coral Reefs can only survive in oceans with clear water and few nutrients at the ideal temperature and depth.
- Backbone of coral reef is the coral polyp
- The Coral is a small organism that lives symbiotically with Zooxanthelle
  - A photosynthetic dinoflagellate

Coral Reefs and Pollution

write it down

- Pollution mostly from fertilizers or sewage causes increase of nutrients
- More nutrients cause increase of algae growth
- This decreases the oxygen and turbidity
- The photosynthetic Zooxanthelle cannot get enough light and coral dies



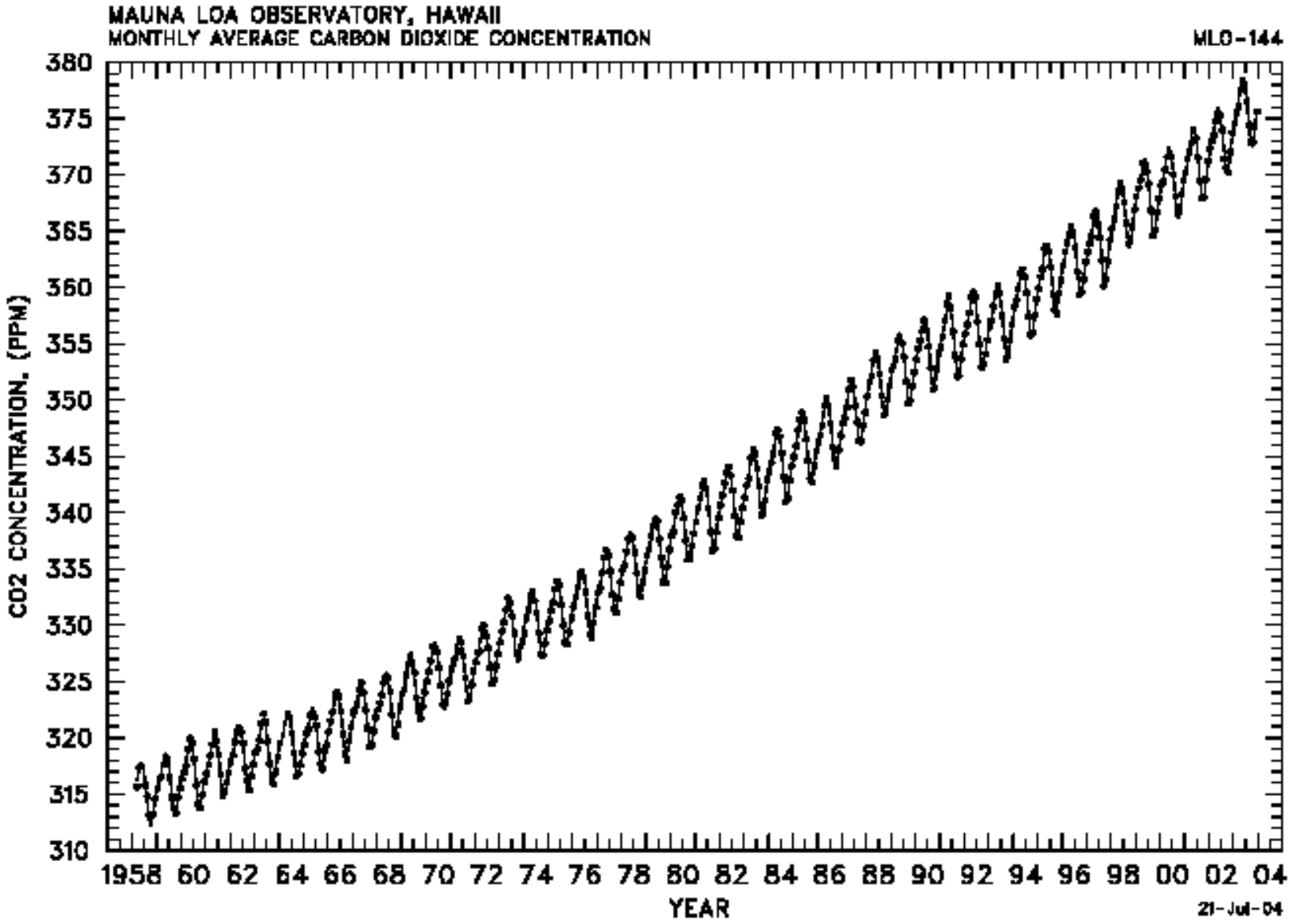
Loss of Biodiversity

- Loss of biodiversity come from death of coral.
- Which reduces the number of fish nurseries and amount of food.
- Many larval organisms die and adults are few.

Commercial Importance

- Reduced numbers of commercially fished fish
- Loss of possibilities for research

Pollution & Climate Change

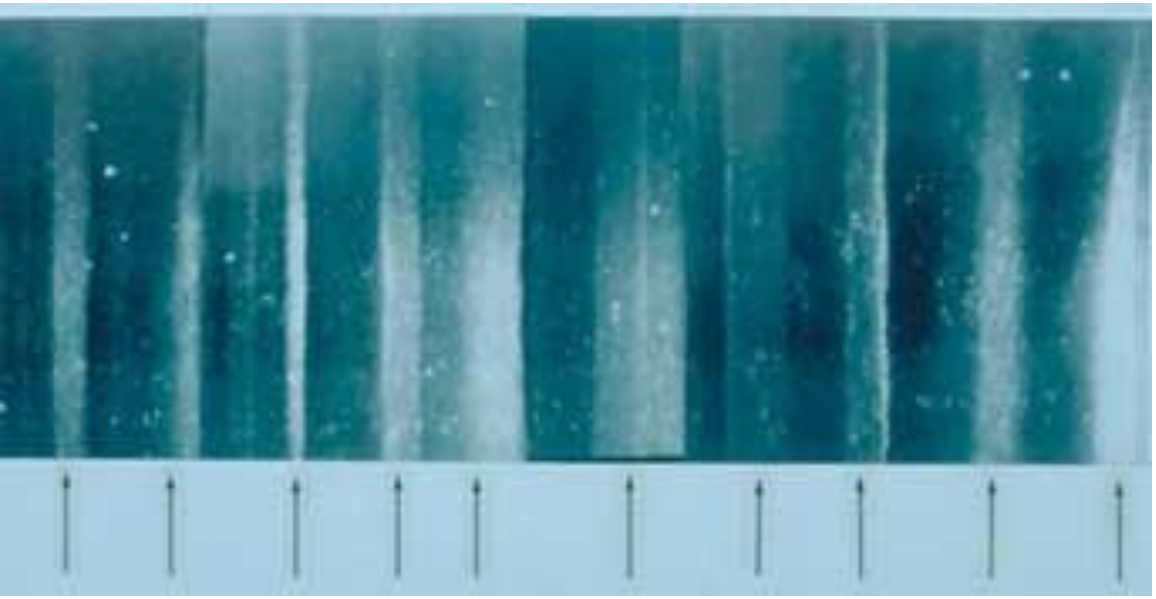


Pollution & Climate Change

- Current rapid build-up of 'greenhouse' gases (eg. CO_2)
- How do we know past climates?

Pollution & Climate Change

- Polar ice caps record history of recent pollution and historical climate change in build-up of ice layers



Other major human impacts

write it down

1) Movement of/ increased exposure to exotic species (including pathogens)
   - Problems of invasive species

Invasive Species

- non-native to the ecosystem whose introduction causes economic or environmental harm or harm to human health
- Second only to climate change in terms of impacy
- Implicated in the extinction of many species
- Introduced by human involvement primarily
  - (ex., soil with a population of native insects to another country)
- Also introduced by nature
  - (ex., flood carries microbial to another ecosystem)


Few predators
Out-compete for food and habitat
Adaptable
Invasive Species
Thrive in disturbed systems
Reproduce quickly

DON'T LET IT LOOSE!



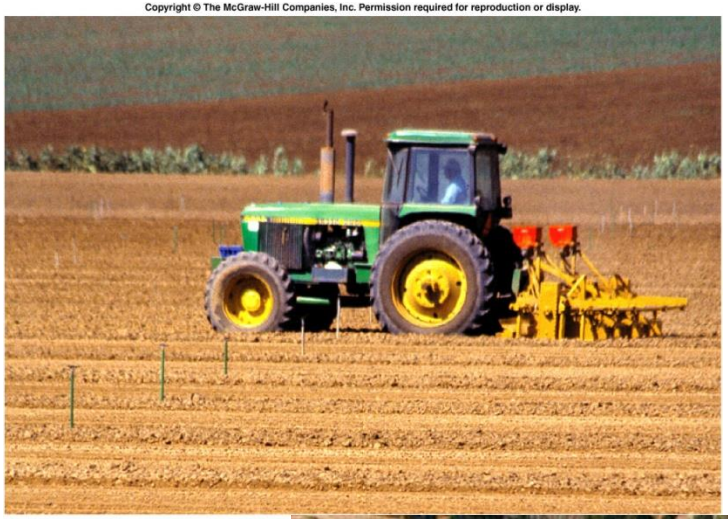




Other major human impacts

write it down

2) Modification of ecosystems to exploit resources



c.

Costs associated with resource use

1) Economic – monetary costs necessary to exploit resource (buy & modify land, labor, construction, etc.)

2) Energy – expended to exploit resource (ultimately converted to economic costs)

3) Environmental – change in environment due to resource exploitation (difficult to convert to economic costs, often deferred)

A common environmental cost:

Loss of Biodiversity and Extinction

Biodiversity –

variety and kinds of organisms and biological processes in an ecosystem

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variety and kinds of organisms and biological processes in an ecosystem

Natural systems are **more diverse** than human managed-ecosystems.

A common environmental cost:

Loss of Biodiversity and Extinction

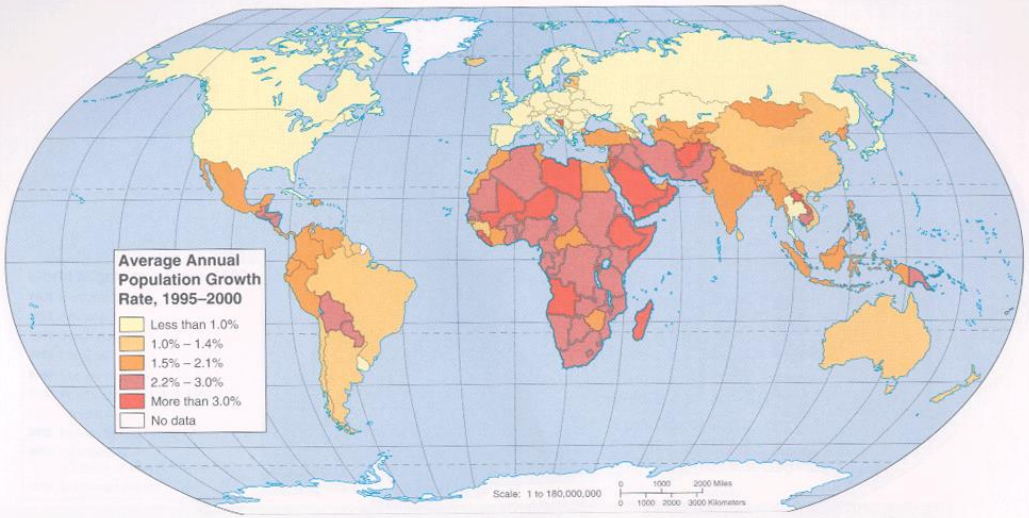
Biodiversity –

variety and kinds of organisms and biological processes in an ecosystem

Natural systems are **more diverse** than human managed-ecosystems.

As human use intensifies, biodiversity loss is inevitable.

Map 21 Population Growth Rates



Of all the statistical measurements of human population, that of the rate of population growth is the most important. The growth rate of a population is a combination of natural change (births and deaths), in-migration, and out-migration; it is obtained by adding the number of births to the number of immigrants during a year and subtracting from that total the sum of deaths and emigrants for the same year. For a specific country, this figure will determine many things about the country's future ability to feed, house, educate, and provide medical services to its citizens.

Some of the countries with the largest populations (such as India) also have high growth rates. Since these countries tend to be in developing regions, the combination of high population and high growth rates poses special problems for continuing economic development and carries heightened risks of environmental degradation. Many people believe that the rapidly expanding world population is a potential crisis that may cause environmental and human disaster by the middle of the twenty-first century.

Why worry about extinction?

write it down

- Ethical – Animals have a fundamental right to exist
- Ecological – Species play specific roles in ecosystem functioning
- Useful to humans
  - Medical – less than 1% of tropical forest species have been tested for pharmaceutical use, but 40% of drugs derived from plants

Extinction prevention

Legal Classifications:

Endangered – very low populations, could become extinct in very near future

Threatened – still exist in large numbers in current range, but are declining in most areas

- Could become extinct if critical environmental factor is changed

Extinction prevention

- Most biodiversity preservation interest occurs in developed countries. Most vulnerable species already eliminated.
- Less-developed and developing countries have both highest population growth and the majority of the world's species.
  - More concerned with immediate needs of food and shelter than long-range issues such as species extinction.

Types of resource exploitation

write it down

Terrestrial Ecosystems

- Fossil fuel and Minerals
- Agriculture
- Forests
- Rangelands

Fossil Fuel and Mineral Use

- Non-renewable resources
  - Fossil fuels (oil, natural gas, coal, etc.)
  - Ores/Minerals (eg. Iron, chromium, aluminum, nickel, tin, copper, uranium, gold, silver, etc.)
- Distribution not uniform, but no single country contains all resources
  - N.A. consumes >30% world minerals
- Easily available resources already exploited, increased pressure on protected areas

Fossil Fuel and Mineral Use

An example: COAL

Fossil Fuel and Mineral Use

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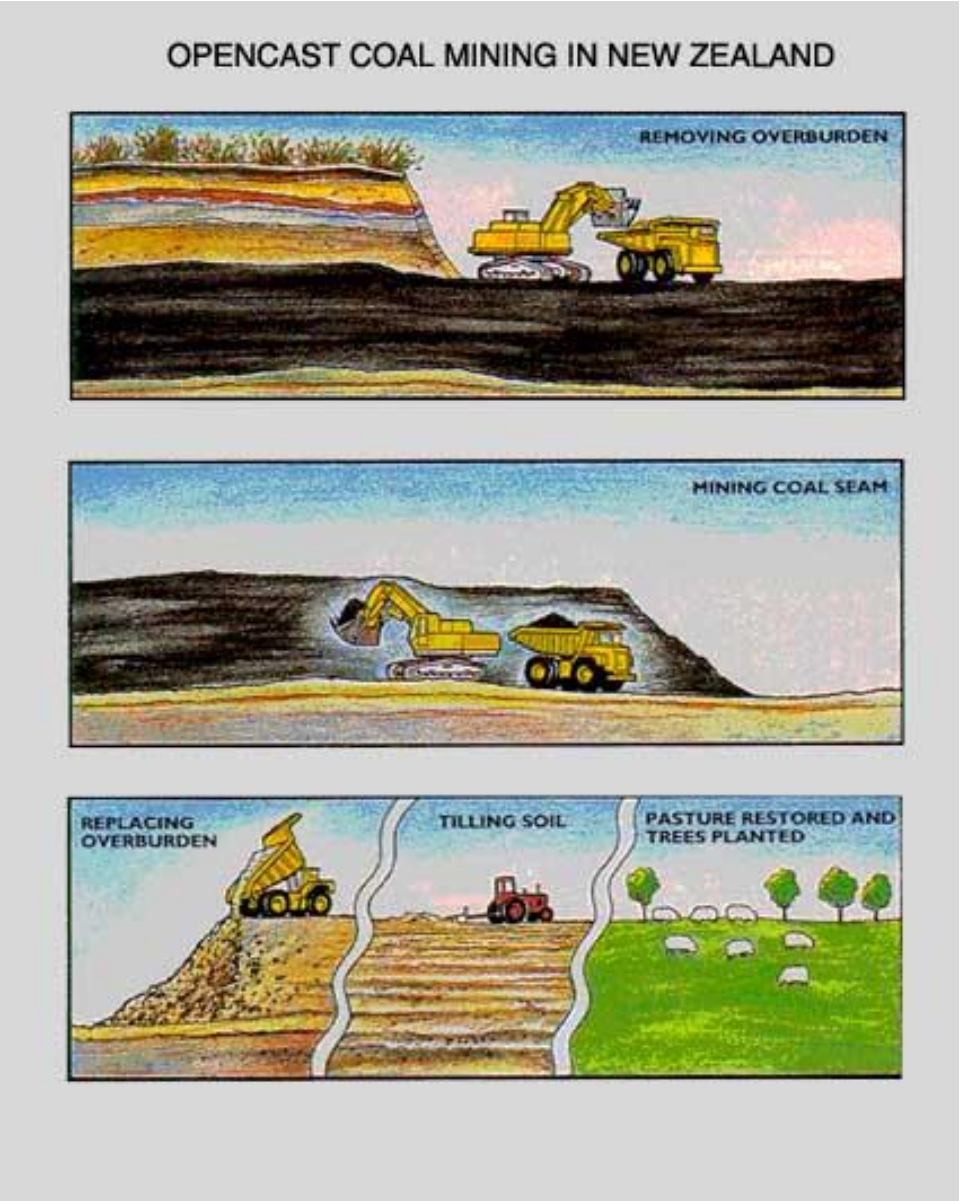
Fossil Fuel and Mineral Use

An example: COAL



Fossil Fuel and Mineral Use

An example: COAL

Agriculture

- 40% of earth's land surface converted to cropland & permanent pasture
- Near-complete loss of native vegetation
- Most productive ecosystems converted first: grasslands & forests
- High population densities can cause pressure to modify less productive ecosystems; can cause degradation
- More details later

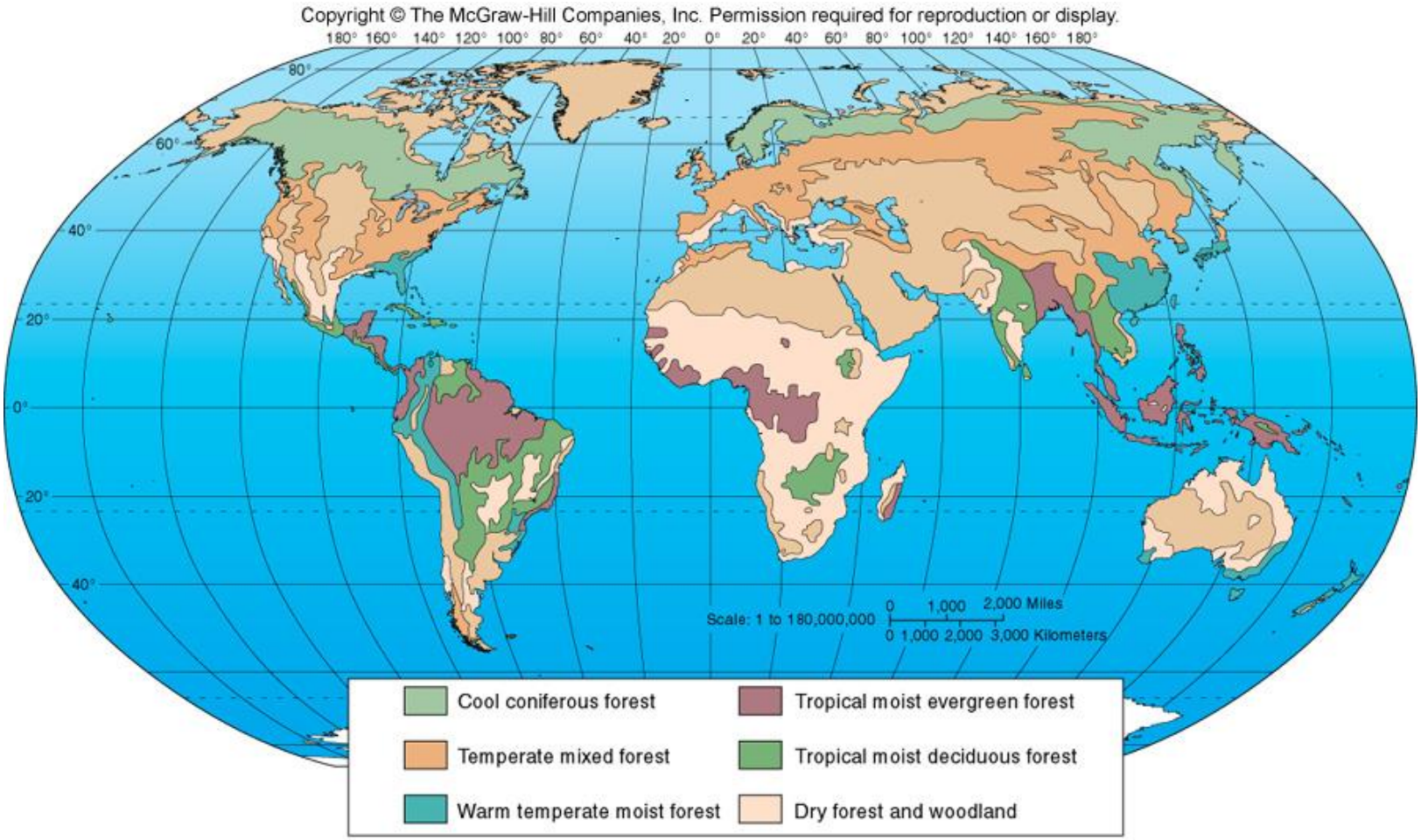
c.

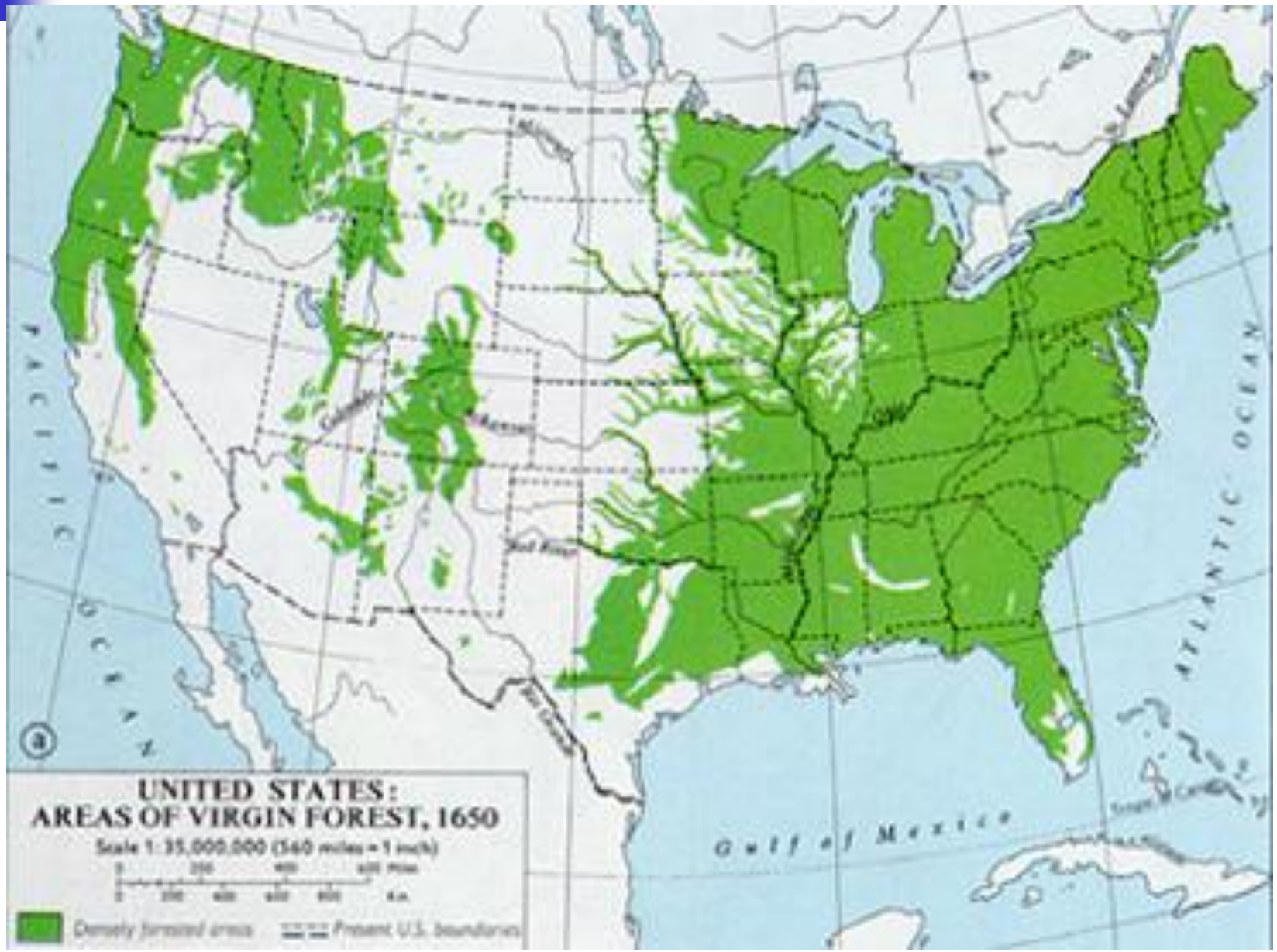
Forest ecosystems

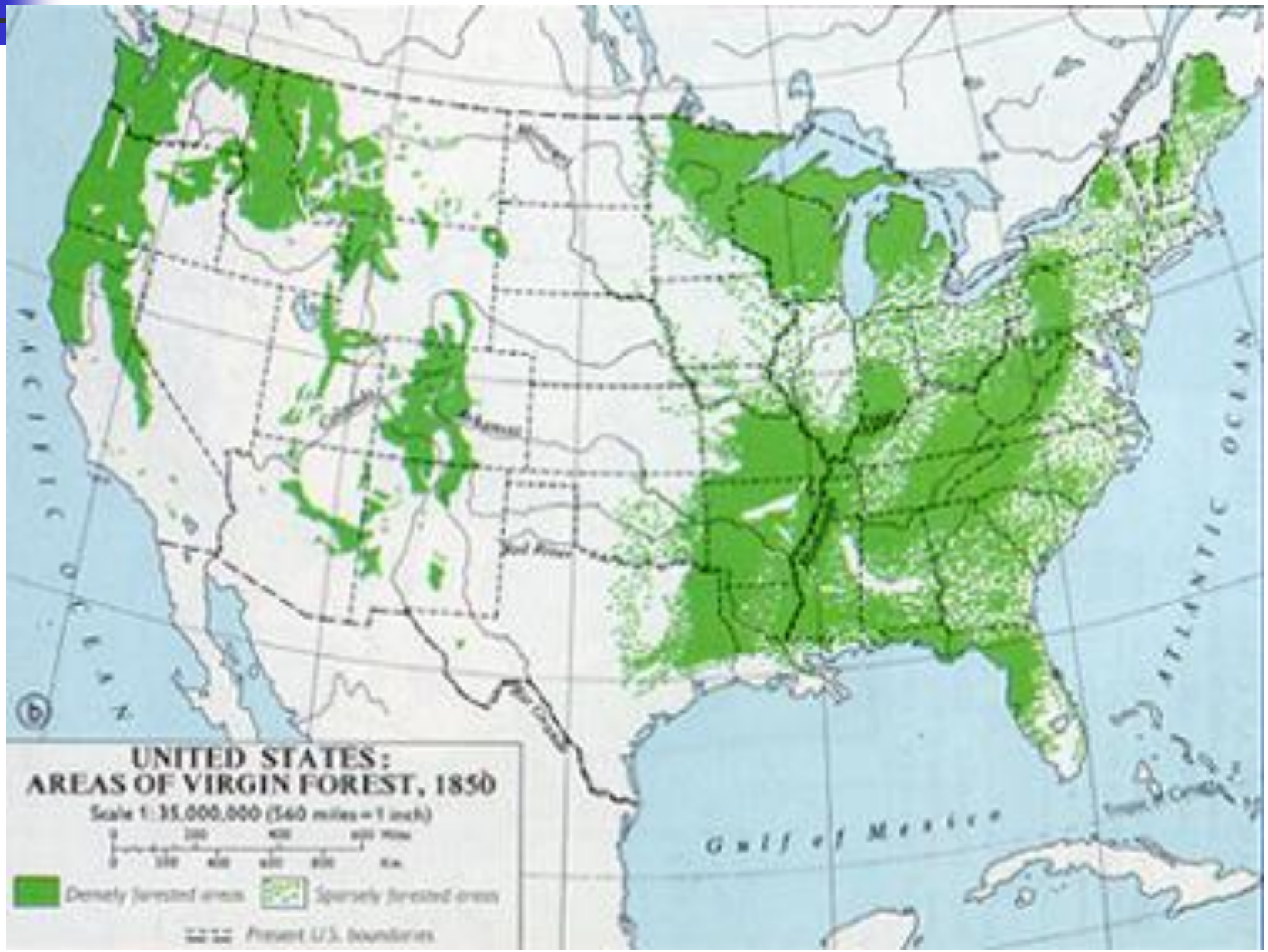
Human population growth puts forests under increasing pressure to provide wood products and agricultural lands

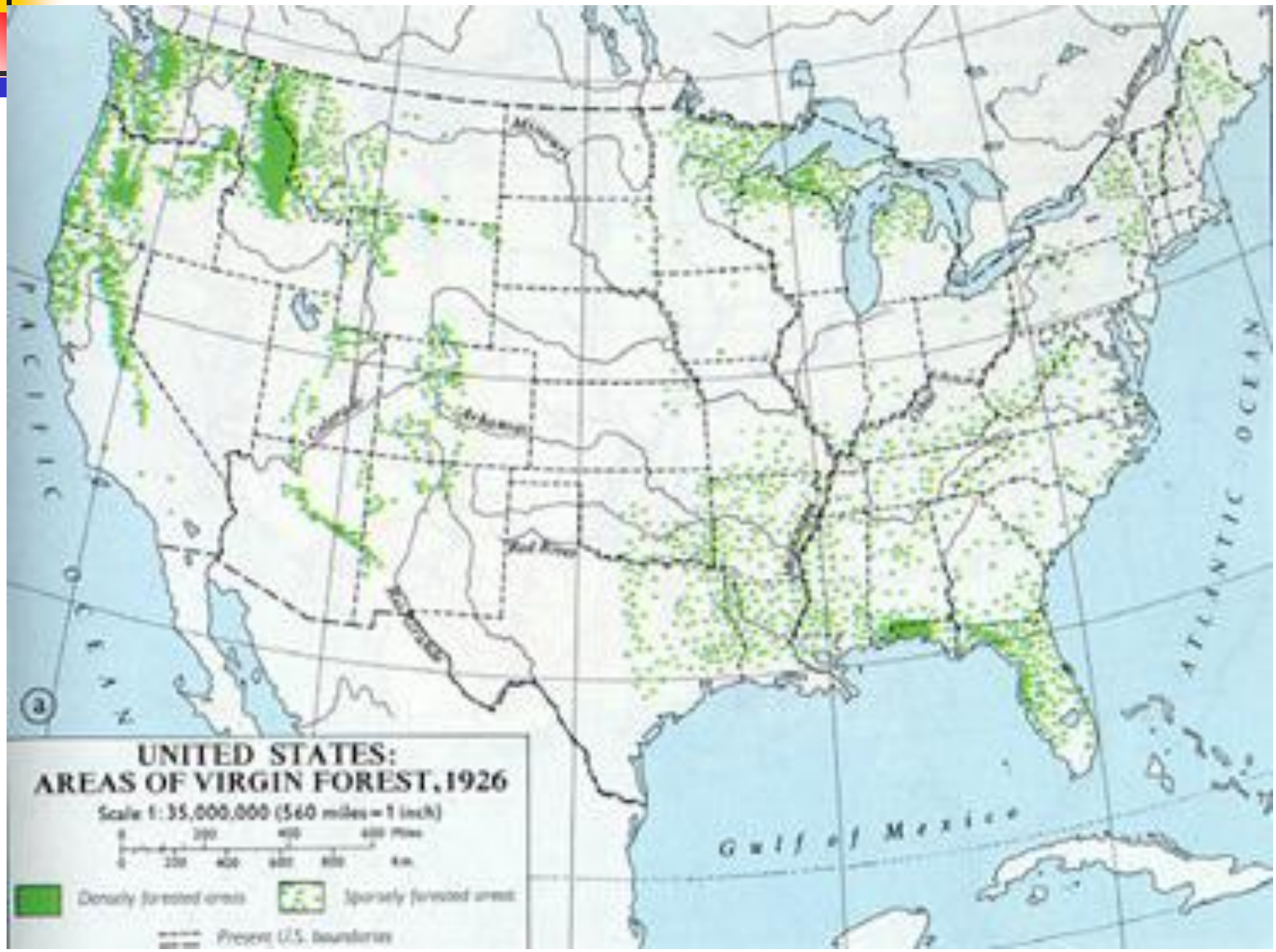
Managing forest ecosystems

- Much of U.S. and most of Canada and Europe originally forested




UNITED STATES:
AREAS OF VIRGIN FOREST, 1650
Scale 1: 35,000,000 (560 miles = 1 inch)
Densely forested areas
Present U.S. boundaries
PACIFIC OCEAN
ATLANTIC OCEAN
Gulf of Mexico


UNITED STATES:
AREAS OF VIRGIN FOREST, 1850
Scale 1:35,000,000 (560 miles = 1 inch)
Densely forested areas
Sparsely forested areas
Present U.S. boundaries
Gulf of Mexico
ATLANTIC OCEAN

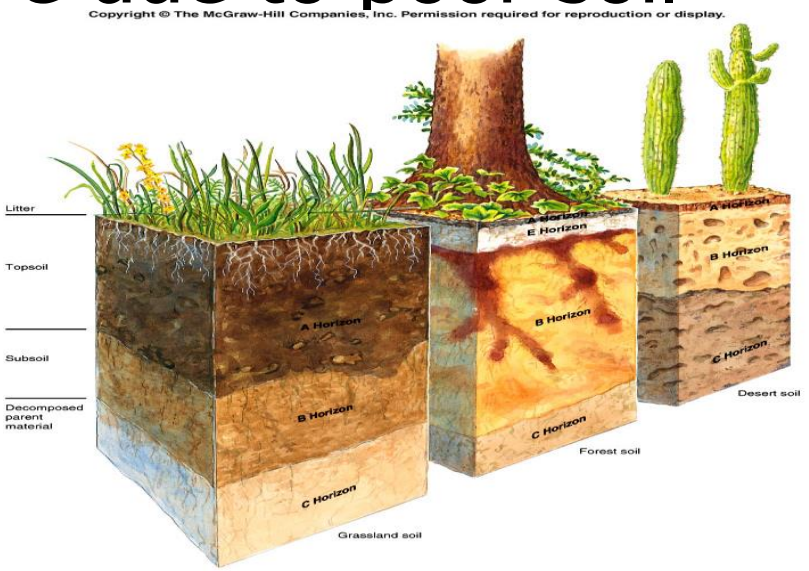

UNITED STATES:
AREAS OF VIRGIN FOREST, 1926
Scale 1: 35,000,000 (560 miles = 1 inch)
Densely forested areas
Sparsely forested areas
Present U.S. boundaries
Gulf of Mexico
ATLANTIC OCEAN
PACIFIC OCEAN

Environmental costs

- Forested areas effectively reduce erosion
  - road building in forests increases erosion
  - loss of soil & nutrients to erosion reduces productivity
- Forested areas modify climate
- Forests provide habitat for many species
- Forest recreation

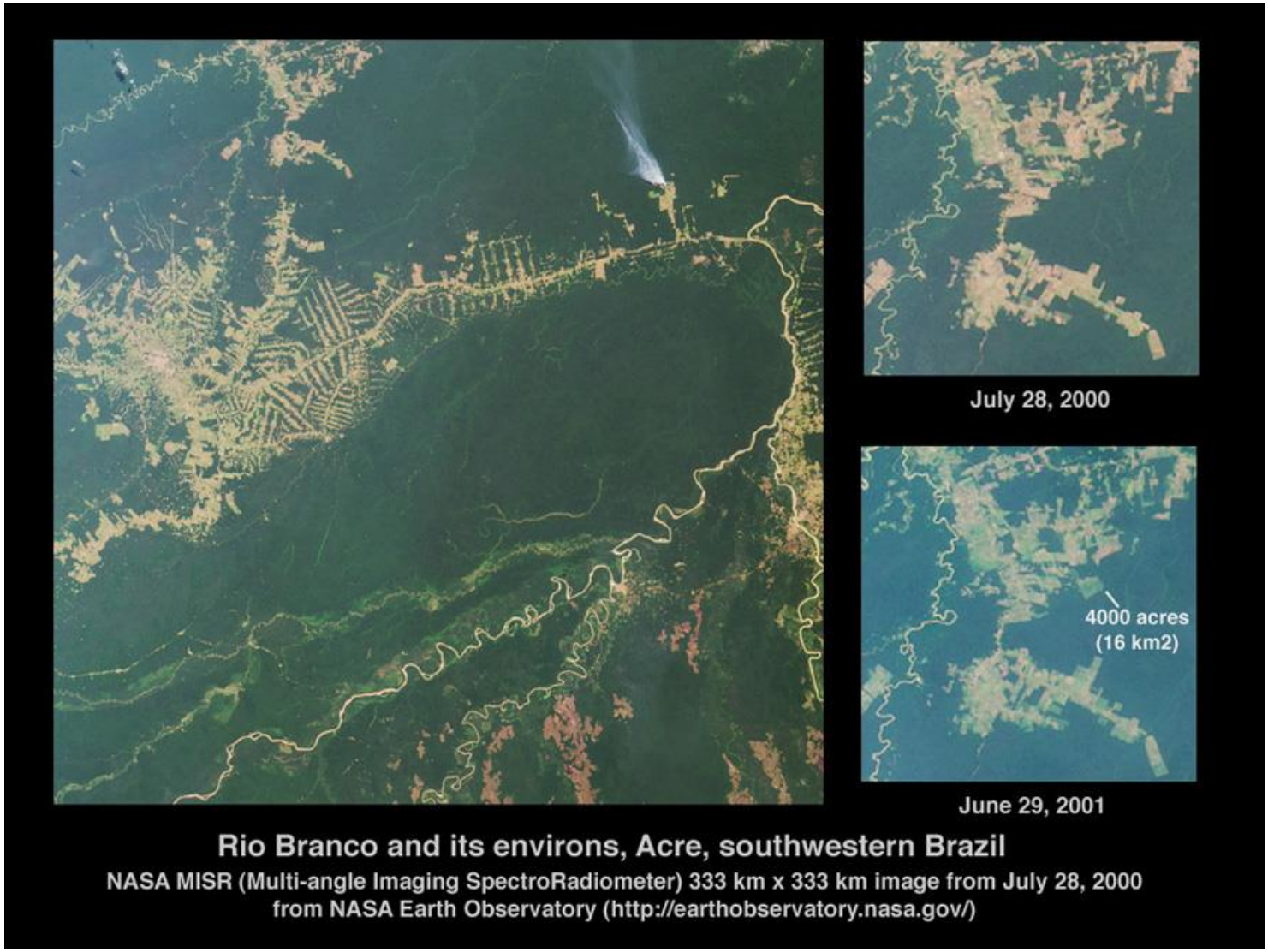
Tropical deforestation

- Tropical forests have greater diversity than any other ecosystem
- Often clear-cut, then burned to clear for agriculture
- Not easy to regenerate after logging or maintain agriculture due to poor soil characteristics



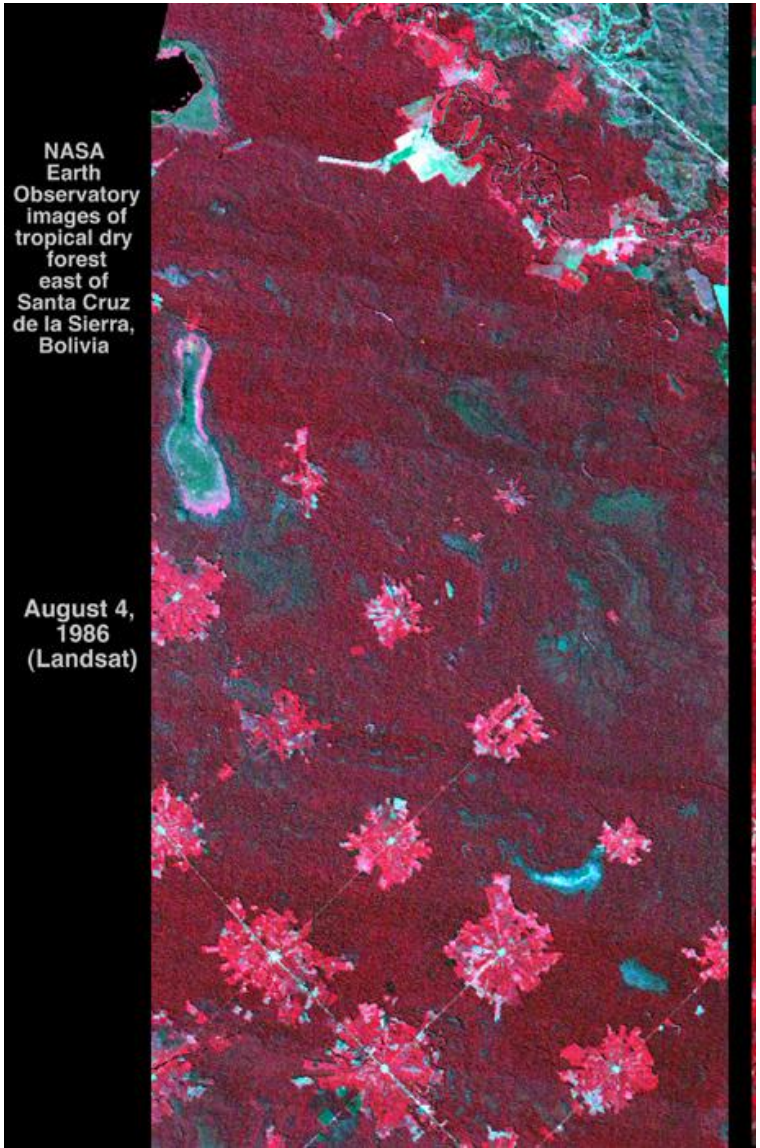
Tropical Deforestation Patterns

Typically starts along roads…



Tropical Deforestation Patterns

…or from centralized settlements.



Tropical Deforestation Patterns

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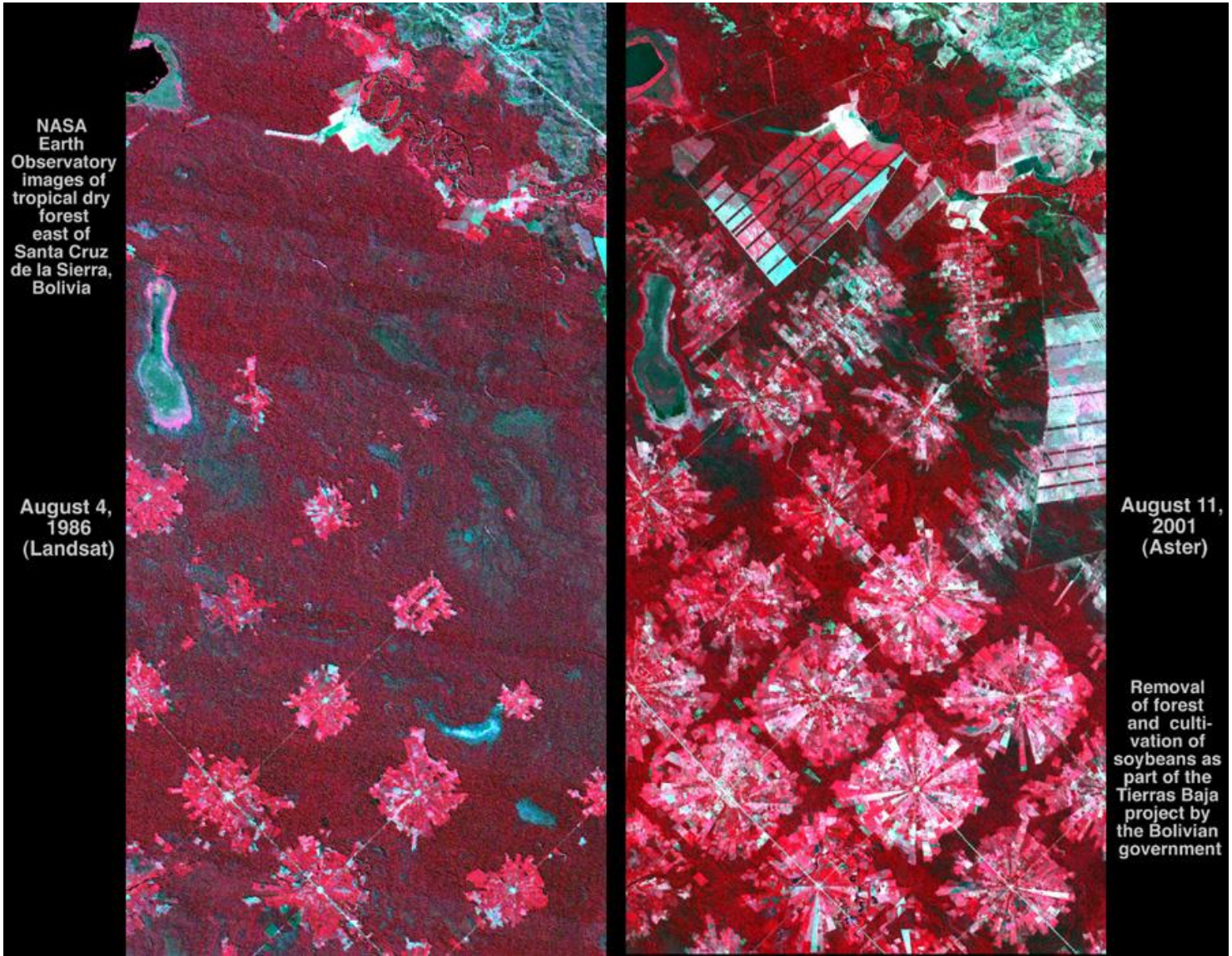


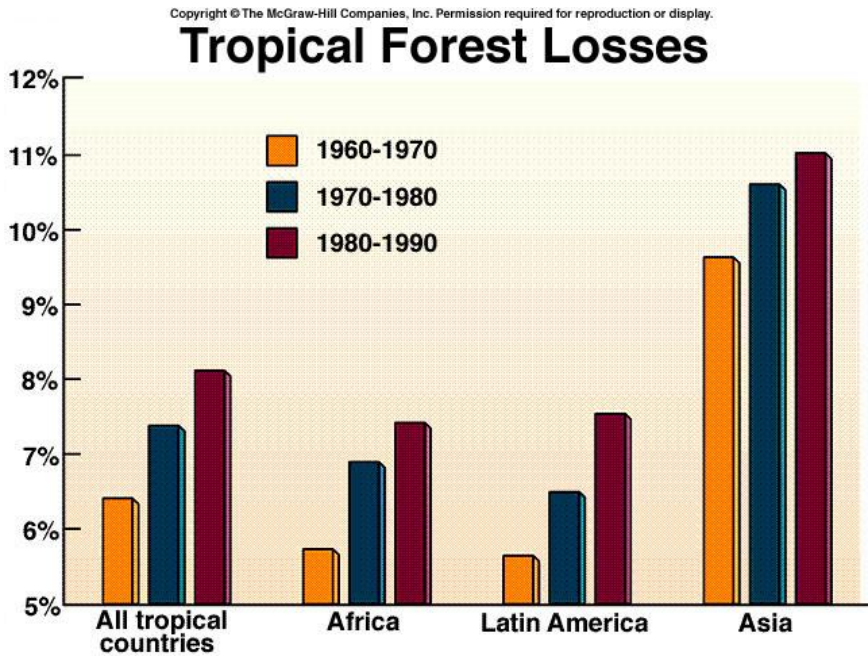
Tropical Deforestation Patterns

…or from centralized settlements.

Photograph by Compton Tucker (NASA GSFC) from NASA Earth Observatory website

Tropical deforestation

- Significantly reduces species diversity
- Impacts climate via lowered transpiration and reduced rainfall trapping – hotter & drier
- CO_2 trap – loss increases global warming
- Human population pressure greatest in tropics, and still increasing



Harvesting methods

1) Clear-cutting: economical, but leads to erosion, loss of plants and animals
   - fewer roads needed
   - reforestation necessary (conifers)
2) Patchwork clear-cutting: smaller, unconnected clearcuts
   - good for deer, rabbits
   - reduces need for reforestation

Harvesting methods

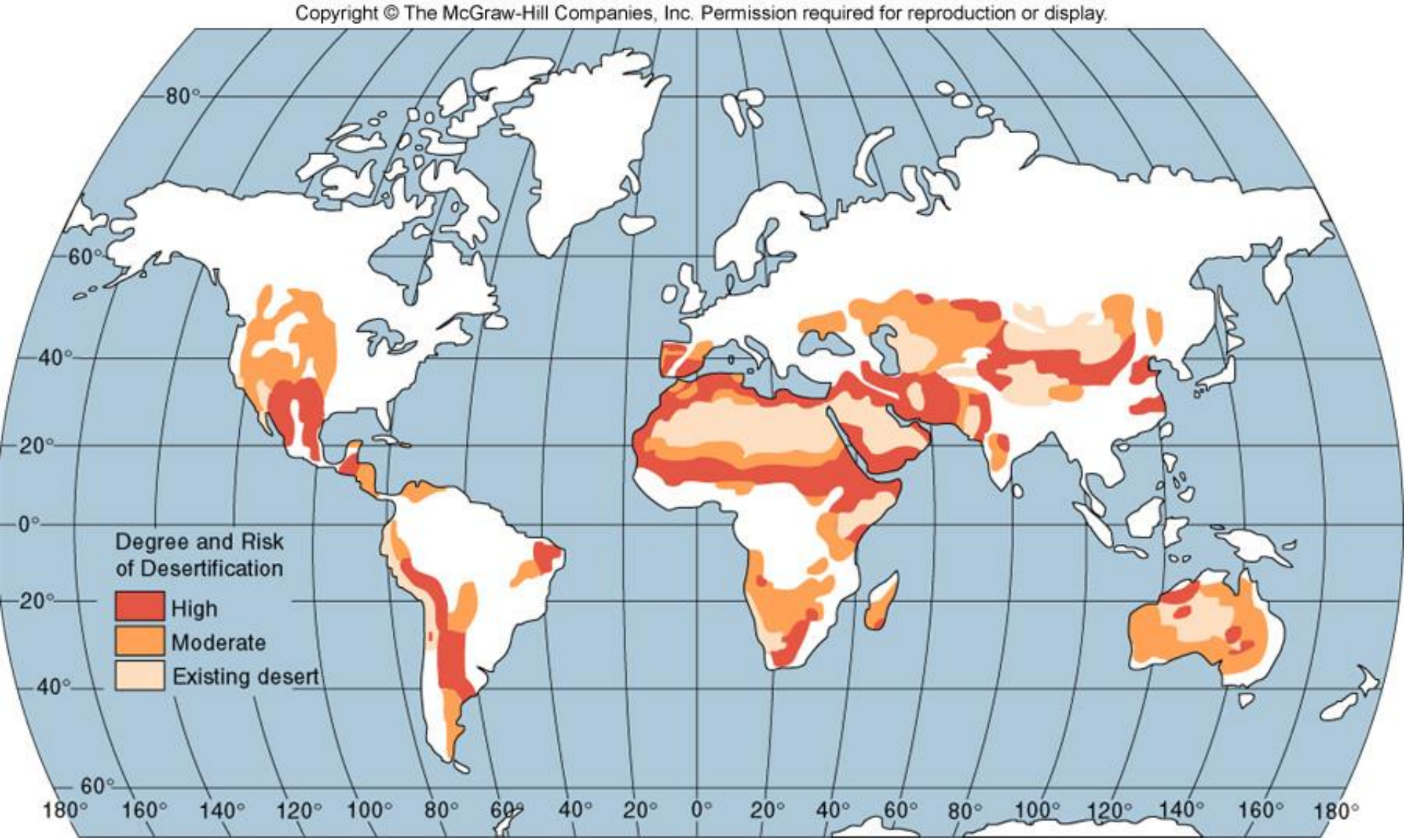
3) Selective harvesting: individuals trees taken

- Less economical
- More roads
- Leaves a more "natural" forest

Debate over "Healthy Forest Initiative"

- Bush policy to decrease risk of forest fires by allowing selective logging and stream-lining legal process
- Fire Prone Trees ≠ Desirable Timber Trees

Possible desertification



Desertification in China

Points to know

1. Know the 3 main ways humans impact the environment (pollution, movement of exotics & resource use)
2. What is pollution? What determines how much of it there is?
3. What are 3 types of material pollution? What are 3 types of energy pollution?
4. What three types of costs are associated with exploitation of resources? Which ones are immediate or delayed and why?
5. What are some problems with loss of biodiversity and extinction? What is a fundamental challenge in trying to prevent extinction?
6. Know 4 types of resource exploitation in terrestrial ecosystems
7. What are some limitations of recycling mineral materials?
8. Why is tropical deforestation a big problem?
9. What is desertification? What causes it?