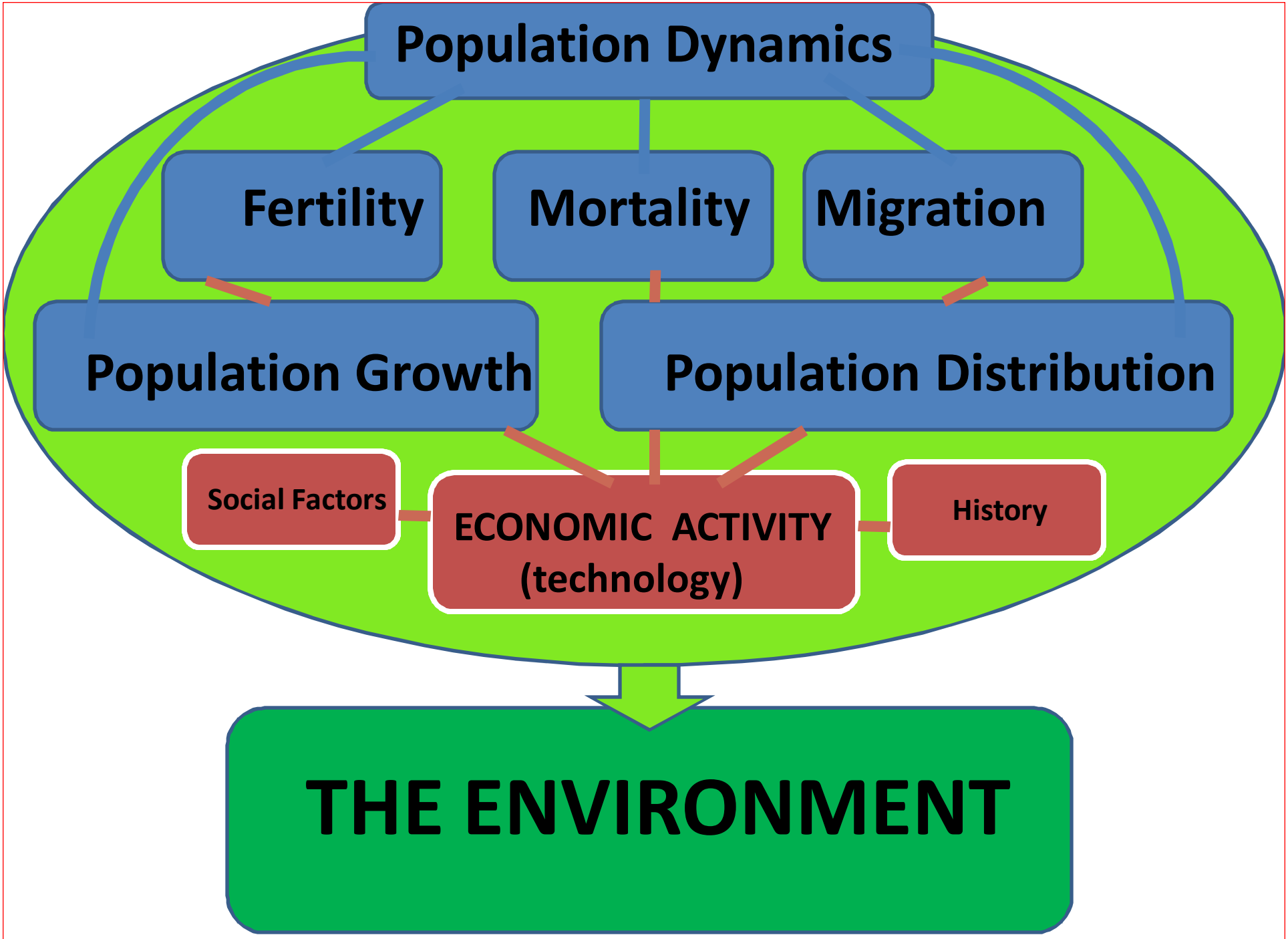
Population and the Environment

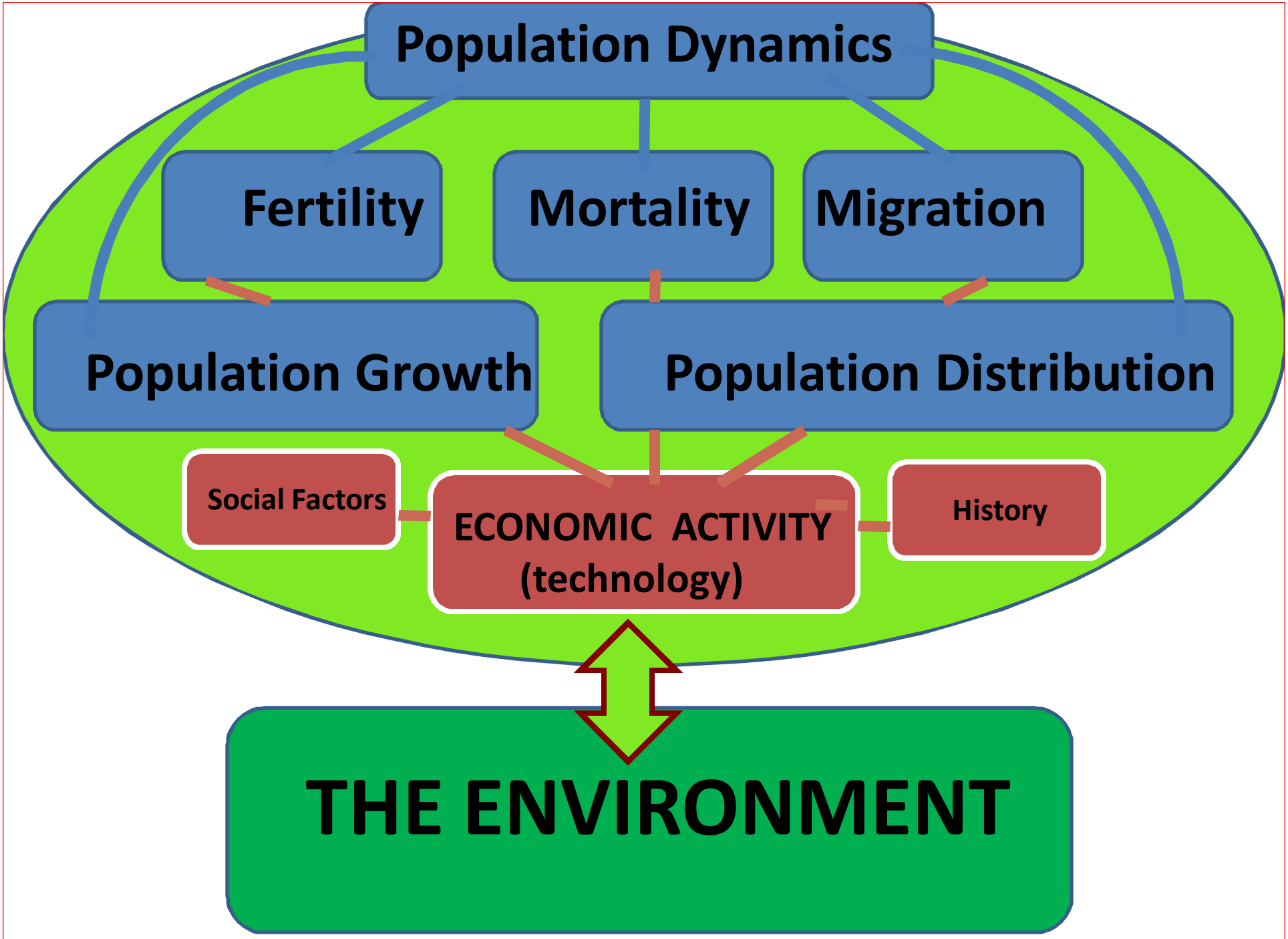
Key Terms

- Environmental degradation
- Pollution
- Crowding
- Deforestation
- Ecological diversity
- Overgrazing


Population Dynamics
Fertility
Mortality
Migration
Population Growth
Population Distribution
Social Factors
ECONOMIC ACTIVITY
(technology)
History
THE ENVIRONMENT

What is the Difference between the diagram above and the diagram in the next slide?

Is the difference important ?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THE ISSUES

“As the century begins, natural resources are under increasing pressure, threatening public health and development. Water shortages, soil exhaustion, loss of forests, air and water pollution, and degradation of coastlines afflict many areas. As the world's population grows, improving living standards without destroying the environment is a global challenge.”

“Most developed economies currently consume resources much faster than they can regenerate. Most developing countries with rapid population growth face the urgent need to improve living standards. As we humans exploit nature to meet present needs, are we destroying resources needed for the future?”

KEY POINTS

- Natural resources under pressure
- Public health being threatened
- Impacts on development
- Water shortages
- Soil exhaustion
- Loss of forests
- Air, water, and soil pollution
- Degradation of coastlines
- Consumption far outstripping the pace of resource regeneration
- LDC much more heavily impacted due to rapid population growth.

THE ISSUES

In the past decades, in every environmental sector, conditions have either failed to improve, or they are worsening:

- **Public health.** Contaminated water, along with poor sanitation, kills over 12 million people each year, mostly in developing countries. Air pollution kills nearly 3 million more. Heavy metals and other contaminants also cause widespread health problems.
- **Food supply.** Will there be enough food to go around? In 64 of 105 developing countries studied by the UN Food and Agriculture Organization, the population has been growing faster than food supplies. Population pressures have degraded some 2 billion hectares of arable land—an area the size of Canada and the US.

➢ **Freshwater.** The supply of freshwater is finite, but demand is soaring as population grows and use per capita rises. By 2025, when world population is projected to be 8 billion, 48 countries (containing 3 billion people) will face shortages.

http://www.infoforhealth.org/pr/m15edsum.shtml

THE ISSUES

"Coastlines and oceans. Half of all coastal ecosystems are pressured by high population densities and urban development. A tide of pollution is rising in the world's seas. Ocean fisheries are being overexploited, and fish catches are down.

Forests. Nearly half of the world's original forest cover has been lost, and each year another 16 million hectares are cut, bulldozed, or burned. Forests provide over US$400 billion to the world economy annually and are vital to maintaining healthy ecosystems. Yet, current demand for forest products may exceed the limit of sustainable consumption by 25%.

Biodiversity. The earth's biological diversity is crucial to the continued vitality of agriculture and medicine—and perhaps even to life on earth itself. Yet human activities are pushing many thousands of plant and animal species into extinction. Two of every three species is estimated to be in decline.

Global climate change. The earth's surface is warming due to greenhouse gas emissions, largely from burning fossil fuels. If the global temperature rises as projected, sea levels would rise by several meters, causing widespread flooding. Global warming also could cause droughts and

Climate Change is not a new Phenomenon.
The Impacts of Early Civilizations:

What was the impact of early people on their environment?

- **The most destructive weapon early humans had was fire** (was Australia made a desert by use of fire?)
- **"Humans have utilized fire for at least half a million years."**
- **The development of farming techniques and diffusion of agriculture around the world significantly increased human ability to negatively impact the environment**

Hunter-gatherers

- **Species of big game became extinct in Africa around 50,000 BP – this may have prompted colonisation of Europe.**
- **Australia was colonised 30,000-40,000 BP. Big game species disappeared around the same time.**
- **Siberia was colonised about 20,000 BP.**
- **North America and South America were colonised by 12,000 BC via Bering Straits and Alaska. Big game species became extinct around 11,000 BC.**
- **http://www.nuim.ie/staff/dpringle/courses/mg/lectures.shtml**

Did Humans Cause Ecosystem Collapse In Ancient Australia?

Science Daily (July 8, 2005) — Washington, D.C. -- Massive extinctions of animals and the arrival of the first humans in ancient Australia may be linked, according to scientists at the Carnegie Institution, University of Colorado, Australian National University, and Bates College.* The extinctions occurred 45,000 to 55,000 years ago. The researchers traced evidence of diet and the environment contained in ancient eggshells and wombat teeth over the last 140,000 years to reconstruct what happened. The remains showed evidence of a rapid change of diet at the time of the extinctions. The researchers believe that massive fires set by the first humans may have altered the ecosystem of shrubs, trees, and grasses to the fire-adapted desert-scrub of today. The work is published in the July 8, issue of Science.

http://www.sciencedaily.com/releases/2005/07/050708061424.htm

Settled Agriculturalists

1. **Population density: Agriculture supported much higher population densities – 10x to 100x hunter gathering.**
2. **Diet: Diets deteriorated due to dependence upon cereals, resulting in beri-beri, pellagra, riboflavin deficiency rickets and kwashiorkor.**
3. **Permanent settlements: water-borne infections due to sewerage contamination of water supplies; rodent transmission of disease due to stored food.**

http://www.nuim.ie/staff/dpringle/courses/mg/lectures.shtml

4. **Animal contacts: Diseases such as flu, the common cold, smallpox, measles, and mumps mutated from animal diseases. Increase in helminth infestations.**
5. **Land clearances: Mosquito transmitted diseases such as yellow fever, malaria, dengue and several kinds of viral encephalitis.**
6. **Scrub: Rickettsial diseases transmitted by ticks (e.g. scrub typhus, endemic typhus).**
7. **Fertilisers: Night soil increased faecal bacterial and worms.**

http://www.nuim.ie/staff/dpringle/courses/mg/lectures.shtml

"**Population growth** was one response to improved agriculture; it further increased the need for food and made it impossible for agricultural people to avoid altering the ecosystem"

One notable example is the decimation of forests; this started in the Near East and spread to Europe.

"The collapse of numerous ancient agricultural systems has been traced to ecological imbalances"

-Soil erosion

-Desiccation

-Stalinization

-Pollution (?)

Yes, pollution !

“Pollution of air and water is not just a product of modern society…”

The rise of early cities and the concentration of people in a small area is among the early causes of environmental stress and degradation.

“When Juan Cabrillo visited California in 1542, he noted that while anchored in San Pedro Bay he could see the mountain peaks in the distance but not their bases. A thermal inversion in the area trapped the smoke from Amerindian fires….”

Collapse of the Maya Civilization

"Archaeologists currently researching the collapse of the Classic Maya seek to explain what caused this great civilization to decline so suddenly. The three main reasons for the collapse that are argued about today are climate change, poor agriculture, and warfare.

Some archaeologists believe the ancient Maya used poor agricultural techniques including slash-and-burn farming, mono-cropping, and over-expanded farming. In slash-and-burn farming, the ash from burned trees covers the soil with nutrients. But these nutrients only last a few seasons, at which point the soil is depleted and a new area of forest must be cleared.

In addition, population growth led to an over-expansion of farming into areas that could not support agriculture. This resulted in increased deforestation, which led to faster nutrient depletion as well as soil erosion." http://www.museumofman.org/html/lessonplan_maya_collapse.pdf

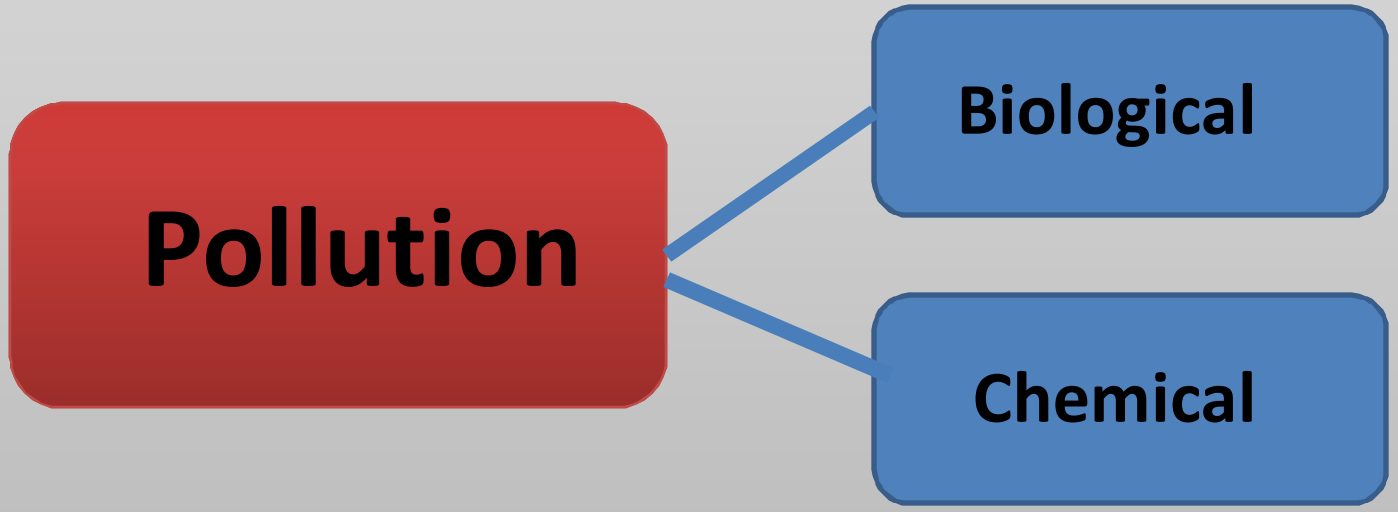
Today's Issues

- ✓ Pollution
- ✓ Crowding and violence
- ✓ Global warming
- ✓ Ozone depletion
- ✓ Deforestation
- ✓ Decreasing ecological diversity
- ✓ Overgrazing

Pollution

"One important function of the earth's ecosystem is the absorption of waste material"

But "…when waste increases to the point that it can no longer be accommodated by the ecosystem, it becomes pollution"



Others…

- Light pollution
- Noise pollution

“….the crowding of a large number of people into small places has brought about increased pollution almost very where. As population increases, so does the accumulation of its human organic waste, for example ”

Another Method of Classification

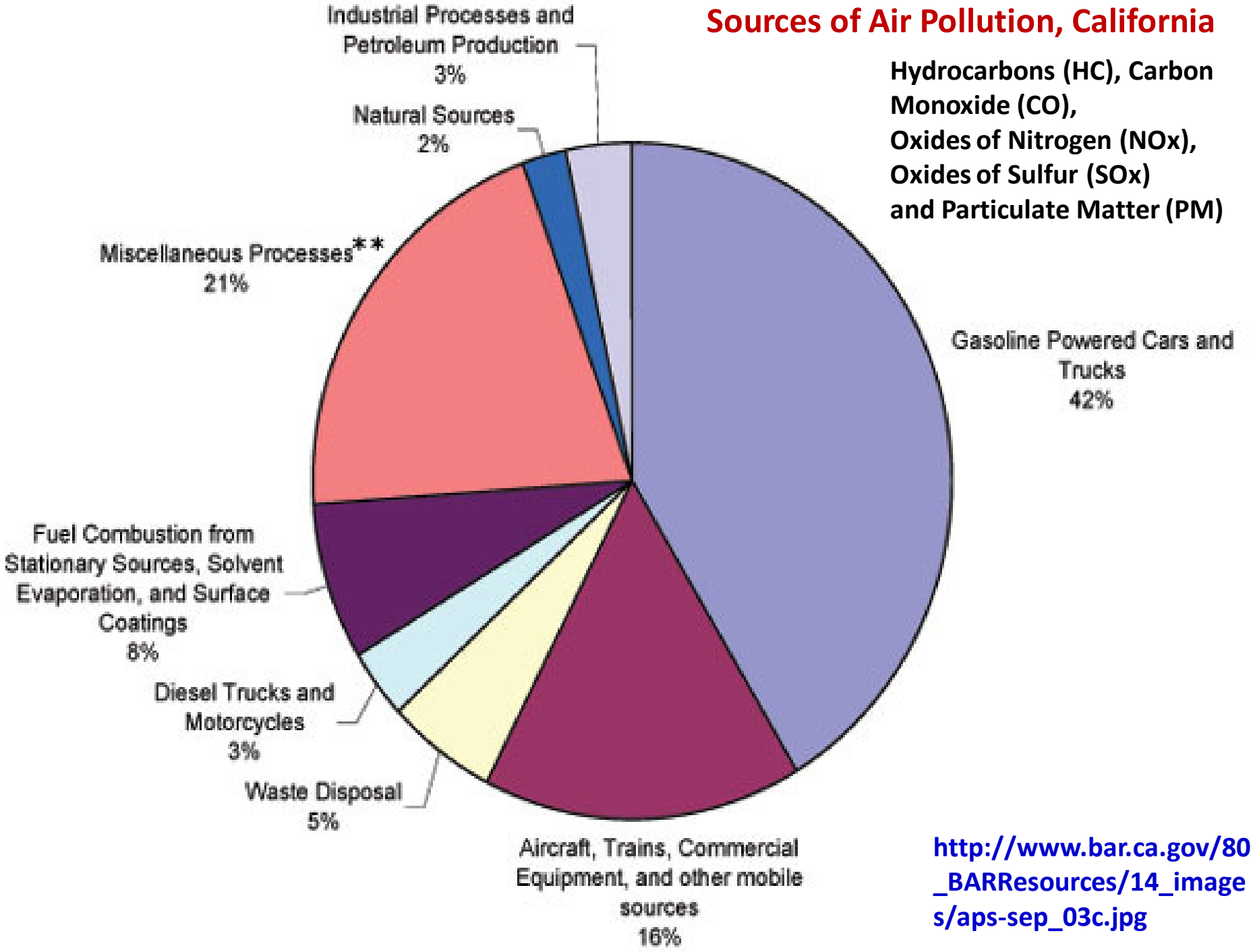
- **Water pollution**
- **Air Pollution**
- **Soil/Land Pollution**

Water Pollution

http://budgetwater.info/farm-land.jpg

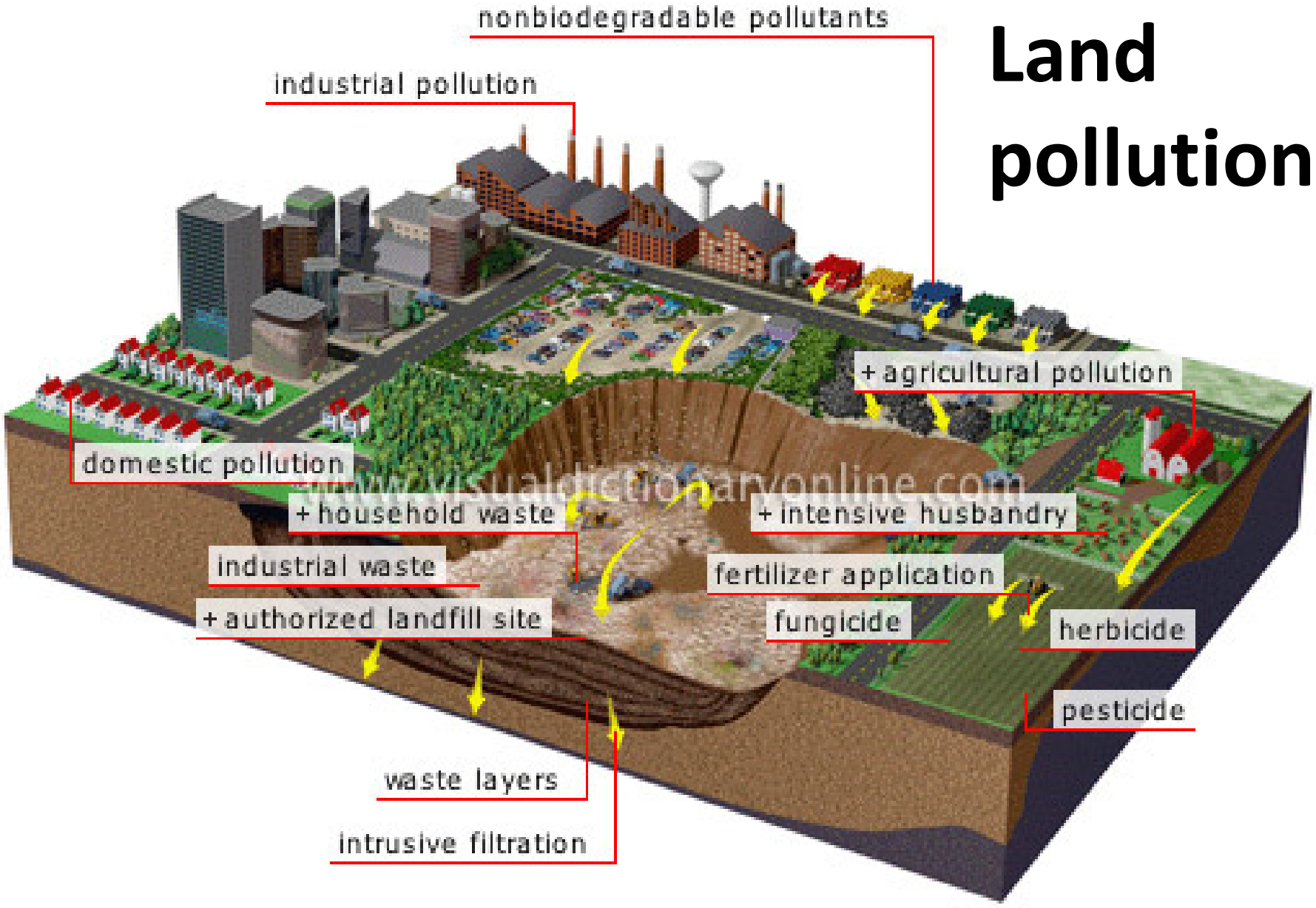
Sources of Air Pollution, California

Hydrocarbons (HC), Carbon Monoxide (CO), Oxides of Nitrogen (NOx), Oxides of Sulfur (SOx) and Particulate Matter (PM)



http://www.bar.ca.gov/80_BARResources/14_images/aps-sep_03c.jpg

Land pollution



http://visual.merriam-webster.com/images/earth/environment/land-pollution.jpg

Example, chemical pollution:

- Minatama Bay (Japan) - Mercury
- Union Carbide: Bopal India
- Love canal
- Industrial refuse - global
- Agricultural run-off - global
- Lead in leaded-gasoline (outlawed in US)
- DDT – used all over the world
- The oceans as sinks

Minatama Bay: The Beginning of Mercury Pollution Awareness

It was not until 1956 that the first official case of mercury-affected "disease" was documented in a small village of Minamata on a small island in Japan, which is now referred to as the Minamata Disease. Repeated cases of villagers getting sick with "random" symptoms raised both local and international scientists' interests. Local doctors were further confused by the mixture of symptom responses from the infected patients. It took doctors over 5 years to finally locate and confirm the source of Minamata Disease as mercury from the local fish dietary. Of course, by then the damages ranging from severe to minor and from long to short-term were already long overdue and irreversible.

It was soon discovered and proven that the main source of mercury was coming from a chemical plant that dumped its mercury waste into the bay and river. Overtime, the concentration of mercury accummulated at the bottom of the bay and river. Mercury was gradually converted into methylmercury, a lethal form. Methylmercury was then passed on to the local villagers who consumed the fish on a regular basis.

http://www.iit.edu/~ipro356s05/bg_history.html

What happened in Bhopal?

Summary

"On the night of Dec. 2nd and 3rd, 1984, a Union Carbide plant in Bhopal, India, began leaking 27 tons of the deadly gas *methyl isocyanate*. None of the six safety systems designed to contain such a leak were operational, allowing the gas to spread throughout the city of Bhopal. Half a million people were exposed to the gas and 20,000 have died to date as a result of their exposure. More than 120,000 people still suffer from ailments caused by the accident and the subsequent pollution at the plant site. These ailments include blindness, extreme difficulty in breathing, and gynecological disorders. The site has never been properly cleaned up and it continues to poison the residents of Bhopal. In 1999, local groundwater and wellwater testing near the site of the accident revealed mercury at levels between 20,000 and 6 million times those expected. Cancer and brain-damage- and birth-defect-causing chemicals were found in the water; trichloroethene, a chemical that has been shown to impair fetal development, was found at levels 50 times higher than EPA safety limits."

http://www.bhopal.org/whathappened.html

"**Love Canal** is a neighborhood in Niagara Falls, New York, United States (USA), which became the subject of national and international attention and controversy following the discovery of 21,000 tons of toxic waste buried beneath the neighborhood. It officially covers 36 square blocks in the far southeastern corner of the city, along 99th Street and Read Avenue.

The Niagara Falls School Board chose to construct a school on a known retired toxic waste dump, and the City of Niagara Falls permitted the building of homes and rental units on this property. The development released the chemical waste, leading to a public health emergency, an urban planning scandal, and a finding of negligence by the former owner. In the words of a state health commissioner, "Among its legacies, Love Canal will likely long endure as a 'national symbol of a failure to exercise a sense of concern for future generations."[1]

According to the United States Environmental Protection Agency (EPA) in 1979, residents exhibited a "disturbingly high rate of miscarriages...Love Canal can now be added to a growing list of environmental disasters involving toxics, ranging from industrial workers stricken by nervous disorders and cancers to the discovery of toxic materials in the milk of nursing mothers." In one case, two out of four children in a single Love Canal family had birth defects; one girl was born deaf with a cleft palate, an extra row of teeth, and slight retardation, and a boy was born with an eye defect.[5] A survey conducted by the Love Canal Homeowners Association found that 56% of the children born from 1974-1978 had a birth defect.[6]"

http://en.wikipedia.org/wiki/Love_Canal

Crowding and Violence

There is no clear-cut cause and effect relationship between crime and violence.

"However, it seems clear that population growth at least exacerbates such problems"

✓Crime rate in the US is five times greater in the largest cities than in rural areas. Small towns and suburbs have rates mid-way between the two.

✓But still, it is difficult to isolate the effects of "crowding" from other factors that determine the differences in rates.

Scarcity and violent conflicts LDC

"…scarcities of renewable resources are already contributing to violent conflicts in many parts of the developing world. These conflicts may foreshadow a surge of similar violence in coming decades, particularly in poor countries where shortage of water, forests and, especially, fertile land, coupled with rapidly expanding populations, already cause great hardship"

Global Warming

Global warming is being talked about much like a religion with discussions about whether people "believe" in it or not.

"On the Senate floor on July 28, 2003, Senator Inhofe described global warming as 'The greatest hoax ever perpetrated on the American people'. On march 21, 2007, Al Gore described global warming as 'A true planetary emergency' "

The main cause: Carbon dioxide from the burning of fossil fuel

CO_2 Estimates .... (also known as a greenhouse gas)

Before the Industrial Revolution: about 280 parts per million (ppm).

Today : About 380 parts per million

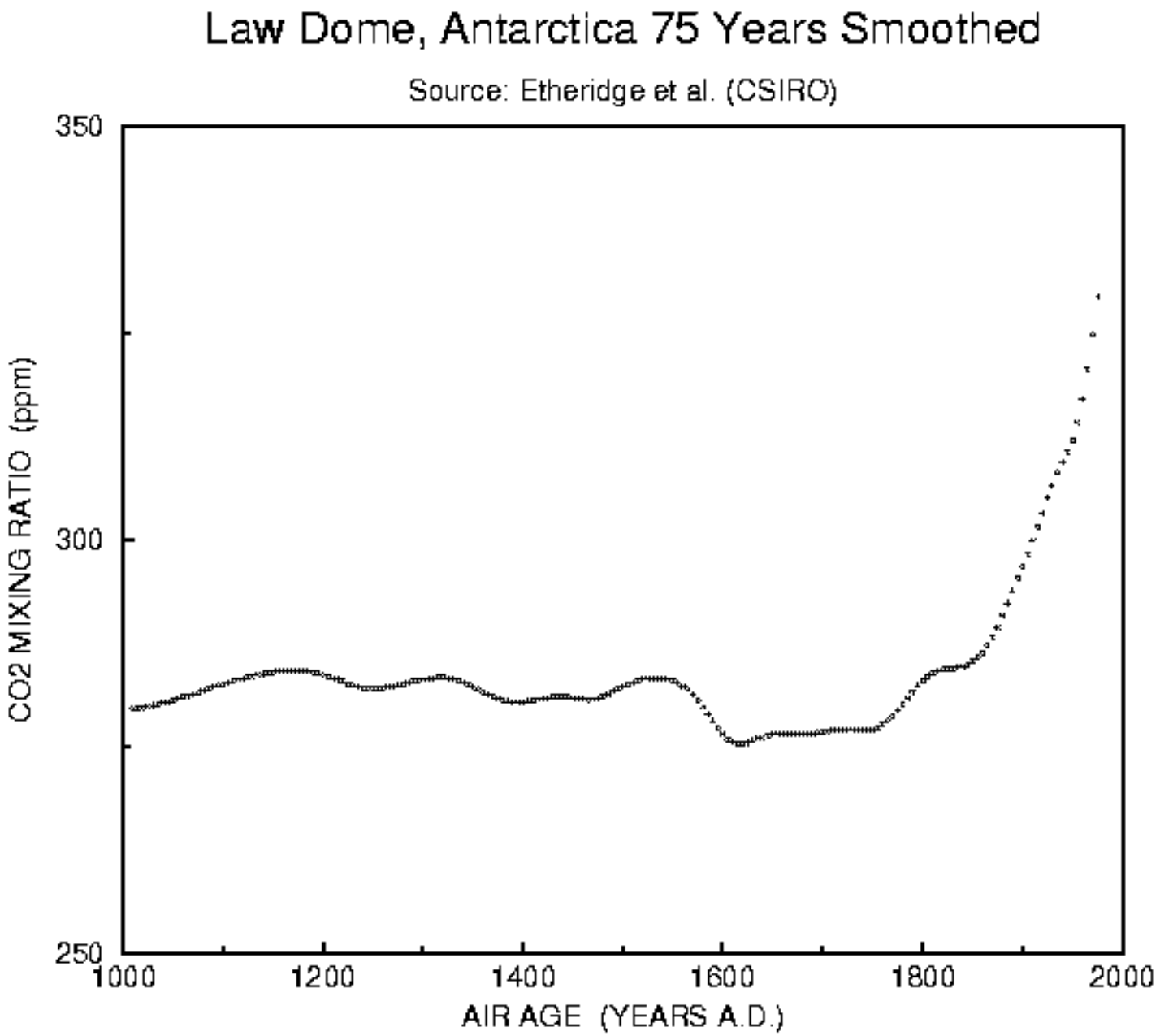
800 parts per million by the end of this century, if current rates of growth in emissions continue

"At the local level, the results of increased population, coupled with the increased burning of fossil fuels, will maintain urban areas as heat islands."

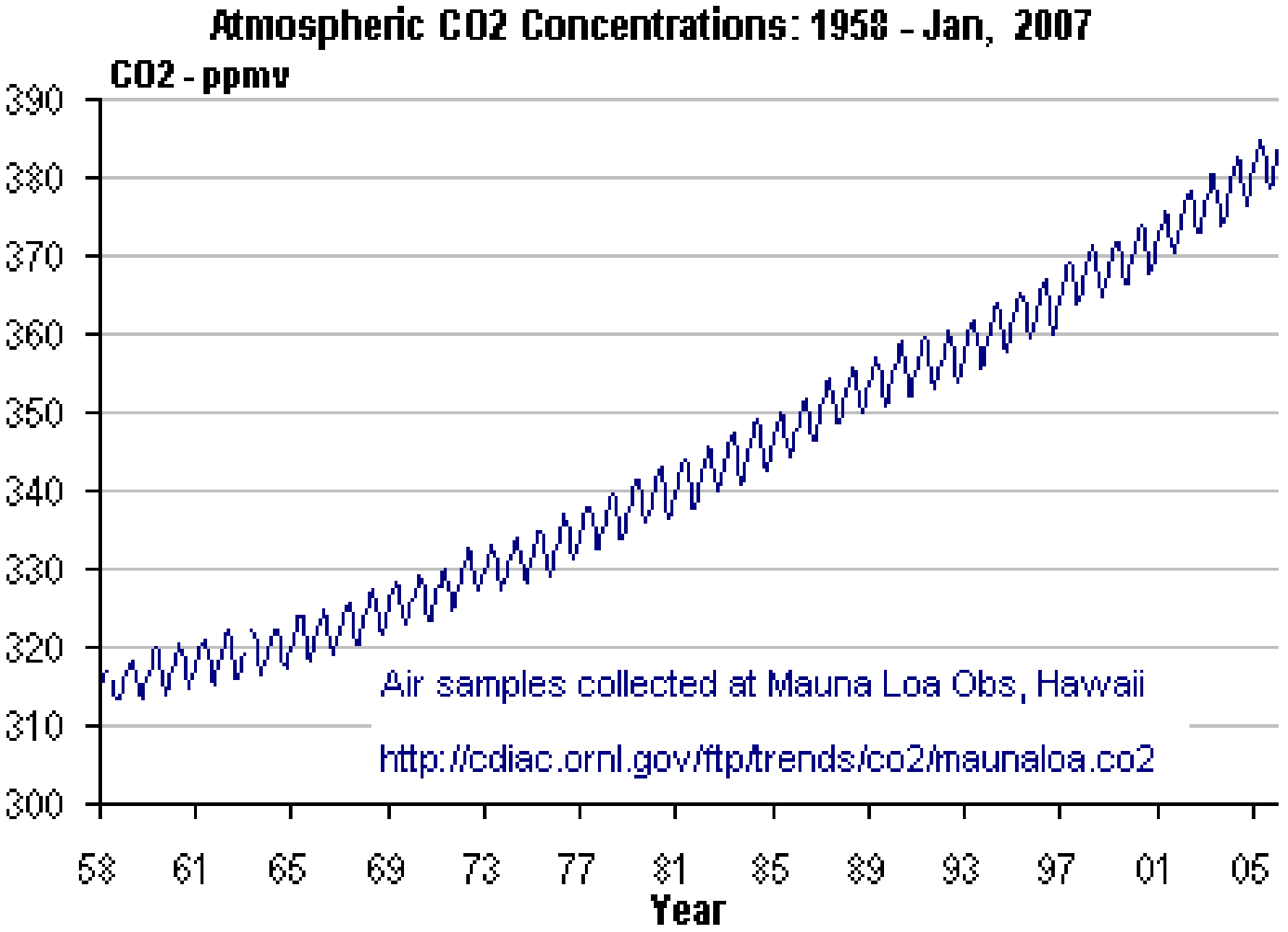
The US has 5% of the world population but produces 25% of the greenhouses - the leading producer until this year.

"It's now official: China emits more greenhouse gases than any other country. Which is to say, more than the United States, which had that dubious distinction until now." One coal-fired power plant comes online here every week.

http://www.csmonitor.com/2007/0628/p12s01-wogi.html



http://cdiac.ornl.gov/trends/co2/graphics/lawdome.smooth75.gif



Source: http://processtrends.com/pg_global_warming.htm#CO2_Trends

Greenhouse effect (animation)

http://earthguide.ucsd.edu/earthguide/diagrams/greenhouse/

- The US National Academy of Sciences predicts a warming of from 1.5 degrees Celsius to 4.5 degree Celsius over the next century. (This will inevitably lead to a rise in sea levels.)
- However, "..the earth has not been more than 1 to 2 degrees Celsius warmer during the 10,000-year era of human civilization"
- International concern over the issue of global warming led to the formation of the IPCC – The Intergovernmental Panel for Climate Change (1988).

The evidence so far:

Heat waves…

- …Killed 35,000 people in Europe in 2003
- Chicago, July 1995, 600 deaths
- "On August 10, 2003, London recorded its first ever triple-digit Fahrenheit temperature"
- More and more species of animals and plants are on the move or going extinct.
- Warmer ocean waters are destroying coral reefs
- More frequent draughts leading to famine, starvation, and conflict (e.g. Darfur)
- Southern ocean saturated with CO2

More evidence:

Text page 271

Also, take a good look at Figures 9-1 and 9-2 (page 270)

Future scenarios…..

- ✓Increased storm intensity
- ✓Rising sea level
- ✓More coastal floods
- ✓Shifting agricultural and forest belts
- ✓More tropical diseases in higher latitudes
- ✓Intensified monsoon rains
- ✓Ecosystem damage
- ✓Crop failures
- ✓Substantial change in circulation of oceanic waters and climatic changes that this might entail

THE SOLUTIONS

Sustainable Development

"It is not that there are no remedies to slow or stop global climate change. Rather, it is reluctance on the part of corporations, especially big oil, big coal, and autos, to change their ways, and, of course, reluctance on the part of politicians to force such changes" Text p. 275.

"Growing human numbers, urban expansion, and resource exploitation do not bode well for the future. Without practicing sustainable development, humanity faces a deteriorating environment and may even invite ecological disaster."

"Taking action. Many steps toward sustainability can be taken today. These include using energy more efficiently; managing cities better; phasing out subsidies that encourage waste; managing water resources and protecting freshwater sources; harvesting forest products rather than destroying forests; preserving arable land and increasing food production through a second Green Revolution; managing coastal zones and ocean fisheries; protecting biodiversity hotspots; and adopting an international convention on climate change."

http://www.infoforhealth.org/pr/m15edsum.shtml

"Stabilizing population. While population growth has slowed, the absolute number of people continues to increase—by about 1 billion every 13 years. Slowing population growth would help improve living standards and would buy time to protect natural resources. In the long run, to sustain higher living standards, world population size must stabilize."

Deforestation

The facts

- The world's forests continue to disappear at an alarming rate. Each year, another 16 million hectares disappear.
- Logging, fires, and land-clearing for agriculture and grazing account for much of the loss.
- In some places, the green Earth is turning to desert.

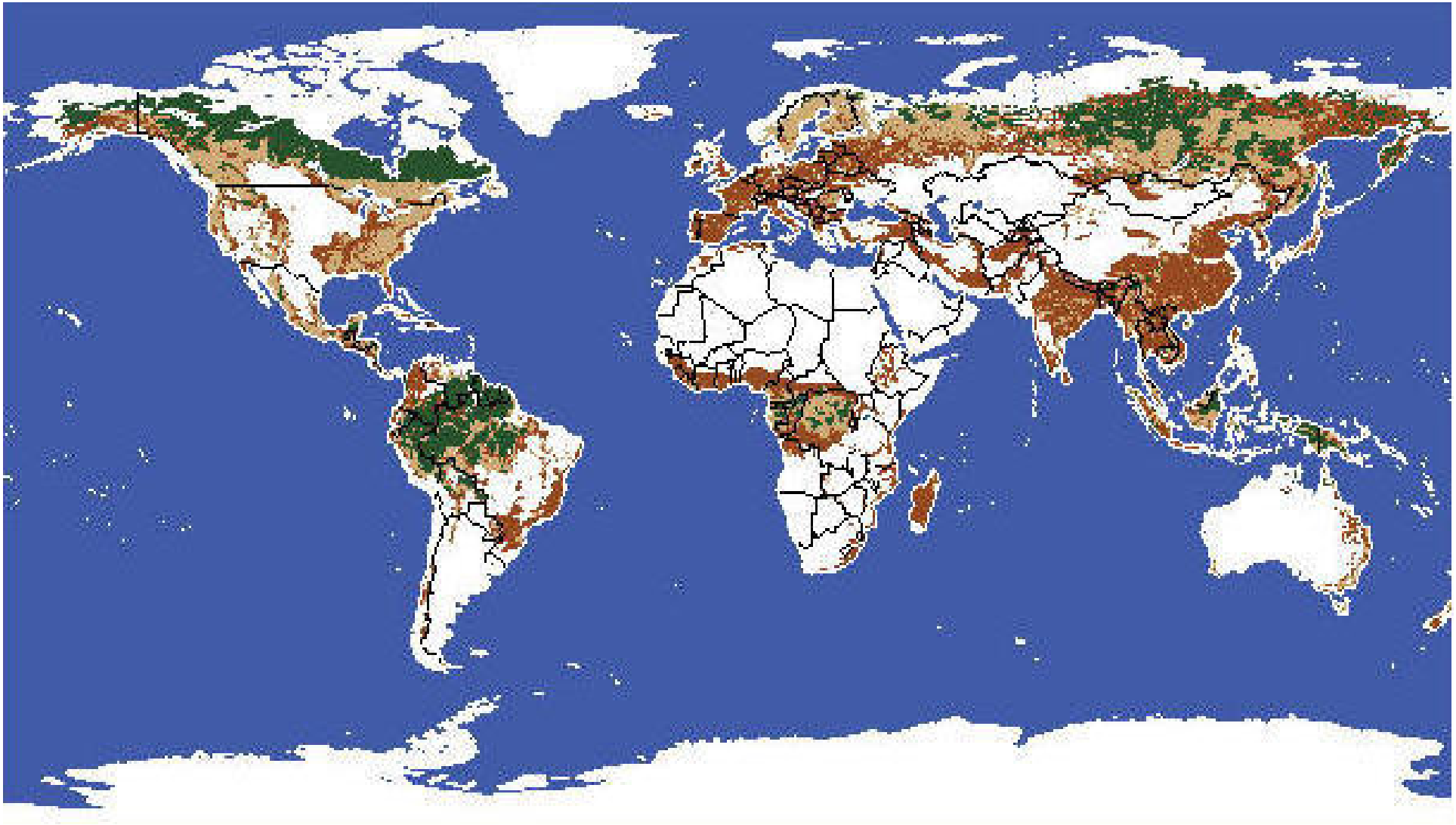
http://www.nationalgeographic.com/eye/deforestation/deforestation.html

Facts…..

“The World Resources Institute estimates that only about 22% of the world's (old growth) original forest cover remains "intact" - most of this is in three large areas: the Canadian and Alaskan boreal forest, the boreal forest of Russia, and the tropical forest of the northwestern Amazon Basin and the Guyana Shield (Guyana, Suriname, Venezuela, Columbia, etc.)” Source: http://www.globalchange.umich.edu/globalchange2/current/lectures/deforest/deforest.html

Visit

http://www.conservation.org/act/get_involved/protect_forests/Pages/deforestation.aspx?gclid=CIWE4suAhJcCFQQCagoduHZlXw



Red = Frontier Forests, 8,000 years ago
Green = Frontier Forests Today
Pink = Current non-frontier forests

Source: http://www.globalchange.umich.edu/globalchange2/current/lectures/deforest/deforest.html

Facts……

“Today, forests cover more than one quarter of the world's total land area, excluding polar regions. Slightly more than 50% of the forests are found in the tropics and the rest are temperate and boreal (coniferous northern forest) zones.”

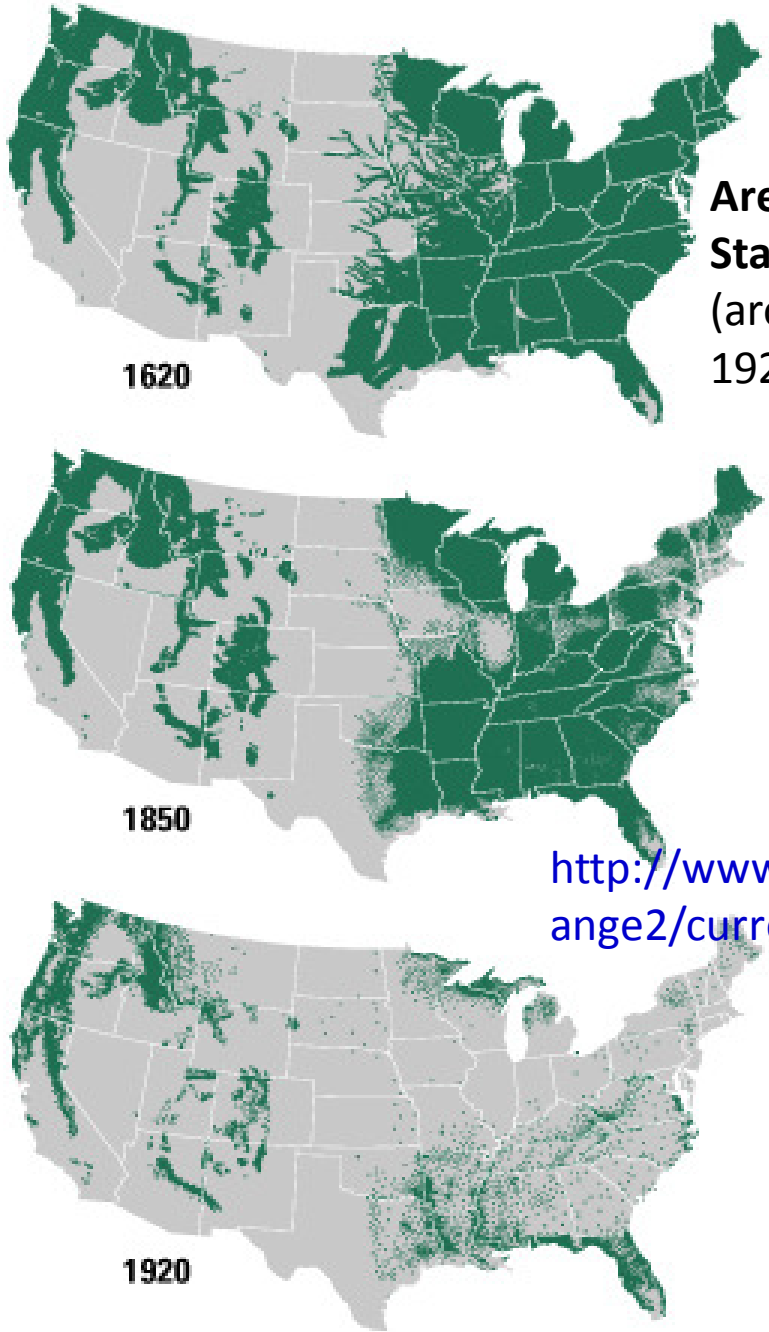
“Seven countries (Russia, Brazil, Canada, the United States, China, Indonesia, and the Democratic Republic of Congo (formerly Zaire) account for more than 60% of the total.”

USA

"Since 1600, 90% of the virgin forests that once covered much of the lower 48 states have been cleared away.

Most of the remaining old-growth forests in the lower 48 states and Alaska are on public lands. In the Pacific Northwest about 80% of this forestland is slated for logging."

However, much forest re-growth has occurred in the eastern USA during the 20th Century, although these second-growth forests differ in structure and



Area of primary forests in the United States (lower 48)
(around 1620, top; and 1850 middle; 1920, bottom)

http://www.globalchange.umich.edu/globalchange2/current/lectures/deforest/deforest.html

Why do we need forests?

Forests influence climate. The within-year fluctuations in atmospheric CO_2 in the temperate zone include a spring-through-autumn decline due to plant photosynthesis during the growing season, and an autumn-through-spring rise in CO_2 as respiration and decomposition exceed photosynthetic uptake. At a more regional scale, forests influence local climate and weather. Rain forests transport great quantities of water to the atmosphere via plant transpiration. (Water is taken up by plant roots, bringing dissolved minerals into plant tissues. Plants exchange gases with the atmosphere through openings in their leaves, and lose water in the same way. That water loss provides the plant with a means to transport materials upwards, and so is beneficial, so long as water loss is not excessive). Much of that transpired water replenishes the clouds and rain that maintain the rain forest. If the forest is cut, much more of that rain will become river water, flow to distant seas, and the region will become permanently drier. No rain forest can regenerate if this occurs. Forests maintain local climate and strongly influence global fluxes of oxygen and carbon dioxide. Before green plants appeared, it is believed that there was very little oxygen in the atmosphere.

Why do we need forests?

"Forests protect the top soil and husband important nutrients. A famous study of Hubbard Brook, New Hampshire found that, after forest harvest, summer stream flows greatly increased (because the forest was no longer transpiring water) and nutrient outflow also increased greatly. The annual flood crest of the Amazon River has increased over recent years without any concomitant increase in Rainfall, presumably due to deforestation. Damaging floods are one frequent consequence of deforestation."

http://www.globalchange.umich.edu/globalchange2/current/lectures/deforest/deforest.html

Decreasing Ecological Diversity

"…the ivory-billed woodpecker, the Israel pained frog, the West Indian monk seal, the Xerces blue butterfly, the Tasmanian tiger, the Bali tiger, the Falkland Island wolf, the Aurochs, and the Moa……All have one thing in common – they are now extinct."

The main issues:

- ✓ Habitat destruction
- ✓ Overkill
- ✓ Extinction
- ✓ Ecological simplification

"…we could be loosing as many as 100 species a day"

- ➢ Declining bee populations
- ➢ Declining amphibian populations
- ➢ Declining sperm count in men

Overgrazing

- Impact similar to deforestation

- "The animals serve as food, security, repository of family wealth, and as power to pull agricultural implements"

- The expansion of arid areas and desertification, is at least partly due to overgrazing (e.g. North Africa.)

- "Even if overgrazing were not a problem, growing herds of cattle pose another environmental concern – they generate significant quantities of methane gas…"

Summary

- Read Paul Ehrlich's five theorems: text p, 283
- Impact = Population x Affluence x Technology
- I = P x A x T
- Barry Commoner's opposing views
- "This debate between Ehrlich and Commoner outlines two of the major viewpoints regarding the role of population in environmental degradation"

Summary: Population-resource region

"In general, the greater the country's level of technology, the greater its ability to exploit its resources"

- **Region 1. European Type – technology-source areas of high population-potential resource ratio**
- **Region 2. United States Type – technology-source areas of low population-potential resource ratio**
- **Region 3. Brazil Type – technology deficient areas of low population-resource ratio**
- **Region 4. India-China Type – technology deficient areas of high population-resource ratio**
- **Region 5. Arctic-Desert Type – technology deficient with few potential food-producing resource**