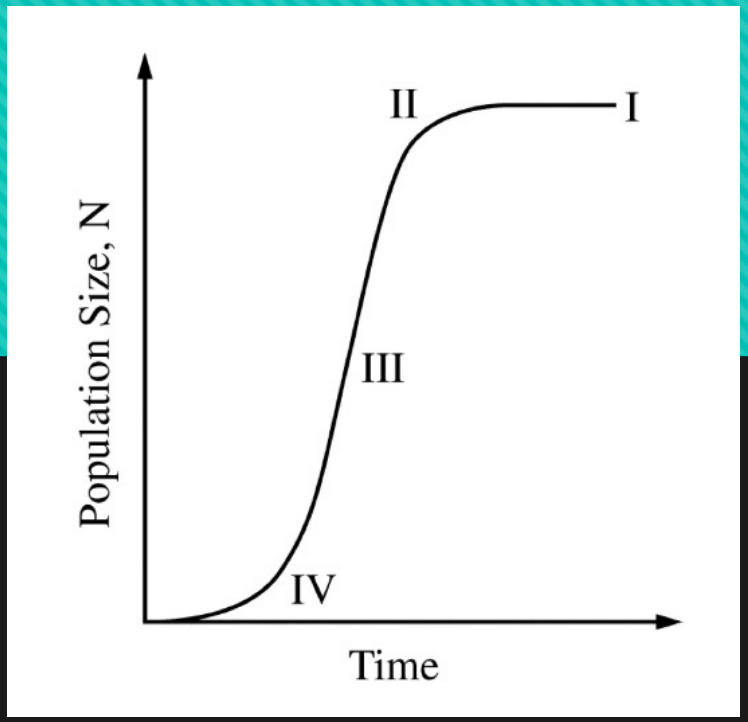
Ch. 43 Warm-Up

1. How does acid precipitation affect the environment?

2. Explain how the greenhouse effect can be both positive and negative.

3. Should humans be concerned about biological magnification? Explain.

Warm-Up

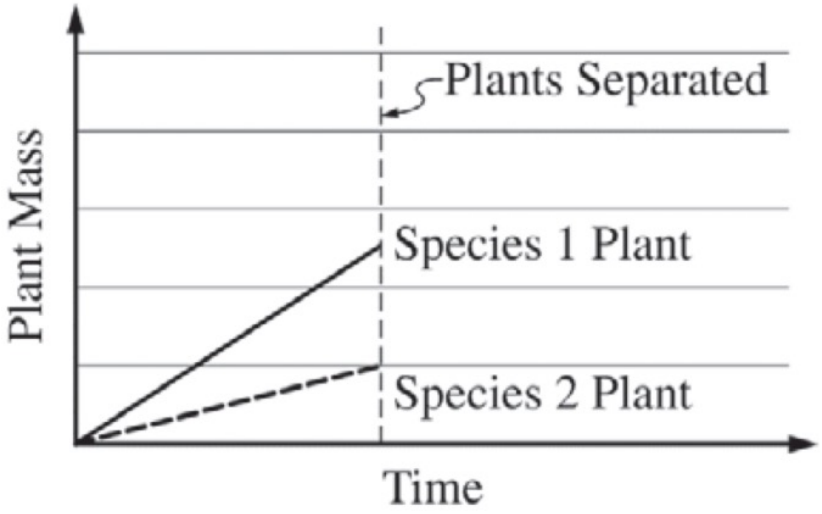


1. If 5000 J of energy is available in producers, how much of that energy would be available to tertiary consumers?

2. The graph to the side represents a population of blue fin tuna living along the Atlantic coast. At which labeled point in the graph is the population growth rate the highest?

Practice Question:

The graph shows the mass of plants from two different species over time. The plants grew while attached to each other. The plants were separated at the time indicated by the vertical line in the graph.



Predict the shape of the plant-mass lines after separation of the two plants if:

(A) The 2 plants are in an obligate mutualistic relationship

(B) Species 2 plant is a parasite of the species 1 plant.

Draw each graph and justify your response.

Define the following terms:

- Eutrophication
- Biological magnification
- Greenhouse effect
- Global warming
- Acid precipitation

Chapter 43: Global Ecology and Conservation Biology

Video: MAN

What you need to know:

- The value of biodiversity, and the major human threats to it.
- How human activity is changing the earth

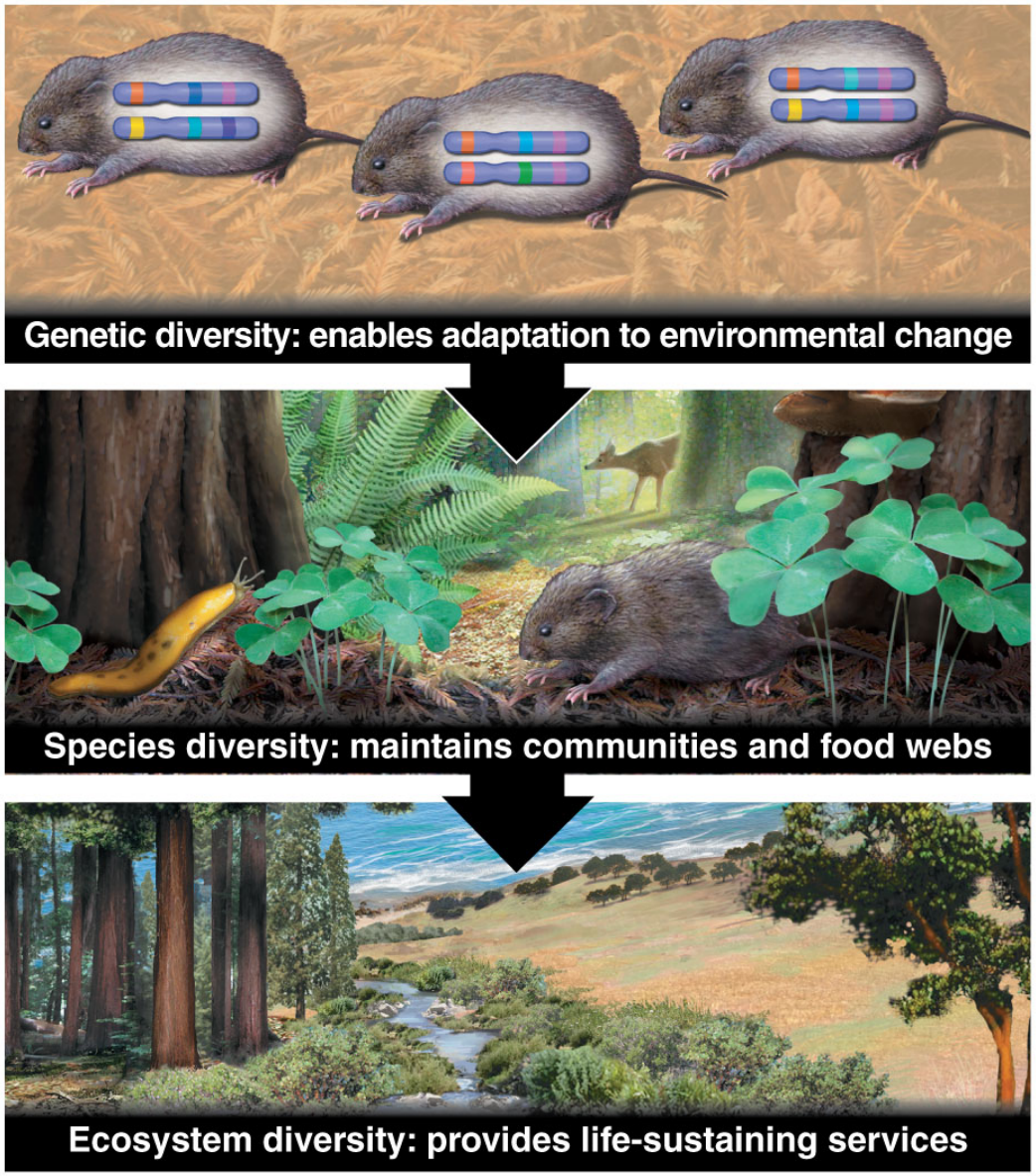
Biodiversity: biological diversity

- Conservation biology = conserve biological diversity at all levels

Why is biodiversity important?

1. More diverse ecosystems are more stable and able to resist threats.
2. Many drugs have been derived from plant, fungi and bacterial species.
3. More likely for species to escape extinction if new pathogen emerges.

Three Levels of Biodiversity



The four major threats to biodiversity:

1. Habitat loss : Human alteration of habitat is the single greatest threat to biodiversity

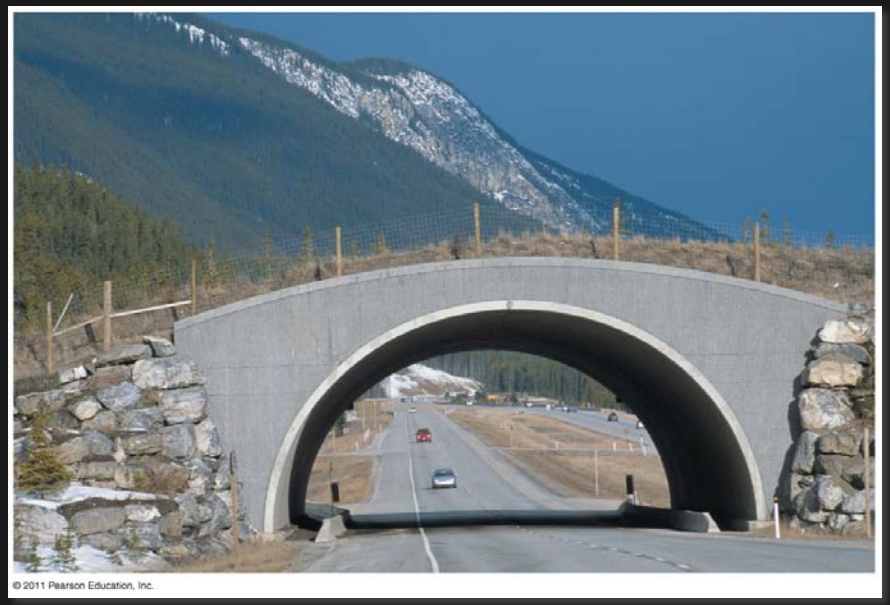
2. Introduced species: invasive/nonnative/exotic species

3. Overharvesting: harvest wild plants & animals

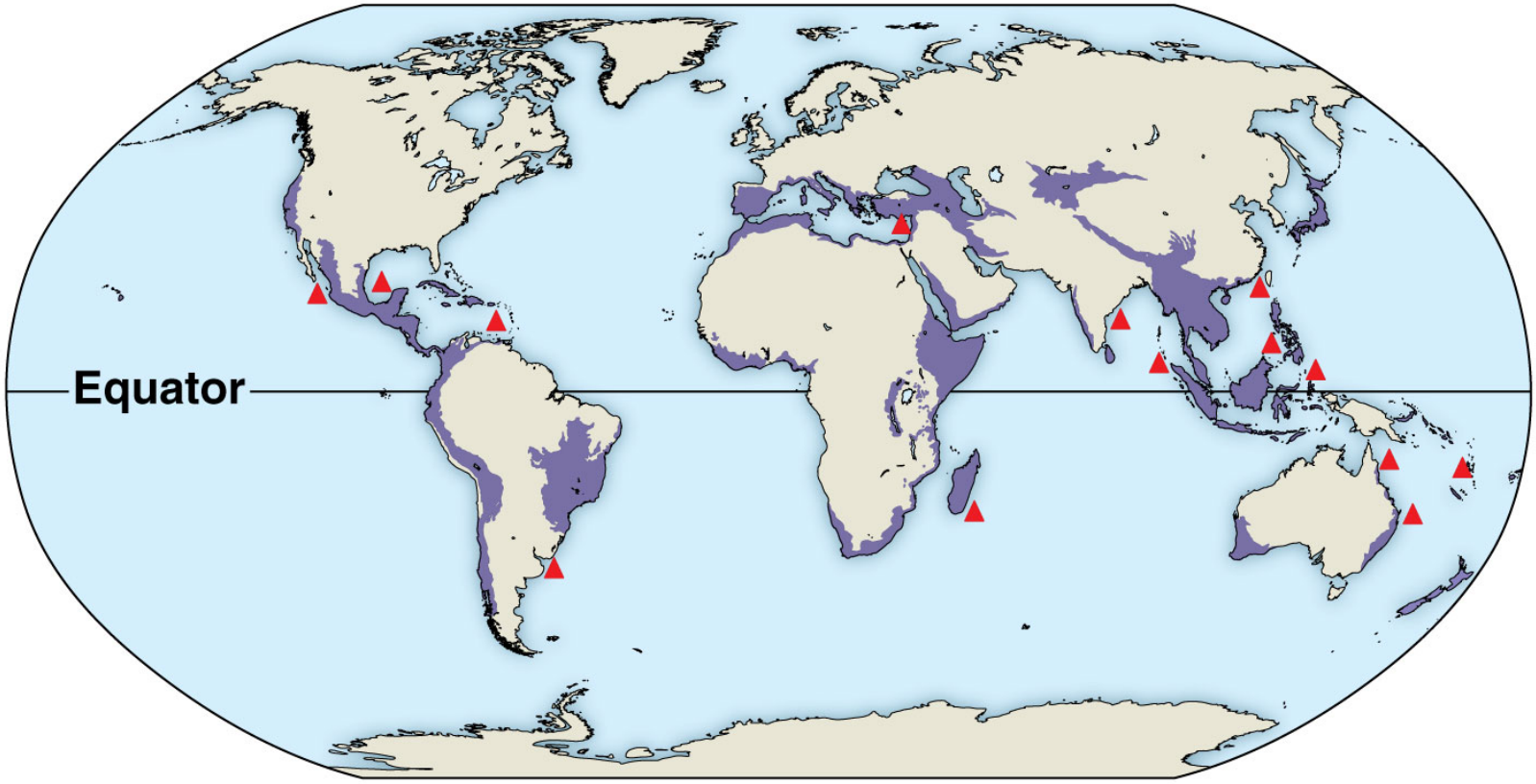
4. Global change: alter climate, atmosphere, & ecological systems → reduce Earth's capacity to sustain life

Landscape Conservation

- **Movement corridors** can promote dispersal if habitats are fragmented



Preserving Biodiversity Hot Spots

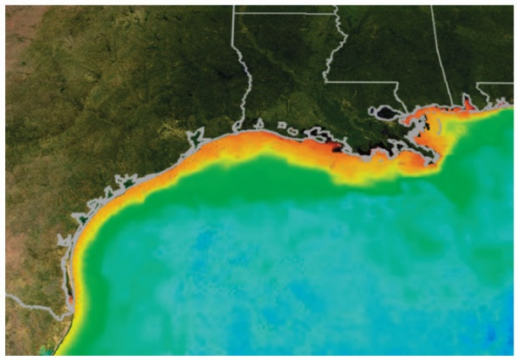


Earth's terrestrial (■) and marine (▲) biodiversity hot spots

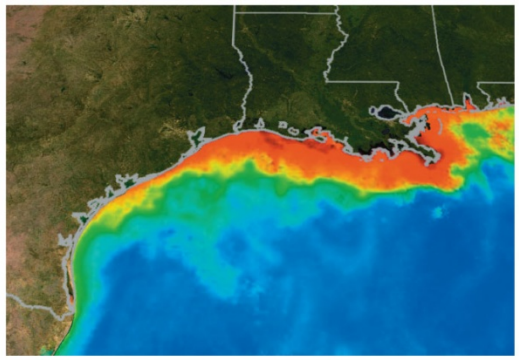
Nature Reserves

Eutrophication

- Excess nitrogen from agriculture enters aquatic ecosystems
- Algae blooms & dies → bacterial decomposition → reduce oxygen → fish and invertebrates die



Winter

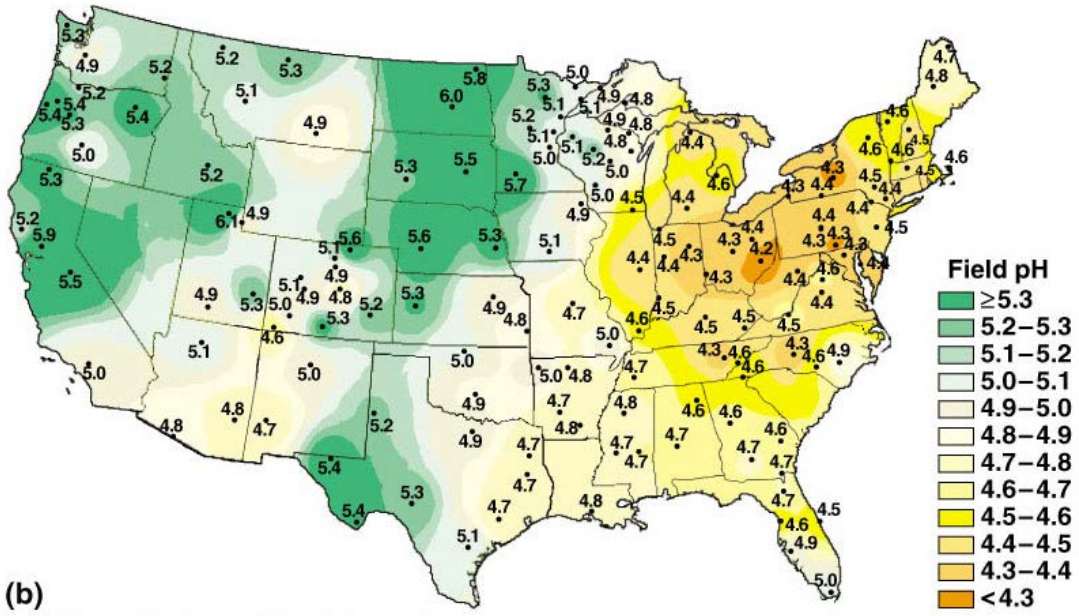


Summer

Mississippi basin dead zone (red)

Acid Precipitation

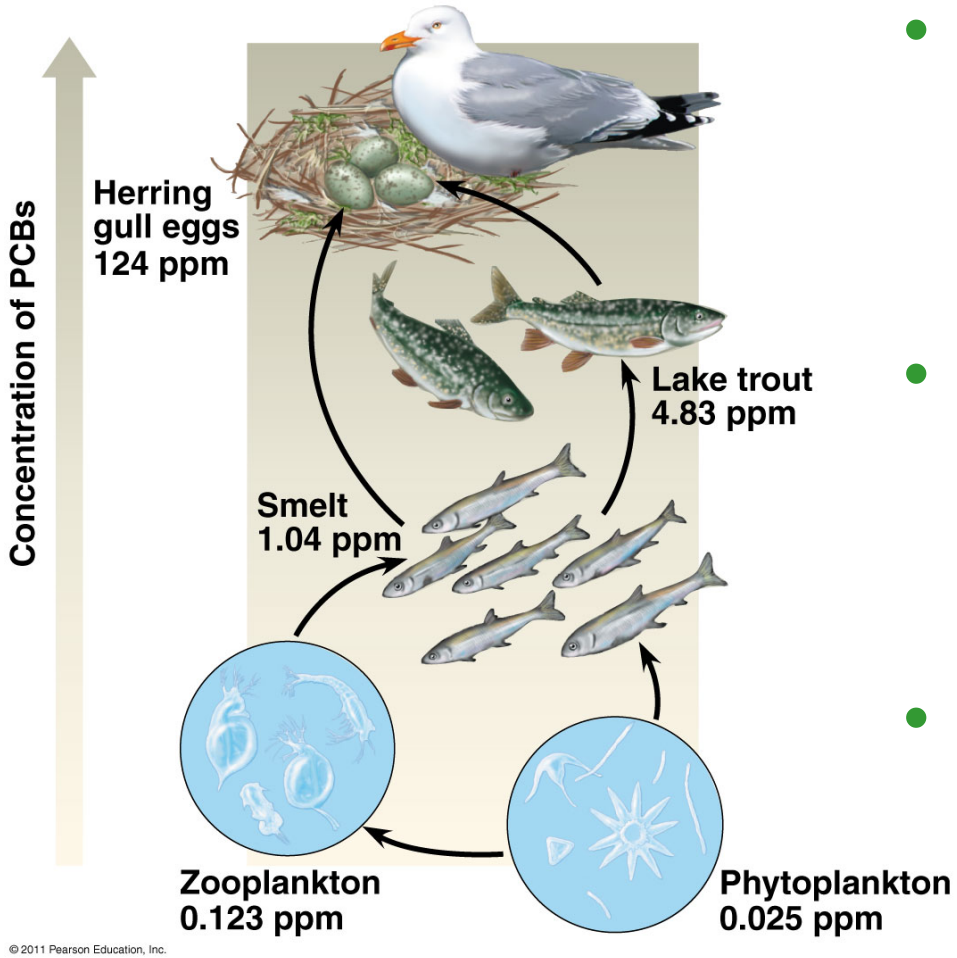
- Rain, snow, or fog with a pH less than 5.6
- Caused by burning of wood & fossil fuels → release sulfur oxides and nitrogen oxides
- React with water in the atmosphere to produce sulfuric and nitric acids



The effects of acid precipitation on a forest

Acid rain damage to statuary, 1908 & 1968

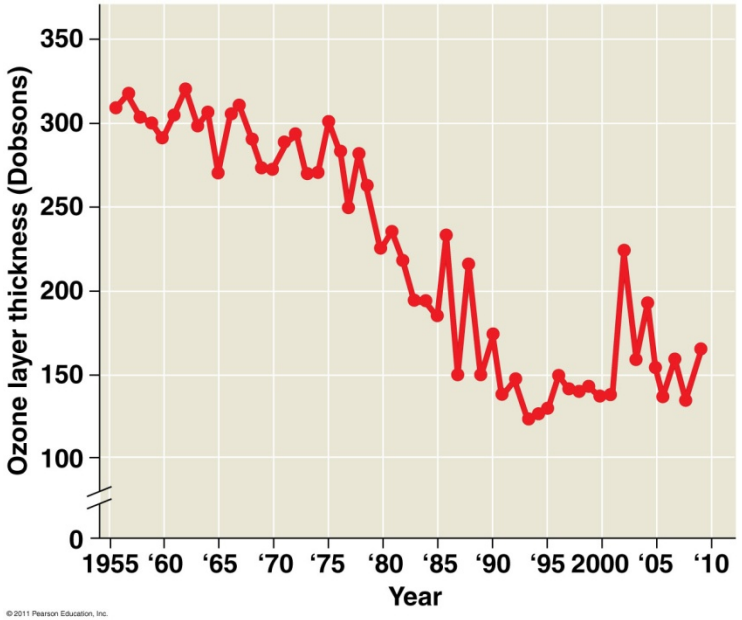
Biological Magnification

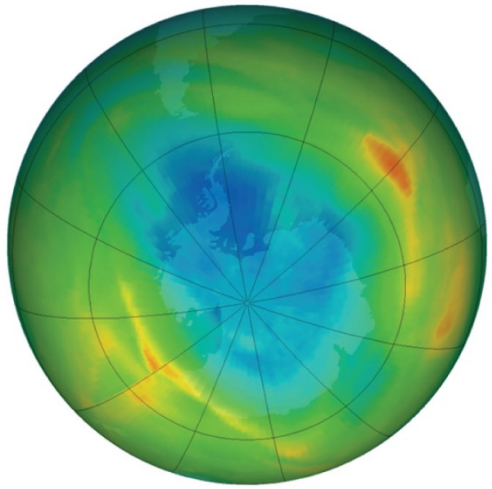


- Toxins become more concentrated in successive trophic levels of a food web
- Toxins can't be broken down & magnify in concentration up the food chain
- Problem: mercury in fish

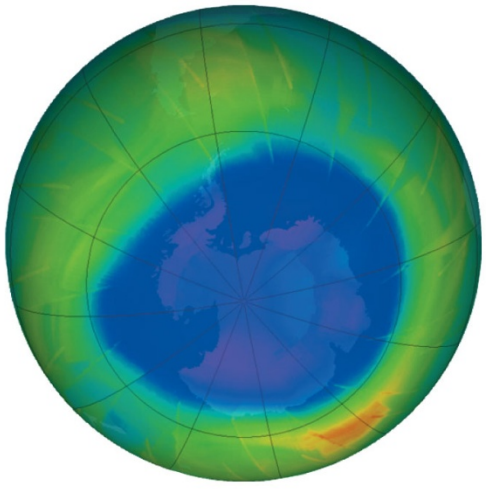
Human activities are depleting the atmospheric ozone

- Life on earth is protected from the damaging affects of ultraviolet radiation (UV) by a layer of O_3, or ozone.
- Chlorine-containing compounds erode the ozone layer





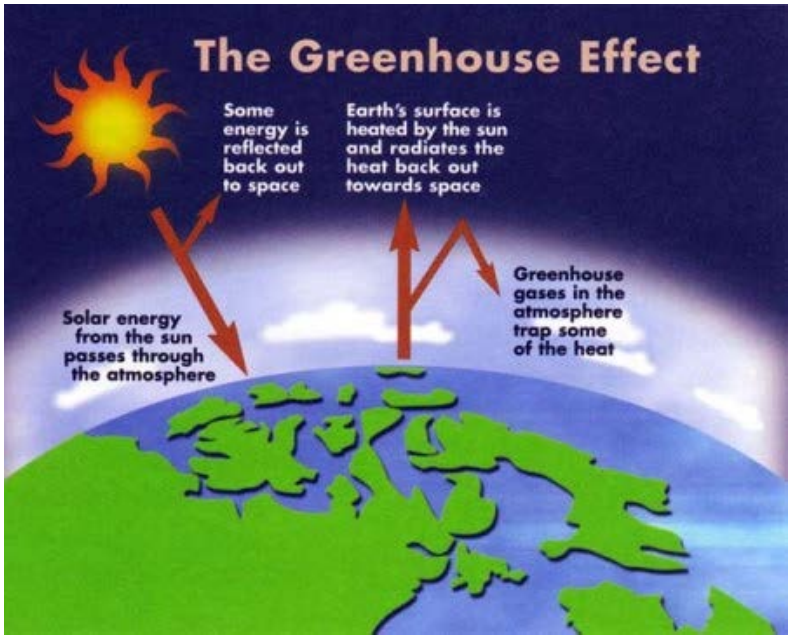
September 1979



September 2009

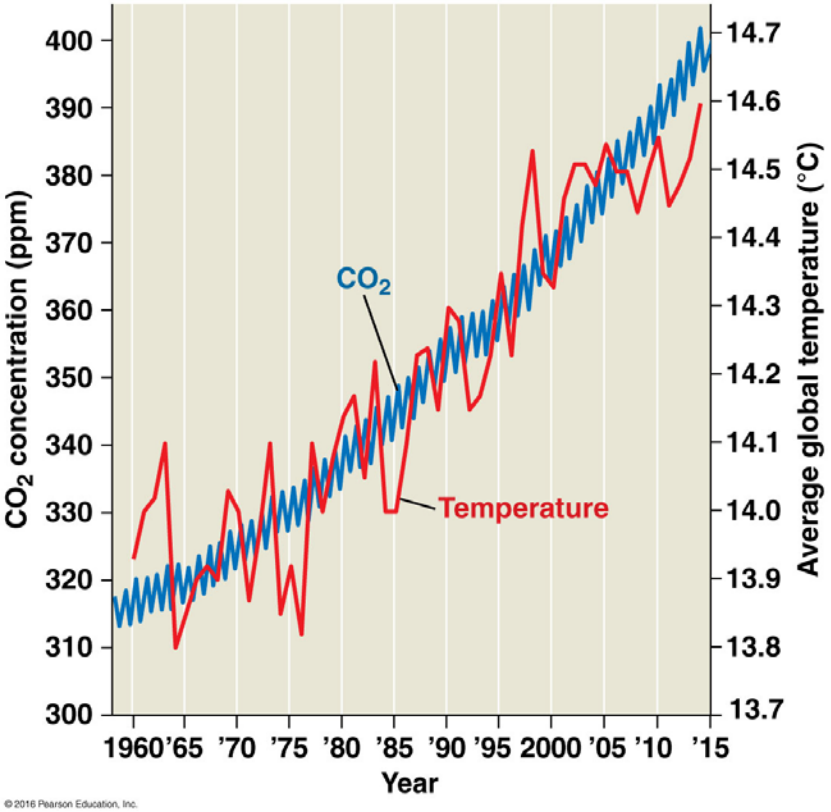
Greenhouse Effect

- Greenhouse Effect: absorption of heat the Earth experiences due to certain greenhouse gases
- CO_2 and water vapor absorb infrared radiation and re-reflect back toward Earth
- The Earth needs this heat, but too much could be disastrous.



Rising atmospheric CO_2

- Since the Industrial Revolution, the concentration of CO_2 in the atmosphere has increased greatly as a result of <u>burning fossil fuels</u>.



Global Climate Change ("Global Warming")

- Studies predict a doubling of CO_2 in the atmosphere will cause a 3ºC increase in the average temperature of Earth.
- Rising temperatures could cause polar ice cap melting, which could flood coastal areas.
- Approach: stabilize use of fossil fuels and reduce deforestation

Global Climate Change

- Snow and rainfall patterns shifting
- Floods, drought, intense rainfall, more frequent and severe heat waves

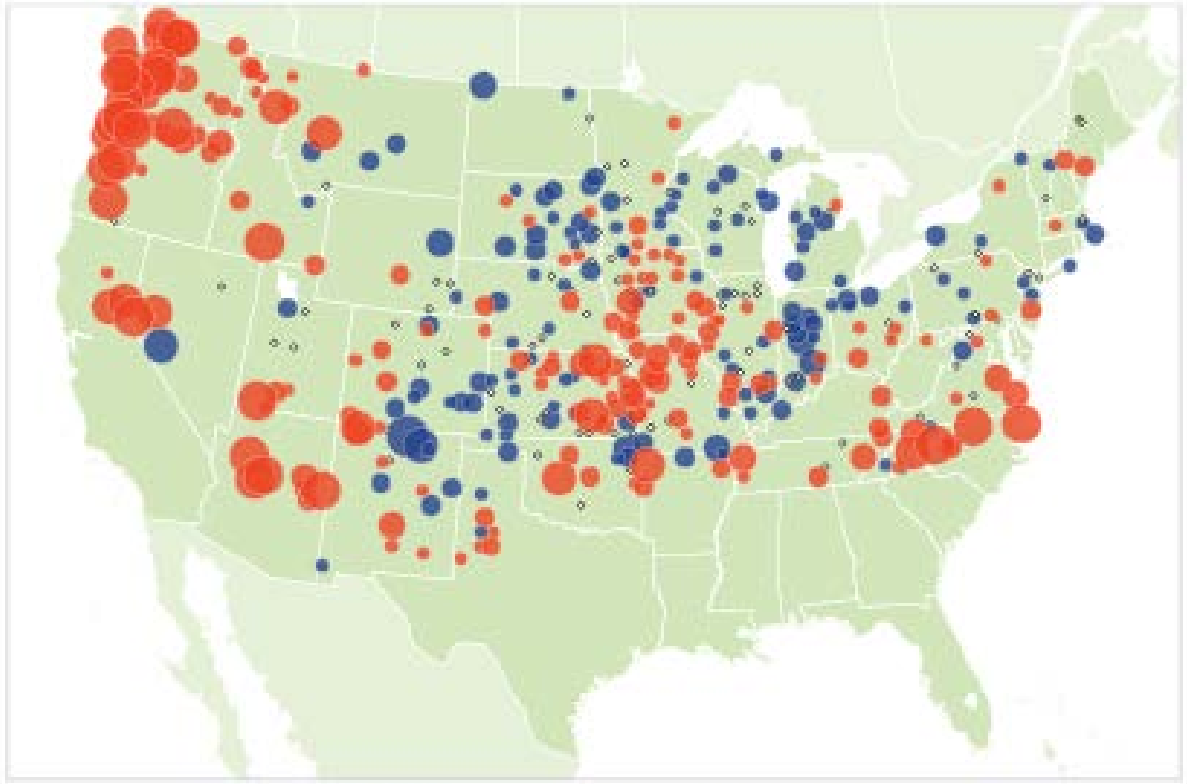
Change in Sea Level Relative to the Land, 1960–2013

Relative sea level change (inches):

≤ -8	-7.99 to -6	-5.99 to -4	-3.99 to -2	-1.99 to 0	0.01 to 2	2.01 to 4	4.01 to 6	6.01 to 8	> 8

Data source: NOAA, 2014

Change in Total Snowfall, 1930–2007



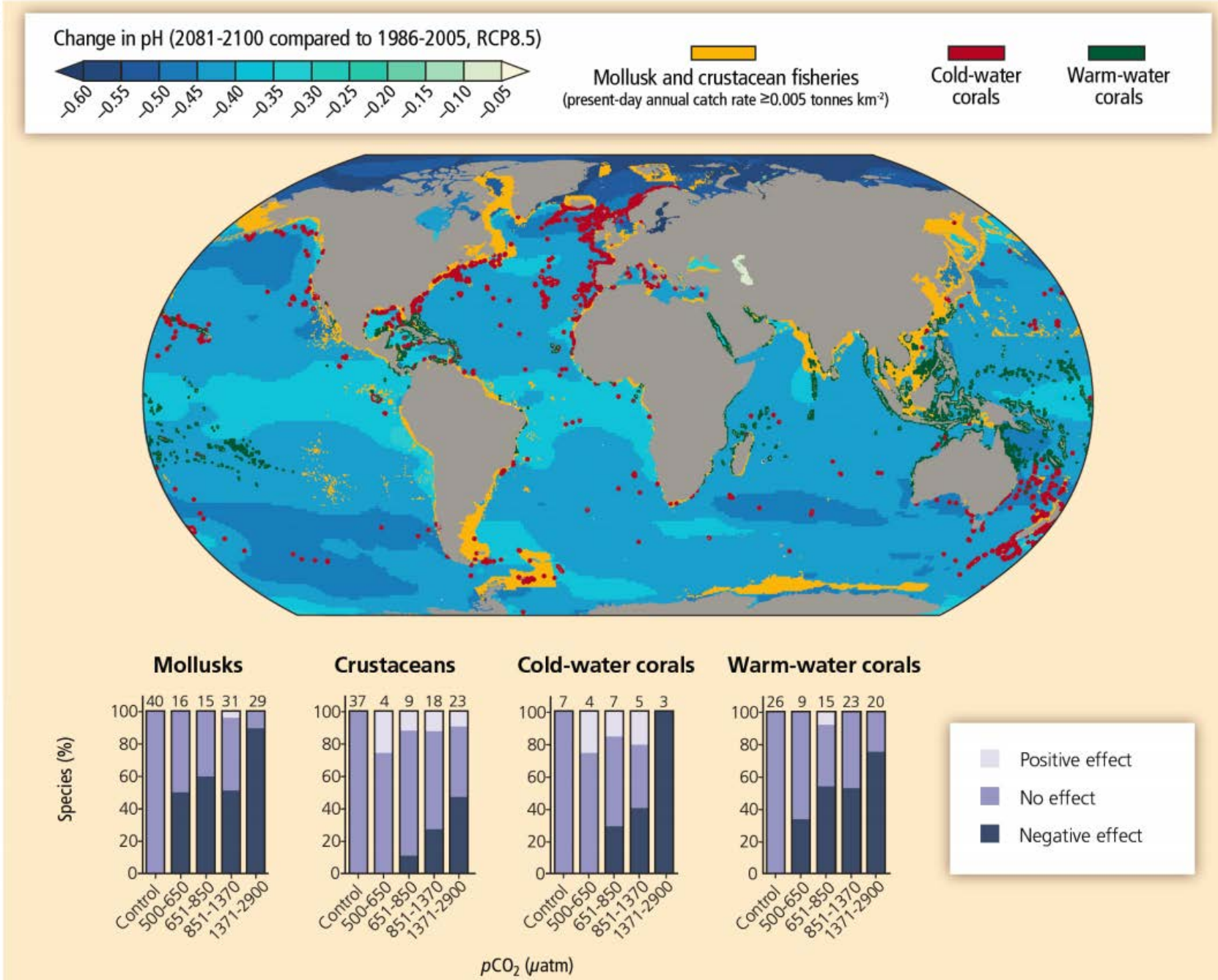
Rate of change (percent per year):

< -1.2	-0.9 to -1.2	-0.6 to -0.9	-0.3 to -0.6	-0.1 to -0.3	-0.1 to 0.1	0.1 to 0.3	0.3 to 0.6	0.6 to 0.9	0.9 to 1.2	> 1.2

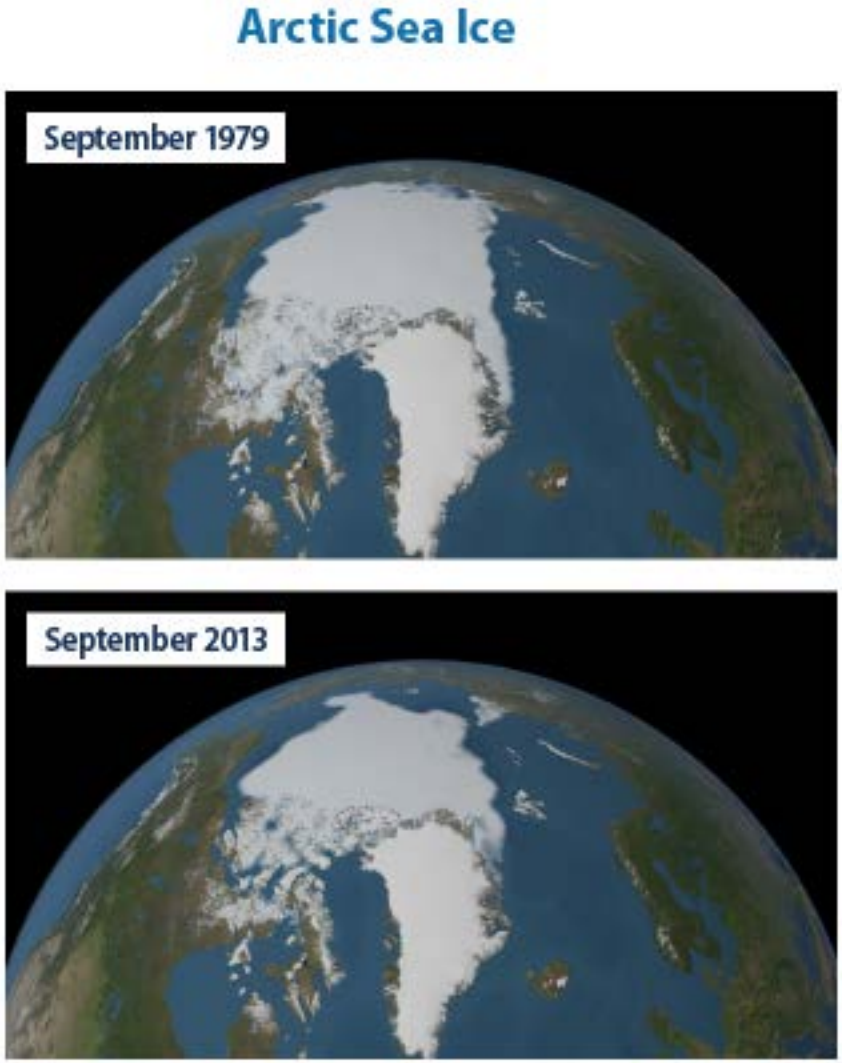
Less snowfall ← → More snowfall

Data source: Kunkel et al., 2009

(B)


Change in pH (2081-2100 compared to 1986-2005, RCP8.5)
-0.60
-0.55
-0.50
-0.45
-0.40
-0.35
-0.30
-0.25
-0.20
-0.15
-0.10
-0.05
Mollusk and crustacean fisheries
(present-day annual catch rate ≥0.005 tonnes km-2)
Cold-water corals
Warm-water corals
Mollusks
Crustaceans
Cold-water corals
Warm-water corals
40 16 15 31 29
37 4 9 18 23
7 4 7 5 3
26 9 15 23 20
Species (%)
0
20
40
60
80
100
Control
500-650
651-850
851-1370
1371-2900
pCO2 (µatm)
Positive effect
No effect
Negative effect

NASA Video Clip: Daily Arctic Sea Ice Changes



Source: NASA, 2014

Global Human Population

Human population (billions)

0
1
2
3
4
5
6
7

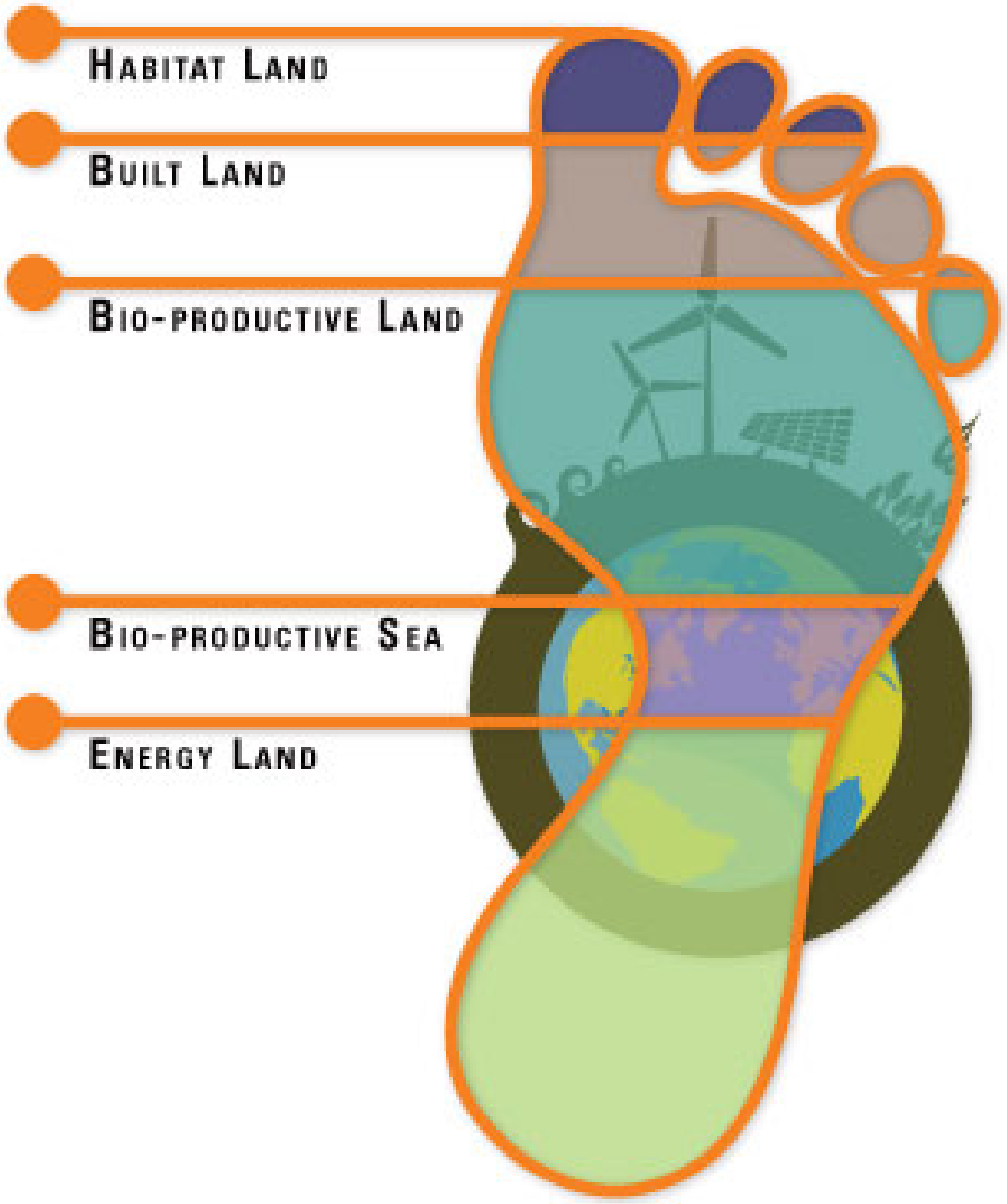
8000 BCE
4000 BCE
3000 BCE
2000 BCE
1000 BCE
0
1000 CE
2000 CE

Global Carrying Capacity

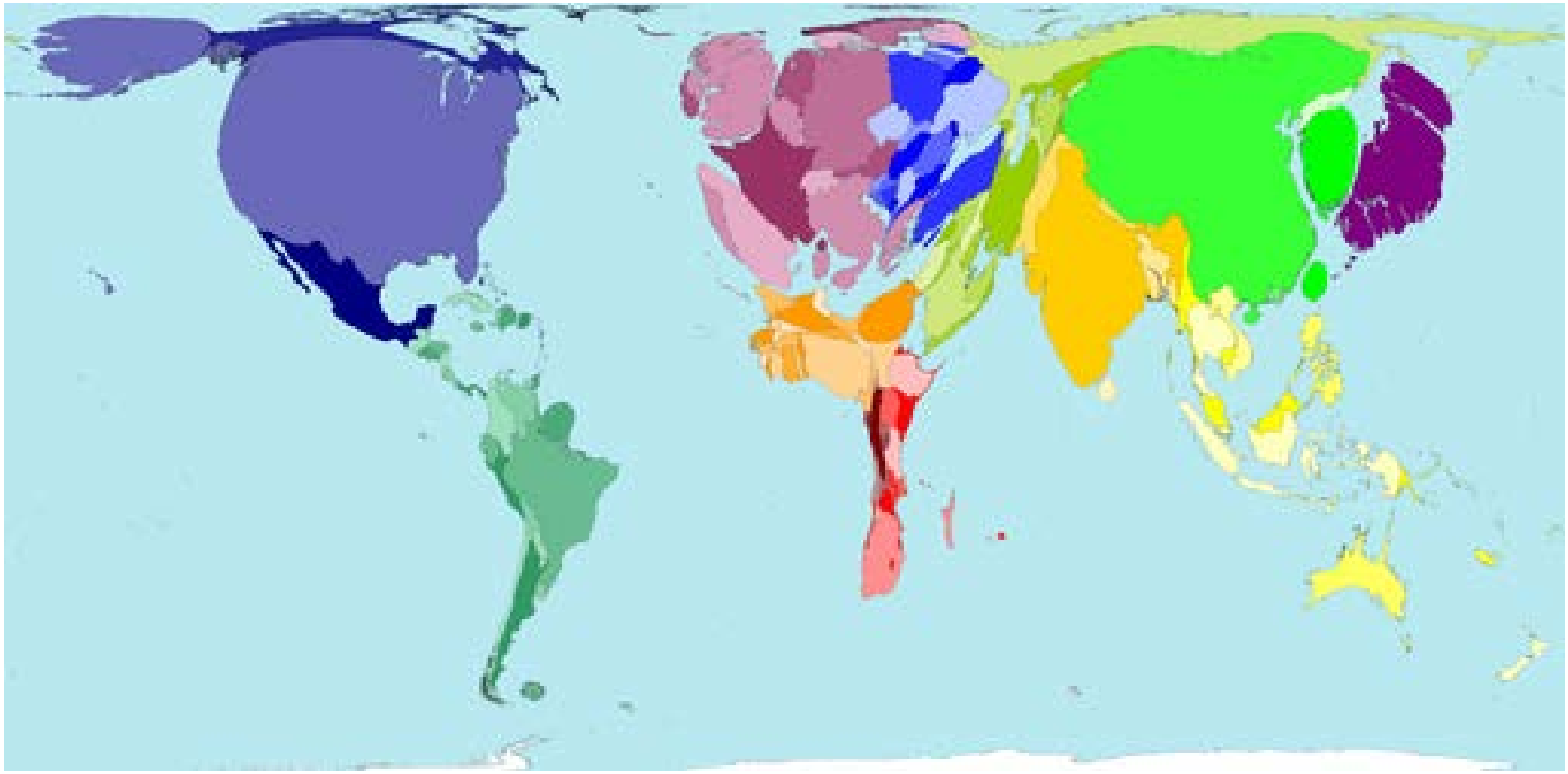
- Current world population (2017) = 7.5 billion
- Estimated carrying capacity = 10-15 billion?
- **Ecological footprint**: total land + water area needed for all the resources a person consumes in a pop.
  - 1.7 global hectares (gha)/person is sustainable
  - Typical person in U.S. = 8 ha footprint

Limitations? Consequences? Solutions?

Ecological Footprint



Map of ecological footprint of countries in the world (proportional sizes shown)



Sustainable Development

- Economic development that meets the needs of people today without limiting the ability of future generations to meet their needs


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS