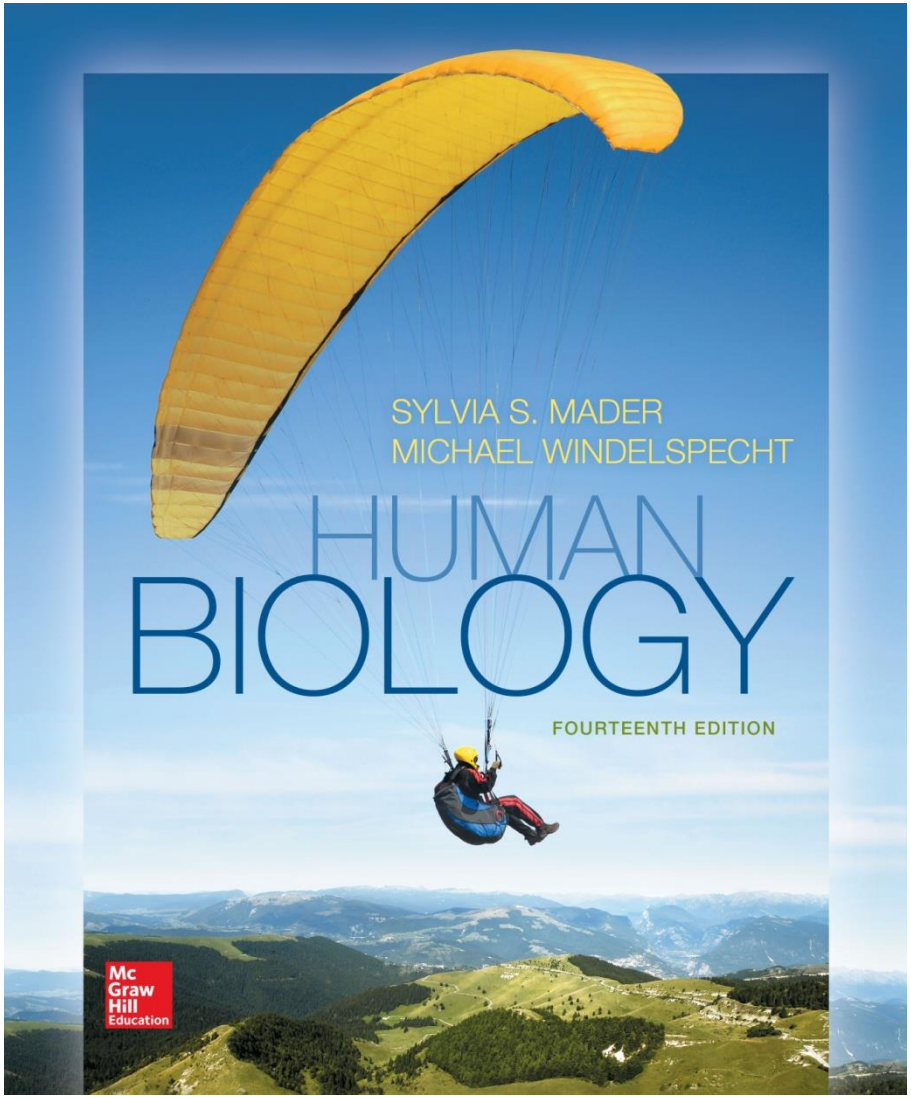
# Chapter 25
# Lecture Outline

**See separate PowerPoint slides for all figures and tables pre-inserted into PowerPoint without notes.**



# Human Population, Planetary Resources, and Conservation

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# Points to ponder

- What does the human population growth look like in the MDCs and the LDCs?
- What are biotic potential and carrying capacity?
- What are the renewable and nonrenewable resources that we use?
- Explain how human activities impact water, food, minerals, land, and energy.
- What is biodiversity?
- What are the direct and indirect values of biodiversity?
- Explain how our current society is unsustainable.
- What are some ways we can increase rural and urban sustainability?
- How is the quality of life assessed?

# Human population growth

- Over 7.2 billion people presently on the planet with more than 80 million added per year.
- Growth rate is determined by the number of births and deaths each year.
- Human population is growing exponentially.
- Biotic potential is the maximum growth rate under ideal conditions that is usually limited by the environment.
- Carrying capacity is the leveling off of growth to a level that can be sustained by the environment indefinitely.
- Some argue humans have already passed the carrying capacity and others suggest the earth can carry 50-100 billion people.

# Human population growth



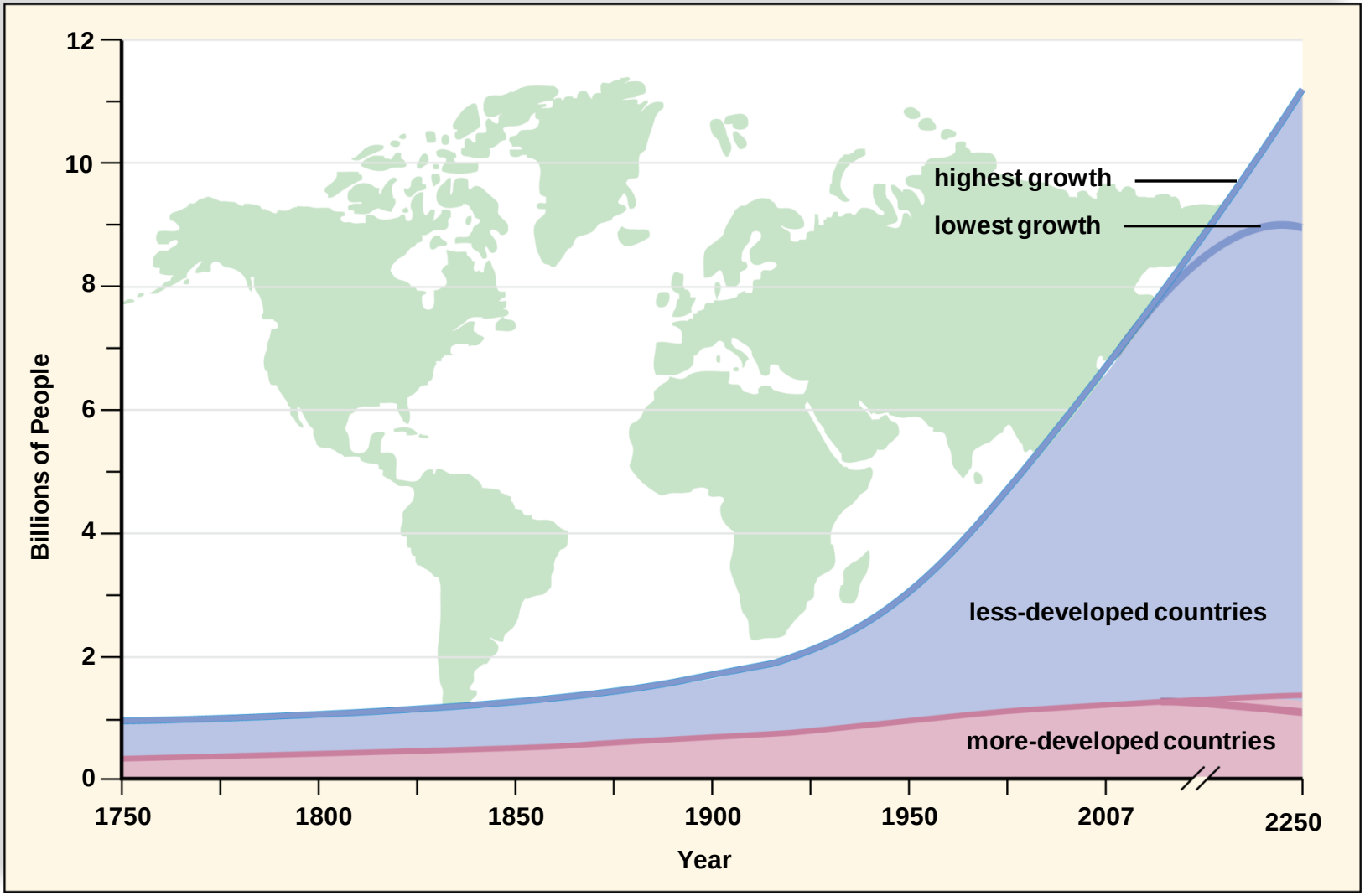


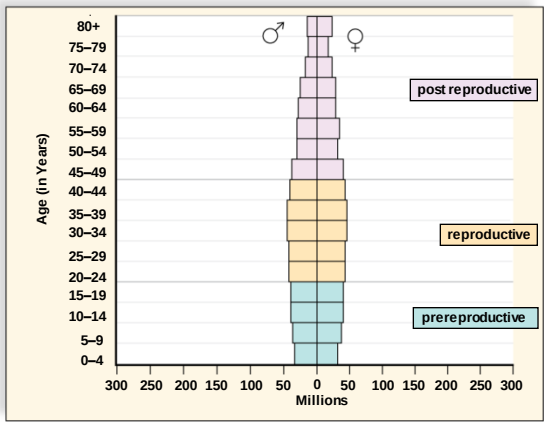

**Figure 25.1** Projections for human population growth.

# Comparing more and less developed countries

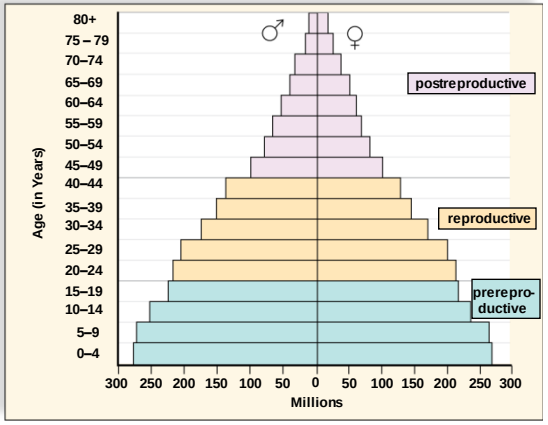
- MDCs have a low population increase averaging ~0.1% (US is ~0.899%).
- The growth rate of the LDCs peaked at 2.5% between 1960 and 1965. Since that time, their collective growth rate has declined.
  - Some countries (most in Africa) are increasing their populations at a much higher rate.
- Even though the world's growth rate has slowed down, the population will continue to increase because more women are entering the reproductive years than leaving them.

# Age structure in MDCs and LDCs






a. More-developed countries (MDCs)




b. Less-developed countries (LDCs)

c.

c: © Tim Graham/Getty Images

**Figure 25.2** Age-structure diagrams of MDCs and LDCs.

# Planetary resources

- Nonrenewable resources are limited in supply.
  - Amount of land, fossil fuels, and minerals
- Renewable resources are able to be replenished naturally.
  - Water, plants, and animals
- Pollution is a side effect of resource consumption, and it increases as the population increases.

# Land

- Beaches
  - 40% of the world's population lives within 60 miles of a coastline.
  - This leads to beach erosion and habitat loss.
  - The loss of wetlands is a problem because they act as buffers for coastal storms, and are important spawning areas for many marine organisms.

# Land

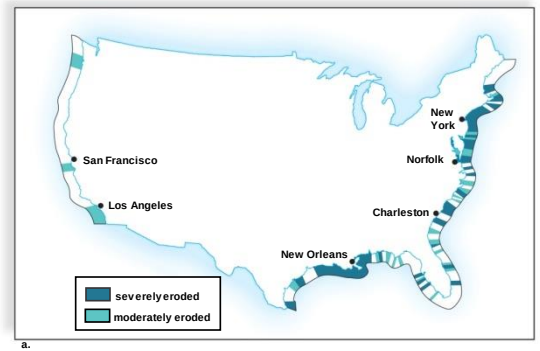
- Semiarid lands
  - Semiarid lands are being converted to desertlike conditions (desertification).

    e.g., Overgrazing, removal of vegetation

- Tropical rainforests
  - Deforestation can lead to infertile agricultural or grazing land as well as loss of biodiversity.

# Land



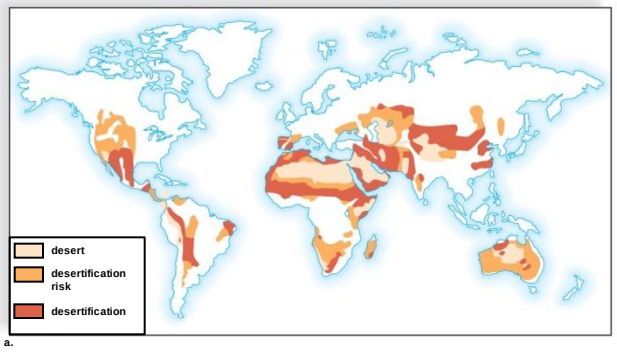




b: © Melvin Zucker/Visuals Unlimited

**Figure 25.4** Beach erosion and coastal development.



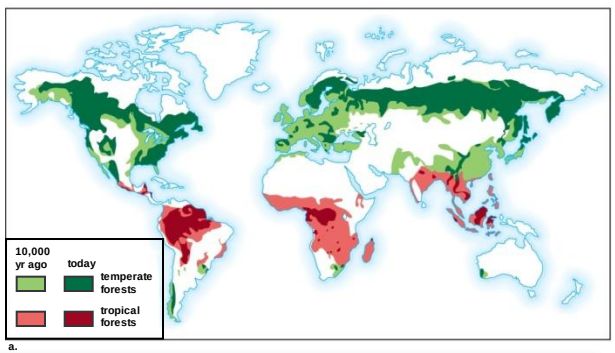




b: © Carlos Dominguez/Photo Researchers, Inc.

**Figure 25.5** Desertification.







b: © PhotoLink/Getty RF

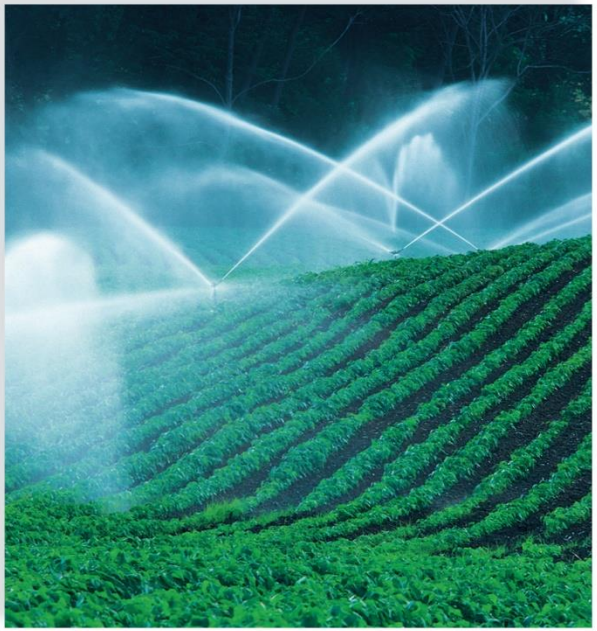
**Figure 25.6** Deforestation.

# Water

- 70% of freshwater worldwide is used for irrigation.
- In MDCs, more water is used for bathing, toilets, and watering lawns than for drinking and cooking.
- Dams change the flow of rivers, lose a lot of water, and can be filled in by sediment.
- Aquifers are being drained of water for our needs.
- Withdrawal of this groundwater can lead to sinkholes and saltwater intrusion.

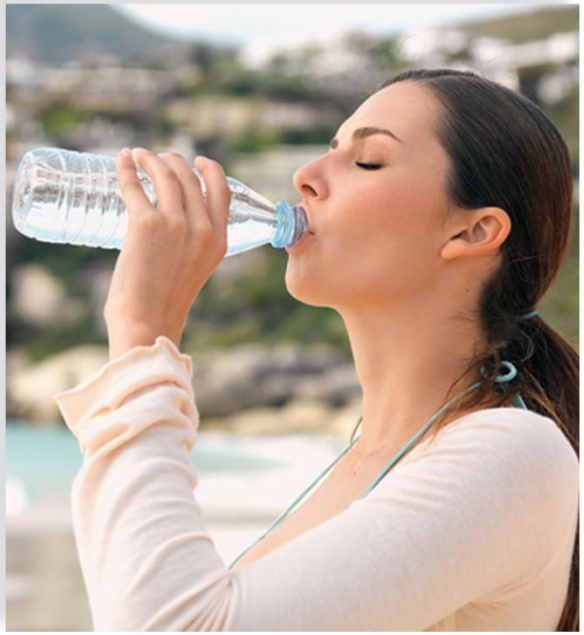
# Water





a. Agriculture uses most of the freshwater consumed.

b. Industrial use of water is about half that of agricultural use.



c. Domestic use of water is about half that of industrial use.



**Figure 25.7** Water use by agriculture, industries, and households.

# Groundwater depletion



© AP Photo/Mark Gormus

**Figure 25.8** Sinkholes may be caused by groundwater depletion.

# Water conservation



a.

b.

c.

a: © Bruno Barbier/Getty Images; b: © Milan Stojanovic/Getty RF;
c: © View Stock/Alamy

**Figure 25.9** Measures that can be taken to conserve water.

# Food

- Food comes from growing crops, raising animals, and fishing.
- Harmful farming methods consist of:
  - planting only a few genetic varieties.
  - heavy use of fertilizers, pesticides, and insecticides.
  - excessive fuel consumption and irrigation.
- Current farming methods lead to soil loss, degradation, and salinization.

# Food

- There is some controversy over genetically engineered crops.
- Raising livestock accounts for a lot of the pollution associated with farming.
- Raising livestock is energy intensive.

# Food



a. Polyculture

b. Contour farming

c. Biological pest control

a: © David R. Frazier/Science Source; b: © Inga Spence/Alamy; c: © Perennou Nuridsany/Science Source

**Figure 25.10** Methods that make farming more friendly to the environment.

# Energy

- Nonrenewable resources: fossil fuels (oil, natural gas, coal, nuclear)
  - Burning of fossil fuels is harmful to the environment.
  - 81% of the world's energy supply comes from fossil fuels.
  - The build up of greenhouse gases will lead to global warming.

# Energy

- Renewable sources: hydropower, geothermal energy, wind, and solar energy
  - Wind and solar energy are expected to become more common.
  - Solar-hydrogen revolution suggests that solar energy will replace fossil fuel energy.

# Energy



a.

c.

b.

d.

**Figure 25.12** Sources of renewable energy.

a: © Corbis RF; b: © Glen Allison/Getty RF; c: © Danita Delimont/ Getty Images; d: © Photo Link/Getty RF

# Minerals

- They are nonrenewable raw materials that are mined from the Earth's crust.
- Minerals includes fossil fuels, and both nonmetallic (sand and phosphate) and metallic raw materials (copper and iron).
- Consumption of minerals contributes to hazardous wastes.
- Production of plastics, pesticides, and herbicides produce a lot of waste.
- CFCs (chlorofluorocarbons) are damaging the ozone shield.
- Wastes entering bodies of water can be biologically magnified.

# What occurs during biological magnifications?



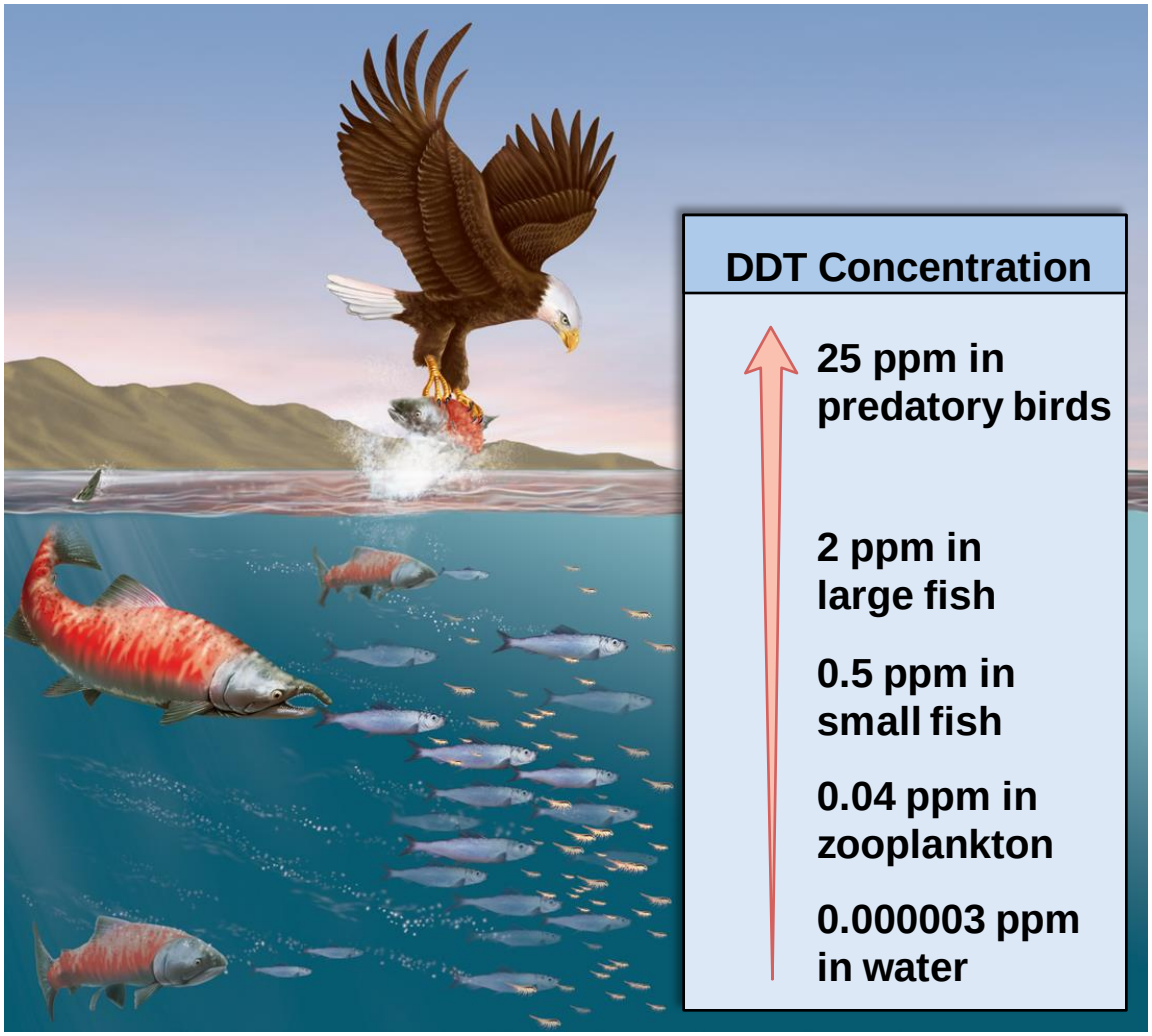



**Figure 25.14** Biological magnification concentrates chemicals in the food chain.

# Loss of biodiversity

- Biodiversity is the variety of life on the planet.

- Loss of biodiversity
  - Habitat loss of coral reefs and rainforests are of particular concern because they have high species diversity.
  - Alien species are exotic species that can become invasive and outcompete native species.
  - Pollution results in acid deposition, global warming, ozone depletion, and synthetic organic compounds including endocrine-disrupting contaminants.

# Loss of biodiversity

- Overexploitation occurs when humans extract enough individuals from a wild population that it becomes seriously reduced in numbers (exotic pets, hunting, fishing).
- Disease is caused by human encroachment on wildlife habitats.

# Loss of biodiversity



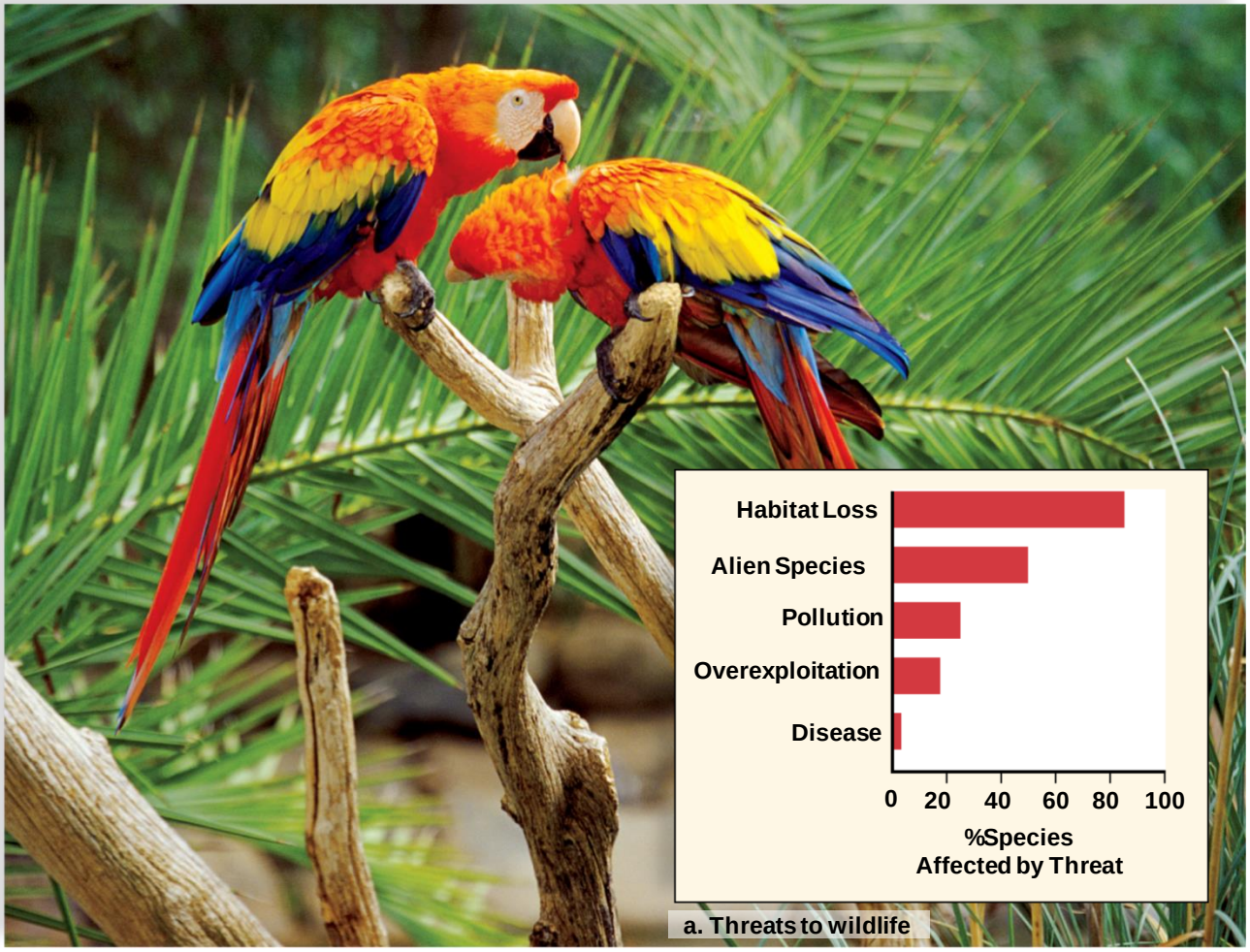
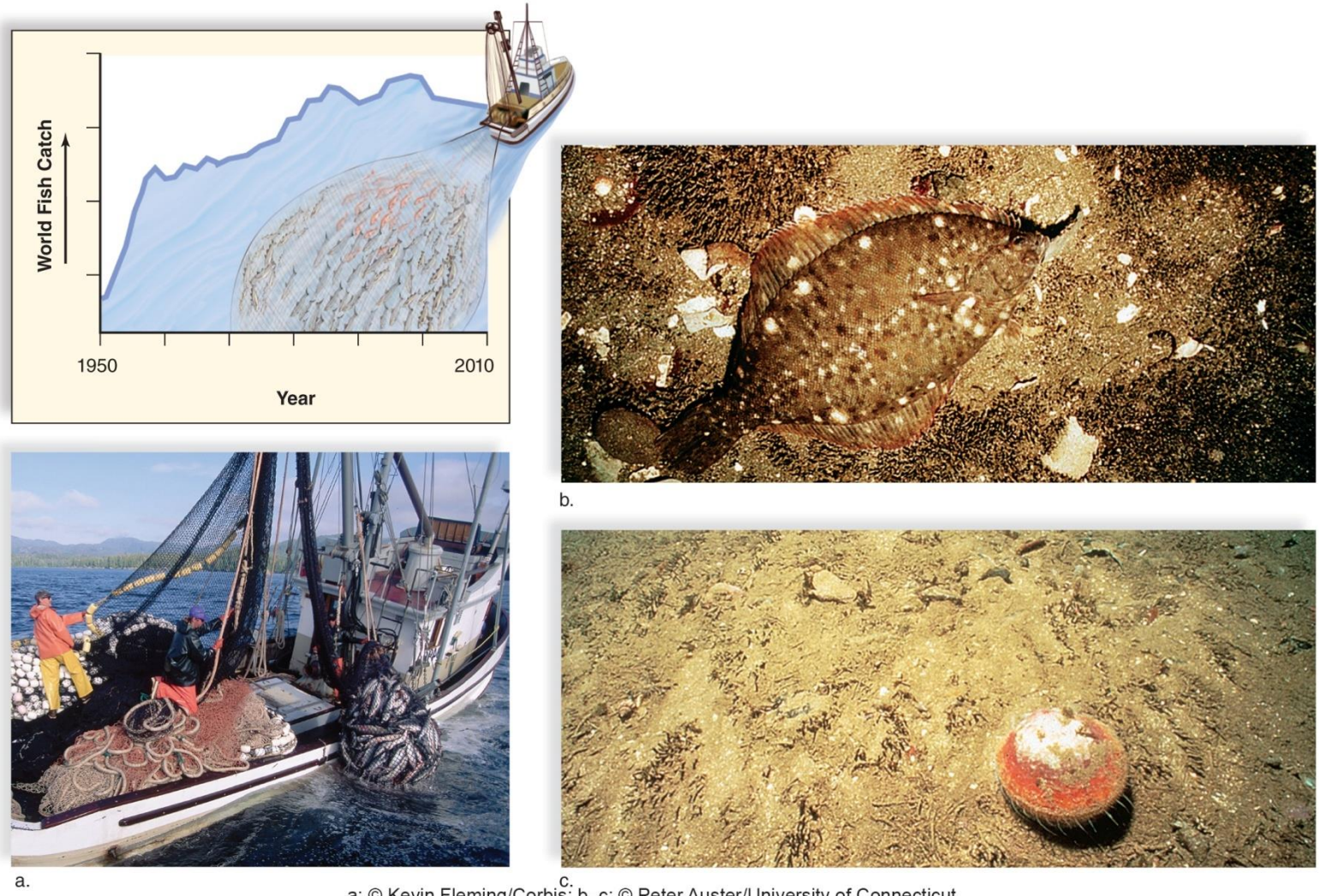



**Figure 25.15** Causes for the loss of biodiversity.

# Fishing practices and biodiversity






a: © Kevin Fleming/Corbis; b–c: © Peter Auster/University of Connecticut

**Figure 25.16** The impact of modern fishing practices.

# Direct value of biodiversity

- Medicinal value
  - Many drugs derived from living organisms
    - e.g., Rosy periwinkle for cancer, antibiotics

- Agricultural value
  - Food and fibers from agricultural crops
  - Biological pest controls
  - Wild pollinators

# Direct value of biodiversity

- Consumptive value
  - Most freshwater and marine harvests depend on wild-caught animals
  - Wild fruits and vegetables, fibers, and honey
  - Trees used for wood and other products

# Direct value of biodiversity



Wild species, like the rosy periwinkle, *Catharanthus roseus*, are sources of many medicines.

Wild species, like the nine-banded armadillo, *Dasypus novemcinctus*, play a role in medical research.

Wild species, like many marine species, provide us with food.

Wild species, like the lesser long-nosed bat, *Leptonycteris curasoae*, are pollinators of agricultural and other plants.

Wild species, like ladybugs, *Coccinella*, play a role in biological control of agricultural pests.

Wild species, like rubber trees, *Hevea*, can provide a product indefinitely if the forest is not destroyed.

(periwinkle): © Steven P. Lynch; (armadillo): © PhotoDisc/Getty RF; (fishing trawler): © Tim Laman/Getty RF; (bat): © Merlin D. Tuttle/Bat Conservation International; (lady bug): © Martin Ruegner/Masterfile RF; (rubber): © Bryn Campbell/Stone/Getty Images

**Figure 25.17** The direct value of biodiversity.

# Indirect value of biodiversity

- Waste disposal
  - Decomposers break down organic matter and other wastes to inorganic nutrients.
  - It breaks down and immobilize pollutants.
- Provision of freshwater
  - It provides us with water for drinking and irrigation.
  - Forests and other ecosystems exert a “sponge effect.”
- Prevention of soil erosion

# Indirect value of biodiversity

- Biogeochemical cycles
  - Biodiversity within an ecosystem contributes to the biogeochemical cycles.
- Regulation of climate
  - Forests help regulate the climate by taking up $CO_2$.
- Ecotourism

# Our unsustainable society

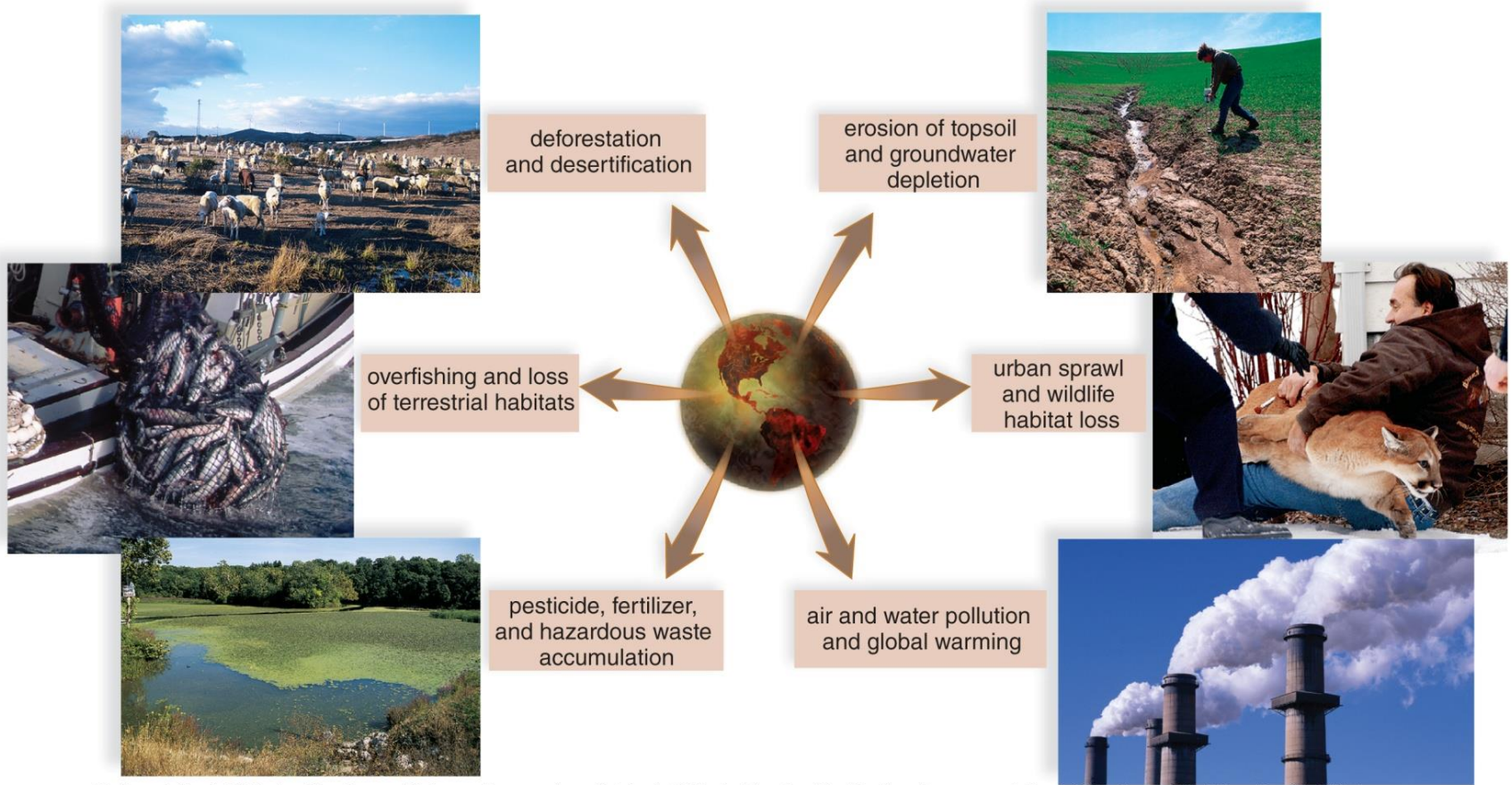
- Population growth in the LDCs is at a high rate.
- Consumption in the MDCs is at a high rate.
- Agriculture uses a lot of the land, water, and fossil fuels and produces pollution.
- Almost half of the agricultural yield feeds our farm animals in the U.S.
  - It takes about 10 lbs. of grain to produce about 1 lb. of meat, therefore the overeating of meat in the MDCs is wasteful.

# Our unsustainable society

- Currently, we mostly use nonrenewable forms of energy leading to acid deposition, global warming, and smog.
- As the human population grows, we encroach on other species, resulting in habitat loss and species extinction.

# Unsustainable activities



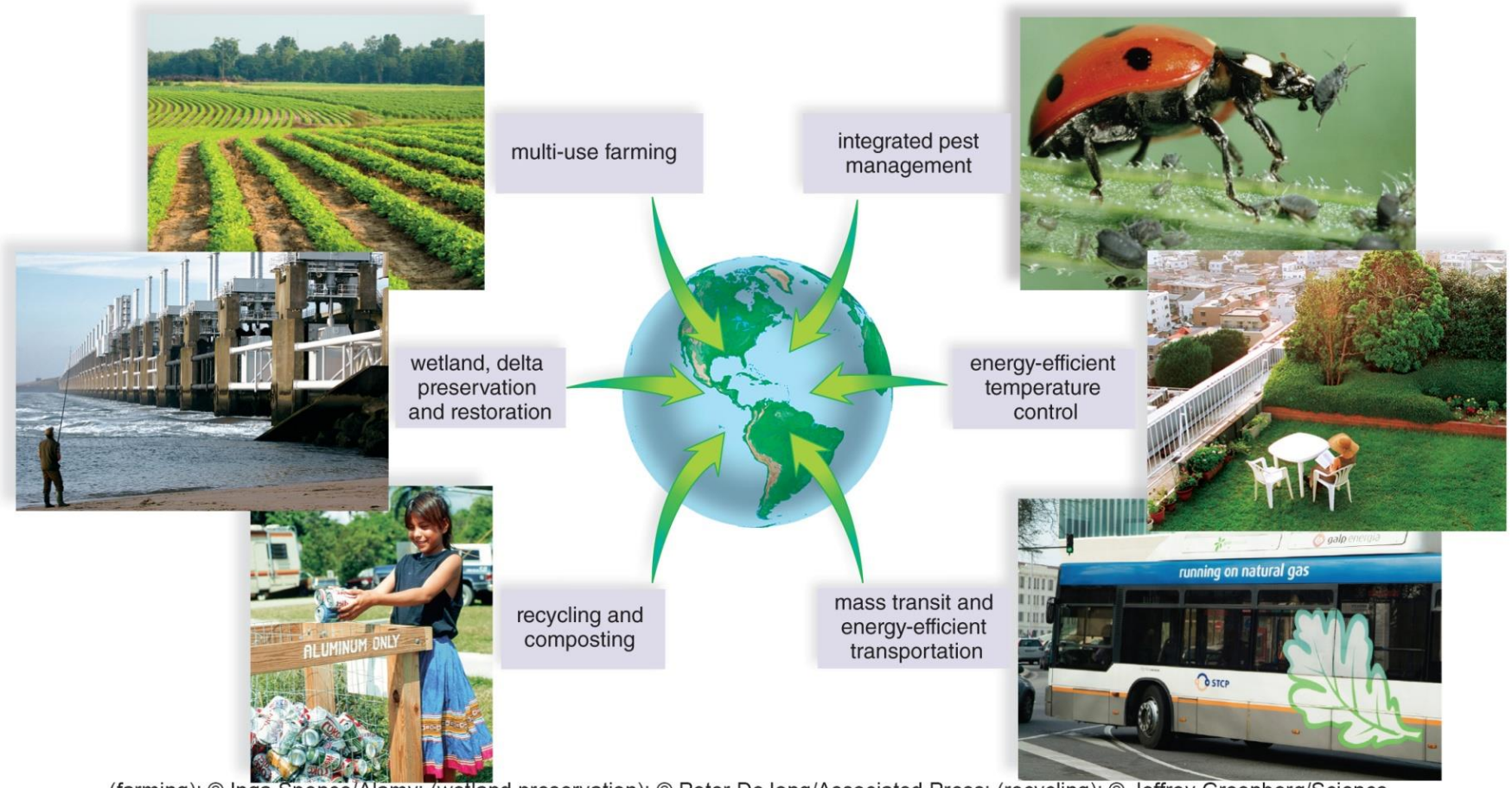



(deforestation): © Carlos Dominguez/Science Source; (overfishing): © Kevin Fleming/Corbis; (waste accumulation): © McGraw-Hill Education/Pat Watson; (erosion): © USDA/Nature Source/Science Source; (habitat loss): © Bill Zimmer/Associated Press; (air pollution): © Larry Lee Photography/Corbis RF

**Figure 25.18** Characteristics of an unsustainable society.

# Characteristics of a Sustainable Society






(farming): © Inga Spence/Alamy; (wetland preservation): © Peter DeJong/Associated Press; (recycling): © Jeffrey Greenberg/Science Source; (pest management): © Perennou Nuridsany/Science Source; (temperature control): © Reuters/Corbis; (mass transit): © LusoEnvironment/Alamy

# Rural sustainability

- Plant a variety of crops and trees.
- Use farming techniques that promote healthy soil and decrease destruction and pollution.
- Use integrated pest management.
- Preserve and restore wetlands.
- Use recycling and composting.
- Use renewable energy forms such as wind and biofuel.
- Buy locally.

# Urban sustainability

- Design energy efficient and mass transit transportation.
- Cool and heat buildings using efficient means.
- Create “green roofs” and “greenbelts”.
- Plant native grasses to attract butterflies and bees.
- Recycle business equipment.

# Assessing quality of life

- The GNP is a measure of money flow that does not take into account whether activities are environmentally or socially harmful.
- Measures that include noneconomic indicators are better indices of quality of life.
  - Index of Sustainable Economic Welfare (ISEW)
  - The Genuine Progress Indicator (GPI)
- Humans do not like to sacrifice their comfort levels, therefore we continue to exploit our environment and its resources.
- It takes an informed individual, creativity, and desire to bring about change for the better.