Chapter 56: Conservation Biology

AP BIOLOGY 2012

1

Conservation Biology

- Conservation biology integrates: ecology, evolutionary biology, physiology, molecular biology, genetics, and behavioral ecology
- Restoration Ecology - applies ecological principles to return degraded ecosystems to conditions as similar as possible to the natural state

2

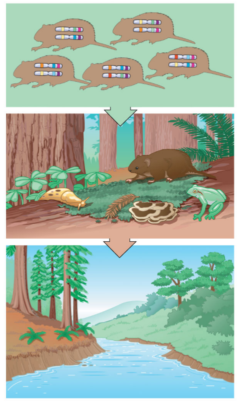
Biodiversity Crisis

- Tropical forests contain the greatest concentrations of species and are being destroyed at an ever increasing rate
- Rates of species extinction are difficult to determine
  - The current rate is higher than in the recent past, and this is thought to be a result of human activities.

3

Levels of Biodiversity

- Three components
  - Genetic Diversity
  - Species Diversity
  - Ecosystem Diversity



Genetic diversity in a vole population

Species diversity in a coastal redwood ecosystem

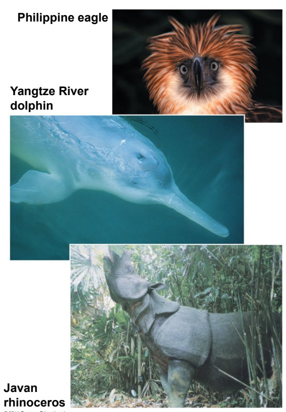
Community and ecosystem diversity across the landscape of an entire region

Fig. 56.3

4

Endangered vs. Threatened Species

- Endangered species: a species in danger of becoming extinct throughout its range
- Threatened species: species that are likely to become endangered in the foreseeable future
- Hundred Heartbeat Club - Harvard biologist E. O. Wilson identified species with fewer than 100 individuals remaining



Philippine eagle

Yangtze River dolphin

Javan rhinoceros

Fig. 56.4

5

Benefits of Species Diversity

- Many pharmaceuticals contain substances derived from plants
- Loss of species results in a loss of genetic diversity
- Loss of one species impacts other species (ex. bats as pollinators)

Fig. 56.6

Fig 56.5

6

Ecosystem Services

- Processes through which natural ecosystems and the species they contain help sustain human life
  - Purification of air and water
  - Detoxification and decomposition of wastes
  - Cycling of nutrients
  - Moderation of weather extremes
  - Pollination
  - Dispersal of seeds
  - Control of pests

Major Threats to Biodiversity

- Habitat destruction (Habitat fragmentation)
- Introduced species (Invasive species)
- Over-exploitation (over-harvesting)
- Disruption of interaction networks

(a) Brown tree snake

(b) Kudzu

Fig. 56.8

Population Conservation

- Small-population Approach - study the processes that can cause very small populations finally to become extinct
  - Sensitive to positive feedback loop (extinction vortex)
  - Key factor that drives it is the loss of genetic variation necessary to enable evolutionary responses to environmental change

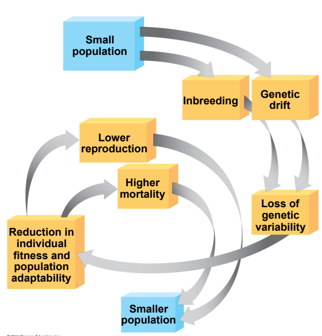


Fig. 56.12

Minimum Viable Population Size

- Minimum Viable Population (MVP) - smallest population size at which a species is able to sustain its numbers and survive
- Population Viability Analysis (PVA) - reasonably predict a population's chances for survival (usually expressed as a specific probability of survival over a particular time)

Population Conservation

- Declining-population Approach
  - Focuses on threatened and endangered populations that show a downward trend regardless of population size
  - Emphasizes the environmental factors that caused a population to decline in the first place
  - Requires that the population declines are evaluated on a case-by-case basis with a step-by-step conservation strategy

Steps for Analysis

- 1. Confirm that the population is in decline
- 2. Study the species' natural history
- 3. Develop hypotheses for all possible causes of decline
- 4. Test the hypotheses in order of likeliness
- 5. Apply the results of the diagnosis to manage for recovery

Case Study: Red-Cockaded Woodpecker

- Require specific habitat factors for survival
- Has been forced into decline by habitat destruction
- Breeding cavities constructed and new breeding groups were formed
- Once habitats were maintained and new breeding cavities were formed, the species began to rebound

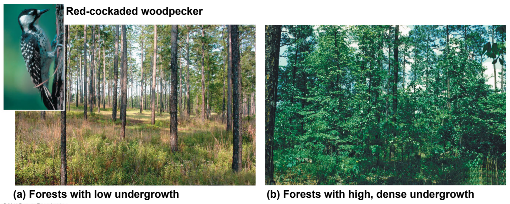


Fig. 56.16

Sustaining Landscapes

- Sustaining the region helps biodiversity of all ecosystems
- Must understand past, present, and future patterns of landscape use to make biodiversity a part of land-use planning
- Boundaries are defining features of landscapes
- As fragmentation increases biodiversity tends to decrease


(a) Natural edges


(b) Edges created by human activity

Fig. 56.16

Studies of Fragmented Forests

- Two groups of species: those that live on the edge of the forest and those that live in the interior

Fig. 56.17

Movement Corridor

- Narrow strip of quality habitat connecting otherwise isolated patches
- Humans sometimes create artificial corridors
- Promote dispersal and help sustain populations

Fig. 56.18

Establishing Protected Areas

- Slows the loss of biodiversity
- Much of the focus is on hot spots (small areas with large concentrations of endemic species and large numbers of endangered and threatened species)
  - Good choices for nature reserves but identifying them is not always easy

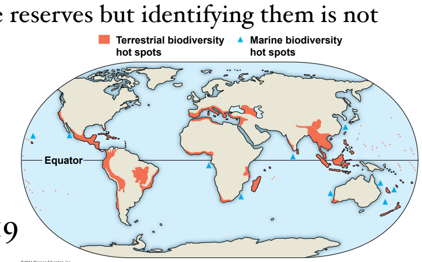


Fig. 56.19

Nature Reserves

- Extensive reserves are important for far-ranging animals
- Many cases the reserves are smaller than the actual area needed to sustain the population
- Zoned reserves are established as conservation areas

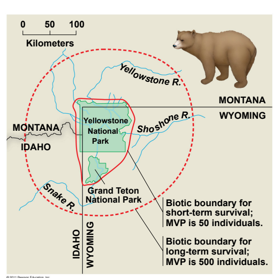


Fig. 56.20

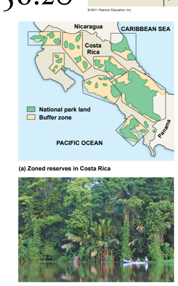


Fig. 56.21

Nutrient Enrichment

- Critical load - amount of added nutrient that can be absorbed by plants without damaging ecosystem integrity
- If nutrients exceed critical load, they will leach into groundwater and runoff into aquatic ecosystems

Fig. 56.23

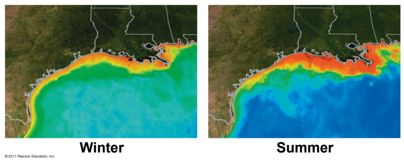


Fig. 56.24

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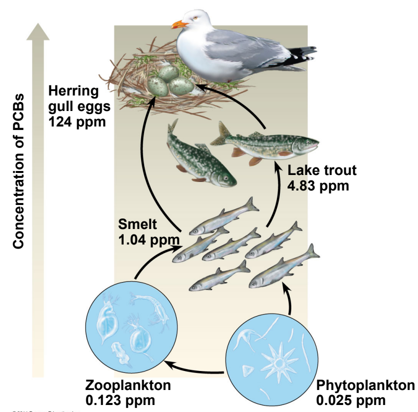
Toxins

- Biological Magnification - retained substances become more concentrated with each successive step up in trophic level
- Some toxins accumulate in body tissues
- DDT
- PCBs

Fig. 56.25



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Greenhouse Gasses

- Increase in the concentration of atmospheric CO_2

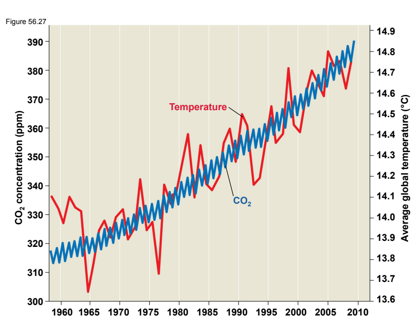


Fig. 56.27

21

CO2 and Forest Ecology

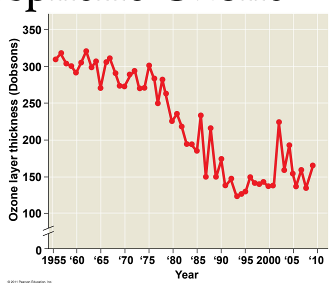
- Forest-Atmosphere Carbon Transfer and Storage (FACTS-I) Experiment (1995)
- How does elevated CO2 influence tree growth, carbon concentration in soils, insect populations, soil moisture, and growth of plants?

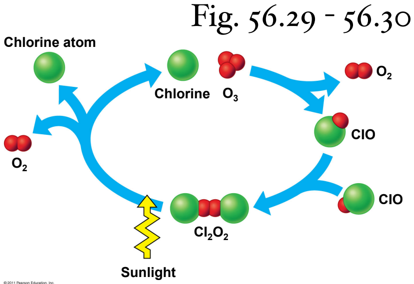
Fig. 56.28

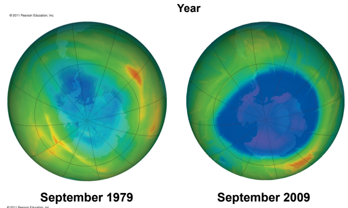
Depletion of Atmospheric Ozone

- Earth is protected from UV rays by the Ozone layer
- Thinning caused mainly by CFCs

Fig. 56.29 - 56.30







Acid Precipitation

- Burning of organic matter releases oxides of sulfur and nitrogen that react with water to form sulfuric acid and nitric acid
- Acids fall with precipitation (pH less than 5.6)
- Impacts aquatic pH and soil chemistry