CHAPTER 7

Biodiversity and Conservation

YOUR WORLD
YOUR TURN
Saving the Siberian Tiger

- Siberian tigers are one of five remaining tiger subspecies.
- In the early 20th century, hunting and habitat loss reduced the wild population to just 20–30 animals.
- Conservation efforts have helped the wild population rebound to 450–500 today.

Talk About It
What are the benefits of wildlife conservation? Are there drawbacks?
There are more known species of insects than any other form of life. Among known insect species, 4% are beetles.
Biodiversity

• Describes the variety of life across all levels of ecological organization

• Includes three types:
  • Genetic diversity: Differences in DNA among individuals
  • Species diversity: Variety of species in a given area
  • Ecosystem diversity: Variety of habitats, ecosystems, communities
Classification

- Taxonomists classify species based on physical appearance and genetic makeup.
- Species are placed into a hierarchy of taxonomic groups:
  - Genus
  - Family
  - Order
  - Phylum
  - Kingdom
  - Domain
- Taxonomic groups reflect evolutionary relationships among species.
- Below the species level, organisms may fall into subspecies—populations with genetically based characteristics that differ area to area.
Biodiversity Distribution

• There are likely between 5 and 30 million species on Earth.
• Species can be difficult to find and identify.
• Species are not evenly distributed globally, among taxonomic groups, or within a given geographic area.

Did You Know? In general, biodiversity increases toward the equator.
Ecosystem Services

• Intact environments provide ecosystem services, such as water purification and pest control.
• High biodiversity increases stability of communities and ecosystems, enabling them to perform services.
• Stable ecosystems are resistant and resilient.
  • **Resistant**: Resist environmental change without losing function
  • **Resilient**: Affected by change, but bounce back and regain function

Wetlands in Loxahatchee National Wildlife Refuge, Loxahatchee, Florida
Other Benefits of Biodiversity

- **Agriculture:** Wild strains are cross-bred with related crops to transfer beneficial traits.

- **Medicine:** Organisms contain compounds that are useful for treating disease.

- **Ecotourism:** Environmentally responsible tourism is a source of income for many nations.

*Did You Know? Of the 150 most prescribed drugs in the United States, 118 originated in nature.*

The yew tree, an original source of Taxol, a cancer-fighting drug.
Biodiversity losses caused by humans are common in our history. Hunting and forest cutting drove the passenger pigeon—once North America’s most numerous bird—into extinction.
Natural Biodiversity Loss

- **Background extinctions:** Naturally occurring extinctions, occurring one species at a time
- **Mass extinctions:** Events when extinction rates far exceed the normal background rate
- There have been five mass extinctions in Earth’s history.
- Each time, more than 1/5 of all families and 1/2 of all species have gone extinct.

Dinosaur extinctions were part of a mass extinction.
Biodiversity at Risk

- The current extinction rate is 100 to 1000 times greater than the natural background rate.
- In 2009, 1321 species in the U.S. were classified as endangered or threatened.
  - **Endangered**: At serious risk of extinction
  - **Threatened**: Likely to become endangered soon through all or part of its range
- **Living Planet Index**: Summarizes global population trends for certain terrestrial, freshwater, and marine species.

**Did You Know?** The Living Planet Index fell nearly 30% between 1970 and 2005.
Causes of Biodiversity Loss

- Habitat change and loss
- Invasive species
- Pollution
- Overharvesting

Siberian tiger
Habitat Change and Loss

- Greatest cause of biodiversity loss
- Organisms, adapted to their habitat, decline in population when the habitat changes.
- **Habitat fragmentation**: Patches of suitable habitat surrounded by unsuitable habitat
- In general, larger habitat fragments can support greater biodiversity than smaller fragments.

**Did You Know?** *Habitat change or destruction is the primary cause of population decline in more than 80% of threatened birds and mammals.*
Invasive Species, Pollution, and Overharvesting

• Invasive species can out-compete and displace native species.

• Harmful chemicals and materials that make their way into habitats can poison people and wildlife.

• Occasionally, species can be driven toward extinction by hunting or overharvesting by humans. Examples include Siberian tigers and passenger pigeons.

Once common in North America, the passenger pigeon is now extinct.
Climate Change

- Increasingly becoming a factor in biodiversity loss
- Unlike the other factors, climate change will have a potentially global effect on biodiversity.

Did You Know? Scientists predict that a 1.5–2.5°C global temperature increase could put 20–30% of plant and animal species at increased risk of extinction.
Lesson 7.3 Protecting Biodiversity

Just 2.3% of the planet’s land surface is home to 50% of the world’s plant species and 42% of its vertebrate animal species.
The Endangered Species Act

• U.S. law that protects biodiversity, passed in 1973
• Has three major parts:
  • Forbids governments and citizens from harming listed species and habitats
  • Forbids trade in products made from listed species
  • Requires U.S. Fish and Wildlife Service to maintain official list of endangered and threatened species, and to develop recovery plan for each listed species

Did You Know? In part because of the Endangered Species Act, 40% of populations that were once declining in the U.S. are now stable.
International Cooperation


- Convention on Biological Diversity (1992): International treaty to conserve biodiversity and ensure its responsible use and distribution.

Ivory products, made from elephant tusks
Single-Species Approaches to Conservation

- **Captive breeding programs**: Raising and breeding organisms in controlled conditions, such as zoos or aquariums.

- **Species Survival Plan**: Program to save individual species, includes captive breeding, education, and research.

- **Cloning**: Inserting DNA from an endangered species into a cultured egg cell; process involves implanting eggs into mothers of closely related species.

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**Did You Know?** The Species Survival Plan for the golden lion tamarin started with only 91 individuals. As of 2007, there were nearly 500 tamarins in zoos, and 150 reintroduced into the wild.
Biodiversity Hotspots

• The “hotspot approach” focuses attention on areas where the greatest number of species can be protected with the least effort.

• Hotspots have:
  • At least 1500 plant species found nowhere else in the world
  • Already lost 70% of their habitat as a result of human activity

• The 34 biodiversity hotspots are home to 50% of Earth’s plant species and 42% of terrestrial vertebrate species.

Northern Pintail ducks, Honshu, Japan
Japan is one of the world’s biodiversity hotspots.
Economic Approaches to Conservation

• Many conservation efforts today attempt to balance protection of land and wildlife with the economic interests of local people:
  
  • **Debt-for-nature swap:** Conservation organizations raise money to pay off a nation’s debt in return for improved conservation measures.
  
  • **Conservation concession:** Conservation organizations buy the rights to conserve resources, instead of harvesting them.
Wildlife Corridors

- Connect habitat fragments enabling once-isolated populations to interbreed
- Interbreeding increases genetic diversity.
- Conservation biologists hope that a planned 250-km long corridor in Australia will enable the endangered southern cassowary to recover from population declines.