CHAPTER 6

Biomes and Aquatic Ecosystems

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Central CASE

Too Much of a Good Thing?

- Elephant populations in southern Africa declined sharply due to hunting but have made overwhelming comebacks within nature reserves and parks.
- Some worry that elephant overpopulation is causing a decline in local biodiversity and damage to farms and infrastructure.
- Many efforts to control elephant populations are being considered and put into practice.

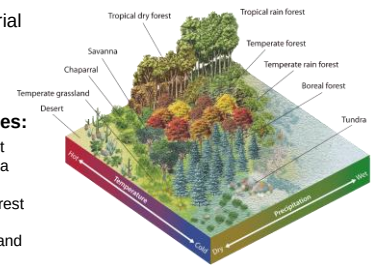
Talk About It *Which elephant population control effort—moving them, sterilizing them, or culling them—do you think has the best chance for long-term, positive effects?*

I. Review

a. Species combine to make populations
b. Populations group to make communities
c. Communities and environments make up ecosystems
d. Similar ecosystems are grouped as biomes
e. All biomes together make up the biosphere

Earth's Major Biomes

- Groups of terrestrial ecosystems that share biotic and abiotic conditions
- **10 primary biomes:**
  - tropical rain forest
  - dry forest savanna
  - desert
  - temperate rain forest
  - temperate forest
  - temperate grassland
  - chaparral
  - boreal forest
  - tundra



Did You Know? *Taiga is another name for boreal forest.*

Climate and Climatographs

- **Climate:** Average conditions, including temperature and precipitation, over long periods of time in a given area
- **Weather:** Day-to-day conditions in Earth's atmosphere
- **Climatographs:** Diagrams that summarize an area's average monthly temperature and precipitation
- Each biome has a set of characteristic organisms adapted to its particular climate conditions.

Biomes and Net Primary Production

- **Gross primary production:** The rate at which primary producers undergo photosynthesis
- **Net primary production:** The amount of organic matter (biomass) that remains after primary producers use some to carry out cellular respiration
- Ecosystems vary in their **net primary productivity,** the rate at which primary producers convert energy to biomass.
- Warm, wet biomes generally have higher net primary productivity than cold, dry biomes.

Tropical Rain Forest

- Year-round warm temperatures and at least 2 m (6.6 ft) precipitation a year
- Soil generally nutrient-poor
- Forest canopy, emergent layer, and understory support enormous variety of plants.
- Plants tend to have large, flat leaves and shallow roots.
- Supports more animal species than any other biome; animals tend to be highly specialized.

Did You Know? *Some tropical plants (epiphytes) grow high on other plants to access sunlight and do not touch the soil.*

Tropical Dry Forest

- Warm year-round, but rainfall highly seasonal
- Most trees are deciduous—they lose their leaves and cease photosynthesis part of the year.
- Plants and animals exhibit adaptations (e.g. waxy leaf coating, deep roots, estivation, migration) that enable them to survive the dry season.

Tiger *(Panthera tigris)*

Savanna

- Receives less precipitation than tropical dry forests, but more than deserts; usually has a distinct rainy season
- Grasses interspersed with groups of trees
- Tree growth limited by frequent fires and strong winds
- Plants are adapted to dry conditions; tend to be deciduous with deep roots, thick bark, and waxy coatings on leaves.
- Many animals migrate to find water, or burrow when water is scarce.

Desert

- Receives less than 25 cm (9.8 in.) of precipitation per year
- Temperatures vary widely from day to night.
- Plants tend to have thick, leathery leaves, store water in their tissues, and have shallow roots.
- Animals get most of their water from the food they eat, and they tend to be nocturnal. Mammals have exaggerated appendages to help regulate body temperature.

Did You Know? *Cactus spines are modified leaves that protect the plant from thirsty animals. Photosynthesis occurs within the green stems and trunks.*

Temperate Rain Forest

- Year-round moderate temperatures and heavy rainfall
- Largest extent found in Pacific Northwest of United States
- Characterized by tall evergreen trees, such as cedars and hemlocks, that don't lose leaves annually; many are conifers (produce seed-bearing cones)
- Forest floor is shaded, damp, covered in moss.
- Animals that require moisture, such as amphibians, thrive here.

Olympic Peninsula, Hoh River rain forest

Temperate Forest

- Precipitation evenly spread throughout the year
- Varied temperatures (hot summers, cold winters)
- Plants tenAd to be broad-leafed and deciduous.
- Soil is enriched with nutrients from annual leaf drop.
- Animals may migrate, hibernate, or store food to survive cold conditions.

Temperate Grassland (Prairie)

- Moderate seasonal precipitation and fairly extreme seasonal temperatures; droughts and fires common
- Not enough precipitation to support large trees; grasses, which grow from their base, thrive despite droughts, fires, animals grazing
- Animals are adapted to deal with lack of cover.
- Soil tends to be rich in nutrients; most of world's grasslands have been converted to farmland.

Chaparral

Did You Know? *Some chaparral plants contain oily compounds that facilitate the spread of fire.*

- Highly seasonal conditions with mild, wet winters and warm, dry summers
- Prolonged hot, dry periods; droughts and fires common
- Plants are drought-resistant; many have thick, waxy leaves or leaves with hairs that trap moisture; succulents are common.
- Plants may have thick bark and deep roots to resist fire; some plants require fire to germinate.
- Many animals burrow or are nocturnal to avoid heat.

Boreal Forest (Taiga)

- Long, cold winters; short, cool summers
- Nutrient-poor, slightly acidic soils
- Low species diversity
- Coniferous trees with waxy needles and conical shape, adapted to harsh, snowy conditions are common.
- Animals feed, breed, and care for young mostly during short warm season; year-round residents tend to have thick insulation and small extremities that maintain heat.

Tundra

- Extremely cold, dark winters; relatively sunny and cool summers
- Found at very high latitudes in the Northern Hemisphere
- Harsh winds, nutrient-poor soil, and freezing temperatures limit plant growth; no tall trees; mosses and lichens common
- Characterized by permafrost (underground soil that is frozen year-round)
- Birds and caribou migrate to the tundra during the mild summer feed on insects and lichens; onl few species live here year-roun

Polar Ice and Mountains

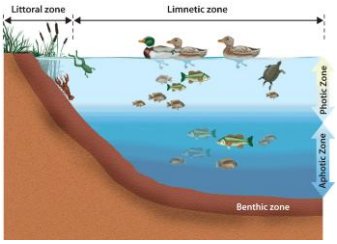
- Not classified as biomes
- No land under polar ice in Northern Hemisphere; ice sits atop Antarctica in Southern Hemisphere
- Very few plants; most life is in surrounding ocean
- Mountain communities change with elevation, similar to how biome communities change with latitude.

Describing Aquatic Ecosystems

- **Salinity:** the amount of dissolved salt present in water. Ecosystems are classified as salt water, fresh water, or brackish depending on salinity.
- Photosynthesis tends to be limited by light availability, which is a function of depth and water clarity.
- Aquatic ecosystems are either flowing or standing.
- **Aquatic ecosystem zones:** photic, aphotic, benthic

Freshwater Ecosystems: Ponds, Lakes, Inland Seas

- Salinity is less than 0.5 ppt (parts per thousand)
- Ponds and lakes are similar, except in size, but inland seas contain organisms adapted for open water.
- Ponds and lakes are divided horizontally into zones: littoral and limnetic



Freshwater Ecosystems: Wetlands

- Areas of land flooded with water at least part of the year
- Include freshwater marshes, swamps, bogs, and fens
- Wetlands prevent flooding, recharge aquifers, filter pollutants, and provide habitats.

Freshwater Ecosystems: Rivers and Streams

- Bodies of surface water that flow downhill, eventually reaching an ocean or inland sea
- **Watershed:** The area of land drained by a river and its tributaries
- Characteristics, such as dissolved oxygen, temperature, water speed, organisms, and others, change from source to mouth.

Estuaries

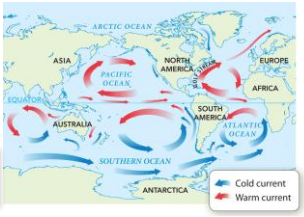
- Occur where a river flows into the ocean or an inland sea
- Coastal estuaries are brackish ecosystems; organisms must tolerate wide salinity and temperature ranges.
- Coastal estuaries are home to salt marshes and mangrove forests.
- Like wetlands, estuaries help prevent flooding and soil erosion as well as provide habitats.

Everglades, Florida, wetlands

Did You Know? *Salt marshes and mangrove forests are two of the most productive ecosystems on Earth.*

Oceans

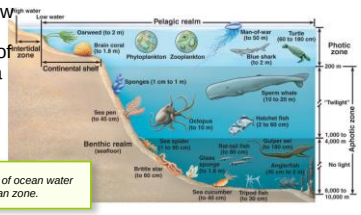
- Currents are driven by water temperature and density differences, wind, and gravity.
- Surface winds and heating generate vertical currents that transport nutrients and oxygen.
- **Horizontal ocean zones:** intertidal, neritic, open ocean
- **Vertical ocean zones:** photic, aphotic, benthic



Did You Know? *If the water in the oceans evaporated, a 60 m (200 ft) deep layer of salt would be left behind.*

Ocean Ecosystems

- **Intertidal:** Highly diverse; extreme range of temperature, moisture, and salinity
- **Neritic:** Productive kelp forests and coral reefs provide habitats and help protect shorelines from erosion.
- **Open ocean:** Low productivity due to low light penetration; phytoplankton base of food chain; deep sea organisms and hydrothermal vent communities



Did You Know? *Over 90% of ocean water on Earth is in the open ocean zone.*