Aquatic biodiversity

Chapter 6
Aquatic Environments

• Saltwater and freshwater aquatic life zones cover almost three-fourths of the earth’s surface.
  ▫ Most of this is saltwater.
  ▫ Less than 1% of earth’s surface is covered by freshwater.
Aquatic Environments

- The types of organisms found in aquatic environments are determined by the water’s salinity.
  - Salinity is the amounts of various salts (such as NaCl) dissolved in a given volume of water.
- Two major types of aquatic life zones
  - Saltwater/Marine
  - Freshwater
Aquatic Life Types

• **Plankton**
  - Phytoplankton – plant plankton - algae
  - Zooplankton – animal plankton - protozoa

• **Nekton**
  - Strong swimming consumers
  - Turtles, fish, and whales.

• **Benthos**
  - Bottom dwellers such as barnacles, crabs, worms
  - Live on or in the sand/mud.

• **Decomposers**
  - Break down organic compounds in the dead bodies and wastes of aquatic organisms.
Aquatic Layers

- Life in most aquatic systems is found in surface, middle, and bottom layers.
- Temperature, access to sunlight for photosynthesis, dissolved oxygen content, nutrient availability changes with depth.
  - Euphotic zone (upper layer in deep water habitats): sunlight can penetrate.
Saltwater Life Zones - Coastal Zone

• The coastal zone makes up less than 10% of the world’s ocean area but contains 90% of all marine species.
  • Warm
  • Nutrient Rich
  • Shallow
• Extends from the high-tide mark on land to the shallow edge of the continental shelf.
Costal Zones - Estuaries and Wetlands

- **Estuaries**
  - where rivers meet the sea
  - Seawater mixes with freshwater

- **Coastal Wetlands**
  - Land areas covered with water all or part of the year.

- Estuaries and coastal wetlands are some of the world’s most productive ecosystems.
Delaware Bay Estuary
Coastal Wetlands - Mangrove Forests

- Trees that can grow in salt.
- Found in tropical and sub-tropical regions.
- Filter toxic pollutants, excess nutrients, sediments.
- Reduce storm damage
- Provide food, habitats, and nurseries to a variety of aquatic species.
Mangrove Forests
Coastal Wetlands - Mangrove Forests

- Threats
  - More than a third of the world’s mangrove forests have been destroyed.
  - Shrimp farms
  - Crops
  - Coastal development projects
Coastal Wetlands - Mangrove Forests

Shrimp farming
Coastal Zone - Intertidal Zone

• The intertidal zone is the area of coast in between the high and low tide.

• Organisms in this zone have a lot of stresses to deal with!
  ▫ Swept away or crushed by waves
  ▫ Immersed during high tide and dry at low tides
  ▫ Changing salinity from rain

• Organisms that live in the intertidal zone have special adaptations to help them deal with these stresses.
  ▫ Hold on to something
  ▫ Dig into sediment
  ▫ Hide in protective shell
ADAPTATIONS

Sea Star has tube feet
Limpet can clamp down
Sea Anemone can fold inward
Barnacle has a trap door
Mussel has attachment threads
Worms have flexible tubes
Gooseneck Barnacle has flexible neck
Sea Palm has flexible stalk
Coastal Zone - Coral Reefs

- Form in clear, warm, coastal waters of the tropics and subtropics.
- Provides habitat for $\frac{1}{4}$th of all marine species.
- Vulnerable to damage
  - Grow slowly
  - Disrupted easily
  - Require clear, warm, fairly shallow water of constant high salinity
  - Coral Bleaching
Coastal Zone - Coral Reefs

- Coral reefs are formed by colonies of polyps.
- They build reefs by secreting a protective crust of limestone (calcium carbonate).
• Polyps have single celled algae living inside of them called **zooxanthellae**.
• Polyps and zooxanthellae have a mutually beneficial relationship.
  ▫ The zooxanthellae provide food, color, and oxygen through photosynthesis to the coral polyp.
  ▫ The coral polyp provides the zooxanthellae with a well protected home and nutrients.
Corals can be stressed by temperature and sedimentation (silt from land).
When a coral becomes too stressed it will expel its zooxanthellae out of the polyps.
Since the zooxanthallae are what provided color to the corals – when they are expelled the coral appears bleached.
Saltwater Life Zones - Open Ocean

**Euphotic zone:**
Brightly lit surface layer

**Bathyal zone:**
Dimly lit middle layer

**Abyssal zone:**
Dark bottom zone
Freshwater Life Zones

- Standing (lentic) bodies of water
  - Lakes
  - Ponds
  - Inland wetlands
- Flowing (lotic) systems
  - Streams
  - Rivers
Freshwater Life Zones - Lakes

- Lakes are large natural bodies of standing freshwater.
- Lakes are formed when precipitation, runoff, and groundwater seepage fill depressions in the earth’s surface.
Lake Zones

- Lakes have four distinct layers
  - Littoral zone – near the shore and consists of the shallow sunlit waters
  - Limnetic zone – open sunlit water surface layer away from the shore
  - Profundal zone – the deep open water where it is too dark for photosynthesis
  - Benthic Zone – bottom of the lake – mostly decomposers, detritus feeders
Lakes and Nutrients

- Oligotrophic – poorly nourished lake
- Eutrophic – well nourished lake
- Eutrophication – human inputs of nutrients which accelerate eutrophication of lakes.
- Lakes which are in between the two extremes of nutrient enrichment are mesotrophic.
Streams and Rivers

• Precipitation that does not sink into the ground or evaporate is surface water.
• It becomes runoff when it flows into streams.
• A watershed is the land area that delivers runoff to a stream.
• Small streams join to form rivers, which flow into the ocean.
Freshwater flow zones

• Source Zone
  ▫ Headwaters of streams
  ▫ Shallow, cold, clear
  ▫ Swift flowing
  ▫ Mountain highlands streams

• Transition Zone
  ▫ Headwater streams merge to form wider, deeper, warmer streams
  ▫ Flow down gentler slopes
  ▫ Warmer conditions support more phytoplankton

• Floodplain Zone
  ▫ Bottom zone, streams join into wider and deeper rivers
  ▫ Flow across broad, flat valleys
  ▫ Slow moving
  ▫ Support large populations of producers, fish
Freshwater Inland Wetlands

- Lands covered with freshwater all or part of the time.
  - Marshes – without trees
  - Swamps – with trees
  - Prairie potholes
  - Floodplains
  - Seasonal wetlands
Inland wetlands act like natural sponges that absorb and store excess water from storms and provide a variety of wildlife habitats.
Freshwater Inland Wetlands: Vital Sponges

- Filter and degrade pollutants.
- Reduce flooding and erosion by absorbing slowly releasing overflows.
- Help replenish stream flows during dry periods.
- Help recharge ground aquifers.
- Provide economic resources and recreation.
Prairie potholes have been drained for conversion to croplands.
Human Impacts on Freshwater Systems

- Dams, diversions, canals fragment 40% of the world’s largest rivers.
  - Alter and destroy habitats by reducing water flow and increasing damage from storms.
- Flood control levees and dikes alter and destroy aquatic habitats.
- Cities and farmlands add pollutants and nutrients.
- Many inland wetlands have been drained or filled to grow crops or have been covered with concrete and buildings.
Our watershed - Pennypack Creek

- Pennypack Creek rises from headwater springs and wetlands in the suburbs of Horsham then gains strength along its middle mainstem in Upper Moreland.
- The creek then drops into the winding greenbelt of Philadelphia’s Pennypack Park before discharging into a broad mudflat on the Delaware River.

**Area**
drains approximately 56 square miles  

**Stream Miles**
approximately 125 linear miles  

**Population**
approximately 230,000 residents  

**Impervious Cover**
approximately 33% impervious  

**Counties / Municipalities**
encompasses areas of Montgomery, Philadelphia and Bucks Counties, with all or parts of 12 municipalities, including Abington, Bryn Athyn, Hatboro, Horsham, Lower Moreland, Rockledge, Upper Dublin, Upper Moreland, Upper Southampton, and Warminster
Pennypack Watershed Issues

The Pennypack Creek Watershed Comprehensive Characterization Report (2009) identified the following watershed issues based on thorough assessments of water quality, physical habitat, and biological data:

• Urbanization and flow modification
• Erosion and sedimentation
• Degraded water quality, primarily due to nutrient enrichment, excess sediment, and bacteria.
• Impaired fish and other aquatic life communities
• Excessive algal growth