Aquatic Biodiversity

Chapter 8

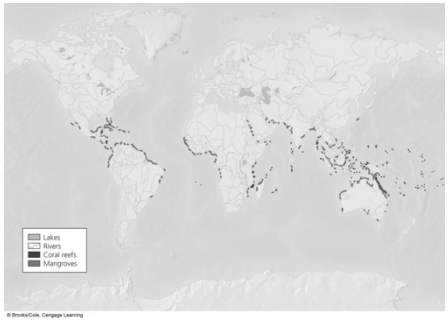
8-1 What Is the General Nature of Aquatic Systems?

- ***Concept 8-1A*** *Saltwater and freshwater aquatic life zones cover almost three-fourths of the earth's surface with oceans dominating the planet.*
- ***Concept 8-1B*** *The key factors determining biodiversity in aquatic systems are temperature, dissolved oxygen content, availability of food and availability of light and nutrients necessary for photosynthesis.*

Most of the Earth Is Covered with Water

- Aquatic life zones
  - Saltwater: marine
    - Oceans and estuaries
    - Coastlands and shorelines
    - Coral reefs
    - Mangrove forests
  - Freshwater
    - Lakes
    - Rivers and streams
    - Inland wetlands

Distribution of the World's Major Saltwater and Freshwater Sources

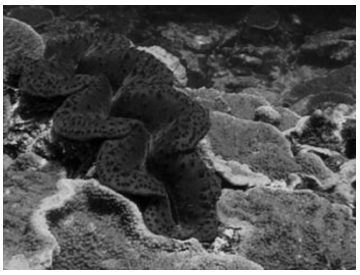


Most Aquatic Species Live in Top, Middle, or Bottom Layers of Water (1)

- Plankton (drifters)
  - Phytoplankton
  - Zooplankton
  - Ultraplankton
- Nekton (swimmers)
- Benthos (bottom dwellers)
- Decomposers (fungi & bacteria)

Video: Schooling fish

Video: Giant clam



PLAY

Most Aquatic Species Live in Top, Middle, or Bottom Layers of Water (2)

- Key factors in the distribution of organisms
  - Temperature
  - Dissolved oxygen content
  - Availability of food
  - Availability of light and nutrients needed for photosynthesis in the **euphotic,** or **photic, zone**

8-2 Why Are Marine Aquatic Systems Important?

- ***Concept 8-2*** *Saltwater ecosystems are irreplaceable reservoirs of biodiversity and provide major ecological and economic services.*

Oceans Provide Important Ecological and Economic Resources

- Reservoirs of diversity in three major life zones
  - Coastal zone
    - Usually high NPP
  - Open sea
  - Ocean bottom

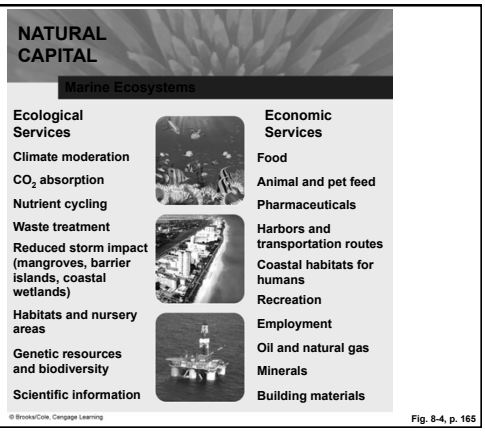


Fig. 8-4, p. 165

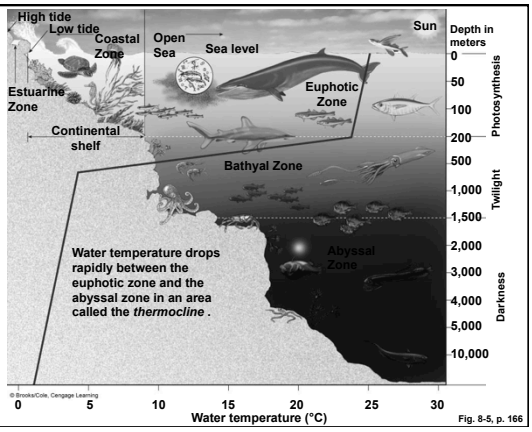


Fig. 8-5, p. 166

Estuaries and Coastal Wetlands Are Highly Productive (1)

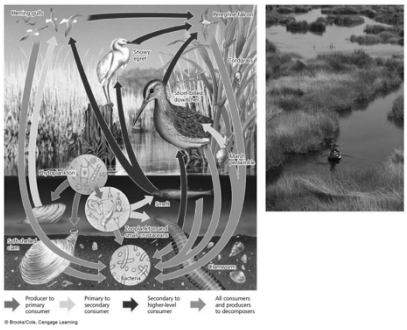
- **Estuaries and coastal wetlands**
  - River mouths
  - Inlets
  - Bays
  - Sounds
  - Salt marshes
  - Mangrove forests
- **Seagrass Beds**
  - Support a variety of marine species
  - Stabilize shorelines
  - Reduce wave impact

Estuaries and Coastal Wetlands Are Highly Productive (2)

- Important ecological and economic services
  - Coastal aquatic systems maintain water quality by filtering
    - Toxic pollutants
    - Excess plant nutrients
    - Sediments
  - Absorb other pollutants
  - Provide food, timber, fuelwood, and habitats
  - Reduce storm damage and coast erosion

View of an Estuary from Space

Some Components and Interactions in a Salt Marsh Ecosystem in a Temperate Area



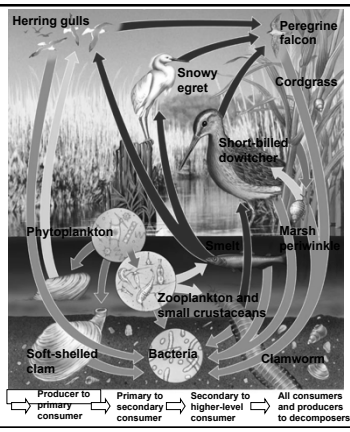


Fig. 8-7a, p. 167

Mangrove Forest in Daintree National Park in Queensland, Australia

© Brooks/Cole, Cengage Learning

Rocky and Sandy Shores Host Different Types of Organisms

- **Intertidal zone** (Fig. 8-9)
  - Rocky shores
  - Sandy shores: barrier beaches
- Organism adaptations necessary to deal with daily salinity and moisture changes
- Importance of sand dunes (Fig. 8-10)

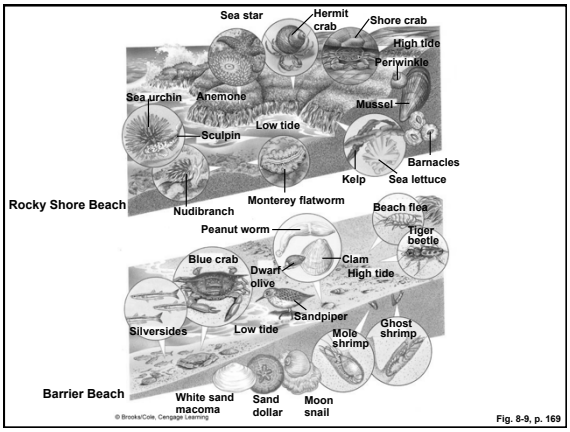


Fig. 8-9, p. 169

Primary and Secondary Dunes

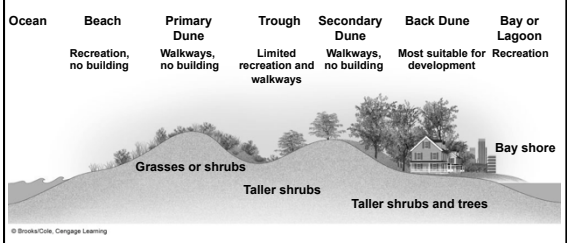


Fig. 8-10, p. 170

Coral Reefs Are Amazing Centers of Biodiversity

- Marine equivalent of tropical rain forests
- Habitats for one-fourth of all marine species

Coral Reef Trophic Interactions

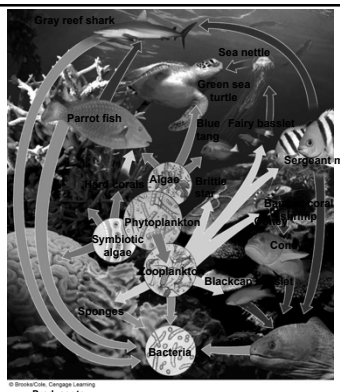
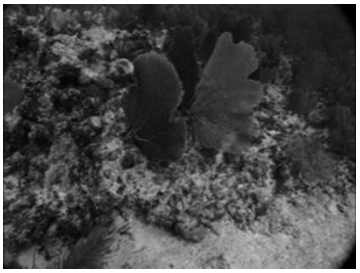


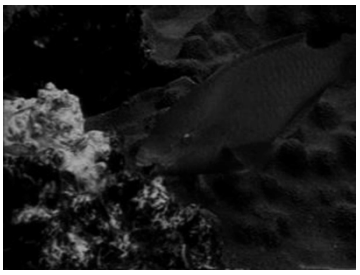
Fig. 8-11, p. 171

Video: Florida reefs



▶ PLAY

Video: Reef fish (Bahamas)

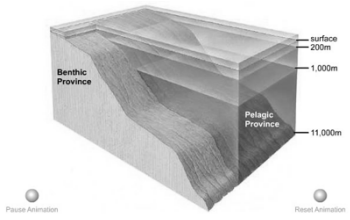


▶ PLAY

The Open Sea and Ocean Floor Host a Variety of Species

- Vertical zones of the open sea (Fig. 8-5)
  - **Euphotic zone**
  - **Bathyal zone**
  - **Abyssal zone:** receives **marine snow**
    - Deposit feeders
    - Filter feeders
  - **Upwelling zones**
- Primary productivity and NPP

Animation: Ocean provinces



▶ PLAY

8-3 How Have Human Activities Affected Marine Ecosystems?

- ***Concept 8-3*** *Human activities threaten aquatic biodiversity and disrupt ecological and economic services provided by saltwater systems.*

Human Activities Are Disrupting and Degrading Marine Systems

- Major threats to marine systems
  - Coastal development
  - Overfishing
  - Runoff of nonpoint source pollution
  - Point source pollution
  - Habitat destruction
  - Introduction of invasive species
  - Climate change from human activities
  - Pollution of coastal wetlands and estuaries

Video: ABC News: Beach pollution

8-4 Why Are Freshwater Ecosystems Important?

- ***Concept 8-4*** *Freshwater ecosystems provide major ecological and economic services and are irreplaceable reservoirs of biodiversity.*

Water Stands in Some Freshwater Systems and Flows in Others (1)

- Standing **(lentic)** bodies of freshwater
  - Lakes
  - Ponds
  - Inland wetlands
- Flowing **(lotic)** systems of freshwater
  - Streams
  - Rivers

Water Stands in Some Freshwater Systems and Flows in Others (2)

- Formation of lakes
- Four zones based on depth and distance from shore (Fig. 8-15)
  - **Littoral zone**
  - **Limnetic zone**
  - **Profundal zone**
  - **Benthic zone**

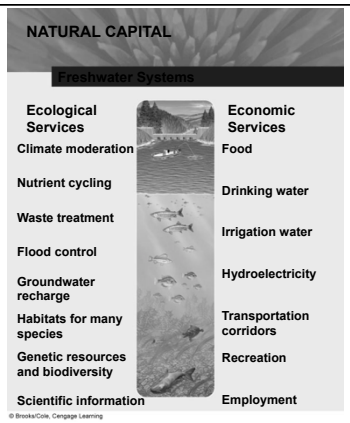


Fig. 8-14, p. 174

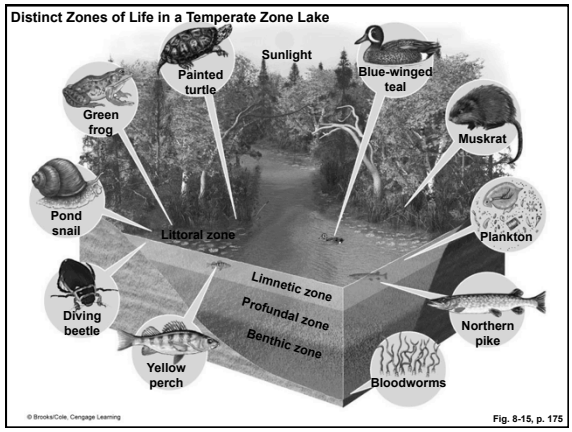
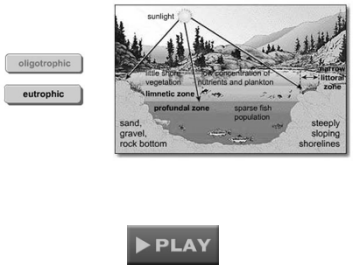


Fig. 8-15, p. 175

Some Lakes Have More Nutrients Than Others

- **Oligotrophic lakes**
  - Low levels of nutrients and low NPP
- **Eutrophic lakes**
  - High levels of nutrients and high NPP
- **Mesotrophic lakes**
- Cultural eutrophication leads to **hypereutrophic** lakes

Animation: Trophic natures of lakes

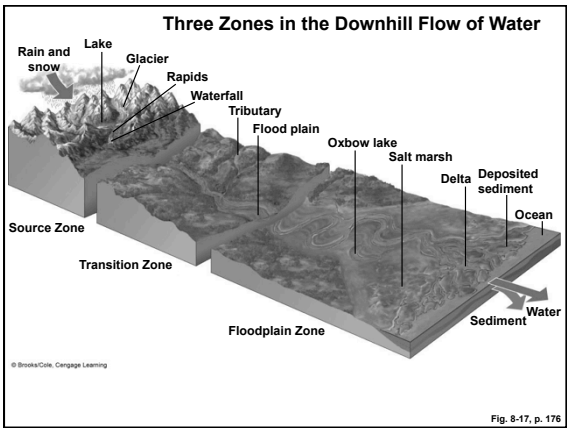


▶ PLAY

The Effect of Nutrient Enrichment on a Lake

Freshwater Streams and Rivers Carry Water from the Mountains to the Oceans

- **Surface water**
- **Runoff**
- **Watershed, drainage basin**
- Three aquatic life zones in downhill flow (Fig. 18.7)
  - **Source zone**
  - **Transition zone**
  - **Floodplain zone**

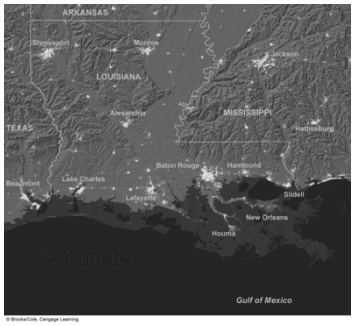


Case Study: Dams, Deltas, Wetlands, Hurricanes, and New Orleans

- Coastal deltas, mangrove forests, and coastal wetlands: natural protection against storms
- Dams and levees reduce sediments in deltas: significance?
- New Orleans, Louisiana, and Hurricane Katrina: August 29, 2005
- Global warming, sea rise, and New Orleans

New Orleans, Louisiana, (U.S.) and Hurricane Katrina

Projection of New Orleans if the Sea Level Rises 0.9 Meter



Freshwater Inland Wetlands Are Vital Sponges (1)

- Marshes
- Swamps
- Prairie potholes
- Floodplains
- Arctic tundra in summer

Freshwater Inland Wetlands Are Vital Sponges (2)

- Provide free ecological and economic services
  - Filter and degrade toxic wastes
  - Reduce flooding and erosion
  - Help to replenish streams and recharge groundwater aquifers
  - Biodiversity
  - Food and timber
  - Recreation areas

8-5 How Have Human Activities Affected Freshwater Ecosystems?

- ***Concept 8-5*** *Human activities threaten biodiversity and disrupt ecological and economic services provided by freshwater lakes, rivers, and wetlands.*

Human Activities Are Disrupting and Degrading Freshwater Systems

- Impact of dams and canals on rivers
- Impact of flood control levees and dikes along rivers
- Impact of pollutants from cities and farms on rivers
- Impact of drained wetlands

Case Study: Inland Wetland Losses in the United States

- Loss of wetlands has led to
  - Increased flood and drought damage
- Lost due to
  - Growing crops
  - Mining
  - Forestry
  - Oil and gas extraction
  - Building highways
  - Urban development