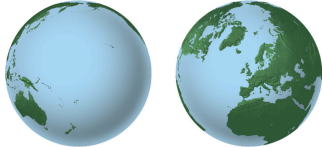


Chapter 8: Aquatic Biodiversity

APES 2013

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Aquatic Life Zones



- 71% of the Earth is covered in saltwater
- 2.2% is freshwater
- Aquatic life zones are the equivalent of biomes
- Two major types: saltwater (marine) and freshwater

2

Salinity

- Salinity - the amounts of various salts (ex. NaCl) dissolved in a given volume of water
- Distribution of aquatic organisms is greatly impacted by salinity

3

Plankton

- Three groups:
 - Phytoplankton - “drifting plants” - these organisms, with rooted plants near shorelines, support the entire aquatic food web (ex. algae)
 - Zooplankton - “drifting animals” - primary consumers (herbivores) that feed on phytoplankton or as secondary consumers that feed on other zooplankton (ex. single celled protozoa, large invertebrates like jellyfish)
 - Ultraplankton - extremely small photosynthetic bacteria (may be responsible for 70% of the NPP near the ocean surface)

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Other Major Types of Aquatic Organisms

- Nekton - strong swimming consumers
- Benthos - bottom dwellers
- Decomposers - mostly bacteria that break down organic compounds so they can be used by aquatic primary producers

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Key Aquatic Limiting Factors

- Temperature
- Dissolved Oxygen
- Availability of food
- Availability of nutrients and light for photosynthesis (carbon as dissolved CO_2 , nitrogen as NO_3^- , and phosphorus PO_4^{3-})
- Shallow systems (lakes, rivers...) have greater supplies of essential factors but the open ocean lacks many of these factors (decreases NPP)

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Photosynthesis

- Confined to upper levels of water (photic or euphotic zone) where sunlight can penetrate
- This zone is reduced in cloudy water (ex. from excessive algae, or sediment)
 - Turbidity - relative cloudiness

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Coastal Zone

- warm, nutrient-rich, shallow water that includes the continental shelf.
- 10% of ocean but 90% of species live here.
- Include estuaries, coastal wetlands, and intertidal zones

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Estuaries

- Where rivers meet the sea (where freshwater meets with seawater)
- Also where huge deposits of nutrients and pollutants are found from runoff upstream



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Fig 8-6

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Coastal Wetlands

- Coastal areas covered with water all or part of the year (marshes and mangroves)
- Very productive ecosystems because of high nutrient inputs from rivers, rapid circulation of nutrients by tidal flows, and high levels of sunlight
- Harsh areas to live because of huge seasonal changes in water flow, water temp, and salinity. Also some of the most contaminated habitats.

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Intertidal Zone

- Tides caused by gravitational pull of the moon and sun and causes tides to rise and fall every six hours
- The area between low and high tide is the intertidal zone.
- Harsh environment: relentlessly pounding waves, immersion during high tide, and dry at low tide. Also must deal with varying salinity (from heavy rainstorms).
- Can be rocky shores, barrier beaches, or barrier islands

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Open Sea and Ocean Floor

- Divided into three sections based on sunlight penetration
 - Euphotic zone - phytoplankton carry out 40% of earth's photosynthesis here, nutrients low, dissolved oxygen is high
 - Bathyal zone - dimly lit middle zone (does not contain photosynthesizing producers)
 - Abyssal zone - deepest zone, dark and cold, little dissolved oxygen, contains enough nutrients from marine snow (dead and decaying organisms drifting down)

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Open Sea and Ocean Floor

- Average NPP is very low per unit area, but because the ocean covers so much of the earth, it makes the largest contribution to the earth's overall NPP.
- NPP is higher where there are upwellings (wind and currents bringing up nutrients from the bottom so producers can use them)

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Human Impact on Marine Environments

- Shorelines (coastal wetlands, mangroves, and coral reefs) most impacted
- Major threats:
 - Coastal development
 - Overfishing
 - Nonpoint source pollution/runoff (fertilizers, pesticides and livestock waste)
 - Point source pollution (sewage and oil spills)
 - Invasive species
 - Climate change

Fig 8-12

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Chesapeake Bay

- READ THE CASE STUDY on page 173 AGAIN!
- Chesapeake Bay questions are often on the AP Exam!

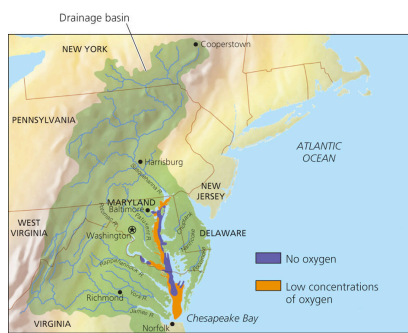


Fig 8-13

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Freshwater Ecosystems

- 2.2% of the Earth's surface
- Lentic (standing water)
 - Lakes, ponds, and wetlands
- Lotic (flowing water)
 - streams and rivers



Fig 8-14

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Lakes

- Formed by precipitation, runoff, and groundwater seepage filling depressions on the surface of the earth
 - Depressions caused by:
 - Glaciations
 - Crustal displacement
 - Volcanic activity

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Lake Zones

- Littoral Zone - near shore, shallow sunlit waters, high biodiversity (b/c ample sunlight and nutrients)
- Limnetic Zone - open sunlit surface layer away from shore, main photosynthetic area

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Lake Zones

- Profundal Zone - deep and open water, too dark for photosynthesis, low oxygen levels
- Benthic Zone - bottom of the lake, nourished by dead matter falling from littoral and limnetic zones

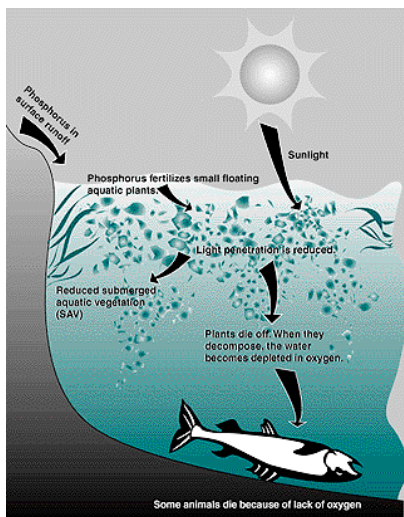
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Nutrient Levels in Lakes

- Oligotrophic lakes - poorly nourished (low NPP)
 - Often deep with steep banks and supplied by glaciers and mountain streams (very little sediment)
- Eutrophic lake - well-nourished (high NPP)
 - Shallow, murky brown or green water, high turbidity
- Hypereutrophic lake - excessive nutrients
- Mesotrophic lake - between the extremes

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Eutrophication



- Cultural eutrophication - human inputs causing eutrophication
- Usually from agricultural and urban areas
 - Large nutrient run off
 - Extensive eutrophication
 - Algal bloom
 - Large oxygen consumption
 - Hypoxic environment

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Freshwater Flow

- Often streams begin in the mountains through three zones
 - Source zone (headwaters) - shallow, cold, clear, fast moving, gathers oxygen from air, low nutrients
 - Species: cold-water fish, compact-flat bodies or streamlined -muscular bodies

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Freshwater Flow

- Transition zone - streams merge to form wide, deep, warm streams
 - high turbidity, slower flowing, less dissolved oxygen
 - Species: more producers, cool- and warm-water fish species with lower oxygen requirements
- Floodplain zone - water flowing can causes canyons and deposit tons of sediment in low-lying areas, streams join into wider, deeper rivers flowing into broad flat valleys
 - higher temperatures, less dissolved oxygen, slow moving, muddy, silt
 - Species: producers (algae, cyanobacteria, rooted aquatic plants), carp, catfish
- Eventually flows to the ocean (often through a delta, wetland, or estuary)

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Inland Wetlands

- Inland wetlands - lands covered with freshwater all or part of the time that are not lakes, reservoirs, or streams
 - Marshes - dominated by grasses with reeds (few trees)
 - Swamps - dominated by trees and shrubs
 - Prairie potholes - depressions carved out by ancient glaciers
 - Floodplains - excess water after heavy rain
 - Arctic tundra - in summer floods
 - Seasonal wetlands - under water or soggy for a short time each year

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Inland Wetlands

- Wetlands are highly productive because of high levels of nutrients
- Habitats for game fish, muskrats, otters, beavers, and waterfowl

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Wetland Natural Services

- Filter and degrade toxic wastes and pollutants
- Reduce flooding and erosion by absorbing storm water and overflow from streams and lakes and releasing it slowly
- Replenish stream flows during dry periods
- Recharge groundwater aquifers
- Maintaining biodiversity as a habitat
- Valuable economic products (fish, shellfish, blueberries, cranberries...)
- Recreation (birdwatchers, boaters, anglers, hunters)

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Human Impact

- Dams and canals - reduce water flow, habitat destruction
- Levees and dikes (flood control) - disconnect rivers from floodplains, destroy aquatic habitats, alter and destroy adjacent wetlands
- Pollutants and excess nutrients - from farms and urban areas (eutrophication)
- Draining or filling - for crops or filled with concrete, asphalt, and buildings

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