**Outline**

Aquatic Environments

1. Saltwater and freshwater aquatic zones cover about 71% of the earth’s surface. These are the equivalent of terrestrial biomes.
2. Salinity of the water determines the major types of organisms found in an aquatic environment.
3. There are four major types of organisms in aquatic systems.
   1. P120
   2. Plankton are free-floating, weakly swimming, generally one-celled organisms. There are three major types of plankton: phytoplankton (plant plankton), zooplankton (animal plankton) that they may be single-celled protozoa to large invertebrates such as jellyfish, and ultraplankton that are no more than 2 micrometers wide and are photosynthetic bacteria.
   3. Ultraplankton may be responsible for as much as 70% of the primary productivity near the ocean surface.
   4. Nekton is a second group of organisms. These are fish, turtles, and whales.
   5. A third group of organisms is benthos, which are bottom dwellers; barnacles, oysters, worms, lobsters, and crabs are examples of benthos organisms.
   6. Decomposers are a fourth group. These organisms break down organic matter into simple nutrients for use by producers.
4. Aquatic environment living has both advantages and disadvantages. Physical boundaries are less fixed, making it more difficult to manage/count aquatic populations of organisms.
   1. Food webs are longer, more complex than on land due to fluidity of medium and variety of bottom habitats.
   2. Size and less visibility make them more difficult to study.
5. Three layers of aquatic life zones can be used: surface, middle, and bottom.
   1. Temperature, sunlight availability, dissolved oxygen, and nutrient availability determine types and numbers of producers found in these zones.
   2. The euphotic zone is the upper layer where sunlight can penetrate. Clouding or excessive algal growth reduces depth of the euphotic zone.
   3. Dissolved oxygen levels are higher near the surface due to photosynthesis in this area.
   4. CO2 levels are lower near the surface and higher in deeper, darker layers due to aerobic respiration.
   5. Open oceans tend to have limited amounts of nitrates, phosphates, iron, and other nutrients that limit productivity.
   6. Shallow waters are generally well supplied with nutrients for growth.
   7. Deep dwelling species depend on animal and plant material that die/float to the bottom. Large fish are vulnerable to overfishing depletion.

Saltwater Life Zones

1. Oceans have two major life zones: the coastal zone and the open sea.
2. The coastal zone interacts with the land and is much affected by human activities.
   1. Ecosystems in coastal zones have a high net primary productivity per unit area. They constitute 10% of the oceans and contain 90% of all marine species.
   2. There is ample sunlight and nutrient flow from land, and wind/currents distribute them.
   3. The coastal zone extends from the high-tide mark on land to the edge of the continental shelf.
   4. Estuaries and coastal wetlands are subject to tidal rhythms, runoff from land, and seawater that mixes with freshwater and nutrients from rivers and streams.
   5. Mangrove forest swamps grow in sheltered regions of tropical coasts. They collect mud and anaerobic sediment.
   6. Coastal wetlands/estuaries make nutrients available due to constant stirring of bottom sediment.
   7. These areas filter toxic pollutants and excess plant nutrients, reduce storm damage, and provide nursery sites for aquatic species.
   8. Humans are destroying/degrading these ecosystems; one-third have already been lost.
3. Organisms living in the intertidal zone have adapted ways to survive the daily changes in wet/dry conditions and changes in salinity.
4. Barrier beaches/sandy shores are gently sloping. Organisms tunnel or burrow in the sand to survive daily changes in conditions.
5. Low, sandy, narrow islands that form offshore from a coastline are barrier islands. They generally run parallel to the shore.
   1. The islands help protect the mainland, estuaries, and coastal wetlands from heavy storm damage.
   2. People want to live on these islands, but they are subject to damage. In spite of this, almost one-fourth of barrier islands are developed.
   3. Sand is constantly shifting due to winds and parallel currents along the islands.
   4. Undisturbed beaches have one or more rows of sand dunes on them. Grass roots hold the sand in place, and the dune is a first line of defense against storms. It is safer to build behind the second set of dunes if any building occurs.
   5. Developers want to build on the islands and do not consider the protective services that the dunes provide. Large storms can and have swept away or severely damaged seaside buildings.
   6. Governments often provide funds for rebuilding and insurance at fairly low rates for building on the dunes.
   7. Some people think that persons building in such risky places should accept all responsibility for repair or replacement due to storm damage.
6. Coral reefs in shallow coastal zones of tropical and subtropical oceans support a very diverse, complex ecosystem.
   1. They grow slowly and are vulnerable to damage.
   2. They thrive in clear, warm, fairly shallow water with a high salinity. The ideal water temperature is between 18–30oC and will bleach if the water warms above this by so much as 1oC.
   3. Severe storms, freshwater floods, and invasions of predatory fish adversely affect the reefs. They have survived natural disturbances for a long geologic history.
   4. The greatest threats today are due to sediment runoff and other human activities. Coral reef systems may not have enough time to adapt to these rapidly changing conditions.
   5. There are indications that recovery is possible when restrictions are imposed and pollution is reduced.
7. The open sea is divided into three vertical zones based primarily on penetration of light.
   1. The euphotic zone is lighted, has floating phytoplankton carrying on photosynthesis, and has low nutrient levels except at upwellings.
   2. Dissolved oxygen level is high.
   3. Large, fast-swimming predatory fish like swordfish, shark, and bluefin tuna live in this zone.
   4. The bathyal zone is the dimly lit middle zone; no producers are in this zone. Zooplankton and smaller fish live in this zone.
   5. The abyssal zone is dark and very cold with little dissolved oxygen. The nutrients on the ocean floor occult support about 98% of species living in the ocean.
   6. Organisms in this area are deposit feeders, or filter feeders.
   7. Hydrothermal vents are present in some areas where specialized bacteria feed on chemical nutrients and are food for other organisms.
   8. Low average primary productivity and NPP occurs, but oceans are so large they make the largest contribution to NPP overall.
8. About 40% of the world population lives along coasts. Over half of the U.S. population lives within 62 miles of the coast.

Freshwater Life Zones

1. Freshwater life zones contain less than 1% by volume of salt. These zones include standing (lentic) bodies such as lakes, ponds, and wetlands and flowing (lotic) systems such as streams and rivers.
2. Lakes are large natural bodies of standing water found in depressions.
   1. Rainfall, melting snow, and stream drainage feed lakes.
   2. Lakes generally consist of four distinct zones depending on depth and distance from shore.
      1. The littoral zone is shallow, sunlit water near the shore.
      2. The limnetic zone is open, sunlit surface water away from shore and is the most productive area for food and oxygen production.
      3. The profundal zone is deep, open water too dark for photosynthesis. Oxygen levels are lower.
      4. The benthic zone consists of decomposers and detritus feeders. Fish swim from one zone to another. Sediment washing and dropping detritus feed this area.
3. Stratification of water occurs in deep temperate lakes into temperature zones; no mixing occurs.
4. During fall and spring, lakes have turnover of water that brings up nutrients, reoxygenates bottom levels, and evens out water temperature.
5. Lakes are described with reference to their plant nutrients.
   1. An oligotrophic lake is one that has been newly formed and has a small supply of plant nutrients. They often have deep, crystal-clear blue or green water with low net primary productivity.
   2. A eutrophic lake has a large or excessive supply of nutrients. They typically are shallow with murky brown or green water with low visibility and high net primary productivity. Cultural eutrophication accelerates this process.
   3. Lakes between these two extremes are called mesotrophic lakes.
6. Waters flowing from mountains to sea create different aquatic conditions and habitats.
   1. Surface water does not sink into the ground.
   2. Runoff is surface water that flows into streams and rivers, and the area it drains is called a watershed or drainage basin.
7. Three aquatic life zones, each with different conditions can be identified along stream flow.
   1. The source zone is narrow and fast moving. It dissolves large amounts of oxygen from air and most plants are attached to rocks. Light is available, but is not very productive.
   2. The transition zone forms wider, deeper streams that flow down gentler slopes. The water is warmer, with more nutrients and supports more producers, but has slightly lower dissolved oxygen.
   3. The floodplain zone has wider, deeper rivers. Water temperature is warmer, less dissolved oxygen is present, and flow is slower. There may be fairly large numbers of producers such as algae, cyanobacteria, and rooted plants.
8. Streams are fairly open ecosystems and receive many nutrients from surrounding lands.
9. Farms, power plants, cities, and recreation areas are often found in floodplains. This also increases excessive nutrient input and pollutant input into the river system.
10. Inland wetlands cover the land for a part of all of each year. Wetlands include swamps, marshes, prairie potholes, floodplains, and arctic tundra in summer.
    1. Scientists also use soil composition and plant life to define whether a particular area is a wetland.
    2. Wetlands provide a number of free ecological services such as filtering toxic wastes/pollutants, absorbing/storing excess water from storms, and providing habitats for a variety of species.
11. Human activities have four major impacts on freshwater systems.
    1. Dams, diversions, and canals fragment ~60% of the world’s large rivers and destroy habitats.
    2. Flood control dikes and levees alter rivers and destroy aquatic habitats.
    3. Cities and farmlands add pollutants.
    4. Wetlands have been drained or covered with buildings. The U.S. has lost more than 50% of its wetlands since the 1600s.
    5. These systems are able to recover when destructive practices are stopped or reduced.