APES/Cintron – UNIT 1

7-1 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.

7-3 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.

13-5 Protecting, Sustaining, and Restoring Wetlands

A. Coastal and inland wetlands are important reservoirs of aquatic biodiversity; they provide ecological and economic services.

B. A law that requires a permit to fill or deposit dredges into wetlands has cut wetland loss by 80% between 1969 and 2002.

1. A study by the National Academy of Sciences found that mitigation banking, the destruction of a wetland as long as an equal area of the same type is created or restored, does not work very well. These projects often fail to meet the standards set for them.
2. An ambitious restoration project is trying to undo the human damage in South Florida’s Everglades. The natural Everglades are half their original size and are drying out, leaving them vulnerable to fire and invasion by nonnative species.
3. Everglades National Park was set up in the lower part of the Everglades, but water did not flow into it and human activity caused disturbances.
4. Ninety percent of the wading birds are gone, and other vertebrates are reduced in number by 75–95%.
5. Florida Bay has become saltier and warmer due to the lack of water flow from the Everglades and the Kissimmee River.
6. Loss of water flow and input from crop fields and cities have caused large algal blooms on the bay. These blooms threaten coral reefs and hinder diving, fishing, and the tourist industry of the bay and the Florida Keys.
7. The U.S. Army Corp of Engineers has begun a restoration project funded by the state and the federal government to restore the meandering river and flow of water to the Everglades. It has several ambitious goals.
8. Restore curving flow of more than half of the Kissimmee River.
9. Remove 250 miles of canals and levees south of Lake Okeechobee.
10. Buy 93 square miles of farmland and allow it to flood to create artificial marshes.
11. Create a network of artificial marshes.
12. Create 18 large reservoirs to ensure water for south Florida’s present and future population and the lower Everglades.
13. Build new canals, reservoirs, and pumping stations to capture and return to the Everglades 80% of the water flowing out to sea.
14. There are indications that the plans are unraveling. Indications are that the restoration project may be secondary to providing water for agriculture.

13-6 Protecting, Sustaining, and Restoring Lakes and Rivers

Invasions by nonnative species have upset the ecological functioning of the Great Lakes for decades, with more invaders coming.

1. At least 162 nonnative species have invaded the Great Lakes since the 1920s.
2. Measures have been taken to control a number of these species.
3. Sea lampreys are one of the biggest threats and have depleted a number of the sport fish species in the lakes.
4. Zebra mussels were brought into the lakes in ballast water and have become very aggressive pests since they have no known natural enemies. They have displaced native mussel species, clogged pipes and piers, fouled beaches, and spread to other parts of the U.S.

Rivers/streams are important ecological and economic resources, but they can be degraded by overfishing, pollution, dams, and water withdrawal.

1. The national Wild and Scenic Rivers Act was passed in 1968 to protect rivers and river segments with outstanding scenic, recreational, geological, wildlife, historical, or cultural values.
2. Congress established a three-tiered classification scheme.
3. Wild rivers are relatively inaccessible; they are not permitted to be widened, straightened, dredged, filled, or dammed.
4. Scenic rivers are free from dams, mostly undeveloped, of great scenic value, and accessible in some places by roads.
5. Recreational rivers are readily accessible by roads and may have some dams or development along their shores.
6. Only 0.2% of the 3.5 million miles of rivers are protected under the Act, and 17% of the total river length has dams and reservoirs on them.
7. Environmentalists want to add 1,500 additional river segments for a total of 2% of the total river systems. There is opposition from several groups.

Threats to aquatic biodiversity are real and growing. We must greatly increase research and expand efforts to protect and restore aquatic biodiversity and promote integrated ecological management.

22-1 Measuring Water Quality

B. Scientists monitor water quality by using bacterial counts, chemical analysis, and indicator organisms.

1. One method of measuring water quality involves measuring the number of colonies of fecal coliform bacteria present in a water sample.

2. Drinking water should not contain any colonies/100 milliliters, and safe swimming water should not have more than 200 colonies/100 milliliters.

3. A new field of science called bacterial source tracking (BST) uses molecular biology techniques to determine subtle differences in strains of *E*. *coli* based on their animal host.

4. Scientists measure biological oxygen demand (BOD), the amount of dissolved oxygen consumed by aquatic decomposers.

5. Chemical analysis includes checking inorganic and organic chemicals present, sediment content, and turbidity of water.

6. Indictor species are living organisms that are monitored to determine levels of poll

22-2 Pollution of Freshwater Streams

A. Streams can recover from moderate levels of degradable water pollutants if the flows are not reduced.

1. A combination of dilution and biodegradation can allow recovery of stream pollution if they are not overloaded, or have reduced flow due to damming, agricultural diversion, or drought.

2. The breakdown of pollutants by bacteria creates an oxygen sag curve. Organisms that have a high oxygen demand can’t survive in the curve.

3. Volume of the stream, volume of wastes entering, flow rate, temperature, and pH levels all affect how great a sag curve is produced.

B. Most developed countries have reduced point source pollution, but toxic chemicals and pollution from non-point sources are still problems.

1. The U.S. has managed to avoid increases in pollution from point sources in most streams.

2. There have been several examples of amazing cleanup of rivers, such as the Cuyahoga River in Ohio and the Thames River in Great Britain.

3. There are still examples of large fish kills and contamination of drinking water from releases of chemicals from industry and mining, and also from non-point runoff of fertilizers and pesticides.

C. Stream pollution in most developing countries is a serious and growing problem. Half of the world’s 500 major rivers are heavily polluted, and most of them run through developing countries where waste treatment is minimal or nonexistent.

D. Religious beliefs, cultural traditions, poverty, little economic development, and a large population interact to cause severe pollution of the Ganges River in India.

1. About 350 million people live in the Ganges River basin with little treatment of sewage produced by them.

2. Hindu beliefs add pollution to the air when bodies are cremated and to the water when partially cremated or non-cremated bodies are thrown into the river in order to find their way to heaven.

3. The government is working to clean up the river by building waste treatment plants in the 29 large cities along the Ganges and by building electric crematoriums on its banks. It has also introduced snapping turtles as body scavengers.

4. Most of these plans are not yet in place, and religious and cultural conditions are difficult to change.