**Chapter 6**

**Major Ecosystems of the World**

**Lecture Outline:**

1. Earth’s Major Biomes
   1. A *biome* is a large, relatively distinct terrestrial region with a similar climate, soil, plants, and animals
      1. It encompasses many interacting ecosystems
      2. It is considered the next level of ecological organization above those of community, ecosystem, and landscape
   2. Tundra (arctic tundra): cold boggy plains of the far north
      1. *Tundra* is a treeless biome consisting of boggy plains covered by lichens and small plants such as mosses
         1. It has harsh, cold winters and extremely short summers
         2. It is characterized by little precipitation (4-10 inches/yr), *permafrost, low species richness, and low primary productivity*
      2. Animal life includes lemmings, voles, weasels, arctic foxes, snowshoe hairs, ptarmigan, snowy owls, and musk oxen
   3. Boreal forests (taiga): conifer forests of the north
      1. *Boreal forest* is a region of coniferous forest (such as pine, spruce, and fir) in the Northern Hemisphere; located just south of the tundra
         1. It has extremely cold, severe winters
         2. It is characterized by little precipitation (20 inches/year), acidic/mineral poor soil, ponds, lakes, and cone-bearing evergreens
      2. Animal life includes caribous, wolves, bears, moose, rodents, rabbits, lynx, sable and mink
   4. Temperate rain forest: lush temperate forests
      1. *Temperate rain forest* occurs on the northwest coast of North America, southeastern Australia and southern South America, and consists mostly of large evergreen trees, mosses, lichens, and ferns
         1. Seasonal fluctuation is narrow; winters are mild and summers are cool
         2. It is characterized by high precipitation (50 inches/year), dense fog, high species richness, and high primary productivity
      2. Animal life includes squirrels, wood rats, mule deer, elk, birds, and several amphibian and reptile species
   5. Temperate deciduous forest: broad-leaved trees that shed their leaves
      1. *Temperate deciduous forest* occurs in temperate areas with a moderate amount of precipitation
         1. It has wide seasonal fluctuation with hot summers and cold winters
         2. It is characterized by moderate precipitation (30 – 60 inches/year), rich top soil, and broad-leaf hardwood trees that lose their foliage annually
      2. Animal life includes large mammals (puma, wolves, bison, deer, bears) and many small mammals and birds
   6. Grasslands (tallgrass prairies): temperate seas of grass
      1. *Temperate grasslands* contain a profusion of grasses and other herbaceous flowering plants and few trees
         1. It has wide seasonal fluctuation with hot summers and cold winters
         2. It is characterized by moderate precipitation (10-30 inches/yr) and a mineral rich top layer of soil ideal for agriculture
      2. Animal life includes grazing mammals such as pronghorn elk and bison, wolves, coyotes, prairie dogs, foxes, ferrets, birds of prey, grouse, reptiles, and insects
   7. Chaparral (mediterranean climates): thickets of evergreen shrubs and small trees
      1. *Chaparral*  is a hilly temperate biome located around the Mediterranean Sea as well as in the North American southwest, southwestern and southern Australia, central Chile, and southwestern South Africa
         1. It has mild winters with abundant rainfall combined and dry summers; files are common during summer months
         2. It is characterized by low precipitation (mostly in winter),dense growth of evergreen shrubs, small trees, and thin, unfertile soil
      2. Animal life includes mule deer, wood rats, chipmunks, lizards, and many species of birds
   8. Deserts: arid life zones
      1. *Deserts* are dry areas found in both temperate (cold deserts) and subtropical regions (warm deserts) usually with sparse plant cover of cacti, yuccas, Joshua trees and sagebrushes
         1. The low water vapor content of the desert atmosphere results n daily temperature extremes of heat and cold;
         2. They are characterized by low precipitation (less than 10 inches/yr), very little plant life, low species richness, and soil low in organic material but high in mineral content
      2. Animal life includes small mammals, insects amphibians, and reptiles (most are desert adapted)
   9. Savanna: tropical grasslands
      1. *Savanna*s are tropical grasslands with widely scattered trees or clumps of trees
         1. They usually occur in areas of low and/or seasonal rainfall with prolonged dry periods, temperature varies little throughout the year, and seasons are regulated by precipitation
         2. Annual precipitation is moderate (30-60 inches/yr), soil is low in nutrient minerals, both trees and grasses have fire-adapted features and protection against herbivores
      2. Animal life includes hoofed mammals (antelope, giraffe, zebra elephants), large predators (lions and hyenas), many bird species, and cattle (present rangeland grazing is leading to *desertification* of savannas)
   10. Tropical rain forests: lush equatorial forests
       1. *Tropical rain forests* are lush, species-rich forest biomes that occur where the climate is warm and moist throughout the year
          1. They are found in Central and South America, Africa, and Southeast Asia and are typically home to evergreen flowering plants, epiphytes, tall trees, and three distinct layers of vegetation
          2. It is characterized by high annual precipitation (80 – 180 inches/yr), ancient, highly weathered mineral-poor soil, high productivity, and high species richness
       2. Animal life includes an enormous array of insects, reptiles, amphibians, birds, and mammals (sloths and monkeys)
   11. Vertical zonation: the distribution of vegetation on mountains
       1. The cooler temperatures at higher elevations of a mountain produce a series of ecosystems similar to the biomes encountered when going toward the North Pole (deciduous/temperate forest, subalpine coniferous/boreal forest, alpine/arctic tundra)
       2. Types of organisms living on the mountain change as the temperature changes
2. Aquatic Ecosystems
   1. Determinants of species composition in aquatic ecosystems include *salinity*, dissolved oxygen, light, temperature, pH, and presences or absence of waves and currents
   2. Aquatic ecosystems contain three main ecological categories of organisms
      1. Free-floating *plankton*
         1. *Phytoplankton* are free-floating photosynthetic algae and cyanobacteria that form the base of most aquatic food webs
         2. *Zooplankton* are nonphotosynthetic organisms that include protozoa, crustaceans, and the larval stages of many animals
      2. Strongly swimming *nekton* (fishes, turtles, whales)
      3. Bottom-dwelling *benthos* (sponges, oysters, barnacles, worms, clams, sea cucumbers, crawfish, insect larvae, brittle stars)
   3. Freshwater ecosystems (occupy only about 2% of Earth’s surface)
      1. Rivers and streams: *flowing-water ecosystems*
         1. The concept of a river system as a single ecosystem with a gradient in physical features from headwaters to mouth is known as the river continuum concept
         2. This gradient results in predictable changes in the organism inhabiting different parts of the river system
      2. Lakes and ponds: *standing-water ecosystems*
         1. A large lake has three zones
            1. The littoral zone is a shallow-water area along the shore of a lake or pond where light reaches the bottom; it is the most productive section of the lake
            2. The limnetic zone is the open water beyond the littoral zone; it extends down as far as sunlight penetrates to permit photosynthesis
            3. The profundal zone is beneath the limnetic zone; light does not penetrate effectively to this depth (no plants or algae found here)
      3. Thermal stratification and turnover in temperate lakes
         1. *Thermal stratification* is the marked layering of large temperate lakes caused by how far light penetrates it, causing temperature to change sharply with depth
         2. Falling temperatures in fall, and rising temperatures in spring cause turnover, a mixing of the layers of lake water
      4. Marshes and swamps: *freshwater wetlands*
         1. Grasslike plants dominate in marshes, while woody trees and/or shrubs dominate in swamps
         2. Wetlands are valued wildlife habitat for migratory birds, beaver, otters, muskrats, and game fishes
         3. They provide natural flood control and serve as groundwater recharging areas
   4. *Estuaries*: where fresh and salt water meet
      1. Estuaries are among the most fertile ecosystems in the world
      2. Temperate estuaries usually contain *salt marshes* which are important in preventing flood damage during storm surges
      3. *Mangrove forests* are the tropical equivalent of salt marshes; they cover nearly 70% of tropical coastlines
         1. Mangroves are breeding ground and nurseries for several commercially important fishes, shellfish, and birds
         2. They also help prevent coastal erosion and provide a barrier against the ocean during storms/hurricanes
   5. Marine ecosystems
      1. The *intertidal zone* is the area of shore line between low and high tides
      2. The benthic environment: seagrass beds, kelp forests, and coral reefs
         1. The *benthic environment* consists of sediments (mostly sand and mud) where many animals burrow
         2. Shallow benthic communities are particularly productive
            1. Seagrass beds are flowering plants adapted to complete submersion in salty ocean water; they are areas of high primary productivity and help stabilize sediments, reducing surface erosion
            2. Kelp forests provide habitats for many marine animals; the diversity of life supported by kelp forests rivals that found in coral reefs
            3. *Coral reefs* are found in warm shallow seawater; they consist of colonies of millions of tiny coral animals, which require light for *zooxanthellae* (the symbiotic algae that live and photosynthesize in their tissues)

Coral reefs are ecologically important because they provide a habitat for many kinds of marine organisms and protect coastlines from shoreline erosion

There are three main types of coral reefs

Fringing reefs are directly attached to the shore of a volcanic island or continent

Atolls are circular coral reefs that surround a central lagoon of quiet water

Barrier reefs are separated from nearby land by a lagoon of open water

Various human activities cause serious threats to the health of coral reefs (runoff, overfishing, disease, etc.)

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         1. Bathyal benthic zone – 200m to 4000m
         2. Abyssal benthic zone – 4000m to 6000m
         3. Hadal benthic zone – 6000m to the bottom of the deepest trenches
    1. The *pelagic environment*: the vast marine system
       1. The pelagic environment consists of all of the ocean water, from the shoreline down to the deepest ocean trenches
          1. The upper reaches of the pelagic environment comprise the euphotic zone
          2. The *euphotic zone* spans from the surface to 150m deep
       2. The two main divisions of the pelagic environment are the neritic and oceanic provinces
          1. The part of the pelagic environment that overlies the ocean floor from the shoreline to a depth of 200m is referred to as the *neritic province*
          2. The part of the pelagic environment that overlies the ocean floor at depths greater than 200m is referred to as the *oceanic province*
    2. A *national marine sanctuary* is a marine ecosystem set aside to minimize human impacts and protect unique natural resources and historical sites
       1. The U.S. has 14 national marine sanctuaries along the Atlantic, Pacific, and Gulf of Mexico coasts
       2. They include kelp forests, coral reefs, fishing grounds, deep submarine canyons and shipwrecks