Chapter 52

An Introduction to Ecology and the Biosphere

Ecology is the scientific study of the interactions between organisms and the environment

The long-term prevailing weather conditions in an area constitute its **climate**

Four major abiotic components of climate are temperature, precipitation, sunlight, and wind

Macroclimate consists of patterns on the global, regional, and landscape level

Microclimate consists of very fine patterns, such as those encountered by the community of organisms underneath a fallen log

Global Climate Patterns

Global climate patterns are determined largely by solar energy and the planet's movement in space

The warming effect of the sun causes temperature variations, which drive evaporation and the circulation of air and water

This causes latitudinal variations in climate

The structure and distribution of terrestrial biomes are controlled by climate and disturbance

Biomes are major life zones characterized by vegetation type (terrestrial biomes) or physical environment (aquatic biomes)

Climate is very important in determining why terrestrial biomes are found in certain areas

A **climograph** plots the temperature and precipitation in a region

Biomes are affected not just by average temperature and precipitation, but also by the pattern of temperature and precipitation through the year

Aquatic biomes are diverse and dynamic systems that cover most of Earth

Aquatic biomes account for the largest part of the biosphere in terms of area

They show less latitudinal variation than terrestrial biomes

Marine biomes have salt concentrations of about 3%

The largest marine biome is made of oceans, which cover about 75% of Earth’s surface and have an enormous impact on the biosphere

Freshwater biomes have salt concentrations of less than 0.1%

Freshwater biomes are closely linked to soils and the biotic components of the surrounding terrestrial biome

Zonation in Aquatic Biomes

Many aquatic biomes are stratified into zones or layers defined by light penetration, temperature, and depth

The upper **photic zone** has sufficient light for photosynthesis, while the lower **aphotic zone** receives little light

The photic and aphotic zones make up the **pelagic zone**

Deep in the aphotic zone lies the **abyssal zone** with a depth of 2,000 to 6,000 m

The organic and inorganic sediment at the bottom of all aquatic zones is called the **benthic zone**

The communities of organisms in the benthic zone are collectively called the **benthos**

Detritus, dead organic matter, falls from the productive surface water and is an important source of food

In oceans and most lakes, a temperature boundary called the **thermocline** separates the warm upper layer from the cold deeper water

Many lakes undergo a semiannual mixing of their waters called **turnover**

Turnover mixes oxygenated water from the surface with nutrient-rich water from the bottom

Communities in aquatic biomes vary with depth, light penetration, distance from shore, and position in the pelagic or benthic zone

Most organisms occur in the relatively shallow photic zone

The aphotic zone in oceans is extensive but harbors little life

Lakes

Size varies from small ponds to very large lakes

Temperate lakes may have a seasonal thermocline; tropical lowland lakes have a year-round thermocline

Oligotrophic lakes are nutrient-poor and generally oxygen-rich

Eutrophic lakes are nutrient-rich and often depleted of oxygen if ice covered in winter

Eutrophic lakes have more surface area relative to depth than oligotrophic lakes

Rooted and floating aquatic plants live in the shallow and well-lighted **littoral zone** close to shore

Water is too deep in the **limnetic zone** to support rooted aquatic plants; small drifting animals called zooplankton graze on the phytoplankton

Streams and Rivers

The most prominent physical characteristic of streams and rivers is current

Headwaters are generally cold, clear, turbulent, swift, and oxygen-rich; they are often narrow and rocky

Downstream waters form rivers and are generally warmer, more turbid, and more oxygenated; they are often wide and meandering and have silty bottoms

They may contain phytoplankton or rooted aquatic plants

A diversity of fishes and invertebrates inhabit unpolluted rivers and streams

Pollution degrades water quality and kills aquatic organisms

Damming and flood control impair natural functioning of stream and river ecosystems

Estuaries

An **estuary** is a transition area between river and sea

Salinity varies with the rise and fall of the tides

Estuaries are nutrient-rich and highly productive

Estuaries include a complex network of tidal channels, islands, natural levees, and mudflats

Saltmarsh grasses and algae are the major producers

An abundant supply of food attracts marine invertebrates, fish, waterfowl, and marine mammals

Humans consume oysters, crabs, and fish

Human interference upstream has disrupted estuaries worldwide

Intertidal Zones

An **intertidal zone** is periodically submerged and exposed by the tides

Intertidal organisms are challenged by variations in temperature and salinity and by the mechanical forces of wave action

Oxygen and nutrient levels are high

Substrate varies from rocky to sandy

Oceanic Pelagic Zone

The **oceanic pelagic zone** is constantly mixed by wind-driven oceanic currents

Oxygen levels are high

Turnover in temperate oceans renews nutrients in the photic zones; year-round stratification in tropical oceans leads to lower nutrient concentrations

This biome covers approximately 70% of Earth’s surface

Coral Reefs

Coral reefs are formed from the calcium carbonate skeletons of corals (cnidarians)

Shallow reef-building corals live in the photic zone in warm (about 20–30°C), clear water; deep–sea corals live at depths of 200–1,500 m

Corals require high oxygen concentrations and a solid substrate for attachment

A coral reef progresses from a fringing reef to a barrier reef to a coral atoll

Marine Benthic Zone

The **marine benthic zone** consists of the seafloor below the surface waters of the coastal, or **neritic,** zone and the offshore pelagic zone

Organisms in the very deep benthic (abyssal) zone are adapted to continuous cold and extremely high water pressure

Substrate is mainly soft sediments; some areas are rocky