FREASH WATER ECOSYSTEM

Freshwater is a precious resource on the Earth's surface. It is also home to many diverse fish, plant, and crustacean species. The habitats that freshwater ecosystems provide consist of lakes, rivers, ponds, wetlands, streams, and springs. There are three main types of freshwater biomes: **ponds and lakes, streams and rivers, and wetlands**. We'll go into the details of each below. Ponds and lakes are often called lentic ecosystems. This means that they have still or standing waters, not moving like rivers or streams. Freshwater is defined as having a **low salt concentration — usually less than 1%**. Plants and animals in freshwater regions are adjusted to the low salt content and would not be able to survive in areas of high salt concentration (i.e., ocean). There are different types of freshwater regions: Ponds and lakes.

LAKE ECOSYSTEM

A lake ecosystem or lacustrine ecosystem includes biotic (living) plants, animals and micro-organisms, as well as abiotic (non-living) physical and chemical interactions. A lake is a **body of standing water** that is generally large enough in area and depth, regardless of its hydrology, ecology, or other qualities. The size of lakes varies considerably. The depth of lakes also varies significantly. **Lake Baikal in Russia** is the **world's deepest lake**. **Nitrogen and phosphorus** are the most important nutrients in the lake. These agents promote the **growth of nutrient-rich plants and algae**. These plants and algae provide food for other creatures, resulting in a complex and healthy environment.

Lake Ecosystem - Zones

- Lake ecosystem can be divided commonly into three zones.
    - The first is the **littoral zone** which is the shallow zone close to the shore. This is where the rooted wetland plants are noticed.
    - The **open water zone** (or photic zone) and the **deep water zone** (or aphotic zone) are the two zones that make up the offshore.
- Sunlight supports photosynthetic algae and the organisms that feed on them in the open water zone.
- Because there is no sunshine in the deep water zone, the food web relies on detritus from the littoral and photic zones.
- The lake's **overall production** is the consequence of plant growth in the **littoral zone** mixed with plankton growth in open water.

- This woody debris protects shorelines from erosion while also providing critical habitat for fish and nesting birds.

Lake Ecosystem - Light

- The solar energy required to fuel photosynthesis, the primary energy source of lentic systems, is provided by light.
- The amount of light received is determined by a number of factors.
- Small ponds may be shaded by trees nearby, and cloud cover can impair light availability in any system, regardless of size.
- Light availability is also affected by seasonal and diurnal factors, as the shallower the angle at which light strikes water, the more light is lost due to reflection.
- Lakes are split into **photic and aphotic zones**, with the former receiving sunlight and the latter lying below the depths of light penetration, devoid of photosynthetic capacity.

Lake Ecosystem - Temperature

- Because most life forms in lentic environments are **poikilothermic**, meaning their internal body temperatures are determined by their surroundings, temperature is an essential abiotic component.
- Radiation at the surface and conduction to or from the air and surrounding substrate can heat or cool water.
- A **constant temperature gradient** from warmer waters at the surface to cooler waters at the bottom is common in shallow ponds.
- Furthermore, **diurnal and seasonal temperature changes** can be significant in these systems.
- Large lakes have significantly varied temperature regimes.
- The frozen layer that forms on the lake's surface breaks up in temperate regions, leaving the water at around **4 degrees Celsius.** The density of water is greatest at this temperature.
- **Warmer air temperatures** heat the surface waters as the season continues, making them less dense.
- Due to limited light penetration, the deeper waters remain chilly and dense.
- As **summer** approaches, two distinct layers emerge, separated by such a great temperature difference that they remain stratified.
- Inverse stratification happens in the winter when water near the surface cools and freezes, while warmer, denser water remains at the bottom. A **thermocline** is formed, and the cycle begins again.

Wildlife

Lake Ecosystem - Wildlife

- **Mosses, ferns, reeds, rushes, and cattails** are some of the plants that thrive along the shoreline.
- Floating plants like **water lilies** and **water hyacinths** thrive further from the coast. They have bladders or sacs filled with air that help them stay afloat.
- Small fish dart in and out of the holes in the leaves of these plants. Waterbugs, beetles, and spiders glide and scurry across or just beneath the surface.
- Turtles can warm themselves in the sun on small islands, floating vegetation, or fallen logs.
- **Snails, shrimp, crayfish, worms, frogs,** and **dragonflies** are among the small animals that live among the plants and deposit their eggs on them both above and below the waterline.
- Many different species of water birds nest and rear their young in lakes. The most prevalent lake birds are ducks.
- Swans, geese, loons, kingfishers, herons, and bald eagles are among the others.

WETLAND ECOSYSTEM

Wetlands are some of the most valuable ecosystems on Earth. They act like giant sponges or reservoirs. During heavy rains, wetlands absorb excess water, limiting the effects of flooding. Wetlands also protect coastal areas from storm surges that can wash away fragile beaches and coastal communities**Wetlands**, or simply a **wetland**, is a distinct ecosystem that is flooded or saturated by water, either permanently (for years or decades) or seasonally (for weeks or months). Flooding results in oxygen-free (anoxic) processes prevailing, especially in the soils.The primary factor that distinguishes wetlands from terrestrial land forms or water bodies is the characteristic vegetation of aquatic plants, adapted to the unique anoxic hydric soils Wetlands are considered among the most biologically diverse of all ecosystems, serving as home to a wide range of plant and animal species. Methods for assessing wetland functions, wetland ecological health, and general wetland condition have been developed for many regions of the world. These methods have contributed to wetland conservation partly by raising public awareness of the functions some wetlands provide.

Wetlands occur naturally on every continent. The water in wetlands is either freshwater, brackish or saltwater. The main wetland types are classified based on the dominant plants and/or the source of the water. For example, marshes are wetlands

dominated by emergent vegetation such as reeds, cattails and sedges; swamps are ones dominated by woody vegetation such as trees and shrubs (although reed swamps in Europe are dominated by reeds, not trees). Examples of wetlands classified by their sources of water include tidal wetlands (oceanic tides), estuaries (mixed tidal and river waters), floodplains (excess water from overflowed rivers or lakes), springs, seeps and fens (groundwater discharge out onto the surface), and bogs and vernal ponds (rainfall or meltwater). Some wetlands have multiple types of plants and are fed by multiple sources of water, making them difficult to classify. The world's largest wetlands include the Amazon River basin, the West Siberian Plain the Pantanal in South America, and the Sundarbans in the Ganges-Brahmaputra delta.

Wetlands contribute a number of functions that benefit people. These are called ecosystem services and include water purification, groundwater replenishment, stabilization of shorelines and storm protection, water storage and flood control, processing of carbon (carbon fixation, decomposition and sequestration), other nutrients and pollutants, and support of plants and animals. Wetlands are reservoirs of biodiversity and provide wetland products. According to the UN Millennium Ecosystem Assessment, wetlands are more affected by environmental degradation than any other ecosystem on Earth Wetlands can be important sources and sinks of carbon, depending on the specific wetland, and thus will play an important role in climate change and need to be considered in attempts to mitigate climate change. However, some wetlands are a significant source of methane emissions and some are also emitters of nitrous oxide. Constructed wetlands are designed and built to treat municipal and industrial wastewater as well as to divert storm water runoff. Constructed wetlands may also play a role in water-sensitive urban design.

STREAM,RIVER ECOSYSTEM

Stream ecology encompasses the study of these aquatic organisms, but also the study of the riparian zone, sediment transport, the movement of energy and nutrients within the stream, and a host of other aspects of stream ecosystems. **River ecosystems are part of larger watershed networks or catchments, where smaller headwater streams drain into mid-size streams, which progressively drain into larger river networks**. The major zones in river ecosystems are determined by the river bed's gradient or by the velocity of the current.

River ecosystems are flowing waters that drain the landscape, and include the biotic (living) interactions amongst plants, animals and micro-organisms, as well as abiotic (nonliving) physical and chemical interactions of its many parts.[1] River ecosystems are part of larger watershed networks or catchments, where smaller headwater streams drain into mid-size streams, which progressively drain into larger river networks. The major zones in river ecosystems are determined by the river bed's

gradient or by the velocity of the current. Faster moving turbulent water typically contains greater concentrations of dissolved oxygen, which supports greater biodiversity than the slow-moving water of pools. These distinctions form the basis for the division of rivers into upland and lowland rivers.

The food base of streams within riparian forests is mostly derived from the trees, but wider streams and those that lack a canopy derive the majority of their food base from algae. Anadromous fish are also an important source of nutrients. Environmental threats to rivers include loss of water, dams, chemical pollution and introduced species.[3] A dam produces negative effects that continue down the watershed. The most important negative effects are the reduction of spring flooding, which damages wetlands, and the retention of sediment, which leads to the loss of deltaic wetlands.[4]

Light

Light is important to lotic systems, because it provides the energy necessary to drive primary production via photosynthesis, and can also provide refuge for prey species in shadows it casts. The amount of light that a system receives can be related to a combination of internal and external stream variables. The area surrounding a small stream, for example, might be shaded by surrounding forests or by valley walls. Larger river systems tend to be wide so the influence of external variables is minimized, and the sun reaches the surface. These rivers also tend to be more turbulent, however, and particles in the water increasingly attenuate light as depth increases.Seasonal and diurnal factors might also play a role in light availability because the angle of incidence, the angle at which light strikes water can lead to light lost from reflection. Known as Beer's Law, the shallower the angle, the more light is reflected and the amount of solar radiation received declines logarithmically with depth. Additional influences on light availability include cloud cover, altitude, and geographic position.

Temperature

Most lotic species are poikilotherms whose internal temperature varies with their environment, thus temperature is a key abiotic factor for them. Water can be heated or cooled through radiation at the surface and conduction to or from the air and surrounding substrate. Shallow streams are typically well mixed and maintain a relatively uniform temperature within an area. In deeper, slower moving water systems, however, a strong difference between the bottom and surface temperatures may develop. Spring fed systems have little variation as springs are typically from groundwater sources, which are often very close to ambient temperature.[6] Many systems show strong diurnal fluctuations and seasonal variations are most extreme in arctic, desert and temperate systems.The amount of shading, climate and elevation can also influence the temperature of lotic systems.

Chemistry

Water chemistry in river ecosystems varies depending on which dissolved solutes and gases are present in the water column of the stream. Specifically river water can include, apart from the water itself,

- dissolved inorganic matter and major ions (calcium, sodium, magnesium, potassium, bicarbonate, sulphide, chloride)
- dissolved inorganic nutrients (nitrogen, phosphorus, silica)
- suspended and dissolved organic matter
- gases (nitrogen, nitrous oxide, carbon dioxide, oxygen)
- trace metals and pollutants

Dissolved ions and nutrients

Dissolved stream solutes can be considered either *reactive* or *conservative*. Reactive solutes are readily biologically assimilated by the autotrophic and heterotrophic biota of the stream; examples can include inorganic nitrogen species such as nitrate or ammonium, some forms of phosphorus (e.g., soluble reactive phosphorus), and silica. Other solutes can be considered conservative, which indicates that the solute is not taken up and used biologically; chloride is often considered a conservative solute. Conservative solutes are often used as hydrologic tracers for water movement and transport. Both reactive and conservative stream water chemistry is foremost determined by inputs from the geology of its watershed, or catchment area. Stream water chemistry can also be influenced by precipitation, and the addition of pollutants from human sources.Large differences in chemistry do not usually exist within small lotic systems due to a high rate of mixing. In larger river systems, however, the concentrations of most nutrients, dissolved salts, and pH decrease as distance increases from the river's source.

Dissolved gases

In terms of dissolved gases, oxygen is likely the most important chemical constituent of lotic systems, as all aerobic organisms require it for survival. It enters the water mostly via diffusion at the water-air interface. Oxygen's solubility in water decreases as water pH and temperature increases. Fast, turbulent streams expose more of the water's surface area to the air and tend to have low temperatures and thus more oxygen than slow, backwaters.[6] Oxygen is a byproduct of photosynthesis, so systems with a high abundance of aquatic algae and plants may also have high concentrations of oxygen during the day. These levels can decrease significantly during the night when primary producers switch to respiration. Oxygen can be limiting if circulation between the surface and deeper layers is poor, if the activity of lotic animals is very high, or if there is a large amount of organic decay occurring.[

ESTUARY

An estuary is a partially enclosed, coastal water body where freshwater from rivers and streams mixes with salt water from the ocean. Estuaries, and their surrounding lands, are places of transition from land to sea. An **estuary** is a partially enclosed coastal body of brackish water with one or more rivers or streams flowing into it, and with a free connection to the open sea. Estuaries form a transition zone between river environments and maritime environments and are an example of an ecotone. Estuaries are subject both to marine influences such as tides, waves, and the influx of saline water, and to fluvial influences such as flows of freshwater and sediment. The mixing of seawater and freshwater provides high levels of nutrients both in the water column and in sediment, making estuaries among the most productive natural habitats in the world.

Most existing estuaries formed during the Holocene epoch with the flooding of river-eroded or glacially scoured valleys when the sea level began to rise about 10,000–12,000 years ago. Estuaries are typically classified according to their geomorphological features or to water-circulation patterns. They can have many different names, such as bays, harbors, lagoons, inlets, or sounds, although some of these water bodies do not strictly meet the above definition of an estuary and could be fully saline.

Many estuaries suffer degeneration from a variety of factors including soil erosion, deforestation, overgrazing, overfishing and the filling of wetlands. Eutrophication may lead to excessive nutrients from sewage and animal wastes; pollutants including heavy metals, polychlorinated biphenyls, radionuclides and hydrocarbons from sewage inputs; and diking or damming for flood control or water diversion.

INTER TIDAL ZONE

The intertidal zone is the area where the ocean meets the land between high and low tides. A tide pool within Monterey Bay National Marine Sanctuary. Intertidal zones exist anywhere the ocean meets the land, from steep, rocky ledges to long, sloping sandy beaches and mudflats that can extend for hundreds of meters. The intertidal zone -- the area between high and low tides -- is a harsh and unforgiving habitat, subject to the rigors of both the sea and the land. It has four distinct physical subdivisions based on the amount of exposure each gets -- **the spray zone, and the high, middle, and lower intertidal zones**.

he **intertidal zone**, also known as the **foreshore**, is the area above water level at low tide and underwater at high tide (in other words, the area within the tidal range). This area can include several types of habitats with various species of life, such as seastars, sea urchins, and many species of coral with regional differences in biodiversity. Sometimes it is referred to as the *littoral zone* or *seashore*, although those can be defined as a wider region.

The well-known area also includes steep rocky cliffs, sandy beaches, bogs or wetlands (e.g., vast mudflats). The area can be a narrow strip, as in Pacific islands that have only a narrow tidal range, or can include many meters of shoreline where shallow beach slopes interact with high tidal excursion. The **peritidal zone** is similar but somewhat wider, extending from above the highest tide level to below the lowest. Organisms in the intertidal zone are adapted to an environment of harsh extremes, living in water pressure with the potential of reaching 5,580 pounds per square inch. The intertidal zone is also home to several species from different phyla (Porifera, Annelida, Coelenterata, Mollusca, Arthropoda, etc.).

Water is available regularly with the tides that can vary from brackish waters, fresh with rain, to highly saline and dry salt, with drying between tidal inundations. Wave splash can dislodge residents from the littoral zone. With the intertidal zone's high exposure to sunlight, the temperature can range from very hot with full sunshine to near freezing in colder climates. Some microclimates in the littoral zone are moderated by local features and larger plants such as mangroves. Adaptation in the littoral zone allows the use of nutrients supplied in high volume on a regular basis from the sea, which is actively moved to the zone by tides. Edges of habitats, in this case land and sea, are themselves often significant ecologies, and the littoral zone is a prime example.

A typical rocky shore can be divided into a spray zone or splash zone (also known as the supratidal zone), which is above the spring high-tide line and is covered by water only during storms, and an intertidal zone, which lies between the high and low tidal extremes. Along most shores, the intertidal zone can be clearly separated into the following subzones: high tide zone, middle tide zone, and low tide zone. The intertidal zone is one of a number of marine biomes or habitats, including estuary, neritic, surface, and deep zones.

PELAGIC ZONE

The **pelagic zone** consists of the water column of the open ocean and can be further divided into regions by depth. The word *pelagic* is derived from Ancient Greek *(pélagos)* 'open sea'. The pelagic zone can be thought of as an imaginary cylinder or water column between the surface of the sea and the bottom. Conditions in the water column change with depth: pressure increases; temperature and light decrease; salinity, oxygen, micronutrients (such as iron, magnesium and calcium) all change. Somewhat analogous to stratification in the Earth's atmosphere, but depending on how deep the water is, the water column can be divided vertically into up to five different layers (illustrated in the diagram).

Marine life is affected by bathymetry (underwater topography) such as the seafloor, shoreline, or a submarine seamount, as well as by proximity to the boundary between the

ocean and the atmosphere at the ocean surface, which brings light for photosynthesis, predation from above, and wind stirring up waves and setting currents in motion. The pelagic zone refers to the open, free waters away from the shore, where marine life can swim freely in any direction unhindered by topographical constraints.

The oceanic zone is the deep open ocean beyond the continental shelf, which contrasts with the inshore waters near the coast, such as in estuaries or on the continental shelf. Waters in the oceanic zone plunge to the depths of the abyssopelagic and further to the hadopelagic. Coastal waters are generally the relatively shallow epipelagic. Altogether, the pelagic zone occupies 1,330 million km^3 (320 million mi^3) with a mean depth of 3.68 km (2.29 mi) and maximum depth of 11 km (6.8 mi). Pelagic life decreases as depth increases.

The pelagic zone contrasts with the benthic and demersal zones at the bottom of the sea. The benthic zone is the ecological region at the very bottom, including the sediment surface and some subsurface layers. Marine organisms such as clams and crabs living in this zone are called benthos. Just above the benthic zone is the demersal zone. Demersal fish can be divided into benthic fish, which are denser than water and rest on the bottom, and benthopelagic fish, which swim just above the bottom. Demersal fish are also known as bottom feeders and groundfish.

Depth and layers

The pelagic zone is subdivided into five vertical regions. From the top down, these are:

Epipelagic (sunlight)

From the surface (MSL) down to around 200 m (660 ft)

The illuminated zone at the surface of the sea with sufficient light for photosynthesis. Nearly all primary production in the ocean occurs here, and marine life is concentrated in this zone, including plankton, floating seaweed, jellyfish, tuna, many sharks and dolphins.

Mesopelagic (twilight)

From 200 m (660 ft) down to around 1,000 m (3,300 ft)

The most abundant organisms thriving into the mesopelagic zone are heterotrophic bacteria. Animals living in this zone include swordfish, squid, wolffish and some species of cuttlefish. Many organisms living here are bioluminescent. Some mesopelagic creatures rise to the epipelagic zone at night to feed.

Bathypelagic (midnight)

From 1,000 m (3,300 ft) down to around 4,000 m (13,000 ft)

The name stems from Ancient Greek 'deep'. The ocean is pitch black at this depth apart from occasional bioluminescent organisms, such as anglerfish. No plants live here. Most animals survive on detritus known as "marine snow" falling from the zones above or, like the marine hatchetfish, by preying on other inhabitants of this zone. Other examples of this zone's inhabitants are giant squid, smaller squid and the grimpoteuthis or "dumbo octopus". The giant squid is hunted here by deep-diving sperm whales.

Abyssopelagic (abyssal zone)

From around 4,000 m (13,000 ft) down to above the ocean floor

The name is derived from Ancient Greek 'bottomless' - a holdover from times when the deep ocean was believed to indeed be bottomless. Among the very few creatures living in the cold temperatures, high pressures and complete darkness here are several species of squid; echinoderms including the basket star, swimming cucumber, and the sea pig; and marine arthropods including the sea spider. Many species at these depths are transparent and eyeless.

Hadopelagic (hadal zone)

The name is derived from the realm of Hades, the Greek underworld. This is the deepest part of the ocean at more than 6,000 m (20,000 ft) or 6,500 m (21,300 ft), depending on authority. Such depths are generally located in trenches.

Pelagic ecosystem

The pelagic ecosystem is based on phytoplankton. Phytoplankton manufacture their own food using a process of photosynthesis. Because they need sunlight, they inhabit the upper, sunlit epipelagic zone, which includes the coastal or neritic zone. Biodiversity diminishes markedly in the deeper zones below the epipelagic zone as dissolved oxygen diminishes, water pressure increases, temperatures become colder, food sources become scarce, and light diminishes and finally disappears.[7]

What is the Benthic Zone?

Benthic zone is one of the ecological regions found at the lowest level of a water body including lake, ocean or stream. This zone also includes the sediment surface as well as some subsurface layers of the water body. An integral part of the benthic zone is the benthic boundary layer that comprises the bottom layer of water and the uppermost sediment layer which is directly influenced by the overlying water. This benthic boundary layer influences

the biological activities that take place over there. Rocky outcrops, coral, bay mud and sand bottom are some examples of the contact soil layers.

Characteristics of Benthic Zone

Some of the important characteristics of benthic zone are as follows:

- **Temperature**

The benthic zone temperature depends upon the benthic zone depth; it ranges from warmer temperature at shallow depth due to close proximity to the water surface and may further drop to 2-3 degree centigrade at the most extreme depths of the abyssal zone. Very few organisms can survive at lower depths and the ones which can grow there move at a very slow rate.

- **Pressure**

The pressure in the benthic region varies from low to high depending upon the depth of the zone. The pressure is lower at shallow depths as compared to hundreds of metres of depth. An example of a very high pressure benthic zone is the Mariana Trench which has a pressure 1000 times more than the normal pressure. An organism of benthic zone living at a higher pressure region is very large in size. Also, at greater depths, there is higher dissolved oxygen and it results in the enlargement of bethos size.

- **Light**

Different Benthic zone depths have different light intensities and it is such that as there is increase in the benthic zone depth, the intensity of the light increases. The intensity of light disappears quickly between 250-1000 meters and it is known as the disphotic zone. As a result, photosynthesis process is difficult to take place in this region and beyond 1000 meters there is no light availability and hence photosynthesis doesn't take place here.

What is Benthos?

- Benthos are the living organisms found in the benthic zone and it includes microorganisms like bacteria, fungi and also larger invertebrates like crustaceans and polychaetes. Crustaceans are large arthropod taxon group organisms that include crabs, crayfish, lobsters, prawns, woodlice, shrimps, krill, etc. Polychaetes are the bristle worms that belong to the class of annelid worms and each of their

body segments consists of a pair of fleshy protrusions known as parapodia having many bristles (chaetae) and made up of chitin. Here, we discuss some of the benthos facts.

- Benthos generally live in close relationship with the substrate and most of them are permanently attached to the bottom layer or the benthic boundary layer.
- Most of the benthos lack a backbone and are referred to as invertebrates and may include sea anemones, sponges, corals, sea stars, worms, crabs, sea urchins, and many others.
- Being the lowest level of a marine or freshwater system, it is often characterized by low temperatures and low sunlight.
- Benthic habitats in the oceanic environments can be zoned by its depth. Different zones from the shallowest to the deepest of these include the epipelagic which is less than 200 meters, the mesopelagic which is 200-1,000 meters, the bathyal which is 1,000 to 4,000 meters, the abyssal which is 4,000 to 6,000 meters and the hadal is below 6,000 meters which is the deepest one.
- Benthic zone is important for the health of aquatic ecosystems where tiny microscopic organisms live. A healthy benthic environment serves as a source of food for bottom feeding animals. Benthos or the organisms living in this zone are good indicators of the water quality of the marine ecosystem.
- Benthos depend upon each other for food and generally feed on worms, crabs, lobsters, sponges and other tiny organisms. Depending on the behaviour of food consumption, they can be divided as filter feeders and deposit feeders.
- Unlike the benthic zone, the littoral zone of a lake is the area near the shore area where sunlight can penetrate all the way to the sediment and enable the aquatic plants or macrophytes to survive.

What are the 4 main benthic zones?

The benthic environment is divided into a number of distinctive ecological zones based on depth, seafloor topography, and vertical gradients of physical parameters. These are the **supralittoral, littoral, sublittoral, bathyal, abyssal, and hadal** zones.