

THEME 4

THE MAIN HABITATS (AQUATIC, TERRESTRIAL, SOIL, LIVING ORGANISMS) AND ENVIRONMENTAL FACTORS

The motivational statement of the theme

Habitat is a part of nature that surrounds living organisms and has a direct or indirect impact on them. From the environment, organisms receive everything necessary for life and in it they also secrete metabolic products. The environment of each organism consists of many elements of the inorganic and organic nature of the elements introduced by man and his production activities. At the same time, some elements may be partially or completely indifferent to the body, others are necessary, and others have a negative impact.

Habitat – "everything that surrounds organisms and directly or indirectly affects their condition, development, survival and reproduction" (Naumov 1963).

The habitat that provides the possibility of life of organisms on Earth is diverse. On the planet Earth, organisms inhabited four environments of life, differing in the composition of environmental factors, the range of their variability.

On our planet, living organisms have mastered four main habitats, which differ greatly in the specifics of conditions. The aquatic environment was the first in which life originated and spread. Subsequently, living organisms mastered the ground-air environment, created and populated the soil. The fourth specific environment of life has become the living organisms themselves, each of which represents a whole world for the parasites or symbionts inhabiting it. In the process of evolution of organisms, adaptations (adaptations) to existence in a particular environment have been formed.

The objective: to form knowledge of the basic concepts and laws of general ecology, to generalize and systematize ideas about the environments of life, their properties, adaptations of organisms to them. To show the diversity of animals on Earth, their connection with the environment.

Questions for oral questioning

- 1 The specifics of the aquatic habitat.
2. The main characteristics of aquatic habitat: water-mass density, oxygen condition, the salt regime, the temperature regime, light conditions.
- 3 Terrestrial habitat. The basic properties of terrestrial habitat.
4. Soil as a habitat. Density and diversity of life in the soil.
5. Living organisms as a habitat.
6. Comparative characteristics of habitats and adaptation of living organisms to them

Students' classroom activities:

1. Situational problems. Reference material, tables and recommended literature may be used. The situational problems should be reported in writing.
2. Discussion report prepared by the students on an individual task of a teacher.

Plan of students' independent activities

" ____ " _____ 20 ____ .

Task 1. Answer the questions.

1. The fastest moving animals live in an environment:

- a) terrestrial;
- b) soil;
- c) water;
- d) in living organisms.

2. Name the largest animal that has ever existed (and still exists) on Earth. What kind of environment does it live in? Why can't such large animals arise and exist in other habitats?

3. Explain why in ancient times warriors determined the approach of enemy cavalry by putting their ear to the ground.

4. Ichthyologists face serious problems when preserving deep-sea fish for museums. Lifted onto the deck of the ship, they literally explode. Explain why this is happening.

5

7. Fill in the gaps by choosing one word from the pair in parentheses.

- ✓ Multicellular parasites living in human organs and tissues, ... (threatened, not threatened) drying out;
- ✓ in their habitat there are fluctuations in temperature, salinity, pressure... (strong, weak);
- ✓ The environment in which they live is chemical for them... (aggressive, not aggressive);
- ✓ they ... (have, do not have) protective covers;
- ✓ they... (have, do not have) organs related to the search for food;
- ✓ they are ...(have, do not have) hearing;
- ✓ they ... (have, do not have) organs of vision;
- ✓ the number of eggs they produce ... (large, not large).

8. In which habitats do animals have the simplest structure of the hearing organ (it is necessary to compare closely related groups of animals)? Why? Does this prove that animals do not hear well in these environments?

9. Explain why freshwater mammals (whales, dolphins) have much more powerful thermal insulation covers (subcutaneous fat) than terrestrial animals living in harsh and cold conditions. For comparison: the temperature of salt water does not fall below -1.3°C , and on the land surface it can fall to -70°C).

10. In spring, many people burn last year's withered grass, justifying this by saying that fresh grass will grow better. Environmentalists, on the contrary, argue that this cannot be done. Why?

11. It rained. A bright hot sun came out from behind the cloud. On which territory in five hours the soil moisture content will be greater (the type of soil is the same):

- a) on a freshly plowed field;

- b) on a ripe wheat field;
- c) on an unpassable meadow;
- d) on a grazing meadow?

Explain why.

12. Explain why ravines are more often formed in non-forest natural zones: steppes, semi-deserts, deserts. What human activity leads to the formation of ravines?

13. It has been established that in summer, after the heat, more precipitation falls over the forest than over the nearby vast field. Why? Explain the role of the nature of vegetation in the formation of the level of aridity of certain territories.

14. In some countries and islands, the import of live goats is prohibited by law. The authorities are motivated by the fact that goats can harm the nature of the country and change the climate. Explain how it can be.

Task 2. Give a brief description of the main properties of the aquatic environment.

Water-mass density _____

Oxygen condition _____

The salt regime _____

Fresh water _____

Brackish waters _____

Salt water _____

Light conditions _____

The temperature regime _____

Task 3. Consider Figure 1 and place the depicted animals in the appropriate ecological group.

Neuston _____

Plankton _____

Nekton _____

Bentos _____

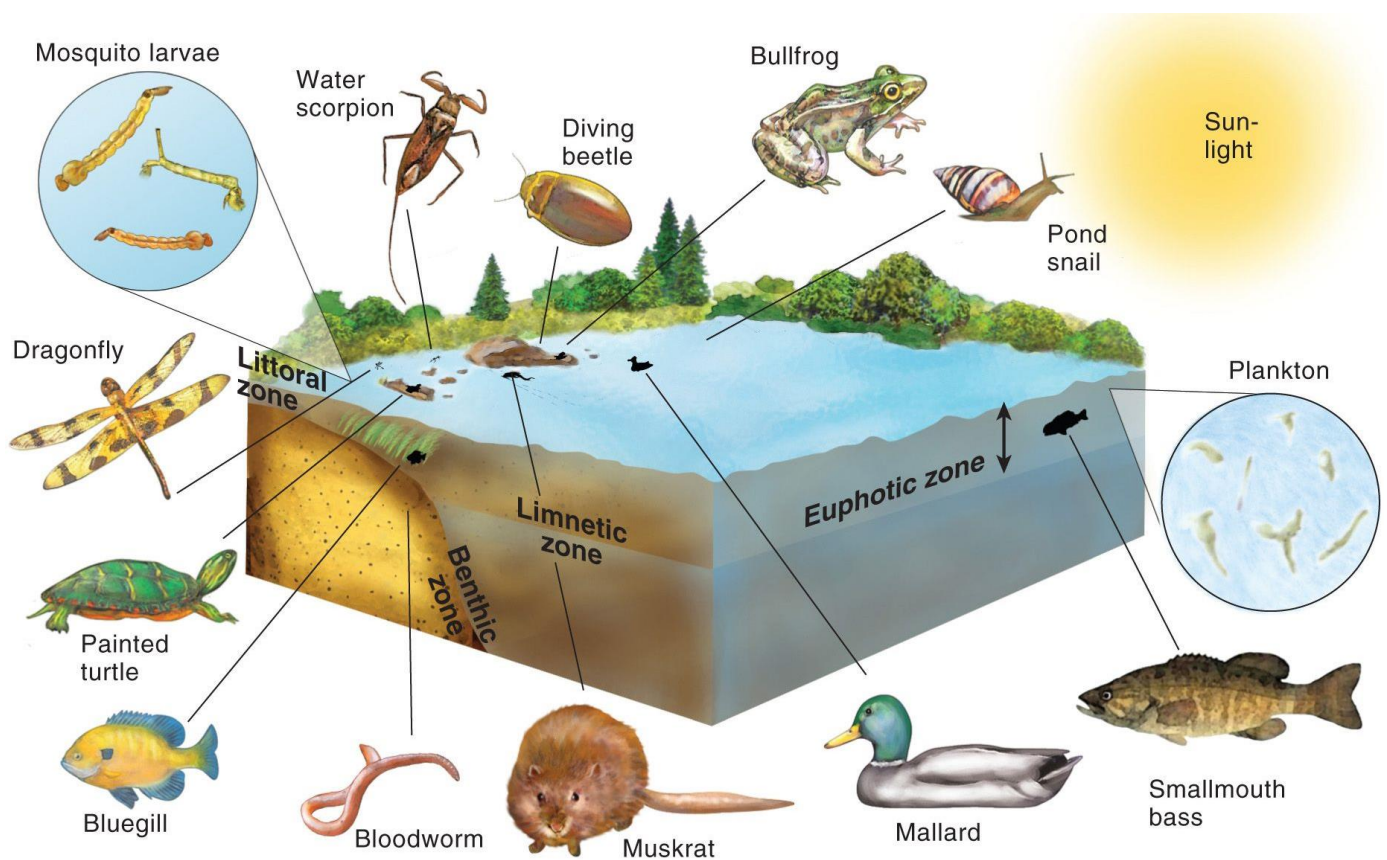


Fig. 1 Inhabitants of a pond (freshwater reservoir) of the temperate zone

Task 4. Fill in the blanks with appropriate words:

1. The place where organisms live is called
2. The plants and animals that live in water, it is called habitat.
3. Plants and animals that live on land, it is called habitat.
4. is a medium in aquatic habitat.

5. is a medium in terrestrial habitat.
6. Soil, water and air are components of a habitat.
7. Plants put in shade for a longer time become
8. Animals living in have very much reduced eyes.
9. Plants growing in hot and dry places are called
10. Desert plants have root system.
11. Forests and trees act as
12. Animals depend on for their food.
13. Matter is anything that has and occupies
14. The process of respiration involves gases.
15. Some objects are categorised as living while others as

Reference information

Term descriptions

Habitat can be defined as a location in which a particular organism is able to conduct activities which contribute to survival and/or reproduction. This definition emphasizes the notion that the term habitat is organism- specific; that is, it focuses on the biotic and abiotic factors that affect the survival or reproduction of a particular type of organism, and on the areas that contain these factors. On our planet, living organisms have acclimated four basic habitats: aquatic, terrestrial, soil and organism as a habitat.

AQUATIC HABITAT

Water as a habitat has a variety of peculiar properties such as heavy density, heavy differential pressure, relatively low oxygen, strong absorption of sunburst, etc. Inhabitants of aquatic habitat are hydrobiontes. They inhabit ocean, inland bodies and underground water.

The ocean is categorized by several areas or zones (fig. 2).

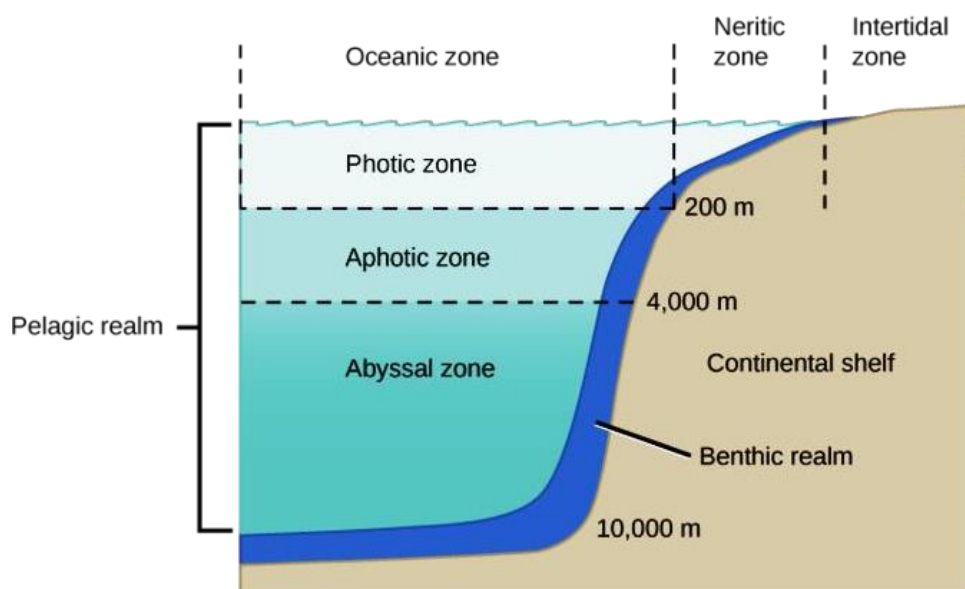


Figure 2 Oceanic zones

All of the ocean's open water is referred to as the pelagic realm (or zone). The benthic realm (or zone) extends along the ocean bottom from the shoreline to the deepest parts of the ocean floor. Within the pelagic realm is the photic zone, which is the portion of the ocean that light can penetrate (approximately 200 m). At depths greater than 200 m, light cannot penetrate; thus, this is referred to as the aphotic zone. The majority of the ocean is aphotic, lacking sufficient light for photosynthesis. The deepest part of the ocean, the Challenger Deep (in the Mariana Trench, located in the western Pacific Ocean), is about 11,000 m deep. To give some perspective on the depth of this trench, the ocean is, on average, 4267 m deep. These realms and zones are relevant to freshwater lakes as well, as they determine the types of organisms that will inhabit each region.

The main characteristics of aquatic habitat:

➤ **Water-mass density.** The pressure increases with depth about 1×10^5 Pa (1 atm.) for every 10 m. Water-mass density is the condition of soaring in water and many hydrobionts are adapted precisely to this way of life. Suspended, floating in the water organisms are united in a special ecological group of hydrobionts - plankton ("planktos" - soaring).

Plankton is tiny aquatic organisms that cannot move on their own. They live in the photic zone. They include phytoplankton and zooplankton. Phytoplankton are bacteria and algae that use sunlight to make food. Zooplankton are tiny animals that feed on phytoplankton.

The plankton consists of unicellular and colonial algae, protozoa, jellyfish, siphonophores, ctenophores, pteropodial and heteropodous mollusks, a variety of small crustaceans, benthic larvae, caviar and fish fry, and many others.

A special kind of plankton is the ecological group of neuston ("nein" - to swim) - the inhabitants of the surface water film on the border with the air environment.

The animals that are capable of rapid swimming and overcoming the strength of currents are united in the ecological group of nekton ("nectos" - floating). The representatives of nekton - fish, squid, dolphins.

Nekton are aquatic animals that can move on their own by "swimming" through the water.

They may live in the photic or aphotic zone. They feed on plankton or other nekton. Examples of nekton include fish and shrimp.

Benthos are aquatic organisms that crawl in sediments at the bottom of a body of water. Many are decomposers. Benthos include sponges, clams, and anglerfish.



➤ **Oxygen condition.** In oxygenated water its content does not exceed 10 ml per liter, this is 21 times lower than in the atmosphere. Oxygen enters the water mainly due to photosynthetic activity of algae and diffusion from the air. Therefore, the upper layers of the water column are, as a rule, richer in this gas than the lower ones. The breathing of hydrobionts is carried out either through the surface of the body, or through specialized organs - gills, lungs, trachea. In this case the integument can serve as an additional respiratory organ.

➤ **The salt regime.** Maintaining the water balance of hydrobionts has its own specifics. The excessive amount of water in the cells leads to a change in their osmotic pressure and disruption in vital functions. Freshwater forms can not exist in the seas; the sea ones do not tolerate desalination. If the salinity of the water is subjected to change, the animals move in search of favourable environment.

FRESHWATER REGIONS

Freshwater is defined as having a low salt concentration—usually less than 1%. They include standing and running freshwater biomes. Standing freshwater biomes include ponds and lakes. Lakes are generally bigger and deeper than ponds. Some of the water in lakes is in the aphotic zone where there is too little sunlight for photosynthesis. Plankton and plants (such as the duckweed in Figure below) are the primary producers in standing freshwater biomes.

Ponds and Lakes

These regions range in size from just a few square meters to thousands of square kilometers. Many ponds are seasonal, lasting just a couple of months (such as sessile pools) while lakes may exist for hundreds of years or more. Ponds and lakes may have limited species diversity since they are often isolated from one another and from other water sources like rivers and oceans. Lakes and ponds are divided into three different “zones” which are usually determined by depth and distance from the shoreline.

Temperature varies in ponds and lakes seasonally. During the summer, the temperature can range from 4° C near the bottom to 22° C at the top. During the winter, the temperature at the bottom can be 4° C while the top is 0° C (ice). In between the two layers, there is a narrow zone called the thermocline where the temperature of the water changes rapidly.

Streams and Rivers

These are bodies of flowing water moving in one direction. Streams and rivers can be found everywhere—they get their starts at headwaters, which may be springs, snowmelt or even lakes, and then travel all the way to their mouths, usually another water channel or the ocean. The characteristics of a river or stream change during the journey from the source to the mouth. At the start there are cool temperatures, clear water, and high oxygen levels. Freshwater fish such as trout and heterotrophs can be found there. Towards the middle of the stream diversity increases—numerous aquatic green plants and algae can be found. Toward the mouth of the river/stream, the water becomes murky from all the

sediments that it has picked up upstream. Less light creates less diversity of flora, and because of the lower oxygen levels, fish that require less oxygen, such as catfish and carp, can be found.

Wetlands

A wetland is an area that is saturated with water or covered by water for at least one season of the year. The water may be freshwater or saltwater. Wetlands are extremely important biomes for several reasons:

- They store excess water from floods.
- They slow down runoff and help prevent erosion.
- They remove excess nutrients from runoff before it empties into rivers or lakes.
- They provide a unique habitat that certain communities of plants need to survive.
- They provide a safe, lush habitat for many species of animals, so they have high biodiversity.

MARINE REGIONS

Marine regions cover about three-fourths of the Earth’s surface and include oceans, coral reefs, and estuaries. Marine algae supply much of the world’s oxygen supply and take in a huge amount of atmospheric carbon dioxide. The evaporation of the seawater provides rainwater for the land.

Oceans

The largest of all the ecosystems, oceans are very large bodies of water that dominate the Earth’s surface. Like ponds and lakes, the ocean regions are separated into separate zones:

intertidal, pelagic, abyssal, and benthic. All four zones have a great diversity of species. Some say that the ocean contains the richest diversity of species even though it contains fewer species than there are on land.

The *intertidal zone* is where the ocean meets the land—sometimes it is submerged and at other times exposed, as waves and tides come in and out. Because of this, the communities are constantly changing.

The *pelagic zone* includes those waters further from the land, basically the open ocean. The pelagic zone is generally cold though it is hard to give a general temperature range since, just like ponds and lakes, there is a constant mixing of warm and cold water. Species include surface seaweeds, many species of fish and some mammals, such as whales and dolphins. Many feed on the abundant plankton.

The *benthic zone* is the area below the pelagic zone, but does not include the very deepest parts of the ocean. The bottom of the zone consists of sand, silt, and/or dead organisms. Here temperature decreases as depth increases toward the abyssal zone, since light cannot penetrate through the deeper water. Species include seaweed, bacteria, fungi, sponges, sea anemones, worms, sea stars, and fishes.

The deep ocean is the *abyssal zone*. The water in this region is very cold (around 3° C), highly pressured, high in oxygen content, but low in nutritional content. The abyssal zone supports many species of invertebrates and fishes. Hydrothermal vents at mid-ocean ridges can also be found here.

Coral Reefs

Coral reefs are widely distributed in warm shallow waters. They can be found as barriers along continents (e.g., the Great Barrier Reef off Australia), fringing islands, and atolls. Naturally, the dominant organisms in coral reefs are corals. Corals are interesting since they consist of both algae and tissues of animal polyp. Besides corals, the fauna include several species of microorganisms, invertebrates, fishes, sea urchins, octopuses, and sea stars.

Hydrothermal Vents

Hydrothermal vents are among the most unusual ecosystems on Earth since they are dependent on chemosynthetic organisms at the base of the food web. This ecosystem is entirely separate from the photosynthesis at the surface. Shrimp, clams, fish, and giant tube worms have been found in these extreme places.

Estuaries

Estuaries are areas where freshwater streams or rivers merge with the ocean. This mixing of waters with such different salt concentrations creates a very interesting and unique ecosystem. Micro-flora like algae, and macro-flora, such as seaweeds, marsh grasses, and mangrove trees (only in the tropics), can be found here. Estuaries support a diverse fauna, including a variety of worms, oysters, crabs, and waterfowl.

➤ **The temperature regime** of reservoirs is more stable than on land. The amplitude of annual temperature fluctuations in the upper layers of the ocean is no more than 10-15°C, in continental reservoirs - 30-35 ° C. Deep layers of water are characterized by a constant temperature. In equatorial waters, the average annual temperature of surface layers is + (26-27)°C, in polar waters - about 0°C and lower. In hot land sources, the water temperature can approach + 100°C, and in the underwater geysers at a high pressure at the ocean bottom the temperature of +380°C is recorded.

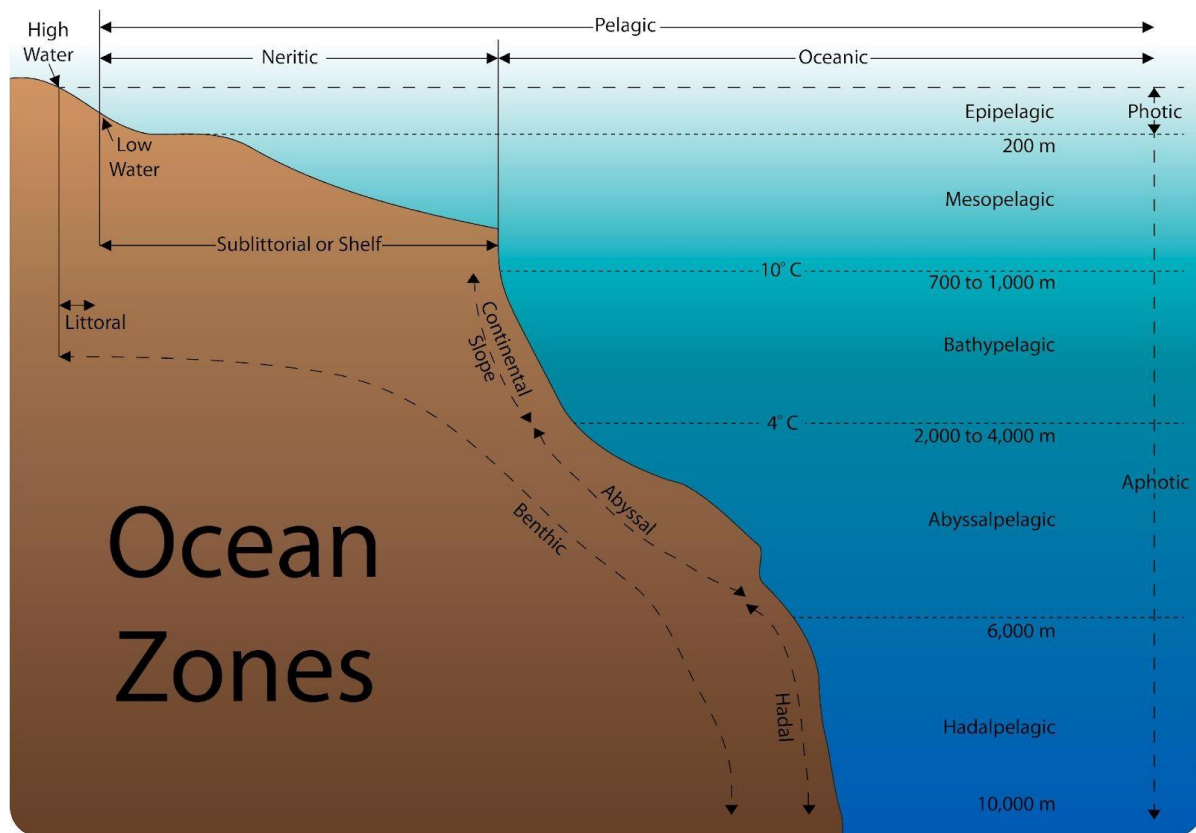
➤ **Light conditions.** Light in the water is much less than in the air. The rapid decrease in the amount of light with depth is due to the absorption of its water. The absorption of light is the stronger, the less the transparency of water, which depends on the number of particles suspended in it.

In large bodies of standing water, including the ocean and lakes, the water can be divided into zones based on the amount of sunlight it receives:

The photic zone extends to a maximum depth of 200 meters (656 feet) below the surface of the water. This is where enough sunlight penetrates for photosynthesis to occur. Algae and other photosynthetic organisms can make food and support food webs.

The aphotic zone is water deeper than 200 meters. This is where too little sunlight penetrates for photosynthesis to occur. As a result, food must be made by chemosynthesis or else drift down from the water above.

The ocean is divided into many different zones, depending on distance from shore and depth of water.



Aquatic habitat and Dissolved Substances

Water in lakes and the ocean also varies in the amount of dissolved oxygen and nutrients it contains:

1. Water near the surface of lakes and the ocean usually has more dissolved oxygen than does deeper water. This is because surface water absorbs oxygen from the air above it.
2. Water near shore generally has more dissolved nutrients than water farther from shore. This is because most nutrients enter the water from land. They are carried by runoff, streams, and rivers that empty into a body of water.
3. Water near the bottom of lakes and the ocean may contain more nutrients than water closer to the surface. When aquatic organisms die, they sink to the bottom. Decomposers near the bottom of the water break down the dead organisms and release their nutrients back into the water.

TERRESTRIAL HABITAT

Terrestrial habitat is the most difficult on environmental conditions. Life on land required such adaptations, which were possible only if the level of organization of plants and animals was sufficient. Inhabitants of terrestrial habitat are aerobiontes.

A terrestrial habitat is an area of land with a similar climate that includes similar communities of plants and animals. Different terrestrial biomes are usually defined in terms of their plants, such as trees, shrubs, and grasses.

Terrestrial include grasslands, forests, deserts, tundra,

- Grasslands are characterized as lands dominated by grasses rather than large shrubs or trees and include the savanna and temperate grasslands.
- Forests are dominated by trees and other woody vegetation and are classified based on their latitude. Forests include tropical, temperate, and boreal forests (taiga).
- Deserts cover about one fifth of the Earth's surface and occur where rainfall is less than 50 cm (about 20 inches) each year.
- Tundra is the coldest of all the biomes. The tundra is characterized for its frost-molded landscapes, extremely low temperatures, little precipitation, poor nutrients, and short growing seasons. There are two main types of tundra, Arctic and Alpine tundras.
- Terrestrial habitat (**Fig. 3**) lying within the Arctic and Antarctic Circles do not have very much plant or animal life.



Figure 3 One of the terrestrial habitats, taiga, is an evergreen forest of the subarctic, covering extensive areas of northern North America and Eurasia.

The basic properties of terrestrial habitat:

➤ **Gas structure of air** in ground layer of atmosphere is homogeneous enough concerning the maintenance of the main components (nitrogen - 78,1%, oxygen - 21 %, argon - 0,9 %, carbonic gas - 0,035 %) because of high diffused abilities of gases and constant intermixture by convection and wind flows.

➤ **Ground properties** and land topography also influence living conditions of land organisms, first of all plants. The properties of land surface having ecological influence on its inhabitants are edaphic factors of environment (from Greek «edaphos» - basis, soil).

➤ **Climate features.** The long-term mode of weather characterizes district climate. The concept climate includes not only average values of meteorological phenomena, but also their annual and daily course, deviations from it and their repeatability. The climate is defined by geographical conditions of area. For the majority of land organisms, especially small, the climate of area is not so important as conditions of their habitat. Very often local elements of environment (relief, exposition, vegetation, etc.) change the mode of temperature, humidity, light, air movement in a concrete site so that it considerably differs from region climate conditions. Such local climate modifications in air-ground interface are called microclimate.

Climate is generally described in terms of temperature and moisture. Temperature falls from the equator to the poles. Therefore, major temperature zones are based on latitude. They include tropical, temperate, and arctic zones (see **Fig.4**). However, other factors besides latitude may also influence temperature. For example, land near the ocean may have cooler summers and warmer winters than land farther inland. This is because water gains and loses heat more slowly than does land, and the water temperature influences the temperature on the coast. Temperature also falls from lower to higher altitudes. That's why tropical zone mountain tops may be capped with snow.



Figure 4 Temperature zones are based on latitude. What temperature zone do you live in?

In terms of moisture, climates can be classified as arid (dry), semi-arid, humid (wet), or semi-humid. The amount of moisture depends on both precipitation and evaporation. Precipitation increases moisture. Evaporation decreases moisture.

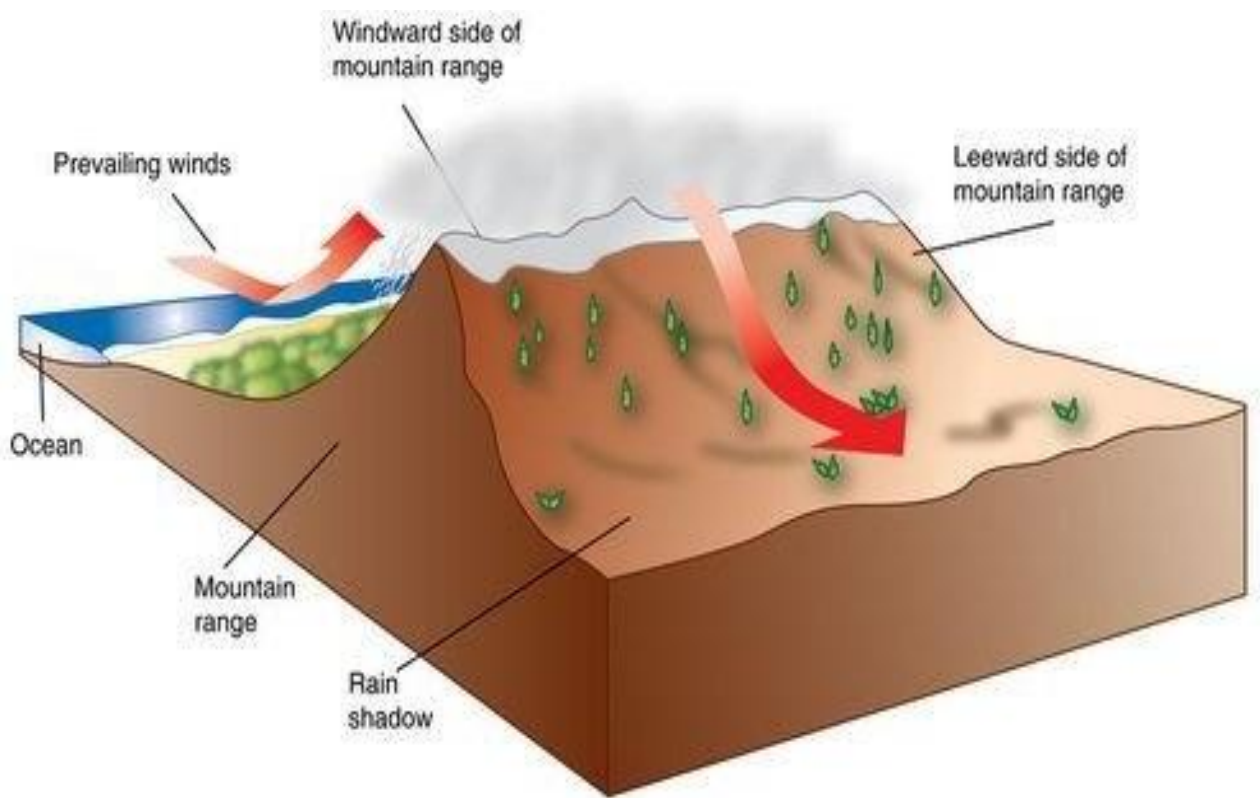


Figure 5 These diagrams show how precipitation is affected by the ocean and a mountain range.

Habitats with the highest amount of biodiversity, that is the most variation in plant and animal life, are near the equator (**Fig.6**).

Survey of Terrestrial habitat

Terrestrial habitats are classified by the climate and their biodiversity, especially the types of primary producers. The world map in Fig. 6 shows where 13 major terrestrial biomes are found.

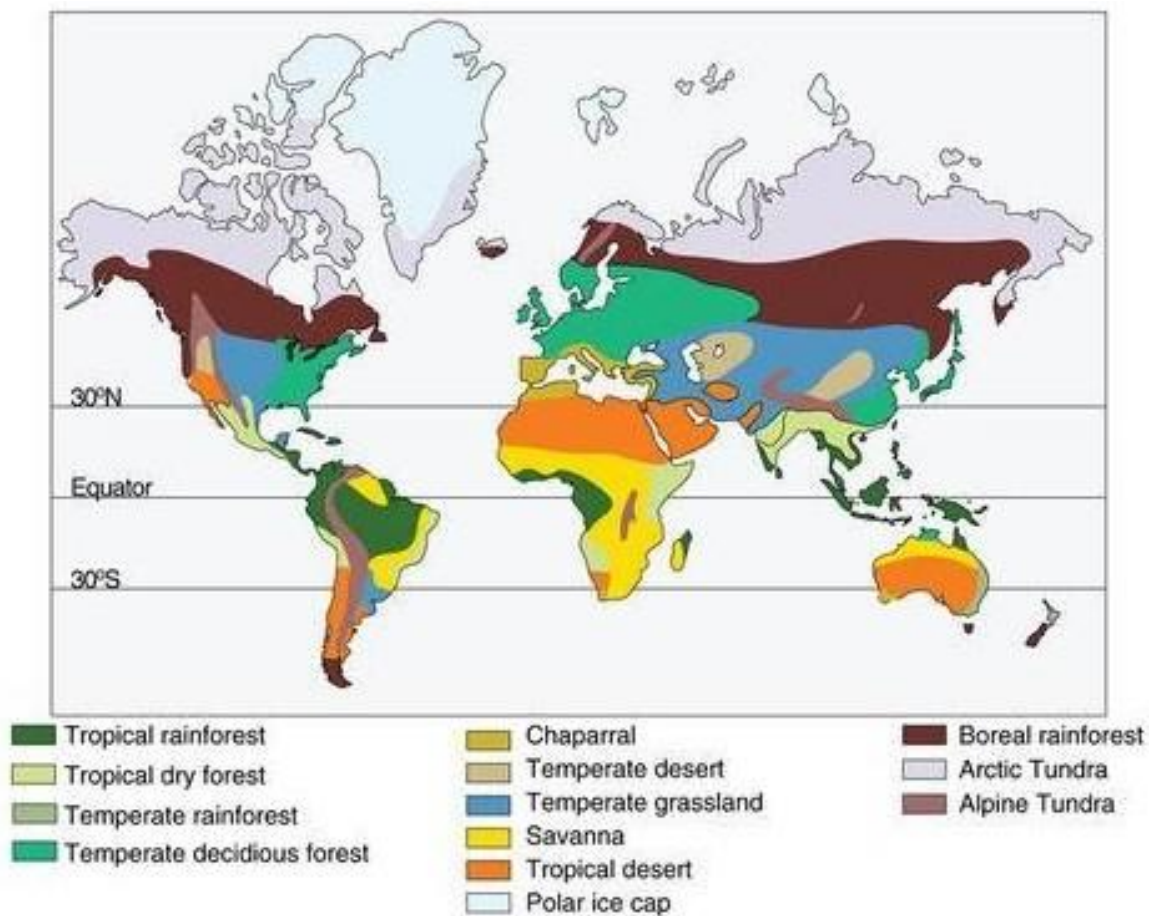


Figure 6 This map shows the locations of Earth's 13 major terrestrial habitats.

SOIL AS A HABITAT

Soil structure results from the long-term interaction of climate, organisms, topography, and parent mineral material. Soil is a complex mixture of living and nonliving material upon which most terrestrial life depends. Inhabitants of soil are edaphobiontes.

Heterogeneity of conditions in soil is most sharply shown in a vertical direction. With depth a number of the major ecological factors influencing life of inhabitants of soil sharply changes. First of all it concerns soil structure. Soil structure can be observed by digging a soil pit, a hole in the ground 1 to 3 m deep. In a soil pit one can see one of the most significant aspects of soil structure, its vertical layering. Though soil structure usually changes gradually with depth, soil scientists generally divide soils into several discrete horizons. Soil profile is divided into O, A, B, and C horizons (fig. 7).

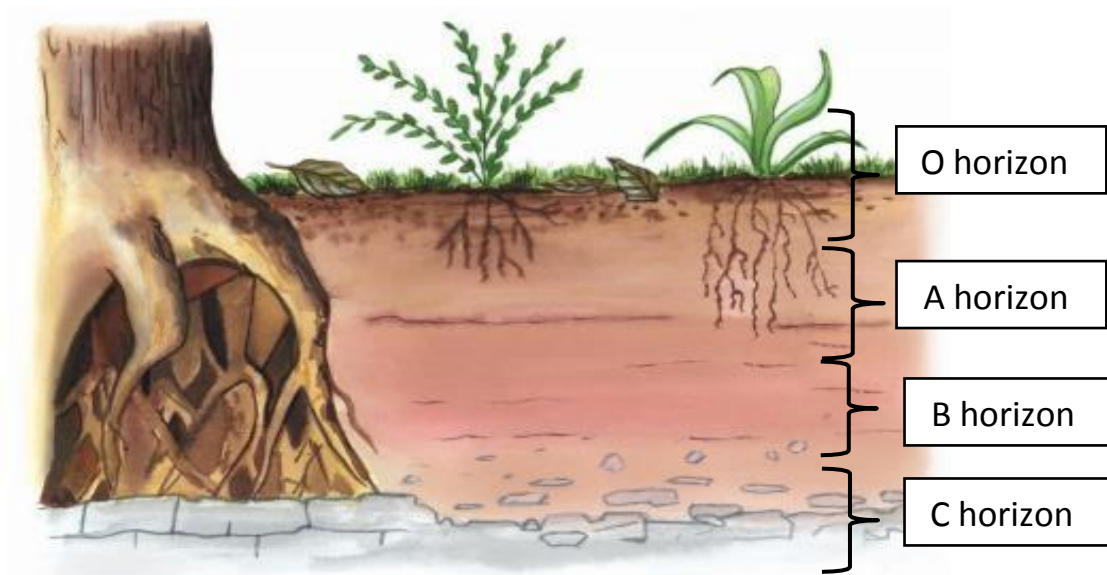


Figure 7 Generalized soil profile, showing O, A, B, and C horizons

O - upper layer contains loose, somewhat fragmented plant litter. Litter in lower layer is highly fragmented.

A - mineral soil mixed with some organic matter. Clay, iron, aluminium, silicates, and soluble organic matter are gradually leached from A horizon.

B - depositional horizon. Materials leached from A horizon are deposited in B horizon. Deposits may form distinct banding patterns.

C - weathered parent material. The C horizon may include many rock fragments. It often lies on bedrock.

The moisture in soil is in various conditions:

- 1) combined water (hygroscopic and pellicular moisture) is strongly kept by the surface of soil particles;
- 2) capillary water occupies small pores and can move on them in various directions;
- 3) gravitational water fills larger emptiness and slowly filters downwards under the influence of gravity;
- 4) vaporous water is in soil air.

The structure of soil air is different. With depth the maintenance of oxygen strongly falls and concentration of carbonic gas increases. Because of the presence of decaying organic substances in soil air there can be a high concentration of such toxic gases as ammonia, hydrogen sulphide, methane, etc. While soil flooding or intensive rotting of plant residues, completely anaerobic conditions can arise in some places.

Temperature fluctuations are sharp only on a soil surface. Here they can even be stronger, than in a ground layer of air. However with each centimeter deep into daily and seasonal temperature changes become ever less and on depth of 1-1,5 m practically are not traced any more

LIVING ORGANISMS AS A HABITAT

Many species of heterotrophic organisms throughout their life or part of the life cycle are found in other living beings whose bodies are used as a habitat, significantly different in properties from the outside. Virtually there is not a single species of multicellular organisms that do not have internal inhabitants. The higher the organisation of hosts, the greater the degree of differentiation of their tissues and organs, the more diverse the conditions they can provide to their cohabitants. Inhabitants of organisms are endobionts.

Table1

Comparative characteristics of habitats and adaptation of living organisms to them

Environment	Characteristic	Adaptation of the organism to the environment
Aquatic habitat	The most ancient. Illumination decreases with depth. When diving, the pressure increases by 1 atmosphere for every 10 m. Lack of oxygen. The degree of salinity increases during the transition from freshwater to marine and oceanic waters. Relatively homogeneous (homogeneous) in space and stable in time	Streamlined body shape, buoyancy, mucous membranes, development of air-bearing cavities, osmoregulation
Terrestrial habitat	Sparse. Abundance of light and oxygen. Heterogeneous in space. Very dynamic in time	Development of the supporting skeleton, mechanisms of regulation of the hydrothermal regime. Release of the sexual process from the liquid medium
Soil habitat	Created by living organisms. It was mastered simultaneously with the ground-air environment. Lack or complete absence of light. High density. Four-phase (phases: solid, liquid, gaseous, living organisms). Inhomogeneous (heterogeneous) in space. In time, the conditions are more constant than in the terrestrial-aerial habitat, but more dynamic than in the aquatic and organismic.	The body shape is lumpy, mucous membranes or a smooth surface, some have a digging apparatus, developed muscles. Many groups are characterized by microscopic or small sizes as an adaptation to life in film water or in air-bearing pores
Living organisms as a habitat	Very ancient. Liquid (blood, lymph) or solid, dense (tissue). The greatest constancy of the environment in time of all habitats	Coadaptation of the parasite and the host, symbionts to each other, development of the parasite's protection against digestion by the host and the anchoring system in the environment, enhancement of sexual reproduction, reduction of vision, digestive system, synchronization of biorhythms