Chapter VI: Concepts of biocenosis and ecosystem

Definitions and basic concepts: I) Definition:

Ecology: Etymologically, the term ecology derives from two Greek roots: →

house, habitat and science logos

Ecology is literally the science of habitat. In this definition, habitat concerns plants and animals considered in their living environment.

The term ecology was first proposed in its scientific usage by the German zoologist Ernst Haekel in 1866. For this author, it was a question of studying the conditions of existence of living beings and interactions of all kinds, between these living beings and their environment and between these living beings in natural conditions.

Today, ecology is defined as the study of the structure and function of nature while recognizing that humanity is an integral part of nature, that is, the science of the natural or man-made environment.

II) Fields of activity

Ecological studies conventionally focus on three levels: the individual,

the population and the community.

- An **individual** is a specimen of a given species.
- A **population:** a set of individuals of the same species gathered in a given medium at a given time. This gathering is characterized by the method of distribution

(uniform distribution, in aggregates or random) of individuals and by state variables such as: emigration, birth rate, mortality, etc.

- A **community** or **biocenosis** is all the populations of the same environment, animal stand (zoocenosis) and plant stand (phytocenosis) that live in the same environmental conditions and in the vicinity of each other.

Each of these three levels is the subject of a division of ecology:

- the individual is concerned **with autoecology:** it is the science that studies the relationship of a single species with its environment. It defines the tolerance limits and preferences of the species studied with regard to various ecological factors and examines the action of the environment on morphology, physiology and ethology.

- Population concerns population **ecology** or population **dynamics**: it is science that studies the qualitative and quantitative characteristics of populations: it analyzes the variations in abundance of various species to look for the causes and if possible predict them.

- Biocenosis concerns **synecology**: it is the science that analyzes the relationships between individuals who belong to the various species of the same group and these with their environments.

III) Concept of ecosystem:

It was in 1935 that the system of interactions between living beings and their environment was named "ecosystem" by the English botanist Arthur Tansley.

An ecosystem comprises two sets = **the biotope** (= living environment) + **biocenosis** (= living beings including "phytocenosis" plants and "zoocenosis" animals). These two sets interact with each other to generate an organized and functional system:

ecosystem **(EE-koh-sihs-tehm)**

The ecosystem is therefore a set of elements interacting with each other forming a coherent and ordered whole. Each element is connected to the others by a network of mutual interactions. An ecosystem is an open system and is characterized by botanical, zoological, topographical, pedological and climatic homogeneity.

It is a set of variable size whose definition can be applied to any medium from a dead tree stump or a puddle (**microecosystem**), a forest (**mesoecosystem**), or an ocean (**macroecosystem**).

A complete ecosystem consists of autotrophic and consumer heterotrophic producers and decomposers.

The biotope:

The biotope consists of all the physical elements (soil thickness, texture, structure, slope, exposure, water depth), chemical elements (pH, salinity, mineral elements) which are themselves subject to the general local action of the climate and which determine the presence of biocenosis. Sometimes the variation of a single physico-chemical factor can cause a radical change in the biocenosis.

Chapter II: Ecosystems in the World

The biosphere literally means the sphere of life, that is, the part of our planet where life developed. The biosphere encompasses three major "compartments": water (**hydrosphere**), air (**atmosphere**), and soil (**lithosphere**).

- **the lithosphere (the soil):** represents the most superficial layers of the Earth's crust (solid medium consisting of all the continents + the various geological constituents of the solid substrate of the oceans). The top layer of the Earth's crust is called "soil".
- **The hydrosphere (water):** the oceans occupy 70% of the Earth's surface, which has earned the Earth the nickname the blue planet.
- **The atmosphere (air):** homogeneous gaseous layer, constitutes the most peripheral area of our planet and envelops the two previous media. It is composed of 78% nitrogen, 21% oxygen, the rest being water vapour, carbon dioxide, ozone and rare gases (argon, neon, helium, etc.).

Within these three large compartments there are many ecosystems of varying size:

1- **Terrestrial or continental ecosystems:** associated with emergent continents that can be subdivided into:

- ❖ **Forest ecosystems** (tropical, temperate, boreal or Mediterranean forests).
- ❖ **Agroecosystems** (grasslands, steppes, savannahs).
- ❖ **Desert ecosystems**
- ❖ **Mountain ecosystems** (low mountain, middle mountain, high mountain)
- ❖ **Underground ecosystems** (caves, karst plateaus) **Coastal ecosystems** (dune ridges, rocky coasts) **2- Inland water ecosystems (wetlands):**
- ❖ **Lentic Ecosystems** (lakes and ponds).
- ❖ **Lotic ecosystems:** (rivers and streams).

3- Ocean ecosystems: (seas and oceans).

I. Terrestrial or continental ecosystems:

I.1-Forest ecosystems:

Definition:

"The forest is a land with a tree cover of density greater than 10%, an area greater than 0.5 ha and the trees must reach a minimum height of 5 m at maturity" The forest has multiple facies according to: latitude - altitude - nature of the soil - climate...etc.

Whether tropical, temperate, boreal or Mediterranean. **-Temperate forests:**

They characterize mid-latitude regions in the northern hemisphere and covered central Europe, eastern Asia and the eastern United States. They are characterized by the presence of hardwood trees. Their composition varies from one part of the world to another: Oak, Beech ...

Tropical Forests

Rainforest grows in the regions near the equator (abundant rainfall), it is where the greatest biological diversity (plant and animal) can be found. Up to 300 species of trees can be counted in a hectare, some of which reach 50 to 60m in height.

-Boreal forests (Taiga or coniferous forests):

They cover a wide band that extends into the cold, snowy regions of North America.

North, Europe and Asia to the southern limit of the Arctic Tundra. Characterized by coniferous stands in particular (pines and fir trees).

- Mediterranean forests:

They are found in the Mediterranean region as well as along the coasts of California, Chile, South West Africa and South West Australia. The Mediterranean forest consists of dense stands of evergreen shrubs and is suitable for periodic fires.

I.2-Agro ecosystems:

Definition:

"The agro-ecosystem is a product of the modification of the ecosystem by man and constitutes a space of interaction between man, his knowledge and practices and the diversity of natural resources".

The agroecosystem is therefore an association comprising crops, livestock, fauna and flora, soil and water in interaction with human uses.

These include:

-**Grasslands:** land covered with grasses or fodder plants intended for livestock feed.

-**Steppes:** herbaceous formations, the grass of which is in very spaced clumps.

-**Savannahs:** from terrestrial plant formations to warm regions dominated by herbaceous plants.

I.3-Desert ecosystems:

Definition:

"A desert is an area of land that is barren and not conducive to life".

There are two types of desert ecosystems: - Cold deserts.

-Hot deserts.

Deserts cover a large area on our planet. These ecosystems are home to only a very small number of species because of: extreme temperatures, strong sunshine and low amounts of water.

I.4-Mountain ecosystems:

There are 3 major types related to altitude:

Low mountain – middle mountain – high mountain.

They are home to many animal and plant species and play an important role in regulating natural hazards (erosion). **I.5- Underground ecosystems** :

They include:

- The caves: made up of cavities and galleries of large dimensions that can be penetrated by humans.

-Karst plateaus (limestone relief): all the limestone massifs eroded by water and which contain underground systems formed by cracks, cavities, galleries and caves.

 

I. **6-Coastal ecosystems**:

They extend from the inner boundary of the coastal zone and they can be divided into: Dune cords and rocky coasts.

II. **Inland water ecosystems (wetlands):**

II.1-Lens Ecosystems: refers to standing (calm) water ecosystems. They are subdivided into (lakes, ponds, marshes)

II. 2-Lotic ecosystems: these are the ecosystems of running waters (rivers and streams).

III. Ocean ecosystems (marine ecosystems):

They constitute the largest ecosystems on the planet and include the (seas and oceans).

Chapter V: Trophic Structure and Functioning of Ecosystems

1.1 Introduction

If we consider that the structure of an ecosystem includes in particular the physico-chemical factors of the environment, biodiversity and interactions between species within this ecosystem, and that the functioning of an ecosystem covers aspects as varied as biomass, material production, stability or resistance of the ecosystem to biological invasions, then the relationship between structure and functioning of ecosystems can be broken down into many relationships.

1.2 Biosphere

The part of the earth where life manifests is called the biosphere. It comprises three different compartments:

- Lithosphere concerns the terrestrial environment;
- Atmosphere concerns the air environment;
- Hydrosphere concerns the aquatic environment.

Life is found in the first two compartments of the biosphere, lithosphere and hydrosphere, on the other hand in the atmosphere no organism lives permanently.

Theoretically, the upper limit of the atmosphere is around 10 km above sea level. Spores of bacteria, fungi and protozoan cysts transported by air currents are still known. The lower limit would be ocean ditches.

1.3 Biomes (Biosphere Spatial Structure)

The earth's natural environment can be subdivided into several natural communities called biomes. The diversity of the natural environment is very great and so doing groups of things that are similar helps us to study it.

Several features can be chosen to subdivide the natural environment. For example, the amount of water there is, the temperature there, the plants and animals that live there. The groups are different depending on the characteristics you choose to make them.

In the biosphere, there are several large plant formations distributed in a marine and terrestrial community called biome such as: Savannah, desert, etc.

The diversity of these biomes and their distributions at the surface of the biosphere defining the spatial structure of the biosphere at the surface of the globe (fig. 1).

Thus, from the pole to the equator, there follows a parallel band of large types of plant formations characteristic of large climatic zones of the biosphere.

A climatic zone gives a type of biome; phytocenosis constitutes with the animal biocenosis associated with them constitutes the biome.

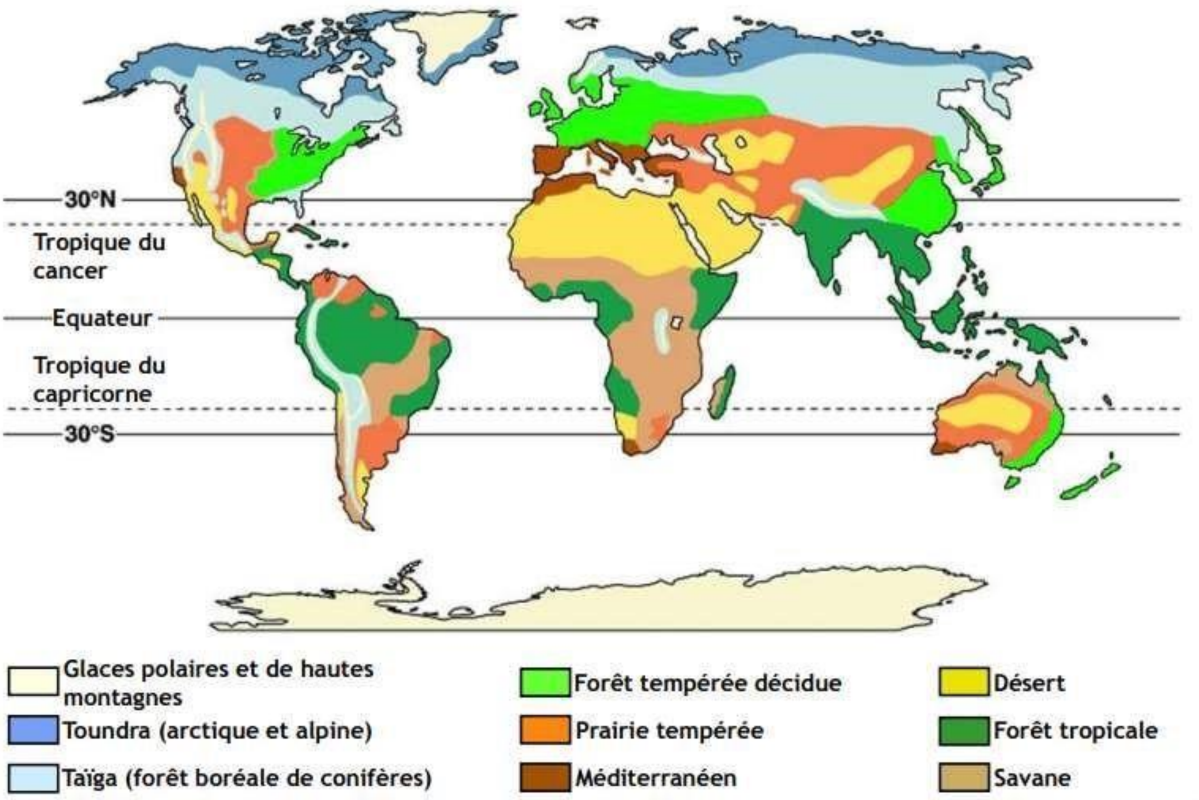

Figure 1: Carte of biomes (7 terrestrial habitat types, 2 aquatic habitat types. and ice-covered areas) (*https://cours-examens.org/images/Etudes_superieures/*).

1.4 Concept of an ecological system

Immediately given or accessible to the naturalist is the individual. Individuals, who are first perceived as isolated in nature, have meaning, for ecology, only through the system of relationships that bind them, on the one hand, to other individuals, and on the other hand, to their physico-chemical environment. Natural populations are never isolated, they can present various interactions of predation, competition, cooperation, and are subject to the physico-chemical factors of the environment (fig. 2).

An ecosystem system therefore includes:

- biotope, physico-chemical factors of the environment (e.g. abiotic parameters of soil and climate: physical structure, temperature, light intensity, humidity, content of chemical elements. . .) ;
- biocenosis, all living beings;
- relationships between living things (biotic interactions);
- the relationships between living beings and their biotope;
- relationships between the ecosystem and its environment.

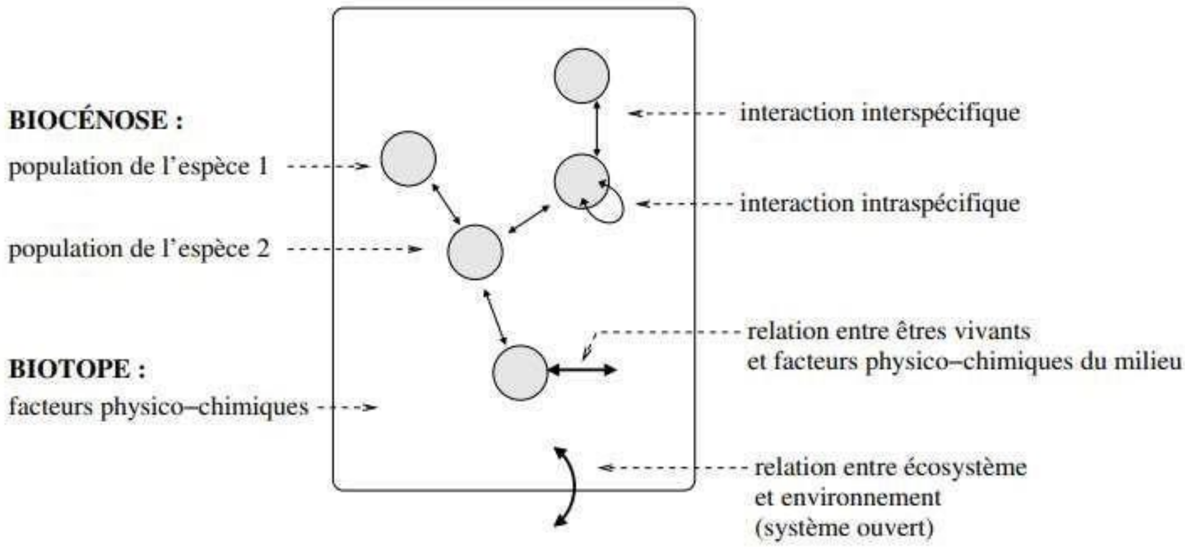

Figure 2: Interaction within an ecological system (Goudard A, 2007)

1.5 The Ecosystem – a network of interaction

The unit studied by ecology is the ecosystem. The term was proposed in 1935 by the English botanist Arthur Tansley, the concept was structured from the 1940s. The ecosystem is a relatively homogeneous and stable set (in the absence of disturbances) constituted by a community of living beings (animals, plants, fungi, microbes) called biocenosis, in relation to a biotope (physicochemical factors determined by climate, topography, soil nature, humidity, etc.) (fig. 3). An ecosystem evolves, in the absence of disturbance of natural or human origin, towards a state of equilibrium called climax. However, most terrestrial or aquatic ecosystems are disturbed by human activities. We are talking about disturbance of anthropogenic origin.

An interaction (intraspecific or interspecific) can be established directly between two individuals or two species, or indirectly, via interactions with a third individual or species or via interactions with an environmental factor. This is an indirect interaction. When the impact of one species on another species requires the presence of a third species, the indirect effect can be transmitted by variation of abundance along the chain of interactions or by modification of the traits of the interacting species (Wootton 1994, Abrams 1995).

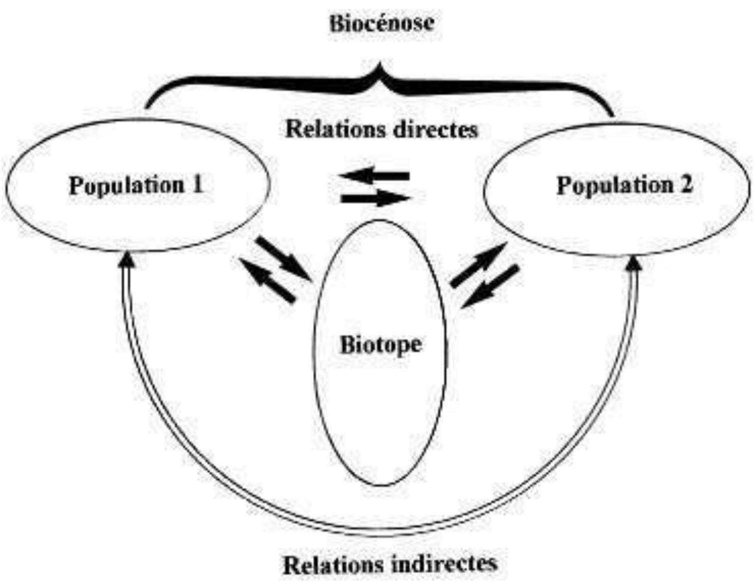

Figure 1: Systematic properties explains the functioning of ecosystems (according to *Frontier and Pichod-Viale).*

1.5.1 The physico-chemical framework (biotope)

The ecosystem is not reducible to its biocenosis. It also includes a physical and chemical environment that intervenes not only in the biology of each species but also in the structure and dynamics of the entire biocenosis (part will be well developed in Chapter II). Conversely, the functioning and transformation of the composition and structure of biocenoses can modify the characteristics of the medium.

A biotope is the physical and chemical environment in which plants and animals live. This medium is the non-living, or abiotic, element of the ecosystem. It contains all the resources necessary for life. The biotope varies across ecosystems. In a pond, it is composed of water and dissolved substances (oxygen, carbon dioxide and mineral salts).

In a forest ecosystem, the biotope is constituted by the soil that allows the rooting of plants and provides them with water and essential mineral salts, and by the atmosphere that provides oxygen and carbon dioxide, which are also essential.

1.5.2 Biocenosis

The second element of the ecosystem includes all living beings, plants, animals and microorganisms, which find in the environment conditions allowing them to live and reproduce. All these living beings constitute a community (a term mainly used in America) or a biocenosis (a term mainly used in France). The biocenosis is a set more or less rich in species between which there are links of interdependence which are manifested by competition, trophic relations (some eat the others), symbiosis, etc. The three categories of organisms of a biocenosis are producers (chlorophyll plants), consumers (herbivorous and carnivorous animals), decomposers (fungi, bacteria and certain animals).

1.6 Ecosystem structure and status:

Every ecosystem has a particular structure that allows it to be recognized. The structure corresponds to the arrangement of the individuals of the various species with respect to each other, either in the horizontal plane or in the vertical plane.

The distribution in the vertical plane corresponds to the stratification, more or less marked according to the ecosystems. It is clearly visible in the forest, where it is possible to recognize a cryptogamic stratum at ground level, a few centimeters at most, consisting of cryptogams, mosses and lichens; an herbaceous stratum formed by grasses that can sometimes reach 1 m in height; a shrubby stratum up to 8 m in height; a tree stratum comprising the tallest trees (more than 50 m in some forests). Overlaid on this stratification is a stratification of animals that can live on the ground or, like birds or insects, settle in the various strata of the undergrowth. The stratification also exists in the soil where it is marked by a staggering of the roots of the various plants at various levels (fig. 4).

Stratification exists even in a simple ecosystem like the prairie. We can distinguish a subterranean stratum formed by roots and soil animals such as earthworms, a stratum of the soil surface composed of animals that live among plant debris, and an aerial stratum formed by animals that live in grass at different heights.

In the horizontal plane, the structure of ecosystems is manifested, in the forest, by a heterogeneity of vegetation, the presence of clearings or trees of different ages and heights.

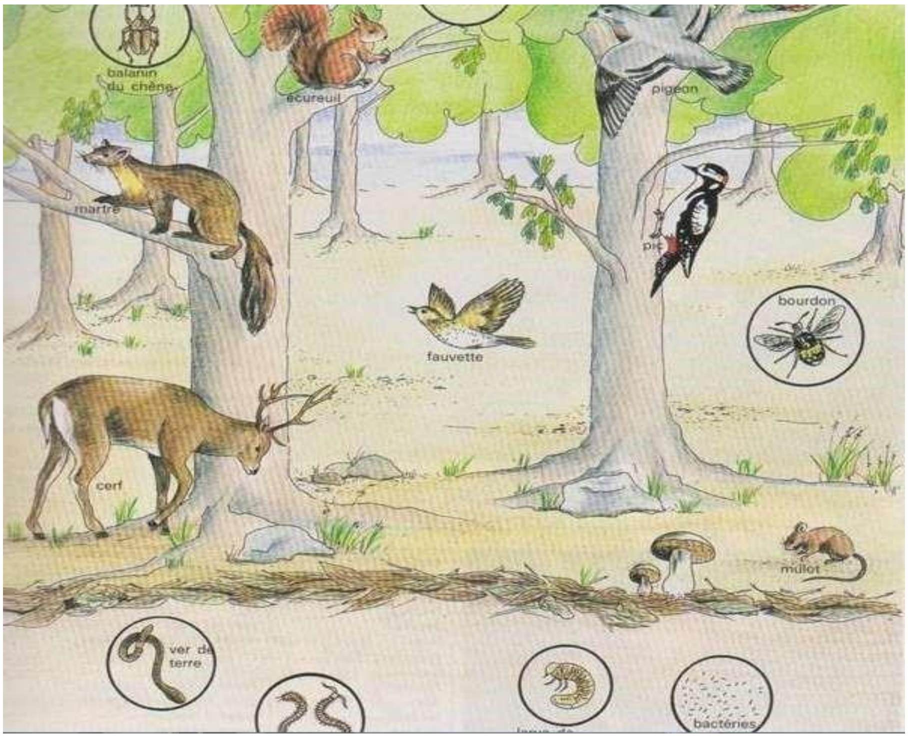

Figure 2. Distribution of different plant and animal species in the horizontal plane in a given ecosystem (*http://mdevmd.accesmad.org/mediatek/mod/)consulted on 28/01/2019*

1.6.1 Spatial structure of the ecosystem

Ecosystems do not spread out, uniform and homogeneous, in space: they have a certain structure, which can be defined horizontally and vertically. To stick to very general considerations it is convenient to distinguish cases where the spatial structure of the ecosystem is defined from abiotic factors alone, from those where biotic components are taken into account. Thus, we can characterize the spatial structure of an ecosystem aquatic, lake, river, oceanic area, using only the physicochemical variables of the environment.

Ecosystems can be described, at the level of their biological framework

(biocenosis), by simply listing their specific composition.
Such an inventory, which must theoretically include all species present (microorganisms, plants, animals), encounters serious difficulties (identification and determination of these species) and has little interest:

As long as we are interested in the structure and functioning of the ecosystem, it cannot be reduced to a shapeless collection of species.

In the case of terrestrial ecosystems, a first integrated description is generally given from the analysis of the vegetation which makes it possible to define the spatial structure of the ecosystem.

In the case of aquatic ecosystems, the spatial structure is more easily defined from the physical variables of the environment.

In general, the study of the chemical physical framework, an integral part of any ecosystem, should never be neglected.

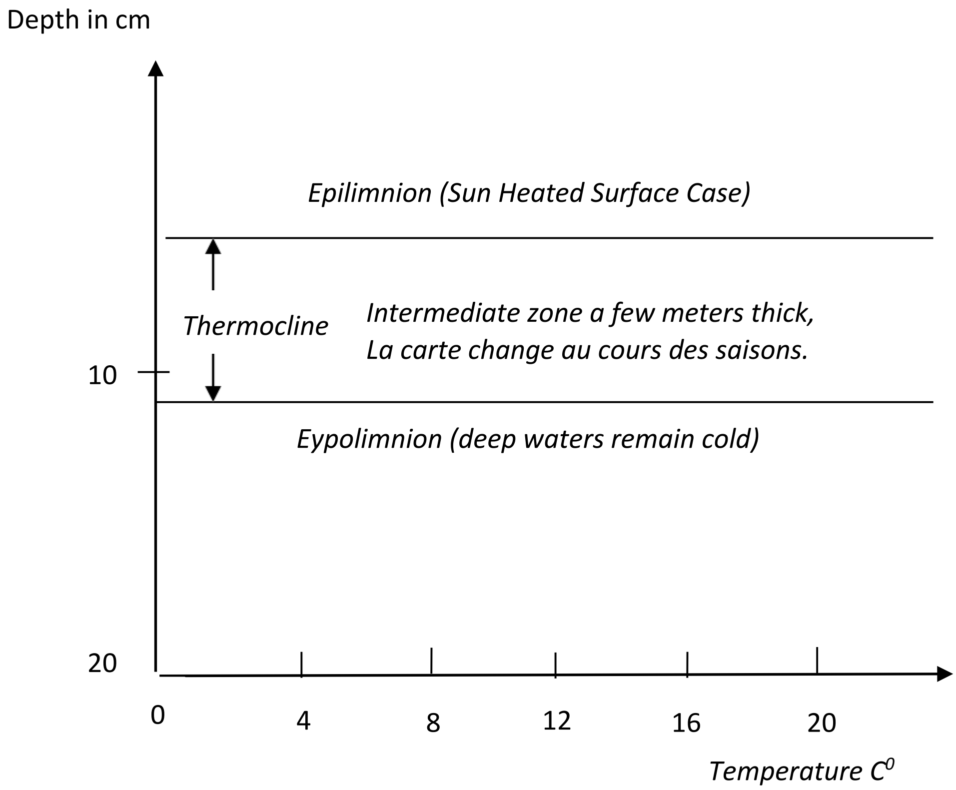

Figure 3: Thermal stratification of a temperate lake in summer (Ramad F, 2006)

1.6.1.1 Biodiversity and dominance

The notion of biodiversity can be found at different scales:

- molecular scale (based on genetic diversity, genetic variability between individuals in a population and between populations of a species); species scale (species diversity or specific diversity); ecosystem scale (ecosystem diversity).

Dominance and diversity are two attributes of biocenoses. Dominance occurs when one or a few species control the environmental conditions that affect other species. In a forest, the dominant species is a tree such as oak or beech. In a near-shore marine biocenosis, the dominant species may be an animal such as the mussel. Diversity is difficult to measure. It can be assessed by simply determining the number of species present. A better estimate is to calculate a diversity index that takes into account both the number of species and the numerical abundance of each.

The relationship between diversity and ecosystem functioning is studied at the ecosystem level and therefore mainly concerns the diversity of species. At each scale, biodiversity has both quantitative and qualitative components. Thus, specific diversity can be described quantitatively, by the number of species for example, or qualitatively, by the specific composition.

Therefore, the study of the relationship between structure and functioning of ecosystems, and in particular the relationship between specific diversity and functioning, testing the effect of species richness makes it possible to determine the impact of the number of species in the community, regardless of their relative abundance, and therefore to take into account the significant effects of certain species that are not very abundant.

1.6.1.2 Productivity, Diversity, Stability, Resilience

A. Productivity

One of the fundamental characteristics of ecosystems, in relation to their functioning, is productivity. The entire organization of ecosystems ultimately depends on the amount of energy captured by primary producers. Thus, attempts have been made to characterize the various types of ecosystems by their gross or net annual production.

The biomass formed over a period of time is called productivity, so determining productivity in a given level is the biomass produced per unit of time, this productivity depends to a large extent on the two major climatic variables (temperature and rainfall).

P = Plant biomass (Kcal/year).

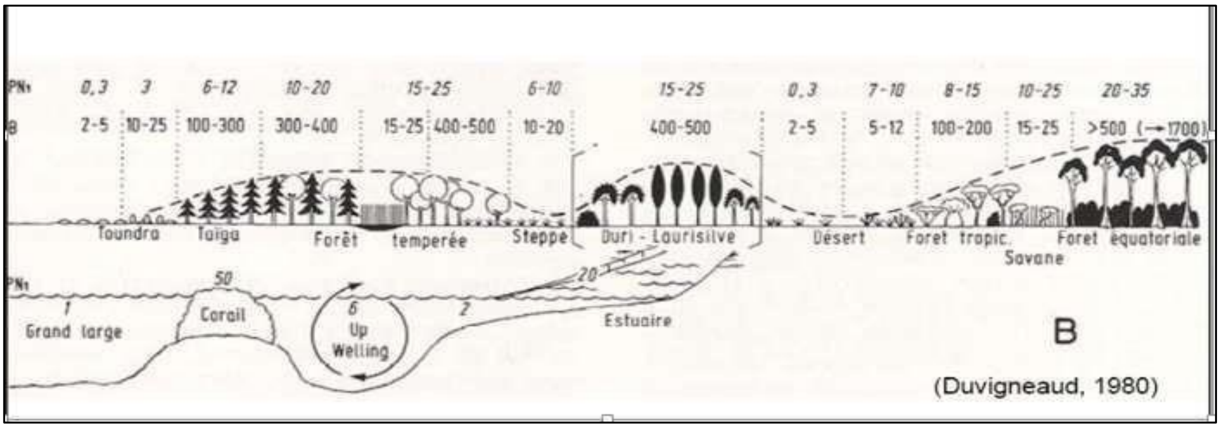

Figure 4: Order of magnitude of biomass (t/ha) and primary production (t/ha/year) in major biome types (Duvigneaud, 1980)

B. Diversity

When we talk about the diversity of an ecosystem we generally refer to its specific richness, that is to say the highest to lowest number of species when it includes (notions of richness and specific diversity are already taken).

C. Stability and Resilience

Ecosystems are all the more stable the more diverse they are (with high specific diversity). If we note that natural ecosystems become over time, after a disturbance that is both richer and more stable, we remain shaken by the fact that any increase in diversity introduced into different mathematical models of ecosystems tends to reduce rather than increase their stability.

There are two essential components in stability: **the first, static**, which can be called stability in the strict sense, refers to the properties of constancy or persistence of ecosystems, possibly linked to the permanence of environmental conditions;
the second, dynamic, which can be called resilience or homeostasis, corresponds to the ability of ecosystems to return to a state of equilibrium after a disturbance.

These properties of stability and resilience are obviously key characteristics of ecological, natural or exploited systems. The exploration of the mechanisms they implement and the evaluation of their effectiveness (resistance to disturbances, speed of return to equilibrium, irreversible degradation threshold) are indeed one of the major objectives of ecology.

1.1.2 Structure

It is possible to define a recognizable fundamental functional structure at which point in the biosphere one is located. Indeed, the biosphere includes living and other non-living elements.

---

[1] CO_2+6H_2O $C_6H_{12}O_{16}+6O_2+Q$ (heat)

This process causes atmospheric carbon to enter the cycle of the elements, unlike the respiration that expels it, thus constituting the development of products

From a functional point of view, the multitude of species that inhabit the earth and the seas can be divided into four main sets constituting as many fundamental compartments of the biosphere system: primary producers, primary consumers, secondary and higher-ranking consumers, decomposers.

Are the primary producers (autotrophic plants, green plants on land, algae and phytoplankton in water, which use solar energy for photosynthesis. The latter allows the chlorophyllous plant to transform mineral matter into organic matter (form complex organic substances from simple inorganic substances).

The fundamental operation of photosynthesis, remember, is the production of glucose and oxygen molecules from carbon dioxide and water:

Secondary consumers (C2), carnivores: All organisms that feed at the expense of other living animals for a more precise analysis we will see that this group should be subdivided into secondary consumers (herbivore eaters), tertiary consumers (C3), who feed on the previous ones, etc. In fact, many species do not easily comply with this classification by trophic levels and can belong to several compartments - primary and secondary consumers (omnivorous species), secondary and tertiary consumers (predators or parasites of herbivores and carnivores), etc.

Decomposers are invertebrates, fungi and bacteria that feed on dead organic matter-cadavities, litter, etc.

The non-living elements of the biosphere can be grouped into two different compartments: dead organic matter and mineral elements.

The various compartments of the biosphere system are linked by transfers of matter and energy. Three fundamental processes summarize how it works:

---

silts. It is the first link in the cycle of matter and therefore that of energy.

Animals that feed at the expense of primary producers are herbivores (C1), they are totally dependent on producers because they also produce organic matter (growth, reproduction), but from the organic matter already developed, we call them secondary producers (C2).

- The consumption process, ingestion of organic matter;
- The production process, synthesis of organic matter;
- The process of decomposition or mineralization, recycling of the material.

1.6 .2.1 Trophic structure

Ecosystems are powered by the sun. The first trophic compartment of any ecosystem is the one that brings together autotrophic organisms, algae, and chlorophyllous plants capable of fixing solar energy and synthesizing their tissues from mineral elements. for primary producers.

Every ecosystem is based on primary production. The living organic matter thus produced is a source of matter and energy for herbivores, or phytophagus, insects, molluscs, vertebrates, but also certain parasitic plants. These organisms are the first consumers of living organic matter if we follow the flow of energy in the ecosystem: They are primary consumers naturally, these organisms also synthesize their own tissues to grow and multiply: they are therefore secondary producers. Herbivores are the prey of many predatory and parasitic consumers who are themselves a source of food for tertiary consumers, victims in turn of possible quaternary consumers.

This food chain is not unlimited. At each stage, at each energy transfer, there are significant losses, so that from third-order consumers, the amount of exploitable material becomes scarce, dispersed and difficult to use, except for a few superpredators and especially parasites. This appears well in the classic presentation of the trophic pyramids (part will be well developed in the following chapter). The food chain fed by plants is an incomplete system: it lacks an essential process, the recycling of matter, under which plants would be deprived of mineral elements (the pedogenetic source being largely insufficient).

This recycling of organic matter (decomposition, mineralization) is ensured by saprophagous organisms, microorganisms mainly (bacteria, fungi) but also associated with a "decomposer" system. These in turn are a source of food for secondary consumers (protozoa, arthropods, small vertebrates). They themselves fall prey to tertiary consumers…tec.

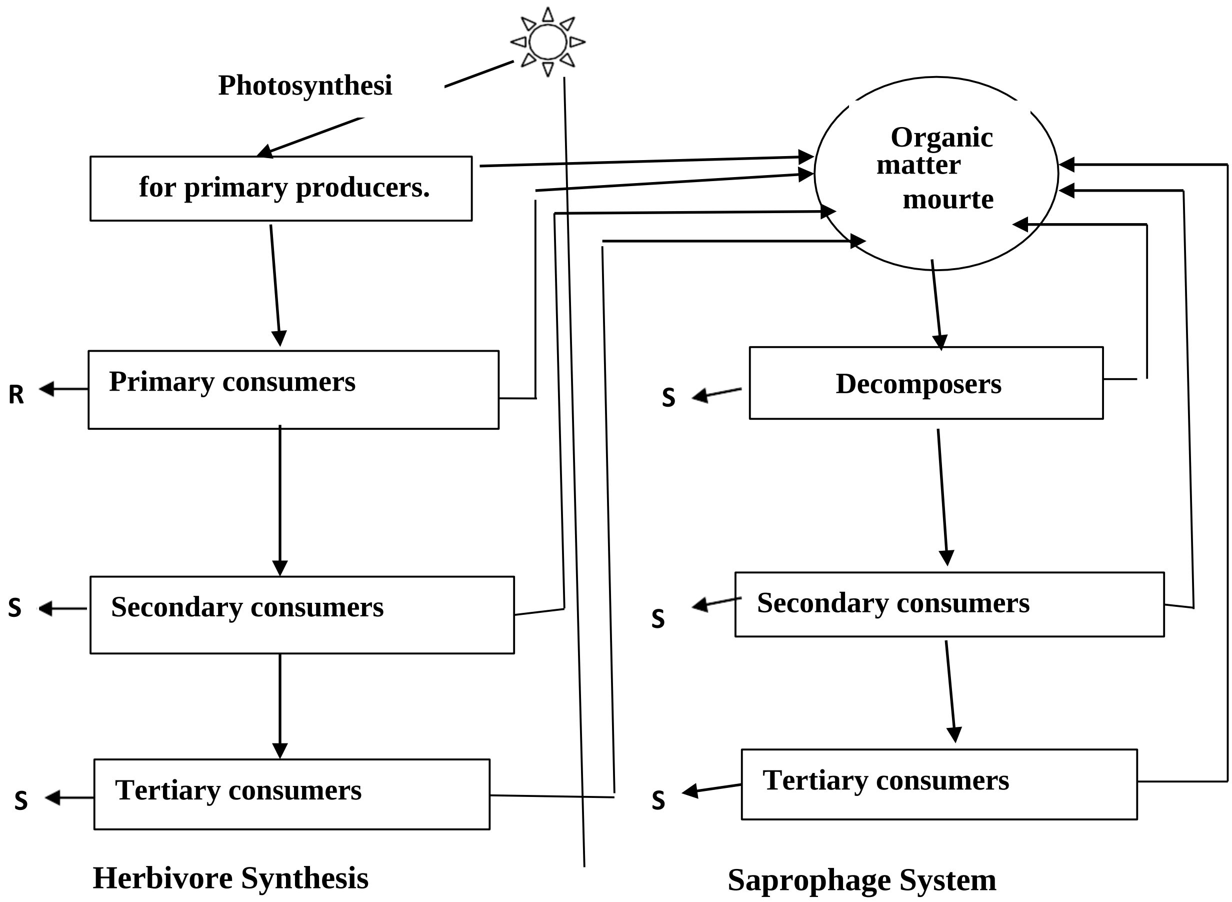

Figure 5: Schematic representation of the trophic structure of an ecosystem (Boulaine J, 1996)

1.6.1.2 Graphical representation of food chains

The diagramming of the structure of biocenoses is generally designed using ecological pyramids, which correspond to the superposition of horizontal rectangles of the same height, but of lengths proportional to the number of individuals, the biomass or the amount of energy present in each trophic level. We then speak of a pyramid of numbers, biomasses or energies.

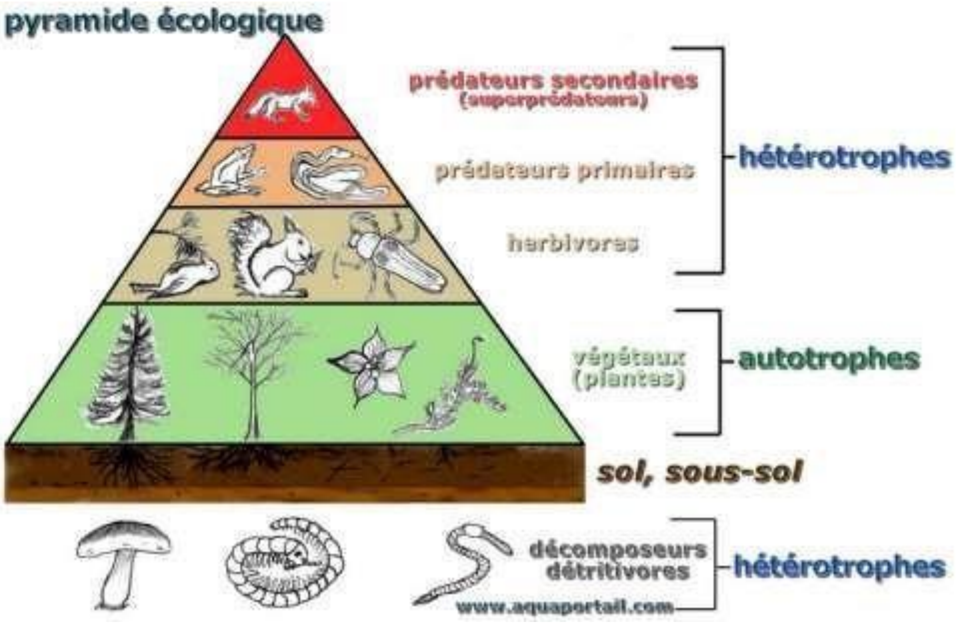

Figure 6: Graphical representation of a terrestrial food chain

(https://www.aquaportail.com/)

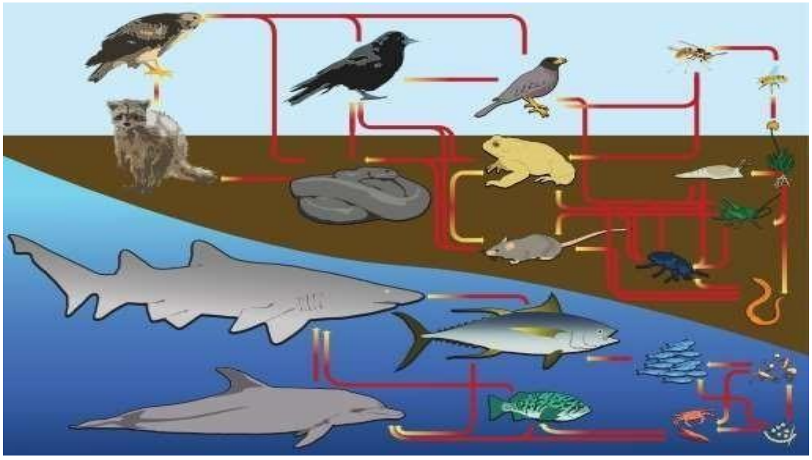

Figure 7: Graphical representation of a trophic chain between sea land and air

(LadyofHats, 2013) *http://www.fcps.edu (ecology on islandcreeks, CK-12 project)*

The qualitative basis of an ecological pyramid is a food chain, i.e. a part of the food chain of an ecosystem, commonly referred to as the food chain . Assigning a certain type to a trophic level is an abstraction that somewhat simplifies the actual conditions. Saprobionts (including scavengers) and destroyers are not included in the list of food pyramids. The most important reason for this is that, unlike herbivores, they have no direct influence on their food base. Parasites are usually left without consideration. The ecological pyramid does not form the entire ecosystem, but only a fraction of it. The functioning of an ecosystem is the set of processes related to the flows of matter and energy in this ecosystem.

It consists of transforming the sun's light energy into chemical energy through the phenomenon of "photosynthesis" on the one hand, and on the other hand there are complex interdependent relationships between the elements of the ecosystem.

Chlorophyllous plants use the light energy of the sun to synthesize organic matter (lipids, carbohydrates, proteins). These organic materials will be used by the other elements of the ecosystem to constitute **a food web:** which is the set of trophic relationships between living beings of different trophic levels.

A- Trophic structure of an ecosystem:

Within a biocenosis, the function of organisms is not random. From a trophic point of view, we can distinguish several groups of organisms whose function is distinct.

1-Primary producers (autotrophs): chlorophyllous plants that use water, mineral elements and CO_2 to manufacture organic matter using solar energy .

2-Consumers (heterotrophs): these are all other living beings with the exception of autotrophic plants, are unable to manufacture organic matter. We can distinguish 03 levels of consumers:

2.1-First-rate consumers or primary consumers: these are the organisms that feed directly from the producers. These are plant pests, granivores, fruit pests, nectarivores, herbivores.

2.2-Secondary consumers or secondary consumers: these are the organisms that subsist by feeding themselves at the expense of primary consumers. So they are carnivores (predators)

2.3-Third-order consumers or tertiary consumers: these are carnivores that feed on other carnivores. These are organisms that are at the top of the food chains (represented by carnivores: sharks, panthers...or parasites or even necrophagous organisms).

Example: ⟶ grasshopper plant ⟶ frog ⟶snake

Producers CP CS CT

3-Decomposers: these are organisms that complete the trophic cycle. They break down organic matter and recirculate mineral elements that are contained in organic form in animal and plant debris, they act at all stages of the food chain.

Food chains do not always flow from a small to a large organism, the opposite is sometimes observed.

In an ecosystem, the phenomena of energy and material transfer are numerous, diversified and independent: in this case, we are talking about **food webs.**

B- The food chain:

A food chain is a succession of organisms, each of which lives at the expense of the previous one.

B.1/ Different types of food chains: There are three main types of food chains:

B.1.1 /Predator food chain: this chain usually starts from the producers, following which, we observe a series of increasingly predatory organisms.

B.1.2 /Parasite food chain: this type of chain is formed from large organisms to small organisms. In these chains, the appearance of hyper-parasites (parasite parasites) can be observed.

Pest chains have a significant impact on the functioning of ecosystems.

They make it possible to achieve a balance in the ecosystem thanks to a role in regulating the numbers of parasitic populations. *Example:*

Producer ---------- herb N I

Herbivore ----------------Rapin N II

Parasite 1 --------------- chip N III

Parasite 2 -------------leptomonas---N IV (flagellated protozoa)

B.1.3 /Saprophyte trophic chain (detritivores): in this case, the trophic support consists of detritic material, i.e. decomposing organic matter. This type of chain involves many organisms (earthworms, bacteria, fungi) and plays a fundamental role in forest ecosystems. Indeed, when the foliage and branches fall to the ground and join the litter, they are fragmented by the saprophagous animals (earthworms, mites, springtails), the fragments are dispersed in the soil and are taken up by fungi and bacteria that will complete the decomposition and release of mineral elements.

Example:

Dead wood → Insects → Mushrooms → Bacteria

Note: Dead organic matter is found at the beginning of each chain of decomposers.

These three types of chains coexist in the same ecosystem and are part of the food web of the ecosystem. Generally speaking, they have three or four trophic levels in the terrestrial environment, and five in the marine environment.

B.2/ Graphic representation of food chains

The diagramming of the structure of biocenoses is generally designed using ecological pyramids, which correspond to the superposition of horizontal rectangles of the same height, but of lengths proportional to the number of individuals, the biomass or the amount of energy present in each trophic level. We then speak of a pyramid of numbers, biomasses or energies.

Chapter IV: Ecosystem Classification: The Biosphere and Ecosystems

4.1 Introduction

Ecosystems, which are sets formed by a group of living beings and their living environment, can be classified in different ways. There are two types of ecosystem classifications: according to the biotope (living environment) or according to the biocenosis (living beings).

The most widely used method of classification is that which is carried out from the biotope, as the middle put it. For example, the marine environment gives rise to ocean ecosystems. A biotope (or environment) is broken down into as many ecosystems as there are groups of living beings living in community. The exception to this method of classification is the ecosystem of humans, which refers to biocenosis and not to the environment.

Table 3: Classification of ecosystems by biotope

Environments on continents	Terrestrial or continental ecosystems
Temperate forests, rainforests, tropical forests	Forest ecosystems
Grasslands, steppes and savannahs	agroecosystems
Springs, rivers and streams:	Lotic Ecosystems
Lakes & Ponds	Lens Ecosystem
Oceans and seas	Ocean ecosystems

4.1.1 Aquatic Ecosystems

4.1.1.1 Freshwater Ecosystem (Limnic Ecosystem)

A. Environmental conditions

The physicochemical properties of aquatic ecosystems are very different from those of the terrestrial environment; the density of water is 775 times greater than that of air. Virtually all known bioelements exist in waters but N and P, in very low concentrations, are limiting (sedimentation of N and P at depth).

The pH is important, it is stable in the oceans (±8), and varies from 3 to 10 in freshwater.

The consumption of O_2 by the decomposing organic matter of dead plants can lead to the asphyxiation of wildlife in closed ecosystems (lakes) (Eutrophication).

B. map the distribution of organisms

- **Pelagic life** (swimming or floating) includes the following communities:

Necton: swimming animals (Fish, cephalopods, Decapods, Mammals);

Neuston: Organisms swimming in the microclimate of the water-air interface;

Seston: All particles and organisms floating in water; subdivided into:

- ○ **Plankton:** microscopic organisms : nannoplankton, phytoplankton, bacterioplankton, zooplankton;
- ○ **Tripton:** detritus of organic origin; **Pleuston:** surface organisms pushed by the wind.

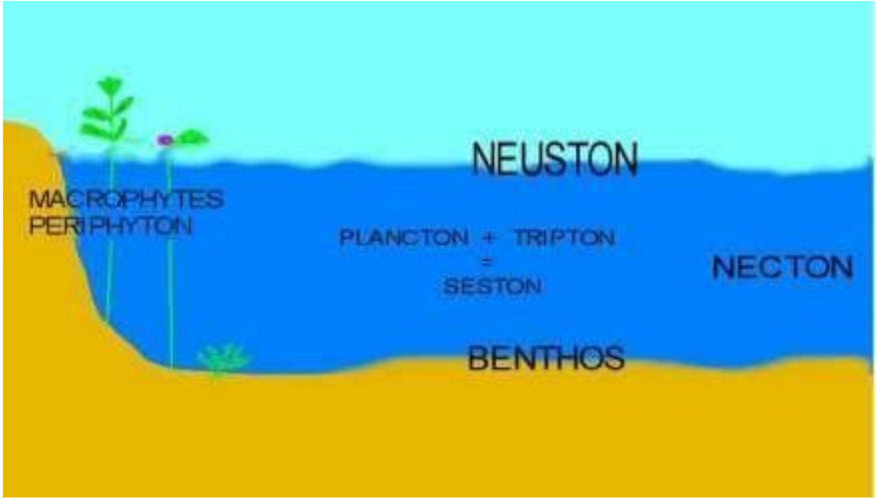

Figure 9: Composition of the biocenosis of a lake according to Stéphan Jacquet MF1, CAH 2B

- **Benthic life** is linked to the bottom of the water: fixed, mobile or swimming forms; phytobenthos, bacteriobenthos, zoobenthos, benthivorous fish. More specifically, we can classify the organisms of the benthos according to their infeodation: ○ Rhizomenon: aquatic plants fixed by roots; ○ Biotecton**:** communities covering the solid substrate such as stones, detritus; ○ **Epiphyton:** communities fixed on aquatic plants;

  ○ **Psammon:** groups together animal and plant species small enough to live in the water of the interstitial spaces of the sediments or sands of the river bed, the bottom of ponds or lakes, beaches and coastal bottoms.

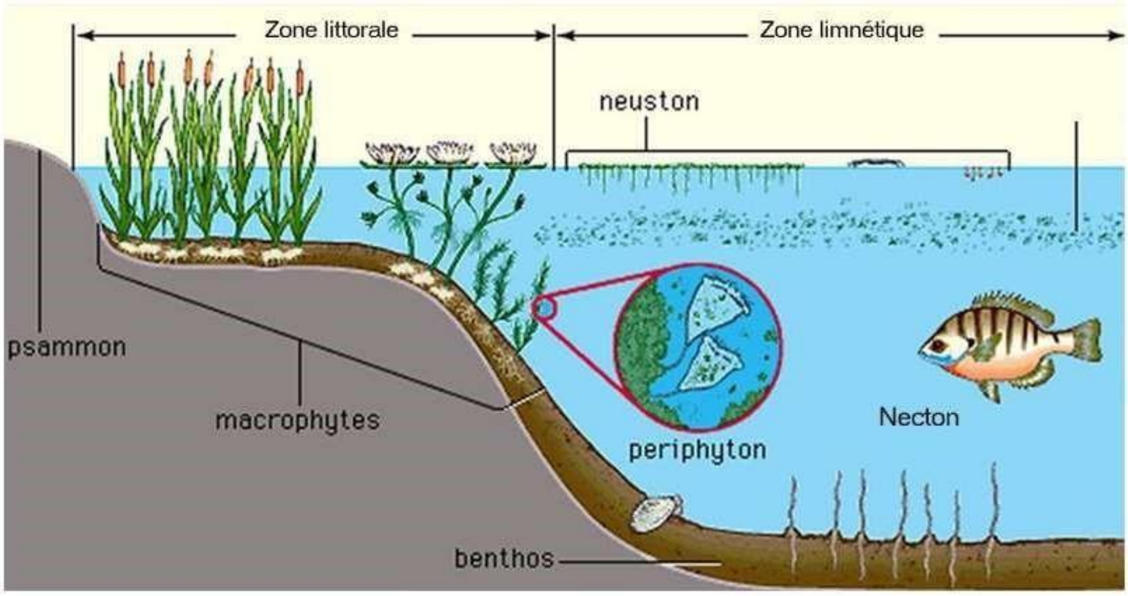

Figure 10: Spatial zonation of a deep lake (Guyard, 1997).

4.1.1.2. Inland Aquatic Ecosystems

These are terrestrial ecosystems: limnic ecosystem, designating all current continental waters, lake or stagnant, they are subdivided into:

4.1.1.2.1. Lens Ecosystem

Concerning inland waters with slow water renewal (lakes, ponds, tides), they are characterized by a richness in plankton and a poverty in oxygen, vulnerable to pollution by organic matter (eutrophication).

A. **Structure according to physicochemical properties:** are subdivided into four distinct regions; there are:
   - **Coastal area**, is on either side of the pond **;**
   - **Limnic zone,** corresponds to the surface layer where photosynthesis is greater than the respiration of autotrophs (colonization by phytoplankton: Diatoms, Cyanobacteria, and zooplankton);
   - **Deep zone,** corresponds to the zone where photosynthesis is absent, dark and dark zone;
   - **Benthic area,** corresponds to the bottom of the pond.

B. **Limnic organisms (trophic structure)** i. **Producers**

- **In the coastal zone,** higher plants are represented (emergent macrophytes, fragmites, etc... ;
- **In the limnic zone,** primary production is provided by phytoplankton exp: diatoms and filamentous algae.

ii. **Consumers:** Consumers of benthic biocenosis belong to three distinct groups:

- **Zooplankton,** consists of microcrustaceans and others **;**
- **Necton,** represented by insects, amphibians and fish;
- **Neuston,** represented by some insects exp: beetles

iii. **Decomposers:** called benthos which designates a particular biocenosis consisting of detritus or decomposers, it consists of the many saprophages, microphages, etc...

The dominant groups are nematodes and protozoa.

C. **Classification of lakes:** We have 3 main categories according to the richness in organic matter.

- **Oligotrophic lakes,** These are lakes with very pure waters with great transparency, their productivity and their biomass is very low;
- **Mesotrophic lakes,** moderately pure, medium productivity;
- **Eutrophic lakes,** a lake rich in nutrients, are too productive and have a good biomass.

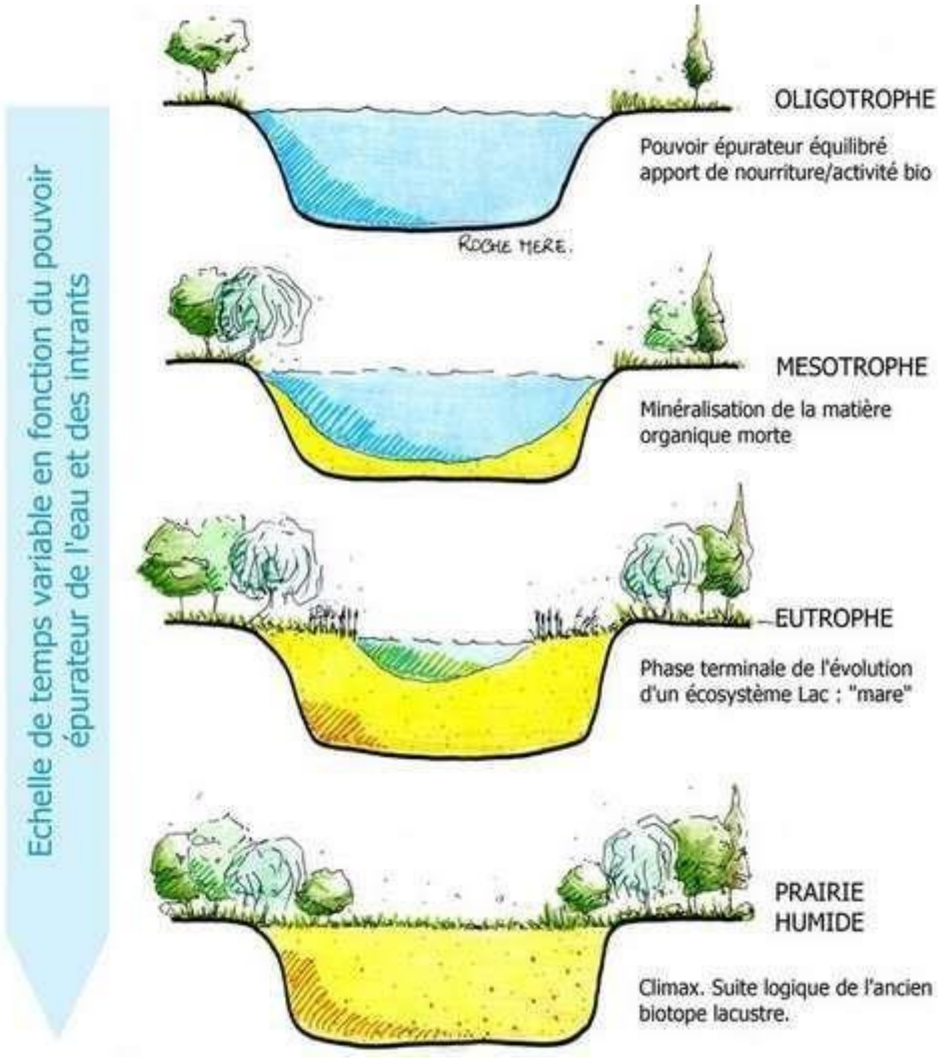

Figure 11: Natural evolution of a lens ecosystem

4.1.1.2.2. Lotic ecosystems

These are continental aquatic ecosystems where water renewal is rapid, they have good oxygenation low in organic matter exp: wadi, river, river.

The structure of lotic ecosystems comprises 4 distinct regions of decreasing altitude (from upstream to downstream):

1) **Crenon,** Corresponds to the highest region where the springs and their outfall are located. It is a biotope with a (torrential) nature (very fast water), often located in mountainous areas.
2) **Rhitron,** constitutes the upper part of the water corners with steep and fast slope, well oxygenated water.
3) **Potamon,** lower area, low slope and slow current.

4) **Estuary,** is the last region of the lotic ecosystems it is a zone of mixing of fluvial and marine waters, it presents a gradual increase in salinity downstream and a significant turbidity of the sediment-laden waters possessing a high biological productivity as a result of the supply of nutrients coming from leaching and erosion of the upper parts of the watershed.

Figure 12: Lotic and lentil ecosystems

4.1.1.3 Ocean Ecosystem

An **ocean** is often defined, in geography, as a vast expanse of salt water. In fact, it is rather a volume, the water of which is constantly renewed by marine currents. Approximately 70.7% of the Earth's surface is covered by the global ocean, commonly divided into five oceans and several dozen seas.

The global ocean generates more than 60% of the ecosystem services that sustain us, starting with the production of most of the oxygen we breathe. **Table 4:** Characteristics of different types of oceans

Surnam	**Surface area**	**% of oceans**	**Remark**

|||UNTRANSLATED_CONTENT_START|||Océan Pacifique|||UNTRANSLATED_CONTENT_END|||	165,250,000 km^2	43.5	It is the largest and deepest of the oceans sinceit covers 1/3 of the planet's surface. Aerial or submarine volcanism is important in its central and western part. It is very open to the south towards the Atlantic Ocean and almost closed to the north by the Bering Strait
|||UNTRANSLATED_CONTENT_START|||Océan Atlantique|||UNTRANSLATED_CONTENT_END|||	106,400,000 km^2	28.0	It is the 2nd ocean by its area. It extends from north to south over an average width of 5,000 km and has little volcanism. The bottom of this ocean is young and it receives a large amount of fresh water with the many rivers that flow into it as amazon, Congo, St. Lawrence , etc.
|||UNTRANSLATED_CONTENT_START|||Océan Indien|||UNTRANSLATED_CONTENT_END|||	73,556,000 km^2	19.4	It is located in southern Asia between Africa and Australia It is almost only present in the southern hemisphere.
Antarctic Ocean	20,327,000 km^2	5.4	It surrounds the Antarctic continent and its boundaries are less sharp than other oceans.
|||UNTRANSLATED_CONTENT_START|||Océan Arctique|||UNTRANSLATED_CONTENT_END|||	14,090,000 km^2	3.7	It is centered on the North Pole and is small in size and shallow. It is surrounded by many lands and covered with a thick layer of ice

Each ocean is in turn divided into seas, gulfs, bays, straits, etc.; the Pacific and the Atlantic are also divided into northern and southern portions, at the equator. There are also saltwater bodies taken from within continents, such as the Caspian Sea , the Aral Sea, the Great Salt Lake or the Dead Sea. But, although some are called “seas” because of their size or salinity, strictly speaking they are not seas but salt lakes, sincethey do not communicate directly with the ocean.

Table 5: The main constituents of seawater

Cations	g/l	Anions	g/l
N/A	10,75	C/	19.34
K	0.39	Br	0.06
Mg	1.29	F	0.001
Ca	0.41	Sulfate	2.70
SR	0.01	Bicarbonate	0.14

The global ocean has a remarkable consistency in these physicochemical factors, especially in its salinity and temperature

a) **Horizontal and vertical zonation:** See Figures 13 and 14

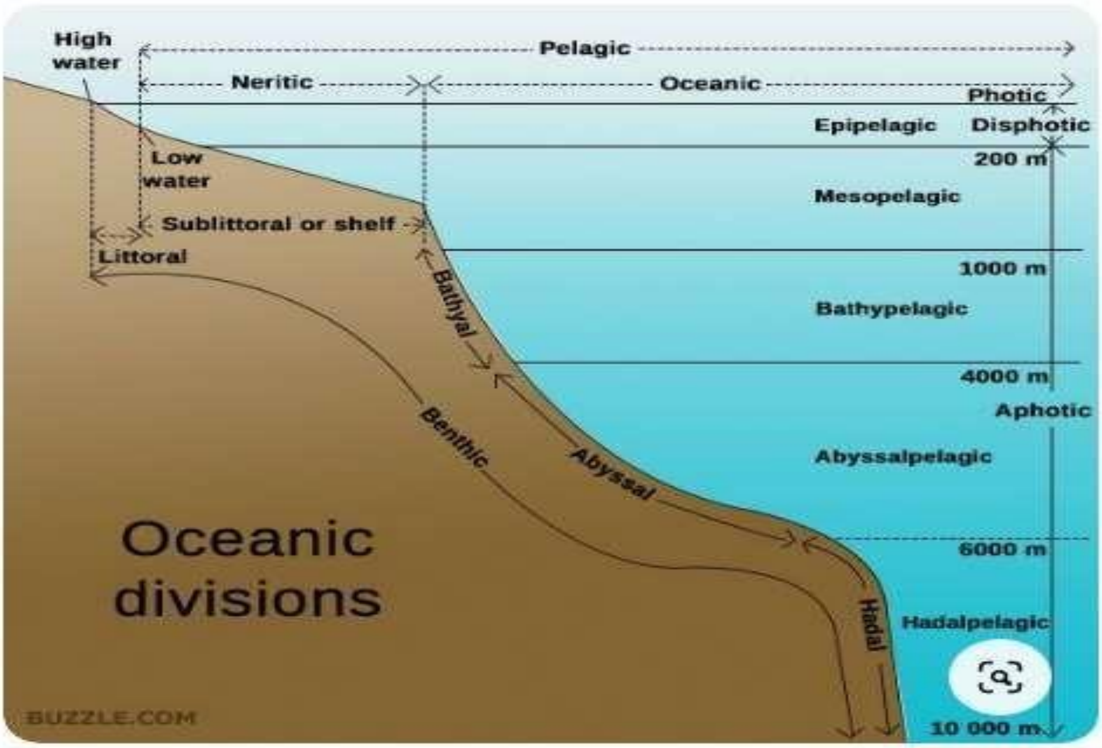

Figure 35: Horizontal and vertical zonation of the oceans

http://www.buzzle.com/articles/understanding-the-ocean-ecosystem.html

Figures 35 and 36 show two areas:

1. **Pelagic domain**: Represents the open water zone, itself divided into several subunits corresponding to the open water is subdivided according to depth into horizontal zone.

Represented by: The continental shelf, bathyal zone, abyssal zone and hadal zone.

2. **Benthic domain:** is defined as the domain where the organisms are more or less linked to the sediment. corresponds to the bottom of the water body subdivided vertically into stages Represented by two provinces:

i. **Neritic province;** corresponding to the shallow water zone and bordering the continental shelf (200m). is home to 2/3 of the known species of fish, rich in depth (phytoplankton).

ii. **Oceanic province;** extends beyond the neritic and represents the waters of the open sea.

Note: it is obvious that for each biotope, there is a given biocenosis, so the epipelagic fauna includes several thousand fish. e xp.**whale**, tuna...etc.

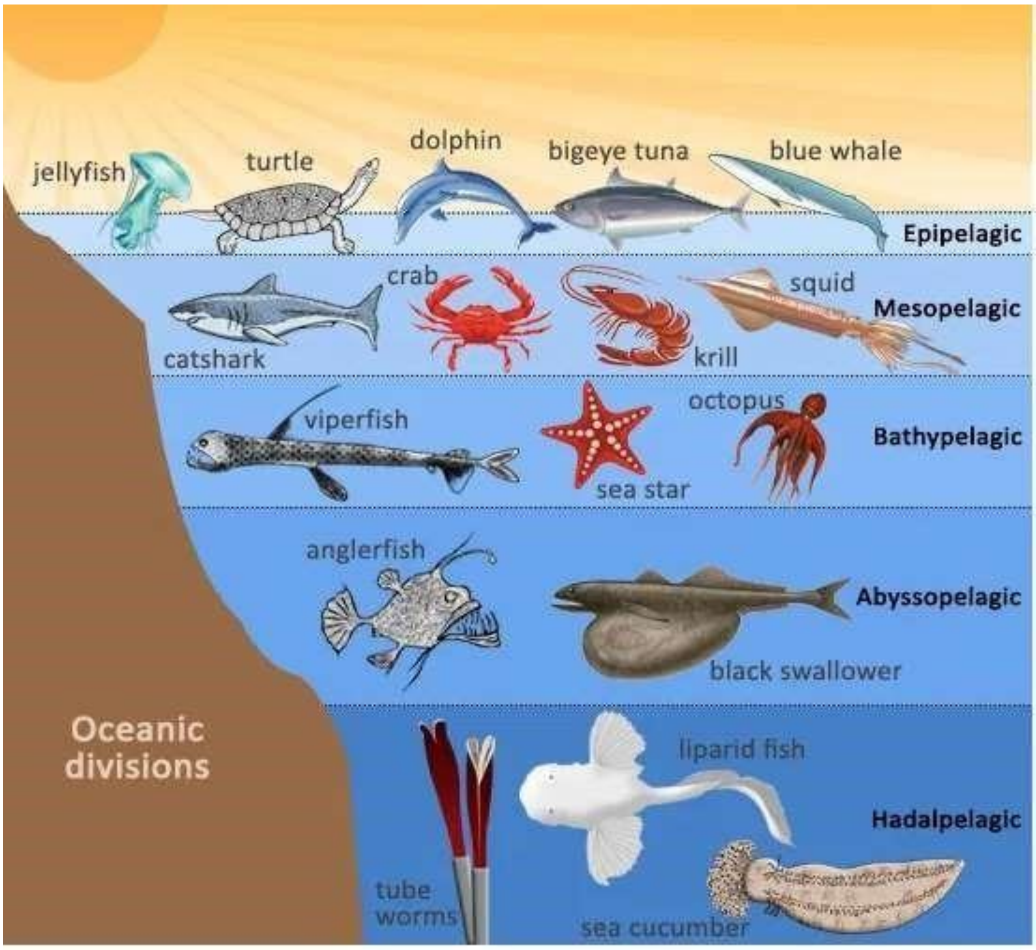

Figure 36: Biocenoses of oceanic stratifications

trophic structure

Phytoplankton constitute the seagrass, it is consumed by small herbivores forming zooplankton (primary consumers). Zooplankton serve as food for a first group of carnivores (crustaceans and fish of which they are secondary consumers) which in turn serve as second-order carnivores or 3 rd-order consumers represented by large predators such as tuna, sharks that live at the foot of the Necton.

Decomposers in the ocean ecosystem are represented by a series of saprophytes that feed on cadavers. Thus, in this last phase of the cycle, the corpses are transformed into mineral salts by a series of invertebrates that reduce organic matter and by the bacteria that carry out mineralization. Bacteria represent the bioreductive element in the marine environment.