Department of biology

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((Ecology))

Stage (-3-)

LEC- ((6))

Ecosystem diversity: Freshwater ecosystems

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Introduction

Freshwater ecology is a specialized sub branch of the overall study of organisms and the environment. Unlike biology, ecology refers to the study of not just organisms but how they react, and are affected by the natural surrounding environment or ecosystem. Freshwater Ecology is a study of the interrelationships between freshwater organisms and their natural environments**.**

Fresh water habitats occupy a relatively small portion of the earth surface as compared to marine and terrestrial habitats, but the importance to man is far greater than their area for the following reasons

1- They are the most covenantal and cheapest sources of water for different domestic and industrial needs.
2- The fresh water ecosystems the more convenient and cheapest waste disposal systems

There are generally three types of freshwater ecosystems: Lotic Systems, lentic systems, and freshwater wetlands.

Lentic systems (standing water)

Lentic systems include standing bodies of water, such as lakes and ponds. No sharp distinction between lakes and ponds. However, there are important ecological differences, other than overall size. **In lake the limentic and profundal zones are relatively large, compared with**

littoral zone. The reverse is true in ponds, also continuous circulation of water in ponds, while the lakes tend to become stratified at certain seasons .

Classification of Lakes

Lakes may be classified according to their trophic status (i.e., their available phosphate content and biological productivity):

1- ***Oligotrophic Lakes* :-** those with low phosphate concentrations and resulting low productivity.

2- ***Mesotrophic Lakes* :-** those with moderate phosphate concentrations and resulting moderate productivity

3- ***Eutrophic Lakes* :-** those with high phosphate concentrations and resulting high productivity.

4- Highly colored, low pH lakes resulting from high humic concentrations are termed ***dystrophic lakes*** .

Light penetration and thermal stratification

Ponds or lakes are divided into two layers due to a decreases in light intensity with increasing depth - as light is absorbed by the water and suspended microorganisms.

- Upper **photic zone** is the layer where light is sufficient for photosynthesis.

- Lower **aphotic zone** receives little light and no photosynthesis occurs.

Temperature stratification also occurs in deeper ponds and lakes during summer in temperate zones. Over time, two distinctly different layers of water become established, separated by a large temperature difference and providing unique ecological niches for organisms. This process is called **stratification**.

The surface area is deemed the **epilimnion**, which is warmed water as a result of direct contact with sunlight. The lower layer is deemed the **hypolimnion,** found below the water surface, and due to increased depth, receives less heat from the sun, as a result only the warm top layer circulates, and does not mix with the more colder water, creating a zone with a steep temperature gradient in between called **thermocline**.

The oxygen supply becomes depleted in the hypolimnion since both the green plants and the surfaces sources is cut off. Distribution of plants and animals in a lake or pond shows stratification based on **water depth and distance from the shore.**

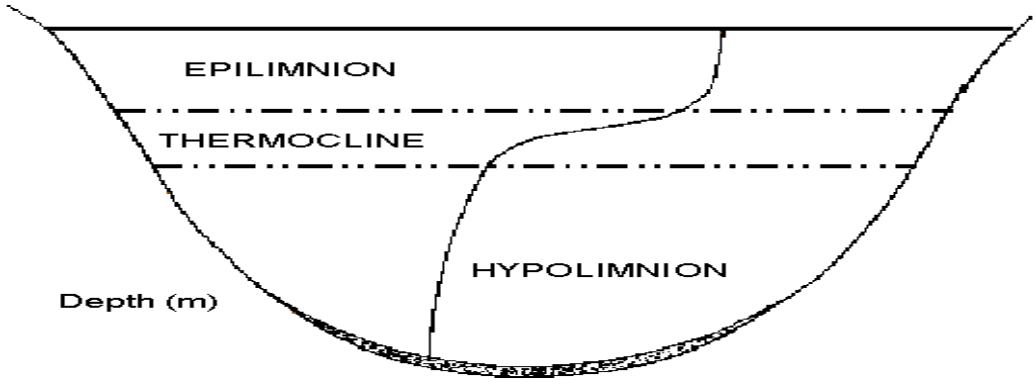

Figure 19: Thermal stratification in lake

Still water animals

Through millions of years of evolution, animals living in an aquatic environment have diversified to occupy the ecological niches available in the ecosystem. When studying the habitats of these particular organisms, three main areas of the freshwater environment can be distinctly classified. Organisms may be classified as to region or sub habitat . In the ponds and lakes three zones are generally evident as shown in figure 20.

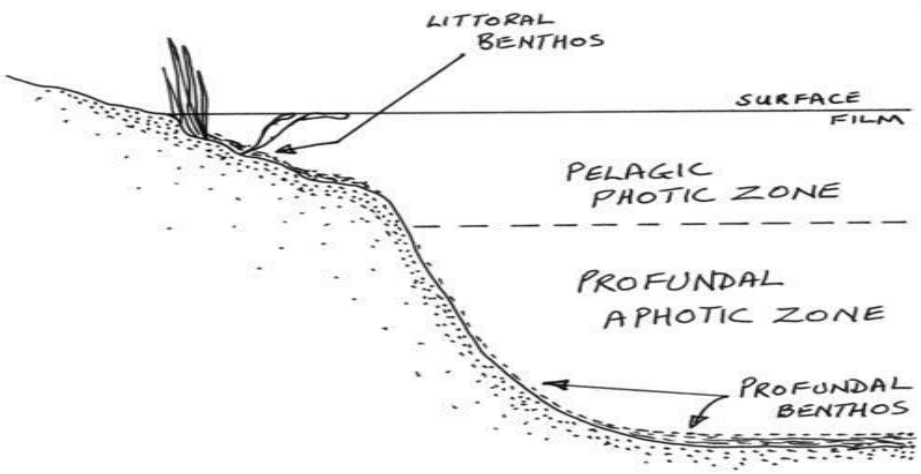

Figure 20: The major zones of Pond or Lake

1- **Littoral zone** :- The shallow water region with light penetrations to the bottom typically occupied by rooted plants in ponds and lakes .

2- **The limentic zone :-** the open water zone to the depth of effective light (pelagic zone). The community in this zone is composed only

of **plankton, nekton** and some time **neuston**. This zone is absent in small shallow ponds.

3- **The profundal zone :-** An area of still water that receives no sunlight therefore lacks autotrophic creatures. The animals in this zone rely on organic material as a means of food, which is sourced from the more energy rich areas above the profundal region.

Lotic systems (running water)

Lotic systems include flowing water, such as rivers and streams. Rivers and streams are places where water is being transported from one place to another. With few exceptions, rivers take the water that collects in a watershed and ultimately deposits that water in the ocean. Along the way, the river biome serves as an important life-giving source to many plants and animal. It seems that the currents factor is the most important factor that distinguishes lotic environments for the lentic environments, as well as other factors listed in the following table:-

Characteristic	Streams (Lotic System)	Lakes (Lentic System)
Water flow	One direction of flow, upstream to downstream	Various flows, no particular direction
Oxygen content	Normally oxygen rich because of the constant mixing	Oxygen depletion exists at times in deeper water
General Depth	Shallower on average	Deeper as average
Size Description	Narrower and longer	Wider and shorter
Riparian Zone Description (the riparian zone is the land area along the banks of the body of water)	Various effects from different terrestrial environments along the stream's course. The shoreline has more potential to affect water quality because a larger portion of the water body is near shore.	Terrestrial environment similar all around the lake shore. A smaller portion of the water is in close proximity to the shore.
Changes in shape / depth over time	Stream continually cuts into the channel, making it longer, wider, and deeper	Lakes become shallower over time from depositing sediments
Water retention time (how long it holds water)	Shorter retention time for water (i.e. it's always flowing)	Longer retention time for water (because it stores water)
Temperature characteristics	Top and bottom waters generally have the same temperature (i.e of the constant mixing)	May have different temperatures from the top to bottom (i.e. it has layers based on density)

Lotic Communities

Running water can bring many factors into play affecting the lives of the organisms in this particular environment:

1. Algae

In general the diversity of plant species in a lotic community is **small** compared to that of a still water (lentic) community although small parts of the lotic community host similar conditions to that of a lentic community. Most plants have went through evolutionary adaptations to cope with the force and different conditions that running water brings. Such adaptations have allowed a number of species to successfully take advantage of the lotic community as their ecological niche. As these conditions are more harsh for a typical species of plant, more notably larger plants, smaller species have found the conditions of the lotic community more favorable. This is due to the fact that they are more flexible in regards to the physical conditions of the water. Algae can grow in all sorts of different places and surfaces, and therefore are a successful constituent of the running water ecosystem. Most of these algae have developed evolutionary adaptations over times that prevent the water current sweeping them away.

There are many species of algae, all of which are capable of growing and reproducing at a quick rate. This consequence results in competition for

niches in the freshwater environment. Algae are also the primary producers of this community, meaning they harness new energy into the ecosystem from the sun which provides the primary consumers with a valuable food source.

2. Plankton

Plankton are microscopic organisms that live suspended in the water environment, and form a very important part of the freshwater community. They move by currents. In almost every habitat of a freshwater ecosystem, thousands of these organisms can be found, and due to their small size and simplicity, they are capable of occupying large expanses of water and multiplying at an exponential rate.

Plankton can be subdivided into two categories.

a. Phytoplankton :- Phytoplankton are microscopic plants which obtain their energy by photosynthesis. They are important to the ecosystem because they are part of the primary producing community and assist in recycling elements such as carbon and sulphur which are required elsewhere in the community.

b. Zooplankton :- Zooplankton consist mainly of crustaceans and rotifers, and on the whole are relatively larger than their phytoplankton counterparts. Physiologically, there are many evolutionary adaptations

that can be found that assist in the buoyancy of them, and prevent their deaths by allowing them to be suspended in the water .

3. Animals

The running water environment offers numerous microhabitats that simulate favorable conditions for many types of animals to successfully succeed the freshwater lotic community. As with plants, animals in this ecosystem have also undergone ongoing evolutionary adaptations to better suit this running water environment.

Some of these animals are sessile, meaning they are immobile and fixed to the one place. These animals are usually small, and include the protozoans and some freshwater sponges. These animals either remain attached to the mass of a plant or the water bank surface or rock.

Animals have developed some of the following adaptations over time that helps them cope with the conditions of lotic environment:

Suckers :- These suckers attach themselves to a surface that leeches them into position and can also assist movement in any given direction.

Hooks / Claws :- These sharp objects can dig into any given object and allow the animal to cling to a position or claw their way around the surface.

Body flattening :- This adaptation can allow the animal in the water bear less of the brunt of the force of water moving downstream, therefore

reducing it as an inhibitor of their movement. This also allows these animals to enter confined areas (such as under stones) that may present a useful environment for them to live in.

Streamlining :- animals who have underwent streamlining adaptations on their external appearance means that less resistance is presented by the running water when the animal attempts to move.