

Freshwater habitat

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Classification of freshwater based on habitat

1. Lentic water (Standing water)

- Lentic is derived from Latin word “Lenis” means calm
- Freshwater having no water current
- Pond, lake, swamp, bog etc.

2. Lotic water ((Running water)

- Lotic is derived from Latin word “Lotus” means washed
- Freshwater having water current
- Spring, stream, river etc.

■It may be noted that lentic water may be transformed into lotic water and vice-versa due to different reasons

■A lotic water like river may be transformed into a lentic water due to reduction in water flow or siltation

■Again action of water flow over a waterbody can change the characteristics of a lentic water

Limiting factors of a freshwater environment

1. Temperature

- Fluctuation in water is not so rapid as found in air
- But aquatic organisms are stenothermal in most cases
- Moreover, changes in temperature results in water stratification and thereby water circulation affecting the organisms

2. Transparency

- Turbid water limits the light penetration which causes slow growth or mortality of organisms
- Smooth reproduction is also constrained by turbid water

3. Current

- Water current severely affects the aquatic organisms
- Water currents controls the movement of gas, minerals and distribution of small organisms

4. Dissolved oxygen and carbon di-oxide

- Changes in concentration due to different reasons
- DO for animal and CO₂ for plant are essential
- Fluctuation in DO or CO₂ may be of diurnal or seasonal

5. Concentration of biogenic salt

- Nitrate and phosphate mostly acts as limiting factors
- Calcium may be limiting factor in soft water

Ecological classification of freshwater organism

A. Based on food chain or energy flow

1. *Producer*

- All green plants and chemosynthetic organisms

2. *Consumer*

- Primary (herbivore) and secondary (Predators and parasites)

3. *Decomposer*

- Bacteria and fungus

B. Based on life form or life habit

1. *Benthos*

- Organisms living on or attached to the bottom
- Tubifex, chironomid larvae etc.

2. *Periphyton*

- Organisms living on the rooted plants (leaves/stems) or on any thing comes out from bottom
- Snail

3. *Plankton*

- Drifts on the mercy of the current
- Phytoplankton- *Spirogyra*, *Chlorella*, *Volvox*, *Anabaena*, *Nostoc*, *Closterium* etc.
- Zooplankton- *Cyclops*, *Keratella*, *Brachhionus*, *Polyarthra*, *Diaptomus*, *Filinia* etc.
- Net plankton: Not capable to pass through plankton net; *Daphnia*, *Cyclops* etc.
- Nanno plankton: Capable to pass through plankton net; different algae

4. *Nekton*

- Free floating
- Fishes

5. *Neuston*

- Organisms living on surface of the water
- Moves on water surface as on land

C. Based on sub-habitat

1. *Littoral zone*

- The zone is close to shore
- Shallow zone having rooted plants with sunlight penetration
- This zone extends down to a point called the the depth at which the rate of photosynthesis equals the rate of respiration)
- Two main producers- rooted plants and algae
- The consumers include: tiny crustaceans, flatworms, insect larvae, snails, frogs, fish, and turtles

2. *Limnetic zone*

- This is the layer of open water where photosynthesis can occur (i.e. the depth after littoral zone where sunlight reaches)
- The amount of light decreases until a depth is reached where the rate of photosynthesis becomes equal to the rate of respiration (light compensation level)
- The limnetic zone is shallower in turbid water than in clear

- This zone is a more prominent feature of lakes than of ponds
- The producers in this ecosystem are planktonic algae
- The primary consumers include such animals as microscopic crustaceans and rotifers - the so-called zooplankton
- The secondary (and higher) consumers are swimming insects and fish

3. *Profundal zone*

- The bottom and deep water area of a lake, which is beyond the depth of effective light penetration
- The profundal zone is chiefly inhabited by bottom-dwelling animals (benthos)
- The sediments also support a large population of bacteria and fungi (Decomposer)
- These decomposers break down the organic matter and releases inorganic nutrients for recycling.

Zonation in stream

1. *Rapid zone*

- Shallow water with more current
- Hardy bottom due to no siltation caused by water flow
- Presence of periphyton other than special types of benthos

2. *Pool zone*

- Deeper water with less current
- Soft bottom due to siltation
- Presence of benthos in the silt
- Plankton and nekton may also exist

Freshwater biota

A. Producer

1. Algae
2. Aquatic spermatophytes

B. Consumers (Animals)

Higher importance group

1. Molluscs
2. Aquatic insects
3. Crustaceans
4. Fishes

Lower importance group

1. Annelids
2. Rotifers
3. Protozoa
4. Helminths

C. Saprotrophs

Aquatic bacteria and fungi with equal importance

Higher plants/aquatic spermatophytes/aquatic vascular plants

1. Floating
 - *Eichornia crassipes* (Kochuri pana), *Pistia stratiotes* (Topa pana), *Lemna minor* (Khudi pana), *Azolla pinnata* (Azolla) etc.
2. Spreading
 - *Ipomoea aquatica* (kolmi), *Enhydra* sp. (Helencha/Maloncho) etc.
3. Emergent
 - *Oxalis* sp. (Amrul), *Marselia* sp. (Shusni), *Leersia hexandra* (Arail), *Hydroryza aristata* (Dol), *Colocasia esculenta* (Kochu)
4. Rooted plants with leaves at surface
 - *Nymphaea* (Shapla/Podmo)
5. Submerged
 - *Najas* sp., *Myriophyllum* sp.

Stratification

- The separation of pond water (due to temperature or DO) into different layers is called stratification
- In ponds/lakes heat enters at the surface and surface water heat faster than deeper waters.
- Because the density (weight per unit volume) of water decreases with increasing temperature above 4 °C, surface water may become so warm and light that they do not mix with the cooler, heavier waters of deeper layers.
- The separation of pond water into distinct warm and cool layers is called thermal stratification
- The upper warm layer is called the epilimnion and the lower cooler layer is known as the hypolimnion
- The layer of rapidly changing temperature between the epilimnion and the hypolimnion is termed the thermocline.
- If the rapidly changing DO is found then it is termed as the chemocline
- Stratification occurs in summer and winter due to temperature and DO in some lakes
- Lakes are considered dimictic when water mix twice a year – spring and fall.

Summer (Stratification)

- Since the lake does not mix during the summer, the hypolimnion is completely cut off from the epilimnion and does not receive a fresh supply of oxygen
- Therefore, the hypolimnion can become anoxic during the summer in a mesotrophic or eutrophic lake.

Winter (Kill)

- In the winter, the lakes are covered with ice. Under the ice, the water cannot mix because it is not exposed to wind.
- Most of the hypolimnion remains 4 degrees Celsius (39°F). There is a thin layer of water under the ice that is colder than 4°C and therefore less dense.
- This thin layer of water floats on top of the hypolimnion throughout the winter, but this stratification is not quite as stable as in the summer because the density difference is much smaller.
- This phenomenon is called inverse stratification because cooler water is sitting on top of warmer water.
- As in the summer, the hypolimnion is cut off from oxygen, so as decomposition takes place in the benthos, oxygen gets used up. When the hypolimnion becomes anoxic in the winter it is called winter kill because fish and other living organisms that need oxygen die
- Winter kill specially occurs during snow fall (barrier for sunlight passing and thereby producing no oxygen)

Spring (Overturn)

- In the spring, the ice melts off the lake, the wind picks up and the lake mixes again. This is called spring turnover (overturn).
- Oxygen and nutrients get distributed throughout the water column as the water mixes.
- Then, as the weather becomes warmer, the surface water warms again and sets up summer stratification.

Ecological classification of lakes

1. Oligotrophic-eutrophic series
2. Special lake types
3. Artificial lake

1. Oligotrophic-eutrophic series

Aspects	Oligotrophic lake	Eutrophic lake
Meaning	“Oligo” means few; “Trophic” means nutrient; thus Oligotrophic lake means lake with few nutrient	“Eu” means more; “Trophic” means nutrient; thus eutrophic lake means lake with more nutrient
Nutrients	Oligotrophic lakes have nutrients like phosphates and nitrates in fewer quantities.	Eutrophic lakes have nutrients like phosphates and nitrates in large quantities.
Depth	Deeper	Shallow
Primary production	Lower	Higher
Plankton bloom	Rarely occurs	Regular phenomeon
DO shortage	Does not occur	Occurs during summer stratification

2. Special lake types

(a) *Dystrophic lake*

- Lakes that contain high amounts of humic substances and organic acids
- The presence of these substances causes the water to be brown in colour
- Having with very lower pH of around 4.0-6.0

(b) *Deep ancient lake with endemic fauna*

- Baikala lake of Russia is the best example of deep and ancient lake
- Having with more than 350 amphipod species as endemic

(c) *Desert salt lake*

- Located in zones under dry weather
- Having with salinity tolerant species (Brine shrimp)
- Salt lake of Utah state in USA

(d) *Desert alkaline lake*

- Located at deserts
- Having very high water pH
- Very high concentration of carbonates
- Pyramid lake in Nevada

(e) *Volcanic lake*

- May be of both acidic or alkaline
- Located at besides the volcanic zones
- Extreme water quality
- Very limited biota
- Some lakes in Japan and Philippines

3. Artificial lake

- Differs from area to area
- Varied level of water depth
- Water may be too turbid
- Kaptai lake in Bangladesh

Adaptations of organisms in lotic water

1. ***Permanent attachment to a firm substance***
 - Attachment to stone, branches of tree, accumulated leaves
 - Caddis fly larvae
2. ***Development of special organs***
 - Having with hooks/suckers/safety ropes
 - *Simulium*
3. ***Sticky under surface***
 - Snail, flat worm
4. ***Streamlined bodies***
 - Oval shaped body requires less energy for movement in water with current
5. ***Flattened bodies***
 - Flattened bodies can take shelter in the space available in stone or other things
 - Stonefly and Mayfly larvae
6. ***Positive rheotaxis (rheo means current; taxis means arrangement)***
 - By born behaviour, capable to move against water current
7. ***Positive thigmotaxis (thigmo means touch; taxis means arrangement)***
 - Attachment with others as by born behaviour
 - Stonefly larvae

General model of production

1. Reception of solar energy by the green plants
2. Production of organic matter by the producers
3. Consumption of these materials by the consumers and it's further elaboration
4. Decomposition to inorganic compounds
5. Transformation into suitable forms for the nutrition of the producers