LAKE ECOSYSTEM (C. Chatterjee)

A **lake ecosystem** include biotic (living) plants, animals and micro-organisms, as well as abiotic (nonliving) physical and chemical interactions. Pond and lake ecosystems are a prime example of lentic ecosystems. Lentic refers to stationary or relatively still water, from the Latin *lentus*, which means sluggish.

ZONATIONS IN LAKE

A typical lake has distinct zones of biological communities linked to the physical structure of the lake. (Figure below) The littoral zone is the near shore area where sunlight penetrates all the way to the sediment and allows aquatic plants (macrophytes) to grow. Light levels of about 1% or less of surface values usually define this depth. The 1% light level also defines the euphotic zone of the lake, which is the layer from the surface down to the depth where light levels become too low for photosynthesizers. In most lakes, the sunlit euphotic zone occurs within the epilimnion.

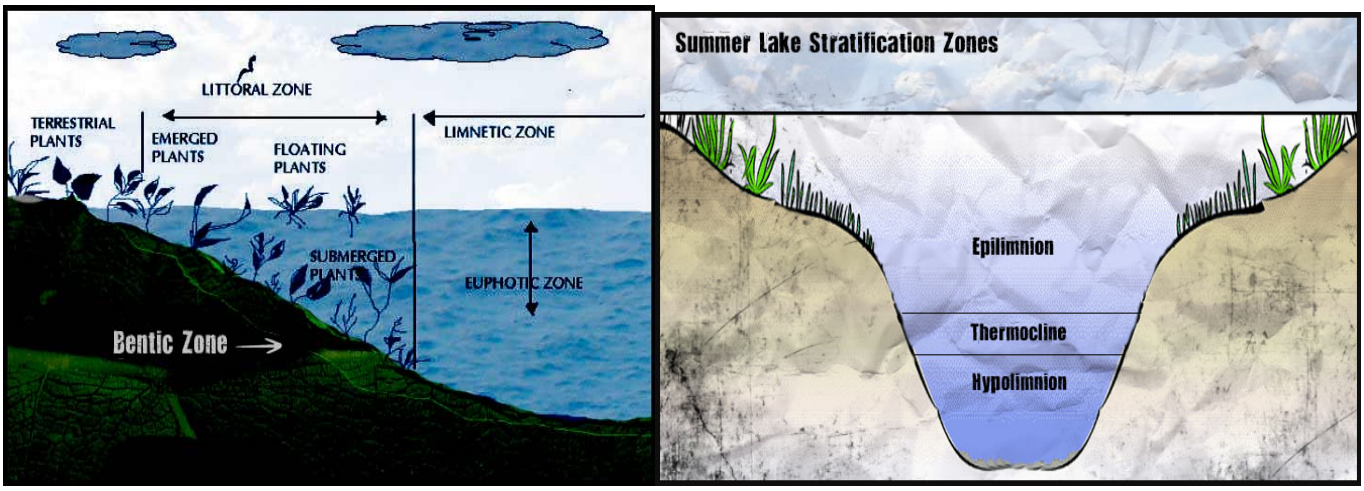
However, in unusually transparent lakes, photosynthesis may occur well below the thermocline into the perennially cold hypolimnion. For example, in western Lake Superior near Duluth, MN, summertime algal photosynthesis and growth can persist to depths of at least 25 meters, while the mixed layer, or epilimnion, only extends down to about 10 meters. Ultra-oligotrophic Lake Tahoe, CA/NV, is so transparent that algal growth historically extended to over 100 meters, though its mixed layer only extends to about 10 meters in summer. Unfortunately, inadequate management of the Lake Tahoe basin since about 1960 has led to a significant loss of transparency due to increased algal growth and increased sediment inputs from stream and shoreline erosion.

The higher plants in the littoral zone, in addition to being a food source and a substrate for algae and invertebrates, provide a habitat for fish and other organisms that is very different from the open water environment.

The limnetic zone is the open water area where light does not generally penetrate all the way to the bottom.

The bottom sediment, known as the benthic zone, has a surface layer abundant with organisms. This upper layer of sediments may be mixed by the activity of the benthic organisms that live there, often to a depth of 2-5 cm (several inches) in rich organic sediments. Most of the organisms in the benthic zone are invertebrates, such as Dipteran insect larvae (midges, mosquitoes, black flies, etc.) or small crustaceans.

The productivity of this zone largely depends upon the organic content of the sediment, the amount of physical structure, and in some cases upon the rate of fish predation. Sandy substrates contain relatively little organic matter (food) for organisms and poor protection from predatory fish. Higher plant growth is typically sparse in sandy sediment, because the sand is unstable and nutrient deficient. A rocky bottom has a high diversity of potential habitats offering protection (refuge) from predators, substrate for attached algae (periphyton on rocks), and pockets of organic "ooze" (food). A flat mucky bottom offers abundant food for benthic organisms but is less protected and may have a lower diversity of structural habitats, unless it is colonized by higher plants.



Components of Lake Ecosystem:- There are two main components:

(A) Abiotic component

(B) Biotic component

(A) Abiotic component:

Abiotic component of pond consists of water, dissolved minerals, oxygen and carbon dioxide. Solar radiations are the main source of energy.

(B) Biotic component:

It includes the following:

(i) Producers

(ii) Consumers

(iii) Decomposers and transformers.

On the basis of water depth and types of vegetation and animals there may be three zones in a lake or pond littoral, limnetic and pro-fundal. The littoral zone is the shallow water region which is usually occupied by rooted plants. The limnetic-zone ranges from the shallow to the depth of effective light penetration and associated organisms are small crustaceans, rotifers, insects, and their larvae and algae. The pro-fundal zone is the deep water parts where there is no effective light penetration. The associated organisms are snails, mussels, crabs and worms (Fig. 3.3).

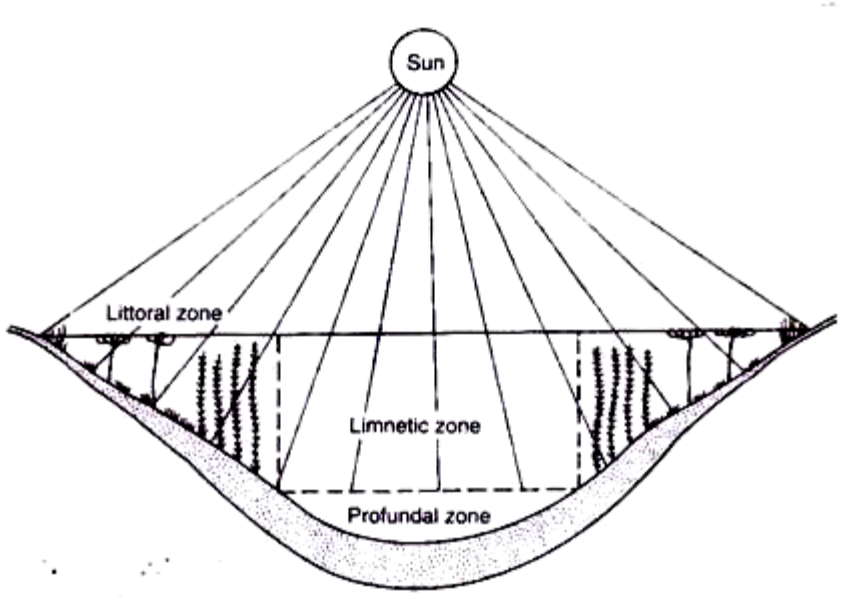


Fig. 3.3 Different zones of a fresh water pond.

(i) Producers:

The main producers in pond or lake ecosystem are algae and other aquatic plants, such as Azolla, Hydrilla, Potamogeton, Pistia, Wolffia, Lemna, Eichhornia, Nymphaea, Jussiaea, etc. These are either floating or suspended or rooted at the bottom. The green plants convert the radiant energy into chemical energy through photosynthesis. The chemical energy stored in the form of food is utilized by all the organisms. Oxygen evolved by producers in photosynthesis is utilized by all the living organisms in respiration.

(ii) Consumers:

In a pond ecosystem, the primary consumers are tadpole larvae of frogs, fishes and other aquatic animals which consume green plants and algae as their food. These herbivorous aquatic animals are the food of secondary consumers. Frogs, big fishes, water snakes, crabs are secondary consumers. In the pond, besides the secondary consumers, there are consumers of highest order, such as water-birds, turtles, etc..

(iii) Decomposers and Transformers:

When aquatic plants and animals die, a large number of bacteria and fungi attack their dead bodies and convert the complex organic substances into simpler inorganic compounds and elements. These micro-organisms are called decomposers chemical elements liberated by decomposers are again utilized by green plants in their nutr.

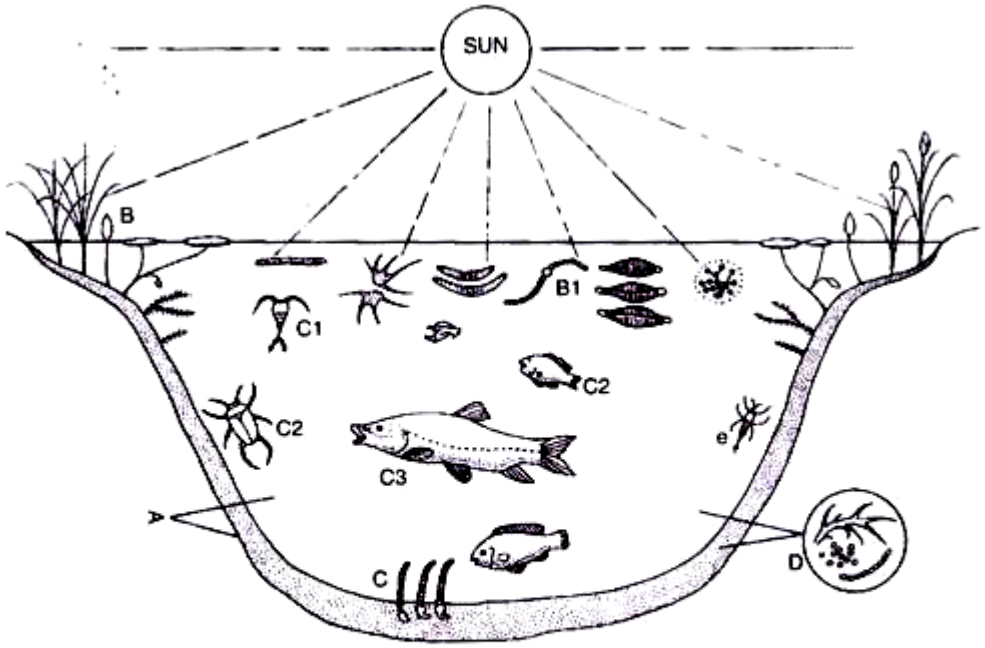


Fig. 3.4 A pond ecosystem.
A—Abiotic component; B and B1—Producers; C1—Primary consumers (herbivores); C2—Secondary consumers; C3—Tertiary consumers; D—Decomposers—saprophytic bacteria and fungi.