Living Organisms in Water

√ Plankton
Nekton
Benthos
Macrophytes
What is a Nekton?

- The consumer organism that inhabit the pelagic zone but are active swimmers are known as nekton.
Nekton - GENERAL CHARACTERISTICS

Nekton have individual control over their movement. All nekton are heterotrophic, either herbivores (grazers) or carnivores (predators and scavengers). Vertebrates dominate the nekton.

1.) Invertebrate nekton. There are relatively few species, although members of this group are abundant. They include large shrimp and several cephalopods (a class of the Mollusca).

2.) Fish (vertebrates) are the dominant nekton. They are distributed world-wide and can occur at all depths. However, most fish are concentrated in the epipelagic zone (= photic zone, 0-200 m).
EPI-PELAGIC Nekton Communities

• This region, characterised as the upper 200 m of the water column, is penetrated by sunlight and subject to seasonal variation in temperature and salinity

• Fishes are the most commonly encountered nektons. But in sea, invertebrates such as squid also constitute important

• Whales and seals tend to concentrate in highly productive areas

• Nekton are long-lived and slow growing

• Some may complete their life cycles in 1 year, but for most fish species their life span is of the order of 5-10.
Representative Nekton communities

- a = squid
- b = shark
- c = deep sea fish
- d = tuna
- e = flatfish
- f = sea turtle
- g = seal
- h = penguin
- i = whale
Salient features of EPI-PELAGIC Nektons

• The diversity of the pelagic fish fauna is relatively low, especially considering the volume of water habitat available.

• Their major adaptations include constant swimming, well-developed vision and perhaps mechanoreception, countershading, fast growth, broadcast spawning, relatively large seasonal migrations often following thermal fronts, carnivorous feeding habits, schooling, and association with floating objects like kelp and flotsam or jetsam.
Salient features of EPI-PELAGIC Nektons

• There are vertical links between the epipelagic fauna and the fauna of deeper waters. The most obvious is the deep scattering layer, a loose assemblage of krill, sergestid shrimp and mesopelagic fishes (e.g., lanternfishes or Myctophidae) that moves up at night and down during the day.

• The trophic interactions of the organisms comprising this layer and those organisms which feed upon them transport food from the surface to deeper water.

• Other interactions involve the simple sinking of detrital materials, such as midwater fish fecal matter, which are a source of food for deeper organisms.

• The main human impacts on the epipelagic zone include shipping and fishing. Many large cargo vessels and tankers venture upon this habitat annually and a large number of chartered vessels take passengers out to view the local fauna, including birds, mammals and epipelagic fishes.

• Certainly, commercial and recreational fishing can have an influence, as exhibited by the large fleet of salmon trollers and larger vessels that set pelagic drift gill nets to capture swordfish and other, non-targeted fishes, such as sharks. Undoubtedly these activities have some sort of interaction with the epipelagic fauna.
Salient features of MESOPELAGIC AND BATHYPELAGIC Nektons

These zones will be considered together. Collectively they occur immediately below the epipelagic zone, discussed above, and down to several thousand meters.

This zone is characterized by low light levels, decreasing temperature, slower currents, lower food availability, and increasing salinity and pressure. This relatively voluminous water mass has been described as harsh and resource limited.

These fishes have adaptations which include silvery or transparent to black and red coloration, large eyes well-equipped with rods, rhodopsin pigment and having a tubular structure, and bioluminescence (Robison 1995).

There is very little fishing activity in meso- or bathypelagic habitats, and therefore human impact through fishing in this zone is minimal.
What is a Benthos?

- The benthos is an aggregation of organisms living on or at the bottom of a body of water. The name *benthos* is derived from the Greek, meaning "depths of the sea." The benthic community is composed of a wide range of plants, animals and bacteria from all levels of the food web.
- Benthic organisms can be divided into three distinct communities:
  - **Infauna:** Plants, animals and bacteria of any size that live in the sediment.
  - **Epifauna:** Plants, animals and bacteria that are attached to the hard bottom or substrate (for example, to rocks or debris); are capable of movement; or that live on the sediment surface.
  - **Demersal:** Bottom-feeding or bottom-dwelling fish that feed on the benthic infauna and epifauna.
Infaunal Benthos

• Infaunal benthic communities often are considered to be "just worms." In reality, however, these groups that inhabit the sediment include animals from all trophic levels—the primary producers, such as diatoms, and primary consumers, such as mollusks and worms; secondary consumers, such as worms and crustaceans; and "decomposers," such as bacteria and flagellates.

• Benthic invertebrate communities are used as prime indicators of environmental conditions because:
  • they have limited mobility and thus are unable to avoid adverse conditions;
  • they live in sediments where they are exposed to environmental stressors, such as chemical contaminants and low dissolved oxygen levels;
  • their life spans are long enough to reflect the effects of environmental stressors; and
  • their communities are taxonomically diverse enough to respond to multiple types of stress.
Epifaunal Benthos

- Epifauna are the most familiar of all the benthic organisms. They include the plants and animals one sees while wading in tidal pools or among pilings or rocks. These communities include seaweeds; oysters, mussels and barnacles; and snails, starfish and crabs. They also include animals that span a wide evolutionary range, from primitive sponges to early vertebrates (for example, tunicates, such as sea squirts). These varied organisms share an important characteristic: they live either attached to the hard substrate or move on the sediment surface.

Demersal Benthos

- The demersal community includes some of the most economically valuable fishes. In order to adapt to life on the bottom, benthic fish have developed some of the most diverse physical characteristics found in any fish community. Soft-bottom fish include the flounders, puffers, searobins and cownose rays. Hard-bottom fish include those found near reefs, such as the oyster toadfish and the goby, which, when stationary, resemble rocks.
The ocean floor (benthos) is divided into regions based on depth.

The **supralittoral** is the beach or shore.

The **littoral** environment is the area between high and low tides. This area may dry out and requires animals adapted to this change. Thus, burrowing animals are common creatures in littoral zones.

The **sublittoral** is the area between low tide and the edge of the continental shelf, usually around 200 meters from shore. This division lies within the photic zone and is therefore very productive; creatures here exhibit a broad range of strategies.

**Bathyal** regions are the areas of continental slope and rise. They are mostly out of the photic zone and are therefore less diverse.

The **abyssal** region is at the base of the continental slope, 4000 meters deep to 6000. After 6000 meters has been reached, the hadal region begins. These are the deep sea trenches. In both of these extreme environments, animals are small and scarce, due to paucity of resources. Many are scavengers.
Classification of Benthos

The benthic animals of freshwaters are extremely diverse, representatives of nearly every animal phylum occur in or are associated with the sediments of lakes and streams.

**Phylum: Protozoa**

- Most freshwater Protozoa are attached to benthic substrata.
- Few protozoans tolerate low dissolved oxygen concentrations.
- Most inhabit surficial sediments and migrate to shallower water when dissolved oxygen of deeper strata declines in stratified productive lakes.
- Protozoan species are segregated by differences in food utilization, reproduction, and timing of population development.
- Many protozoan populations exhibits summer maxima.
- Little is known about protozoan productivity in freshwaters.
- Although protozoan community biomass is low, rates of turnover (number of generations) are high.
Classification of Benthos

**Phylum: Porifera**
- Freshwater sponges are rarely abundant, and their contribution to total benthic productivity is usually minor.

**Phylum: Coelenterates**
- The hydroid coelenterates are not common in freshwaters.
- Occasionally, dense populations of Hydra can impart significant predation pressures upon populations of small zooplankton.

**Phylum: Platyhelminthes**
- The turbellarian flatworms are the only important free living members of the Platyhelminthes in freshwaters.
- Most are restricted to shallow areas of lakes and low velocity streams.
- Flatworms prey upon other small invertebrates, and species segregate by the dominant type of prey consumed and by differences in reproductive capacities.
- Flatworms productivity is directly correlated with the general fertility and productivity of freshwaters.
Classification of Benthos

Phylum: Nematoda

- Free-living nematodes, or roundworms, are widely distributed in freshwaters.
- They constitute a significant component of the benthic fauna.
- Nematode feeding habits are diverse; some species are strict herbivores, others are strict carnivores on other small animals, and still others are detritivores on dead particulate organic matter.

Phylum: Annelida

- Two major groups of aquatic annelids or segmented worms form significant components of the benthic fauna.
  a) Oligochaete worms are diverse, and occur in a spectrum of freshwaters, from unproductive to extremely eutrophic lakes and rivers.
  b) Leeches are also abundance and is highly variable and generally increases in more productive freshwaters. Rates of growth and production are most rapid during spring and early summer.
Phylum: Arthropoda

- Aquatic insects are most diverse.
- Some orders of insects are entirely aquatic; others inhabit freshwaters only during certain life stages.
- Feeding mechanisms and types of food ingested by insects are extremely varied.
- The biomass of aquatic insects is relatively constant if food supplies of similar nutritional content are supplied.
- Growth efficiency of carnivores tends to be less than that of herbivores or detritivores.
- The bivalved microcrustacean ostracods are widespread in freshwaters. Little is known of ostracod ecology, population dynamics or productivity.
- Representatives of four groups of malacostracean crustaceans can form major components of the benthic fauna of freshwaters.
- The mysida, or opossum shrimps.
- The isopods, or sowbugs, occasionally become a significant part of the benthic animal community of lakes and streams.
- The decapod crustacea, or freshwater crayfish and shrimps, often reach a high density in some lakes and streams.
- The amphipods, or scuds, are restricted to well oxygenated waters.
Classification of Benthos

**Phylum: Mollusca**

- The freshwater molluscs consist of univalve snails (Gastropoda) and bivalve clams and mussels (Pelecypoda).
- The snails are grazers on attached microorganisms, where clams and mussels are filter feeders on particulate detritus and microzooplankton of the sediments.
- In spite of the large biomass of the molluscs, the life cycle is long and productivity is relatively low.
- Eggs and juvenile mortality is commonly very high in both the groups.
Invertebrates as Indicators

Aquatic invertebrates live in the bottom parts of our waters. They are also called **benthic macroinvertebrates**, or benthos, (benthic = bottom, macro = large, invertebrate = animal without a backbone) and make good indicators of watershed health because they:

- live in the water for all or most of their life
- stay in areas suitable for their survival
- are easy to collect
- differ in their tolerance to amount and types of pollution
- are easy to identify in a laboratory
- often live for more than one year
- have limited mobility
- are integrators of environmental condition
Macrophytes

- Macrophytes are the conspicuous plants that dominate wetlands, shallow lakes, and streams.
- Macroscopic flora include the aquatic angiosperms (flowering plants), pteridophytes (ferns), and bryophytes (mosses, hornworts, and liverworts).
- An aquatic plant can be defined as one that is normally found growing in association with standing water whose level is at or above the surface of the soil.
- Standing water includes ponds, shallow lakes, marshes, ditches, reservoirs, swamps, bogs, canals, and sewage lagoons.
- Aquatic plants, though less frequently, also occur in flowing water, in streams, rivers, and springs.
Classification of Aquatic Macrophytes of the Littoral Zone

Classification of Aquatic Macrophytes on the basis of morphology and physiology (after, Arber 1920):

A. Aquatic Macrophytes attached to the substratum
   • Emergent Macrophytes: eg., Phragmites communis, Salix spp.
   • Floating Leaved Macrophytes:
   • Submersed Macrophytes: Potamegeton lucens, P. perfoliatus

B. Freely floating Macrophytes: they are restricted to nonturbulent protected areas

Emergent Macrophytes: they grow on water saturated on submersed soils from where the water table is about 0.5 m below the soil surface (supralittoral) to where the sediment is covered with approximately 1.5 m of water (upper littoral).

Floating Leaved Macrophytes: they are rooted in submersed sediments in the middle littoral one (water depths of 0.5 to 3 m) and possess either floating or slightly aerial leaves.

Submersed Macrophytes: they occur at all depths within the photic zone. Vascular angiosperms occur only to about 10 m within the lower littoral (infralittoral) and nonvascular macrophytes occur to the lower limit of the photic zone (littoriprofundal).
Macrophytes as Indicators

Macrophytes are excellent indicators of watershed health because they:

- respond to nutrients, light, toxic contaminants, metals, herbicides, turbidity, water level change, and salt
- are easily sampled through the use of transects or aerial photography
- do not require laboratory analysis
- are easily used for calculating simple abundance metrics
- are integrators of environmental condition