PLANKTON

INTRODUCTION

- The term ‘plankton’ was first used by a German Scientist, Victor Hensen (1887).
- The word plankton is derived from the Greek word ‘planktos’, meaning for wanderer or drifters.
- These organisms are free floating with limited locomotory powers and are transported horizontally with the mercy of the prevailing water movements such as tides, waves and currents.
- Plankton are often used as indicator of environmental and aquatic health because of their high sensitivity to changes such as eutrophication and pollution with their short life span.

CLASSIFICATION OF PLANKTON

I. BASED ON NUTRITION

- Plankton are classified into phytoplankton and zooplankton based on nutrition.

1. Phytoplankton

- Phytoplankton are the free floating organisms of the sea that are capable of photosynthesis and synthesise organic matter as their food i.e. primary producers.

- Phytoplankters are microalgae, which includes diatoms, dinoflagellates, blue-green algae, silicoflagellates, etc.

- Zooplankton are the various free floating animals, i.e. heterotrophic or primary and secondary consumers.
- They are heterotrophic in nature as they depend on the already formed organic matters for their source of food.
- Their food materials include phytoplankton, smaller or micro zooplankton and detritus.
- Zooplankton encompasses many different groups of animals that range in size from microscopic crustaceans to jellyfish up to a few feet across
- zooplankton forms an important and intermediate link in the food web between primary producers and the higher trophic levels.
- E.g., copepods, foraminiferans, siphanophores, eggs and larvae of fishes, veligers of molluscs etc.

II. BASED ON LIFE HISTORY

Zooplankton are further classified into two types based on their life history stages viz. holoplankton and meroplankton.

1.Holoplankton- These are organisms that spend their entire lives in the plankton. These are the permanent plankton organisms.

- This includes both phytoplankton and zooplankton, covering the whole spectrum of plankton sizes and types.

- E.g. most phytoplankton, some seaweeds, copepods, salps, jelly fishes etc.

2.Meroplankton - These are organisms that spend only part of their life in the plankton.

- These are temporary planktonic organisms.
- These include the larval forms of majority of benthic invertebrates and nektonic forms.
- Often benthos have an early stage of the life history which is planktonic, followed by a stage during which the plankton metamorphoses into an organism which settles to the bottom .
- This includes species of seaweeds and kelps, and also crabs, lobsters, clams, oysters, and worms among many others..

III. BASED ON SIZE

Based on size, these organisms are classified into seven groups as follows.

1.Megaplankton - are organisms above 20 cm in size

2.Macroplankton - are organisms of 2-20 cm in size range

3.Mesoplankton - fall between 0.2-20 mm in size range

4.Microplankton - are organisms of 20-200 µm in size range

5.Nanoplankton - are very small organisms ranging from 2-20 µm in size.

6.Picoplankton - are minute organisms of 0.02-2.0 µm in size

7.Femtoplankton - are still smaller organisms of 0.02-0.20 µm in size.

PHYTOPLANKTON

- The free-floating plant plankton are called phytoplankton and wide range of photosynthetic organisms are included under this category.
- Generally, phytoplankton are grouped under algae.
- Phytoplankton also contribute a significant portion of the oxygen found in the air we breathe.
- There are several types of phytoplankton viz., diatoms, dinoflagellates, blue-green algae, etc.

1.DIATOMS (CLASS: BACILLARIOPHYCEAE)

- Diatoms with their characteristic yellow-brown pigment that masks their green chlorophyll are also called golden algae.
- They are unicellular and either chain forming or solitary.
- The cell contents are enclosed in a unique glass (pill box), which is called as frustules and have no visible means of locomotion.
- The frustule is made of two parts, much like a petridish /petriplate, one valve fitting over another.
- The upper part (largest part) is called as epitheca and the smaller part is called as hypotheca.
- The cell wall (frustule) is made of silicon dioxide.

- Diatoms may occur singly or they may occur in chains of various kinds.
- Many species have flotation mechanisms (spines, internal oil droplets or disc shaped).
- These are important oxygen producers in marine ecosystems as they are the most predominant and abundant organisms.
- Some of these are holoplanktonic and some are not planktonic at all i.e benthic.
- When conditions are bad they die, sink, the cell decomposes and the frustule breakes up and mixes with sand and mud.
- This combination of sediments and glass frustules makes the siliceous ooze called diatomaceous earth.

REPRODUCTION: Diatoms reproduce mainly by simple fission i.e. each diatom divides into two halves.

- Each half will then develop a new inner valve so that the typical box is recreated.
- The very tiny ones can no longer undergo divisions and at that time they cast off both valves and become a structure called an auxospore.
- Within this spore, new valves are secreted that re-establish the original size of the diatom species.
- Though this is the general mechanism of diatom reproduction and reestablishment of size, there are some diatoms which undergo division of cells without reduction of valve size and hence, without auxospore formation.

- Diatoms belong to two orders viz. Centrales and Pennales.

- Some bloom forming species of diatoms are known to produce harmful chemicals (i.e. domoic acid) which can concentrate in animals who feed on such plankton (i.e. filter feeders).

- The toxin attacks the human central nervous system causing vomiting, abdominal cramps and diarrhoea.

- Some species of diatoms can be mass cultured under controlled conditions and used as larval feed in the shrimp and finfish hatcheries. E.g. Skeletonema costatum, Chaetoceros sp., etc.

2.DINOFLAGELLATES (CLASS: DINOPHYCEAEA)

- Dinoflagellates are very abundant next to diatoms.
- Like plants, they convert sunlight into food and however, like animals, many varieties of dinoflagellates eat microscopic pieces of matter found in the water.
- Some dinoflagellates even eat each other, which the condition is known as phagotrophy.
- They have two whip-like appendages, called flagella, which provide some mobility. They lack an external skeleton of silicon but are impregnated with armored plates of the carbohydrate, cellulose.
- These are generally small organisms and usually solitary, rarely forming chains.

- They reproduce by simple fission, as do the diatoms.
- Some dinoflagellates are also capable of producing toxins that are released into seawater.
- At this times, dinoflagellates become extremely abundant , the condition is known as blooms (2-8 million cells per liter), and the toxins released by these forms may affect other organisms, causing mass mortality.
- Some dinoflagellates have non-motile stages called zooxanthellae, which are symbionts in the tissues of many invertebrates such as corals, sea anemones, and giant clams.
- The dinoflagellate species like Noctiluca scintillans is highly bioluminescent.

3.OTHER PHYTOPLANKTON

- Constituents of the Nano plankton and Pico plankton size classes (sometimes collectively called Nano plankton) include a number of photosynthetic organisms.
- The important groups are the prochlorophytes, the haptophytes (Coccolithophoridae, Haptophyceae) and the blue-green algae, also called the cyanobacteria (Cyanophyceae) .
- Cyanobacteria are abundant in the tropics, where they occasionally form dense mats of filaments and colour the water (red tide) by Trichodesmium erythraeum.
- The abundant haptophytes are the coccolithophores, easily distinguished by the tiny calcareous plates (coccoliths) on their outer surface

- Coccolithophores are now recognized as a major source of primary production in many ocean areas.
- Other less abundant microalgae include the silicoflagellates (Chrysophyceae), the cryptomonads (Cryptophyceae), and certain motile green algae (Chlorophyceae).
- Pelagic bacteria or bacterioplankton, are also found in all oceans.
- They are usually found in association with organic particles in the water column, collectively called Particulate Organic Carbon (POC), or on various gelatinous zooplankton pieces known as marine snow.
- They decrease markedly with depth, and their role in the microbial loop of the oceanic food web is now clearly recognised.

ZOOPLANKTON

- Zooplankton comprises many microscopic and macroscopic animals represented by almost all the major taxa of the Kingdom Animalia.
- Zooplankton are ubiquitous.
- Zooplankton play a pivotal role in the aquatic food web, having the potential to affect water transparency, levels of suspended algae (phytoplankton), and the fishery.
- Many economically important fish depend on a diet of zooplankton during some stages in their life cycle.

HOLOPLANKTON (PERMANENT PLANKTON)

- The holoplankton are composed of forms representing nearly every phylum of the animal kingdom with the exception of the sponges, bryozoans, and phoronids.
- Among the echinoderms, only the sea cucumbers have members, Pelagothuria with two species and Planktothuria with one species, which are planktonic throughout their life.
- However, no plankton animals play so vital role in the economy of the sea as do the crustacea of the phylum Arthropoda.
- Among these, the copepods rank first in most parts of the ocean although in many instances euphausiids are of equal or greater importance as food for the larger plankton-feeding animals.

MEROPLANKTON (TEMPORARY PLANKTON)

- The temporary plankton is characteristically seasonal in occurrence as it is dependent upon the spawning habits of the benthic parental stock.
- This variation in time of spawning of the various benthos i.e. some spawn in different times of the year or some spawn throughout the year, the occurrence of meroplankton is always there in the seawater.
- meroplanktonic forms are abundant mostly in the inshore waters or neritic waters as this region is in close proximity to the littoral region, where more benthos known to live

ADAPTATIONS

FLOATATION BY INCREASING SURFACE OF RESISTANCE

- Plankton, show several important morphological and ecological adaptations crucial in their survival.
- For this many plankton have flattened body shapes, for example some are bladder like, ribbon like, needle like, or branched types.
- Certain phytoplankton like Chaetoceros, which possess hair like setae on its cell and zooplankton, phyllosoma (larva of lobster) have long projected appendages help these forms in creating surface of resistance, hence aids in floating in the surface.

FLOATATION BY REDUCING OVER WEIGHT

- For reducing the weight of the organisms so as to live as plankton in the surface layers of the water, these organisms simply change their body fluid composition so as to make the body less dense than the seawater without affecting the salt balance/ osmotic conditions.

- The most common way for this is the replacement of heavy ions in the body fluids with lighter ones.

- This is seen in Noctiluca, by having ammonium chloride in its internal body fluid with the specific gravity of 1.01 against the seawater value of 1.025.

- Some plankton will have more water contents in their body to reduce the specific gravity, thereby increasing the buoyancy e.g. jelly fish.
- Some animals like foraminiferans have many perforations in their test or shells so as to reduce the weight of the animal to increase the buoyancy.
- Some are having oil globules or droplets in their body to reduce the specific gravity so as to increase the buoyancy e.g. fish eggs and diatoms.
- Another mechanism that is employed to reduce density is the possession of a gas float of some sort. Some siphonophores have air filled sacs called pneumatophores in its body.

IMPORTANCES OF PHYTOPLANKTON

BENEFICIAL EFFECTS

- They are very much important in the aquatic environments as these are the basis of the life in any aquatic system .About 8o % of the oxygen on the earth is known to be produced by these marine phytoplankton .
- They are also playing a major role in the cycling of biogeochemical in the marine environment and hence these are of great significance on the aspects of global warming.
- Phytoplankton cycles major nutrients in aquatic habitats.
- Phytoplankton are used as indicators of water quality

- Phytoplankton species are known to serve as indicators of some commercially important fishery .
- For example, the abundance of diatom , Fragillaria oceanica in the plankton samples is very high, then it is the indication of the presence of oil sardine fishes (Sardinella longiceps) in that location . Similarly, the species of diatom Hemidiscus hardmanianus is observed to indicate the choodai fishery (lesser sardine) in the west coast of India.
- They are also known to serve as a food for the fish larvae in the hatcheries.
- E.g. diatoms(Chaetoceros, Skeletonema), silicoflagellates (Isochrysis galbana) and green algae (Chlorella).

II.HARMFUL EFFECTS

- Some red tide causing dinoflagellates (Gonyaulax and Gymnodinium) are toxic to the organisms of higher trophic levels of the aquatic systems when they form bloom .

- They are responsible for the localized mass mortality of fishes in the marine ecosystem .

- Besides the mass mortality of fishes, they are also responsible for the transmission of some diseases to human beings particularly, PSP, when the shell fish harvested from the red tide affected coastal waters is consumed by human beings.

IMPORTANCES OF ZOOPLANKTON

I. BENEFICIAL EFFECTS

- Zooplankton are playing a pivotal role or as serving as an intermediate links in the aquatic food chain and transfer the energy to the higher trophic levels.
- Most of the zooplankton are serving as a very good food source to the larval and adult fishes of the commercially important marine fishes.
- The abundance of the rich shoal of herrings and mackerels is indicated by the abundance of copepod species Calanus.
- The presence of abundant krills (Euphausia superba) will indicate the presence of baleen whales.

II.HARMFUL EFFECTS

- Some zooplankton are known to have some adverse effects on the fishery as they are the voracious predators on the fish eggs and larvae, which may leads to the poor fishery of that location.

- E.g., Sagitta sp. (arrow worm)

- It is worth mentioning here that the abundance of jelly fishes in the sea is considered as a menace or hindrance to the fishing operation as these are known to clog the fish nets.

- Apart from this, the area rich in jelly fishes are also invariably observed to be devoid of fishes.