

ZOOPLANKTON

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Zooplankton are myriads of animal organisms that drift with currents. By virtue of sheer abundance and intermediary role between phytoplankton and fish, they are considered as the chief index of utilization of aquatic biotope at the secondary trophic level. The herbivorous zooplankton are efficient grazers of the phytoplankton and have been referred to as living machines transforming plant material into animal tissue. The zooplankton are being used as the indicator organisms for the physical, chemical and biological processes in the ocean. They occur at different depths and constitute a complicated ecological system worthy of special attention.

CLASSIFICATION :

Zooplankton are characterised by their faunal diversity compared to phytoplankton and include arrays of animal organisms, varying in size from the microscopic protozoans of a few microns to some Jelly fish with tentacles of several metres. No single system of classification has been adopted universally. They have been classified into several groups by size (ultraplankton < 5 μ m, nannoplankton 5-60 μ m, microplankton 1-500 μ m, mesoplankton 0.5-1.0 mm, macroplankton 1-10 mm, megaplankton > 10 mm) (Cushing et al, 1958). The larger planktonic organisms (20-100 mm) are called micronekton. Besides size, the zooplankton are classified by length of planktonic life (holoplankton - permanent plankton & meroplankton - temporary plankton), habitat (oceanic, neritic, estuarine, brackish and freshwater plankton), depth distribution (pleuston, neuston, epipelagic, mesopelagic, bathypelagic and epibenthic plankton) and feeding pattern (herbivores, omnivores and carnivores).

SURVIVAL STRATEGY:

There are perhaps more than two lakh species of animals and plants living in the sea. The species evince different survival strategies such as bodysize, food and feeding habits, response to stress and reproduction rates. For prolonged passive suspension in the water column, a small bodysize is preferred. The sinking rates are also reduced by extending appendages provided with setae and fine hairs. The presence of air-filled floats in siphonophores, Velella, Porpita and spines in decapods assist floatation. The oil droplets serve a dual function as food reserve and a buoyancy device. The zooplankton organisms employ various methods to capture food, but the most common is filter feeding. The herbivorous filter the planktonic algae from the water currents generated by tides and waves or by animal itself. The different filters used by zooplanktonic organisms include mucus nets (salps),

meshwork secretions (copelates) and basket work of setae (crustacea). The planktonic crustaceans even use specialized limbs, fringed with setae for filter feeding. In contrast with the relative stability of the sea, the estuaries are dynamic environments, often showing sudden and extensive changes in salinity. The rate and magnitude would depend on the geological, meteorological and hydrographic conditions. The estuarine zooplankton species have to be highly adaptive and are reported to show mechanism to detect changes in salinity and oxygen. They produce resting eggs to tide over unfavourable conditions. The reproduction rates counter mortality. Several zooplankton species show quick maturation, reproduce early, with shorter generation time and low species diversity (r = selection strategy).

DISTRIBUTION :

The variability of an ecosystem in space and time is one of its most important features. The physico-chemical boundaries play an important role as there are usually strong gradients in terms of light, temperature and salinity from surface to the bottom layers. The zooplankton exhibit uneven distribution both along the horizontal and vertical planes. It is well known that zooplankton are abundant at depth during day and their abundance shifts to surface at night. This has been explained on the basis of vertical migratory behaviour. It could be ontogenetic, seasonal and diel migrations. Besides light, food availability, inter and in raspecific competition, predation pressure, niche selection, energy conservation and physiological state of zooplankton are other factors responsible for this phenomenon. The diel migration is most common but some planktonic forms don't show migration and occur in discrete depth zones or in the surface layers. In the marine environment, the zooplankton usually congregate above the thermocline or discontinuity layer which acts as an ecological barrier and results in stratification in distribution. The vertical zooplankton abundance has also been associated with chlorophyll concentration and primary productivity. In addition to vertical gradient, there are also patches in horizontal distribution. The zooplankton patchiness or spatial heterogeneity becomes a dominant character of distribution of some taxa during certain period of the year. The patchiness extends on scales of several metres to hundred or thousands of kilometres. The zooplankton are dispered according to the scales of ocean turbulence. Since the latter range from small scale eddies to very large gyre, the scales of zooplankton patchiness will be correspondingly varied (Parsons, 1980). The intensity of zooplankton aggregation will depend on their ability to counter dispersion, phytoplankton growth, grazing rates, predator/prey relationship and reproduction strategies of zooplankton. The zooplankton patchiness is utilized by higher trophic levels particularly by pelagic fish species and their larvae.

INDICATOR ORGANISMS :

The zooplankton being passive drifters, they are used as indicators of water masses and their movements, circulation, coastal upwelling, productivity of waters, neritic or oceanic conditions and so on. It is well known that

several zooplankton organisms and their species have their main centres of distribution within a specific water mass. Their geographical range would depend on the temperature and salinity tolerance limits. The indicator species could be selected on the basis of adults carried by currents into regions where no recruitment occurs; planktonic larvae carried into regions where the adults don't occur and the species that have their greatest abundance in mixing zones with little recruitment from the outside source. The zooplankton species also serve as indicator of coastal upwelling. The copepod species of family Calanidae dominate zooplankton population during upwelling events. The calanoid copepods, calanus marshallae has been shown to adapt reproductive and behavioral strategies to a coastal upwelling system (Peterson et al 1979). The upwelling results in high primary productivity over an appreciable area with high production of herbivorous zooplankton. The zooplankton production and fauna are also indicators of neritic or oceanic conditions. The neritic and inshore waters are most productive with typical seasonal fluctuations influenced by monsoons and upwelling.

FUTURE PROSPECTS :

Investigations on zooplankton have been confined mainly to taxonomy, zoogeography, distributional patterns, community structure and trophic relationships. However, efforts are underway to integrate studies of biological and physical phenomena in the ocean. New techniques, either already available or in process of development are being used for synoptic sampling (acoustics, optical imaging, bioluminescence) and biochemical indicators (digestive enzymes, lipids, genetic markers). The ultra-high frequency acoustic systems are available to map zooplankton standing crop. The zooplankton patchiness and vertical distribution have been detected and measured acoustically by Richter (1985). An automated image analysis systems assist in quick sample analysis for size spectrum. Bioluminescence patterns in zooplankton organisms could help to study community functions and optical properties of the ocean. The activity of digestive enzymes and lipid contents of zooplankton would be used as an index of spatial and temporal aspect of feeding activity. Allozymes are going to be an important tool for the studies of zooplankton would be used as an index of spatial and temporal aspects of feeding activity. Allozymes are going to be an important tool for the studies of the reproductive and genetic isolation of zooplankton population.

The use of new sampling and analysis technologies in zooplankton research would greatly facilitate rapid data acquisition for evaluation of biological resources and understanding of processes in the ocean.

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