



Review paper

Diversity of Zooplankton in the Lentic Ecosystem of Lake

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ARTICLE INFO	ABSTRACT
<p><i>Article history</i></p> <p>Received 29 September 2024 Revised 03 October 2024 Accepted 03 October 2024 Published 05 October 2024</p>	<p>Zooplankton are numerous organisms found in almost all water bodies. The study of plankton is a valuable method for assessing the biotic potential of water bodies and contributes to understanding their overall biological characteristics and economic potential. Zooplankton are microscopic, free-floating organisms that are crucial to the functioning of aquatic ecosystems. As a vital link in the energy transfer between phytoplankton and higher aquatic animals, zooplankton are key biotic components, playing a significant role in aquatic environments. They influence food chains, food webs, energy flow, and nutrient cycling in aquatic ecosystems.</p>
<p><i>Keywords</i></p> <ul style="list-style-type: none">• Zooplanktons• Lentic ecosystem• Physico-chemical properties• Lentic lake	<p>Zooplankton populations serve as important indicators of the stability of food chains. Various environmental factors, such as pH, temperature, salinity, and oxygen levels, affect zooplankton populations. They play a critical role in the transfer of energy between primary and tertiary trophic levels. Additionally, zooplankton are indicators of the physical, chemical, and biological processes occurring in aquatic systems due to their high densities. Since they are highly sensitive to environmental changes, shifts in the abundance or composition of certain species can be used to assess the health of the ecosystem.</p>

1. Introduction

The term lentic which means 'to make calm' is used for nevertheless water of lakes, ponds, marshes, ditches, and swamps. These ecosystems range in length from very small ponds or pools that may be brief, to large lakes. The oxygen content material of lentic surroundings is notably low even as in evaluation to the lotic environment [2]. Lake and ponds are damaged down into three one-of-a-kind zones, each with its personal one-of-a-type sort of organisms. The littoral area is the most effective closest to the shore. Because the ones regions are shallow, mild is capable of acquire to the lowest. The

variety of plants and animals are abundance in this quarter. Moving inward faraway from the shore is the limnetic zone nonetheless receives plenty of daytime. It extends few meters into the water body. This region is very attain in microorganisms referred to as plankton. Under the limnetic region, there is a whole lot less warm and denser area known as the seasoned-fundal area. There is little slight so the photosynthesis is less outstanding [1-3].

Water is seemed as polluted at the same time as it has modified in its exceptional or composition, without delay or in a roundabout way by means of human sports activities. Water pollutants is a phenomenon this is characterised through the deterioration of its nice because of severa human sports activities. Rapid industrialization and indiscriminate use of chemical, fertilizers, and



DOI 10.5281/ib402924



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insecticides inside the agriculture are inflicting heavy and varied pollutants in aquatic surroundings major to deterioration of water best and consequently depletion of aquatic biota [5]. The satisfactory of aquatic gadget has now turn out to be a severe situation because of its direct effects on aquatic and human fitness. Lake water is a source for eating and home functions for each rural and urban region. The all at once increasing human populace inside the catchment area of lake and unplanned urbanization, speedy industrialization and indiscriminate use of chemical as fertilizer are inflicting vast pollution in aquatic environments principal to the deterioration of water first-rate and depletion of aquatic organisms [4-6].

2. Trophic Status of Lake

A term 'Trophic popularity' of water frame is used as an outline of the water body. The status of freshwater atmosphere may be categorised on the premise of richness of nutrients as follows:

1. Oligotrophic Lake: It is typically easy, deep and freed from weeds or big algae blooms. It has a tremendously low productiveness because of the low nutrient content material within the lake. The water of such lakes has high consuming satisfactory. This form of lakes are commonly determined in cold place in which blending of nutrients is uncommon and sluggish due to the low temperature [5,4].

2. Mesotrophic Lake: Lake is lie between the oligotrophic and eutrophic levels because of the intermediate degree of productiveness. Devoid of oxygen in overdue summer, their hypolimnion restrict cold water fish and cause phosphorus biking from sediments [6,7].

3. Eutrophic Lake: Lakes are excessive in vitamins and aid a huge biomass. It regularly assist massive fish populace however additionally prone to oxygen depletion. Initially, eutrophic lakes boost up multiplication and growth of lakes fauna due to the excessive stages of oxygen supplied by way of flora or algal blooms [7,3,4].

3. Zooplanktons

Zooplanktons are the unfastened floating and microscopic animal discovered in aquatic atmosphere. The phrase Zooplankton is derived from the Greek word zoon, meaning animal and planktons, meaning wonders or drifter. Zooplankton can survive

below a extensive range of environmental situations. They are the indicator of the presence or absence of certain fish species and population densities of the zooplankton. Zooplanktons are categorised in diverse companies viz. Cladocera, Copepoda, Rotifera, Ostracoda and Protozoa [8,9].

3.1 Cladocera

Cladocera are commonly referred to as water fleas. It is main element of the micro crustacean zooplankton and diagnosed 4 orders viz, Anomopoda, Ctenopoda, Onychopoda and Haplopoda. They belong to the magnificence Branchiopoda and length ranging from 0.2mm - 5.00 mm. Family Chydoridae became the maximum species rich family with 12 species accompanied by Daphniidae with five species [9,6].

3.2 Copepoda

Copepoda arise in all freshwater habitats from the most important ancient lakes to subterranean waters. Copepods are most considerable metazoan in the world. They are minute (zero.Three-2.5 mm). Mesocyclops, Cyclops, Calanus, Macrocyclops, Diaptomus, Microcyclops, Tropocyclops, Orthocyclops, Eucyclops and so on species of Copepods belonging to exclusive groups have been recognized from lake [4,10].

3.3 Rotifera

Rotifera are ubiquitous, observed in all sorts of fresh water habitat. Their densities up to 1,000 people in step with liter. Rotifers are usually known as 'wheel animalcule'. Brachionus and Keratella are the maximum common recorded genera in Indian lakes. Maximum species had been recorded from own family Brachionidae (12 species) which followed by circle of relatives Lecanidae (04 species), own family Tichocercidae, Euchlanidae and Filinidae (02 species) and (01 species) from family Asplanchnidae, Mytilinidae, Testudinellidae, Colurellidae and Hexarthridae [8,11].

3.4 Ostracoda

Ostracoda is a category of crustacean, additionally known as seed shrimp. They are small, commonly around 1 mm (zero.04 in) in length, however varying from zero.2 to 30 mm (zero.008 to 1 in) in the case of Gigantocypris. The species from lake are Cyclocypris

globosa, Clcocypria kinkaidia, Cypriamediana, Physocypria furfuracea, Eucypris bisponsa, Hemicypris fossuata, Cyprinottus nudus and Srandentia elonata and from lake are Candona pierce, Cypriconcha alba, Stenocypris fontinalis and Cycloocypris globosa. Among the 2 species, Stenocypris sp changed into ruled over Cypris sp [12,13].

3.5 Planktonic pratozoans

It is a collection of unicellular ciliated or flagellated organisms that feed on both picoplankton or nano flagellates and small nano phytoplankton, consistent with their size. Most of the protozoans are typically now not sampled because of their minute length. Heterotrophic non of flagellates (approximately 1.0 to about 20 μm in size) are more plentiful (105 - 108 L⁻¹ in fairly eutrophic lentic atmosphere) than ciliates (eight-300 μm in length) in sparkling water frame [5,8,13].

4. Diversity of Zooplankton in Different Lentic Ecosystem

Biodiversity can be defined because of the fact the range, and variability of plant life, fauna and microbes in an surroundings. In modern-day 3 hundred and sixty 5 days, the sustainable usage of to be had biodiversity has assumed excellent significance in the face of growing environmental threats [15,4]. Biodiversity conservation has, consequently emerge as a need so you can protect this planet from disintegration. Biodiversity has intimate courting with the improvement and development of human civilization, as most of the human desires are related with organic sources be it meals, clothing, safe haven, treatment or undertaking [16,17]. The stage of information and the perceptions on biodiversity conservation remains terrible, especially in developing countries like India, in which biomass economic machine holds the important thing of development. The zooplankton composition and companies varies with habitat and its associated abiotic and biotic elements. The seasonal variant within the primary productivity, phytoplankton and zooplankton in lake the numerical and volumetric variations in plankton populations of a polymictic tropical lake [14-17].

The Cladoceran samples had been amassed in Tamilnadu, Rajasthan, Andaman and Nicobar Islands and West Bengal from numerous sorts of habitats

which includes rice fields, marshes, ponds, lakes, reservoir, streams, and rivers. In tropical and subtropical latitudes of India, character males seem for a very quick duration and in small numbers. The adult adult males had been no longer determined to be similar to person women, however, juveniles of guys were discovered to have some similarity [14]. Physico-chemical fluctuations of lake located out nitrogen uptake via summer time phytoplankton in lake. Seasonal versions of dissolved oxygen and deoxygenation in tropical reservoirs. Plankton internet modified into dragged maximum of the plants near the bottom of the shallow waters in marshes to build up zooplankton. Five species of Daphnia have been decided, which have been considered as limnetic cladocera observed in temperate place. The examine indicates that temperature The zooplankton samples had been amassed through dragging the net close to the bottom among plant life and easy water [13]. 38 species belonging to 21 genera of 5 households had been discovered of which 24 had been chydorids and 14 nonchydorids. The determined on 7 stations were in comparison by the use of the Sorensen index of similarity and Koch index of biotic range. The aquatic biodiversity assessment and their conservation is the want of the contemporary millennium. Several reservoirs had been studied through severa human beings for assessing biodiversity of Ichthyofauna [21]. The dynamics of internet primary manufacturing and zooplankton variety in brackish water shrimp manner of life pond in northern a part of Ganjam district, Orissa. Significant lousy correlation changed into observed amongst net primary production and zooplankton population. Copepods and rotifers had been decided to be the dominant groups among zooplankton. The zooplankton population various with different seasons of the one year with wet and summer season seasons showing the minimum density in zooplankton population [18-22].

The cyclopoid copepod Mesocyclops aspericornis from an Indian pond. The body of the species emerge as obvious, cylindrical, elongated and highly segmented into four prosomal and five urosomal somites, while the body of the male have turn out to be divided into 4 prosomal and 6 urosomal somites [23]. The talents which includes antennae, antennule, legs 1 to six (P1 to P6) and moreover some of the species-specific characters of this organism

were described. The species type of planktonic population numerous consistent with the watershed vicinity and kind of basin. Species belonging to Chlorophyceae had been immoderate in western reservoirs viz., Parambikulam (sixty three.Three%), Thoonakkadavu (forty one.Three%), Peruvuripullam (fifty three.1%) and in a few plateau reservoirs like Palarpaoranthalar (38.Five%), Uppar (38.1%) and Vidur (45.0%). Silicate rich reservoirs viz., Odathurai, Amaravathy, Vaigal, Krishnagiri, Willington and Pillor contained extra vegetation belonging to Bacillariophyceae. Sandynulla, Orathupalayam and Vembakottai showed dominance of Myxophyceae over Bacillariophyceae inspite of their higher content material cloth of silica [24]. The rotifer range of 3 macrophytes infested lakes from Thane metropolis, Maharashtra that encompass Lake Ambegosale, Lake Rewale and Lake Makhmali. Rotifera with 19 species belonging to nine genera had been received. This have turn out to be in comparison with uninfested lakes wherein great 10 species belonging to six genera have been obtained [1]. The check shows that the macrophytes assist to boom the style of rotifers and rotifer population severa amongst mesotrophic and oligotrophic lakes [5,25]. Rotifers and copepods had been located to be maximum critical groups. Copepods have been specially ruled through Mesocyclops species and cladocerans, the least considerable grou incorporate Moina species and Ceriodaphnia species. Ostracods had been moreover positioned of their series with Cypris species being the dominant organism [23-26].

The lake modified into perennial and alkaline in nature. The parameters determined to show marked seasonal versions include temperature, transparency, pH, dissolved oxygen, loose carbondioxide, alkalinity, calcium, chloride, nitrite and phosphate. The take a look at famous that Govindgarh lake changed into polluted. The induction, termination and significance of benthic - pelagic coupling in the dormancy of zooplankton [12]. The induction of dormancy was almost completely seasonal, which have been dependant on temperature, photoperiod, meals super and amount and extraordinary abiotic elements. The popular factors discovered to persuade zooplankton boom, replica and mortality have been water degree, salinity, pH, vitamins, photoperiod and temperature [5,27].

The morphology and identification developments of 4 copepods species especially Thermocyclops crassus, Mesocyclops leukarti, Apocyclops royi (order cyclopidae) and Eudiaptomus gracilis (order Calanoida and own family Diaptomidae). Eudiaptomus gracilis and Apocyclops royi were the first document for Mumbai. Cladocerans and rotifer have been sizeable groups (9 species each) observed by using way of the usage of seven species of copepoda, and one species of ostracoda. The species had been immune to coal dust and indices for richness, range and evenness of the zooplankton did now not present a fashion within the dynamics of the plankton community [29]. The evenness (J) confirmed insignificant courting with species variety index (H'), species richness (S) showed terrible dating with species range index values. The common range of plankton modified into low due to excessive alkalinity of water because of fly ash deposition [9]. Zooplankton assemblages and water wonderful had been tested in eleven northeastern lake Michigan coastal lakes of comparable starting place but numerous trophic structure and limnological condition. A normal of eighty 5 taxa had been recognized from 11 look at lakes. The Shannon range index (log_e) based absolutely virtually on the lakes averages ranged from 2.07 to two.29 [29]. The rotifers had been determined to be the quality signs of trophic reputation on the same time as in comparison to the possibility groups. Zooplankton is essential additives of aquatic meals webs and contributes notably to aquatic productiveness in freshwater ecosystems [28-30].

5. Role of Plankton as Bio-Indicators

Variations within the populations of animals may additionally imply risky adjustments triggered because of pollution into the surroundings. Change within the population density can also endorse negative affects to the environment. Changes in populations can be a end end result of the relationship amongst populations and food assets [31]. Planktons are profoundly touchy to natural exchange they may be extremely good markers of water satisfactory and particularly lake conditions. One of the motives plankton are being considered in lakes is to screen the water quality of the lake, while there are immoderate centralizations may be indicated with the aid of nice planktons at an

advanced charge. This is evidence of horrible water top notch that may have an effect on other organisms living inside the water frame. To screen the aquatic ecosystems and integrity of water, plankton has been used these days as bioindicators [30-32].

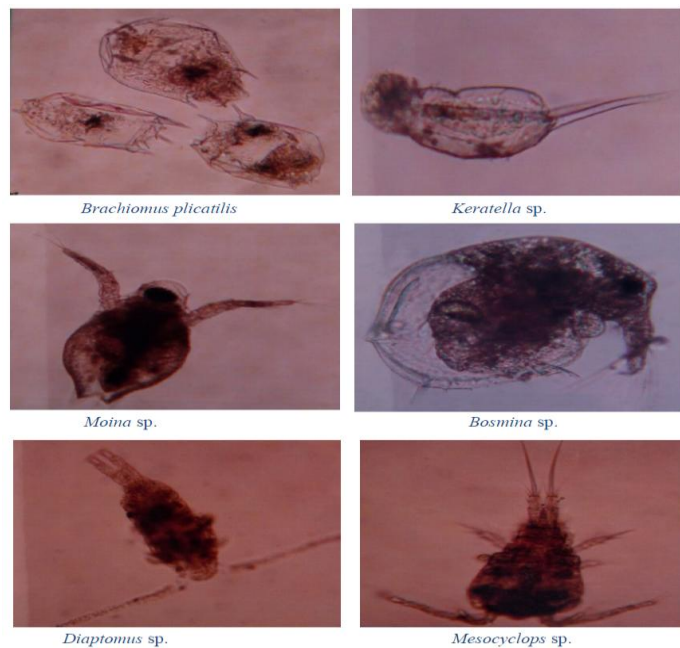


Fig. 1 Zooplankton Species [24]

Bioindicator is a related group or network of organisms, whose occurrence or an without difficulty discovered trait can be so closely correlated with sure environmental condition that it could be applied as a pointer or quantitative check. A species or organization of species that conveniently reflects the abiotic or biotic state of an environment, represent the effect of environmental trade on a habitat, community or atmosphere or is indicative of the diversity of a subset of taxa or the entire variety inside an area [34]. Zooplanktons play an important position as bioindicator and assist to evaluate the extent of water pollutants. In order to decide the status of a Freshwater frame, it is vital to measure seasonal variations and presence of zooplankton. Some plankton are sensitive to precise contaminant whilst different are strong or have law or cleansing mechanism. The occurrence of Branchionus species suggests, the water of pond is polluted. Many opportunistic species alternate whole populace dynamics in such water. Abundance of Keratella vulga, Keratella tropica suggests the mesotrophic nature of the reservoir [33-34].

Bacterial and protozoan population may additionally have drastically multiplied due to marginal increase in organic waste and water

pollution. Zooplanktons are bio-signs and help in measuring water pollutants repute, those are vital in breaking down the organic pollutant and therefore reducing the harm. Mosquito larvae and chironomus are pollutants indicator; they located abundance in Nagrala lake [25]. The bacteria adapt very quickly to environmental modifications. Protozoa and algae take longer time and a number of the bugs which spend 12 months or in order larval stage react longer duration for high quality environmental trade. The sensitivity of different zooplankton to various varieties of aquatic chemical pollutants confirmed their potentiality to function biological indicator. The dominant conduct of zooplankton in specific kinds of home sewage oxidation ponds. It became determined that there were twenty one species of zooplankton found in each (primary and secondary) oxidation ponds [34]. Keratella, Cyclops, Daphnia, Branchionus, Eybranchiopus and Nauplius larva often took place in oxidation ponds. Rotifera institution of zooplankton is the first-rate indicator of the Eutrophic popularity of the lake and among Rotiferans, Branchionus species is the higher indicator of water pollution [34-36].

6. Conclusion

Above evaluate of literature on zooplankton confirmed that the Maharashtrian in addition to Indian researches have made zooplanktons a subject for his or her research and published every the coolest quantity of research papers and books. The above description indicates actually that nearly every a part of the Maharashtra has got pond and reservoir and diversity of zooplanktons has been stated every taxonomically and ecologically. The furnished work showed that the zooplanktons play a essential role in indicating water pollutants. Their range varies in keeping with the modifications in splendid of water parameters. Eutrophication moreover affected zooplanktonic assemblages in which rotifers and cladocerans are most affected. This studies paintings additionally explains the feature of zooplankton as an intermediate species in meals chain which transfers strength from number one manufacturers to the larger predators.

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