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Zooplankton And Its Role: A Critical Review

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Abstract

In the aquatic ecosystem, zooplankton plays a crucial role. Its distribution and assortment, however, are driven by several physicochemical parameters in an association. Zooplanktons are an important group of plankton in the aquatic food chain. The abundance of zooplankton is regulated by a variety of physicochemical parameters, as well as the interplay of biological factors. Zooplankton species play an important role in the food webs of aquatic ecosystems. They are not only a vital member of the lentic community, but they also contribute greatly to the freshwater ecosystem's biological production.

Keywords- Environmental factors, Seasonal Variation, Zooplankton Diversity, Zooplankton Community

Introduction

Plankton is the weakly swimming but most drifting small organisms that inhabit the water column of ocean and bodies of freshwater. The name comes from the Greek term, plankton-meaning “wanderer” or “drifter”. The various functional aspects of an aquaticsystem, such as food chains, food webs, energy flow and cycling of matter are influenced by the zooplankton members, which are important biotic components of an aquatic system (Murugan, Murugavel and Koderkar, 1998). In freshwater systems, zooplankton forms important groups and form the basic link of the food chain. Plankton are very sensitive to the environment in which they live and any change in the environment causes changes in plankton communities in terms of tolerance, abundance, diversity and dominance in the habitat (Mathivonam, 2007). All the secondary production in aquatic ecosystems directly or indirectly relies on them. They play a major role in recycling nutrients as well as cycling energy within their respective environments (Sinha and Islam, 2002). The density and diversity of plankton is significantly influenced by various physicochemical parameters of water (Wetzel, 1975). The species composition of the plankton community is an efficient indicator of water quality. Zooplankton includes protozoans, Cladocera, copepods, rotifers, etc. that can serve as indicators of water quality. Zooplankton play an important tropical level role in aquatic ecosystems as they constitute the most import link in energy transfer between phytoplankton and higher aquatic organisms (Iloba, 2002). Ecologically, zooplankton is one of the most important biological components that influence all functional aspects of aquatic ecosystems such as food chains, food webs, energy flow and cycling of matter (Park and Shin, 2007). Ecologically, zooplankton is one of the most important biological components influencing all functional

aspects of aquatic ecosystems, such as food chains, food webs, energy flows and cycling of matter (Murugan *et al*., 1998; Dadhik and Sexena, 1999; Sinha and Islam, 2002; Park and Shin, 2007).

Review

The distribution of zooplankton community depends on many factors such as, changes in climatic conditions, physical and chemical parameters and vegetation cover (Rocha *et al*., 1999; Neves *et al*., 2003). Most species of planktonic organisms are worldwide in distribution (Mukherjee, 1997). According to Murugan *et al*. (1998) and Dadhich and Sexena (1999) Zooplankton plays an integral role and provides bioindicators and is a suitable tool to understand water pollution conditions (Ahmed, 1996; Contreras *et al*., 2009). Several studies have been conducted on the ecological status of freshwater bodies in different parts of India (Gulati and Schultz, 1980; Rana, 1991; Sinha and Islam, 2002; Singh *et al*., 2002; Smita *et al*., 2007), But there is very little ecological study of freshwater bodies in the southern part of Tamil Nadu (Hanifa and Pandian, 1980; Smita *et al*., 2007). However, information on the relationship between physico-chemical parameters and planktonic organisms is very limited (Ahmed and Siddiqui, 1995; Chaudhary and Singh, 1999). The functioning of any aquatic system largely depends on the physico-chemical characteristics of its water (Sharmila and Rajeshwari, 2015). Water quality in any ecosystem provides important information about the resources available to support life in that ecosystem (Pandit and Solanki, 2004 and Thirupathiah *et al*., 2012) and it determines the health of the water body. (Shinde *et al*., 2011) Important physical and chemical parameters affecting the aquatic environment are temperature, precipitation, dissolved oxygen and free carbon dioxide. These parameters are limiting factors for the survival of aquatic organisms (flora and fauna) because they provide a way to understand changes in the abundance and distribution of flora and fauna over time. Zooplankton are major components of the food web in organisms and their qualitative and quantitative studies play an important role in water quality assessment. They are an important component of secondary production in aquatic systems and act as primary consumers and form an important link between primary producers (phytoplankton) and higher consumers such as carnivorous fish in the aquatic food chain (Pradhan, 2014). They are known to not only form an integral part of the lentic community, but also contribute significantly to the biological productivity of the lentic ecosystem (Wetzel, 2001). They are closely related to their surrounding environment throughout their life cycle, causing sudden changes in their populations whenever a disturbance occurs. As a result, any changes in their abundance, species diversity or community composition can provide important signals of environmental change or disturbance. Therefore, they are considered a potential bio-indicator species for water pollution (Jakhar, 2013). Zooplankton communities fluctuate according to the physico-chemical parameters of the environment, and their density in any water is controlled by various water quality parameters such as light penetration, temperature, nutrient enrichment, herbivory and heterotrophic microorganisms (Reynolds, 1987). So, the inference of plankton analysis also helps in explaining the reason for the presence of colour, turbidity, smell, taste and visible particles in water (Pradhan, 2014). The quantitative and qualitative information on the seasonal variation of Zooplankton and selected physico-chemical variables based on the nutrient data was indexed Sawanth *et. al.,* (2010). Therefore, the present investigation attempts to study the zooplankton species richness, diversity and evenness among physico-chemical parameters in three perennial ponds of Raisen district of Madhya Pradesh.

Aquatic biodiversity is primarily threatened by human abuse and management of both living resources and the ecosystems that support them. Most of the ponds are getting polluted due to domestic waste, sewage, industrial, aquatic and agricultural effluents. The need of water in everyone's life from microorganisms to humans is a serious problem of the present time as water resources have reached the crisis point due to unplanned urbanization, industrialization and other man-made activities. In the present investigation Species Diversity of Zooplankton in Relation to Water Quality in Puran Pond Raisen district of Madhya Pradesh. Many biotic and abiotic processes contribute to variability in plankton diversity in aquatic ecosystems. Seasonal requirements of plankton assemblages are closely linked to seasonal changes in temperature, external hydraulics, nutrient load and light availability (Malten *et al*., 1991), ranging from days to days such as meteorological and hydrological events (Guillermo Other processes acting over time periods ranging from weeks to weeks, 2009) and also the pressure of pollution on them (Raja *et al*., 2008). Zooplankton diversity responds rapidly to changes in the aquatic environment. Many zooplankton species are served as bioindicators (Ahmed *et al*., 2011, Mola, 2011). Several studies have been conducted on the ecological status of freshwater bodies in different parts of India (Singh *et al*., 2002; Smith *et al*., 2007; Rajagopal *et al*., 2010), but coastal Andhra Pradesh especially the Kolleru region There is very little ecological study of the freshwater body. However, information on the relationship between physicochemical parameters and planktonic organisms is very limited (Ahmed and Siddiqui, 1995, Chaudhary and Singh, 1999). So, the present investigation attempts to study the zooplankton species richness, diversity and evenness among physicochemical parameters in a perennial pond in Kolleru lake area. The diversity of zooplankton indicates a chronic water pollution problem. Zooplankton is essential for the survival of commercially significant fish populations. The study of zooplankton diversity, abundance, and the impact of seasonal fluctuation on them are significant in fisheries planning and management. The most significant parameters influencing planktonic biomass production were physicochemical conditions and the nutrition statuses of water (Singh *et al*., 2012). Zooplanktons are connecting links between producers and secondary consumers. Several studies on physicochemical parameters affecting the productive condition of confined water bodies have been carried out (Sharma *et al*., 2010). The toxicity of different contaminants to freshwater organisms and the sensitivity of these organisms to toxicants are affected by changes in environmental and climatic conditions. During fish culture, the presence of zooplankton is critical to ensuring high fish output (Agrawal, Thiske and Mondal, 2014). Therefore, the current study seeks to evaluate the variety of zooplankton species concerning water quality indicators. The diversity of Zooplankton is influenced by seasonal physicochemical parameters and some zooplankton species are a good biological indicator on this point several studies have been conducted on the zooplankton diversity and abundance at Saheb Bandh by (Chattopadhyay, and Panda, 2021).

Limnology is an interdisciplinary science that involves detailed field as well as laboratory studies to understand the structural and functional aspects and problems associated with freshwater environments from a holistic perspective (Adoni *et al*., 1985). Aquatic biodiversity is primarily threatened by human abuse and mismanagement of both living resources and the ecosystems that support them. Most of the ponds are being polluted due to domestic waste, sewage, industrial and agricultural effluents (Shiddamallaiah and Pratima, 2008; Shekhar *et al*., 2008). The need of water in everyone's life from micro-organisms to humans is a serious

problem today because due to unplanned urbanization and industrialization all water resources have reached the crisis point.

Water quality assessment generally involves the analysis of physico-chemical, biological and microbiological parameters and reflects the abiotic and biotic status of the ecosystem (IAAB, 1998; Kulshrestha and Sharma, 2006; Mullani *et al*., 2009). Gothwal and Gupta (2018) conducted a limnological study on Nakki Lake, Mount Abu in the summer season. Moderately alkaline water with pH 7.08, alkalinity of 102.16 mg/L, and research results of other limnological parameters show low average values including TDS 161.83 mg/L, hardness 95.66 mg/L and chloride 109.73 mg/L. The average dissolved oxygen level was 5.75 mg/L while the average nitrate and sulphate levels were 31.19 mg/L and 123.73 mg/L. Based on the results of water quality parameters, Nakki lake is at risk of becoming eutrophic. Shah *et al.* (2019) concludes an increasing movement in limnological parameters for dissolved oxygen, nitrogen and phosphorus mainly in Hokarsar wetland, Jammu and Kashmir. His research approach confirms that the natural release of domestic sewage and agricultural wastes, which will cause cultural eutrophication and result in the pollution of wetlands, will endanger the aquatic environment. Shahid *et al.* (2020) used high-resolution GIS satellite data from 2003 and 2016 to map the lake surrounding area and studied limnological characters, water quality, Lake Bathymetry, and settlements using multiple datasets at Nigeen Lake, Kashmir. Bathymetry ware is measured transversely; Spawn the surface of the lake with 235 points. Limnological characterization of surface water with 22 parameters was analysed at five sampling sites. The water quality ware as per the drinking standards by World Health Organization within acceptable limits. Sharma *et al.* (2020) analysed that enzymes present in soil ecosystems are biomarkers of environmental changes. Their research conclusion states an augment in the deliberation of heavy metals and water pollution level in river Yamuna resulting in amplifying movement of a certain enzyme such as nitrate reductase, dehydrogenase, and arginine deaminase while inhibiting the activity of urease enzyme. During the summer season, high temperature increases the enzyme activity of arginine deaminase and urease, whereas, during the winter season, higher soil moisture fascinates the activity of the dehydrogenase enzyme.

Ishtiaq and Abdul (2020) found that unprecedented land use/land cover (LULC) changes resulted in deterioration of water quality in Dal Lake by increased nutrient and silt load in Dal Lake. LULC change analysis with five time periods indicates that the dominant land cover in forest class ware 135.72 km2 in 1980, 131.84 km2 in 1992, 126.83 km2 in 2000, 120.63 km2 in 2010, and 118.30 km2 in 2018, respectively. Aquatic vegetation noticed an enlargement of 180.65% within the lake, with 2.03 km2 of the area in 1980, and 5.70 km2 in 2018; however, agriculture land noticed a decline in 30.02% of the area with 34.44 km2 of land in 1980 got reduced to 24.10 km2 in 2018. Gothwal and Jangir (2020) studied the soil properties of a lentic ecosystem, Nakki Lake in a semi-arid region, their research verdict determines that the soil profile parameter balances the ecological symmetry in a lake-ecosystem and maintains the portability of water through its inter-relationship among phytoplanktons and zooplanktons. Verma and Prakash (2020) recorded that the water temperature ranged from 12.8–35.4^{o}C, transparency ranged from 28.6–38.8 cm, dissolved oxygen ranged from 6.1–9.4 ppm, free carbon dioxide ranged from 15.0–28.0 ppm, pH 7.1– is from 9.8. Total alkalinity ranges between 137.0 and 296.0 ppm, total solids between 34 and 116 ppm, nitrate between 1.08 and 1.41

ppm and phosphate between 1.02–1.08 ppm. A total of 25 species of phytoplankton and 24 species of zooplankton were also recorded. A biphasic pattern of plankton seasonal variation was observed, with a primary peak in July and a secondary peak in January. Gothwal (2021) Limnological research has detected immense momentum worldwide in the last few decades. It has developed into an individual division of ecology and limnology acknowledges several areas of expertise such as physical limnology, chemical limnology, planktonology, paleolimnology, and specific regions such as deserts, high altitudes, temperate regions, tropical regions Limnology. There will be rapid progress in the field of limnology, especially in European countries and North America. Eutrophication, community dynamics, planktonology and pollution are the approaches actively engaged by various laboratories in the exploration of inland water bodies. Singh and Samartha (2021) carried out to study seasonal abundance of certain zooplankton in Upper Lake, Bhopal. The abundance of zooplankton was studied in pre-monsoon, monsoon and post monsoon season. In the present study zooplanktons comprised of total 5 taxonomic groups: Protozoa, Ostracoda, Rotifera, Cladocera and Copepoda. Paquette, Gregory-Eaves and Beisner (2022) Zooplankton are excellent bioindicators of lake health, given their central food web position. To date, many studies have investigated the effect of individual stressors on zooplankton communities, mediated through changes in water quality. Karmakar *et al.*, (2022) Zooplankton an intermediary connection between primary producers and higher trophic levels, zooplankton are an important component of the aquatic food chain, contributing significantly to aquatic biological productivity. Parveen *et al.*, (2018) there are various natural causes of land use such as climate change resulting in floods, droughts, or anthropogenic causes such as industrialization or urbanization. Zooplanktons are minute aquatic organisms size ranging from a few microns to a millimetre or more. They include representatives of almost every taxon of the animal kingdom (Goswami 2004) that live all (holoplankton) or part (meroplankton) of their life as plankton (Lindeque *et al.* 2013) plays an important role in the aquatic ecosystem. They are non-motile or very weak swimmers drifting in ocean, seas and fresh water bodies and are greatly associated with changes in phytoplankton community (Perbiche-Neves *et al.* 2016), increase in phytoplankton population is most favorable for growth of zooplankton population (Kumar *et al*. 2011). The biotic component of the aquatic ecosystem is strongly related to the diversity, abundance and seasonality of the zooplankton (Jose and Sanalkumar, 2012), combinations of low food quality and high fish predation cause zooplankton elimination (Danielsdottir, Brett and Arhonditsis, 2007). Not only the biotic factors, the physicochemical parameters like temperature, pH, turbidity, BoD, CoD etc may affect the zooplankton distribution (Raut and Shembekar, 2015), seasonal variation also alter the zooplankton abundance (Goswami and Mankodi 2012; Jomet and Yamakanamardi 2014; Reddy *et al*. 2016; Das and Kar 2016; Kumar *et al*. 2011; Dede and Deshmukh 2015). Mahajan and Sharma (2020) studied the geomorphological evolution and comparative assessment of nine Himalayan watersheds and estimated the state and rate of erosion processes for better planning and management with GIS system and remote sensing data. The research verdict states that morphometric analysis is important to study drainage behavior and its impact on the prevailing rock units in a watershed area.

Conclusion

This study provides a useful global assessment of zooplankton communities living in aquatic environments, and zooplankton diversity focusing on the harms and environmental benefits of the communities. If the number and diversity of species remains high throughout the water column, other organisms present there are affected, Zooplankton plays an important role in the aquatic environment. However, its distribution and classification are governed by several physicochemical parameters in an association. Zooplankton are an important group of plankton in the aquatic food chain. The abundance of zooplankton is controlled by the interplay of various physico-chemical parameters as well as biological factors. Zooplankton species play an important role in the food web of aquatic ecosystems. They are not only an important member of the lentic community, but they also contribute greatly to the biological production of freshwater ecosystems.

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