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A study on Zooplankton and Phytoplankton Diversity in Wetlands

Pooja Narwat[1]*, Dr. Munshi Lal Patel[2]

[1] PhD Student, Kalinga University, Raipur (CG)

[2] PhD Guide, Dept of Zoology, Kalinga University, Raipur (CG)

Abstract - Ecologically important habitats like wetlands are essential for maintaining biodiversity, purifying water, and cycling nutrients. Zooplankton and phytoplankton populations are two of the many elements that make up wetland ecosystems, and they play a crucial role in preserving the delicate balance of these environments. The goal of this review paper is to provide a thorough summary of what is currently known about the variety of zooplankton and phytoplankton in wetlands. This review emphasises the complex interactions between these two planktonic communities and their significance in wetland ecology by combining the results of many investigations.

Keywords - Wetlands, Zooplankton, phytoplankton, Diversity

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INTRODUCTION

Wetlands include a variety of waterlogged landscapes, such as marshes, swamps, bogs, and floodplains, each with a unique hydrology and water chemistry. Zooplankton and phytoplankton play a crucial role in nutrient cycling, energy transmission, and overall ecosystem health in wetlands since they are essential parts of aquatic food webs. Effective management and protection of wetlands depend on an understanding of the variety and dynamics of these plankton groups.

Water is the precious gift of nature. it is the most crucial for sustaining life and it is required in almost all the activities of person (for drinking , municipal use, for irrigation to meet the growing food and fiber needs, for industries ,power generation, navigation and recreation). The development, conservation and use of water therefore, form the main elements in the country's development planning. Water has been described as the 'Elixir of Life' and cleanser of sins'. People's lives and livelihoods depend on water. The demand for water is rising as population; economic activity and agriculture irrigation grow. However, worldwide resources of accessible water are decreasing due to overdue use and pollution. Though the defilement of water as a result of human activities is a phenomenon as old as hills, the increasing industrialization, urbanization and development activities and consequent pollution of water have brought a variable water crisis. Today most of the rivers of world are polluted by domestic water, industrial and agriculture effluents. The water resources in the country are however limited considering the future demands. In the very near future water will be a scarce resource and therefore, needs to be harnessed in the most scientific and efficient manner. The importance of groundwater for the existence of human society cannot be over emphasized. Groundwater is the major source of drinking water in both urban and rural India. Besides it is an important source of water for the agriculture and the industrial sector. Being an important and integral part of the hydrological cycle its availability depends on the rainfall and recharge conditions. The demand for water has increased over the years and this has led to water scarcity in many part of the world.

Water is important component of all living beings. It also performs unique and indispensible activities in earth ecosystem, biosphere and biogeochemical cycles.

In addition to water resource supply, surface waters serve a variety of functions and values ranging from hydrological (floodplain water storage and flood protection), ecological (biodiversity support and conservation), econ01ruc (recreation in the form of the ever popular 'river lime') and social/ cultural/ technological values (religious rituals such as the annual Hindu festival Ganga Dharaa). Surface water ecosystems in Gujarat and Madhya Pradesh do not include natural large lakes, the equivalent being reservoirs constructed for water supply. These are generally unproductive with a depauperate native fauna.

Limnology is the study of fresh water including their physical & biological aspects. There are two basic types of fresh water habitats, lentic, (standing water) and lotic (flowing water) Lakes and ponds are lentic habitals. Flowing water or

lotic habitats which include springs streams and rivers etc (Odum 1971). Lake are Generally deep and stratified with respect to temperatures oxygen and nutrients while ponds are generally shallow without seasonal stratification and those water mix regularly from top to bottom. A common system classifying lakes, refers to relatively young, deep cold and non-productive lakes as aligotrophic relatively shallow, warm and productive lakes are eutrophic.

In its modem definition, limnology is sometimes considered as onymous with freshwater ecology. However, Wetzel (2001 recognizes a distinction based on the fact that limnology is not limited to freshwater system.

Rivers and lakes cover less than 1 percent of the Earth's surface; by volume these fresh waters amount to just 0.01 percent of the world's total water. The remainder is marine (97.5 percent), permanently frozen, or in aquifers beneath the ground surface.

Biodiversity:

Biodiversity and conservation of freshwater ecosystems has been the focus of regional assessments recently since along with their terrestrial counterparts, aquatic ecosystems have been increasingly placed under pressures to provide renewable resources while being exposed to the ravages of poor planning and pollution. Listed among the identified impacts on aquatic biodiversity are deforestation, agriculture (including pesticides and irrigation), urban and industrial development, river regulation for water and hydropower production, mining, petroleum extraction, introduction of exotic species, dumping of solid wastes, dredging and channelization, overfishing and the aquanum trade identified Trinidad and Tobago's freshwater ecosystems as being of local importance in terms of biological distinctiveness, but endangered in term of conservation status. They concluded that they are a priority area for conservation at the regional scale.

Free floating organisms in water comprise two groups' viz. plankton and neuston. The terms Plankton was first proposed by Henson in 1887 to designate that heterogeneous assemblage of minute organisms and finely divided non-living material which occurs in the aquatic medium floating at the will of water current and other water movement. Presently Plankton is defined as free floating animal and plant-organism, whose interinsive power of locomotion, if present is so feeble that they remain almost, comprises organisms which are related to the surface film of water. All true plankton whether pertaining to fauna or flora belongs to euplankton and differ from pseudo-plankton which consists of dead plankters and non-living debris. The euplankton has been often arbitrarily classified as: (i) macro plankton consists of forms larger than 3 mm in size (ii) micro plankton comprising which can not pass through the blotting cloth no. 25 Plankton, according to their quality are classified as phytoplankton, the chlorophyll bearing organisms and the non-photosynthesis plants or seproplankton e. g. bacteria and fungi. Zooplankton consists of plankters of animal origin. On the basis of the sites of occurrence, plankton has been classified as limno plankton or the lake plankton, rhoplankton or potamoplankton (running water plankton); heleoplankton or pond plankton; halioplankton or salt water plankton and hypalmycroplankton or brakish water plankton.

Plankton:

The term 'plankton' refers to the group of organisms which float in the surface waters of the rivers, lakes and oceans. The great majority of the floating plants in the oceans are the unicellular microscopic algae collectively called phytoplankton. Many phytoplankton species are curious and beautiful organisms contributing to the greater diversity of forms in the aquatic environments. These micro algae are present throughout the lighted regions of all the seas and oceans including the polar regions. Their total biomass is many times greater than that of the total plants on land and they serve as the "pasture grounds" in the aquatic environment. Without phytoplankton, the primary producers, there would be no life in the seas and oceans and these micro - algae form the basis for the marine food - web process by way of fuelling energy to the higher trophic level organisms with the products of their photosynthesis.

Plankton are of immense value as food and play an important role in the disposal of sewage and in the natural purification of polluted waters. However some plankton, from a harmful bloom that may cause high mortality among the aquatic organisms and pose a serious hazard in the water supply for domestic and industrial use.

Plankton are organisms of relatively small size mostly microscopic , which have either relatively small powers of locomotion or else none at all and which drift in the water subject to the action of waves, currents and other forms of water motion.Phytoplankton mainly includes ,diatoms and dianoflagellates. Plankton is of utmost importance in the freshwater ecosystem as these are the main source of energy and having a very high nutritive value.

Plankton abundance and distribution are strongly dependent on factors such as ambient nutrients concentration the physical state of the water column, and the abundance of other plankton.

Phytoplankton:

Phytoplankton (from Greek Phyton), autotrophic, prokaryotic or Eukarotic algae that Jive near the water surface where there is sufficient light to support photosynthesis. Among the more important

groups are the diatoms, cynobacteria and dinaflagelates.

Phytoplankton converts solar radient energy into biological energy through photosynthesis as primary production. It plays an important role in conditioning the microclimate, helps in regulating the atmospheric level of 02 and CO2, vital gases for life. Apart form primary production , ,phytoplankton plays an important role as food for herbivorous animals. Distribution of phytoplankton and their variation at different zones of a water body is known to be influenced by physico-chemical parameters of water. Phytoplankton study provides a relevant and convenient point of focus for research on the mechanism of eutrophication and its adverse impact on an aquatic ecosystem. Algal flora constitutes a vital link in food chain and its productivity depends on water quality at a given time (Meshram and Dhande, 2000).

Marine phytoplankton comprise a complex community of several thousand floating micro - algae in the sea, ranging in size from about 1 µm upto a few millimeters. Based on their size, phytoplankton can be classified as macroplankton (more than 1 mm), microplankton (less than 1 mm, retained by nets of mesh size 0.06 mm), nanoplankton (between *5* and 60 micrometers) and ultraplankton (less than 5 micrometers). Many phytoplankton species belong mainly to the nanoplankton and microplankton fractions.

The planktonic study is a very useful tool for the assessment of water quality in any type of water body and also contributes to understanding of the basic nature and general economy of the lake (Pawar et al., 2006). In these systems phytoplankton is of great importance as a major source of organic carbon is located at the base (Gaikwad et al., 2004). The maintenance of healthy aquatic ecosystem are dependents on the abiotic properties of water and the biological diversity of the ecosystem (Harikrishnan et al., 1999).

Over the last few decades, there has been much interest in the processes influencing the development of phytoplankton communities, primarily in relation to physico-chemical factors (Akbay *et al.,* 1999; Peerapompisal *et al.,* 1999; Elliott *et al.,* 2002). The algae co-occur even though each species has a specific niche based on its physiological requirements and the constraints of the environment. These are many detailed descriptions of phytoplankton succession being correlated with changes in environmental parameters particularly temperature, light, nutrients availability and mortality factors such as grazing and parasitism. Because the variation of phytoplankton succession is strongly linked to meteorological and water stratification mixing processes, patterns in temperate ecosystems differ considerably from those of tropical waters (Wetzel, 2001).

The dynamics of phytoplankton are a function of many of the some environmental processes that affect species diversity. For example, the onset of the spring bloom in dimitic lakes is controlled by the relief of light limitation at a time when nutrient concentrations are high and growth abundance is low (Roelke and Buyukates, 2002). The abundance of algae of different kinds is rather closely associated with restricted seasonal periodicity, differing of course in widely separated geographical locations(Smith, 1951). Within reservoirs, the irregular dynamics of inflow and variable flushing rates markedly alter environmental conditions for biotic communities. A reservoir can be viewed as a very dynamic lake in which a significant portion of its volume possesses characteristics of, and functions biologically as,a river (Wetzel, 2001).

Zooplankton:

The zooplanktons are animal plankton and move at the mercy of water currents. They occupy central position between the autotrophs and other heterotrophs in an aquatic ecosystem and form a major link in the entire food chain and main energy source for fishes truly planktonic animals in fresh waters are dominated by Rotifera, Cladocera and · Copepoda. Protozoans also form a significant part of fresh water zooplankton.

Zooplankton assume a great ecological significance in ecosystem as they play vital role in food web of the food chain, nutrient recycling, and in transfer of organic matter from primary producers to secondary consumers like fishes (Krishnamurthy *et al.,* 1979). They are more abundant within mangrove water ways than in adjacent coastal waters, and a large proportion of the juvenile fish of mangroves are zooplanktivorous (Robertson and Blabber, 1992). The zooplankton determine the quantum of fish stock. The failure of fishery resources is attributed to the reduced copepod (zooplankton) population (Stottrup, 2000). Hence, zooplankton communities, based on their quality and species diversity, are used for assessing the productivity viza viz fishery resource, fertility and health status of the ecosystem.

Marine zooplankton comprises a large variety of different organisms with some ten thousands of species if meroplankton is included. Their sizes range from tiny flagellates (a few mm large) to giant jellyfish (2 m diameter) and thus span six orders of magnitude. To cope with this enormous size range volume and weight span eighteen orders of magnitude a first attempt at size classification was already undertaken as early as 100 years ago during the earlier period of quantitative plankton research (Schutt, 1892).

The zooplanktons from major link in the energy transfer at secondary level in aquatic biotopes. The occupy an intermediate position in aquatic food webs between autotrophs and heterotrophs. The distribution and diversity of zooplankton in aquatic ecosystems terms depends mainly on the physico-chemical proportion of water. Pollution of

water bodies by different sources will result in drastic changes in zooplankton potential of the ecosystem. Zooplanktons are known to accumulate chemicals by direct absorption from water and through food intake.

The grazing rate of zooplankton is one of the major factors influencing the size of the standing crop of phytoplankton, and thereby the rate of production. A sharp decline in the number of diatoms following their spring outburst has been found to occur before the nutrients are fully exhausted. This is correlated with the increase in quantity of zooplankton, and so grazing by the zooplankton can be suggested as one of the causes for the decline in the standing crop of phytoplankton. An inverse relationship in the distribution of phytoplankton and zooplankton is usually discernible.

Zooplankton Diversity:

Zooplankton, consisting of various small aquatic animals, include copepods, rotifers, cladocerans, and protozoans. These organisms serve as primary consumers, feeding on phytoplankton and detritus, and in turn, provide a vital food source for higher trophic levels. The diversity of zooplankton in wetlands is influenced by factors such as water temperature, nutrient availability, predation, and habitat complexity. Studies have shown that wetlands with greater structural complexity tend to host higher zooplankton diversity due to increased microhabitats and resource availability (Wetzel, 2001).

Phytoplankton Diversity:

Phytoplanktons, comprising microscopic photosynthetic organisms, are the primary producers in wetland ecosystems. They are responsible for the production of organic matter and oxygen through photosynthesis. The composition and abundance of phytoplankton are influenced by water nutrient levels, light availability, and hydrological fluctuations. Cyanobacteria, diatoms, green algae, and dinoflagellates are common phytoplankton groups found in wetlands. Their diversity and community structure play a pivotal role in shaping the overall water quality and ecosystem dynamics.

Interactions and Dynamics:

The relationship between zooplankton and phytoplankton is complex and intertwined. Zooplankton grazing controls phytoplankton populations, regulating their abundance and composition. Conversely, phytoplanktons serve as a primary food source for zooplankton, driving their growth and reproductive success. Trophic cascades and feedback loops can occur when shifts in one planktonic community affect the other, subsequently impacting the entire wetland ecosystem.

Environmental Implications:

Understanding zooplankton and phytoplankton diversity in wetlands has profound implications for water quality management, biodiversity conservation, and sustainable resource utilization. Elevated nutrient inputs, often resulting from human activities, can lead to imbalances in plankton communities, causing harmful algal blooms and reduced water clarity. Effective wetland management strategies can help mitigate these issues by restoring natural hydrological regimes and promoting biodiversity conservation.

CONCLUSION

In conclusion, the variety of zooplankton and phytoplankton in wetlands is an essential part of the health and functioning of these ecosystems. The complex interconnections between these two groups have an impact on trophic dynamics, nutrient cycling, and water quality. Further study is required to understand the intricacies of planktonic communities and their reactions to shifting environmental circumstances as wetlands come under increasing human strain. To maintain the long-term viability of these priceless ecosystems, this analysis highlights the necessity for coordinated approaches to wetland management that place a priority on zooplankton and phytoplankton variety protection.

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Corresponding Author

Pooja Narwat*

PhD Student, Kalinga University, Raipur (CG)