A Review of Phytoplankton Ecology in Freshwater Rivers and Lakes of India

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Abstract

Water resource is an essential ingredient for human survival. The availability of safe drinking water is important for proper growth of human being. This is a comprehensive review of phytoplankton ecology in freshwater lakes of India. A review study was undertaken for the better understanding of the phytoplankton distribution. In broad terms, authors discussed the relations of phytoplankton with factors like lake temperature, sunlight exposure period, sunlight penetration, water pH, wind, transparency, seasonal variations, water characteristics, nutrient enrichment and prey-predator relation in the lakes of India. From the results, authors noticed that each lake habitat is different from other lake habitat. Finally, authors concluded that phytoplankton ecology is an indicator for the evaluation of impacts of influencing factors. These factors provide a suitable management plan for lakes. Phytoplankton ecology provides a ground for monitoring and assessing the strategies of the fresh water lake management.
Keywords: Phytoplankton ecology, River, Lake, Seasonal fluctuation, Phytoplankton distribution

I. INTRODUCTION

About four thousand million years ago, life initiated in an aquatic environment. Today, most of the taxonomic phyla dwell in an aquatic environment. In an aquatic environment, phytoplankton is most ubiquitous, unicellular and microscopic life form. Phytoplankton collectively accounted about half of the earth's primary producers Manisha D. Giripunje 2013. Word plankton originates from the Greek meaning "Wandering". 'Plankton' as a term was first used by Victor Hensen (1887) for the aquatic communities of floating and drifting organisms that are carried primarily by movement of water current rather by their own swimming ability. While this is so, it must be remembered that, considering their small size, many plankton animals are strong swimmers and are capable of moving through relatively long distances over a period of time, particularly in a vertical direction. Plankton includes organisms of both plant and animal origin. The plant component of the plankton is called phytoplankton and the animal component is called as zooplankton. There is a third group that can absorb dissolved organic matter called saproplankton. The majority of phytoplankton belongs to Chlorophyceae, Cyanophyceae and Bacillariophyceae. Their unique ability to fix inorganic carbon to build up organic matter through primary production makes them very important in food web.

In recent years, researchers have participated in the study of phytoplankton ecology of freshwater lakes in India. However, in early years, researchers reported many research studies on phytoplankton distribution and density in freshwater lakes of all over India (Ganapati, 1940; Mohan, 1987; Chaudhary & Pillai 2009; Singh & Balasingh 2011; Dakshini & Gupta 1979; Sarwar,1996, Tiwari & Chauhan 2006, Mukherjee et al., 2010; Jain et al., 1999; Chattopadhyay & Banerjee 2007; Ghosh et al., 2012; Jhingran, 1989; Somani et al., 2007; Maske et al., 2010). In this review, we presented an elaborative literature synthesis on the phytoplankton ecology and various factors interacted in freshwater lakes of north, south, east and west regions of India. This review may provide a better understanding of phytoplankton ecology in Indian freshwater lake scenario. It should assess qualitatively for anthropogenic changes which resulted nutrient enrichment. It provides a ground for future studies on management of freshwater lakes with phytoplankton distribution.

II. PHYTOPLANKTON ECOLOGY

Indian researchers reported the several studies on the phytoplankton distribution with availability of light (Singh & Sharma, 2012), physical, chemical and biological qualities (Zafar, 1967; Munawar, 1974) in freshwater lakes. Today, Indian freshwater lakes are facing tremendous ecological stress due to raising of pollution from rapid industrialization. However, mainly seasonal changes regulated pattern of phytoplankton growth. Studies reported that the summer is the most suitable season for the growth of phytoplankton in freshwater lakes because of long duration of sunshine period, increased salinity, pH and trophotropic activities (Chaturvedi et al.,1999). Conversely, in late summer and monsoon season, 129 the production of phytoplankton reduced because of heavy rainfall, high turbidity, reduced salinity, temperature, pH, overcast skies and low nutrient concentration along with consumption of phytoplankton by zooplankton and fishes etc. (Saravanakumar et al., 2008). Phytoplankton community progresses a serial successions to culminate in a peak sequences with low turbidity and low wind velocity in the lakes (Chaudhary & Pillai, 2009; Sugunan, 2000). Anand (2000) studied the ecology of a Diatom species in relation to changes in water quality parameters at different regions of a stream in Jammu and explained its limnological significance. Coesel (2001) noted that, Desmids are

ecologically highly sensitive microorganisms and are useful tool in aquatic conservation management especially in those cases where macro organisms fail.

Mahadev and Hosmani (2002) correlated Langliers index and phytoplankton in two lakes of Mysore city in India. They reported that the absence of Desmids is an indication of heavy pollution in water. Steinhart et al. (2002) studied phytoplankton as indicators of nutrient deficiency in the southern Chilean lakes and found that phosphorus should not be discounted as a limiting nutrient in aquatic system. They identified Desmids as indicators of good quality of water. According to Brunberg and Blomqvist (2002) Microcystis is a widely distributed organism, which dominates the phytoplankton community in nutrient rich lakes.. Lange and Tiffany (2002) noticed that when turbulence is high in a lake as during strong winds, Diatoms that are usually associated with benthic and epiphytic habitats gets mixed into plankton in such systems..

Izaguirre et al. (2004) analyzed the algal assemblages across a wetland in South America. The study revealed that phytoplankton of the Lake comprised of many small autotrophic green algae, accompanied by many flagellates of the classes Cryptophyceae, Euglenophyceae and Dinophyceae. The results indicated that the macrophytes cover was probably the stirring factor in the selection of algal species along the transitional zone comprising a floodplain shallow lake. Owen et al. (2004) made a detailed investigation of the wetlands in Kenya and observed that the Diatom flora shows clear differences between contrasting wetland types. Tewari and Srivastava (2004) investigated the distribution pattern of algal flora in a water body affected by the effluents form the nearby rubber factory in India. According to them algae play very important roles as pollution indicators, because they show high range of tolerance capacity against the polluted water releasing from rubber factory.

G.M.N. Rao, et.al (2010), Seasonal Abundance of Micro Algae in Pandi Backwaters of Godavari Estuary, Andhra Pradesh, composition of phytoplankton varied seasonally in relation to salinity fluctuations. Present study indicates that diatoms are the dominant group followed by the Chlorophyceae and others. Jafari, N.G and Gunale, V. R (2006), Hydro biological Study of Algae of an Urban Freshwater River. The algal flora of polluted water bodies shows the dominance of blue green and diatoms like, Oscillatoria, Lyngbya, Anabena, Microcystis, Navicula, Nitzschia, Synedra, Gomphonema throughout the investigation many green algae like,Pandorina,Scenedesmus,Stigeoclonium,Ankistrodesmus, Chlamydomonas, also occur abundantly and frequently. Impact of Physico-Chemical Characteristics of lakes on Phytoplankton Communities, studied by Kolhapur, Patil Shilpa G. et.al (2012), There were 9 species observed from the class Chlorophyceae, 4 species of the class Cyanophyceae, 3 of the class Bacillariophyceae, 3 of the class Euglenophyceae.

III. DISCUSSION

Phytoplankton is a fundamental component of aquatic ecosystem as they are major sources of biologically important and labile organic carbon, located at the base of the food chain. The density and productivity of the phytoplankton are greatly influenced by different physico-chemical characteristics of water. Algae are very useful for eutrophication estimation. Quality and distribution of algal flora in river have been carried out systematically to evolve algal indices of pollution.

Light and temperature influence the quality and quantity of phytoplankton. Considering plankton as a whole the present observation showed peak period between April and June. It is probable that the gradual increase in temperature in water promoted optimum condition for growth and reproduction of algal population. Prescott (1984) reported that for fresh water the optimum temperature is between 20-25 ^{0}C. An increase in temperature may affect the net growth of phytoplankton positively or negatively depending upon the type of species

This review study discussed the ecology of phytoplankton in the result section. Factors played an important role to regulate the phytoplankton in Indian freshwater lakes and rivers, focused on the factors. The phytoplankton groups such as green and blue-green algae varied with the nutrient availability in the freshwater. Phytoplankton diversified with the effect of factors in lakes of different regions of India. Nationwide, diatoms such as Navicula sp., Nitzschia sp., Synedra sp., Melosera sp. contributed to the phytoplankton composition in early winters. Diatoms occurred in unpolluted part of the freshwater which were good indicators of pollution. Phytoplankton group substituted diatom flora by green and blue green algae with increased pollution in the freshwater. Factors such as seasonality, period of sunshine, wind patterns, depth of lake, temperature, pH, turbidity, dissolved oxygen, nutrient enrichment like dissolved chloride, phosphate and organic carbon ultimately influenced the occurrence phytoplankton in the freshwater. We also focused on influence of biotic factors on phytoplankton population. That might influence on the distribution pattern of phytoplankton. In this review; authors discussed different factors influenced the phytoplankton in freshwater of India. Each resource habitat is different from other. So, rivers and lakes needed their suitable management plans to control algal blooms from identified factors. Some freshwater studies showed diffused nutrient sources from land cover changes. Such studies are likely to manage but needs many years for restoration.

IV. CONCLUSION

It is clear from the review; phytoplankton ecology in freshwater of India is greatly influenced by factors. Review study reported most of the studies on phytoplankton ecology in India are related to climatic conditions. But, climatic conditions are not only affected phytoplankton assemblages. Watershed features, land use, geochemical features, soil or sediment also affected phytoplankton ecology. Research works on these factors or other unknown factors are not clearly reported in studies of Indian freshwater. Research works required further investigation to explain the relation between phytoplankton communities and fresh

water chemistry and other factors in Indian scenario. However, most of the discussed case studies are basic and provides necessary information to develop protection and management plans.

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