SJIF IMPACT FACTOR: 5.79 CRDEEP Journals
International Journal of Life Sciences Dube et. al., Vol. 7 No. 2 ISSN: 2277-193x
International Journal of Life Sciences. Vol. 7 No. 2. 2018. Pp. 71-74

Review Paper

A Critical Review on the Studies of Phytoplanktons in Lotic Water of India

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Article history
Received: 05-01-2018
Revised: 10-01-2018
Accepted: 17-01-2018

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Abstract
Phytoplanktons are microscopic free floating animals which play a vital role in aquatic ecosystem. They are highly sensitive to environmental variation, as a result change in abundance, species diversity or community composition can provide important indication of environmental health. In the present paper an extensive review of the literature available on Phytoplanktons in lotic water of India have been made which is a long felt necessity in this field.

Key Words: *Diversity, Pollution, Phytoplanktons, Lotic water, Environment.*

Introduction
Lotic refers to flowing water, it includes river, spring, streams etc. In lotic water flow is unidirectional and there is a state of continuous physical change and the biota is specialized to live with flow condition. Rivers are important system of biodiversity and are among the most productive ecosystems on the earth because of the favourable conditions that supports number of flora and fauna (Gupta *et al*., 2005). Planktons are diverse group of organism with feeble lcomotors that live in the water column of water bodies that cannot swim against a current (Dube 2005). The study of plankton is very useful tool for the assessment of biotic potential and contributes to overall estimation of biotic nature and general economic potential of water bodies (Pawar *et al.,* 2006).

Phytoplanktons
These are microscopic creatures mainly algae contain chlorophyll and live near the surface of water where there is sufficient light, producing their own food and thus providing meals for countless other aquatic dwellers. They play important role in maintaining the equilibrium between living organism and abiotic factors. The density and diversity of phytoplanktons and their association as biological indicator is significant in the assessment of water quality. Phytoplanktons are good indicator of environmental changes and their variation provides a ground for monitoring and assessing the strategies of the river management.

Review
Margalef (1968) suggested that phytoplanktons population in fertile water is more diverse than those in infertile water. Odum (1971) stated that phytoplanktons are the primary producers for the entire aquatic body and comprises the major portion in the ecological pyramids. Reddy and Venkateswarlu (1986) investigated impact of pulp and paper mill on the abudance of algae in the River Tungabhadra. They observed that in the effluent channel algae were present in very low numbers. After the effluent were discharged in the river, blue green algae made their appearance in good number. Nandan and Patel (1984) has showed the algal genera, *Euglena, Oscillatoria, Scenedesmus, Navicula, Nitzschia and Microcystis* are the species found in originally polluted waters. Narendra *et al.*, (1990) revealed that due to the pollution, phytoplanktons population is affected and leading to drastic change in the food chain of the fresh water environment. Mukherjee and Pankajakshi (1995) assessed the impact of detergents on plankton in freshwaters. They observed that *Microcystis* was tolerant species to the toxic effects of detergents. Sarojini (1996) observed that high turbidity, pH, bicarbonate, orthophosphate, alkalinity, chloride may be responsible for the Cyanophycean growth and bloom.

Sunder (1996) assessed the planktonic community of Kumaon Himalayan River Gaula. They investigated that the diatoms formed the major group among the total phytoplanktons. Kalavati *et al.,* (1997) studied phytoplanktons occupy the functional and basic significance in the overall food web. Mishra and Tripathi (2002) showed that phytoplanktons are ecologically significant as they form the basic link in the food chain of all aquatic animals. Hambright and Zohary (2000) revealed that phytoplanktons are one of the

most essential characteristics of the aquatic ecosystem for maintaining its stability and a means of coping with any environmental change.

Begam and Khan (2002) checked the impact of the pollution of River Burhi Gandak on plankton, Bihar. They noticed a decrease in water temperature while dissolve oxygen concentration and number of phytoplanktons was dropped in summer. Dube(2005) has studied physicochemical characteristics of semi-permanent pond at Baran Rajasthan, India. The plankton study is very useful tool for the assessment of biotic potential and contributes to overall estimation of basic nature and general economic potential of water body. (Pawar *et al*., 2006)

Joshi (2005) observed the phytoplanktons population in the River Sutlej of western Himalayas, was changes with the floods. He stated that the dilution effect of floods not only reduced the plankton-density but also lowered the organic carbon productivity.

Mathivanan *et al*., (2007) studied plankton of River Cauvery water (Tamil Nadu), the qualitative and quantitative evaluation of the variation in river water showed high quantity of phytoplanktons belonging to Chlorophyceae, Bacillariophyceae, Myxophyceae and Euglinae. This study revealed that the water of River Cauvery is highly polluted by direct contamination of sewage and other industrial effluents.

Desai *et al*., (2008) studied Phytoplanktons diversity in Sharavati River basin, Central Western Ghats. During this study total of 216 species of 59 genera belonging to Bacillariophyceae, Desmidials, Chlorococcales, Cynophyceae, Dinophyceae, Euglenophyceae and Chrysophyceae were recorded. Various pollution indices showed the oligotrophic nature of the reservoir waters with slight organic pollution in stream waters.

Mishra *et al*., (2008) studied that in fresh water ecosystems primary productivity by phytoplanktons involves trapping of radiant energy and its transformation into high potential biochemical energy by photosynthesis, using inorganic materials of low potential energy.

Shekhar *et al*., (2008) studied water quality status of River Bhadra receiving Mysore paper mill and iron and steel mill effluent. A total of 45 species of phytoplanktons belonging to 5 classes were recorded. This study showed phytoplanktons diversity. It did not show the same type of water quality. This study showed the need of phytoplanktons community as index of water quality polluted by industrial effluents at the downstream of the Bhadra River.

Dube *et al.,* (2010b) have studied the occurrence and seasonal variation of the plankton in Kishore Sagar Tank, Kota, Rajasthan and twenty four species of phytoplankton were recorded.

Annalakshmi and Amsath (2012) studied phytoplanktons diversity of River Cauvery. He reported 68 species of phytoplanktons comprising Cholrophyceae 33.82%, Bacilleriophyceae 27.94%, Cyanophyceae 32.35% and Euglenophyceae 5.88%.

Ferdous *et al.*, (2012) studied phytoplanktons diversity in River BuriGanga. He estimated 27 genera of phytoplanktonss belonging to five families viz. Cyanophyceae, Bacillariophyceae Chlorophyceae, Euglenophyceae and Cryptophyceae.

Khanna *et al*., (2012) studied the analysis of water samples for plankton diversity of river Ganga, In this study of River Ganga, the phytoplanktons diatoms were dominated and class Blue green algae was found.

Shyam *et al*., (2012) studied water chemistry and phytoplanktonic variation of Kalisil River, district Karuli. This study revealed fluctuations in the various physico-chemical properties of water in different seasons. A total of 36 algal genera with 60 species belonging to four class have been accounted viz Chlorophyceae(23species) , Cyanophyceae(20species) Bacillariophyceae (13 species) and Euglenophyceae(13 species).

Sudha Summarwar (2012) investigates the plankton diversity in Thadoli area of Bisalpur reservoir. During this study the most pollution tolerant species of *Oscillatoria,Euglena* and *Navicula* were recorded. Only 4 groups of Phytoplanktons belonging to Chlorophyceae (22 species), Euglenophyceae (7 species) ,Bacillariophyceae(7 species) and Cyanophyceae (12 species) were recorded.

Bhatnagar and Bhardwaj (2013) studied the seasonal algal diversity and the physico-chemical properties of water of Chambal River. This study shows the presence of a total of 65 algal species. Some algal forms are good indicators of water pollution and their presence show signs of water pollution.The algal forms consisted of a total of 65 taxa belonging to Chlorophyceae(32 species),Cyanophyceae(18 species), Bacillariophyceae (12 species), and Euglenophyceae (3 species). Negi and Rajput (2013) studied Phytoplanktons Community Structure in Ganga River at Bijnor. They reported 43 genera of phytoplanktons belonging to 5 groups viz. Chlorophyceae 16 genera, Bacillariophyceae 12 genera, Cyanophyceae 10 genera, Euglenophyceae 4 genera and Xanthophyceae 1

genera. Chlorphyceae exhibited maximum abduance and genera diversity and Xanthophyceae exhibited minimum abudance and genere diversity.

Komala *et al*., (2013) studied plankton diversity and abundance of Arkavathi River. It was assessed before and after pollution. Plankton diversity and abundance varied during different seasons, both at non-polluted and polluted sites. A total of 71 species of phytoplanktons were recorded belonging to Myxophyceae(36 species), Bacillariophyceae(13 species), Euglenophyceae (5 species), Chlorococcales (6 species) and Desmidiceae (11 species). Singh, P (2013) studied biodiversity of River Gomti which is heavily affected by pollution. Planktons are important biological parameters to access the pollution level. This study shows biological productivity as ecological indicator to identify the ecological quality of River Gomti. The phytoplanktons density fluctuated maximum during monsoon season and minimum during winter season. Phytoplanktons consists of the members of Chlorophyceae (7 species), Bacillariophyceae (5 species),Cyanophyceae (4 species) and Euglenophyceae (1 species).

Subhashree and Patra (2013) studied phytoplanktons of River Mahanadi of Odisha. This study revealed that diversity of species Chlorophyceae 53.45% whereas Cyanophyceae 20.78% and Bacillariophyceae 25.77% were composed.

Mukati *et al*., (2014) studied phytoplankton-ecology in Narmada River of West Nimar, MP, and India. Ten species of phytoplanktons have been collected from various freshwater habitats in the West Nimar. This study revealed Cyanophyceae has a dominant class. Phytoplanktons belonging to Cyanophyceae (4 species), Charophyceae (3 species), Trebouxiophyceae(1), Ulvophyceae(1), Zygnematophyceae(1) were reported from River Narmada.

Ekpo *et al*., (2015) studied plankton abduance and diversity in great KWA, River, Nigeria. He revealed a total of 26 species and 574 phytoplanktons individuals belonging to 4 families.The family represented were Bacillariophyceae 49.83%, Chlorophyceae 21.25%, Chrysophyceae 16.55% and Cyanophyceae 12.37%. Hossain *et al*., (2017) studied diversity of plankton communities in the River Meghna. He reported Chlorophyceae with 16 genera, Dinophyceae with 2 genera, Bacillariophyceae with 13 genera, Cyanophyceae with 2 genera, Myxophyceae with 5 genera, Englenophyceae with 1 genera and Xanthophyceae with 2 genera.

Conclusion

Concluding the above account we can state that Phytoplanktons are popular organisms found in fresh water resources.They are important part of aquatic food chain and food webs and proves to be very good indicators about the water quality.In the above account it has been observed that studies were reported regarding their diversity impact of pollution and toxic materials.Thus phytoplanktons study is a very important tool in limnology.

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