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Original Research Paper

Pollution Monitoring by Algae in a Sacred Water Body of Belgaum District

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ABSTRACT

Biological evaluation is a useful alternative for rating the ecological quality of aquatic ecosystems, as biological communities amalgamate the environmental effects of water chemistry. To recognize the nature of species composition of phytoplankton and their significance, the present surveillance was made for a period of twelve months in a sacred water body in Belgaum district. The study exposed the occurrence of 50 phytoplankton species belonging to 26 genera. Among these, 19 genera are identified as most pollution tolerant genera. According to the list, dominant group was represented by Bacillariophyceae followed by Chlorophyceae and Euglenophyceae. The algal flora of this sacred water body showed the dominance of *Scenedesmus, Pediastrum, Ankistrodesmus, Coelastrum, Cyclotella, Navicula, Nitzschia, Synedra, Melosira, Euglena, Lepocinclis* and *Phacus.* These floating, inconspicuous primary producers of aquatic ecosystem are indicators of organic pollution. The present paper highlights the assessment of water quality status using pollution index based on the phytoplankton community of water.

INTRODUCTION

Phytoplanktons are floating, inconspicuous primary producers of aquatic ecosystems. The phytoplanktons are more sensitive to pollution than other organisms and are used for water quality characterization by many authors by using different indices, for many years. Algae are known as a reliable biological indicators of water pollution (Palmer 1969 and Patrick 1971). Biological indices are aimed at providing a numerical version of the biological information, especially the species composition, the diversity of species, their distribution pattern and by the presence or absence of the indicator species or various groups etc. (Trivedy & Goel 1984).

Phytoplankton abundance in a water body reflects the average ecological condition and, therefore, it may be used as an indicator of water quality (Bhatt et al. 1999, Saha et al. 2000). Biological assessment is a useful alternative for assigning the ecological quality of aquatic ecosystems, since biological communities merge the environmental effects of water chemistry in addition to the physical and geo-morphological characteristics of rivers and lakes (Steven & Pan 1999). Chemical analyses of water provides a good indication of the quality of aquatic systems, but they do not integrate ecological factors such as altered riparian vegetation or altered flow regimes and, therefore, do not necessarily reflect the ecological state of the system (Karr et al. 2000). According to Whitton & Patts (2000), phytoplanktons have revealed tremendous scope for the environmental management as soil conditioners, bio-fertilizers, bio-indicators, bio-monitors, ameliorators, as feed for animals, protein supplement and rehabilitators of degraded ecosystems through bio-absorption of pollutants.

Stress due to anthropogenic activity results in cultural eutrophication and in the recent approaches, assessment of pollution tends to use algal communities as indices (Vaishali & Madhuri 2007). Pollutants bring about a change not only in the physical and chemical quality of water but also transform the biotic components, resulting in the elimination of some probably valuable species. Growth of different algae and planktonic groups in a water system are the reflection of the water quality of that particular water body.

A water quality index provides a convenient means of summarizing complex water quality data and facilitating its communication to a general audience. The pollution index of Palmer (1969) developed for rating of water samples as high or low organically polluted is a useful technique, since algal populations are used. The ranking technique is also another important aspect. The technique enables the researcher to place the sites under study from the most polluted to the least polluted or compare similar sites for conservation strategies. These techniques put together can be a better way of studying organic pollution in tanks. Hence, in the present work an attempt was made to know the phytoplankton diversity of a sacred tank in Belgaum district and Palmer pollution index was applied to know the status of the water body. In the present study it is observed that the tank is under contamination threat by wastes derived from anthropogenic activities and agricultural activities that alter the ecology of the biotic environment.

MATERIALS AND METHODS

The sacred water body selected for the present study is an ancient sacred tank found in the premises of Sathyamma Devi temple that fulfills everyday needs of devotees visiting the temple, during important festivals (Fig. 1). It is located at 5 km from Savadatti in Belgaum district in the state of Karnataka, India. It is located nearly 2,500 ft (762 m) above the sea-level. In recent times, this temple tank is facing an acute pollution problem and emitting a foul odour. Apart from this, seasonal congregation of humans to celebrate the festivals often have a severe impact on this water body. Consumption of this water, including an age old ritual 'Mass bathing' is a regular activity at this point. Mass bathing increases the organic matters in the water body, apart from impurities like soaps, detergents and a lot of clothes, hairs, bangles, photo frames, flowers, etc.

The composite water samples were collected in acid washed one-litre capacity plastic containers from a depth of 5-10 cm between 9.30 a.m. to 10.30 a.m. Water temperature was recorded using a mercury centigrade thermometer at a depth of 5-6 cm. Chemical values were determined following APHA (1998). For laboratory investigation, the samples were preserved in 5% of formalin followed by sedimentation and centrifugation. Microscopic scrutiny of the sample was done preparing temporary slides to gather information about number of genera present and their relative dominance. The planktons were identified using the keys provided by Prescott (1951), Desikachary (1959) and Philipose (1967).

RESULT AND DISCUSSIONS

Fig. 1: The congregation of devotees at the holy tank, Jogula Bavi

Table 1: Pollution tolerant genera with index values from the study areas, Palmer (1969).

S. No.	Genera	Pollution index numbers	Algal Groups
1	*Acnanthes*	2	Bacillariophyceae
2	*Cyclotella*	1	Bacillariophyceae
3	*Cymbella*	-	Bacillariophyceae
4	*Fragilaria*	-	Bacillariophyceae
5	*Melosira*	-	Bacillariophyceae
6	*Navicula*	4	Bacillariophyceae
7	*Nitschia*	-	Bacillariophyceae
8	*Pinnularia*	-	Bacillariophyceae
9	*Synedra*	1	Bacillariophyceae
10	*Ankistrodesmus*	-	Chlorophyceae
11	*Closterium*	-	Chlorophyceae
12	*Coelastrum*	1	Chlorophyceae
13	*Crucigenia*	3	Chlorophyceae
14	*Pediastrum*	3	Chlorophyceae
15	*Scenedesmus*	-	Chlorophyceae
16	*Selenastrum*	2	Chlorophyceae
17	*Euglena*	5	Euglenophyceae
18	*Lepocinclis*	1	Euglenophyceae
19	*Phacus*	2	Euglenophyceae
Total scores	25	3 groups	

In the present study, a distinct seasonal variation was noted in the number of phytoplankton. A total of 26 genera were noted in the sacred water body at Savadatti, in which 19 genera were identified as the most pollution tolerant genera according to the Palmer's list (Table 1). Of them, 9 genera belong to the group Bacillariophyceae, 7 genera belong to Chlorophyceae and 3 to Euglenophyceae. The overall Palmer's score in Savadatti tank is 25. The algal flora of this polluted sacred water body showed the dominance of *Scenedesmus, Pediastrum, Ankistrodesmus, Coelastrum, Cyclotella, Navicula, Nitzschia, Synedra, Melosira, Euglena, Lepocinclis, Phacus* and many others as listed in Table 1. Monthly variations in phytoplankton genera are given in Table 2.

According to the observations, *Melosira* and *Syndera* among Bacillariophyceae were common during all seasons, but minimum during winter season, while *Pinnularia* and *Fragilaria* were observed only once in a year during summer and winter seasons respectively. *Melosira* and *Fragilaria* grow well in polluted waters (Palmer 1969) which is true in the present study.

Among the Chlorophyceae, *Coelastrum* genera was found dominant and was observed only during late monsoon and early winter season. To our surprise it was observed that the September and December months of the study period, did not show any species; only *Coelastrum microporum* showed its existence depicting that it is the most tolerant species. Many green algae such as *Scenedesmus,*

Table 2: Monthly variations in the genera observed in the study area (May 2012-April 2013)

Sl No	Algal Genera	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
	Chlorophyceae												
1	*Ankistrodesmus**	0	p	p	p	0	p	p	0	0	0	0	0
2	*Botryococcus*	0	0	0	0	0	0	0	0	0	0	0	p
3	*Coelastrum**	0	0	0	0	p	p	p	p	0	0	0	0
4	*Closterium**	0	0	0	p	0	0	0	0	0	0	0	0
5	*Crucigenia**	0	p	0	p	0	0	0	0	0	0	0	0
6	*Pediastrum**	p	p	0	0	0	p	0	0	0	0	0	0
7	*Scenedesmus**	0	p	0	p	0	p	p	0	p	0	0	0
8	*Selenastrum**	0	p	0	0	0	0	0	0	0	0	0	0
9	*Tetradesmus*	0	p	0	0	0	0	0	0	0	0	0	0
10	*Tetrastrum*	0	p	0	0	0	0	0	0	0	0	0	0
11	*Staurastrum*	p	p	0	0	0	0	0	0	p	0	0	0
12	*Westella*	0	0	0	p	0	0	0	0	0	0	0	p
	Bacillariophyceae												
1	*Acnanthes**	p	0	p	p	0	p	0	0	p	0	0	p
2	*Aulocosiera*	p	p	p	p	0	0	p	0	p	p	P	p
3	*Cyclotella**	p	p	0	p	0	0	0	0	p	0	0	0
4	*Cymbella**	p	0	0	0	0	0	0	0	p	0	0	0
5	*Fragilaria**	0	0	0	p	0	0	0	0	0	p	P	0
6	*Melosira**	p	p	0	p	0	0	0	0	p	p	P	0
7	*Navicula**	0	0	0	0	0	0	0	0	p	0	0	0
8	*Nitschia**	p	p	0	p	0	0	0	0	p	p	0	0
9	*Pinnularia**	0	0	0	0	0	0	0	0	p	0	0	p
10	*Synedra**	p	p	p	p	0	p	0	0	p	p	P	p
	Euglenophyceae												
1	*Euglena**	p	p	p	p	0	p	p	0	0	0	0	0
2	*Lepocinclis**	p	p	0	p	0	0	0	0	0	0	0	0
3	*Phacus**	0	p	p	p	0	p	p	0	0	0	0	0

*represent the organic pollution indicator genera as identified by Palmer (1969), P-Present, 0-Absent

Ankistrodesmus and *Pediastrum* also occurred abundantly and frequently in the water body.

Euglenophyceae was a third populated group with *Euglena* > *Lepocinclis* > *Phacus* species. Maximum population density of Euglenophyceae was observed during monsoon followed by summer and absent during winter season. Euglenophyceae though found in less number, showed distinct periodicity and sudden disappearance and correlates with the above result.

According to Patrick (1965), the species of *Euglena* are most tolerant to highly polluted water and significant indicator of eutrophication. Palmer (1969) has shown that genera like *Scenedesmus, Euglena, Nitschia* and *Navicula* are generally found in organically polluted waters. This was also confirmed by the study of Goel et al. (1986), Nandan & Aher (2005) and Shekhar et al. (2008). It has been reported by Rathnasabapathy (1975) that *Euglena* and *Ankistrodesmus* are typical inhabitants of heavily polluted waters. Moreover, *Euglena* is recorded with very high grade points on Palmer's scale. The results of the present study agree with the conventions of the above authors. According to the Palmer's algal index, the study site is categorized as organically polluted and species of *Euglena, Scenedesmus, Lepocinclis* and *Synedra* are the top indicators of the water quality as supported by Hosmani (2013).

The seasonal trend in total phytoplankton was reported as summer > monsoon > winter, which correlates with the observations accounted by Tripathi & Pandey (1990). Maximum growth of phytoplanktons in summer and minimum in winter may be accredited to the effect of temperature on the assembly of phytoplanktons. It was also noticed that the pre-monsoon and monsoon rain play a key role in seasonal dynamics of the water samples collected every month. The rain water carried organic matter in the form domestic waste and agricultural runoff to this sacred water body. As the runoff water is rich in clay, silt and colloidal organic matter which also attributed to the excessive plankton growth and thus increase turbidity during pre-monsoon and monsoon season (Radhika et al. 2004, Pathak & Limaye 2012 and Dhanalakshmi et al. 2013). High water temperature could raise the rate of microbial decomposition of the rain water carried organic load, resulting in reduction of dissolved oxygen content in the water sample (Prasad et al. 1985, Hulyal & Kaliwal 2011, Ramulu & Benarjee 2013). In the present study, Savadatti tank showed green alga *Staurastrum*, which is the indicator of comparatively less polluted water as supported by Venkateshwaralu & Reddy (1985) and Verma & Mohanthy (1994).

CONCLUSION

From the observations made and from the Palmer's score, it may be concluded that the water body is highly organically polluted as the algal genus index were more than 20. The most pollution-tolerant species like *Euglena, Navicula, Nitzschia, Ankistrodesmus* and *Scenedesmus* were recorded to be maximum indicating the highest degree of organic pollution. Algal analysis thus showed that water quality has reached its threshold level and therefore, it needs some corrective measures to maintain the water chemistry to save the historical heritage from further deterioration. With regular monitoring of phytoplanktons, public must be made aware of the pollution status using a simple Palmer index that can be easily understood by people.

As far as conservation and management is concerned, primarily, prominence should be laid on the overall prevention of external nutrient input into the tank. Thereafter, one should allow the tank to restore its natural process and use modern eco-technologies for upgrading the water quality. Intensification of water, by any means of proper screening and silt trapping will be needed to increase the water volume with reduced nutrient content.

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