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Studies on biodiversity of cyanobacteria in polluted ponds of Pattukkottai, Tamil Nadu, India

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ABSTRACT

Studies on the description of Cyanobacterial diversity and physicochemical chemical analysis of five different polluted ponds in Pattukkottai, Tamilnadu, India. Cyanobacterial samples were collected along the water samples. Totally 21 cyanobacteria were isolated and identified. Among the isolates of cyanobacteria, *Oscillatoria* was the dominant genus with 5 species unicellular cyanobacteria such as *Aphanizomenon, Chroococus, Cyanosarcina, Gloeolapsa, Microcystis and Synenchoajtis* were recorded. Among the unicellular forms, Microcystis was recorded with two species and the remaining genera were recorded single species each. The physicochemical characteristics of water samples such as pH, temperature, free CO_2, alkalinity, DO, Nitrate, Nitrite and ammonia, Phosphates, Calcium hardness, Magnesium harness, BOD and COD were also analysed.

INTRODUCTION

Biological monitoring or Bio-monitoring is the use of biological response to assess charges in the environment, generally charges due to anthropogenic causes. Bio-monitoring programs may be qualitative, semiquantitative or quantitative. Bio-monitoring is a valuable assessment tool receiving increased use in water quality monitoring programs of all types. (Kennish, M. J., 1992). Both algae and cyanobacteria occur naturally in surface waters. Although their size is usually microscopic, when conditions are ideal both can undergo a phenomenon known as bloom. Cyanobacteria are not always visible on the surface of water. Generally, they are large numbers in one particular area. In the latter case a blue green colouration can be observed in the water and the surface of the water (colour may vary from green olive to red). However not all members are this colour, some are olive or dark green and others are even publish in colour. Heavy blooms can overtake water bodies and even check out portions of stream or rivers. It is difficult to predict when a bloom will occur.

Cyanobacteria need warm temperatures, light, Phosphorus, and Nitrogen to reproduce phosphorus and nitrogen are commonly found in animal and human waste and in fertilizers. Some common ways for Phosphorus and Nitrogen to enter lakes and streams are from agricultural and lawn run off due to improper function of septic systems and erosion of nutrient rich soil. Considering all the above facts the present study was undertaken for the determination of water quality using cyanobacteria as Bio-monitars. In the present investigation cyanobacteria were used as indicator organisms because of the following advantages. Cycanobacteria have very short life cycle and rapid reproduction. Cyanobacteria tend to be most directly affected by physical and chemical environmental factors. Sampling is inexpensive and has a lesser impact on other organisms.

MATERIALS AND METHODS

Study Area :

Pattukkottai 10.43°N 79.32°E(3) is located along the southeast coast of India in the East central region of Tamilnadu. Pattukkottai Municipality covers an area of 21.83 km^2 and have an average elevation of 0.5 meters (16 feet). Pattukkottai is 48km from the city of Thanjavur. The coast of the Bay of Bengal is just 12km away with manora Fort and 15km away from this town.

A study of cyanobacterial flora in polluted habitats. Five different polluted ponds were selected at Pattukkottai. Water samples were collected in large sterilized bottles and brought to the laboratory. Physico chemical characteristics were done on the same day when the samples were brought to the laboratory. Standard microbiological methods were followed for isolation and purification of cyanobacterials strains. Algal samples were microscopically examined and plated on solid agar medium (Rao, G. S., 1995). Analysis of physic-chemical characteristics (APHA, 1985).

RESULTS AND DISCUSSION

Totally 21 species of cyanobacteria belonging to 13 genus were isolated and identified from 5 different samples (Table 1 & Fig. 1). Among the genera, oscillatoria recorded maximum number with 5 species such as *O.boryanum, O.limnetica, O.princeps, O.terebriformis* and *Oscillatoria* sp. All the above species were recorded in S1. Whereas in S2 O.boryanum and O.limnetica were not recorded. Similarly O.princeps and O.terebriformis were not detected in S3 and S5 respectively. The unicellular cyanobacteria such as *Aphanizomenon, Chroococcus, Cyanosarcina, Gloeocapsa, Microcystis and Synechocytis* were recorded from different samples examined. Among the unicellular forms, *Microcystis* was recorded with two species and the remaining genera were recorded single species each (Table 1) of the unicellular forms, station 3 and 5 represented with 6 species each while the rest of the stations with 5 species each. In the present study the heterocyst forms such as *Nostoc* sp and calothrix were recorded in all the stations except station 4, where *Nostoc* sp was not recorded. Similarly *Arthospira* and *Spirulina* were recorded in S4. Whereas, the *Spirulina* was not recorded in S5. *L.majuscula* and *Lyngbya* sp were recorded during the study period. Different stations S1, S4 and S5 recorded for above two species of *Lyngbya.* Whereas, the *Lyngbya* sp was not recorded in S2. Similarly the *L. majuscula* was not recorded in S3 (Table1). The majority of cyanobateria are aerobic photoautotrophs. Their life processes require only water, carbon dioxide, inorganic substances and light. Photosynthesis is their principal mode of energy metabolism. In the natural environment, however, it is known that some species are able to survive long periods in complete darkness. Furthermore, certain cyanobacteria show a distinct ability for heterotrophic nutrition (Fay, P., 1965).

Cyanobacteria have a number of special properties which determine their relative importance in phytoplankton communities. However the behavior of different cyanobacterial taxa in nature is not homogeneous because their ecophysiological properties differ. An understanding of their response their environmental factors is fundamental for settling water management targets. Because some cyanobacteria show similar ecological and ecophysiological characteristics. They can be grouped by their behaviour in planktonic ecosystems as “ecostrategists” typically inhabiting different niches of aquatic ecosystems. A number of properties and relations to environmental conditions are discussed below in order to describe these ecostrategists. The results of the physico-chemical parameters are presented in fig.2-9. The ponds were alkaline in the period of study. pH of the water bodies ranged from 7.7 to 8.5. The higher pH was noticed in S5. Similarly the maximum number of algal species were also noticed in thus pond (S5) than the other ponds studies. The reason for the large number of algae present in the pond is that blue green algae need warm temperatures (9) which was observed in the present study (fig.1). Thus result is inconformity with earlier findings of (Kumar, A. and Singh, N. K., 2000), (Chaudhari, U. S. *et al.,* 2001). Several important publication deals with the ecological distribution of Cyanophyceae (Fritsch, F. E., 1907), (PearsallW.H.,1932)., (Presecott, G.W., 1938), (Rao, G. S., 1995), (Singh V. P., 1960), (Philipose, M. T., 1960), (Venkateswarlu, V., 1994) , (Munawar, M., 1970). Many of them emphasize the importance of light, temperature, pH, carbon dioxide, organic matter, alkalinity, nitrates and phosphates as factors important in determining the distribution of blue-green algae.

In the present investigation, the carbonate was completely absent in all the ponds studied, where as the bicarbonate alkalinity was observed. The concentration of bicarbonate alkalinity is a key factor which stimulate the algal bloom (Ramakrishnan, N., 2000). In the present study the cyanobacterial blooms were observed in all ponds studied and thus confirmed the earlier findings (Ramakrishnan, N., 1990), Ramakrishnan, N., 1991). During the present investigation the amount of Dissolved oxygen (Do) ranged between 5-10 to 6.4 mg Fig.2. This showed that the ponds were not highly polluted. However the occurancy of sufficient levels of various nutrients favoured the growth of different cyanobacteria (Mishra, G. P., and yadav, A. K., 1978), (Ramasamy, S. N., 1983), (Singh, N. K., 1993). Hence the large number of algal species were noted in the present investigation. Nitrogen and phosphorous levels in freshwater ponds affect the productivity and growth of phytoplankton and macro algae. Additions of nitrogen or phosphorus cause phytoplankton levels to increases rapidly, an algal bloom occurs, and can result in a entropic environment (Munawarb., 1970).

Rich blooms of some cyanobacteria have been observed in all the ponds. This abundance is attributed to favourable conditions of oxidizable organic matter and high calcium content (Fig.3) and observation. Which

supports (Rao, G. S., 1995).,andVenkateswarlu.(1969). Observations of (Munawar, M., 1970),. Suggest that Cyanophyceae grow luxuriously with great variety and abundance in ponds rich in calcium. (Sarojini, Y., 1996). Observed positive correlation between phosphate and cyanobacteria. The luxuriant growth of cyanobacteria at low concentration of oxygen and in the presence of high concentration of nitrogen and phosphate has also been reported by Rai, L. C., and Kumar, H. D., 1997), and (Nazneen, S.,1980). Similar observations were also made in the present study with reference to various nutrients. Though DO content was moderately high in all the stations examined.

Genus *oscillataria* has been found to be tolerant to polluters, which frequently inhabits the polluted water Rai, L. C., and (Kumar, H. D.,1976).Present study confirmed their observation as *Oscillataria* was found dominating the polluted ponds with five species (Table-1)Unicellular cyanobacteria are frequently occurring in polluted ponds in which microcytis present predominantly (Trainor, F. R., 1984). In this present investigation the unicellular cyanobacteria. Such as *Aphanizomenon, Chroococcus cyanosarcine, Gloeocapsa* and *microcystis* were dominating the ponds. According to Palmer (1969 – 1980) the species of algae which are frequently occurring in a habitat may be considered as indicator species of that habitat because of their dominant occurance and hence in the present investigation the genus *Oscillatoria* with 5 species was considered as the indicator species of all the ponds examined.

TABLE:1 Cynobacterial flora in various polluted ponds

S.No	Name of the cyanobacteria	S1	S2	S3	S4	S5
1.	*Aphanizomenon flos-aquae*	+	-	+	+	+
2.	*Microcytis aerogenosa*	+	+	+	-	+
3.	*M. protocytis*	-	+	+	+	+
4.	*Synechocystis sp*	-	+	+	+	+
5.	*Chroococcus sp*	-	+	+	+	+
6.	*Cyanosarcina sp*	+	-	+	+	+
7.	*Gloeocapsa sp*	+	+	-	+	-
8.	*Arthrospira maxima*	+	+	+	-	+
9.	*Sppirullina maxima*	+	+	+	+	-
10.	*Nostoc sp*	+	+	+	-	+
11.	*Calothrix sp*	+	+	+	+	+
12.	*Oscillatoria sp*	+	+	+	-	+
13.	*O. boryanum*	+	-	+	+	+
14.	*O. limnetica*	+	-	+	+	+
15.	*O. princeps*	+	+	-	+	+
16.	*O. terebriformis*	+	+	+	+	-
17.	*Phormidium sp*	+	+	+	-	+
18.	*P. tenue*	-	+	+	+	+
19.	*P. uncinatum*	+	+	-	+	+
20.	*Lyngbya sp*	+	-	+	+	+
21.	*L. majuscule*	+	+	-	+	+

\+ PREASENT, - ABSEANT

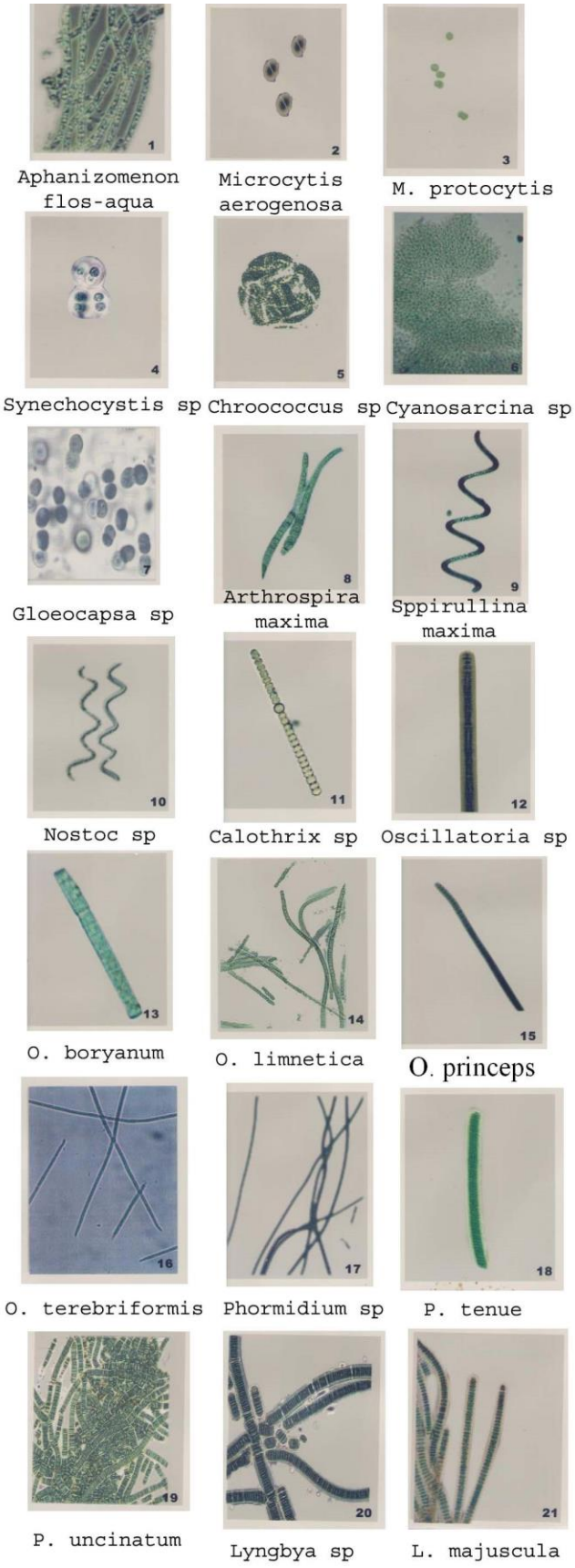

Fig. 1 Cyanobacterial species isolated from polluted pond water samples

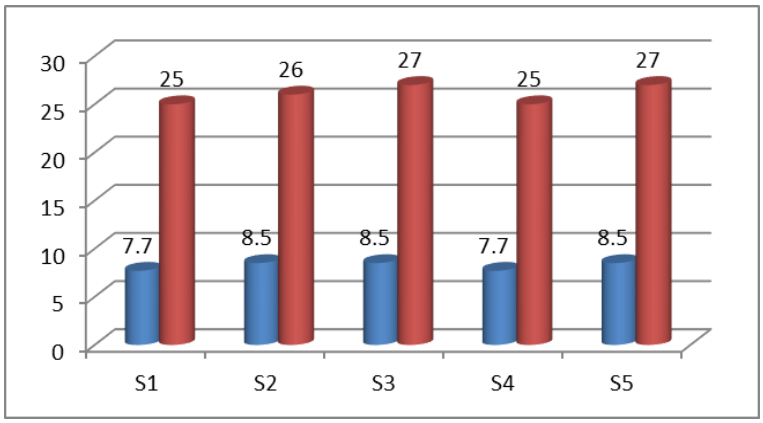

Fig. 1. pH and Temperature level in different watelj0r sample

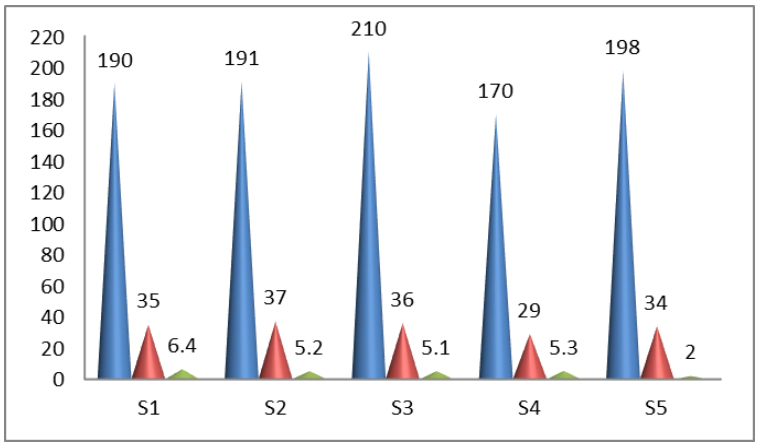

Fig. 2 Free Co_2 and DO level in different water sample

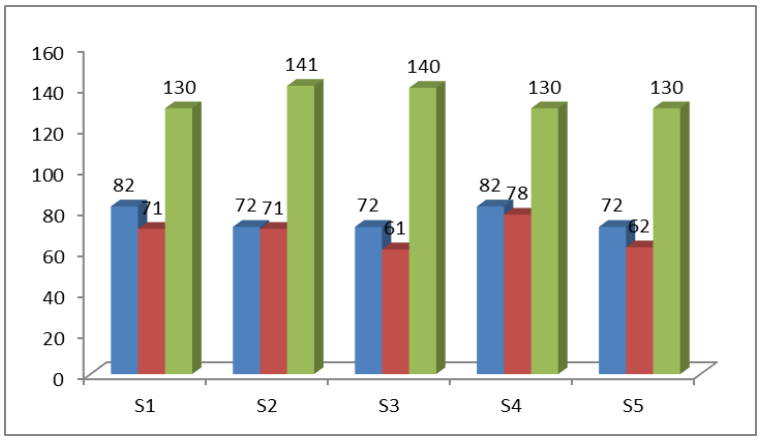

Fig. 3 Calcium, Magnesium and Chloride level in different water Sample

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