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ORIGINAL ARTICLE

STUDIES ON THE MICROBIAL POPULATION OF PERUMAL LAKE, ALAPPAKKAM, CUDDALORE DISTRICT, TAMIL NADU, INDIA

P. Pushpanathan and *S. Hemalatha
Department of Zoology, Annamalai University, Annamalainagar-608002, Tamilnadu, India.

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ABSTRACT

The diversity of microbial population and their activities are subjective of the physico-chemical and biological characteristics of particular water as well as the presence of growing flora. Pathogenic or non-pathogenic microorganisms are always present in water in which pathogenic forms include various species of bacteria, viruses, fungi and protozoans. Further, the interaction of water and microorganisms help in biochemical purification of wastewater in the silt places and in biological ponds. The present study has been conducted to understand the seasonal variations in microbial population such as bacteria, fungi and actinomycetes of Perumal lake, Tamil Nādu, India. Surface water samples were collected once in a month in sterilized bottles for the period of 24 months from January 2018 to December 2019 and was subjected to microbiological analysis. The result showed that bacterial population were maximum among the microorganisms in summer season and minimum in monsoon season. The fungal count was maximum during post-monsoon and minimum during pre-monsoon. The actinomycetes population occurred maximum in post monsoon season and minimum in pre monsoon season. The maximum quantity of bacteria in summer season may be due to low water level, high organic matter, low bacterivores and optimum growth supporting nutrient favour for higher bacterial count. Eventhough land washing organic matter and animal manure added by runoff rain water, the dilution effect reduce the bacterial count in monsoon season. High temperature, lowering of the water level and desiccation of periphyton communities suppress growth and increase mortality of hypomycetes during summer which resulted in low count of fungi. The maximum quantity of actinomycetes may be due to high organic matter and optimum growth supporting nutrients in river water.

Keywords: : Perumal Lake, Bacteria, Fungi, Actinomycetes.

1.INTRODUCTION

Water is vital for life and the essential natural resource for the ecological sustenance, environmental purity, industrial growth, power production and enrichment and renewal of land and air Availability of well-analysed safe water is required for day-to-day activities like human consumption, agriculture, and human purposes The quality of water in both lentic and lotic systems has deteriorated due to various types of pollution. Industrial effluents, sewage water, pesticides and fertilizers are contaminating the surface and ground water.Assessment of water quality today in terms implies the need for a reference point against which results of monitoring can be measured and weighed. Aquatic ecosystems as a part of the natural environment are balanced both within themselves and with other environmental components. This equilibrium is subjected to natural variations and evaluations as well as variations caused by human intervention. Slow response of the aquatic biogeochemical systems to gradual increase of continent level over long time span is one of the main causes for poor understanding of the complex inter compartmental linkage and feedback mechanisms in the hydrosphere It has been suggested that water pollution is the leading worldwide cause of deaths and diseases, and that it accounts for the death of more than 14,000 people daily. An estimated 700 million Indians have no access to a proper toilet and 1,000 Indian children die of diarrhoea sickness every day. To determine the potability of water quantitative microbiological examination may be undertaken (Lal et al., 2005). Hence, the present study has been conducted to understand the seasonal variation in microbial population(bacteria, fungi and actinomycetes) of Perumal lake, Tamilnadu, India.

Corresponding author:* ***Dr. S.Hemalatha,* *Professor, Department of Zoology, Annamalai University, Annamalainagar-608002,Tamil Nadu, India.*

2.MATERIALS AND METHODS

Study Area: The Perumal lake, spread over an area of 500 acres, selected as a model water body for the present investigation, is a natural perennial lake located near Kullanchawadi, Cuddalore, Tamil Nadu. The bottom of the lake is composed of 40% sand, 20% silt and dead planktonic organisms, fishes and other wind flown materials. Perumal lake is a community lake and constitutes as a major water resource for agriculture and fishing activities (Fig 1.).

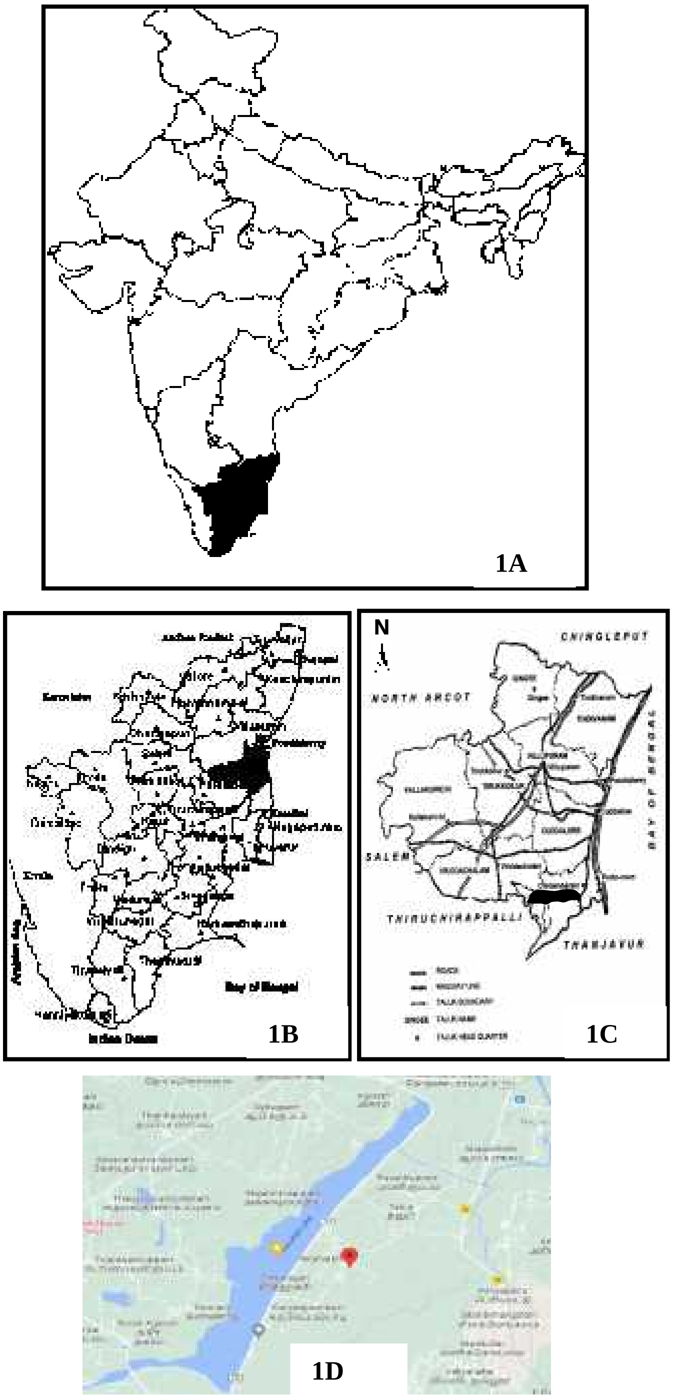

Fig 1A-D Showing Study area , Perumal Lake

Microbiological Analysis of Water: Water samples were collected from five sampling sites at once in a month in sterilized bottles for the period of 24 months from January 2018 to December 2019. The months were divided into different seasons such as Summer (April, May and June); Pre-Monsoon (July, August and September) Monsoon (October, November and December), andPost Monsoon (January, February and March). The average of monthly data was taken for representing the seasonal data. The water samples were serially diluted in physiological saline and. serial dilution technique is one of the methods used to isolate pure culture. This method is also used for estimating the cell number in a culture of bacteria or fungi. In this method, the sample is serially diluted and cultured on different agar plates. Each microbe grows into a colony. The colony is visible to naked eye, and it is counted. The number of colonies corresponds to the number of cells present in the water. Culture and enumeration of bacteria, fungi and actinomycetes were done following the methods of Anwar *et al.*, (1992), APHA (2008) and Safferman and Morris (1962) respectively.

Statistical Analysis: The data obtained were subjected to standard statistical analysis. One way analysis of variance (ANOVA) followed by Duncan's multiple range test (Brunings and Kintz, 1968) was performed to determine whether the parameters altered significantly by different seasons.

3.RESULT

Microorganisms are always present in water that may be pathogenic or non-pathogenic. Pathogenic forms include various species of bacteria, viruses, fungi and protozoans. Further, the interaction of water and microorganisms help in biochemical purification of wastewater in the silt places and in biological ponds. In the present study, the seasonal average of microbial population was calculated (Table 1). Bacteria, actinomycetes and fungi showed a significant difference ($p < 0.05$) in different seasons during the study period.

Bacteria: Bacterial population were maximum among the microorganisms in summer season and minimum in monsoon season. In 2018, the low value for bacteria recorded as 16.93 ± 1.10 CFU/ml in monsoon period and high value of 24.90 ± 1.16 CFU/ml in summer period (Table 1). Similarly in 2019, the values were 27.01 ± 1.25, 20.02 ± 0.96, 19.03 ± 1.16 and 23.40 ± 2.10 CFU/ml in summer, pre monsoon, monsoon, and post monsoon periods respectively (Table 1). The maximum quantity in summer season may be due to low water level, high organic matter, low bacterivores, and optimum growth supporting nutrient favour for higher bacterial count. Even though land washing organic matter and animal manure added by runoff rainwater, the dilution effect reduce the bacterial count in monsoon season.

Fungi: The fungal count was maximum during post-monsoon and minimum during pre-monsoon. In 2018, the values were 0.27 ± 0.06, 0.25 ± 0.98, 0.30 ± 0.72 and 0.38 ± 0.08 CFU/ml for summer, pre monsoon, monsoon and post monsoon periods (Table 1). In 2019, 0.30 ± 0.02, 0.31 ± 0.01, 0.51 ± 0.01 and 0.59 ± 0.05 CFU/ml were recorded for summer, pre monsoon, monsoon and post monsoon periods (Table 1). High temperature, lowering of the water level and desiccation of periphyton communities suppress growth and increase mortality of hyphomycetes during summer which resulted in low count of fungi.

Actinomycetes: In 2018, the actinomycetes population occurred maximum in post monsoon season (6.81 ± 0.35 CFU/ml) and minimum in pre monsoon season (5.06 ± 0.12 CFU/ml). The summer and monsoon season recorded 6.20 ± 0.96 and 5.71 ± 0.04 CFU/ml respectively (Table 1). In 2019 maximum colony was counted in post monsoon season (8.85 ± 0.16 CFU/ml) and minimum in pre monsoon period (6.63 ± 0.02 CFU/ml) (Table 1). The maximum quantity may be due to high organic matter and optimum growth supporting nutrient favour for higher actinomycetes count.

4.DISCUSSION

Microbial populations depend upon their numbers and quantities of food material dissolved in the water. Climatic, geographical and biological conditions bring about great variations in microbial population of surface water (Power and Daginawala, 1986). River and streams show their highest count during the rainy period. Dust blowing into the rivers and animals also contributes many microorganisms which can be harmful to organisms and plants living in those water bodies or to the humans those used these water (Suresh *et al.*, 2009).Prajapati and Mathur, (2002) reported that high microbial population in an aquatic system is a reflection of the input of microorganisms from extraneous source and availability of growth supporting organic matter. Water borne pathogen includes various species of bacteria viruses, fungi and protozoa (Michel *et al.* 1995; Tamagnini and Gonzalez 1997; Vachae*et al.* 1997; Grant, 1998; Kavitha and sivapriya, 2005; Noorjahan, 2008). The fungal species cause diseases like Aspergillosis, Coccidomycosis, Blastomycosis, Histoplasmosis and Pneumonia (Nicklin*et al.*, 2001). According to WHO, about 80% of all the disease in human beings are caused by contaminated water (Vanish, 2004; Meenambal, 2005; Chaturvedi*et al.*, 2008).

In the present study, the bacterial population is higher during summer seasons, the analysis of variance shows the significant difference ($p < 0.05$) between the different seasons. The comparative study revealed that the bacterial population was higher during 2019 than 2018 in all the seasons. A number of studies have shown that bacterioplanktonic growth is positively correlated with temperature, particularly at relatively low temperature (<10°C – 15°C) (Tibbles, 1997; Simon and Winsch, 1998). Above these temperatures, bacterial growth is less strongly correlated and presumably in the seasonally warmer in upper part of the water column, temperature-adapted bacterial communities developed and are limited to a greater extent by other parameters and resources, particularly organic substrates and nutrients. In the present study, a maximum count occur during summer season and minimum in rainy seasonmay be the lower part of the water column, temperatures can directly control bacterial growth. Like temperature, pH also plays a role in determining the ability of bacteria to grow or thrive in particular environments. Most commonly, bacteria grow optimally within a narrow range of pH between 6.7 and 7.5. Many biological activities can occur only within a narrow pH range (Venkateshwaralu, 1969). Any variation beyond acceptable range will affect the growth and density. In the present study, the pH value range from (7.24 to 8.46) and such condition may be suitable for the growth of microorganisms.

In addition to water, bacteria also require a wide variety of elements, especially carbon, hydrogen and nitrogen, sulfur, phosphorus, potassium, iron, magnesium and calcium (Elser*et al.*, 1995; Jansson*et al.*, 1996). High bacterial counts are attributed to contamination by domestic sewage (Kowsalya*et al.*, 2010). Significant increases in organic and bacterial load after rain from point sources have been linked to increase risk of infectious disease transmission (Kistemann*et al.*, 2002). Another study revealed that higher bacterial concentrations were strongly associated with rainfall and sewage sources were linked total coliform and faecial coliform (Crowther *et al.*, 2001; Vincent *et al.*, 2006). In the present study, the maximum total viable count in our study may be due to the addition of land washing and organic matter by rain (Thorat and Sultana, 2000). the value of bacterial population drops down during the rainy season which is due to the dilution caused by the rain water through flood and increased in post-monsoon and summer season may be due to low water level, optimum temperature and high microbial nutrients.

The presence of fungi in water sources used for drinking and recreational purposes would cause allergic reaction, infections, toxic responses (Gomi*et al.*, 2002) and cause disease like aspergillosis, coccidiomycosis, blastomycosis, histoplasmosis and pneumocystis (Nicklin*et al.*, 2001). Planktonic fungi found in the open water is likely originate mainly from wetland and littoral areas (Willoughby, 1965; Novotny and Tews, 1975). Fungal propagules are transported in the water directly or in association with inflowing particulate plant debris. In water bodies, water levels can fluctuate widely, obviously, the lowering of the water level and desiccation of periphyton communities suppress growth and increase mortality of hypomycetes. results say that the proportion of the fungi was low when compared to bacteria and actinomycetes. The presence of fungal counts may be due to the addition of land washing and organic matter by rain. This hypothesis was supported by Thorat and Sultana (2000).The maximum fungal count observed during the post-monsoon season may be due to optimum temperature, stable water levels, turbulence from wave action and suitable particulate plant debris. The minimum count observed during the summer season may be low water level and high temperature.

Year	Microbial Population (CFU / ml)	Summer	Pre Monsoon	Monsoon	Post Monsoon	'F' value
2018	Bacteria	24.90 ± 1.16*	18.75 ± 1.28	16.93 ± 1.10	22.40 ± 1.75*	80.16
	Fungi	0.27 ± 0.06	0.25 ± 0.98	0.31 ± 0.72	0.38 ± 0.08*	8.15
	Actinomycetes	6.20 ± 0.96	5.06 ± 0.12*	5.71 ± 0.04*	6.81 ± 0.35*	17.25
2019	Bacteria	27.01 ± 1.25	20.02 ± 0.96	19.03 ± 1.16	23.40 ± 2.10	48.79
	Fungi	0.30 ± 0.02	0.31 ± 0.01	0.51 ± 0.01	0.59 ± 0.05	4.16
	Actinomycetes	8.21 ± 0.00	6.63 ± 0.45	8.75 ± 0.02	8.85 ± 0.16	34.86

Actinomycetes are gram positive filamentous forms that are abundant in soils (Goodfellow and Williams, 1983) and are often found in freshwater (Persson, 1980; Cross, 1981; Niemi*et al.*, 1982; Wnorowski, 1992).). In surface waters, actinomycetes often are often associated with sediment (Cross, 1981). Actinomycetes are often capable of producing highly potent volatile odourous compounds.

In the present study, the actinomycetes count is higher in 2018 when compared with the year 2019. The actinomycetes concentration was lower during pre-monsoon and gradually increased in monsoon, post-monsoon and summer. But in 2019 the low concentration was observed during monsoon season and gradually increased in pre-monsoon, post-monsoon and summer season. It is well established that organic load and ultimately suspended solids promote the growth of actinomycetes. The primary sources of actinomycetes in the water are associated with soil, animal manure and agricultural runoff. Zaitlin*et al.* (2003) suggested that the actinomycetes were coming from similar areas as the *E.coli*.,ie., terrestrial sources associated with animal manure. Actinomycetes concentration in monsoon season is due to the addition of agricultural soil sediment and animal manure runoff of rainwater and higher concentration in summer season is due to low level of water, rich in organic matter and high turbidity. In the present study, the proportion of the bacteria was maximum followed by actinomycetes and fungi. It is well accepted fact that actinomycetal population lies intermediate to bacteria and fungi. Shejul (1998), Jadhav (2001) and Chougule (2006) were also observed similar results. The seasonal trend in actinomycetes count was reported in the order summer > post-monsoon>premosoon> monsoon during the study period. It is well established that organic load and suspended solids ultimately promote the growth of actinomycetes.

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