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Original Research Article

EFFECT OF WATER QUALITY ON PHYTOPLANKTON ABUNDANCE IN SELECTED PONDS OF ATHIYANNOOR BLOCK PANCHAYAT, KERALA

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ABSTRACT

The present study was carried out in 37 ponds of 5 panchayaths within Athiyannoor Block in Thiruvananthapuram dist., Kerala, India. The present study helps to analyze each and every pond in the Athiyannoor block panchayath quantitatively in terms of plankton identification. Objectives of this work was water quality analysis of different ponds in Athiyannoor block, to generate a database about the ponds of the Athiyannoor Block, identification of plankton (phytoplankton, zooplankton)species in different ponds in athiyannoor block and also to identify the interrelationship between water quality and the occurrence of the plankton species in each pond. In the present study, plankton identification showed 13 species of phytoplankton and 2 species of zooplankton. Statistical analysis or correlation of abundance of phytoplanktons with parameters established negative correlation between abundance and pH and DO but a moderate positive correlation with temperature and an independent nature of EC can be concluded from this study. Results of physico-chemical parameters of various ponds showed that the water is not good for human consumption and also struggling for their existence. So there is an immediate need of restoration, improvement and proper management of these secret water bodies for the human and environment.

Keywords: abundance, dissolved oxygen, phytoplankton, water quality, zooplankton

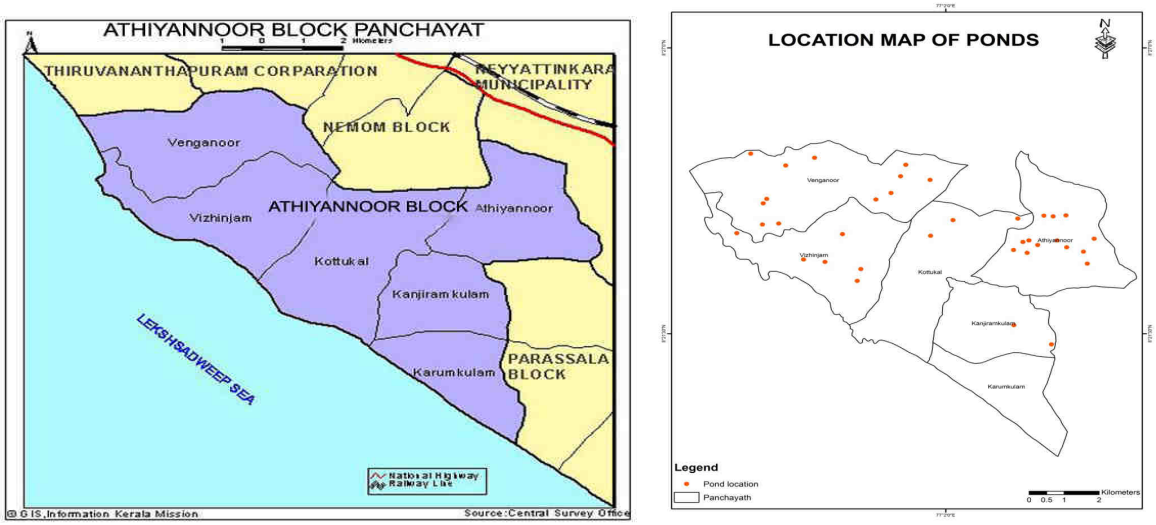
INTRODUCTION

Ponds have been used since time immemorial as a traditional source of water supply in India. The quality of water depends mainly on its source of origin. It varies if and when its source is changed. The quality of water is assessed on the basis of laboratory analysis of various parameters. Thus the terms "source" and "laboratory analysis" are interdependent. The availability of water unfortunately is not uniform everywhere especially in between rural and urban areas. So people construct ponds in rural areas for instant ponds are common in the Indian rural areas. However, the water of the ponds, lakes and river are polluted mainly due to discharged waste water from residential areas, sewage outlets, solid wastes, detergents, automobile oil wastes, fishing facilities and agricultural pesticides from farmlands (Hasan *et al*, 2007). In recent years their importance has somewhat declined due to technological advancements leading to more centralized water supply systems. So the present study is important to identify the current status of each pond and to determine their water quality. Phytoplankton and zooplankton are good indicators for changes in nutrient pollution over time because they respond quickly to changes in nutrient input to the lagoon. The biological analysis of waterbodies, especially the phytoplankton analysis will describe clearly about the pollutant materials impact on the aquatic life and a decrease in biological diversity. Furthermore, the phytoplankton will reflect the condition of the waters, not only at the time of sampling, but also the condition at a previous time point. Moreover, planktons are sensitive to many environmental conditions such as salinity, rainfall, temperature, dissolved oxygen levels, turbidity, and other factors. Hence an attempt has been put forward to identify and thereby understand the diversity of the phytoplankton and zooplankton species in the collected water samples through usual standard methods.

Study Area

For the present study 37 ponds of 5 panchayats (Vizhinjam, Venganoor, Athiyannoor, Kanjiramkulam, Kadinamkulam) in the Athiyannoor block panchayath were analyzed in terms of their water quality indicated by the presence of plankton diversity and is depicted in map 1.

MAP 1: LOCATION MAP OF ATHIYANNOOR PANCHAYATH AND LOCATION OF SAMPLING PONDS



MATERIALS AND METHODS

The samples were labeled and transported to the laboratory, stored at 4^0C in the refrigerator for analysis of selected parameters. Samples were collected in plastic containers (Can) previously rinsed with distilled water. The present study was carried out in 36 ponds of 4 panchayaths within Athiyannoor Block in Thiruvananthapuram dist., Kerala, India. Ex-situ measurements were conducted for each physical parameter.

Plankton Analysis

Phytoplankton samples were collected by filtering a known volume of water through plankton net as per standard methods (APHA, 2005) from 10 representative ponds. The collected samples were fixed in 4-5% formaldehyde and brought to laboratory for analysis. Counting is done as per standard methods (APHA, 2005; Trivedi and Goel, 1986). Identification of plankton was done by observing through the microscope and by using standard keys for plankton identification.

RESULTS AND DISCUSSION

Plankton diversity

A pre-impoundment survey of the fauna and flora of any water body is necessary because it provides a checklist of organisms present in the water for subsequent exploitation, conservation and sustainable management of the resources

TABLE 1: PLANKTON SPECIES IDENTIFIED IN VARIOUS POND WATER SAMPLES

Plankton Species	S 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Oscillatoria sp.	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Spirogyra sp.	+	+	+	+	+	-	+	+	-	-	-	+	-	-	-	-	-	-
Cosmarium sp.	+	-		-	-	-	-	+	+	-	-	-	+	-	-	-	-	-
Scenedesmus sp.	-	+	+	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-
Navicula sp.	-	+	+	-	+	-	+	+	+	+	-	-	+	-	-	-	-	-
Pinnularia sp.	-	-	+	+	+	-	-	-	-	+	-	-	-	-	-	-	-	+
Tabellaria sp.	-	-	+	-	+	-	-	+	-	+	+	-	+	+	-	+	-	-
Cladophora sp.	-	-	-	-	+	-	+	-	+	+	-	-	+	-	+	-	-	+
Volvox sp.	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Chaetonotus sp.	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Oedogonium sp.	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-
Ulva sp.	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Chlorella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Zoea larva	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Mougoetia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+

*S denotes Samples

The maintenance of a healthy aquatic ecosystem is highly depends on the physico-chemical properties of water and the biological diversity. The physico-chemical means are useful in detecting the effects of pollution on the water quality but changes in the trophic conditions of water are reflected in the biotic community structure including species pattern, distribution and diversity (Kaushik and Saksena 1995).

The productivity of plankton is directly linked with the fresh production and various exchange process of the pond ecosystem. Diverse plankton species were found in water samples under study. Here, 13 species of phytoplankton and 2 species of zooplankton were recognized and identified and is tabulated in table 1. Among these, composition of phytoplankton species was dominated by Spirogyra sp. (8 samples), Navicula sp. (8 samples), Tabellaria sp. (8 samples), Cladophora sp. (7 samples). However, Mougoetia sp. Zoea larva, Ulva sp., Chlorella sp., Chaetonotus sp. , Volvox species are least density of planktons. Many authors have opined that the abundance of plankton has a defined relation with the change of season (Moitra and Mukherjee, 1972; Chakraborty and Asthana, 1998). .

Sample 17, sample 7 showed the presence of zooplankton Chaetonotus and Zoea larva. Very poor phytoplankton diversity was observed in ponds 16, 17, 18 and may be caused by several factors like low Light penetration, high turbidity of water, low dissolved oxygen levels. Poor quality of water also contributes to low phytoplankton diversity. Ponds with more depth showed higher density of phytoplankton and zooplanktons compared to the ones with less depth. The ponds showing more covering of plants showed less number of both phytoplankton and zooplanktons. The Study of physico-Chemical parameters and plankton Diversity of the ponds in The V.P.M. Campus, Thane, Maharashtra, India, showed that the plankton diversity was found to be very poor (Kamini and Madhura , 2013).

. Among the phytoplankton species, *Chlorella* spp, *Navicula* spp, Diatoms were found. The study concluded that very poor phytoplankton diversity observed in these ponds may be caused by several factors. Light penetration was low. Numerous plants were growing on the surface of the water like lotus, hydrilla, Water hyacinth, *Pistia*, etc. Water was highly turbid.

The metabolic activity of phytoplankton may be low as well (Wetzel, 2001). On the contrary, in eutrophic lakes the nutrient concentrations, including the inorganic fractions, can be higher and the same is true of the metabolic activity of phytoplankton. This motivated us to study the interplay between phytoplankton and water chemistry.

Plankton abundance

Phytoplankton populations, or blooms, can grow rapidly, particularly on sunny days when the water is warm and nutrients are available. Nutrients can wash into the pond from woods, pastures, fields, human activities in the watershed, or come from pond fertilization. Generally, the more nutrients, the more planktonic algae (or other aquatic plants) will grow or

bloom. Although phytoplankton is good from an abundance of natural food and oxygen producing standpoint, it can become too abundant or excessive. When phytoplankton become so abundant that water visibility is limited to less than 12 inches there is a danger of oxygen depletion. Phytoplankton populations, or blooms, can grow rapidly, particularly on sunny days when the water is warm and nutrients are available. Oxygen dissolves in water at very low concentrations but seldom will a pond have more than 10 ppm oxygen dissolved in its water as obtained in the stations KTL-2 (10.84 ppm), VGR-12 (10.96 ppm) (Table 2).

Water quality determines the species optimal for culture under different environments (Dhawan and Karu , 2002). The overall productivity of a water body can easily be deduced from its primary productivity, which forms the backbone of the aquatic food chains. The plankton community is comprised of the primary produces or phytoplankton and zooplankton; the secondary producers (Battish, 1992).

TABLE 2: ABUNDANCE OF PLANKTON SPECIES BASED ON PHYSICO-CHEMICAL PARAMETERS

SAMPLE	ABUNDANCE	TEMP(^{o}C)	DO	pH	EC
VZM-1	1560	29	2.39	4.51	132.5
VGR-4	120	27.7	7.25	5.44	149.3
VGR-5	180	27.4	8.13	5.48	105.10
VZM-2	1080	28	1.56	5.49	72.50
VZM-3	395	27.6	0.62	6.05	517.70
KJM-1	130	27.6	9.98	6.18	95.78
VZM-4	260	28.4	4.58	6.20	158.40
KJM-2	1000	26.5	7.65	6.27	221.40
ATH-13	75	28.1	6.29	6.36	95.43
VGR-11	140	28.9	6.20	6.57	91.22
VZM-6	465	28	4.36	6.99	313.60
VGR-12	190	28	10.84	7.30	260.60
KTL-2	210	28.2	10.96	7.70	279.50

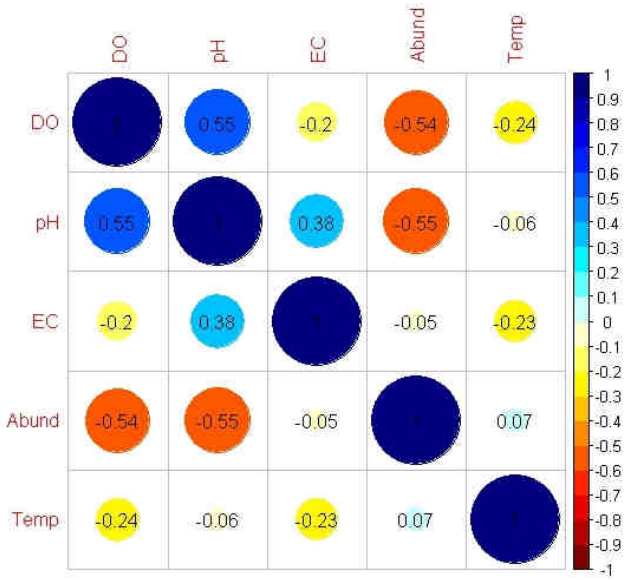
The phytoplankton population represents the biological wealth of a water body, constituting a vital link in the food chain. Both the qualitative and quantitative abundance of

phytoplankton in a fish pond are of great importance for managing the successful aquaculture operations, as they vary from location to location and pond to pond within the same location even within similar ecological conditions (Boyd and Tucker, 1988).

Phytoplankton not only serves as food for aquatic animals, but also plays an important role in maintaining the biological balance and quality of water (Pandey *et al*, 1998). They have a short life span and responds quickly to environmental changes (Zębek, 2004).

The productivity of freshwater community that determines the fish growth is regulated by the dynamics of its physico-chemical and biotic environment (Wetzel, 2001). The physicochemical and biological characteristics of water also play a big role in plankton productivity as well as the biology of the cultured organisms and final yields. The pH, dissolved oxygen, alkalinity and the dissolved nutrients are important for the phytoplankton production (Bais and Agarwal, 1990). Plankton diversity responds rapidly to changes in the aquatic environment particularly in relation to nutrients. Physico-chemical attributes of a water body are principle determinants of fish growth rates and developments (Jhingran, 1991). Climate has a major influence on water quality and consequently, the biodiversity within the water bodies (Boyd and Tucker, 1988).

GRAPH 1: SHOWS CORRELATION AND INTERDEPENDENCE OF TEMPERATURE, DO, EC, PH AND ABUNDANCE OF PLANKTONS



Graph 1 clearly indicates a direct relationship between plankton abundance and temperature as they are positively correlated to some extent (r = 0.07). Phytoplankton

populations, or blooms, can grow rapidly, particularly on sunny days when the water is warm and nutrients are available. The primary source of this variability is the availability of light. However, the local abundance of plankton varies horizontally, vertically and seasonally.

DO levels are influenced by temperature and salinity. DO shows a negative correlation **(r = -0.54),** with abundance which implies that as the there is a hike in the levels of phytoplankton the DO decreases as shown in Graph 1. DO also possess an indirect relation with temperature. The solubility of oxygen, or its ability to dissolve in water, decreases as the water's temperature and salinity increase. The DO concentration within a water body can experience large daily fluctuations. Aquatic flora and fauna use oxygen in respiration, similar to organisms on land. Plant life and phytoplankton require DO for respiration when there is no light for photosynthesis. These organisms also use DO to decompose organic material at the bottom of a body of water as microbial decomposition is an important contributor to nutrient recycling. However, if there is an excess of decaying organic material (from dying algae and other organisms), in a body of water with infrequent or no turnover (also known as stratification), the oxygen at lower water levels will get used up quicker. Thus, it can be estimated from this study that greater the phyto- or zooplanktons in the pond water body greater is the amount of DO used up by them. So, higher abundance of planktons leads to lowering of DO.

As represented in Graph 1 the value of correlation of abundance and EC does not show any significant relationship among themselves as they maintain a negative trend among themselves **(r = - 0.05).** EC is an indication of extent of salinity in the pond water samples collected as EC is a numerical expression of the ability of an aqueous solution to carry electric current. This ability depends on the presence of ions, their total concentration, mobility, valence and relative concentrations and on the temperature of measurement. Therefore, this study shows that EC of a water body does not affect the abundance of phyto- and zooplanktons.

pH of the water samples decides whether an aquatic flora and fauna is able to survive in the present condition in the water and thus the abundance of the both phyto- and zooplanktons in the ponds under consideration is a measure of its water quality. Abundance and p H shows negative correlation **(r = -0.55)**, illustrated in Graph plot 1 based on the values obtained in this study**.** As pH of the pond water enhances rapidly, abundance decreases accordingly. High pH levels can be attributed to over feeding, photosynthesis and respiration of algae as it can affect the natural acid-base balance of aquatic systems. The decrease of the pond's pH may be due to

the increase of carbonic acid in the water body. Greater phytoplankton release greater amount of carbon dioxide during respiration especially at night. This CO_2 when combines with water leads to acid formation thereby causing the lowering of water pH.

Thus, based on the statistical analysis or correlation of abundance of phytoplanktons with parameters a negative correlation between abundance and pH, DO can be established but at the same time a moderate positive correlation with temperature and an independent nature of EC can be concluded from this study.

CONCLUSION

Results of plankton abundance of various ponds as studied in the present investigation clearly shows that the water is not good for human consumption and also struggling for their existence. So there is an immediate need of restoration, improvement and proper management of these secret water bodies for the human and environment.

Basic pond management principles are designed to maintain good water quality and reduce incidence of disease. It is important to develop a plan of action to be taken when a water quality measurement approaches being outside the desirable range and stressful concentrations. This is why monitoring regularly and recording data is important—it will aid in anticipation of needed action.

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