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An assessment of Plankton diversity and abundance of Arkavathi River with reference to pollution

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ABSTRACT

Plankton diversity and abundance of Arkavathi river 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 and 27 species of zooplanktons were recorded. Myxophycean species were found to be dominant at both the stations. Euglenophyceae have shown less number of phytoplanktons abundance in both the sites. The studies have revealed that polluted water shows relatively grater abundance of Myxophyceae and zooplanktons as compared to the non-polluted water. Nutrient enrichment of the river due to silk industries effluents has altered the structure of plankton community.

Keywords: Plankton, Diversity, Abundance, Pollution, Arkavathi River.

INTRODUCTION

Rivers are important systems of biodiversity and are among the most productive ecosystems on the earth because of the favourable conditions that supports number of flora and fauna. River ecosystem is one of the natural resource which comes into the service of mankind in many parts of the world. They play a vital role in the productivity as they are beset with varieties of flora and fauna including planktons. Urbanization, expansion of irrigation and increasing trend of industrialization has contributed towards the demand for water. Surface water is the principal source of irrigation in rural areas. Most of the fresh water bodies all over the world are getting polluted water, thus decreasing the potability of the water [1].

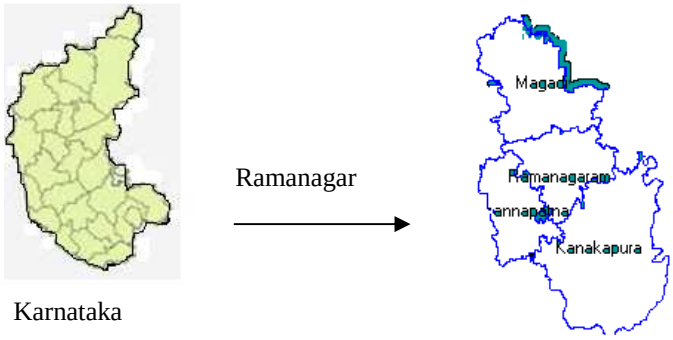
The concept of sustainable utilization by maintaining the natural properties of the wetland ecosystem becomes a practical reality only by a proper assessment of the relation between the parameters of water with the plankton, understanding its delicate functioning and by creating an increasing awareness about its ecological value. Several interdependent and influencing abiotic factors along with high primary productivity have made it a suitable niche for many aquatic forms.

The biota of an aquatic system directly reflects condition existing in the environment [2] and data generated in the past has been utilized for biological monitoring of the water pollution level. In this regard, scientists have studied the planktons as an index of water quality with respect to industrial, municipal and domestic pollution [3,4].

The present investigation was carried out on the surface planktons population in the aquatic ecosystem of Arkavathi river water of Ramanagar district in Karnataka state (Fig.1). The industrial effluents form silk industries in and around Ramanagar contain numerous pollutants and have entered into the river Arkavathi affecting the water quality. As a consequence, the plankton population of the Arkavathi river has been affected in terms of abundance and diversity. The study is aimed at evaluating the plankton index as the water quality criteria with reference to the fresh water river Arkavathi polluted by silk industries at Ramanagar.

MATERIALS AND METHODS

Fig.1: Study area-Ramanagar, Karnataka state.



The river Arkavathi has its origin in Nandi hills, Chikkaballapur district and flows for distance of more than 100kms before joining river Cauvery in Ramanagar district. The investigation also examines the effect of silk industries pollutants and assesses the planktonic population in Arkavathi river at Station I (non-polluted) and Station II (polluted).

Collections of phytoplankton were made using a conical net of bolting nylon of 0.069mm mesh width and mouth ring diameter of 35 cm with the help of an outrigger canoe. The net was towed for ten minutes for surface hauls and the volume of water filtered through it was determined by flow meter attached to it and the net was backwashed between the two stations to avoid clogging of meshes. The filtered samples were fixed and preserved in 4% formalin with a few drops of Lugol's iodine solution. For the quantitative analysis of phytoplankton, the settlement method described by Sukhanova [5] was adopted. Numerical plankton analysis was carried out using an inverted microscope. Planktons were identified and enumerated by using the methods described by Hosamani and Bharathi [6]. For qualitative analysis of zooplanktons was done according to the methods given by Edmondson [7], Needham and Needham [8], Pennak [9], and Tonap [10]. Zooplanktons were identified by using monographs of Edmondson [11], Batish [12] and Althof [13].

RESULTS AND DISCUSSION

Phytoplanktons were collected from the river water during the study period from non-polluted site (Station I) and polluted site (Station II). The results of phytoplanktons counts from each of the selected sites of Arkavathi River are shown in Table-1 and Table-2.

Table 1: Distribution of phytoplankton in Station I (non-polluted site).

Months	Bacillariophyceae		Desmidaceae		Chlorococcales		Myxophyceae		Euglenophyceae	
	Number of Individuals	Number of Species	Number of Individuals	Number of Species	Number of Individuals	Number of Species	Number of Individuals	Number of Species	Number of Individuals	Number of Species
January	400	7	600	8	315	4	60	9	50	5
February	415	8	650	8	412	5	100	12	30	4
March	300	8	620	7	318	4	50	20	Nil	0
April	350	7	518	6	400	4	80	24	40	4
May	360	7	545	7	415	4	90	26	20	2
June	280	6	612	7	218	3	72	21	30	3
July	415	7	600	6	318	3	102	23	10	2
August	450	8	300	4	400	4	68	15	40	3
September	389	9	680	7	215	2	94	17	20	2
October	400	11	610	6	118	1	180	11	10	1
November	250	6	590	5	181	2	104	13	18	1
December	180	4	580	5	190	2	84	9	15	2
Total	4189	7(Mean)	6905	6(Mean)	3818	3(Mean)	1084	17(Mean)	283	2(Mean)

A detailed microscopic examination of phytoplanktons revealed, the presence of maximum species of Myxophyceae (17 species in Station-I and 19 species in Station-II) followed by Bacillariophycean species (7 species in Station –I and 6 species in Station-II). However, the least number of Euglenophycean species (2) and Chloroococcales species(3) were recorded in Station-I and Station-II respectively. Desmidaceae showed highest number of individuals (6905) and euglenoid showed less number of individuals(283) in Sation-I. Myxophyceae showed highest number of individuals and Chlorococcales showed less number of individuals in Station-II. Nutrients are considered

as one of the most important parameters in the aquatic environment which influences the growth, reproduction and metabolic activities of living beings. Distribution of nutrients is mainly based on the season tidal conditions and fresh water flow from land source [14]. In the present investigation a visible change in phytoplankton community with regard to the numerical abundance and species composition was noticed among the stations studied. A total of 71 phytoplanktons taxa were identified.

Table 2: Distribution of phytoplankton in Station II (polluted site).

Months	Bacillariophyceae		Desmidaceae		Chlorococcales		Myxophyceae		Euglenophyceae	
	Number of Individuals	Number of Species	Number of Individuals	Number of Species	Number of Individuals	Number of Species	Number of Individuals	Number of Species	Number of Individuals	Number of Species
January	150	6	200	8	70	4	350	9	112	4
February	80	4	80	5	28	4	300	13	114	4
March	70	4	60	6	35	3	428	18	154	3
April	112	5	50	4	48	4	412	26	106	2
May	106	6	30	6	106	3	218	24	180	4
June	250	6	116	7	250	3	289	19	189	4
July	260	7	106	5	66	2	291	20	192	3
August	270	7	180	4	177	4	358	22	106	4
September	116	8	90	6	98	2	415	22	88	3
October	180	9	70	5	89	1	454	20	95	4
November	110	4	60	5	69	2	402	18	108	4
December	90	4	48	4	50	1	359	18	160	2
Total	1794	6(Mean)	1090	5(Mean)	1086	3(Mean)	4276	19(Mean)	1604	3(Mean)

Desmidaceae (8 Species with 6905 individuals) and Bacillariophyceae (11 species with 4189 individuals) were found to be dominant in non-polluted site. Their population was found to be relatively less in polluted site. Generic representation of the Euglenophyceae was lowest throughout the study period, where as the algal population was dominated by Myxophyceae followed by Bacillariophyceae in polluted site. Maximum phytoplankton abundance was observed during the month of February and while lowest number was recorded in the month of December in Station I. From the analysed data, it is observed that species evenness decreased with the increasing size of algal population. The abundance and species composition of phytoplankton varied strongly at the successive months and between the stations in the study area. Algal abundance was noticed during summer and their number declined in monsoon, which was in accordance with Thomas and Prasad [15] who recorded similar results in wetlands of Mysore. Abundance of Myxophyceae was noticed in the polluted sites during all the seasons. The maximum abundance of Euglenophyceae was observed in the month of June at polluted site while no individual of Euglenoids was observed in March at non-polluted site. Euglenophyceae and/or Chlorophyceae, however, occurred as a transition stage. Such transition stage always occurs when intermediate conditions of light and rainfall exist [16]. Such conditions are favouring to Euglenophyceae and Chlorophyceae. A similar pattern of phytoplankton species succession has been previously recorded in the lake [17].

In the present work four types of Zooplanktons were identified and are shown in Table -3. Rotifera and Crustacea constituted the most dominant groups in both non-polluted and polluted stations.

The most commonly seen zooplankton species in the both sites are *Asplachna*, *Cyclops*, *Daphnia*, *Mesocyclops*, *Nauplius*, *Siphlonurus* species. *Arcella* sp., Lacane sp., *Macrocyclops* sp., *Tipula* sp., *Anopheles* larvae, and *Chironomus* larvae are exclusively seen only in polluted site while *Carchesium polypium*, *Paramaecium aurelia*, *Brachionus caudatus*, *Epiphanes macrourus*, *Diurella* sp., *Gastropus hyptopus*, *Keratella quadrata*, *Diaphanosoma* sp. and *Chaoborus* sp. are seen in non-polluted site. Although zooplanktons exists under a wide range of environmental conditions, yet many species are limited by dissolved oxygen, temperature, salinity and other physico-chemical factors [18]. The dominance of any species in the polluted water for one season or more may be considered as indicator species. The natural unpolluted environments are characterized by balanced biological conditions and contain a great diversity of plants and animals life's with one species dominating. The great fluctuations in the quantitative and qualitative composition of the phytoplankton in the different stations over the months were mainly due to several environmental factors, which are variable in different seasons and regions [19]. Nutrients present in silk industrial waste water have been identified as the main cause for changing the trophic status of water body from oligotrophic to eutrophic.

Table 3: Distribution of zooplankton in non-polluted site (Station-I) and polluted site (Station- II)

Species	Non-polluted site (Station-I)	Polluted site (Station-II)
Protozoa:		
Amoeba species	+	+
Arcella species	-	+
Carchesium polypium	+	-
Paramaecium caudatum	-	-
Paramaecium Aurelia	+	-
Sphaerophysa species	-	-
Rotifera:		
Asplachna species	+	+
Brachionus caudatus	+	-
Epiphanes macrourus	+	-
Diurella species	+	-
Gastropus hyptopus	+	-
Keratella quadrata	+	-
Lacane species	-	+
Microcodon species	+	-
Crustacea:		
Cyclops species	+	+
Daphnia species	+	+
Diaphanosoma species	+	-
Macrocyclops species	-	+
Mesocyclops species	+	+
Nuplius larvae	+	+
Nauplius species	+	+
Zoea larvae	+	+
Insecta:		
Anopheles larvae	+	+
Chironomus larvae	-	+
Chaoborus species	+	-
Siphlonurus species	+	+
Tipula species	-	+

CONCLUSION

The present study provides vital details on plankton distribution and abundance of Arkavathi river which may unravel the information on the energy turnover of the river ecosystem. It will serve as an useful tool for further ecological assessment and monitoring of the river ecosystem. The results have shown the need of planktons as index of water quality.

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