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Research Article

DIVERSITY AND ECOLOGY OF PHYTOPLANKTON IN MANAKUDY ESTUARY, KANYAKUMARI, TAMILNADU, INDIA

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ABSTRACT

The present study was performed to explore the diversity and ecology of phytoplankton in Manakudy estuary, Kanyakumari from January 2013 to June 2013. Estuarine water samples were collected fortnightly during the morning hours between 0830 and 0900 A.M. and the same were fixed in 4% formalin. The samples were concentrated by centrifugation and the phytoplankton cells were observed, photographed and identified with the help of identification manuals. The ecological role of phytoplankton was studied by field survey of Manakudy estuary. During the present study 26 species of phytoplankton were recorded. The results of ecological survey showed that Manakudy estuary treasures an abundant diversity of phytoplankton that play a key role in maintaining the ecological interlinks in Manakudy estuary and the adjacent Indian Ocean, where it joins. Our study favors a continuous monitoring and further assessment of phytoplankton which is needed to explore more about ecological enigma in Manakudy Estuarine Ecosystem (MEE), Kanyakumari.

Key words: Diversity, Ecology, Phytoplankton, Manakudy estuary, Kanyakumari.

INTRODUCTION

An estuary is a partly enclosed coastal body of brackish water with one or more rivers or streams flowing into it and with a free connection to the open sea. The inflows of both sea water and fresh water provide high levels of nutrients in both the water column and sediments, making estuaries among the most productive natural habitats in the world. Estuaries are economically important ecosystem for fisheries in tropical regions and they act as a transitional zone between land and sea (Bardarudeen *et al.,* 1996).

Phytoplankton-the primary producers of aquatic ecosystem, usually gather at the euphotic zone where light intensity that makes photosynthesis possible. The pelagic phytoplanktonic communities make important contributions to the smooth functioning of estuarine ecosystem (Kawabata *et al.,* 1993).

In aquatic habitats, the environmental factors include various physical properties of water such as solubility of gases and solids, the penetration of light, temperature and the chemical factors such as salinity, pH, hardness, phosphates and nitrates are very important for growth and density of phytoplankton on which zooplankton and some higher consumer depend for their existence (Balasubramaniam and Kannan, 2005).

The physico-chemical parameters and quantity of nutrients in water play significant role in the diversity and ecology of plankton (Ponmanickam *et al.,* 2007; Shekhar *et al.,* 2008).

The qualitative and quantitative studies of phytoplankton have been utilized to assess the diversity, ecology and quality of water (Adoni *et al.,* 1985*;* Chaturvedi *et al.,* 1999). Estuaries and shallow bays and lagoons function as tightly linked benthic–pelagic systems where the

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benthos can be a strong sink for phytoplankton biomass (Cloern, 1982) or a source as phytoplankton resting stages in sediments develop into vegetative cells that form seasonal blooms (Shikata *et al.,* 2008).

Though a large number of research efforts have been made to access the diversity and ecology of marine phytoplankton but the reports on estuarine phytoplankton in Kanyakumari is still limited and scanty (Kavitha *et.al.*,2005; Saraswathi *et.al.*, 2014). Thus the present research is carried out with a goal to explore the diversity and ecology of phytoplankton in Manakudy estuary, Kanyakumari. This work also explores more detail about the ecological importances of phytoplankton in a major estuarine ecosystem of Kanyakumari.

MATERIALS AND METHODS

Study Area

Manakudy is a small village located at 7 kms distance from Kanyakumari, the nearest town which is one among the best tourist places in India. Kanyakumari uncovers the joining of three huge marine worlds; these are the Indian Ocean, the Arabian Sea and the Bay of Bengal. The geographical location of Manakudy estuary is found to be at 8.1160 latitude and 77.4882 longitudes. The pictorial representation of the study area is represented in figure-1.

Collection of Sample

The sampling was done on random basis and different sampling areas were selected because of particular choices. Station-1 has the advantage of mixing fresh water and saline water at its best whereas the stations S_2, S_3 and S_4 have the advantage of getting nutrients and waste disposals from nearby housing localities. The end point of sampling area was fixed as S_5 which has the biggest advantage of diffusion of house holding wastes continuously enriching the phytoplankton diversity.

Fixation and Concentration of Sample

The samples were fixed in 4% formalin and concentrated by centrifugation (REMI) for the further analysis of phytoplankton.

Analysis of Physico-Chemical Parameters

The various physico-chemical parameters of the sample such as water temperature, pH, salinity turbidity, dissolved oxygen (DO), Nitrate and phosphate were analyzed by following the standard procedures of APHA (2005).

Observation of Phytoplankton

The observation of phytoplankton was done by exposing the concentrated sample to the Light microscope (COSLAB). The phytoplankton observed under microscope were captured with the help of a digital camera (MDCE-5C).

Identification of Phytoplankton

The identification of phytoplankton was carried out with the help of standard books and identification manuals (Tomas, 1997; Mitra and Banerjee, 2004).

Diversity Analysis

The diversity of phytoplankton in Manakudy estuary of Kanyakumari district was analyzed by calculating different Diversity Indices (DI).

Shannon-Weiner's Diversity Index (H)

The Shannon-Weiner's diversity index was calculated by following Shannon and Weiner (1949).

Diversity Index (H) = $- \sum$ Pi In Pi

Where Pi = S / N

S = Number of individuals of one species

N = Total number of all individuals in the sample

In = Logarithm to base e

Similarly the Evenness Index (e) and Richness index (d) were calculated by following Margalef (1958) and Pielou (1966).

Ecological study

The data on ecological and conservational status of Manakudy estuary was obtained by field survey and also from the questionnaire made to the local residents.

RESULTS

Physico-Chemical Parameters

The maximum and minimum value of each physico-chemical parameters recorded during the present study is represented in Table 1.

Diversity Analysis

A total number of 26 species, representing 4 groups (Table-2) of phytoplankton (Bacillariophyceae, Chlorophyceae, Cyanophyceae and Dinophyceae) were recorded during the present study. It's interesting to note that Bacillariophyceae (Diatoms) was found as the dominant group of phytoplankton, covering a total number of 19 species in the entire phytoplankton diversity of Manakudy estuary. The diversity of Phytoplankton in Manakudy estuary was analyzed by calculating different Diversity Indices (DI). The detail about diversity indices are represented in the table-3.

Ecological Analysis

The results of ecological survey represents that the diversity of phytoplankton plays a crucial role on the diversity of nektonic, benthic and avian fauna of Manakudy estuarine ecosystem. The detail about ecological and conservational roles of phytoplankton is represented in the table-4.

Table 1. Physico-Chemical parameters recorded at Manakudy estuary during the present study.

Parameters	Level	Stations				
		S_1	S_2	S_3	S_4	S_5
Water Temp.(°C)	Maximum	29	29	28	28	28
	Minimum	28	28	28	28	27
pH	Maximum	8	8	8	8	8
	Minimum	7	7	7	7	7
Salinity (ppt)	Maximum	21	19	18	17	15
	Minimum	17	13	11	9	11
Turbidity (Cm)	Maximum	19	19	21	22	26
	Minimum	17	16	18	21	23
DO (mg/L)	Maximum	7.8	7.6	7.4	7.7	7.4
	Minimum	7.5	7.3	7.5	7.4	7.2
Nitrate (µM)	Maximum	1.85	1.24	1.57	1.54	1.58
	Minimum	1.79	1.11	1.43	1.41	1.27
Phosphate (µM)	Maximum	1.60	1.51	1.52	1.34	1.10
	Minimum	1.45	1.42	1.37	1.22	1.02

Table 2. List of phytoplankton species recorded at Manakudy estuary during the present study.

Phytoplanktonic species	January	February	March	April	May	June
Bacillariophyceae (Total)	4	6	4	2	1	2
Nitzschia longissima	+	-	-	-	-	-
Nitzschia sigma	-	+	-	-	+	-
Pleurosigma angulatum	+	-	-	-	-	-
Lauderia annulata	-	+	-	-	-	-
Golenkinia sp.	-	-	+	-	-	-
Coscinodiscus sp.	+	-	-	-	-	+
Gyrosigma sp.	+	-	-	-	-	-
Cylindrotheca closterium	-	+	-	-	-	-
Navicula sp.	-	+	-	-	-	+
Navicula cuspidate	-	-	+	-	-	-
Navicula halophila	-	-	+	-	-	-

Fragillaria crotonensis	-	+	-	-	-	-
Fragilariopsis cylindrus	-	-	-	-	-	-
Cyclotella maneghiniana	-	-	-	-	-	-
Navicula cuspidate	-	-	-	-	-	-
Rhizosolenia fragilissima	-	-	-	+	-	-
Haslea sp.	-	+	-	-	-	-
Pinnularia sp.	-	-	+	+	-	-
Chlorophyceae (Total)	1	1	2	1	0	0
Actinastrum hantzschii	+	-	-	-	-	-
Chlorella sp.	-	-	+	+	-	-
Chlorella pyrenoidosa	-	+	-	-	-	-
Chlorella regularis	-	-	+	-	-	-
Scenedesmus quadricauda	-	-	-		-	-
Cyanophyceae (Total)	0	0	1	0	0	0
Oscillatoria sp.	-	-	+	-	-	-
Dinophyceae (Total)	0	0	0	1	0	0
Protoperidinium crassipes	-	-	-	+	-	-

+ = Presence

- = Absence

Table 3. Diversity indices of phytoplankton in Manakudy estuary recorded during the present study.

Months	Diversity Indices	S_1	S_2	S_3	S_4	S_5
January	Shannon-Weiner's Diversity Index (H)	0.110	0.117	0.862	0.759	0.336
	Evenness Index (e)	0.101	0.110	0.454	0.564	0.225
	Richness index (d)	8.332	8.291	6.753	7.102	7.113
February	Shannon-Weiner's Diversity Index (H)	0.150	0.112	0.120	0.119	0.150
	Evenness Index (e)	0.249	0.245	0.249	0.221	0.211
	Richness index (d)	7.324	5.571	5.342	3.139	3.121
March	Shannon-Weiner's Diversity Index (H)	0.144	0.127	0.145	0.153	0.150
	Evenness Index (e)	0.129	0.101	0.129	0.117	0.112
	Richness index (d)	6.334	6.643	6.421	4.709	4.362
April	Shannon-Weiner's Diversity Index (H)	0.172	0.156	0.132	0.155	0.136
	Evenness Index (e)	0.232	0.251	0.274	0.128	0.113
	Richness index (d)	5.437	4.298	4.266	4.197	4.134

May	Shannon-Weiner's Diversity Index (H)	0.142	0.141	0.132	0.125	0.116
	Evenness Index (e)	0.139	0.131	0.129	0.119	0.112
	Richness index (d)	5.428	5.412.	5.328	5.248	5.278
June	Shannon-Weiner's Diversity Index (H)	0.157	0.161	0.152	0.155	0.146
	Evenness Index (e)	0.172	0.161	0.153	0.149	0.142
	Richness index (d)	2.218	2.124	1.128	1.048	0.101

Table 4. Ecological and conservational parameters accessed in Manakudy estuary during the present study.

Ecological and Conservational Parameters	Nektonic Diversity	Benthic Diversity	Avian Diversity	Fisheries Status	Pollution Control	Awareness and Conservation
Level of Assessment and Monitoring	SFT*	SFT*	EXT!	EXT!	USFT+	USFT+

* SFT: Satisfactory level

! EXT: Excellent level

+ USFT: Unsatisfactory level

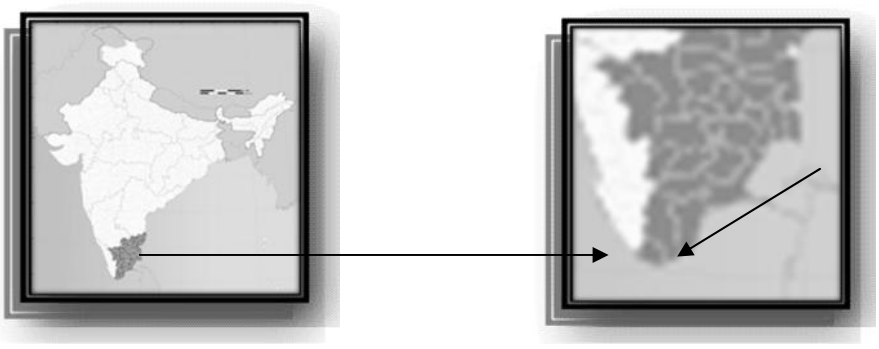

Figure 1. Geographical map of the sampling area.

DISCUSSION

The major estuarine ecosystems of Kanyakumari are Rajakkamangalam, Thengayapattinam, Manavalakurichi and Manakudy estuary. These estuaries entrap an abundant diversity of phytoplankton. During the present study a total number of 26 species of phytoplankton were recorded that indicates a very rich diversity of estuarine phytoplankton in Manakudy estuary. Further the results of ecological survey also supports that there is a direct ecological interlink of phytoplankton on the nektons, benthos, and water birds in this estuarine ecosystem. In the present study it was observed that the value of physico-chemical parameters fluctuates greatly during different months. This may be due to the role of various physico-chemical factors which are well known to alter the diversity of phytoplanktonic life forms in aquatic ecosystem. This is supported from the earlier study on phytoplankton done by Devika *et al.,* (2006) which suggests that the physico-chemical conditions had a direct relationship on phytoplankton diversity.

Further the results of ecological aspects of the present study also showed that the phytoplanktonic diversity essentially determines the estuarine biodiversity in Manakudy estuary (Nekton, Benthos and Avian). Additionally the ecological role of phytoplankton is must to know since Manakudy estuary is highly polluted. Thus phytoplankton can be used as the indicators of pollution in this major estuarine ecosystem. Similarly the harmful ecological roles of phytoplankton such as Harmful Algal Bloom (HAB) must be accessed here to protect the potential of fisheries. These ecological results are supported by the earlier studies on ecology of phytoplankton that describe the ecological aspects of phytoplankton in aquatic ecosystems (Saraswathi *et al.,* 2014).

CONCLUSION

Since, estuaries have been called as the "Nurseries of the Sea", the proper monitoring of diversity and ecology of Planktonic flora in Manakudy estuary is a thrust area of marine biological research in order to enrich many species of fishes, benthos and birds that depend on this estuary for food and nesting areas. Hence the conservation of Manakudy Estuarine Ecosystem (MEE) is a must in diversity, ecology and fisheries point of view. Further long term survey, monitoring and assessment studies are necessary to know the role of seasonal variation on diversity and ecological instances of phytoplanktons such as HAB (Harmful Algal Bloom). Hence the present study establishes a milestone towards conducting the future research on diversity, ecology, taxonomy and conservation of estuarine phytoplankton in Manakudy Estuary (Kanyakumari): The Enchanting Estuarine Ecosystem of Kanyakumari".

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

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