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Phytoplankton diversity of Tirur River, Malappuram District, Kerala

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Abstract

The present report was the systematic assessment of the phytoplankton in Tirur River, Malappuram District, Kerala, India. The survey was conducted at the three sites namely Tirur, Thazhepalam and Parapadi, of Tirur River and the species diversity of phytoplankton was analyzed from January to June 2015. From Tirur River, 57 taxa of phytoplankton were identified during the period of study, which come under 30 genera belonging to four taxonomic classes. The Bacillariophyceae (diatoms) was the diverse group comprised of 39 taxa belonging to 21 genera followed by the Cyanophyceae (blue green algae) represented by 14 taxa belonging to 7 genera. The Chlorophyceae (green algae) and the Euglenophyceae were represented by 2 species each belonging to one genus each. The algal taxa found in the marine environments included *Podosira montagnei* Kuetzing, *Stephanopyxis palmeriana* (Greville) Grunow, *Chaetoceros affine* Lauder, *Chaetoceros breve* Schutt, *Chaetoceros gracile* Schutt, *Chaetoceros lorenzianum* Grunow, *Pleurosigma angulatum* (Quekett) W. Smith, *Pleurosigma elongatum* W. Smith, *Pleurosigma normanii* Ralfs, *Pleurosigma salinarum* Grun. and *Gyrosigma balticum* (Ehr.) Rabh. were noticed in Tirur River, which indicates the brackish nature of water during the period of study.

Key words: Tirur River; Algal diversity; Phytoplankton; Malappuram District; Kerala.

Introduction

The phytoplankton are the major primary producers in the food web of riverine ecosystems, which serve as food for heterotrophic animals and finally the energy made available to the fish. The knowledge of the spatial and temporal distribution of plankton and the effect of environmental variables on them, will give a proper understanding of the ecosystem for the scientific utilization of the natural waters for fishery exploitation.

The phytoplankton respond rapidly to a wide range of pollutants and thus, provide potentially useful early warning signals of deteriorating conditions and the possible causes. A study on the diversity of phytoplankton in Kavery River, Tamil Nadu, showed higher quantity of

phytoplankton (Babu *et al.*, 2014). The taxonomy and ecology of Bacillariophyceae in the river Moosi was studied by Venkateswarlu (1984). The plankton diversity in Krishna River, Maharashtra was carried out by Sarwade and Kamble (2014) and observed that the algal diversity was less in number during pre-monsoon season with dominating class Chlorophyceae.

The water in the lower reaches of the rivers in Kerala faces the water quality problems. The physico-chemical characteristics of the water body affect the abundance of species composition and stability of aquatic organisms. The phytoplankton was used as a reliable indicator of water pollution (APHA, 1998). The water quality of Chalakudy River in Kerala was continuously changing and the ecology was threatened (Chattopadhyay *et al.*, 2005; Joseph and Tessy, 2010; Thomas and Tessy Paul, 2015). The quantitative assessment of phytoplankton and the impact of pollution on the phytoplankton of Tirur River, Malappuram district, Kerala were reported by the authors (Sreenisha and Tessy Paul, 2016). The present paper reports the systematic assessment of the species diversity of phytoplankton in Tirur River.

The algal biodiversity of rivers in Kerala have still to be explored. Sheeba and Ramanujan (2005) studied the composition and distribution of phytoplankton in Ithikkara River, Kerala. Roy and Joy (2007) reported algal biodiversity and succession in Periyar River at Aluva, Kerala. The algal diversity of Vamanapuram River of Kerala was reported by Maya (2007).

Materials and methods

The present study was conducted in Tirur River at three sites between the Tirur railway station and the Parapadi colony. It lies in between 75° 55' and 75° 54' East longitude and 10° 55' and 10° 54' North latitudes. Tirur River is also called Tirur - Ponnani River, act as a water resource for the Tirur town, Malappuram District, Kerala.

The site 1 is Tirur, located near the railway station and is 1 km away from site 2. The site 2 is Thazheppalam, which is 1km away from the Tirur market and also from Parapadi, the site 3. The surface water samples were collected on monthly basis from the selected sites from January to June, 2015.

For the analysis of the algal diversity, one litre of water sample was collected twice a month from each of the three selected sites of Tirur River. The samples were brought to the laboratory and were preserved in 4% formaldehyde solution. Micro slides were prepared from the collected samples and were examined under the research microscope. The phytoplanktons were identified with the help of monographs and standard publications (Venkataraman, 1939; Subrahmanyan, 1946; Desikachary, 1959; Hendey, 1964; Sarode and Kamat, 1984; Gopinathan, 1984; Prasad and Srivastava, 1992; Komárek and Anagnostidis, 1998, 2005; Khondker *et al.*, 2008; Joseph and Saramma, 2011; Komárek, 2013). The photomicrographs of phytoplankton were taken using research microscope fitted with digital camera and were saved as JPEG images.

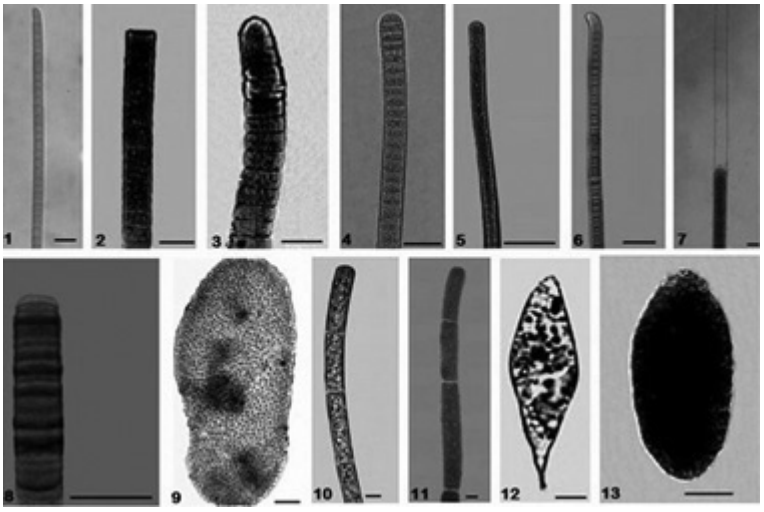

Plate 1: Photomicrographs of selected members of Cyanophyceae, Chlorophyceae and Euglenophyceae (1 – *Oscillatoria chalybea* (Mertens) Gomont; 2 – *Oscillatoria laetevirens* (Grouan) Gomont; 3 – *Oscillatoria ornata* Kuetz. ex Gomont; 4 – *Oscillatoria subbrevis* Schmidle; 5 – *Oscillatoria vizagapatensis* Rao, C.B.; 6 – *Oscillatoria willei* Gardner em Drouet; 7 – *Lyngbya birgei* Smith; 8 – *Oscillatoria princeps* Vaucher ex Gomont; 9 – *Aphanocapsa littoralis* Hansgirg; 10 – *Microspora* sp. 1; 11 – *Microspora* sp. 2; 12 – *Euglena hemichromata* Skuja; 13 – *Euglena* sp. 1 (Scale bar: 20 µm)).

Results and discussion

During the present study 57 taxa of phytoplankton belonging to 30 genera coming under four taxonomic divisions namely the Cyanophyta, the Chlorophyta, the Bacillariophyta and the Euglenophyta were identified and documented in systematic order with photomicrographs from the Tirur River, Malappuram district, Kerala (Plate 1, figs. 1–13; Plate 2, figs. 14–25 and Plate 3, figs.26–42).

The Bacillariophyceae was the major group represented by 39 taxa (68.4%) belonging to 21 genera followed by the Cyanophyceae (blue green algae) represented by 14 species (24.6%) belonging to 7 genera. The Chlorophyceae (green algae) and the Euglenophyceae were represented by 2 species (3.5%) each belonging to 1 genus each (Table 1 and Fig. 1). *Oscillatoria* (8), *Nitzschia* (7), *Navicula* (6) *Chaetoceros* (4) and *Pleurosigma* (4) were the diverse genera found in the study area (the no: in parenthesis represents the number of taxa). Site wise biodiversity of phytoplankton in Tirur River is represented in Fig. 2.

During the period of study, the salinity was higher in Tirur River, which ranged from 0.22 ppt (site 2) to 19.15 ppt (site 3) with the average value 7.38 ± 5.44 to 10.39 ± 8.24 ppt (Sreenisha and Tessy Paul, 2016). The analysis of phytoplankton showed a number of marine diatoms during the pre-monsoon season, which indicates the brackish nature of water. *Podosira montagnei* Kutzing., *Stephanopyxis palmeriana* (Greville) Grunow., *Chaetoceros affine* Lauder, *Chaetoceros breve* Schutt, *Chaetoceros gracile* Schutt, *Chaetoceros lorenzianum* Grunow,

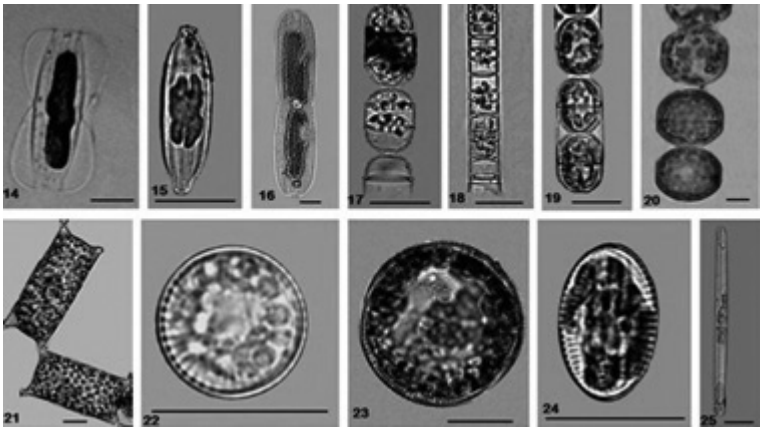

Plate 2: Photomicrographs of selected members of the Bacillariophyceae (14 – *Amphiprora paludosa* W. Smith var. *subsalina* Cleve; 15 – *Amphora coffeaformis* Agardh; 16 – *Tropidoneis lepidoptera* (Greg.) Cleve; 17 – *Melosira dubia* Kutz.; 18 – *Aulacoseira granulata* (Ehr.) Ralfs var. *angustissima* Muell; *19 – Podosira montagnei* Kutzing; 20 – *Stephanopyxis palmeriana* (Greville) Grunow; 21 – *Terpsinoe musica* Ehr.; 22 – *Cyclotella meneghiniana* Kutzing; 23 – *Coscinodiscus radiatus* Ehrenberg; 24 – *Cocconeis placentula* Ehr.; 25 – *Synedra ulna* (Nitzsch) Her (Scale bar: 20 µm)).

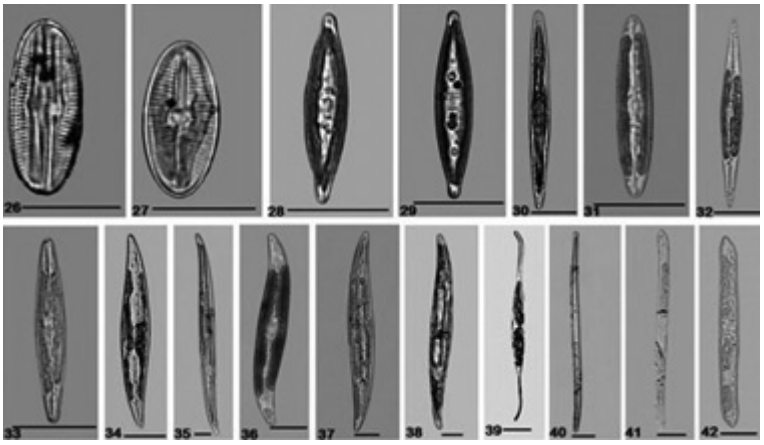

Plate 3: Photomicrographs of selected members of the Bacillariophyceae (26 – *Diploneis fusca* Gregory var. *sub-rectangularis* Cleve; 27 – *Diploneis subovalis* Cleve; 28 – *Navicula salinarum* Grun.; 29 – *Navicula halophila* (Grun.) Cleve f. *subcapitata* Ostrup; 30 – *Navicula hasta* Pantoesek; 31 – *Navicula digitoradiata* (Greg.) A. Schmidt; 32 – *Navicula rostellata* Kutz.; 33 – *Navicula peregrina* (Ehr.) Kutz.; 34 – *Pleurosigma angulatum* (Quekett) W. Smith; 35 – *Pleurosigma elongatum* W. Smith; 36 – *Pleurosigma normanii* Ralfs; 37 – *Pleurosigma salinarum* Grun.; 38 – *Gyrosigma balticum* (Ehr.) Rabh.; 39 – *Nitzschia closterium* (Ehrenberg) W. Smith; 40 – *Nitzschia sigmoidea* (Nitzsch) W. Smith; 41 – *Nitzschia obtusa* W. Smith; 42 – *Nitzschia obtusa* W. Smith var. *scalpelliformis* Grun (Scale bar: 20 µm)).

Pleurosigma angulatum (Quekett) W. Smith, *Pleurosigma elongatum* W. Smith, *Pleurosigma normanii* Ralfs, *Pleurosigma salinarum* Grun. and *Gyrosigma balticum* (Ehr.) Rabh. are usually found in the marine environments (Venkataraman, 1939; Subrahmanyan, 1946; Hendey, 1964; Joseph and Saramma, 2011).

Table 1: Site wise species diversity of phytoplankton in Tirur River.

S. No.	Name of algae	Site 1	Site 2	Site 3
	Division: CYANOPHYTA Class: Cyanophyceae Order: Chroococcales Family: Chroococcaceae			
1	*Chroococcus turgidus* (Kuetz.) Nag.	+	+	–
2	*Gloeocapsa crepidinum* Thuret	–	+	–
3	*Aphanocapsa littoralis* Hansgirg	+	–	–
4	*Merismopedia elegans* Meyen	+	+	+
5	*Hydrococcus rivularis* Kutz.	–	+	–
	Order: Nostocales Family: Oscillatoriaceae			
6	*Oscillatoria chalybea* (Mertens) Gomont	–	+	+
7	*Oscillatoria laetevirens* P.Grouan & H. Crouan ex Gomont	–	+	+
8	*Oscillatoria limosa* Ag. ex Gomont	–	–	+
9	*Oscillatoria ornata* Kuetz. ex Gomont	–	+	–
10	*Oscillatoria princeps* Vaucher ex Gomont	+	+	–
11	*Oscillatoria subbrevis* Schmidle	–	+	–
12	*Oscillatoria vizagapatensis* Rao, C.B.	–	–	+
13	*Oscillatoria willei* Gardner em Drouet	–	+	–
14	*Lyngbya birgei* Smith	–	+	+
	Division: CHLOROPHYTA Class: Chlorophyceae Order: Ulotrichales Family: Microsporaceae			
15	*Microspora* sp. 1	+	–	–
16	*Microspora* sp. 2	+	+	+
	Division: BACILLARIOPHYTA Class: Bacillariophyceae Order: Centrales Sub order: Discoideae Family: Coscinodiscaceae Sub family: Melosiroideae			
17	*Melosira dubia* Kutz.	+	+	+
18	*Aulacoseira granulata* (Ehr.) Ralfs var. *angustissima* Muell.	+	+	+
19	*Podosira montagnei* Kutzing.	–	+	–
20	*Stephanopyxis palmeriana* (Greville) Grunow.	–	+	–
	Sub family: Coscinodiscoideae			
21	*Cyclotella meneghiniana* Kutzing	+	+	+
22	*Coscinodiscus radiatus* Ehrenberg	+	–	–
	Sub order: Biddulphineae Family: Chaetoceraceae			
23	*Chaetoceros affine* Lauder	+	+	+
24	*Chaetoceros breve* Schutt	+	+	+
25	*Chaetoceros gracile* Schutt	+	+	+
26	*Chaetoceros lorenzianum* Grunow	+	+	+
	Sub family: Anaudeae			
27	*Terpsinoe musica* Ehr.	+	+	+
	Order: Pennales Sub order: Araphidineae Family: Fragilariaceae Sub Family: Fragilarioideae			
28	*Synedra ulna* (Nitz.) Ehr.	+	+	+
	Sub order: Monoraphidineae Family: Achnanthaceae Sub family: Cocconeoideae			
29	*Cocconeis placentula* Ehr.	+	–	+
	Sub order: Biraphidineae Family: Naviculaceae Sub family: Naviculoideae			
30	*Gyrosigma balticum* (Ehr.) Rabh.	+	+	+
31	*Pleurosigma angulatum* (Quekett) W. Smith	+	–	–
32	*Pleurosigma elongatum* W. Smith	+	–	–
33	*Pleurosigma normanii* Ralfs	–	–	+
34	*Pleurosigma salinarum* Grun.	–	–	+
35	*Diploneis fusca* Gregory var. *sub-rectangularis* Cleve	–	+	–
36	*Diploneis subovalis* Cleve	+	+	–
37	*Stauroneis anceps* Ehr.	+	+	+

(Continued)

Table 1: ***(Continued)***

S. No.	Name of algae	Site 1	Site 2	Site 3
38	*Navicula digitoradiata* **(Greg.) A. Schmidt**	+	–	–
39	*Navicula halophila* (Grun.) Cleve f. *subcapitata* Ostrup	–	+	+
40	*Navicula hasta* Pantoesek	+	–	–
41	*Navicula peregrina* (Ehr.) Kutz.	–	–	+
42	*Navicula rostellata* Kutz.	+	+	–
43	*Navicula salinarum* Grun.	–	+	–
	Sub family: Amphiproroideae			
44	*Amphiprora paludosa* W. Smith var. *subsalina*	+	+	+
45	*Tropidoneis Lepidoptera* (Greg.) Cleve	+	+	+
	Sub family: Gomphocymbelloideae			
46	*Amphora coffeaformis* Agardh	+	+	+
47	*Cymbella hustedtii* Krasske	+	+	+
	Family: Nitzschiaceae Sub family: Nitzschioideae			
48	*Bacillaria paradoxa* Gmelin	+	+	+
49	*Nitzschia closterium* (Ehrenberg) W. Smith	+	+	+
50	*Nitzschia fasciculata* Grun.	–	+	+
51	*Nitzschia longissima* (Brebisson) Ralfs	+	+	+
52	*Nitzschia obtusa* W. Smith	–	+	–
53	*Nitzschia obtusa* W. Smith var. *scalpelliformis* Grun.	+	+	+
54	*Nitzschia sigma* (Kutzing) W. Smith var. *indica* Karsten	–	–	+
55	*Nitzschia sigmoidea* (Nitzsch) W. Smith	+	–	–
	Division: EUGLENOPHYTA Class: Euglenophyceae Order: Euglenales Family: Euglenaceae			
56	*Euglena hemichromata* Skuja	+	–	–
57	*Euglena sp.*	+	–	–
	TOTAL	36	40	33

+ Present, – Absent

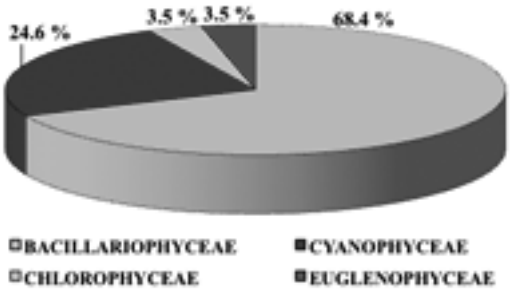

Fig. 1: Species diversity of phytoplankton in Tirur River.

During the period of this investigation members of the Bacillariophyceae were dominant in all sites followed by that of the Cyanophyceae. The most dominant phytoplankton genera in Indian Rivers are *Oscillatoria, Nitzschia, Navicula, Synedra* and *Melosira.* The Ithikkara River in Kerala showed the predominance of diatoms as reported by Sheeba and Ramanujan (2005). The genera such as *Nitzschia*, *Navicula* and *Cymbella* were the dominant diatoms in Periyar River (Joy *et al.*, 1990).

The analysis of physico-chemical parameters indicated that the water quality of Tirur River was deteriorated at all the three sites studied during the period of study and the contaminants came from fish market and railway station (Sreenisha and Tessy Paul, 2016). The pollution tolerant algal genera were *Lyngbya, Oscillatoria, Cocconeis, Cyclotella, Cymbella, Melosira, Navicula, Nitzschia, Stauroneis, Synedra* and *Euglena.* The diatoms namely *Synedra, Melosira*, and *Nitzschia* were highly resistant to pollution and they dominate depending upon the severity of the pollution level.

The class Bacillariophyceae was the diverse group of algae in all three sites of Tirur River throughout the period of study. The diatoms are ecologically

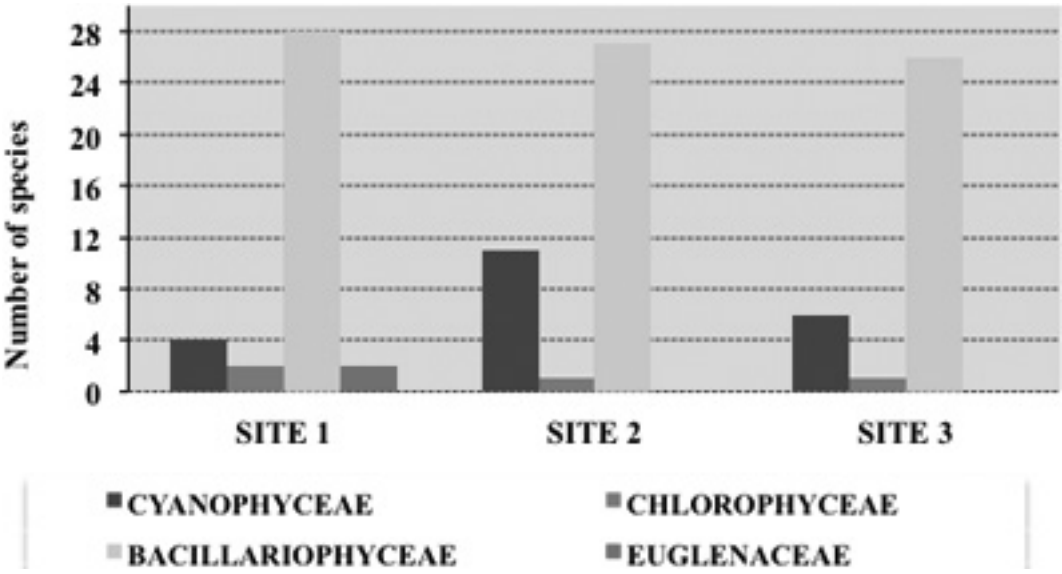

Fig. 2: Site wise species diversity of phytoplankton in Tirur River.

resistant and are highly adapted to riverine environment. The present study identified eleven pollution tolerant algal genera and it revealed the deteriorated quality of the water at all the three sites in the Tirur River during the period of study and are polluted due to human interventions.

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