



Qualitative and quantitative study of phytoplankton of River Wainganga near Markandadeo, Dist. Gadchiroli (M.S.)

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Abstract

Phytoplankton is a heterogeneous group of micro-organism and plays a major role in the food chain of aquatic ecosystems by biosynthesis of organic matter and thus they act as primary producers of food. The phytoplankton of many Indian rivers consists of diverse assemblages of major taxonomic groups. Many of these forms have different physiological and environmental requirements. During the investigation period of two years phytoplankton were collected randomly from three different sites i.e. S₁, S₂ and S₃ of river Wainganga for qualitative and quantitative analysis. During the course of study total 31 species of phytoplankton were recorded belonging to five different classes. Seasonal analysis of plankton from this lotic water body showing wide diversity of phytoplankton. Chlorophyceae or green algae comprise an important phytoplanktonic group both in terms of abundance (15 species) and frequently occurrence and Bacillariophyceae (Diatoms) was represented by seven species. Myxophyceae or blue-green comprises of six species and Euglenophyceae were represented by two species i.e. *Euglena* sp. and *Phacus* sp. while Dinophyceae was represented by only one species of genus *Ceratium*.

Key Words: *Environmental conditions, Markandadeo, Planktonic diversity, Phytoplankton, Quantitative, Wainganga*

Introduction

The Wainganga River flows from north to south and makes a U turn to flow north again at Markandadeo region and flows again towards south on its way to meet the Pranhita river and then the mighty river Godavari. The Wainganga river is situated at latitude 19° 59'55" North and 79° 52'21" East in Markanda (19°59'40"N and 79°51'59" E), Dist. Gadchiroli. The river has developed an extensive floodplain with sweeping graceful alluvial flats and meander traces having an area about 58.22 hectares. The flow of river water in this particular region is 1.6 km and the climate of the area is both warm and cool. The river is considered as a holy place as the hemadpanthi temple of Shiva is situated at its bank. Many devotees and tourists visits throughout the year the temple for their cultural and mythological activities. Phytoplankton is a heterogeneous group of micro-organism and plays a major role in the food chain of aquatic ecosystems by biosynthesis of organic matter and thus they act as primary producers of food (Patil and Panda, 1997). Many herbivores,

mostly zooplankton graze upon phytoplankton thus, passing the stored energy to their subsequent trophic levels. Phytoplankton are ecologically significant as they trap radiant energy, sensitive to pollution and used for water quality characterization, they have revealed tremendous scope for environmental management as soil conditioners, biofertilizers, bioindicators, biomonitors, ameliorators, feed for animals, protein supplement and rehabilitators of degraded ecosystems through bioabsorption of pollutants (Pandey *et al.*, 2014). The phytoplankton population is influenced by grazing, light, temperature and nutrients. They play an important role in regulating the dynamics of the aquatic food web and become a driving force in shaping the community structure of zooplankton (Mithani *et al.*, 2012). The phytoplankton of many Indian rivers consists of diverse assemblages of major taxonomic groups. Many of these forms have different physiological and environmental requirements. The number, type and distribution of these organisms present in any aquatic habitat provide a clue on the environmental conditions prevailing in that particular habitat. Many environmental factors interact to provide conditions for the growth of

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plankton both specially and seasonally (Sabata and Nayar, 1995). Various studies on planktonic diversity have been done by Khanna *et al.* (2005), Khanna *et al.* (2006) and Bhutiani and Khanna (2014).

Material and Methods

Collection of phytoplankton was carried out by using plankton net made of silk bolting cloth (200 meshes/cm). The free end of the net was attached by a plastic bottle having 100 ml capacity. The plankton was collected randomly from three different sites i.e. S₁, S₂ and S₃ of river Wainganga for qualitative and quantitative analysis. S₁ site is chosen from where the river makes a turn towards the north, S₂ site is exactly near the temple region where the most anthropogenic and ritual

activities are carried out while S₃ site from where the river continues its flow again towards the south. Water sample (50 litre) was filtered through the net from littoral and open water zones and carefully transferred to 100 ml bottle.

The fresh sample of phytoplankton was observed immediately under labomed compound microscope and identified with the help of standard available keys (Bellinger and Sigeo, 2010 and Reynolds, 1984) and then preserved in 4% formalin. The quantitative analysis of phytoplankton was carried out by using Sedgewick Rafter Cell (S.R. Cell) and the photographs were taken by Celestron 2 MP digital microscope imager. The collected data of phytoplankton of all groups were analyzed for calculating mean and standard deviation.

Fig 1. Satellite image of Wainganga River at Markandadeo Dist.- Gadchiroli (M.S.) showing three different sampling sites i.e S₁, S₂ & S₃ (Courtesy : Google photo).



Results and Discussion

Among the Myxophyceae yearly total maximum mean value was recorded by *Oscillatoria* sp. with 10.78 ± 7.30 ind/ltr followed by *Spirulina* sp. 10.50 ± 6.97 ind/ltr while minimum value was shown by *Rivularia* sp. with 3.89 ± 3.66 ind/ltr followed by *Nostoc* sp. 4.75 ± 3.84 ind/ltr in year 2010-11. During the year 2011-12, yearly mean value of *Oscillatoria* sp. was shown dominance and

found to be 10.28 ± 6.45 ind/ltr followed by *Nostoc* sp. with 4.64 ± 3.83 ind/ltr and *Rivularia* sp. with 3.42 ± 3.35 ind/ltr. The least density was recorded by *Microcystis* sp. with 5.89 ± 4.17 ind/ltr in the same year. In Bacillariophyceae yearly maximum average value was recorded by *Fragilaria* sp. with 10.94 ± 7.00 ind/ltr followed by *Mastogloia* sp. 9.89 ± 6.95 ind/ltr. The minimum value was shown

by *Gyrosigma* sp. with 3.58 ± 3.51 ind/ltr followed by *Nitzschia* sp. 7.06 ± 5.91 ind/ltr during 2010-11. The yearly average value of *Mastogloia* sp. in 2011-12 was recorded to be 9.28 ± 5.54 ind/ltr with dominance while the least population was recorded by the *Gyrosigma* sp. with a density of 2.64 ± 2.84 ind/ltr. Among Chlorophyceae, total yearly mean value of *Spirogyra* sp. was observed 9.92 ± 7.58 ind/ltr shows more population which followed by *Zygnema* sp. with 9.42 ± 6.49 ind/ltr. The

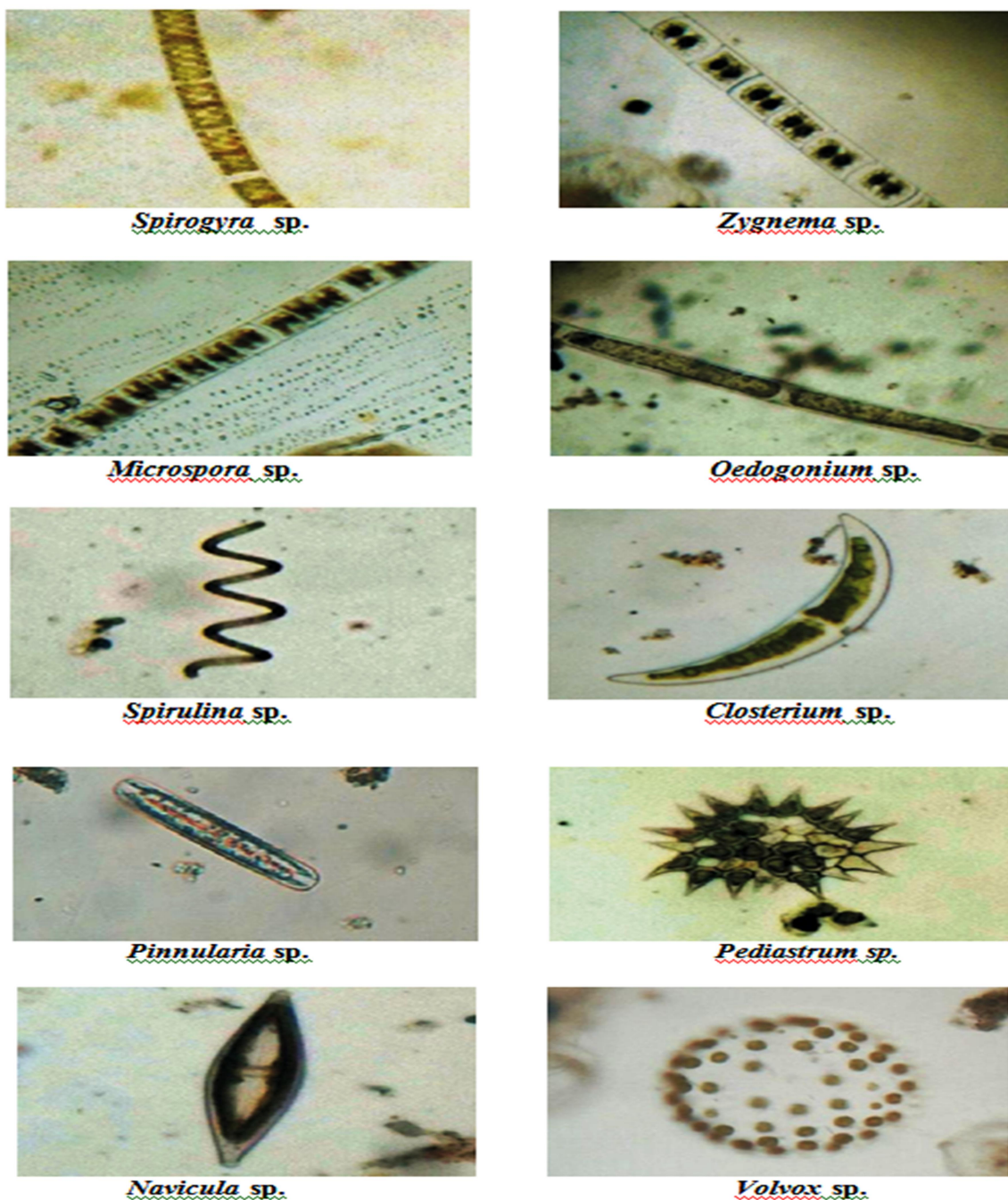


Fig 2. Plate showing Phytoplankton reported from Wainganga River near Markandadeo, Distt.-Gadchiroli.

Table 1. Population of phytoplankton in Wainganga River near Markandadeo Distt.–Gadchiroli, Maharashtra during 2010-11.

SN	Year Group & Species	2010 - 2011			
		Site 1	Site 2	Site 3	Total
A	Myxophyceae				
1	<i>Anabaena</i> sp.	6.33 ± 5.93	6.92 ± 5.31	6.75 ± 4.57	6.67 ± 5.27
2	<i>Microcystis</i> sp.	5.67 ± 3.79	7.33 ± 4.38	6.08 ± 3.73	6.36 ± 3.97
3	<i>Nostoc</i> sp.	5.17 ± 5.03	4.33 ± 3.40	4.75 ± 3.09	4.75 ± 3.84
4	<i>Oscillatoria</i> sp.	10.08 ± 6.68	11.92 ± 8.39	10.33 ± 6.83	10.78 ± 7.30
5	<i>Rivularia</i> sp.	3.67 ± 3.82	4.08 ± 3.43	3.92 ± 3.73	3.89 ± 3.66
6	<i>Spirulina</i> sp.	8.50 ± 5.35	11.92 ± 8.39	11.08 ± 7.17	10.50 ± 6.97
B	Bacillariophyceae				
1	<i>Diatoma</i> sp.	9.08 ± 6.20	14.75 ± 7.50	11.00 ± 7.43	11.61 ± 7.04
2	<i>Fragilaria</i> sp.	10.75 ± 6.26	11.42 ± 7.84	10.67 ± 6.91	10.94 ± 7.00
3	<i>Gyrosigma</i> sp.	3.67 ± 3.14	4.83 ± 5.68	2.25 ± 1.69	3.58 ± 3.51
4	<i>Mastogloia</i> sp.	9.33 ± 6.33	10.67 ± 8.25	9.67 ± 6.28	9.89 ± 6.95
5	<i>Navicula</i> sp.	7.67 ± 5.95	12.42 ± 8.61	9.42 ± 4.46	9.83 ± 6.34
6	<i>Nitzschia</i> sp.	5.58 ± 4.03	9.67 ± 7.96	5.92 ± 5.74	7.06 ± 5.91
7	<i>Pinnularia</i> sp.	6.75 ± 5.21	10.50 ± 9.60	8.08 ± 4.89	8.44 ± 6.57
C	Chlorophyceae				
1	<i>Chlorella</i> sp.	4.92 ± 3.90	12.58 ± 14.30	7.42 ± 5.59	8.31 ± 7.93
2	<i>Cladophora</i> sp.	6.92 ± 5.60	10.92 ± 6.91	6.83 ± 5.11	8.22 ± 5.88
3	<i>Closterium</i> sp.	7.17 ± 4.22	12.00 ± 9.43	8.50 ± 7.49	9.22 ± 7.05
4	<i>Coelastrum</i> sp.	2.33 ± 2.39	6.33 ± 9.69	2.83 ± 2.73	3.83 ± 4.94
5	<i>Cosmarium</i> sp.	0.58 ± 0.76	5.58 ± 4.55	1.58 ± 1.75	2.58 ± 2.36
6	<i>Euastrum</i> sp.	2.83 ± 3.44	1.58 ± 2.56	0.00 ± 0.00	1.47 ± 2.00
7	<i>Micrasterias</i> sp.	2.33 ± 2.56	0.58 ± 1.04	0.42 ± 0.95	1.11 ± 1.52
8	<i>Microspora</i> sp.	0.75 ± 0.83	5.17 ± 5.10	1.08 ± 1.04	2.33 ± 2.32
9	<i>Oedogonium</i> sp.	2.58 ± 3.15	4.42 ± 4.57	3.50 ± 2.47	3.50 ± 3.40
10	<i>Pediastrum</i> sp.	3.50 ± 3.38	5.50 ± 3.95	4.42 ± 3.45	4.47 ± 3.59
11	<i>Scenedesmus</i> sp.	0.00 ± 0.00	8.25 ± 6.30	0.00 ± 0.00	2.75 ± 2.10
12	<i>Spirogyra</i> sp.	12.58 ± 10.36	6.92 ± 5.35	10.25 ± 7.04	9.92 ± 7.58
13	<i>Ulothrix</i> sp.	5.17 ± 6.12	4.08 ± 3.07	2.67 ± 2.13	3.97 ± 3.77
14	<i>Volvox</i> sp.	2.75 ± 2.35	5.08 ± 3.64	3.83 ± 2.70	3.89 ± 2.90
15	<i>Zygnema</i> sp.	13.58 ± 7.72	3.58 ± 2.47	11.08 ± 9.30	9.42 ± 6.49
D	Euglenophyceae				
1	<i>Euglena</i> sp.	3.92 ± 3.80	9.08 ± 6.20	10.25 ± 7.08	7.75 ± 5.69
2	<i>Phacus</i> sp.	2.83 ± 2.70	6.58 ± 4.17	8.17 ± 5.54	5.86 ± 4.14
E	Dinophyceae				
1	<i>Ceratium</i> sp.	1.33 ± 1.31	1.83 ± 1.86	1.50 ± 1.55	1.56 ± 1.58

*all values are in ind/liter



Table 2. Population of Phytoplankton in Wainganga River near Markandadeo, Distt.-Gadchiroli, Maharashtra during 2011-12.

SN	Year Group & Species	2011 - 2012			
		Site 1	Site 2	Site 3	Total
A	Myxophyceae				
1	<i>Anabaena</i> sp.	6.08 ± 4.91	8.92 ± 5.48	6.50 ± 4.91	7.17 ± 5.10
2	<i>Microcystis</i> sp.	4.92 ± 3.77	7.17 ± 5.08	5.58 ± 3.66	5.89 ± 4.17
3	<i>Nostoc</i> sp.	4.92 ± 4.97	4.08 ± 3.23	4.92 ± 3.28	4.64 ± 3.83
4	<i>Oscillatoria</i> sp.	8.25 ± 6.06	13.67 ± 7.81	8.92 ± 5.39	10.28 ± 6.42
5	<i>Rivularia</i> sp.	3.25 ± 3.51	3.92 ± 3.20	3.08 ± 3.33	3.42 ± 3.35
6	<i>Spirulina</i> sp.	6.50 ± 6.05	9.17 ± 6.69	6.92 ± 4.59	7.53 ± 5.78
B	Bacillariophyceae				
1	<i>Diatoma</i> sp.	7.17 ± 4.63	13.08 ± 7.31	9.92 ± 5.98	10.06 ± 5.97
2	<i>Fragilaria</i> sp.	7.33 ± 4.87	11.67 ± 10.55	8.50 ± 7.51	9.17 ± 7.65
3	<i>Gyrosigma</i> sp.	2.67 ± 2.46	2.83 ± 3.80	2.42 ± 2.25	2.64 ± 2.84
4	<i>Mastogloia</i> sp.	8.08 ± 5.54	11.08 ± 6.80	8.67 ± 6.21	9.28 ± 6.18
5	<i>Navicula</i> sp.	5.33 ± 5.10	14.00 ± 9.57	8.25 ± 6.40	9.19 ± 7.02
6	<i>Nitzschia</i> sp.	3.83 ± 3.18	9.42 ± 5.72	5.92 ± 5.69	6.39 ± 4.87
7	<i>Pinnularia</i> sp.	6.58 ± 5.71	11.75 ± 7.95	7.83 ± 6.69	8.72 ± 6.78
C	Chlorophyceae				
1	<i>Chlorella</i> sp.	4.33 ± 3.45	14.83 ± 14.51	6.42 ± 5.12	8.53 ± 7.69
2	<i>Cladophora</i> sp.	5.75 ± 4.83	7.58 ± 7.34	6.17 ± 5.00	6.50 ± 5.72
3	<i>Closterium</i> sp.	7.58 ± 6.30	11.50 ± 11.92	8.58 ± 8.33	9.22 ± 8.85
4	<i>Coelastrum</i> sp.	1.83 ± 1.99	6.08 ± 7.05	2.33 ± 2.46	3.42 ± 3.84
5	<i>Cosmarium</i> sp.	0.75 ± 0.83	3.17 ± 3.60	1.42 ± 2.10	1.78 ± 2.18
6	<i>Euastrum</i> sp.	0.00 ± 0.00	0.25 ± 0.60	0.00 ± 0.00	0.08 ± 0.20
7	<i>Micrasterias</i> sp.	0.00 ± 0.00	0.00 ± 0.00	0.75 ± 1.16	0.25 ± 0.39
8	<i>Microspora</i> sp.	0.50 ± 0.76	0.92 ± 1.26	0.50 ± 0.76	0.64 ± 0.93
9	<i>Oedogonium</i> sp.	2.00 ± 2.45	2.83 ± 3.21	2.58 ± 1.04	2.47 ± 2.23
10	<i>Pediastrum</i> sp.	1.42 ± 1.26	1.92 ± 2.36	3.42 ± 3.57	2.25 ± 2.40
11	<i>Scenedesmus</i> sp.	0.00 ± 0.00	2.42 ± 3.23	0.00 ± 0.00	0.81 ± 1.08
12	<i>Spirogyra</i> sp.	12.25 ± 8.67	6.50 ± 6.71	10.08 ± 7.22	9.61 ± 7.53
13	<i>Ulothrix</i> sp.	3.92 ± 4.89	3.58 ± 3.25	3.17 ± 3.26	3.56 ± 3.80
14	<i>Volvox</i> sp.	1.92 ± 1.32	6.08 ± 4.65	3.58 ± 4.33	3.86 ± 3.43
15	<i>Zygnema</i> sp.	11.83 ± 7.66	4.67 ± 3.40	10.92 ± 9.14	9.14 ± 6.73
D	Euglenophyceae				
1	<i>Euglena</i> sp.	3.67 ± 3.68	8.83 ± 6.69	9.33 ± 5.50	7.28 ± 5.29
2	<i>Phacus</i> sp.	3.17 ± 3.05	6.42 ± 5.59	5.92 ± 5.60	5.17 ± 4.75
E	Dinophyceae				
1	<i>Ceratium</i> sp.	1.08 ± 1.19	1.58 ± 1.55	1.42 ± 1.38	1.36 ± 1.37

*all values are in ind/liter

Cosmarium sp. population was 2.58±2.36 ind/ltr showed least appearance during the year 2010-11. During the year 2011-12 the same protocol was followed, *Spirogyra* sp. was found to be dominant

with 9.61±7.53 ind/ltr followed by *Zygnema* sp. with 9.14±6.73 ind/ltr and *Microspora* sp. having a population with 0.64±0.93 ind/ltr showed minimum appearance in this year. The yearly maximum mean



value among Euglenophyceae was recorded by *Euglena* sp. with 7.75 ± 5.69 ind/ltr and 7.28 ± 5.24 ind/ltr which followed by *Phacus* sp. 5.86 ± 4.14 ind/ltr and 5.17 ± 4.75 ind/ltr in 2010–2011 and 2011–2012 respectively. The Dinophyceae was recorded as a single member i.e. *Ceratium* sp. The total density was recorded as 1.56 ± 1.58 ind/ltr and 1.36 ± 1.37 ind/ltr during the investigation period i.e. 2010–11 and 2011–12. During the investigation a total of 31 species of phytoplankton were recorded belonging to classes Chlorophyceae, Myxophyceae, Bacillariophyceae, Euglenophyceae and Dinophyceae. Chlorophyceae was found to be dominant followed by Bacillariophyceae, Myxophyceae, Euglenophyceae and Dinophyceae. Seasonal analysis of phytoplankton from three different sites from this lotic waterbody i.e. Wainganga River reveals that the maximum number of phytoplankton was observed in winter, moderate in summer and minimum in monsoon season. Low density of phytoplankton communities during monsoon season may be attributed to high inflow of water from the catchment area changing the hydrology of the river system as a result of dilution and may be due to high influx of flood water, ultimately much of it was also lost in the heavy draw-down (Mithani *et al.*, 2012). The maximum numerical abundance of the phytoplankton community in the winter might be attributed to the impact of nutrients through surface runoff during monsoon at high precipitation rate (Panigrahi and Patra, 2013). A Chlorophyceae or green alga comprises an important phytoplanktonic group both in terms of abundance and frequent occurrence. Green algae are found as unicellular, filamentous, colonial and multicellular forms. Various physico-chemical parameters like temperature, light, pH, dissolved oxygen, carbon dioxide and hardness play an important role in periodicity of green algae (Rai, 1978).

About 90% of green algae are recorded from freshwater ecosystems (Das and Dutta, 2011). In the present investigation, Chlorophyceae appeared as a dominant group and represented by 15 species of 15 genera viz. *Chlorella*, *Cladophora*, *Closterium*, *Coelastrum*, *Cosmarium*, *Euastrum*, *Micrasterias*, *Microspora*, *Oedogonium*, *Pediastrum*, *Scenedesmus*, *Spirogyra*, *Ulothrix*, *Volvox* and *Zygnema*. During the study it has been reported that members of Chlorophyceae were

found to be maximum in winter, moderate in summer and minimum in monsoon season. The minimum density of Chlorophyceae in monsoon season may be attributed to high turbulence which has profound effect on phytoplankton growth that plays a negative role (Dahagaonkar *et al.*, 2012). A more or less similar observations has been reported by Khanna *et al.* (2009) and Khanna and Bhutiani (2005) in River Ganga at Haridwar.

Maxima of Chlorophyceae count in winter may be due to high DO and bicarbonate levels prevailing during these periods, which favour its quick growth and *Spirogyra* sp. were recorded as dominating species. Bacillariophyceae are unicellular and microscopic, popularly called as diatoms. Diatoms are more common in submerged aquatic conditions and may be found to float in water or they may be present at the bottom, as a part of benthos. These occur in all types of habitats except hot waters and extremely dry areas (Devi and Antal, 2013). During the present study, Bacillariophyceae (Diatoms) were represented by 7 species of genera i.e. *Diatoma*, *Fragilaria*, *Gyrosigma*, *Mastogloia*, *Navicula*, *Nitzschia*, *Pinnularia*. Myxophyceae or blue-green algae are the only prokaryotic algae. They exist either as a unicellular individual or as a chain or filament called a trichon. The presence of phycocyanin pigment enables the blue green algae to absorb green, red, orange and yellow wavelengths of light than green algae. Some blue-green algae are able to fix the elementary nitrogen of the atmosphere (Khan *et al.*, 2013, Jackson, 1961). During the present study, 6 species of class Myxophyceae were reported. Euglenophyceae showed tolerance to organic pollution and species belonging to this group could be used as biological indication of organic pollution (Tijare, 2013). They occur in most freshwater habitats, particularly in water contaminated by animals or decaying organic matter (Rai, 1978). In the present investigation, Euglenophytes were represented by two species i.e. *Euglena* sp. and *Phacus* sp. Dinophytes are unicellular flagellated algae, many of which are motile. A few species are naked or without a cell wall but most develop a conspicuous cell wall. Only a few phytoplankton undergo seasonal polymorphism or cyclomorphosis, one of example as temperatures increase, is the dinoflagellate *Ceratium* of class Dinophyceae (Das and Datta, 2011). Presumably, these changes are of adaptive



significance in that they reduce the rate of sinking out of the photic zone. Dinophyceae was represented by only 1 species of genus *Ceratium* and constitutes the lowest percentage of total plankton throughout the study.

Conclusion

Human and animal waste discharge directly in to the river not only imparts the quality of water but also affects the health of the aquatic flora and fauna. The urban runoff and continuous dumping of waste materials are affecting the water quality of river Wainganga. Therefore, it has been suggested to regularly monitor the water quality of river so as to take an immediate action for better management of river water.

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