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Phytoplankton Diversity and Various Indices in Ponds at Navi Mumbai, Maharashtra (India)

Monica Vidhate, Shashank Sarang, Vaishali Somani, Madhuri Pejaver, Milan Gholba

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ABSTRACT

The present study is based on diversity and seasonal variation of phytoplankton in few urban ponds from Navi Mumbai region. The The observations were recorded from February 2013 to January 2014. Six groups of phytoplankton were recorded namely Chlorophyta, Cyanophyta, Xanthophyta, Bacillariophyta, Euglenophyta and Dinophyta. Dominance of Chlorophyceae was observed including bloom of *Monoraphidium*. Nygaard trophic status index and Palmer index showed heavy pollution at Nerul and Kamothe pond.

Keywords Phytoplankton, *Monoraphidium*, Navi Mumbai.

INTRODUCTION

A study was carried out to note the diversity of phytoplankton in urban fresh water pond. Phytoplankton communities are important link between abiotic factors and biota in the aquatic ecosystem. Phytoplankton is initial component from which the energy is transferred to higher organisms through food chain. The density and the diversity of phytoplannkton are biological indicator for evaluating water quality and eutrophication. The study of phytoplanton communities have been especially fruitful and have provided predictions for the occurrence of plankton blooms among others (Kumari et al. 2018). Phytoplankton communities are an important factor in the production of standing waters (Sarkar et al. 2020). This study was undertaken in four urban ponds of Navi Mumbai region. The diversity and abundance were analyzed using different indices to compare the environmental status of these ponds.

MATERIALS AND METHODS

Study Area

Navi Mumbai city is located at 19°01′ N 73°01′ E coordinates in the state of Maharashtra, India (Fig.1). For the present investigation, four ponds were selected i.e. Nerul (19°02′47.384′′ N 073°01′05.314′′E), Belapur (19°01′20.296 ′′N 073°02′13.896′′E), Kamothe (19°01′00.000′′N 073°05′35468′′E) and rabale (19°08′37.790′′N 073°0′7.810′′E). These are perennial fresh water ponds. These ponds are influenced by various anthropogenic activities.

Monica Vidhate, * Shashank Sarang, Vaishali Somani, Madhuri Pejaver, Milan Gholba
Zoology Department, Maharshi Dayanand College of Arts, Sciences and Commerce, Parel, Mumbai 400012, India
Email monicavidhate289@gmail.com
* Corresponding author

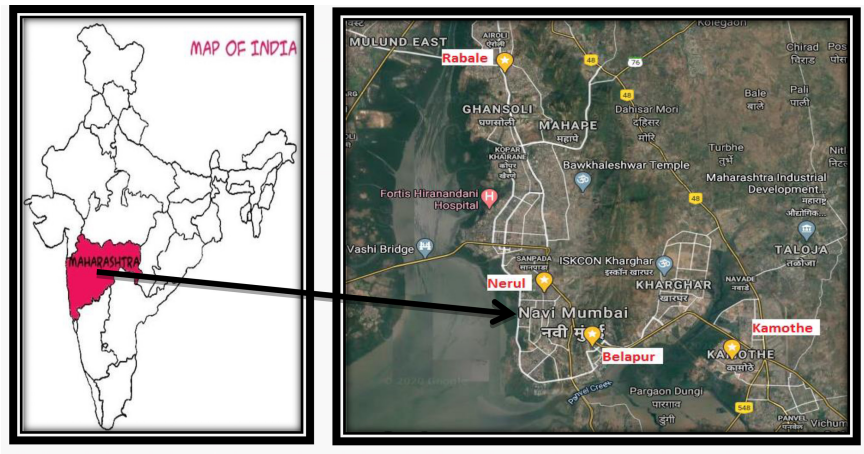

Fig. 1. Location of study area.

For phytoplankton, 500 ml water sample was collected in separate container from each pond on monthly basis (February 2013 to January 2014). For immediate fixation Lugol's iodine solution was used in the field and later 4% formaldehyde was used for long term preservation. The phytoplankton was concentrated and identified up to genera level using atandard keys Fritch (1979); Sarode and Kamat (1984); Bellinger (1992). For quantitative estimation, the counting was done by Haemocytometer method (Trivedy and Goel 1984). Water sample collection and analysis for physico-chemical properties was performed as per the standard methods (APHA et al 1980; Trivedy and Goel 1943). Statistical analysis was performed using MS-Excel 2013 and ComEcolPaC 1.0 (Drozd 2010).

RESULTS AND DISCUSSION

Total of 42 genera belonging to six groups of phytoplankton were recorded from the four fresh water bodies : 14 genera under the group Chlorophyta, 8 genera of Cyanophyta, 2 genera of Xanthophyta and 1 genera of dinophyta were recorded. Among all these groups of phytoplankton, Bacillariophyta showed high diversity as compared to other groups. Mean phytoplankton abundance varied from 60 to 16627 × 10/ in these ponds (Fig. 2) the peak was recorded from April to June in Nerul, Belapur, Kamothe and Rabale Ponds.

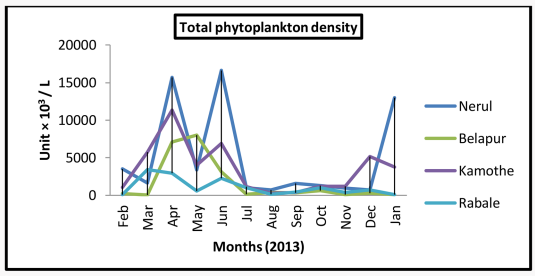

Fig 2. monthly variation of phytoplankton abundance.

Percentage contribution of Chlorophyta was higher in Nerul (76%) (Fig. 3). Percentage contribution of Cyanophyta was higher in Kamothe (24%) and lower percentage recorded in Nerul (6%) (Figs 3—5). In Rabale, bacillariophyta showed higher contribution (51%) whereas, in Kamothe (11%) it was lower (Fig.6 and Fig. 5). Euglenophyta showed lowest percentage contriburtion in Belapur (1%) (Fig. 4). Dinophyta was recorded only in Kamothe pond.

In terms of abundance, Chlorophyta was recorrded as dominant group in Nerul, whereas Cyanophyta was recorded as the most dominant group in Kamothe. Chlorophyceae was recorded as dominant group in pond at Uttarakhand (Singh et al. 2019) and two perenial ponds at Coimbatore, India (Narasimman Manickam et al.2020). Xanthophyta was recorded only in Kamothe and Rabale ponds. Bacillariophyta was the dominant algal group in phytoplank to community of Rabale in tern of abundance. Among all the ponds, Dinophyta was better represented in Kamothe ponds.

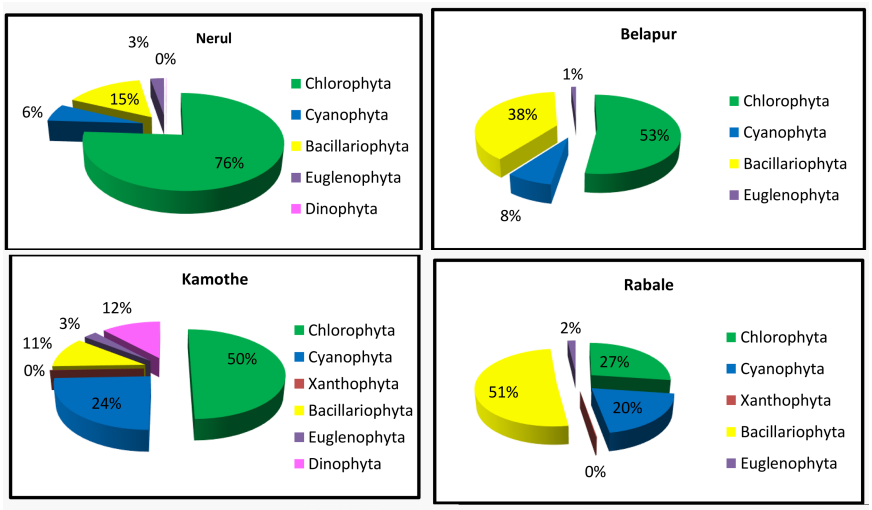

Fig. 3—6. Percentage contributions of total phytoplankton.

Density wise dominance was recorded by *Monoraphidium* sp. *Chlotrella* sp. *Scenedesmus* sp., *Crucigenia* sp., in Nerul, Belapur and rabale ponds. *Monoraphidium* sp., peak was achieved in March, May, June and January (Fig.7). Persence of *Monoraphidium* sp., was recorded by vidhate and Somani (2015) in Amruteshwar, Gunani and Chatrapati Shivaji pond in Navi Mumbai region. Prominent occurrence of *Scenedesmus* sp. in Belapur pond indicated probable organic pollution.

Surirella sp. *Nitzschia* sp., *Amphora* sp., was recorded as dominant members from diatoms in Navi Mumbai ponds. Among the blue green algae *Synechocystis* sp. *Merismopedia* sp. *Aphanocapsa* sp. *Chroococcus* sp. *Oscillatoria* sp. was recorded dominant member. Occurrence of *Synechocystis* sp., was recorded in Chikkamalappanakere tank (Sayeswara 2014). Prominent presence of *Oscillatoria* sp. was recorded in Kamothe pond. Kadam et al. (2014) recorded that high temperature and organic matter favored the growth of blue-green algae. In Kamothe pond, higher temperature in April, May and probable availability of organic matter must have supported growth of blue green algae.

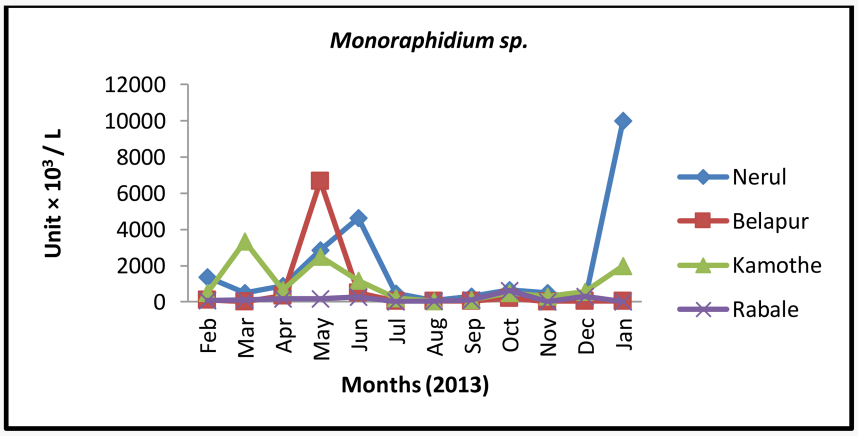

Fig. 7. Monthly Variation of *Monoraphidium* sp.

Table 1. Monthly variations of Diversity indices at nerul.

Nerul	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Shannon-Wiener (H)	2.29	1.93	2.13	1.03	2.32	1.99	1.29	2.24	2.10	1.51	1.75	0.95
Eveness (E)	0.66	0.58	0.57	0.34	0.73	0.77	0.65	0.80	0.66	0.58	0.55	0.47
Simpson's index (1-D)	0.27	0.35	0.42	0.72	0.25	0.31	0.52	0.24	0.33	0.42	0.42	0.63
Hill's index (N2)	3.66	2.79	2.37	1.38	3.93	3.17	1.91	4.14	3.00	2.37	2.38	1.58
Margalef index (Dma)	1.22	1.21	1.24	0.86	0.82	0.72	0.45	0.81	1.11	0.73	1.21	0.31
Menhinick index (Dme)	0.18	0.24	0.10	0.13	0.07	0.19	0.15	0.17	0.25	0.19	0.33	0.03
Boyd Diversity index (H)	1.22	1.22	1.24	0.86	0.82	0.73	0.46	0.81	1.12	0.73	1.21	0.32

The members of *Euglenophyceae* showed tolerance to organic polution and species belonging to this group can be used as biological indicator of organic pollution. The Euglenophyta appeared to be minor groups. Occurrence of *Euglena* sp. was occasional. *Phacus* sp. and *Euglena* sp. these two species were recorded.

In Kamothe Pond, *Peridinium* sp. was recorded as only mmber of Dinophyta with higher abundance in June. According to Bellinger (1992) the class Xanthophyceae is better representd in oligotrophic and mesotrophic water bodies. *Tribonema* sp. was recorded as occasional in occurrence in Rabale pond. *Goniochloris* sp. represented this group in Kamothe pond only.

Correlation between physico-chemical parameters and phytoplankton

During the present study in Nerul pond, total phytoplankton density denoted significant positive relationship with chlorides as r=0.56. In Belapur pond, total phytoplankton density showed positive relationship with pH (r=0.75).

In Kamothe pond total phytoplankton density exhibited positive relationship with pH, free carbon dioxide and total alkalinity (r=0.52, r=0.54 and r=0.57 respectively). In rabale pond, Nitrate showed negative correlation with phytoplankton (r=-0.67) and inorganic phosphorus (r=0.46) influenced positively whereas other physico-chemical parameters did not show any relation with phytoplanton.

Conclusion

For comparing the composition of phytoplankton during the persent study, we used the Jaccard's similarity index (1908). Based on the qualitative composition of phytoplankton, values of the Jaccard similarly index showed relatively greater similarity of phytoplankton composition in Nerul and Kamothe Pond (0.65).

The two most common measures of diversity are Simpson index (Simpson 1949) and Shannon index (Shannon and Weaver 1945) (Table 1to Table 4). High value of Simpson's and Shannon index was recorded in Karecorded in Kamothe and minimum in Rabale.

Almost similar range of evenness index was recorded in all the ponds of Navi Mumbai. For spe-

Table 2. Monthly variations of diversity indices at Belapur.

Belapur	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Shannon-wiener (H)	1.73	2.52	1.75	0.97	2.25	1.34	2.36	0.83	2.06	1.50	1.52	1.48
veness (E)	0.86	0.89	0.46	0.37	0.75	0.85	0.74	0.52	0.89	0.94	0.65	0.74
Simpson's index (1-D)	0.34	0.20	0.51	0.70	0.29	0.42	0.30	0.67	0.26	0.37	0.46	0.44
Hill's index (N2)	2.88	4.80	1.95	1.42	3.37	2.37	3.31	1.47	3.81	2.66	2.16	2.25
Margalef index (Dma)	0.54	1.46	1.46	0.55	0.86	0.42	1.34	0.34	0.62	0.43	0.71	0.71
Menhinick index (Dme)	0.25	0.90	0.16	0.06	0.14	0.28	0.45	0.17	0.20	0.30	0.29	0.49
Boyd Diversity index (H)	0.55	1.47	1.47	0.56	0.87	0.43	1.34	0.35	0.63	0.43	0.71	0.72

Table 3. Monthly variations of Diversity indices at Kamothe.

Kamothe	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Shannon-Wiener (H)	2.27	2.27	1.40	1.82	2.21	2.89	2.95	1.60	2.07	2.26	2.17	1.28
Eveness (E)	0.68	0.63	0.49	0.60	0.66	0.78	0.89	0.69	0.65	0.65	0.60	0.49
Simpson's index (I-D)	0.29	0.36	0.56	0.42	0.29	0.18	0.16	0.37	0.32	0.25	0.31	0.46
Hill's index (N2)	3.44	2.75	1.78	2.34	3.36	5.56	6.26	2.65	3.12	3.92	3.17	2.15
Margalef index (Dma)	1.28	1.27	0.64	0.84	1.01	1.70	1.62	0.68	1.13	1.41	1.28	0.60
Menhinick index (Dme)	0.30	0.15	0.06	0.12	0.12	0.38	0.62	0.26	0.26	0.31	0.16	0.09
Boyd Diversity index (H)	1.29	1.27	0.54	0.72	1.02	1.71	1.62	0.68	1.13	1.41	1.29	0.61

Table 4. Monthly variations of Diversity indices at Rabale.

Rabale	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Shannon-Wiener (H)	0	0.60	1.54	1.80	2.27	0.08	2.50	1.12	1.51	1.52	2.41	1.77
Eveness	NA	0.26	0.48	0.70	0.59	0.08	0.97	0.70	0.53	0.65	0.69	0.88
Simpson's index (I-D)	1.00	0.82	0.54	0.35	0.37	0.98	0.18	0.54	0.46	0.47	0.27	0.32
Hill's index (N2)	1.00	1.20	1.82	2.78	2.66	1.02	5.45	1.83	2.14	2.12	3.64	3.07
Margalef index (Dma)	0	0.49	1.00	0.79	1.68	0.14	1.02	0.33	0.86	0.67	1.53	0.71
Menhinick indx (Dme)	0.12	0.08	0.16	0.25	0.29	0.06	0.52	0.14	0.22	0.25	0.41	0.49
Boyd Diversity indx (H)	0.00	0.56	1.02	0.52	2.02	0.17	0.95	0.37	0.48	0.62	1.32	0.34

cies richness, Margalef's diversity index (Margalef 1968) and Menhinick's index (Menhinick 1964) were considered. The range for Margalef index was slightly higher in kamothe pond as compared to others ponds. This was in accordance with observations by Halder et al. (2019). Hill numbers showed higher values in Kamothe pond as compared to others. As per Boyd's diversity index (Boyd 1981) all ponds were heavily polluted.

Nygaard (1949) proposed five indices five indices to evaluate the organic pollution of a water body on the basis of algal groups. The Myxophycean and Chlorphycean index was calculated for all ponds and it indicated eutrophic nature of these water bodies. Diatom index mostly indicated lower trophic status of these ponds. According to Compound index Nerul and Kamothe pond showed eutrophic in nature.

In the present study, Palmer index showed highest score for Kamothe pond (Palmer 1969). The score of all ponds exceeded 20, indicated higher organic pollution.

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