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Diversity of Phytoplankton Set up of Industrial Creeks' Water Found Around Surat City, Gujarat and its Economic Importance

Alpa Varsani, Kapila Manoj

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ABSTRACT

Nutrient concentration in water influences the abundance of phytoplankton communities. The aim of the study was to analyze the diversity of the plankton community with reference to nutrient concentration of the water in the industrial creeks of Surat city, Gujarat. Regarding this, the samples were collected and analyzed as per the standard methods from three different selected sites during April-2013 to September-2013. This paper presents the results of the nutrients and phytoplankton at 3 sites of Industrial creek's water located around Surat City, Gujarat. During the study Bacillariophyceae, Cyanophyceae, Euglenophyceae, Dothideomycetes and Euascomycetes were found and among them the Bacillariophyceae were found the dominant group. From the results it was confirmedthat creeks' water was strongly affected by the industrial effluent and domestic sewage. The Bacillariophyceae and Cyanophyceae found in this type of environment is having many ecological importance in various industries is also incorporated in this study.

Keywords: Effluent, Industrial creek, Nutrient, Phytoplankton, Sewage.

INTRODUCTION

The functioning of an aquatic ecosystem and its stability to support life forms depend, to a great extent, on the physico-chemical characteristics of its water. The key feature of an ecosystem is the interaction among the biotic and abiotic components. The external controls and internal interactions combine to produce a certain ecosystem structure and species develop certain pattern of abundance. Any change in the abiotic components like physico-chemical changes will be reflected by the biological organisms that are by the phytoplankton (Veronica *et al*. 2014). By changing in this properties directly affect diversity of phytoplankton and this can be used as bioindicators. Knowledge of plankton together with data on water characteristics is useful assessment of water quality as it provides information on the minute and subtle changes in the environment.

Information on the plankton community structure in the industrial creek water will give details about the condition of that ecosystem. Therefore, this study aims to analyze the diversity of the plankton community to describe the condition of the water in

Alpa Varsani*
Department of Aquatic Biology, VNSGU, Udhana Magdalla Road, Surat 395007, India
Email: alpamanoj87@gmail.com

Kapila Manoj
Department of Aquatic Biology, VNSGU, Udhana Magdalla Road, Surat 395007, India
Email: kapilamanojeee@yahoo.com
*Corresponding author

the industrial creeks of Surat city. The present paper deals with the species composition of phytoplankton in relation to physico-chemical properties of water of the industrial creeks of Surat city.

MATERIALS AND METHODS

Area of study

Geographical location of Surat district is 21.0 ° to 21.23° N latitude and 72.38° to 74.23° E longitude. Surat is a city which drains its storm drainage through Mithi, Kankara, Khajod, Koyali, Bhedwad, Sonari and Varachcha creeks into Mindhola River. Creeks receive domestic raw sewage as well as industrial effluent from surrounding habitation and nearby industrial belt. Among all the creeks flow through Surat city, three sites were selected for study purpose viz. Site-1 Bhedwad creek, Site-2 Mithi creek and Site-3 Saniya Hamed creek.

Physico-chemical analysis

Water samples were collected monthly from three sampling sites for the period of six months during April-2013 to September-2013 as described in APHA (2005) and transported to laboratory for analysis. Among the selected parameters for study,temperature was measured at site itself and other physico-chemical parameters pH, Silicate, Phosphate, Nitrate and Nitrite were analyzed in the laboratory by standard methods as described in APHA (2005) and IS-3025.

Phytoplankton analysis

Phytoplankton samples were collected on monthly basis from selected sites by using silk bolting nylon plankton net of 20 µm mesh size. Required known quantity of water was filtered through the net and residues were preserved immediately with 4% formalin. Preserved samples of phytoplankton were examined under compound microscope in the laboratory and were further identified (Sarode and Kamat 1984, Tripathi and Pandey 1995, Desikacharya 1987-1991).

RESULTS AND DISCUSSION

In order to assess phytoplankton distribution and abundance it is essential to study physico-chemical parameters of the study area.Table1 show average concentration of the physic-chemical properties of water samples collected from different sampling sites whereas Table 2 represented phytoplankton community found during the study period.

Average water temperature was found 31˚C, 3 , 30˚C and 30˚C at Site-1, Site-2 and Site-3 respectively throughout the study period (Table1).

Average pH was found 6.9, 7.4 and 7.4 at Site-1, Site-2 and Site-3 respectively throughout the study period (Table1). pH was remain alkaline which may accelerate primary production. Same was also observed by Kumar and Prabhahar (2012). Solubility of minerals and nutrients is influenced by the pH.

Average phosphate was found 2.81 mg/l, 1.94 mg/l and 1.94 mg/l respectively throughout the study period at Site-1, Site-2 and Site-3 (Table1). It may accelerate the growth of plankton.

Average concentration of Silicate was found 60.71 mg/l, 45.80 mg/l and 45.04 mg/l at Site-1, Site-2 and Site-3 during the study (Table1). It is used by the plankton as a nutrient so abundance of plankton may be reflected by its concentration.

Average concentration of Nitrate was found 1.79 mg/l, 0.97 mg/l and 0.80 mg/l at Site-1, Site-2 and-Site-3 where as average concentration of Nitrite was found 0.20 mg/l, 0.05 mg/l and 0.06 mg/l at Site-1, Site-2 and Site-3 during the study (Table1). Nitrate and nitrite are also source of nutrient for phytoplank ton as their concentration change plankton diversity may also change.

A total number of 13 genera having 26 species of phytoplankton represented by five classes Bacillario-

Table 1. Average concentration of physico-chemical properties of water at different Sites.

Site	Temperature (°C)	pH	Nitrite (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Silicate (mg/l)
1	31	6.9	0.20	1.79	2.81	60.71
2	30	7.4	0.05	0.97	1.94	45.80
3	30	7.4	0.06	0.80	1.94	45.04

Table 2. Phytoplankton community found in water at different Sites.

Site-1	Site-2	Site-3
Alternaria sp.		*Alternaria* sp.
Arthrospira fusiformis		*Arthrospira fusiformis*
Arthrospira platensis	*Arthrospira fusiformis*	*Cocconeis placentula*
Bipolaris sp.	*Coscinodiscus* sp.	*Cyclotella meneghiniana*
Coscinodiscus sp.	*Euglena* sp.	*Cyclotella* sp.
Curvularia sp.	*Fragilria* sp.	*Fragilaria* sp.
Euglena sp.	*Hantzschia amphioxys*	*Gyrosigma* sp.
Fragilaria sp.	*Navicula cuspidata*	*Navicula cuspidata*
Navicula sp.	*Navicula* sp.	*Natzchia obtusa*
Nitzschia sp.	*Nitzschia commutana*	*Nitzchia obtusa W. Smith*
Nostoc commune	*Noizschia obtusa*	*Nitzschia* sp.
Nostoc sp.	*Nitzschia* sp.	*Nostoc commune*
Oscillatoria agardhii	*Nostoc* sp.	*Nostoc* sp.
Oscillatoria boryana	*Oscillatoria* sp.	*Oscillatoria agardhii*
Oscillatoria brevis	*Oscillatoria agardhii*	*Oscillatoria boryana*
Oscillatoria formosa	*Oscillatoria boryana*	*Oscillatoria brevis*
Oscillatoria limosa	*Oscillatoria brevis*	*Oscillatoria formosa*
Oscillatoria sp.	*Oscillatoria formosa*	*Oscillatoria limosa*
Oscillatoria subsalsa	*Oscillatoria limosa*	*Oscillatoria okeni*
Oscillatoria tenuis	*Phormidium* sp.	*Oscillataria* sp.
Oscillatoria willei	*Spirulina major*	*Oscillatoria subsalsa*
Spirulina major	*Spirulina platensis*	*Oscillatori willei*
Spirulina platensis	*Spirulina* sp.	*Philodina* sp.
Spirulina sp.	*Spirulina subsalsa*	*spirulina major*
Spirulina subsalsa	*Synedra unla*	*Spirulina maxima*
Synedra ulna		*Spirulina platensis*
		Spirulina sp.
		Spirulina subsalsa
		Surirella sp.
		Synedra ulna
		Synedra ulna (Nitz.) Ehr. amphirhynchus
		Synedra ulna (Nitz.) Ehr. v. subaequalis Grun.

phyceae, Cyanophyceae, Euglenophyceae, Dothideomycetes and Euascomycetes were recorded at Site-1 during the study period (Table 3). The results show the dominancy of class of phytoplankton community according to genera are Bacillariophyceae (38%)>Cyanophyceae (31%)>Dothideomycetes (15%)>Euglenophyceae and Euascomycetes (8%) during the study period (Fig.1). It shows that Bacillariophyceae was most dominantly found during the study.

A total number of 14 genera having 32 species ofphytoplankton represented by four classes Bacil-

Table 3. Distribution of phytoplankton genera and species found in water at different Sites.

	Site-1 (Bamroli)		Site-2 (Udhana)		Site-3 (Saniya Hamed)	
Class	No. of genera	No. of species	No. of genera	No. of species	No. of genera	No. of species
Bacillariophyceae	5	5	6	9	8	13
Cyanophyceae	4	17	5	13	4	17
Euglenophyceae	1	1	1	1	1	1
Euascomycetes	1	1	0	0	0	0
Dothideomycetes	2	2	0	0	1	1
Total	**13**	**26**	**12**	**23**	**14**	**32**

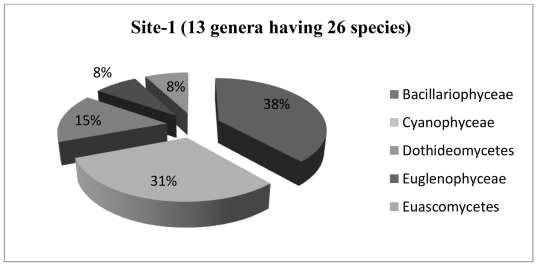

Fig. 1. Distribution of phytoplankton genera found in water at Site-1.

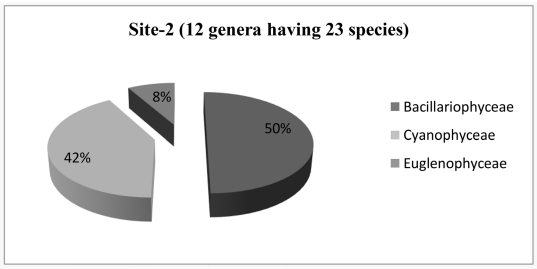

Fig. 2. Distribution of phytoplankton genera found in water at Site-2.

lariophyceae, Cyanophyceae, Euglenophycea and Dothideomycetes were recorded at Site-3 during the study period (Table 3). The results show the dominancy of class of phytoplankton community according to genera are Bacillariophyceae (57%)>Cyanophyceae (29%)>Dothideomycetes and Euglenophyceae (7%) at Site-3 during the study period (Fig. 3).

During the study Bacillariophyceae were found to be the most dominant followed by the Cyanophyceae at all the three sites. The high amount of silica may be the reasons for the diversity of Bacillariophyceae group. The high nutrient amount was due to the discharge of sewage and different industrial effluent. High relative abundance of Cyanophyceae may be indicative of the influence of organic pollution on the plankton community (Atobatele *et al*. 2007). The seasonal and spatial distribution of the plankton is sensitive to changes in levels of nutrients (Rabiu *et al*. 2014). Nutrient availability chiefly determines the diversity of phytoplankton (Pitchaikani and Lipton 2016). Most tolerant species reported are

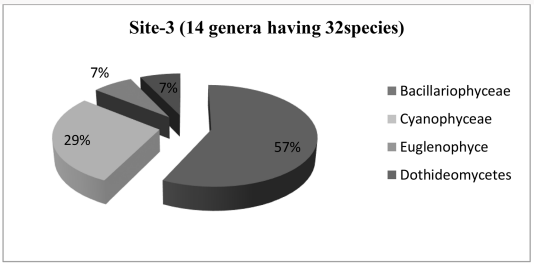

Fig. 3. Distribution of phytoplankton genera found in water at Site-3.

Synedra ulna and *Fragilaria* sp.*, Arthrospira fusiformis, Oscillatoria boryana, Oscillatoria formosa, Oscillatoria limosa, Oscillatoria* sp., *Spirulina major, Spirulina platensis, Spirulina* sp., *Spirulina subsalsa*. Kshirsagar (2013) has made similar observation that *Synedra ulna* and *Oscillatoria limosa* to be the pollution tolerance species. High relative abundance of Cyanophyceae may be indicative of the influence of organic pollution on the plankton community (Atobatele *et al*. 2007). That was may be due to high amount of nutrients which favored the growth of Cyanophyceae. Similarly Oben and Oben (2013), Nowrouzi and Valavi (2011) suggested that there was a positive correlation between nutrient concentration and Cyanophyceae concentration.

Though Cyanophyceae indicate water pollution but Bacillariophyceae and Cyanophyceae having ecological importance which is described below.

Ecological importance of Bacillariophyceae

The diatoms of Bacillariophyceae class are directly or indirectly used economically in the different fields for a variety of purposes.

Diatomite is made by accumulation of cell wall made up of silica, when diatoms deposit at the bottom of water body after the death. When favorable conditions are there this accumulation may be thicker and becomes as a diatomite which is called as diatomaceous earth which is very applicable for use in different industries as follows :

1. It is used as filter in different industries like

sugar, oil and chemical industry, battery boxes to filter microorganism.

2. It is used as insulator in boilers and blast furnaces as it is having heat-resistant ability.

3. It is used as absorbent of liquid nitroglycerine.

4. Diatomite is used as abra¬sive substance for the manufacturing of metal paints, polish, varnish, toothpaste. It is also used with bake-lite for electrical fuse and switch boxes.

5. The diatoms are consumed by fish so it is used as food source in Aquaculture industries. (http://www.biologydiscussion.com/algae/diatoms-characteristics-occurrence-andreproduction/46940)

Ecological importance of Cyanophyceae

Cyanophyceae are also economically important to medical and agriculture field.

Spirulina contain phycocyanin pigmentin high amountwhich has numerous biological properties that's why it is used currently in food, cosmetic and pharmaceutical, agriculture sectors in a wide range.

Spirulina is used as food because it increases brain power, lowers cholesterol, controls tumor growth; edible blue green algae reduce risk of cataract, muscular degeneration, and protect from liver damage.

Spirulina hasrich content of protein, polysaccharide, lipid, essential amino and fatty acids, dietary minerals and vitamins which gives it several pharmacological effects such as antimicrobial, antiviral, antibacterial, anticancer, metalloprotective as well as immunostimulant and antioxidant (Hosseini *et al*. 2013). Antiretroviral extract of *Arthrospira platensis* or *spirulina* inhibits replication of HIV-1 and AIDS virus in human beings, supports growth of healthy bacteria in human gut, saves patients with arsenic poisoning.

Agriculture field to fix elemental nitrogen from the atmosphere to increase soil fertility.Intensive assessment of water clearly indicates that the collected water of creek is strongly affected by the industrial effluent and sewage and so it is highly polluted which a negative impact is observed during the study. But even though in this type of environment the species of Bacillariophyceae and Cyanophyceae are growing which is having ecological importance so this type of environment they can be cultured and applied in the various field as discussed above.

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