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RESEARCH ARTICLE

SEASONAL VARIATION AND PHYTOPLANKTON DIVERSITY IN SHETTER LAKE OF NAVALGUND, DHARWAD IN KARNATAKA, INDIA.

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Abstract

Seasonal variation and Phytoplankton diversity in Shetter Lake with regard to quality of water was undertaken from May 2012 to April 2013. Nineteen physicochemical parameters were studied related to the diversity of phytoplankton. A total of forty four genera were recorded belonging to Chlorophyceae (18), Cyanophyceae (10) Bacillariophyceae (9) Euglenophyceae (4) and Dinophyceae (1). During rainy season phytoplankton population was abundant compared to other two seasons. But during winter and summer season much fluctuation was observed in the density of Chlorophyceae, Cyanophyceae, Bacillariophyceae and Euglenophyceae members. Cyanophyceae population was high during rainy season followed by Chlorophyceae, Euglenophyceae, Bacillariophyceae members. It was specially documented that Dinophyceae members were appeared only during summer season (in the months of March and April) when phosphates were found least in the lentic water body. A total of sixty four species were recorded throughout the year belonging to Chlorophyceae (27), Cyanophyceae (15), Bacillariophyceae (11), Euglenophyceae (10) and Dinophyceae (1). Therefore, it can be concluded that the heavy load of nutrients in Shetter Lake has influenced abundance of Phytoplankton species. The investigation may also suggest that the water of Shetter Lake is not fit for drinking according to drinking water quality standards.

INTRODUCTION

The periodicity and density of plankton is controlled by various complex factors. Sometimes a particular group of phytoplankton appears all of a sudden and multiplies in the water body under certain physicochemical conditions (Goel et al., 1992). Environmental pollution is a modern day evil affecting all ecosystems. Therefore, the conservation of freshwater environment and its monitoring is highly essential (Mohapatra and Rangarajan, 1995). Most of the water bodies have become polluted and unfit for human usage and changes in water chemistry are mainly due to mud and silt, rain water dilution, the underlying spring and human activities like washing and bathing (Jeeji Bai and Lakshmi, 1999). Eutrophication is a global phenomenon associated with nutrient enrichment of aquatic ecosystem. Monitoring of water quality is the first step that can lead to management and preservation of aquatic ecosystem (Abdar, 2014). The management of any aquatic ecosystem is aimed to the preservation of its habitat by suitably maintaining the physicochemical quality of water within acceptable range.

Literature Survey

Senapathi et al., (2011) have observed variation in phytoplankton diversity and its relation with Physico-Chemical parameters of a semi lentic water body of Golapbag, West Bengal, India. Hosamani et al., (2011) examined 1000 Lakes of Mysore district, Karnataka State, India. Amte and Gore, (2012) have investigated the physico-chemical status and primary productivity of Gauripada lake, Kalyan city, Maharashtra, India. Kumar et al., (2012) have studied the spatial variation in phytoplankton diversity in the Sabarmati River at Ahmedabad, Gujarat, India. Begum et al., (2012) studied on physicochemical profiles of lakes in and around Davangere City, Karnataka, India. Ghosh et al., (2012) were observed the diversity and seasonal variation of Phytoplankton community in Santragachi Lake, West Bengal, India. Archana and Shaikh (2013) have studied seasonal variations in physicochemical parameters and primary productivity of Shelar lake Bhiwandi, Thane, Maharashtra. Long et al., (2013) have investigated the relationship between Phytoplankton and environment factors in Lake Hongfeng quarterly. Airsang and Lakshman (2013) have examined the impact of seasonal fluctuation on Phytoplankton diversity in fresh water Lake of Arekurahatti in Navalgund of Dharwad District in Karnataka-India. Sinha et al., (2014) have assessed the water quality of two ponds of Samastipur District, India. Choudhary et al., (2014) have recorded the impact of seasonal variation on Phytoplankton in response to abiotic parameters in Basman Lake, Motihari District (North Bihar) India. Bhat et al., (2014) have assessed the water quality parameters for pollution source identification in Sukhnag the major inflow stream of Lake Wular (Ramsar site), Kashmir Himalaya, India.

The present study is on Shettar Lake (lentic water body) situated in Navalgund taluk in Dharwad district which shows phytoplankton diversity in relation to physico-chemical parameters and different degree of pollution. Observation was made for a period of one year seasonally in order to study the possible relation between the phytoplankton floras with the varying physico-chemical parameters. This fresh water body varied with different percentage of Cyanophyceae, Chlorophyceae, Bacillariophyceae, Euglenophyceae and rare occurrence of Dinophyceae members. Such fluctuating phytoplankton diversity in the lentic water bodies of Navalgund has not been studied till today. At this contest the present study on Seasonal variation in Phytoplankton diversity of in relation to Physico-chemical parameters of Shetter Lake has been under taken.

Description of study area

Navalgund is a taluk comes under Dharwad district, Karnataka state, India (Fig-1). It is located 48 kms away from Dharwad and 374 kms from Bangalore. Navalgund is situated at 15.57° North latitude, 75.37° East longitude and 578 (1,896 ft above the sea level) meters elevation. Annual Rainfall recorded was as follows: in 2011 - 462.9 mm, in 2012 - 262.2 mm and in 2013 - 624 mm. Navalgund has geographical area of about 1080 Sq. Kms and had a population of 1, 90,208 (as per 2011 Census). Average winter temperature is 20^0C and summer temperature reaches 39^0C. Shetter Lake is a midsized lentic water body occupying an area about 87,120 sq. ft. (2 acres) located very near to the Gulburga Bijapur Hubli state highway. The lake depth measures about 5 meters and average water level is 3 meters. Navalgund people use this lake water for domestic purposes, washing clothes and vehicles; but not for drinking. This lentic water body is surrounded by agricultural fields and very much near to highway. The sources to this water body are agricultural runoff water and rains. During rainy season water rushes to this water body from the surrounding agricultural fields.

Materials and methods

The surface water samples were collected seasonally and monthly from the selected fresh water body from May-2012 to April-2013. Precleaned Polyethylene carbonyl cans of the capacity of one liter were employed for this purpose with utmost care. Winklerization was made in separate 350 ml BOD Bottles for the estimation of dissolved oxygen. The Physico-chemical analysis of the water was carried out as per the standard methods of APHA (1995). One liter of sample was separately collected and sedimentation was made in acid Lugol's solution. The supernatant was discarded. The phytoplankton sediment was concentrated to 30ml by centrifugation. Diversity of Phytoplankton was studied by Lackey's drop method (1938) and microphotographs were taken by using high resolution microscope.

Figure 1: Showing the location of selected site Shetter Lake, Navalgund Taluk of Dharwad District in Karnataka – India.

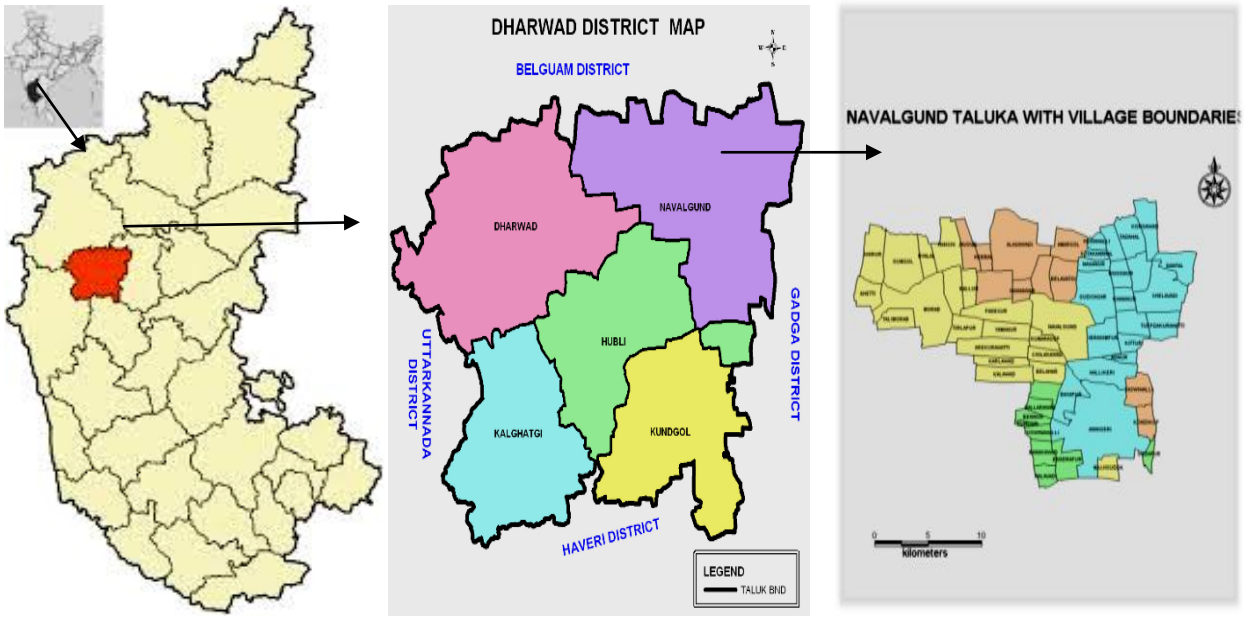

Figure 2: Showing the Satellite view and Photographs of Shetter Lake

Results and discussion

The seasonal study of physicochemical parameters in Shetter Lake showed much fluctuation as shown in Table 1. During rainy season air and water temperature were varied between minimum of 27˚C to 28˚C and maximum of 31˚C to 33˚C. Subsequently, during winter these varied between of 21˚C to 27˚C and maximum of 32˚C to 34˚C. But during summer, it was specially noted that the comparatively decreased temperatures as minimum of 17˚C to 19˚C and maximum of 26˚C due to climatic fluctuation. Turbidity values were also varied much and ranged between 2.0 to 640 NTU. pH is the scale of intensity of acidity and alkalinity of water and measures the concentration of hydrogen ion. In the present investigation, the pH of water ranged between 7.73 to 8.25 during rainy season, 7.15 to 7.75 during winter and 7.65 to 8.25 in summer. The DO and pH of the water showed a highly positive correlation in the lentic water body. Total alkalinity is due to salts of weak acids and bicarbonates .The highly alkaline water is not potable. Total alkalinity was observed between 148 to 252 mg/L in Rainy season, 228

mg/L to 268 mg/L in winter season and 100 mg/L to 292 mg/L in summer season. Similar findings were reported by (Amte and Tejali, 2012).

Electric conductivity (EC) values were ranged from 490 µmhos/sec to 2250 µmhos/sec. The total dissolved solids indicate the general nature of water quality (Venkataramaiah, 2011). TDS varied between 319 µmhos/sec to 1463 µmhos/sec. These values showed progressive increase during the present investigation. Total hardness, Calcium and Magnesium were also showed much fluctuation accordingly during all the seasons (Table 1). Total chloride concentration depends on the characteristic of the sediment and pollution load (Mary Kensa and Jeyakavi, 2013). Thus, in the present study chloride content gradually increased in rainy season and winter but during summer there was sudden fall in the chloride concentration and gradually increased at the end of the season. The mean value of chloride varied between 155.50 mg/L to 390.0 mg/L. Sulphates exhibit positive correlation with Nitrates, Phosphates and Chlorides. A positive correlation between Sulphate and Chloride suggests that they are from similar sources (Bhandari *et al*., 2008). Sodium and Potassium values were increased during rainy and winter seasons and gradually decreased in the summer season. Sodium was found maximum (176 mg/L) during Rainy season and Potassium (6.80 mg/L) in winter season. These were found minimum in the summer. DO was found maximum of 8.4 mg/L in the Rainy season and minimum of 0.3 mg/L in the winter season. COD values were gradually increased in the rainy season from 16.0 mg/L to the maximum of 161.0 mg/ L. BOD values were also found maximum (12.25 mg/L) in the rainy season and minimum in the winter season (0.3 mg/L).

The seasonal variations in water quality parameters were played an important role in the diversity of Phytoplankton shown in (Figure 3). Sreenivasan *et al.,* (1966) have observed that the peaks of phytoplankton occurred at different period in different years. Inflow of nutrients from the surrounding fields during rainy season has increased the population of Bacillariophyceae, Cyanophyceae, Euglenophyceae and Chlorophyceae members in the present study. But during winter season the same population showed gradual decrease in the number. Again in the summer there was gradual increase in the population of the same with the addition of Dinophyceae members during summer. A total of forty four genera were recorded belonging to Chlorophyceae (18), Cyanophyceae (10) Bacillariophyceae (9) Euglenophyceae (4) and Dinophyceae (1). Tripathy and Pandey (1990), Hegde and Sujata (1997) and Airsang and Lakshman (2013) reported that the water temperature, phosphate, nitrate and low DO support the growth of phytoplankton. During rainy season phytoplankton population was abundant compared to other two seasons. But during winter and summer season much fluctuation was observed in the density of Euglenophyceae, Chlorophyceae, Bacillariophyceae and Cyanophyceae members. Davis (1995) suggested that a number of Physico-chemical and biological factors simultaneously must be taken into consideration in understanding the fluctuations of plankton population. Cyanophyceae population was high during rainy season followed by Chlorphyceae, Euglenophyceae and Bacillariophyceae members. Surprisingly, Dinophyceae members were appeared during summer season (only in the months of March and April) when phosphates were found least in the lentic water body. Total of sixty four species were recorded (Table 2) throughout the year belonging to Chlorophyceae (27), Cyanophyceae (15), Bacillariophyceae (11), Euglenophyceae (10) and Dinophyceae (1).

Table 1: Showing Seasonal Mean and standard deviation values of physico-chemical parameters of Shetter Lake during May 2102 to April 2013.

Parameters	**Rainy season Mean ± SD (Min – Max)**	**Winter season Mean ± SD (Min – Max)**	**Summer season Mean ± SD (Min – Max)**
Air Temperature	31.75 ± 2.50 (28.00 – 33.00)	30.75 ± 03.30 (27.00 – 34.00)	23.50 ± 03.10 (19.00 – 26.00)
Water Temperature	28.50 ± 1.71 (27.00 – 31.00)	25.00 ± 04.96 (21.00 – 32.00)	22.00 ± 03.91 (17.00 – 26.00)
Turbidity	113.75 ± 68.73 (47.00 – 176.00)	174.70 ± 311.05 (2.00 – 640.00)	32.00 ± 32.17 (12.00 - 80.00)
pH	7.89 ± 0.2389 (7.73 – 8.25)	7.44 ± 0.28 (7.15 – 7.75)	7.99 ± 0.46 (7.65 – 8.25)
Electric conductivity	597.00 ± 144.08 (490.00 – 810.00)	915.00 ± 61.37 (840.00 – 990.00)	1645.00 ± 618.09 (1040.00 – 2250.00)
Total Alkalinity	185.00 ± 46.58 (148.00 – 252.00)	249.00 ± 18.29 (228.00 – 268.00)	192.00 ± 96.17 (100.00 – 292.00)

Total dissolved solids	388.75 ± 93.72 (319.00 – 527.00)	595.00 ± 40.08 (546.00 – 644.00)	1069.00 ± 401.80 (676.00 –1463.00)
Total hardness	152.00 ± 81.01 (98.00 – 270.00)	316.00 ± 36.82 (280.00 – 366.00)	228.00 ± 111.27 (148.00 – 386.00)
Calcium	88.50 ± 65.69 (36.00 – 180.00)	177.00 ± 39.68 (120.00 – 212.00)	128.50 ± 70.93 (68.00 – 230.00)
Magnesium	15.31 ± 04.53 (11.66 –21.87)	33.90 ± 17.34 (22.84 – 59.77)	24.18 ± 10.41 (13.61 – 37.91)
Chlorides	205.00 ± 134.78 (90.00 – 400.00)	390.00 ± 73.94 (320.00 – 480.00)	155.50 ± 119.39 (60.00 – 330.00)
Sulphates	30.00 ± 9.76 (22.00 – 43.00)	70.25 ± 38.27 (35.00 – 119.00)	86.75 ± 47.88 (44.00 – 150.00)
Nitrates	3.15 ± 1.40 (1.80 – 5.10)	2.68 ± 1.77 (0.90 – 5.10)	1.75 ± 0.28 (0.90 – 02.50)
Phosphates	7.13 ± 2.33 (4.30 – 10.00)	4.35 ± 1.19 (2.70 – 5.40)	02.85 ± 00.58 (02.10 – 03.40)
Sodium	118.50 ± 45.74 (70.00 – 176.00)	136.75 ± 25.53 (110.00 – 161.00)	35.75 ± 05.91 (28.00 – 42.00)
Potassium	3.05 ± 0.80 (2.10 – 4.00)	5.20 ± 1.18 (4.00 – 6.80)	3.33 ± 1.42 (2.00 – 5.20)
Dissolved Oxygen	7.10 ± 0.90 (6.50 – 8.40)	4.03 ± 2.85 (0.30 – 7.00)	5.35 ± 1.30 (3.70 – 6.70)
Chemical Oxygen Demand	73.45 ± 43.27 (16.00 – 121.00)	72.20 ± 14.61 (60.00 – 92.80)	65.28 ± 17.30 (43.10 – 80.00)
Biological Oxygen Demand	10.81 ± 01.77 (8.23 – 12.25)	05.87 ± 04.59 (0.53 – 11.73)	5.47 ± 1.61 (3.85 – 7.70)

All parameters are in mg/L, except pH, Turbidity in NTU, Temperature in ˚C and EC in µmhos/sec

Figure 3: Showing Graphical representation of seasonal occurrence of phytoplankton population (organism/L) in Shetter Lake during May 2102 to April 2013.

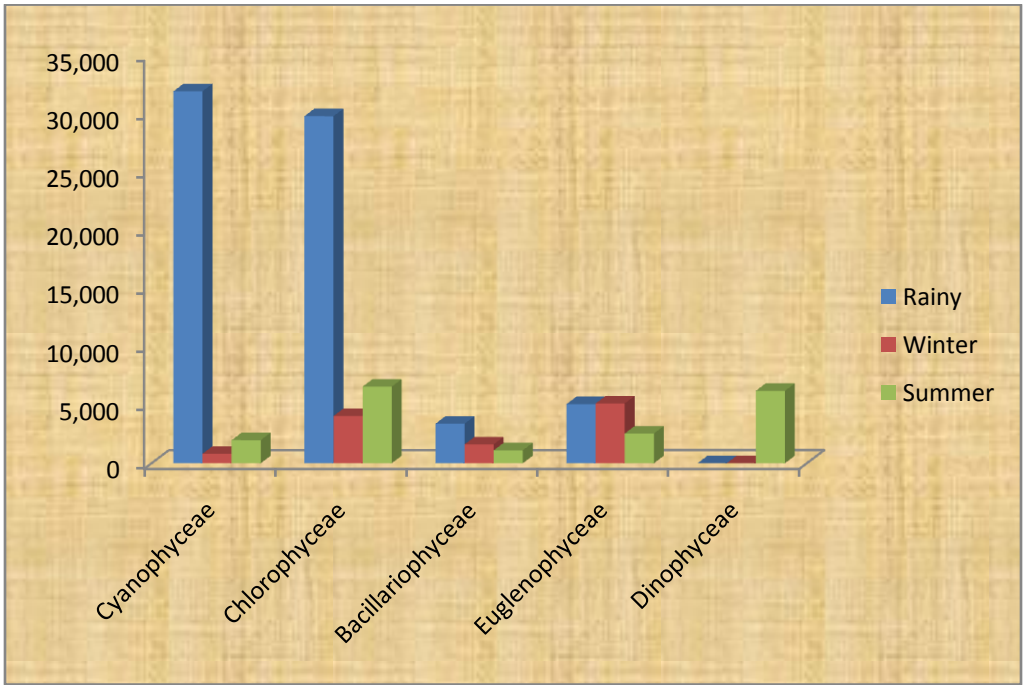

Table 2: Showing the distribution of some important Phytoplankton species in Shetter Lake belonging to different Genera under five classes during May 2102 to April 2013.

S. No.	Phytoplankton Species
I	**Cyanophyceae**
	1. *Anabaena* sp.
	2. *Anacystis* sp.
	3. *Arthrospira jenneri* Stizenb. Ex Gomont
	4. *Chroococcus tenax* (Kirchn.) Hieron.
	5. *Lyngbya contorta* Lemm.
	6. *Merismopedia glauca* (Ehrenberg) Kützing
	7. *Merismopedia punctata* Naegeli
	8. *Merismopedia tenussima* Lemm.
	9. *Oscillatoria splendida* Grev.
	10. *Oscillatoria tenuis* Ag.
	11. *Phormidium* sp.
	12. *Pseudanabaena galeata* Böcher
	13. *Pseudanabaena* sp.
	14. *Spirulina major* Kütz.
	15. *Spirulina subsalsa* oerstd.
II	**Chlorophyceae**
	1. *Ankistrodesmus falcatus* Corda
	2. *Chlamydomonas* sp.
	3. *Chlorella vulgaris* Beyerinck
	4. *Chlorococcus* sp.
	5. *Closterium acerosum* (Schrank) Ehrenb.
	6. *Closterium parvulum* Nägeli
	7. *Coelastrum* sp.
	8. *Crucigenia quadrata* Morren
	9. *Crucigenia rectangularis* (Nägeli.) Gay
	10. *Crucigenia tetrapedia* (Kirch.) West & West.
	11. *Desmodesmus* sp.
	12. *Dictyosphaerium pulchellum* Wood
	13. *Gloeotilopsis* sp.
	14. *Kirchneriella contorta* (Schmidle) Bohlin
	15. *Kirchneriella elongata* G. M. Smith
	16. *Microactinium* sp.
	17. *Monoraphidium* sp.
	18. *Oocystis* sp.
	19. *Scenedesmus Bernardii* G. M. Smith.
	20. *Scenedesmus opoliensis* P.G.Richter
	21. *Scenedesmus arcuatus* Lemmermann
	22. *Scenedesmus dimorphus* (Turpin) Küetzing
	23. *Selenastrum gracile* Reinsch
	24. *Selenastrum minutum* (Naeg.) Collins
	25. *Spirogyra* sp.
	26. *Tetraëdron pusillum* (Wallich) West & G.S.West
	27. *Tetraëdron trigonum* (Nägeli.) Hansgirg
III	**Bacillariophyceae**
	1. *Amphora* sp.
	2. *Craticula cuspidata* (Kutzing) D.G. Mann
	3. *Epithemia turgida* (Ehrenberg) Kützing
	4. *Gomphonema* sp.

5. *Melosira* sp.
6. *Navicula cuspidata* Kuetz.
7. *Navicula grimmei* Krasske
8. *Nitzschia acicularis* (Kützing) W.Smith
9. *Nitzschia palea* (Kuetz) W. Smith
10. *Stauroneis* sp.
11. *Synedra ulna* (Nitzch) Ehr.

IV Euglenophyceae

1. *Euglena oxyuris* Presscott
2. *Euglena acus* Ehrenberg
3. *Euglena elastica* Prescott
4. *Euglena viridis* Ehr.
5. *Euglena proxima* Dangeard
6. *Lepocinclis ovum* (Ehrenb.) Lemmermann
7. *Phacus curvicauda* Swirenko
8. *Phacus onyx* Pochmann
9. *Phacus orbicularis* Hubner
10. *Trachelomonas fluviatilis* Lemmermann

V Dinophyceae

1. *Peridinium* sp.

Conclusion

In the present study, temperature, pH, alkalinity and nutrient content in Shetter Lake water played a vital role. During the investigation phytoplankton distribution was varied in different seasons from May 2012 to April 2013. Dissolved oxygen, Phosphate, Nitrate and pH are the most significant parameters operating in this water body. The nutrients accumulated in the lake water have increased the number of Cyanophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae members to the maximum during the months of Monsoon over the population of Dinophyceae. But during the months of winter and summer season much fluctuation in the density of Chlorophyceae, Cyanophyceae, Bacillariophyceae and Euglenophyceae members was observed. On an average the percentage of occurrence of members Chlorophyceae was found maximum followed by Cyanophyceae, Euglenophyceae, Bacillariophyceae. Special appearance of Dinophyceae members was recorded during summer season when phosphate levels were found least in the lentic water body. The investigation may suggest that the water quality parameters of Shetter Lake influenced much in the occurrence of phytoplankton with much fluctuation and the lake water may be used for domestic purposes but not for drinking according to drinking water quality standards (WHO, 1990).

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