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Phytoplanktonic diversity in lake Jaisamand, Rajasthan (India)

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Abstract: The present study describes the diversity of phytoplankton in the lake Jaisamand of Rajasthan (India). Results depict that phytoplankton was contributed by six major groups which comprised total 85 species. Out of which 13 belongs to Myxophyceae, 5 to Euglenophyceae, 38 to Chlorophyceae, 3 to Xanthophyceae, 1 to Cryptophyceae and 23 to Bacillariophyceae. Thus, Bacillariophyceae and Chlorophyceae turned up as the dominant groups in terms of density (159-554 numbers per liter and 24-485 numbers per liter) and species number (23 and 38), respectively. It was revealed that Jaisamand Lake maintained fairly good population of phytoplankton which is indication of providing broad base for achieving high productivity in this water body.

Keywords: Bacillariophyceae, Chlorophyceae, Jaisamand, Phytoplankton, Rajasthan

INTRODUCTION

The phytoplankton are the important components of aquatic ecosystem and contributing to the bulk of total primary productivity by producing organic matter which is the base of complex aquatic food webs. Further, the composition and abundance of phytoplankton can reflect the nutritional status and trophic condition of the water body within the stipulated period of time (Busing, 1998; Diazpardo *et al*., 1998). Besides aquatic plants, Phytoplankton is primary biological component from which the solar energy is transferred to higher organisms through various trophic levels of aquatic food chain (Tiwari and Chauhan, 2006; Tas and Gonulo, 2007 and Shashi shekher *et al*., 2008). For these obvious reasons therefore, phytoplankton is often used to estimate the potential fish yields (Hecky and Kling, 1981), productivity (Park *et al*., 2003), water quality (Walsh *et al*., 2001), energy flow (Simciv, 2005), trophic status (Reynolds, 1999) and management measures (Beyruth, 2000) of any water body. Furthermore, the seasonal fluctuations and species composition of phytoplankton in any water body depend on levels of light, temperature, nutrients, grazing pressure, onset of parasitic infections, extracellular metabolites of plants and animals with changing season during the year (Agrawal, 1999). Pawar *et al.* (2006) elucidated that study of plankton can be a very useful tool for the assessment of biotic potential thereby contributing to the overall assessment of basic nature and general economic potential of water body. The phytoplankton diversity and its importance were also described by Vaulot (2001), Pongswat *et al.* (2004), Kemdirim (2001), Millman *et al*.(2005), Sridhar *et al*.(2006), Senthilkumar and Sivakumar (2008), Ganai *et al.* (2010), Jagad eeshappa and Kumara (2013) and Chopra *et al.* (2013). The focus of the current study was to estimate the variability in phytoplankton throughout the year in terms of its distribution, abundance and diversity to assess the fishery potential of lake Jaisamand.

MATERIALS AND METHODS

Study area: Jaisamand is considered as one of the oldest manmade lake as it was constructed during the year 1729 AD by putting an embankment across the Gomti River near the village Veerpura in Udaipur district of Rajasthan state. In this lake nine rivers and several seasonal cannels (Nalahas) are emptying. For wide area coverage three sampling stations (A, B and C) were selected (Fig. 1). The morphometric details of the water body illustrated in Table 1.

Sample collection: For the present study samples were collected at monthly intervals from three preselected sampling stations during July 2005 to June 2006. For the sample collection 100 liters of surface water was filtered with bolting silk No. 25 and the filtered plankton concentrate was immediately preserved in Lugol's solution.

Sample analysis: The preserved phytoplankton samples were transported to Research laboratory, College of Fisheries (Maharana Pratap University of Agriculture and Technology), Udaipur (Rajasthan) for quantitative and qualitative analyses. For the quantitative analysis, plankton concentrate was diluted in a beaker and one

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ml of sub-sample was taken in a Sedgwick-rafter plankton counting cell with the help of a plankton pipette. Counting of phytoplankton was done under Carl Zeiss Inverted Microscope as per the method explained in APHA (1989). The total numbers of phytoplankton were counted in each sub-sample and multiplied with dilution factor and results are expressed as number per liter. For the qualitative analysis, the phytoplankton was identified up to the species level and it was done following Needham and Needham (1962), Edmondson (1965), Subrahmanyan (1971) and Adoni (1985).

RESULTS AND DISCUSSION

During the present study, total number of phytoplankton was observed to vary between 64-2029 number per liter whereas, the seasonal variation in phytoplankton density depicted that Bacillariophyceae, Myxophyceae and Cryptophyceae were high during the monsoon (July-October) and pre-monsoon (March-June). These were however, low during the post-monsoon (November-February). The density of Chlorophyceae, Xanthohyceae and Euglenophyceae was high during post-monsoon and low during the monsoon and pre-monsoon periods (Fig. 2). These quantitative estimations further show that distributional trend of phytoplankton remained almost same throughout the study period considering all the three sampling stations. Bacillariophyceae emerged as the most dominant group by contributing 35% to the total phytoplanktonic community (Fig. 3).

The trends of seasonal density of phytoplankon observed in the present study corroborates with findings reported by Lashkar and Gupta (2009), Hassan *et al.* (2010), Gayathri *et al.* (2011), Jagadeeshappa and Kumar (2013) and Yilmaz (2013). SenthiKumar and Siva Kumar (2008) identified total 160 species of phytoplankton in Veeranamlake in Tamil Nadu with bacillariophyceae being the dominant group. The phytoplankton density was high during summer season and low during the winter season. Lashkar and Gupta (2009) recorded total 34 phytoplankton, belonging to cyanophyceae, chlorophyceae, bacillariophyceae and euglenophyceae in Chatla flood plain lake, Barak Valley Assam. They found highest number of species (29) in pre-monsoon and lowest (23) in winter. The density of phytoplankton reported for Jaisamand by Sarang *et al.* (2002) was 20 to 214 (number per liter). In the present study, however, the mean phytoplanktonic abundance was relatively higher in surface water. This observed discrepancy could be due to varying grazing pressure by the prevailing fish stock and especially exotic omnivore Tilapia occurring in abundant quantity in this lake.

The minimum number of bacillariophyceae was (159 per liter) found in November-December, 2005 at station B and maximum number was (554 per liter) found in September- October, 2005 at station C (Fig. 2). Chlorophyceae was second dominant group with the contribution of 33% (Fig. 3), where the minimum number was (24 per liter) observed during the month of May-June, 2006 and maximum number was (485 per liter) during November-December, 2005 at the stations B and C, respectively (Fig. 2). Myxophyceae turned up as the third prominent group in the phytoplankton with 16% contribution and it was minimum (8 No.l^{-1}) during March-April, 2006 at station C while maximum number (463 per liter) was found during July-August, 2005 at Station A (Fig. 2 and Fig. 3). Xanthophyceae was the fourth group and contributed 10% of total

Table 1. Morphometric features of Jaisamand lake.

S.N.	Morphometric features	Morphometric values
1.	Location	
	Latitude	24°14'N
	Longitude	73°57'E
2.	Altitude	587 m (MSL)
3.	Annual rainfall	627.7 mm
4.	Catchment area	1127 sq.m
5.	Area (FRL)	7,160 ha
6.	Maximum depth	32 m
7.	Mean depth	15 m
8.	Mean depth/Maximum depth	0.469
9.	Maximum breadth	8.05 km
10.	Maximum length	13.60 km
11.	Length of shoreline (L)	89.4 km
12.	Shoreline development index (DL)	3.75
13.	Length of dam	335 m
14.	Width of dam	31.4 m
15.	Height of dam	40.16 m
16.	Type of dam	Earthen and masonry
17.	Tehsil	Sarada
18.	Accesses	58 km from Udaipur city (Rajasthan)

Table 2. Diversity of phytoplankton in Jaisamand lake.

A.	**Myxophyceae**	25.	*Closterium liebleinii*
1.	*Anacystis cyanea*	26.	*Cosmarium granatum*
2.	*Gomphosphaeria* sp.	27.	*Ulothrix* sp.
3.	*Nostoc* sp.	28.	*Microspora* sp.
4.	*Anabaena* sp.	29.	*Hormidium subtile*
5.	*Rivularia* sp.	30.	*Spirogyra* sp.
6.	*Phormidium* sp.	31.	*Protococcus* sp.
7.	*Oscilllatoria tenuis*	32.	*Cladophora* sp.
8.	*Oscillatoria rileyi*	33.	*Oedogonium* sp.
9.	*Spirulina* sp. (Major)	34.	*Chlamydomonas* sp.
10.	*Merismopedia* sp.	35.	*Eudorina* sp.
11.	*Cylindrospermum* sp.	36.	*Pandorina* sp.
12.	*Candelabrum spinulosum*	37.	*Penium polymorphum*
13.	*Microcystis aeruginosa*	38.	*Oophia amblystomatis*
C.	**Euglenophyceae**	**E.**	**Xanthophyceae**
1.	*Euglenopsis vorax*	1.	*Botrydiopsis* sp.
2.	*Heteronema* sp.	2.	*Botryococcus* sp.
3.	*Gloeomonas ovalis*	3.	*Tribonema bombycium*
4.	*Polytoma uvella*	**F.**	**Cryptophyceac**
5.	*Platydorina* sp.	1.	*Cyanomonas coeruleus*
D.	**Chlorophyceae**	**G.**	**Bacillariophyceae**
1.	*Volvox* sp.	1.	*Synedra ulna*
2.	*Pleodorina* sp.	2.	*Rhopalodia gibba*
3.	*Tetraspora cylindrical*	3.	*Gyrosigma kutzingii*
4.	*Palmella mniata*	4.	*Pinnularia* sp.
5.	*Ourococcus bicaudatus*	5.	*Neidium dubium*
6.	*Nannochloris bacillaris*	6.	*Gomphonema* sp.
7.	*Schroederia setigera*	7.	*Amphora ovalis*
8.	*Pediastrum boryanum*	8.	*Diatoma* sp.
9.	*Pediastrum simplex*	9.	*Cymbella cistula*
10.	*Pediastrum duplex*	10.	*Diatoma vulgare*
11.	*Hydrodictyon reticulatum*	11.	*Diatoma elongatum*
12.	*Coelastrum* sp.	12.	*Navicula* sp.
13.	*Coelastrum cambricum*	13.	*Navicula cupsidata*
14.	*Coelastrum sphaericum*	14.	*Navicula cyclotella*
15.	*Chlorella* sp.	15.	*Navicula radiosa*
16.	*Pachycladon umbrinus*	16.	*Navicula reinhardtii*
17.	*Oocystis* sp.	17.	*Cyclotella operculata*
18.	*Ankistrodesmus spiralis*	18.	*Asterionella* sp.
19.	*Ankistrodesmus falcatus*	19.	*Fragilaria* sp.
20.	*Closteridium lunula*	20.	*Fragilaria capucina*
21.	*Closteridium longissima*	21.	*Gomphonema olivaceum*
22.	*Tetradesmus wisconsinensis*	22.	*Melosira granulate*
23.	*Spirolaenia condensate*	23.	*Surirella ovate*
24.	*Closterium setaceum*		

observed phytoplankton community (Fig. 3). The minimum number was (3 per liter) during the month of September -October, 2005 at station B and maximum number (345 per liter) was seen during November-December, 2005 at station A (Fig. 2). The Euglenophyceae and Cryptophyceae on the other hand were relatively low in density and occupied fifth and sixth positions in dominancy with 5% and 1% contributions, respectively (Fig. 3). The minimum number of Euglenophyceae was observed (2 per liter) during May-June, 2006 at station A and maximum number was (132 per liter) found during November-December, 2005 at station B (Fig. 2). The Crytophyceae was not observed from the stations B and C during the months of November – December, 2006 but the maximum number of this group was recorded (38 per liter) from the sampling station C during the months of May –June, 2006 (Fig. 2).

The qualitative result of present study further made it clear that planktonic flora in Jaisamand lake was

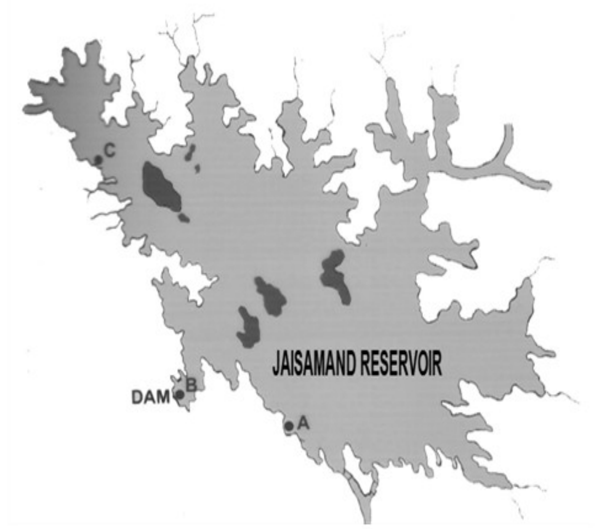

Fig. 1. *Map of Jaisamand lake along with sampling stations (A, B and C).*

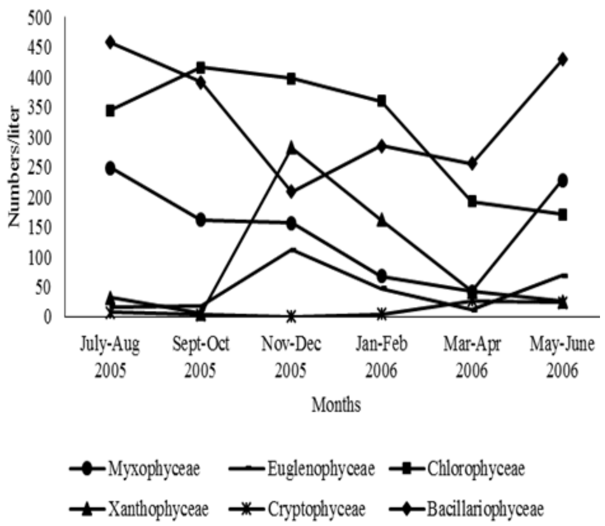

Fig. 2. *Bimonthly distribution of phytoplankton in aisamanad lake.*

contributed by six major groups i.e. Myxophyceae, Euglenophyceae, Chlorophyceae, Xanthophyceae, Cryptophyceae and Bacillariophyceae. These six groups comprises total 85 species in that 13 were from Myxophyceae, 5 from Euglenophyceae, 38 from Chlorophyceae, 3 from Xanthophyceae, 1 from Cryptophyceae and 23 belonged to Bacillariophyceae (Table 2).

The phytoplankton diversity of Jaisamand lake during 1981-82 was 52 species (Anonymous, 1984). During the present investigation, a total 85 species of phytoplankton were noticed. However, Rao and Durve (1987) have reported 52 genera out of which 25 belonged to Chlorophyceae, 12 to Bacillariophyceae, 2 to Euglenophyceae, 1 to Xanthophyceae and 12 to Myxophyceae from Jaisamand. Sarang *et al.* (2002) reported only 18 species of phytoplankton with dominance of green algae followed by blue green algae. Further, as regards relative dominance of different algal groups, Bacillariophyceae was followed by Chlorophyceae, Myxophyceae, Xanthohyceae, Euglenophyceae and Cryptophyceae in the present study which could be considered a desirable feature from the fisheries point of view. In Udaipur lakes receiving organic pollutants, Solomon (1994) reported the dominance of blue-green algae. Sarang (2001) reported dominance of green algae followed by blue green algae in Lake Jaisamand. Willen (1990), Yusoff and Patimah (1994) considered lakes as eutrophic on the basis of abundance of blue-green algae whereas Lake Jaisamand in the present study can not be considered eutrophic on the basis of observed planktonic densities. This is desirable feature from lake conservation point of view.

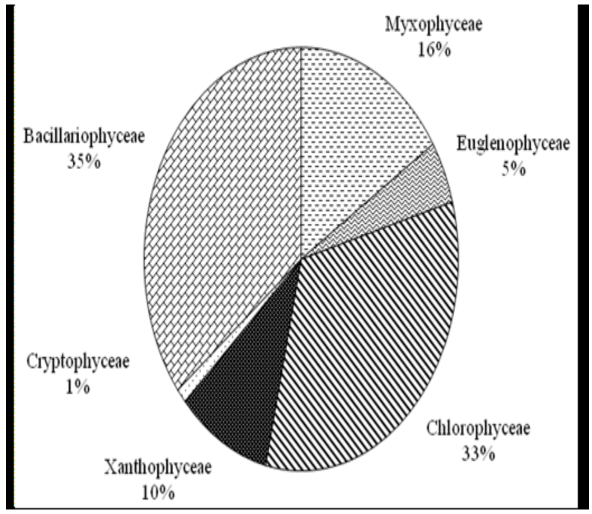

Fig. 3. *Phytoplankton distribution in Jaisamand lake.*

Conclusion

From the present study it can be inferred that the diversity and density of phytoplankton and are indicative of good productivity of Jaisamand Lake. The observed abundance of phytoplankton in lake was in order of Bacillariophyceae > Chlorophyceae > Myxophyceae > Xanthophyceae Euglenophyceae > Cryptophyceae. Further, is clearly depicted from this study that Jaisamand Lake maintained fairly good population of phytoplankton which is providing opportunity for sustaining more fish biomass having broad based feeding habits for achieving high productivity in this water body. The data generated may be used for managing scientific fisheries in this lake.

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