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Research Article

STUDY OF BLUE-GREEN ALGAE FROM LONAR LAKE

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ABSTRACT
The alkaline lake is situated in the periphery of Lonar town in district Buldhana, Maharashtra, India (lat 19° 58', lag 76° 34'). It is the third largest natural saltwater lake in the world. The lake is rich in flora and fauna need to be renowned as Ramsar Site of India. Present work deals with study of blue-green algae, physico-chemical parameter that aims to investigate the pollution level and eutrophication status of Lonar Crater Lake.

Keywords: *Blue-Green Algae, Lonar Lake, Physico-Chemical Parameter*

INTRODUCTION
The lake is originated as a meteorite impact crater around 50-60 thousand years ago having surface area 1.13 km^2 and average depth 150 meters. Lonar Lake lies within the Deccan Traps basaltic formation of India **(**Pittarello *et al.,* 2010). Lonar Lake is the third largest crater in the world and situated to southwest of Lonar village.
The lake water is highly alkaline due to high content of sodium carbonate. A crater has a unique ecological environment. The important feature of lakes is the presence colored blooms of blue-green alga. Few algal indicators have been studied by Nandan *et al.,* (2003). Few phytoplankton's from the eutrophic lake were listed by Agrawal, (1999). Near about 13 alkaliphilic cyanobacteria were reported to grow under alkaline conditions (Ciferri and Tiboni, 1985).
Blue-green algae have been screened for useful bioactivities including cytotoxic, multidrug resistance reversals, antifungal and antiviral effects (Sundararaman and Sekar, 2001). The lake water was deep blue –green, blackish in color due to the blue-green algal bloom. The water sample was emitting strong murky odor.
The blue-green algal bloom in Lonar Lake water is responsible for absorption of light and heat from sunlight due to its colored pigments leading to higher temperature of lake water. The Lonar Lake water has high concentration of dissolved solids and total suspended solids (Verma and Chaudhari, 2013). The eutrophication takes place due to: The domestic sewage and garbage from Lonar town that reaches into the lake.
Near the periphery of the crater, some farmers downing farming and the use of inorganic fertilizers, insecticides and pesticides enter in lake. Simultaneously, Hygienic activities are carried out by the local people in the fresh water springs and used waste water enters in lake at last (Yannawar and Bhosale, 2013).
Present study deals with the study biodiversity of blue-green algae & physico-chemical parameter of the Lonar crater.

MATERIALS AND METHODS
Sample Collection
Blue-green algae and water samples were collected in and around different spot in the Lonar Lake during, May 2015-2016.
For the present paper water samples were collected from different sampling stations in airtight and opaque polythene container.
Water temperature, EC, turbidity, TDS, Total Hardness, Free CO_2 and Salinity was analyzed with the help of standard method for water analysis (APHA, 2006).

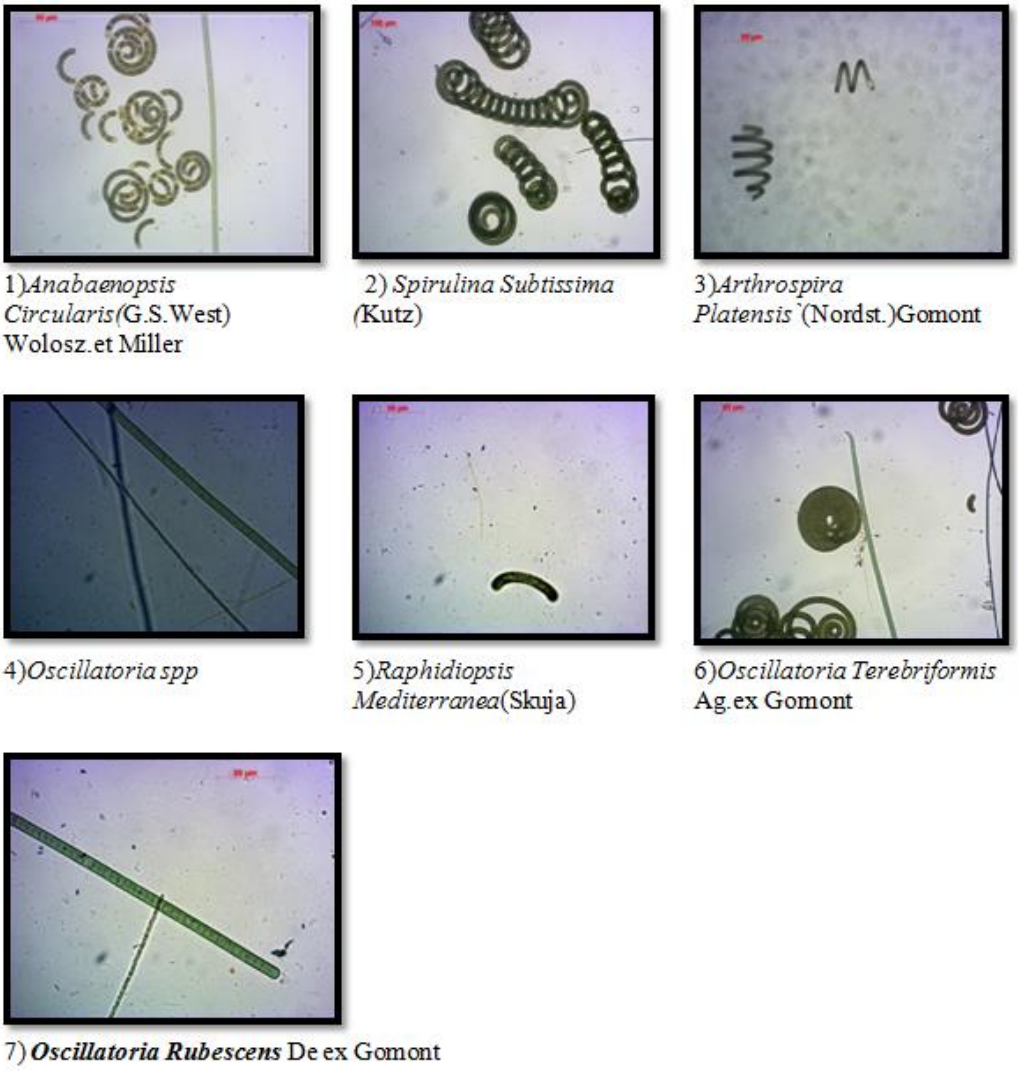

Figure 1: Biodiversity of Blue-Green Algae from Lonar Lake

Table 1: Physico-Chemical Parameter (Month, May 2015)

Parameters	**Sampling Locations**		
	1	**2**	**3**
Temp (C^0)	26.0	27.0	27.0
Odour	grouty	grouty	grouty
Colour	Dark green	Dark green	Dark green
pH	8.13	8.21	8.9
EC mS	7.57	9.6	8.1
Salinity(mg/L)	9999	8765	7546
Turbidity(NTU)	1.3	2.1	1.9
TDS ppt	4.2	5.8	5.2
Total hardness mg/L	127	177	143
Total Alkalinity mg/L	1300	1270	1259
CO_2 mg/L	6.6	5.9	5.3

RESULTS AND DISCUSSION

Presence of blue-green algae like *Anabaenopsis circularis* (G.S.West) Wolosz.et Miller, *Spirulina subtissima* (Kutz) ex Gomont, *Arthrospira platensis* (Nordst) Gomont, *Oscillatoria spp, Raphidiopsis mediterranea* (Skuja), *Oscillatoria terebriformis* (Fillament) AG.exGomont and *Oscillatoria rubescens* De ex Gomont were found.

1. *Anabaenopsis Circularis (G.S.West) Wolosz.et Miller:-* Trichomes free swimming, very short, mostly spirally coiled,4.5-6µ broad,cells spherical or somewhat longer than broad with large granule. Heterocysts spherical 5-8µ broad.

2. *Spirulina Subtissima (Kutz) ex Gomont:-* Coiled spiral bright blue-green, Trichome 0.5-0.10µ

3. *Arthrospira Platensis (Nordst) Gomont:-* Blue green in colour, more or less regularly spirally coiled. Cells nearly long as broad. Ends cells rounded, 2-6µ, broad 26-36µ and spirals 49-61µ.

4. *Oscillatoria Spp*:- Trichomes free floating, mostly straight often curved or weakly sigmoid of 6-12 cell, attenuated at both ends, 40-110µ long.

5. *Raphidiopsis Mediterranea* (*Skuja*):- Unconstricted at the cross walls, cells 2-5 times as long as broad.

6. ***Oscillatoria Terebriformis* (*Fillament*) *AG.exGomont:-*** Trichomes end bend in a srew like manner, Slightly attenuated, unconstricted at the crosswall 4-6.5µ, end cell rounded, not capitate, Calyptra absent.

7. *Oscillatoria Rubescens De ex Gomont:-* Trichome straight, attenuted at the end, not constricted at the cross wall, End cells capitate with convex calyptra, 6-8µ broad.

Colour of water, murky smell like a gas, presence of few species of blue-green algae indicates the characteristic nature of flora, which needs the further investigations. Shaikh (2010) listed *Chlorella Sp, Clasterium, Spirulina sp*. from Lonar Lake. The alkalinity of Lonar Lake was in between 1259-1300 mg/l. Due to the optimal concentrations of salts and alkalinity population of *Spirulina spp* is considerably more in Lonar water body. An analogous situation appears to exist in the alkaline lakes of the Rift Valley in East Afri*ca*. It is argued that, the evaporation of the lake water in the absence of the drain was responsible for the alkalinity of the lake waters and also due the conversion of sulphate ion to carbonate of 32 sulphides (Blandford, 1868). Presence of Blue-green like *Arthospir*a and *Spirulina* are as the primary predominant producer present along with alkaline bacteria and fungi. These blue-green algae show variations in their morphological characteristics and also capable of adaptation to very extreme habitat and colonize in these type environments predominantly in which life for other microorganism is, if not impossible, but very difficult. Cyanobacteria such as *Halomonas* sp, *Paracoccus* sp. *Klebsiella* sp, *Slackia* sp. and *Actinopolyspora* sp. has been reported from this lake. According to Deshmukh and Puranik (2014), blue-green algae like *Spirulina platensis, Synechocystis aquatilis, Oscillatoria minimus, Oscillatoria amphibian, Phormidium laminosum, Phormidium tenue, Phormidium fragile* were listed.

According to Chuodhary and Handa, (1978); Badve *et al.,* (1993) and Muley and Baber (1998), V the salt concentration could be major reason of predominant population of cynobacteria such as *Oscillatoria, Synechocystis, Anabaenopsis* and *Spirulina* in the lake. It is confirmed that the cynobacterial population is regulated by the concentration of salt and become monospecific (Iltis, 1968; 1969). Satyanarayan *et al.,* (2008) reported 10 species of algae in the Lonar Lake. The pH of the Lonar lake was recorded 8.9-8.21 which is alkaline was observed in summer season. These lakes have high pH values close to 11 and high salt concentration, particularly sodium carbonates originating from the volcanic deposits as in Lonar Lake. In some of the lakes, such as Nakuru, Elenenteia and the Crater Lake in which pH range from 9.4 to 11 *Spirulina platensis* and *S platensis var. minor* are predominant blue –green algae present (Jenkin, 1936; Blum, 1976; Anusuyadevi *et al.,* 1981). Therefore, in such lakes cyanobacteria would represent more than half of the phytoplankton population. Lake Arangudi is more similar in characteristics with Lonar Lake as alkaline pH ranging near to 10.3 to 10.5 and predominance of *S. platensis* resulting in waters appears deep green. There appearance of high concentrations *Spirulina*, which is an indicator of extremely high photosynthetic, rates showing 1.2 to 2.4 g of oxygen produced/sq. meter/h. *Arthrospira platensis* were also studied by (Mohite and Wake, 2011) from Lonar Lake. Durning the summer season minimum TDS was found to 4.2-5.8 ppt. Electrical conductivity was found minimum during month of

May. As the Lonar Lake is well known for alkalinity and salinity during this study, the minimum value of salinity was 7546mg/l and maximum was 9999mg/l. This may be the reason of the growth of *Spirulina sp* in large quantity.

Conclusion

Lonar Lake is the third biggest in the world originated due to meteoritic impact has unique bio-diversity. Only seven species of blue-green algae other than diatoms of salt tolerance was observed. Many researchers have studied on several aspects, but study on blue-green algae has not been studied so far as Lonar crater is a wet land of important biodiversity. Not only *Spirulina* but near about seven different algae has been identified.

Again more and more taxonomical research is necessary to study the algal flora and to access its value of Lonar Lake. Higher rate of photosynthetic activity in lake increases the pH value. But decreasing physcio-chemical parameter of water due to pollution and disturbance of more and more human activity, grouty smell, the algal flora is been decreasing.

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