

Distribution and Occurrence of Desmids in Bhadra Reservoir, Karnataka

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Abstract: *Desmid diversity is an important criterion for evaluating the suitability of water for irrigation and drinking purposes. Desmid population of Bhadra reservoir was studied for a period of two years from July 1998 to June 2000. In the present study, a total of 9 genera and 46 species of desmids were recorded and the important genera include Cosmarium with 25 species, Closterium with 3 species, Euastrum (2 species), Staurastrum (11 species), Micrasterias (1 species), Desmidium (1 species), Arthrodesmus (1 species), Staurodesmus (1 species) and Xanthidium (1 species). With regard to their seasonal occurrence, they were found to be more during summer (58174o/l) and low during rainy season (42016 o/l).*

Keywords: *Bhadra reservoir, desmids, diversity, water quality.*

1. INTRODUCTION

Phytoplankton is considered as important component of aquatic flora, play a key role in maintaining equilibrium between abiotic and biotic components of aquatic ecosystem (Pandey et al., 2004). Desmids are an order in the Charophyta, a division of green algae that forms a sister group to the land plants (Gontcharov et al., 2003). The desmids are often treated as members of the Zygnematales, as family Desmidiaceae (Kanetsuna, 2002; World Register of Marine Species, 2014). The structure of desmid algae is unicellular, while the cell is sometimes divided into two symmetrical compartments separated by a narrow bridge or isthmus, wherein the spherical nucleus is located. Each semi-cell houses a large, often folded chloroplast for photosynthesis (<https://en.wikipedia.org>).

The present study has been carried out to know the diversity and distribution of desmids in Bhadra reservoir of Karnataka. This study is relevant since the present water body forms the source of water for irrigation, drinking, fisheries and for producing hydro electric power.

2. MATERIALS AND METHODS

2.1. Study Area

The location of the study area is depicted in Figure 1. The Bhadra reservoir is located on the Bhadra river a tributary of Tungabhadra river in Chikkamagaluru district in Tarikere Taluk, in the Western part of Karnataka in India. The benefits derived from the reservoir storage are irrigation with gross irrigation potential of 162,818 hectares (402,330 acres) (Bhadra reservoir project,2011), hydro power generation of 39.2 MW (three powerhouses, located on the right and left bank main canals (Srinivasa Raju & Nagesh Kumar,2011; "Bhadra dam left bank power house,2011), drinking water supply and industrial use. The dam commissioned in 1965 is a composite earth cum masonry structure of 59.13 metres (194.0 ft) height with length of 1,708 metres (5,604 ft) at the crest level, which submerges a land area of 11,250.88 hectares (27,801.5 acres) (Bhadra reservoir project,2011; Modernization strategy for Irrigation management: Bhadra Project",2011 ; Harish Kumara et al., 2010 ; (https://en.wikipedia.org/wiki/Bhadra_Dam).

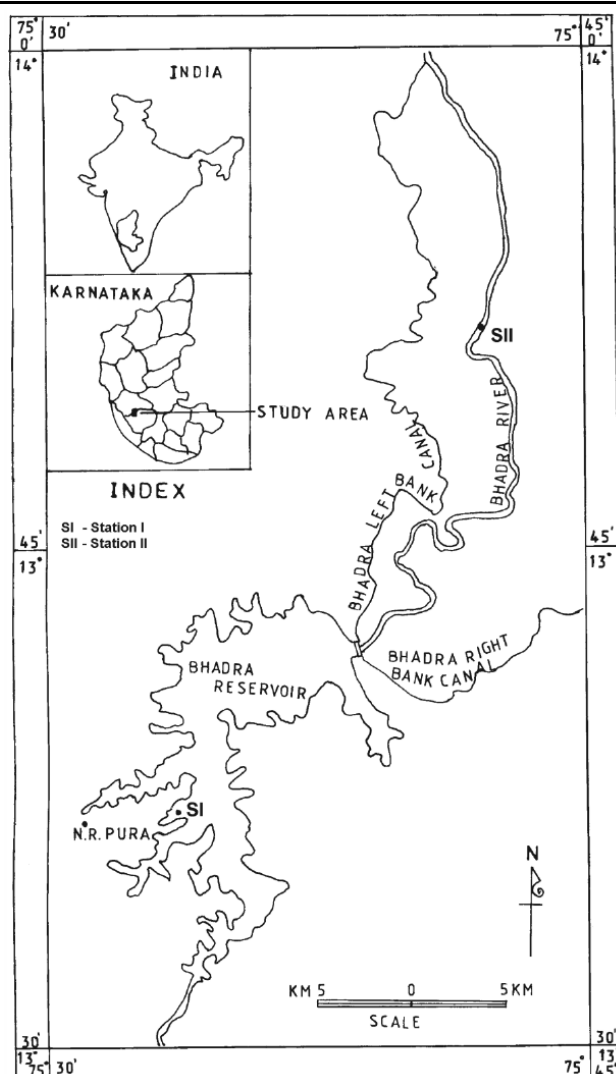


Figure1. A sketch map showing sampling stations of Bhadra reservoir, Karnataka

2.2. Estimation of Desmids

Planktonic forms were collected by using plankton net made of bolting silk cloth of meshes of 10 μ m fixing a glass bottle of 100 ml at a narrow end. For taking the samples of qualitative analysis, the net was towed for 5 minutes just below the surface of water (Green and Holden, 1960). Tows were restricted to a small area around each sampling point. The samples were immediately transferred to other bottles and preserved by adding 4% formalin as per the practice of Welch (1948). The qualitative estimation was done by taking one ml of sample from the stock samples at each time and repeated 5 times. Uniform distribution was made by agitating the samples thoroughly. Qualitative identification of desmid organisms was done with the help of monographs and they are identified upto species level (Adoni et al. 1985; Bharathi and Hegde, 1982; Coesel, 1996; Digamber and Vidyavathi, 1985; Hegde and Bharathi, 1985 and Prasad and Mehrotra, 1977).

Further, recorded desmids are appended in Table 1. For the quantitative estimation of desmids a drop of the sedimented sample was taken on a clean slide and a known size of coverslip was put over it. Then the whole coverslip area was scanned under ten different microscopic fields and then the organisms appeared were counted and tabulated as per the Rao's (1953) method.

Table1. List of Desmids recorded in Bhadra reservoir, Karnataka

Arthrodesmus hiatus	Cosmarium boeckii
Closterium lunula	Cosmarium quadrifarium
Closterium remarginatum	Cosmarium scabrum
Closterium subtrigosum	Cosmarium pseudoconnatum
Cosmarium subtumidum	Cosmarium subspeciosum
Cosmarium retusifforme	Cosmarium vitiosum

Distribution and Occurrence of Desmids in Bhadra Reservoir, Karnataka

Cosmarium decoratum	Cosmarium striolatum
Cosmarium margaritatum	Cosmarium contractum
Cosmarium granatum	Cosmarium bioculatum
Cosmarium lundelli	Cosmarium depressum
Cosmarium contractum	Cosmarium ocellatum
Cosmarium spinuliferum	Cosmarium perfissum
Cosmarium ordinatum	Cosmarium tumidum
Cosmarium moniliforme	Desmidium baileyii
Cosmarium corda	Euastrum sublobatum
Cosmarium capitulum	Euatrum verrucosum
Staurastrum wilde	Micrasterias inciser
Staurastrum paradoxum	Stauroidesmus hirudinella
Staurastrum gracile	Staurastrum sebaldi
Staurastrum heterocantha	Staurastrum circulus
Staurastrum tohopekaligense	Staurastrum hexacerum
Staurastrum longibrachiatum	Staurastrum arachne
Staurastrum trilobatum	Xanthidium armatum

2.3. Method of Water Sampling

Water samples were collected for chemical analysis from Bhadra reservoir at an interval of 30 days. Samples were collected in black plastic carbuoys of 5 litres capacity. For the estimation of certain factors like dissolved oxygen, water samples were taken in 300 ml BOD bottle and fixed immediately using Winkler's reagent. Water temperature and p^H were recorded at the time of collection. Remaining water quality parameters were estimated as per the standard methods (APHA, 1998).

3. RESULTS AND DISCUSSION

A total of 9 genera and 46 species of desmids were recorded (Table 1) during the present study and the important genera include Cosmarium with 25 species, Closterium with 3 species, Euastrum (2 species), Staurastrum (11 species), Micrasterias (1 species), Desmidium (1 species), Arthrodesmus (1 species), Stauroidesmus (1 species) and Xanthidium (1 species). With regard to their seasonal occurrence, they were found to be more during summer (58174 o/l) and low (Table 3 and 4) during rainy season (42016 o/l). Figure 2 shows monthly occurrence (o/l) of Desmids in Bhadra reservoir.

Table2. Yearly and two yearly occurrence (o/l) of Desmids in Bhadra reservoir

1998-99	1999-2000	1998-2000
70997.0	74501.0	145498.0

Table3. Seasonal occurrence of Desmids in Bhadra reservoir during 1998-2000 (o/l)

Seasons	
Rainy	42016.0
Winter	45308.0
Summer	58174.0
Total	1,45,498.0

Table4. Seasonal average of Desmids in Bhadra reservoir (o/l)

Seasons	1998-99	1999-2000	1998-2000
	Rainy	5397.00	5107.00
Winter	6083.75	5243.25	5663.50
Summer	6268.50	8275.00	7271.75
Total	17749.25	18625.25	18187.25

Among desmids *Arthrodesmus hiatus*, *Coelastrum microporum*, *Cosmarium subtumidum*, *C. granatum*, *C. contractum*, *C. depressum*, *C. tumidum*, *Micrasterias inciser*, *Staurastrum sebaldi*, *S. hexacerum*, *S. arachne*, *S. heterocantha*, *S. longibrachiatum*, *S. trilobatum* and *Xanthidium armatum* occurred in good numbers. While, *Desmidium baileyii* occurred in less numbers. Hence, Bhadra reservoir is moderately oligotrophic in nature. Sayeswara (2014) recorded 04 genera and 05 species of desmids from Chikkamalappanakere tank of Shimoga district, Karnataka *Cosmarium* was represented by 2 species. *Closteriopsis*, *Euastrum* and *Staurastrum* was represented by a single species with a

relative abundance of 11.1 %. Patil and Kumawat (2014) reported 36 taxa of desmids from Abhora dam of Maharashtra. Their study deals with the descriptions of 22 taxa of genus *Cosmarium corda* belonging to 13 species and 09 varieties.

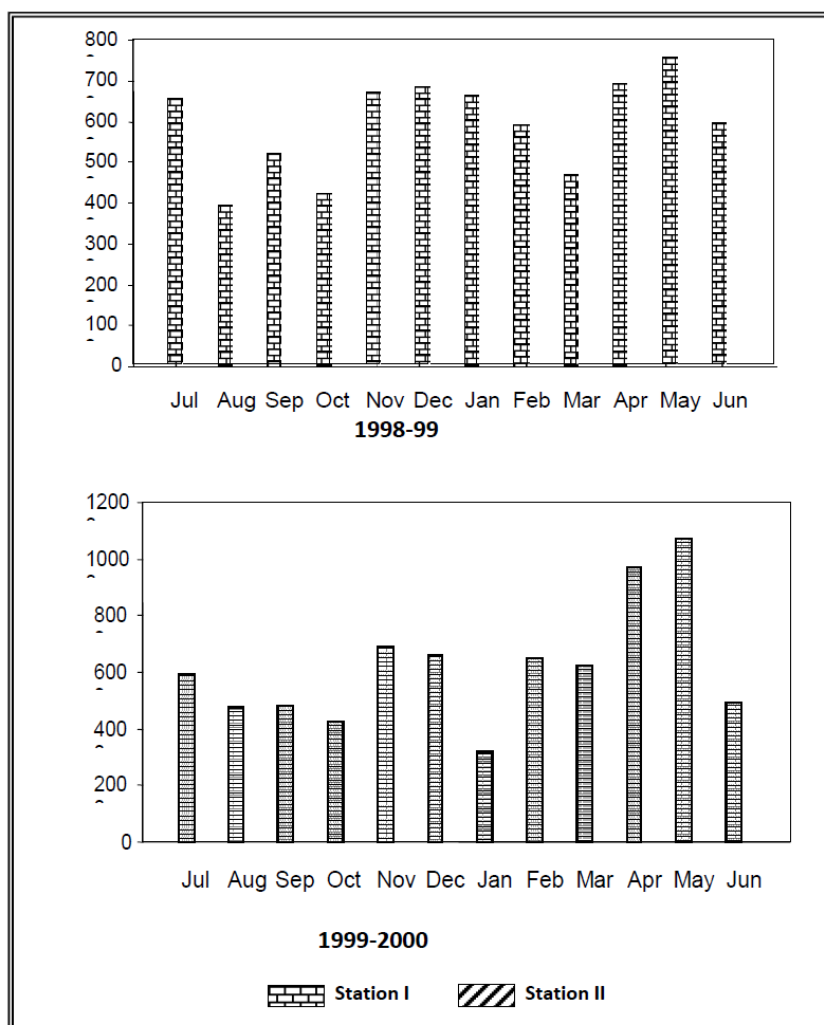


Figure 2. Monthly occurrence (o/l) of Desmids in Bhadra reservoir

Zafar (1967) and Pandey and Pandey (1980) have pointed out that the water temperature in the range of 20°-30° C is favourable for the growth of the desmids. Further, Gonzalves and Joshi (1946) and Zafar (1967) have recorded thicker population of desmids in moderately alkaline waters. Rao (1955) concludes that certain species of desmids are favoured by high p^H and few by low p^H and, still others do not show any relationship with p^H. Shashikanth and Anand (1978) correlated high rainfall and turbidity for their minima in the aquatic systems. Nonetheless, a great emphasis is laid on calcium as a factor for their growth and multiplication by Seenayya (1971 b), Mitra (1982), Raj Kumar (1984) and Venkateswarlu (1986).

p^H was above 7 which contained fairly good number of desmids indicating that the alkaline water supports the desmid population, as corroborated by Gonzalves and Joshi (1946). Shashikanth and Anand (1978) opined that desmids prefer clear and uncontaminated water hence the desmids were nil at lower stretch of Bhadra river as the water is polluted by Industrial effluents and domestic wasters. While, the turbidity values were found to be less and hence harboured desmids, indicating that lower the turbidity values, higher will be the desmid population in Bhadra reservoir. This is an essential agreement with Shashikanth and Anand (1978).

The behavior of desmid towards calcium concentration is rather peculiar. As per Table 5 an average level of calcium (5.93 mg/l) lodged very high population (Table 4) of desmids (6062.41 o/l). This finding is in confirmity with Hutchinson and Pickford (1932) who opined that desmid avoid waters with high calcium. While, Munawar (1970) pointed out that desmid respond irregularly towards calcium.

Table5. Averages of the physico-chemical parameters of Bhadra reservoir

Sl.No	Parameters	Average 1998-99	Average 1999-2000	Total 1998-2000
1	Water temperature (°C)	26.6	27.45	27.02
2	P ^H	7.46	7.46	7.46
3	Turbidity (NTU)	7.75	7.56	7.65
4	Electrical conductivity (µm hos/cm)	66.32	61.81	64.06
5	Total solids (mg/l)	249.75	324.00	286.87
6	Total suspended solids (mg/l)	206.87	288.80	247.83
7	Total dissolved solids (mg/l)	42.88	35.19	39.03
8	Chloride (mg/l)	11.21	13.59	12.40
9	Total hardness (mg/l)	32.00	23.83	27.91
10	Total alkalinity (mg/l)	36.50	36.66	36.58
11	Nitrite (mg/l)	0.24	0.22	0.23
12	Ammonia (mg/l)	0.008	0.015	0.011
13	Dissolved oxygen (mg/l)	7.05	6.55	6.80
14	BOD (mg/l)	1.28	0.75	1.015
15	Phosphate (mg/l)	0.002	0.002	0.002
16	Calcium (mg/l)	5.80	6.07	5.93
17	Magnesium (mg/l)	5.40	5.69	5.54
18	Free carbon dioxide (mg/l)	8.66	9.16	8.91
19	COD (mg/l)	2.60	2.53	2.56

Hegde (1986) has reported desmid from lentic water bodies of Karnataka and concluded that desmids prefer to grow in both in acidic and alkaline waters. He has reported *Staurastrum spinipendens* from a lentic water body with a p^H of 4.5 and similarly *Staurastrum pseudounicorne* in a water body with a p^H of 8.5 suggesting that desmid occur both in acidic and alkaline waters.

The present work has revealed that phosphate at lower concentration trigger the abundance of desmids. A similar observation has been made by Venkateswarlu (1986). Seenayya (1971 b) is of the opinion that the total solids at higher concentration favour the abundance of desmids. When this is taken into consideration, the content of total solids was high ,nevertheless the population of desmid was higher. This observation is quite reverse to the findings of Seenayya (1971 b).

However, Venkateswarlu (1986) is of the opinion that desmids do not show any correlation with that of high or low concentration of total solids. Therefore, our observations are not in essential agreement with that of Venkateswarlu (1986) and Seenayya (1971b).

A large number of workers Zafar (1967), Seenayya (1971b), Rajkumar (1984), Venkateswarlu (1986) have pointed out that the desmids avoid polluted waters. In the present study, downstream stretch of the Bhadra river is highly polluted as it receives the industrial effluent and even a single desmid was not found to grow at this station revealing that desmids do not tolerate the high degree of organic pollution. Hence, the observations made are in essential agreement with that of the above workers.

Desmids are group of phytoplankton that very sensitive to environmental changes and eutrophic conditions are not support their growth (Charles,1955; Edmondson ,1959; Gayathri et al., 2011). Their high density indicates the oligotrophy and free of pollution of the reservoir. Gerrath (1993) reported that desmids are generally more common and diverse in oligotrophic lakes and ponds.

Desmid population was declined during rainy season and recorded the lowest values. This is an agreement with the earlier works of Sukumaran and Das (2001) and Senthilkumar and Sivakumar (2008) .In the present study, among the desmid the genus *Cosmarium* was the dominant with 25 species. Das et al (2014) recorded 02 species of desmids i.e.,*Cosmarium* and *Closterium* from Ox-Bow lake in Nadia district of West Bengal (India).

The low density of plankton during rainy season was due to turbid water, which reduced penetration of sun light and adversely affects the production of plankton. A similar observation was reported by Sugunan et al (2000). In the present study alkaline pH, low levels of calcium, phosphate and turbidity promote the growth of desmids. Continuous monitoring of water is required to know the status of Bhadra reservoir. It suggested a possibility of prediction for desmid variability patterns by some water quality parameters.

4. CONCLUSION

Desmids did not appear at downstream stretch of Bhadra river. Alkaline waters support luxuriant growth of desmids in the Bhadra reservoir. Water temperature has no bearing on the distribution of desmids, also, high turbidity value do not support the luxuriant growth of desmids. Low phosphate (0.001 mg/l) encourages their growth. Relatively higher concentration of calcium i.e., above (36.87 mg/l) is not favourable for desmid population. Seasonally, desmids were high during summer and low during rainy season. The data generated clearly reveals that the reservoir is basically productive and uncontaminated. Therefore, it is suggested that the status of the reservoir should be maintained by enforcing the environmental protection acts. The catchment area of the reservoir should be protected from the adverse effects of human activities.

RECOMMENDATIONS

The following recommendations are made for development and Management of the reservoir on scientific lines.

1. The downstream stretch of Bhadra river near Bhadravathi town, where the effluents of Mysore Paper Mills Limited, Visweshwaraiiah Iron and Steel Limited and sewage water enters the river, the Desmids were nil. A proper treatment of effluent and sewage is needed at the earliest to improve the quality of water which would certainly help fishes to grow.
2. A small well-equipped field laboratory may be established at Bhadra reservoir for monitoring the hydrobiological parameters and other ecological conditions of the reservoir.
3. The farmers of the adjoining areas of the river system should be informed not to use the chemical fertilizers thereby rendering the river system useful for public. The people living in the areas of the river bank should be kept informed about the impact of environmental degradation and sustainable conservation programmes.
4. It is necessary to develop biological criteria for assessing the quality of water. Hence, attention must be devoted to the critical analysis of the biological data. Field oriented biology is highly desirable at the moment for the real progress on bio-monitoring studies.
5. Awareness among the public about the importance of fishes and water bodies and their sustainable exploitation should be created.
6. It is obvious that, to maintain the healthy conditions of reservoir the catchment area should be protected from the adverse effects of human activities.

ACKNOWLEDGEMENT

I express my indebtedness and heartfelt thanks to my guide Prof. E.T. Puttaiah, Department of P.G. Studies and Research in Environmental Science, Kuvempu university, Shankaraghatta - 577 451 for his constant encouragement and able guidance throughout the course of the present investigation.

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