Biological Forum – An International Journal **15(6): 44-52(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Study on Diversity and Bio-Monitoring of Mamchari Dam in District Karauli (Rajasthan), India, with Special Reference to Algal Flora

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(Received: 14 March 2023; Revised: 20 April 2023; Accepted: 25 May 2023; Published: 20 June 2023)
(Published by Research Trend)

ABSTRACT: Bio-monitoring is considered to be a key process that enables biological indicators to survey the ecological healthiness of the habitat. The present study was conducted to assess the water quality by using biotic communities like algae which play an important role in aquatic ecosystems. This study was carried out for two years February 2018 to January 2020 in three different season's *viz.* summer, monsoon and winter season to manuscript the diversity of algae and bio-monitoring purposes at Mamchari dam situated in district Karauli (Rajasthan). This lentic ecosystem is located in the local sub-basin of the Gambhir river basin near Village Mamchari, Keladevi road and approachable 15 km far from the city of Karauli in Karauli district toward the east of Rajasthan state of India. A total number of 42 algal species belonging to four different classes i.e. Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae were reported from the two sampling sites studied. The class Chlorophyceae was dominated with 23 species (55%) followed by nine species of Bacillariophyceae (21%), eight species of Cyanophyceae (19%) and two species of Euglenophyceae (5%). The seasonal variation with respect to algal diversity was documented among summer (27 and 18 species), monsoon (9 and 8species) and winter season (19 and 19species) from the Site-I and Site-II, respectively. A total number of twelve pollution-tolerant genera such as *Chlorella, Chlamidomonas, Closterium, Scenedesmus, Cyclotella, Synedra, Navicula, Nitzschia, Euglena, Phacus, Microcystis* and *Oscillatoria* were reported. The Palmer Pollution Index 22, 4, 17 at Site-I and 8, 4, 8 at Site-II was calculated during summer, monsoon and winter season, respectively. This view discusses about the challenges in aquatic-bio monitoring of water system and provide an elementary vision into fresh water bio indicators and their role in assessment of water quality. This will be appropriate method for evaluation of ecosystem and important to quality control plan for aquatic systems.

Keywords: Algae, Bio-monitoring, Diversity, Mamchari dam, Water Pollution.

INTRODUCTION

Biological monitoring is the systematic use of biological responses to evaluate environmental changes with the commitment to use this information in quality control (Rosenberg and Resh 1993). It plays an important role in aquatic ecosystems. Bio-monitoring used in water quality monitoring as well as for the biological population (Zwart, 1995). It is a fact that water is a most useful natural vital resource on the earth for all kinds of life to survive. Water is not only the most essential commodities for our day-to-day life, but it is also play a crucial role in our economic and social development process. While the total amount of water in the world is constant and is said to be adequate to meet all the demands of mankind, its quality and distribution over different regions of the world is uneven and contribute to the problems of availability and suitability (Saras, 2021*)*. From the origin of universe, water is being remained most important material for civilization. In rural areas, there is more scarcity of water for irrigation as well as drinking purposes particularly in winter and summer seasons.

Studies with the use of algae were carried out by passive bio-monitoring, during which algae present in the natural environment are analyzed and active bio-monitoring, during which algae, living in environments with little pollution, are transferred to and exposed in the ecosystems with higher pollution levels (Rajfur and Kłos 2014). Bio-monitoring is considered as a significant process that assesses the state and ongoing changes (pollution) in natural habitats (Pramila *et al.*, 2008). All living organisms including microorganisms, plants and animals which are used to measure the healthiness of the natural habitat are known as bio-indicators. Bio-indicators are used to evaluate the healthiness of the environment and play an essential role in detecting changes in the environment (Hosmani, 2013). The pre-pollution-tolerating phytoplankton and algae can be used as the biological pollution indicators of water quality of different water bodies (Brook, 1965; Palmer, 1969; Adoni, 1985). When the algal species diversity is rich it indicates that the nutrient level is high and there is no eutrophication (Ajayan *et al.*, 2013). Seasonal dynamics of the phytoplankton population and nutrient status of water were conducted (Sharma *et al*., 2013).

In the last decades, several freshwater habitats have been investigated for algal distribution and various indicator species enlisted as organic pollution (Sharma *et al*., 2020). Saras (2021) recognized *Euglena acus*as the most dominant and frequent species in the lentic water systems. The ability of algae to tolerate in versatile environments gained attention from phycologists over generations. Incredible on the diversity of algae in lentic habitats situated around Rajasthan has been carried out by many researchers (Singh *et al.,* 2011; Sharma *et al.,* 2012; Bhatnagar and Bhardwaj 2013; Verma *et al.,* 2014; Verma and Khan 2015; Sharma and Srivastava 2016; Sharma and Bhardwaj 2017; Rajawat and Sharma 2018, 2020; Shivani *et al.,* 2019; Qureshi and Dube 2022).

Although The Indian subcontinent is found to be the natural reservoir for variety of algal flora but still there is a scarcity for exploration of the algal resources from all possible habitats. Literature revealed that most of the water bodies in India on the limit of eutrophication. It is therefore essential to take positive step towards water management. Observance in view, the present study was carried out to estimate the algal diversity of Mamchari dam in district Karauli (Rajasthan). This investigation is based on the data collected over a period of two years from distribution of algal flora into two sampling sites of the dam. The possible role of algal flora as bio-monitors of organic pollution has been discussed.

MATERIALS AND METHODS

Study Area. Mamchari dam is a freshwater reservoir located in Karauli district of Rajasthan, India (Google map cxj4+wvm mamchari). It lies in the local sub-basin of the Gambhir river basin near village Mamchari, Keladevi road, and approachable 15 Km far from city of Karauli in district Karauli toward the east of Rajasthan state of India. Geographically, the dam is located at 25˚20' N latitude and 76˚50' W longitude. It is a minor irrigation project and a homogenous earthen type of dam was constructed in 1964-65.The name of Mamchari dam was given on the basis of Mamchari village. This village has a recently developing residential area near the district head quarter of Karauli. Catchment area of Mamchari dam is 25.50 Km^2 with covering area 4 Km^2, 756 m length and 3 m top width. The dam is protected three sides by hills (Vindhyan Range) having mining operations in the catchment area. Trucks, tractors camel-carts etc. vehicles pass through the dam from the mining area. On the hills and bank of the dam have a large number of trees species such as *Beutia monosperma, Anogisus, Moringa, Acacia, Saccharum, Balanitese egyptiaca, Mitragyna* etc. The summer climate consists maximum 45°C and a minimum 24°C while winter having maximum of 31°C and minimum 9°C temperatures. The average rainfall of the area is 711 mm. Two different water sampling sites of the dam (Fig. 1a-c) have been selected for the present study i.e. (1) area near the main dam channel at waterfall of the dam (named as Site-I), and (2) opposite side of the dam channel located at Badi Ka Teela spot of the dam (named as Site-II). The local inhabitants use the dam water for bathing and washing of cloths and vehicles using detergents, shampoo, soap etc at Site-I. The funeral ash is also dropped into the dam water at Site-I. Land runoff also derives within the dam especially towards the Site-II during the rainy season. Besides this, the dam also has appreciable fish productivity potential of freshwater fishes for commercial purposes. The dam also attracts migratory birds. The data were interpreted with respect to three seasons i.e. winter season (November to February), summer season (March to June) and monsoon season (rainy season, July to October).

Collection, Observation and Identification of Samples. Temperature (air and water), water pH, TDS and relative humidity were recorded immediately after visit to the Mamchari dam. Algal water samples were collected during morning hours between 8 am to 10 am once in a last week of each month in the clean plastic bottles of one liter capacity. The bottles were properly washed with normal water followed by distilled water before sampling. The samples were collected from both the sampling sites (Site-I and Site-II) simultaneously for two years of investigation (February 2018 to January 2020). All the collected samples were brought to the laboratory for the identification of algal flora. The samples were first studied under the light microscope for morphological features of the algae. Color, size, shape of the cell, nature of the filament, branching pattern were recorded. Microphotographs of identified algal genera were taken with the help of a digital camera attached to the binocular microscope and analyzed with the D-Winter bio wizard software. Algal flora were identified up to species level with the help of the standard monographs, proceedings and various published research articles such as West and West (1904, 1905, 1912); Fritsch (1935), Randhawa (1934, 1936, 1943), Eddy (1934), Venkataraman (1939); Gonzalves and Gandhi (1952); Gandhi (1955); Desikachary (1959); Prescott (1954 and 1962); Philipose (1984); Round (1990); John and Whitton (2011); Sahu *et al.* (2013); Bellinger and Sigee (2015).

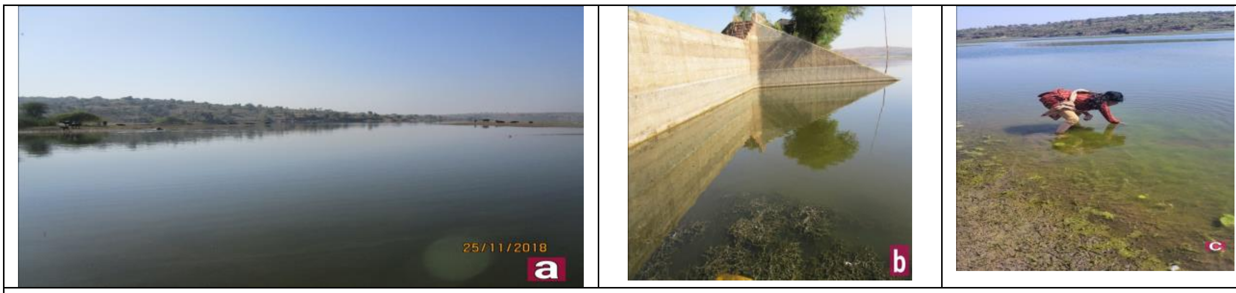


Fig. 1. Images showing an actual view of Mamchari dam: A Larger overview of the dam(a), Sampling Site-I (b) and Sampling Site-II (c).

Diversity Analysis. To analyze and evaluate the level of diversity from study area, the diversity indices such as Simpson's Diversity Index, Shannon's Wiener Index and Evenness were derived.

1. Simpson's Diversity Index (D) for species abundance
2. Shannon's Wiener Index (H) for species richness
3. Jacquard Evenness (EH) for measurement of evenness

The formulas are used as follows:

- Simpson's Diversity Index (D) $=1-\Sigma\, n(n-1)/N(N-1)$
- Shannon's Wiener Index $H = -\Sigma^{s}_{i} pi \ln pi$
- Evenness (EH) $= H / H_{max} = \ln(N)$

Where N =total number of individuals found
n =particular species found
pi= n/N

Palmer Pollution Index. Palmer (1969) prepared a list of genera and species of algae tolerant to organic pollution of freshwater. He developed pollution index based on the presence of algal species. The Palmer Algal Pollution Index was employed in the present study to measure the pollution level of each study area. Palmer (1969) has listed out twenty algal genera with ratings to evaluate the pollution level of the water bodies (Table 1). Presence of 50 or more individuals per milliliter may confirm the alga (Palmer, 1969). Based on the number of genera with their ratings the pollution levels were measured (Table 2).

Table 1: Palmer (1969) has listed out twenty algal genera with ratings.

Sr. No.	Genus	Pollution Index	Sr. No.	Genus	Pollution Index
1.	*Anacystis* (*Microcystis*)	1	11.	*Micractinium*	1
2.	*Ankistrodesmus*	2	12.	*Navicula*	3
3.	*Chlamydomonas*	4	13.	*Nitzschia*	3
4.	*Chlorella*	3	14.	*Oscillatoria*	4
5.	*Closterium*	1	15.	*Pandorina*	1
6.	*Cyclotella*	1	16.	*Phacus*	2
7.	*Euglena*	5	17.	*Phormidium*	1
8.	*Gomphonema*	1	18.	*Scenedesmus*	4
9.	*Lepocinclis*	1	19.	*Stigeoclonium*	2
10.	*Melosira*	1	20.	*Synedra*	2

Table 2: Palmer rating of pollution index.

Pollution Index	Status of Pollution
0-10	Lack organic pollution
<15	Light organic pollution
15 to 20	Organic pollution
>20	High organic pollution

RESULTS AND DISCUSSION

A total number of forty-two algal species belonging to four classes of algae namely Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae were recorded in Mamcharidam in district Karauli, Rajasthan (Table 3). Most abundant algal species from the study area was represented in Plate I. It has been reported that Cyanophyceae, Chlorophyceae, Bacillariophyceae, and Euglenophyceae were the four classes commonly found in most of the freshwater environments (Fritsch, 1935). Out of the eleven classes of algae, four are represented in the present study area. The order of dominance is a preliminary study on diversity and bio-monitoring of Mamchari dam with special reference to algae Chlorophyceae >Bacillariophyceae >Cyanophyceae >Euglenophyceae. Maximum representation was from the members of Chlorophyceae which had twenty three species accounting 55% of the total species. Class Bacillariophyceae was second dominant comprised of nine species forming 21% followed by Cyanophyceae representing eight species with 19% contribution. Two species belonging to class Euglenophyceae forming 5% were also reported from the study area (Fig. 2). The highest diversity of Chlorophycean algae directly related to good health of water (Descy, 1987). They play significant role in freshwater ecosystem as most of the members are found to be ecologically important. Further, the taxonomic categories from the study area were illustrated in Fig. 2. It exposes that the species of four classes includes eleven orders. They are Volvocales, Chlorococcales, Chetophorales, Oedogoniales, Conjugales and Charales of Chlorophyceae; Centrales and Pennales of Bacillariophyceae; Chroococcales and Nostocales of Cyanophyceae and Euglenales of Euglenophyceae.

Among that the members of Conjugales were found to be dominant as compared to other forms of green algae with 10 species followed by the order Pennales with 8 species. Members of Chlorophyceae and Bacillariophyceaeare considered fundamental in the food chain due to which they form direct or indirect food sources for various heterotrophic groups (Rao, 1975). The freshwater algal members of Chlorophyceae show an ability to tolerate a wide range of environmental conditions. They usually grow in mixed community and shows colonization. It has been studied that members of Chlorophyceae tend to be more abundant in nutrient-rich and standing water bodies (Singh and Kumar, 2017). Among the Chlorophycean members the genus *Spirogyra* was found dominant with 6species followed by *Pediastrum*, *Scenedesmus*, *Cosmarium* and *Oedogonium* each with 2 species (Fig. 4a). Chlorophycean species can be found mainly in unpolluted water (Bisht, 1993). Similarly, in class Bacillariophyceae genus *Navicula*, *Pinnularia* and *Synedra* were found with 2 species. Rest of the genera from the class Bacillariophyceae was recorded with single species each (Fig. 4b). Venkataraman (1939) gave a systematic account of South Indian diatoms. Bakthavachalam and Gifty (2020) estimated cosmopolitan and pollution tolerant species such as *Diadesmus*, *Nitzschia*, *Pinnularia*, *Gomphonema*, *Encyonema*, *Eunotia*, *Ulnaria* etc. from the world heritage Mamallapuram region. They also explain that these species can be used as pollution indicators to monitor and evaluate the lotic and lentic water bodies in India.

Diatoms are primary producers which play a major role in aquatic ecosystems and contribute to about a quarter of global primary production and 43% of primary production in the oceans (Treguer *et al.*, 1995); biochemical cycling and global fixed Carbon (Willey *et al*., 2008); oxygen-evolving organisms (Meena, 2022). Biological monitors such as diatoms, reflect the overall ecological integrity by combining various stressors, thus providing a broad measure of their synergistic impacts Grover *et al.* (2017). Many of the blue-green algae species are capable of living in the soil and other terrestrial habitats, where they play an important role in the functional processes of ecosystems (Whitton, 1992). Cyanophyceae are most abundant in habitats rich in organic matter such as polluted lakes, rivers, and shallow bodies of water (Seeta *et al.*, 2022). Genera such as *Microcystis*, *Oscillatoria*, *Lyngbya*, *Nostoc*, *Anabena* and *Spirulina* were reported from class Cyanophyceae (Fig. 4c), whereas two species including *Euglena gracilis* and *Phacus curvicauda* were reported from class Euglenophyceae. Gopinath and Kumar (2015) documented species diversity of euglenoids in Vellayani Lake of Thiruvananthapuram district, Kerala. Biological indices are a useful way to summarize data even for the people with little biological information and expertise (Norris, 1995).

In the present study, the value of Simpson's Diversity Index is 0.974 at Site-I and 0.957 at Site-II. The results showed that the study area has greater level of diversity (Fig. 5). Shannon's Wiener Index is calculated to find out the species richness and species evenness as overall index of diversity. The value of Shannon's Wiener index also ranges between 0-3.5. It is noted that higher the value greater the species diversity. In this study, the Shannon Wiener Index and evenness index of Site-I and Site-II is sequentially (3.073, 3.2) and (0.408, 0.439), respectively, were derived (Fig. 5). The present study reveals that diversity indices such as Simpson, Shannon-Wiener and Evenness showed moderate level of species abundance, richness and evenness in study area. The seasonal variation (summer, monsoon and winter) of algae recognized from the study area was given in Table 3. The maximum number of 27 species were reported during summer season at Site-I (March 2018 to June 2018), while at the Site-II, maximum 19 species were found in winter season(November 2019 to February 2020). Further, Chlorophyceae, Bacillariophyceae, Euglenophyceae and Cyanophyceae were recorded in summer, monsoon and winter season, whereas class Euglenophyceae was not reported in Monsoon season and at Site-II. Whole the season was dominated by class Chlorophyceae (Figs. 6a-c and 7a-c) both of the Site-I and Site-II. Similarly, the dominance of Chlorophycean algae during summer season was previously reported by Raghavendra *et al.* (2015) and monsoon season by Shakila and Natarajan (2012). Chlorophycean algae improve water quality and influence biodiversity of aquatic ecosystems (Cardinale, 2011). A total number of twelve pollution tolerant genera were reported from the study area. They are *Chlorella*, *Chlamydomonas*, *Closterium*, *Scenedesmus*, *Cyclotella*, *Synedra*, *Navicula*, *Nitzschia*, *Euglena*, *Phacus*, *Microcystis* and *Oscillatoria.* Same dominant pollution indicating algal species were observed in two Prrenial Lake of Coimbatore district Tamil Nadu (Bala and Piryadarshinee 2023). The seasonal-wise Palmer's Pollution Index of the study area is given in Table 4. It is illuminated that the maximum pollution index of the study area was reported during summer season. Further, it indicates the study area was found high organic pollution during summer season at Site-I while organic pollution at the Site-II while rest season during monsoon and winter lack organic pollution. Precisely, high organic pollution during summer season was reported in Putetenahlli Lake, Bengaluru, India (Veenashree *et al.*, 2022). The increase of organic pollution during summer and winter season at Site-I is due to high anthropogenic activities including cleaning of heavy vehicles, runoff, bathing washing and fish culture. Bio-monitoring is considered to be a key process that employs biological indicators to survey the ecological health of the habitat (Rosenberg and Resh 1993). The number of species recorded from the present study area indicated the algal wealthiest and quality of the habitat. Moreover, studies on biodiversity and its pattern, provides us an opportunity to know the different species in their natural habitat. These studies give a wide scope for the choice of other potential species which are available in plenty.

Table 3: Diversity of algal species at Site-I and Site-II with seasonal variation in Mamchari dam, district Karauli (Rajasthan) during the study period (February 2018 to January 2020).

Sr. No.	Algal flora	Site-I			Site-II		
		Summer	Monsoon	Winter	Summer	Monsoon	Winter
	Class Chlorophyceae						
1.	*Chlorococcum* sp.	+	+	+	-	-	-
2.	*Chlorella vulgaris*	+	-	+	+	+	+
3.	*Pediastrum duplex*	+	-	-	-	-	-
4.	*P. sculptatum*	+	-	-	-	-	-
5.	*Scenedesmus acutus*	-	-	-	+	-	+
6.	*S. aristatus*	-	-	-	+	+	+
7.	*Chlamydomonas dinobryonis*	+	-	+	+	-	-
8.	*Volvox aureus*	-	-	-	-	-	-
9.	*Spirogyra borgeana*	+	-	+	-	-	-
10.	*S. chenii*	+	-	+	-	-	-
11.	*S. dentireticulata*	+	-	+	-	-	-
12.	*S. hyalina*	-	-	-	+	-	+
13.	*S. neglecta*	-	-	-	+	-	+
14.	*S. willei*	-	-	-	+	-	+
15.	*Zygnema oudhense*	+	-	+	-	-	-
16.	*Cosmarium botrytis*	-	+	-	-	-	-
17.	*C. granatum*	-	+	-	-	-	-
18.	*Closterium acerosum*	+	-	-	+	-	+
19.	*Coleocheat nitellarum*	+	+	+	+	-	+
20.	*Oedogonium angustissimum*	+	-	+	+	+	+
21.	*O. smithi*	+	-	+	+	+	+
22.	*Chara braunii*	+	-	-	-	-	-
23.	*Nitella hyallna*	+	-	-	-	-	-
	No. of species present	**15**	**4**	**10**	**11**	**4**	**10**
	Class Bacillariophyceae						
24.	*Cyclotella meneghiniana*	-	-	+	-	-	+
25.	*Naviculacuspidata*	-	+	-	-	-	-
26.	*N. gracilis*	-	+	-	-	-	-
27.	*Nitzschiapalae*	+	-	+	-	-	+
28.	*Pinnularia biceps*	+	+	+	+	-	+
29.	*P. viridish*	+	+	+	-	-	-
30.	*Synedra ulna*	-	-	+	-	-	-
31.	*S. acus*	-	-	+	-	-	+
32.	*Cymbella turgida*	+	-	+	+	-	+
	No. of species present	**4**	**4**	**7**	**2**	**1**	**5**
	Class Euglenophyceae						
33.	*Euglena gracilis*	+	-	-	-	-	-
34.	*Phacus curvicauda*	+	-	+	-	-	-
	No. of species present	**2**	**-**	**1**	**-**	**-**	**-**
	Class Cyanophyceae						
35.	*Microcystis aeruginosa*	+	-	-	-	-	-
36.	*Oscillatoria limosa*	+	-	-	-	-	-
37.	*O. princeps*	+	-	+	+	-	+
38.	*Lyngbya wollei*	+	-	-	+	-	-
39.	*L. major*	+	-	-	+	-	+
40.	*Nostoc commune*	+	+	-	+	+	-
41.	*Anabaena* sp.	-	-	-	-	+	+
42.	*Spirulina meneghiniana*	-	-	-	-	+	+
	No. of species present	**6**	**1**	**1**	**5**	**3**	**4**
	Total species among the four classes	**27**	**9**	**19**	**18**	**8**	**19**

Table 4: Palmer's genus Pollution Index of the Mamchari dam.

Summer			Monsoon			Winter		
Genus	Palmer's Pollution Index		Genus	Palmer's Pollution Index		Genus	Palmer's Pollution Index	
	Site-I	Site- II		Site-I	Site- II		Site-I	Site- II
Chlorella	3	-	*Closterium*	-	1	*Chlorella*	3	-
Scenedesmus	-	4	*Cyclotella*	1	-	*Scenedesmus*	-	4
Chlamydomonas	3	3	*Navicula*	3	-	*Chlamydomonas*	3	-
Closterium	1	1				*Phacus*	2	-
Euglena	5	-				*Oscillatoria*	4	-
Phacus	2	-				*Cyclotella*	-	1
Microcystis	1							
Oscillatoria	4	-				*Nitzschia*	3	3
Nitzschia	3	-				*Synedra*	2	-
Total	**22**	**8**	**Total**	**4**	**1**	**Total**	**17**	**8**

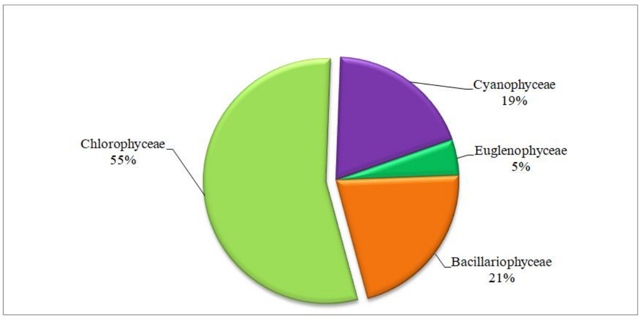


Fig. 2. Class wise distribution of algae.

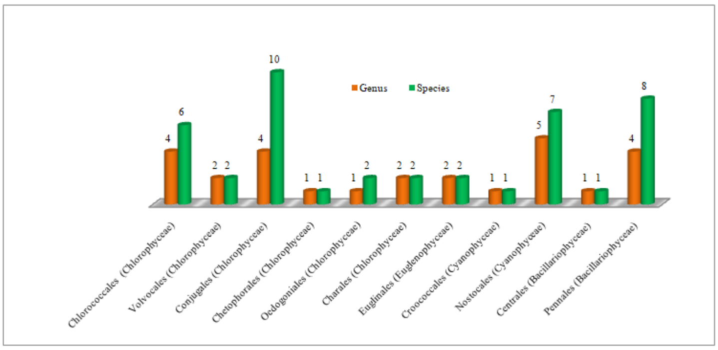


Fig. 3. Order wise taxonomic categorization of algae.

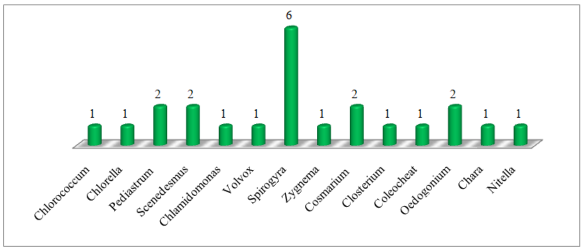


Fig. 4a. *Chlorophyceae.*

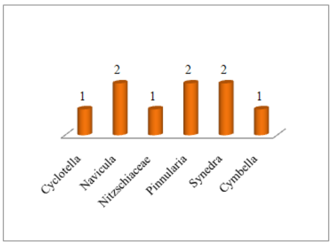


Fig. 4b. *Bacillariphyceae.*

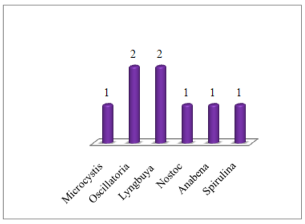


Fig. 4c. *Cyanophyceae.*

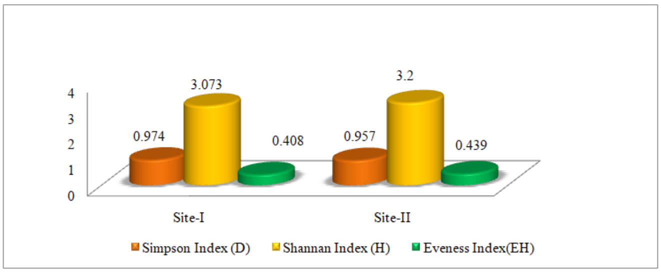
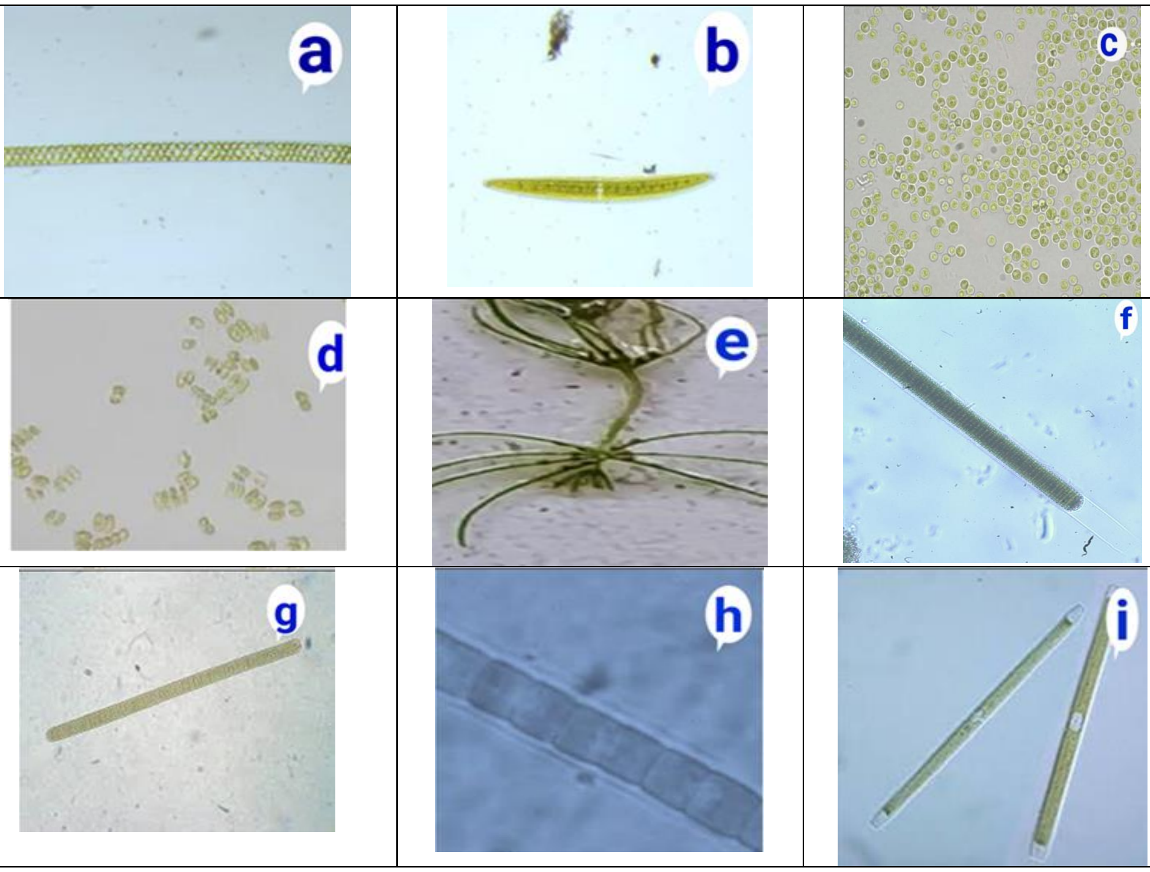


Fig. 5. Diversity Index of Mamchari dam.



(a) *Spirogyra*, (b) *Closterium*, (c) *Chlorella*, (d) *Scenedesmus*, (e) *Chara*, (f) *Lyngbya*, (g) *Oscillatoria*, (h) *Nostoc*, (i) *Synedra*

Plate I. Most abudent algal froms found in Mamchari dam.

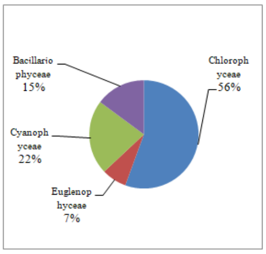


Fig. 6a. Summer Season.

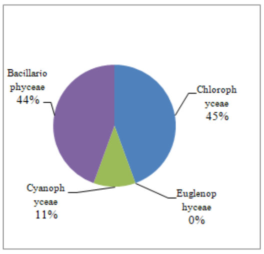


Fig. 6b. Monsoon Season.

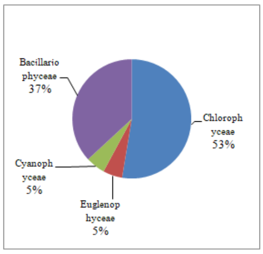


Fig. 6c. Winter Season.

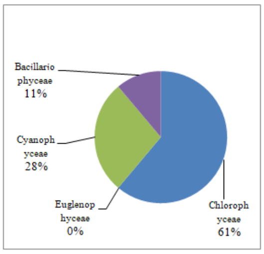


Fig. 7a. Summer Season.

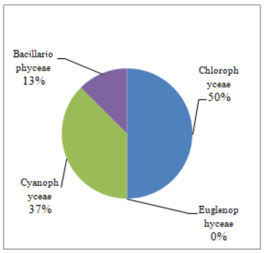


Fig. 7b. Monsoon Season.

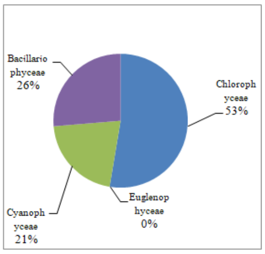


Fig. 7c. Winter Season.

Fig. 6 and 7. Show seasonal variation of algal flora at Site-I (6a-c) and Site- II (7a-c) in Manchuria dam.

CONCLUSIONS

In the present investigation, the study on the algal diversity of Mamchari dam, a freshwater dam, situated in Karauli district (Rajasthan) was explored for the first time. The investigation resulted in a total of forty-two species belonging to twenty-seven genera and four classes of freshwater algal flora was recognized during the study period. The study was conducted to explore the diversity of algae along with seasonal variation and bio-monitoring status of the study area. The seasonality studies shows that 25, 9, 19 species and 18, 8, 19 species were reported during summer, monsoon and winter season at Site-I and Site-II, respectively. A total number of twelve pollution-tolerant genera were reported from the study area. The Palmer Pollution Index 22, 4, 17 at Site-I and 8, 1, 8 at Site-II was calculated during summer, monsoon and winter season, respectively. Further, it indicates the study area was found high organic pollution during summer season, organic pollution during winter season and lack organic pollution in monsoon season at the Site-I. Besides, at the Site-II all three season found lack organic pollution. This increase of organic pollution is due to anthropogenic activities at Site-I. Thus, if water bodies are to be preserved for their intended use, one should protect their biota and maintain a sustainable and holistic approach to conserve such water systems. Scientists, environmentalists, local inhabitants and youth need joint efforts to protect water quality and biodiversity of this precious dam system. Regular monitoring of freshwater ecosystems, documentation of algal flora and study of their utility is encouraging area for future research. Effective methods to be adopt for Karauli founded on algal flora usefulness. Future scope of this study takes in the direction of:

- Phytoremediation
- Fish culture
- Algal farming for food resource

Acknowledgements. The first author is express sincere thanks to Dr. Shyam S. Sharma, Department of Botany, Shri Agrasen PG Girls' College, Hindaun City (Rajasthan) and Dr. Lakhpat Meena, Department of Botany, Government PG College, Sawai Madhopur (Rajasthan) for valuable suggestions and identification of algal flora. Author is also highly thankful to Mr. CP Meena, Assistant Professor, Department of Horticulture, SKRAU, Bikaner (Rajasthan) for data compilation and analysis.

Conflict of Interest. None.

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How to cite this article: Rameshi Meena and Vijendra K. Sharma (2023). Study on Diversity and Bio-Monitoring of Mamchari Dam in District Karauli (Rajasthan) India, with Special Reference to Algal Flora. *Biological Forum – An International Journal, 15*(5): 44-52.