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STUDY ON THE SEASONAL ALGAL DIVERSITY OF SHAHANOOR DAM, ANJANGAON SURJI, DISTRICT AMRAVATI (M.S.), INDIA

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ABSTRACT

Shahanoor Dam is an earth fill dam on Shahanoor river near Anjangaon Surji, Amravati district in the state of Maharashtra. Present study was planned in order to assess seasonal algal diversity. Overall 38 genera of algal group viz. chlorophyta, cyanophyta and bacillariophyta were recorded from dam water during different seasons. Chlorophyta represents 14 genera in all seasons with maximum species (15) and density (43%) during winter season. The group cyanophyta was reported with 9 genera and characterized by the presence maximum algal species (11) and density (42%) during winter season. Bacillariophyta was reported with 15 genera altogether during different seasons with 14 species and density (41%) during winter season. Shannon-Wiener diversity index was applied to calculate seasonal algal diversity revealed maximum index value (1.09) during summer followed by winter (1.08) and rainy (1.07) seasons. However more number (40) of species was recorded in winter than other seasons. Overall dam water showed characteristically significant algal diversity during all seasons. Dominance of chlorophyta and bacillariophyta during winter season indicates purity and fresh environment of water with poor ionic status. However on the other hand dominance of algal group cyanophyta during winter points out water quality mainly affected by alkalinity, total dissolved solids and hardnesss which might be contributed due to hydrology and geology of the region.

KEYWORDS: *Shahanoor dam, Seasonal, Algal diversity, Shannon-Wiener Index.*

1. INTRODUCTION

Algal community is considered as the most sensitive to the water pollution, indicates any undesirable changes in aquatic environment which leads to the decline in diversity as well as biomass of the community. Therefore the measurement of their diversity in different climatic conditions, seasons can be helpful in understanding possible causes with respect to conservation at different trophic levels and proper management

of water quality scenario of dam water. It has been stated that the study of phytoplankton diversity can be useful in overall estimation of nature and general economic potential of water body (Pawar et al., 2006).The deterioration of dam water quality in catchment area contributed largely by the use of fertilizers, agrochemicals (Kremser & Schnug, 2002; Jimoh et al., 2003), anthropogenic activities and causes water pollution which in turn affects the diversity of algal community (Lal,1984; Akhtar et al.,2007) of lakes and reservoirs. In recent years many reports and studies on algal diversity of dams / reservoirs of Maharashtra were presented (Mahajan,2012; Mahadik & Jadhav, 2014; Kadam et al.,2014; Patil,2015 and Narwade, et al.,2015). Hence an attempt is made in present investigation on the seasonal status of algal diversity of Shahanoor dam.

2. MATERIAL AND METHODS

2.1 Sampling site

Shahanoor Dam, is an earth fill dam on Shahanoor river near Anjangaon Surji, Amravati district in the state of Maharashtra between the coordinates 21.2580714°N to 77.3229682°E and is built in the year 1990 by Govt. of Maharashtra, India. It mainly impounds the water of Shahanoor river, a right bank tributary of Purna river in Tapi basin with height 57.81 m (189.7 ft.) , length of about 828 m (2717 ft) and volume 3,446 km^3 (827 cubic meters). It covers total surface area 2970 km^2 (1150 square meter) with total capacity of water reservoir 46,040 km^3 (11,050 cubic meter). The dam water is mainly used for irrigation and water supply for various domestic purposes (https://en.wikipedia.org).

2.2 Survey of dam and collection of algal samples.

A survey of Shahanoor dam was conducted on all directions of catchment area in summer, rainy and winter seasons for algal collection. During algal collection notes were made on visible algal growth along with descriptions on each collection site followed by collection of macroscopic and microscopic (water sample) forms in glass bottles for estimation of abundance and taxonomic analyses in laboratory.

2.3 Taxonomical analyses

Sub-sample of each macroscopic and microscopic form was added to 100 ml of water and homogenized with the help of handheld blender for 15s. Then the obtained homogenate was preserved in Lugols iodine and stored in temperature controlled incubator for establishing taxonomic composition and the relative abundance of algal taxa present. Determination of relative abundance were made by preparing one to three slides of homogenate and counting over 300 algal units (individual algal cells or a fragment) at magnification of 400-1000X with the help of microscope (Olympus BX50) for identifications and an Olympus Camedia C5060 Wide Zoom digital camera for photographic records. Identifications were made by using appropriate literature on chlorophyta, cyanophyta and bacillariophyta (Desikachary 1959, Gandhi 1998; Prescott 1982; Anand 1998; Hustedt 1930; Guiry, and Guiry 2014.)

2.4 Calculation of Shannon-Wiener Index (H')

Shannon – Wiener index is most commonly used index in ecological studies for comparing diversity between various habitats (Clarke and Warwick 2001).Shannon –Weiner index is given by the following formula

$$\mathbf{H'} = -\sum\left[\left(\frac{ni}{N}\right) \times ln\left(\frac{ni}{N}\right)\right]$$

Where,

ni= number of individuals or amount (e.g. biomass) of each species (the i^{th} species)

N= total number of individuals (or amount) for the site,
ln = the natural log of the number.

From the data set of seasonally obtained values of algal taxa the Shannon –Weiner index for different seasons was calculated by using above mentioned formula.

3. RESULTS

Overall 38 genera of algal group viz. chlorophyta, cyanophyta and bacillariophyta were recorded from dam water during different seasons. The seasonal distribution, density along with species of each group is clear from the Table 1, 2, 3 and figures 1, 2, 3 and 4.

3.1 Chlorophyta

During different seasons about 14 genera represents the group chlorophyta. Rainy season characterized by the presence of 5 genera and 8 algal species *Closterium sp., Coelastrum microsporum, Spirogyra notabilis, Spirogyra borgeana, Spirogyra condensata, Oedogonium sp., Scenedesmus bijugatus* and *Scenedesmus quadricauda* while summer season with 11 genera and 12 species *Chlorococcum sp., Pediastrum duplex , Chlorella vulgaris Closterium sp., Pithophora sp. Spirogyra borgeana, Oedogonium sp., Scenedesmus bijugatus, Scenedesmus quadricauda, Stigeoclonium tenue, Chara zeylanica,* and *Nitella furcata.* Among seasons only winter season shows maximum ie 12 genera and 15 algal species *Chlorococcum sp., Chlorella vulgaris Closterium sp., Coelastrum microsporum, Cosmarium subalatum, Pithophora sp., Spirogyra notabilis , Spirogyra borgeana, Spirogyra condensata, Scenedesmus bijugatus, Scenedesmus quadricauda, Zygnema fanicum , Stigeoclonium tenue, Chara zeylanica,* and *Nitella furcata.* Maximum algal density of chlorophyta was reported during winter (43%) followed by summer (34%) and least (23%) during rainy season (Table 1, Fig.1 & 4)

Table 1: Seasonal density and diversity of Chlorophyta.

Sr.No.	Algal group	Seasons		
I	Chlorophyta	Rainy	Summer	Winter
		No.of cells in water (No./L)		
1	*Chlorococcum sp.*	-	4	5
2	*Pediastrum duplex*	-	3	-
3	*Chlorella vulgaris*	-	8	4
4	*Closterium sp.*	2	6	4
5	*Coelastrum microsporum*	4	-	6
6	*Cosmarium subalatum*	-	-	5
7	*Pithophora sp.*	-	3	4
8	*Spirogyra notabilis*	1	-	3
9	*Spirogyra borgeana*	3	5	7
10	*Spirogyra condensata*	1	-	6
11	*Oedogonium sp.*	3	5	-
12	*Scenedesmus bijugatus*	2	6	4
13	*Scenedesmus quadricauda*	2	5	3
14	*Zygnema fanicum*	-	-	4
15	*Stigeoclonium tenue*	-	1	3
16	*Chara zeylanica*	-	4	5

17	*Nitella furcata*	-	3	4
	Total density	**18**	**53**	**64**
	No.of Species	**8**	**12**	**15**

3.2 Cyanophyta

The group cyanophyta was reported with 9 genera during different seasons. Rainy season characterized by the presence of 5 genera and 5 algal species *Nostoc muscorum, Chroococcus cohaerens, Microcystis aeroginosa, Oscillatoria subbrevis, Phormidium sp.* whereas summer season with 7 genera and 10 species *Chroococcus cohaerens, Chroococcus turgidus , Lyngbya majuscule, Microcystis aeroginosa, Merismopedia punctata,Oscillatoria subbrevis, Oscillatoria ornate , Oscillatoria vaucher Phormidium sp. Spirulina sp.*and winter season with 8 genera and 11 species *Chroococcus cohaerens, Chroococcus turgidus , Lyngbya majuscule, Microcystis aeroginosa, Merismopedia punctata,Oscillatoria subbrevis, Oscillatoria ornate , Oscillatoria vaucher Phormidium sp. Scytonema iyengari* and *Spirulina sp.* Winter season was reported with maximum algal density (42%) followed by summer (39%) and least (19%) during rainy season (Table 2, Fig.2 & 4)

Table 2: Seasonal density and diversity of Cyanophyta.

Sr.No.	Algal group	Seasons		
II	Cyanophyta	Rainy	Summer	Winter
		No.of cells in water (No./L)		
1	*Nostoc muscorum*	6	-	-
2	*Chroococcus cohaerens*	2	7	3
3	*Chroococcus turgidus*	-	5	4
4	*Lyngbya majuscula*	-	6	6
5	*Microcystis aeroginosa*	3	2	8
6	*Merismopedia punctata.*	-	6	2
7	*Oscillatoria subbrevis*	2	6	3
8	*Oscillatoria ornate*	-	9	2
9	*Oscillatoria vaucher*	-	4	1
10	*Phormidium sp.*	3	8	7
11	*Scytonema iyengari*	-	-	3
12	*Spirulina sp.*	-	8	4
	Total density	**16**	**61**	**41**
	No.of Species	**5**	**10**	**11**

3.3 Bacillariophyta

The group bacillariophyta was reported with 15 genera altogether during different seasons. Among seasons rainy season characterized by the presence of 8 genera and 8 algal species *Bacillaria paradoxa, Cocconeis sp., Cymbella amphicephala, Fragilaria construence, Gomphonema sp., Naviculla hustedtii, Nitzschia intermedia* and *Pinnularia amanuensis* whereas summer season with 11 genera and 12 species *Amphora ovalis , Cocconeis sp., Diploneis suovalis , Epithemia sp.,Fragilaria construence, Gyrosigma scalproides, Gomphonema sp., Naviculla hustedtii, Nitzschia intermedia , Pinnularia amanuensis, Synedra acus* and *Synedra ulna* and winter season with 13 genera and 14 species *Amphora ovalis , Bacillaria paradoxa, Cocconeis sp., Cymbella amphicephala*, *Diploneis suovalis , Epithemia sp.,Fragilaria construence, Gyrosigma scalproides, Mastogloia*

amoyensis, Naviculla hustedtii, Surirella linearis, *Pinnularia amanuensis, Synedra acus* and *Synedra ulna.* Maximum algal density was reported during winter (41%) followed by summer (35%) and least (24%) during rainy season (Table 3, Fig.3 & 4).

Table 3: Seasonal density and diversity of Bacillariophyta.

Sr.No.	Algal group	Seasons		
III	Bacillariophyta	Rainy	Summer	Winter
		No.of cells in water (No./L)		
1	*Amphora ovalis*	-	3	5
2	*Bacillaria paradoxa*	4	-	8
3	*Cocconeis sp.*	2	2	4
4	*Cymbella amphicephala*	1	-	5
5	*Diploneis suovalis*	-	2	2
6	*Epithemia sp.*	-	3	6
7	*Fragilaria construence*	2	4	3
8	*Gyrosigma scalproides*	-	3	2
9	*Mastogloia amoyensis*	-	-	3
10	*Gomphonema sp.*	5	7	-
11	*Naviculla hustedtii*	4	8	5
12	*Nitzschia intermedia*	8	2	-
13	*Surirella linearis*	-	-	6
14	*Pinnularia amanuensis*	2	5	7
15	*Synedra acus*	-	3	3
16	*Synedra ulna*	-	4	2
	Total density	**28**	**46**	**56**
	No.of Species	**8**	**12**	**14**

Fig.1:Chlorophyceae

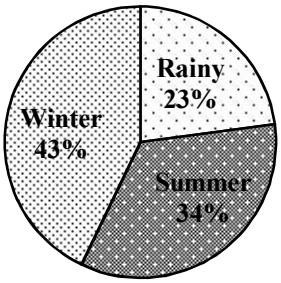
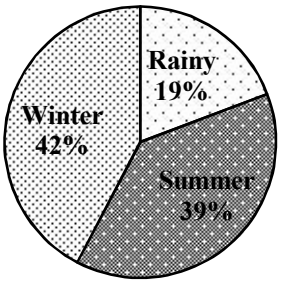
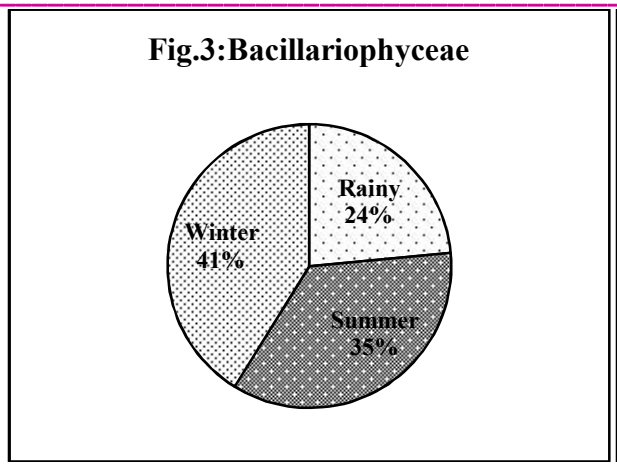
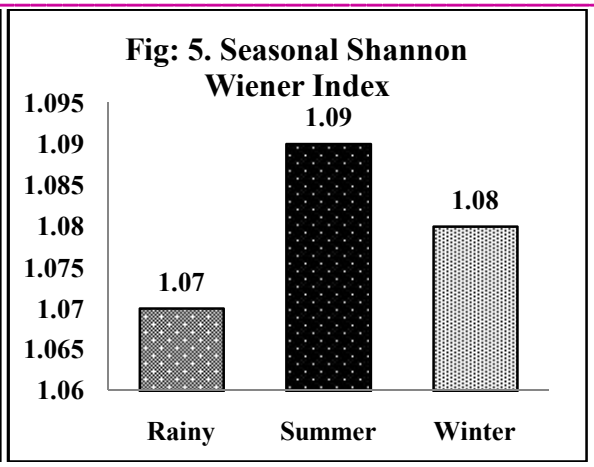


Fig.2:Cyanophyceae

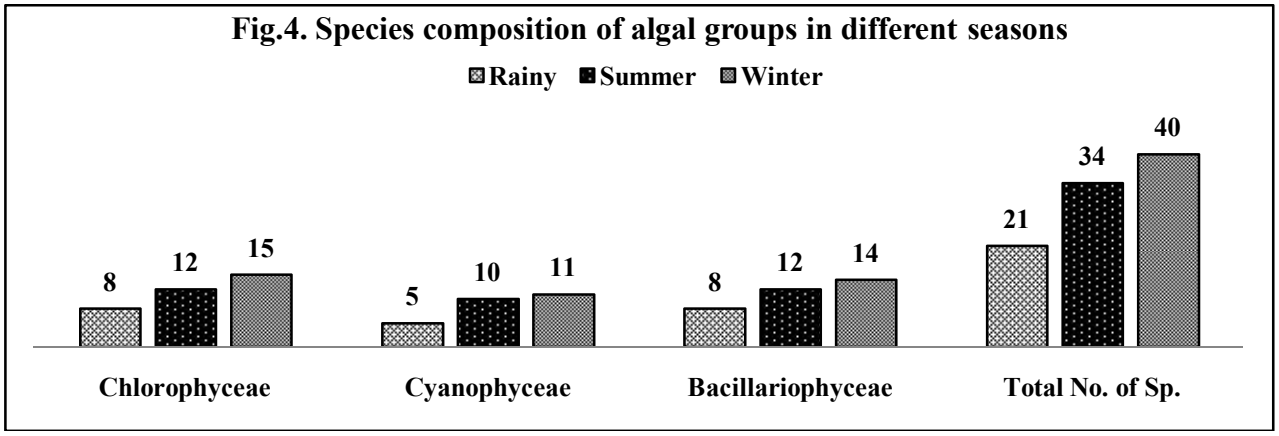






3.4 Seasonal Diversity

Seasonal variations in diversity of algal species in dam water were calculated by means of Shannon-Wiener diversity index. Variations in diversity were visible during all the three seasons. The calculated Shannon – Wiener diversity Index values 1.07, 1.09, and 1.08 were recorded during rainy, summer and winter season respectively. Among seasons summer season reported with maximum value of diversity index followed by winter and rainy season (Fig.5).



Species diversity during all seasons was recorded from dam water belonging to 3 major groups Cyanophyta, Chlorophyta and Bacillariophyta (Fig. 4). Chlorophyta emerged as the main dominating algal group with maximum number of species during all seasons as compared with other groups. Bacillariophyta remained second in position followed by cyanophyta with less number of species during all seasons. However winter season reported with maximum number of species followed by summer and less in rainy season.

4. DISCUSSION

Overall results of present study reveals that algal diversity seems to be pronounced more in winter season than summer and rainy season. Winter season also characterized by the presence of more number of species and density of algal groups viz. chlorophyta, bacillariophyta and cyanophyta in dam water. These seasonal variations in algal diversity might be due to seasonal changes during a course of time and the response

of algal species to the seasonally changing factors like light, temperature, nutrients and grazing pressure (Agrawal, 1999) in the dam water. Algal species contributes an important role in food chain and its productivity directly affected by the quality of water body at given time (Meshram and Dhande, 2000). The dominance of algal species during winter might be attributed to the low water temperature, dissolved oxygen, pH, low turbidity, low conductivity and nutrient status (Rajagopal *et al*., 2010, Rao and Pragada, 2010 ; Panigrahi and Patra , 2013; Verma *et al*., 2014). Since the winter season is characterized in maintaining the algal diversity at its peak rather than other season with respect to the species composition and density could be due to less metabolic activities and organic decomposition in dam water results in less water pollution which increases the suitability of habitat for the most dominant algal group like chlorophyta as reported by Descy (1987) for its indication of purity of water body. Also the second dominant algal group bacillariophyta characteristically points out fresh water environment with poor ionic status (Kadiri, 2006) during winter season. However the dominance of algal group cyanophyta during winter and summer provides a scope to establish connection of water quality mainly affected by alkalinity, total dissolved solids and hardnesss with its diversity during these seasons which finds correlation with earlier reports and findings on water quality and geology of the region (MPCB, 2015-16; Tiwary et al. 1995; Tiwary and Dhar, 1994) where Shahanoor dam is located.

5. CONCLUSION

Based on the findings of seasonal algal diversity of Shahanoor dam it can be concluded that the dam water is significantly characterized by the presence of three major algal groups viz. chlorophyta, bacillariophyta and cyanophyta during rainy, summer and winter season. Among all seasons studied only winter season revealed with maximum diversity, density and species composition of algal groups and were attributed to the seasonal changes in water quality with respect to the factors like low turbidity, low temperature, pH, dissolved oxygen and nutrient status. Dominance of chlorophyta and bacillariophyta during winter season indicates purity and fresh environment of water with poor ionic status. However on the other hand dominance of algal group cyanophyta during winter points out water quality mainly affected by alkalinity, total dissolved solids and hardnesss which might be contributed due to hydrology and geology of the region.

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