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Diversity indices of phytoplankton at Munj sagar talab (Dhar, Madhya pradesh, India).

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Abstract

Phytoplankton is the significant formal natural occupier of all water bodies. They play an important role in the biosynthesis of organic material. Being an index of trophic status phytoplankton reflects the overall environmental condition of the system and its potentiality. Present investigation was carried out for a period of twenty four month to study the diversity indices. Simpson's Index of Dominance ranged from 0.0441 to 0.0952. Shannon-Wiener Diversity (H) index ranged from 2.6298 to 3.2112.273. Evenness Index ranged from 0.5593 to 0.9808 during the study period. Keywords: Diversity index, Evenness Index (J), Shannon and Weaver diversity index (H), Simpson's Index of Dominance (D) and phytoplankton,

Keywords: *Diversity, phytoplankton, dominance, Simpson's index*

Introduction

Plankton are minute organism and are effective tools in environmental bio monitoring of aquatic system. They are essential link in food chain. Phytoplanktons are the significant formal natural occupier of all water bodies. They play an important role in the biosynthesis of organic material. Being an index of trophic status phytoplankton reflects the overall environmental condition of the system and its potentiality. Plankton population is directly or indirectly governs by the interaction of the number of physical, chemical and biological factors of the water body (Reid and Wood, 1976). Using the biological approaches to determine the ecological effects of pollution has been preferred widely for decades. These approaches have more advantages than determining the pollution with only using physico-chemical methods, because physicochemical variables give information about only the situation of water at the time of measuring (Rosenberg and Resh, 1993). Diversity index is a statistical method which is planned to evaluate the variety of a data group consisting of different types of components. Features of a population such as number of existing species (Richness), distribution of individuals equally (Evenness) and total number of existing individuals underlie the basis of diversity indices (Wilhm and Dorris, 1968, Allan, 1975). Thus, any changes in any of these three features will affect the whole population, so that the diversity indices depending upon these features are used effectively to determine the changes in a population (Mandaville, 2002, Dügel, 1995). The diversity index is a measure of the relationship between the number of species collected and the evenness of their distribution. Diversity index based on the Shannon-Wiener function of information theory, and describes the uncertainty of predicting the species of a randomly chosen individual from the community (Heister, 1972).There are three different levels of biological diversity ,first one is spices diversity which embraces the variety of living organism on earth, second is genetic diversity which is concerned with variation in genes with in a particular species and third one is ecological diversity which is related to variety habitat,(Salam and Rizvi,1999;Salam *et al*.,2000;Ali *et al*.,2005).

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Material and Method

Dhar is located in the Malwa region of Western Madhya Pradesh. The climate of Dhar is tropical and the month of November announces the winter and it continues until February. The summer season starts in mid March and continues through out the June. Munj Sagar is located in the district Dhar. It covers an area of about 49.596 h .The altitude of Munj Sagar Talab is 554m.In Year 2005 it was deepen by removing the bottom soil. This water body was basically constructed for drinking water purpose but now-days its water is mainly utilize for irrigation and fish culture purpose.

Munj Sagar talab has mainly three Pakka Ghats. These ghats were chosen as sampling station. First one is Ganesh Ghat (S1) geographically located at $22^0$36'13.55" North latitude and $75^0$17'54.25" East latitude. Second is Shankar Ghat (S2) geographically located at $22^0$36'05.28" North latitude and $75^0$17'59.66" East latitude and third is Chatri Ghat (S3) geographically located at $22^0$35'58.34" North latitude and $75^0$17'45.82" East latitude .These sampling stations named as S1, S2 and S3 during the course of study .

The samples were collected in the first week of every month from November 2006 to October 2008 between 7 to 9 a.m. Plankton sample were collected by filtering the 50 liters of water through a plankton net (No. 20).The counting of plankton was done with the help of a Sedgwick Rafter cell count of 1 ml capacity. All planktons were counted according to the procedure given by Welch (1952). The identification of phytoplankton was done by taking the help of standard books and publications. Phytoplanktons were identified up to genus in most cases by key given by Turner (1982), Smith (1950), Prescott (1962), Ward and Whipple (1959) and Ruttner-Kolisko (1974). The Shannon and weaver diversity index (H), Simpson's Index of Dominance (D) and Evenness Index (J).were calculated by diversity calculator software.

Result and Discussion

29 species of phytoplankton have been identified in Munj Sagar Talab. Phytoplankton group/class consists of Chlorophyceae (12), Bacillariophyceae (9), Cynophyceae (6), and Euglenophyceae (2).The Shannon-Weaver Index (H) for phytoplankton was always found above one at all the station during the study period of 24 months. The maximum observed value of H (3.2111) was at station S3 in the month of June 2008. While the minimum observed value of H (2.6298) was at Station S1 in the month of November 2006. The Simpson's diversity Index (D) for phytoplankton was always less than one. In the present study the maximum value of D (0.0952) was obtained at Station S1 in the month of August '07. The minimum value of D (0.0441) was obtained in month of May'07 at station S2 and April'08 at Station S1. The Evenness Index (J) for phytoplankton was always less than one. In the present study the maximum value of J (0.9808) was obtained in month of April'08 at station S2. The minimum value of J (0.8893) was obtained in the month of August'07 at station S2

The diversity index is a good tool for measuring the health of an ecosystem. It measures the stability of an ecosystem, which increases with its diversity. Shannon-Wiener Diversity index (H) greater than 3 indicates clean water, values in the range of 1-3 are characteristics of moderately polluted condition and values less than one characterize heavily polluted condition(Mason, 1981) Almost in all cases an increase in spices diversity is considered as an increase in ecological quality (Magurran,1996).

Staub *et al.* (1970) suggested another scale for categorizing the status for water body , if Shannon-Wiener Diversity index(H)ranging between 3.5 to 4.5 indicates slightly polluted water , values in the range of 2-3 are characteristics of light polluted condition, values in the range of 1-2 are characteristics of moderate polluted condition and values less than one characterize heavily polluted condition

In the present study the Shannon-Wiener Diversity index (H) for phytoplankton ranged from 2.629to 3.208 during the study period 2006 and 2007 and during the study period 2007-08 the diversity index ranged between 2.880 to 3.268.

Shannon-Wiener Diversity index (H) almost near to 3 for phytoplankton suggests that water is good for growth of phytoplankton in water body (Ali *et al.*, 2005). Theses value of Shannon-Wiener Diversity index (H) also indicates presence of longer food chain (Margalef, 1968) present study also indicates the same. In present study the Simpson Diversity index (D) for phytoplankton ranged from 0.0441to 0.0952 during the study period 2006 and 2007. During the study period 2007-08 the diversity ranged in-between 0.0403 to 0.0604.

Table-1: Monthly variations in diversity indices of phytoplankton at Munj sagar talab(2006-07)

MONTHS	STATION 1			STATION 2			STATION 3		
	Simpson Diversity Index(D)	Shannon-Wiener Diversity Index (H)	Evenness (J)	Simpson Diversity Index(D)	Shannon-Wiener Diversity Index (H)	Evenness (J)	Simpson Diversity Index(D)	Shannon-Wiener Diversity Index (H)	Evenness (J)
Nov 06	0.0502	3.0849	0.9707	0.0489	3.0967	0.9744	0.0578	2.9340	0.9637
Dec 06	0.0614	2.9583	0.9309	0.0592	2.9843	0.9390	0.0635	2.8814	0.9464
Jan 07	0.0803	2.7868	0.9016	0.0764	2.8003	0.9059	0.0549	3.0479	0.9469
Feb 07	0.0651	2.9082	0.9408	0.0593	2.9411	0.9515	0.0543	3.0759	0.9333
Mar 07	0.0513	3.1202	0.9577	0.0614	3.0060	0.9226	0.0497	3.0987	0.9627
Apr 07	0.0453	3.2086	0.9629	0.0493	3.1386	0.9523	0.0566	3.0260	0.9401
May 07	0.0449	3.2059	0.9621	0.0441	3.2142	0.9646	0.0453	3.1860	0.9667
Jun 07	0.0533	3.0928	0.9384	0.0619	2.9206	0.9449	0.0474	3.2037	0.9514
Jul 07	0.0618	2.9764	0.9247	0.0714	2.8869	0.9207	0.0461	3.1978	0.9597
Aug 07	0.0952	2.6298	0.8932	0.0887	2.7076	0.8893	0.0534	3.0155	0.9617
Sep 07	0.0593	2.8979	0.9674	0.0629	2.8726	0.9589	0.0529	3.1108	0.9439
Oct 07	0.0524	3.0300	0.9664	0.0621	2.9021	0.9532	0.0518	3.1090	0.9433

TABLE- 2: MONTHLY VARIATIONS IN DIVERSITY INDICES OF PHYTOPLANKTON AT MUNJ SAGAR TALAB(2007-08)

MONTH	STATION 1			STATION 2			STATION 3		
	Simpson Diversity Index(D)	Shannon-Wiener Diversity Index (H)	Evenness (J)	Simpson Diversity Index(D)	Shannon-Wiener Diversity Index (H)	Evenness (J)	Simpson Diversity Index(D)	Shannon-Wiener Diversity Index (H)	Evenness (J)
Nov 07	0.0609	2.9046	0.9540	0.0617	2.8957	0.9511	0.0597	2.9292	0.9621
Dec 07	0.0634	2.8800	0.9460	0.0546	2.8344	0.9461	0.0604	2.8948	0.9508
Jan 08	0.0627	2.9863	0.9166	0.0651	2.9906	0.9291	0.0628	3.1166	0.9456
Feb 08	0.0565	3.0624	0.9292	0.0601	3.0498	0.9475	0.0508	3.0188	0.9265
Mar 08	0.0548	3.0681	0.9417	0.0548	3.1063	0.9650	0.0457	3.1228	0.9585
Apr 08	0.0441	3.1121	0.9442	0.0484	3.2682	0.9808	0.0495	3.1661	0.9606
May 08	0.0513	3.2082	0.9527	0.0403	3.0715	0.9427	0.0474	3.1796	0.9647
Jun 08	0.0463	3.2058	0.9727	0.0446	3.2290	0.9589	0.0459	3.2111	0.9536
Jul 08	0.0489	3.1511	0.9457	0.0459	3.1966	0.9593	0.0481	3.1726	0.9521
Aug 08	0.0664	2.9203	0.9189	0.0575	2.9639	0.9589	0.0705	2.8930	0.9103
Sep 08	0.0581	3.0470	0.9245	0.0550	3.0670	0.9413	0.0593	3.0335	0.9204
Oct 08	0.0555	3.0763	0.9334	0.0529	3.0565	0.9617	0.0554	3.0697	0.9422

Theoretically Simpson Diversity index (D) varies between 0 to 1.0 and value more than 0.5 considered as a higher value. According to Dash (2003) mature and stable communities in general have high diversity value (0.6 to 0.9) and rare communities or unstable communities and communities under stress exhibiting low diversity, usually shows nearer to zero value. In light of these facts it can be concluded that the low value of Simpson Diversity index (D) in present study shows that species studied are under stress condition. According to Whittaker (1693) the value

of Simpson Diversity index (D) is always higher where the community is dominated by fewer numbers of spices and when the dominance is shared large number of species. This supports the results of present study.

In present investigation, during 2006-07 maximum and minimum degree of evenness (J) were (0.974) and (0.889) respectively for phytoplankton, while during 2007-08 these values were 0.980 (maximum) and 0.910 (minimum). Balloch (1976) and Suresh *et al*. (2009) reported high association of Shannon Wiener diversity index with high evenness index, reflecting the multi dominance pattern in cluster. Present study also shows same pattern in these two indices for phytoplankton. Present study indicates that, whenever diversity index (D) was higher the evenness index was lower and vice versa this finding is in agreement with the finding of Walting *et al.* (1979).

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