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Comparative diversity of freshwater phytoplankton in Mysore and Mandya districts Wet lands of Karnataka

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ABSTRACT

A comparative account of the diversity of freshwater phytoplankton from two districts of Karnataka (Mysuru-T. Narasipura; and Mandya-Srirangapatna Talukas) was carried out. Twenty one species appeared in T. Narasipura taluka and 15 species appeared in Srirangapatna Taluka. Anabaena macrospora and Chroococcus turgidus were abundant while Stauroneis phoenicenteron and Merismopedia tenuissima appeared at all sites of collections Shannon index showed variation to a certain extent while the other indices were not well marked. Blue green algae dominated in all the study sites. According to most limnologists species poor communities indicate adverse effects of pollution which in turn reduce the diversity of the habitat.

Key words: *Plankton, Diversity, Shannaon, Simpson, Dominance, Evenness*

INTRODUCTION

Phytoplankton has played an important role in the ecology of fresh water ecosystems. Anthropogenic activities in water bodies exert pressure on the diverse biota. Sometimes formation of algal blooms cause nuisance to people living around wetlands[4] states that richness of species can be used to detect disturbances in wetlands. A large number of wetland diversity studies have been conducted. Some of them include[1,3,5]. During an extensive study on the distribution of phytoplankton from different districts a large number of phytoplankton were recorded. This paper is an attempt to understand the biodiversity of phytoplankton in two districts of Karnataka. Species richness, species dominance and species evenness have been stressed. Srirangapatna taluka of Mandya district and T. Narasipura of Mysore district were chosen for the present study. Twelve sites in each of the talukas were sampled during the year 2014-2015 and their diversity discussed. A comparative account of the distribution of phytoplankton in the two districts has been discussed.

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MATERIALS AND METHODS

Study area

Map 1: Mysuru District

Map 2. Mandya Distric

Water samples for plankton analysis wer collected from 12 sites of Mandya District (Srirangapatna taluka). It is the southern part of Karnataka State it kies between $76^0$19′ and $77^0$22′ East Longitude and $12^0$13′ and $13^0$4′ North Latitude. The district is between 2500 through 3000 feet above MSL. It has large number of small and bigh water reservoirs in addition to the perennial river, Kavari that flows through the district.

Water samples for plankton analysis were collected from 12 sites of Mysore district (T. Narasipura taluk) lying in the Southern part of the state. The total area of the district is 5715 sq. Km. It is located between $11^0$30′ and $12^0$50′ North latitude and $75^0$45′ and $77^0$45′ East Longitude at a height of 250ft above MSL.The rivers Kapila and Kabani, Tributaries of the Cauvery flow through this district with a large number of channels creating many wetlands. (Map2)

Sampling and enumeration: Water samples for the enumeration of phytoplankton were collected from 12 sites in each of the talukas of the districts during 2014-15. Random sampling was done. The collection, preservation, identification and enumeration was done as per the methods described by Hosmani[6] and Bharathi and Lackey[8], Suxsena[15]. Identification was done by consulting monographs of algae[2,11,12,13,14]. Diversity indices were calculated by subjecting the data to PAST Software Program[4].

RESULTS AND DISCUSSION

The results of the distribution of plankton for Srirangapatana Taluka are presented in Table 1 and that for T. Narasipura taluka in Table 2. About 15 species appeared in water samples of Srirangapatna. Only one site showed the appearance of all 15 species. The number of sites having meagre number of plankton was high. *Anabaena macrospora, Chroococcus turrgidus* were the most abundant, while *Stauroenies phoenicenteron* appeared in all the 12 sites (Table 1). The number of species that appeared in T Narasipura samples was 21 with two sites having a fairly higher number of species. *Merismopedia tenuissim* appeared in all the 12 sites of collection (Table 2). The maximum count of phytoplankton in both the areas was as high as 28000 organisms/litre.

Table No.1 Phytoplankton population in Srirangapatna Tq. (2014-2015) (Organisms/liter)

Species	SRS1	SRS2	SRS3	SRS 4	SRS5	SRS 6	SRS 7	SRS 8	SRS9	SRS10	SRS 11	SRS12
Anabaena macrospora	0	14000	11200	5600	2800	12600	4200	5600	12600	14000	5600	1400
Chroococcusturgidus	4200	2800	2800	0	1400	2800	12600	8400	28000	4200	1400	0
Merismopediaglauca	0	9800	11200	0	0	7000	7000	1400	5600	4200	0	2800
Microcystiscrassa	2800	11200	8400	4200	7000	25200	28000	0	0	14000	5600	4200
Spirulinanordestedtii	0	1400	1400	0	0	2800	1680	0	0	1400	01600	1400
Dictyosperiumindicum	0	0	0	4200	2800	0	4200	5600	5600	2800	1400	0
Tetrastrumstaurogeniforme	0	0	0	1400	2800	1400	1400	1400	1400	0	1400	1400
Closteriumlunula	0	0	0	2800	1400	1400	1400	0	0	0	2800	1400
Pediastrum simplex	0	0	1400	4200	2800	0	2800	0	1400	2800	4200	1400
Scenedesmusquadricauda var. westeii	2800	4200	5600	5600	5600	0	4200	2800	1400	2800	0	4200
S. dimorphous	4200	0	4200	4200	4200	0	4200	4200	0	0	1400	0
Coelastrummicroporum	0	4200	0	12600	5600	0	1400	4200	5600	2800	1400	2800
Cyclotellaantiqua	0	0	0	1400	0	0	2800	8400	7000	7000	1400	4200
Melosiragranulata	4200	1400	0	2800	0	1400	7000	9800	9800	7000	2800	2800
Stauroneisamphicephala	12600	4200	2800	5600	12600	16800	16800	14000	15400	2800	14000	12600

Table No.2 phytoplankton Population in sites of T. Narsipura tq (2014-2015) (Organisms/liter)

Species	TNS1	TNS2	TNS3	TNS4	TNS 5	TNS6	TNS 7	TNS 8	TNS 9	TNS 10	TNS 11	TNS 12
Chroococcusdispersus	0	0	1400	0	2800	0	16800	2800	5600	12600	11200	7800
C. turgidus	0	2800	1400	0	8400	0	12600	11200	11200	14000	12600	12600
Merismopediatermissims	8400	8400	2800	7000	9800	5600	21000	16800	14000	15400	7000	2800
M. glauca	1400	0	1400	0	0	0	28000	23800	28000	28000	25200	28000
Oscillatoriaacutissima	0	0	0	0	0	1400	7000	1400	2800	1400	2800	2800
Microcystiscrassa	1400	0	1400	2800	4200	0	2800	5600	7000	7000	2800	2800
M. wesnbergii	0	0	1400	1400	2800	1400	1400	1400	0	0	0	0
Spirulinanordestedtii	0	0	0	0	0	0	1400	0	1400	1400	1400	1400
Tetrastrumstaurogeniaeforme	0	0	0	1400	2800	0	1400	1400	1400	2800	1400	1400
Cosmariumobtusatum	8400	2800	0	2800	1400	0	5600	0	0	0	0	0
C. ocellatum	8400	2800	0	2800	1400	5600	0	0	0	0	0	0
P. simplex	0	0	0	1400	1400	0	5600	0	5600	1400	2800	2800
P. tetras	0	0	0	0	0	1400	4200	2800	1400	2800	2800	1400
Scenedesmusquadricauda var. westeii	8400	9800	0	5600	5600	0	4200	1400	2800	5600	2800	2800
S. dimorphus	1400	2800	0	0	0	0	1400	1400	0	2800	2800	1400
Coelastrummicroporum	1400	1400	0	7000	0	4200	1400	1400	1400	2800	1400	1400
Nitzschiaamphibia	0	0	0	0	0	0	1400	0	2800	2800	2800	2800
Cyclotellaantiqua	0	0	0	0	1400	1400	0	1400	1400	1400	1400	2800
Synedraacus	11200	0	2800	4200	0	0	4200	1400	2800	2800	5600	1400
Stauroneisamphicephala	4200	0	4200	0	0	1400	0	4200	2800	1400	2800	1400
Amphora ovalis	1400	0	0	0	0	0	1400	2800	1400	2800	1400	0

Fig. 1: Srirangapatna

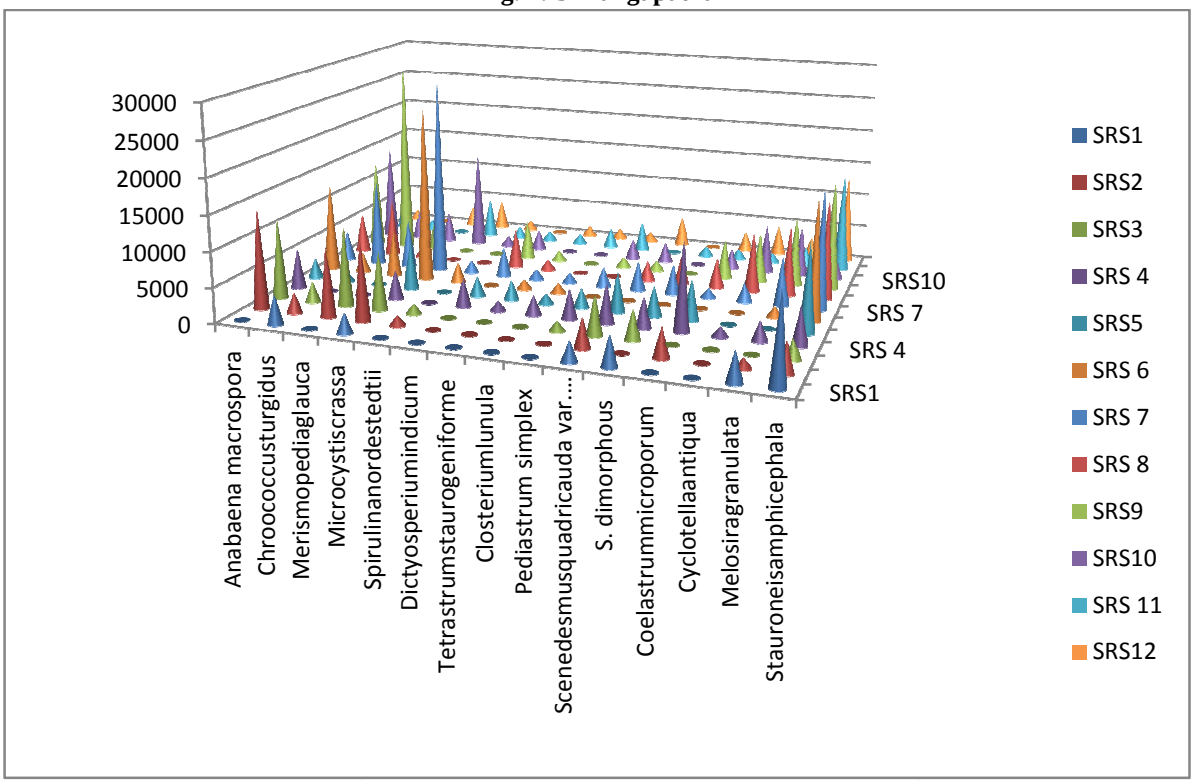


Fig. 2: T Narsipur

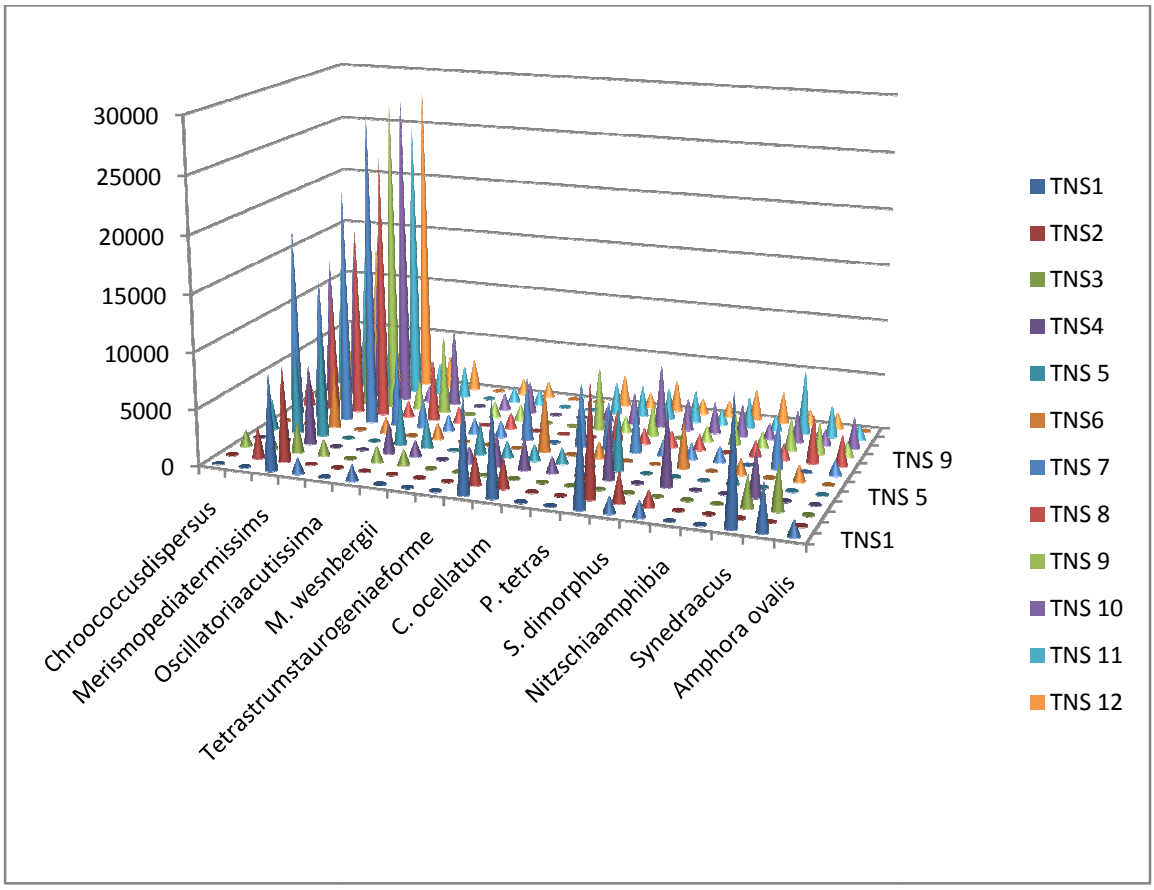


Table No 3. Diversity indices in the phytoplankton population of Srirangapatna tq taluk

	Srs1	Srs2	Srs3	Srs4	Srs51	Srs6	Srs7	Srs8	Srs9	Srs10	Srs11	Srs12
Taxa_S	12	13	14	7	8	14	10	11	8	17	13	14
Individuals	21^3	93^2	10^4	29^3	29^3	81^3	63^3	58^3	57^3	11^4	88^3	77^3
Dominance_D	0.1	0.1	0.12	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
Simpson_1-D	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8
Shannon_H	2.4	2.1	2.3	1.8	1.9	2.2	2.1	1.7	1.9	2.4	2.2	2.3
Evenness_e^H/S	0.9	0.6	0.7	0.8	0.8	0.7	0.8	0.5	0.8	0.6	0.7	0.7
Brillouin	2.3	2.1	2.3	1.8	1.9	2.2	2.1	1.7	1.9	2.4	2.2	2.3
Menhinick	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Margalef	1.1	1.0	1.1	0.5	0.6	1.1	0.8	0.9	0.6	1.3	1.0	1.1
Equitability_J	0.9	0.8	0.8	0.9	0.9	0.8	0.9	0.7	0.9	0.8	0.8	0.8
Fisher_alpha	1.2	1.1	1.2	0.6	0.7	1.2	0.9	1.0	0.7	1.5	1.1	1.2
Berger-Parker	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.4	0.1	0.2	0.1	0.2

Fig. 3: Srirangapatna

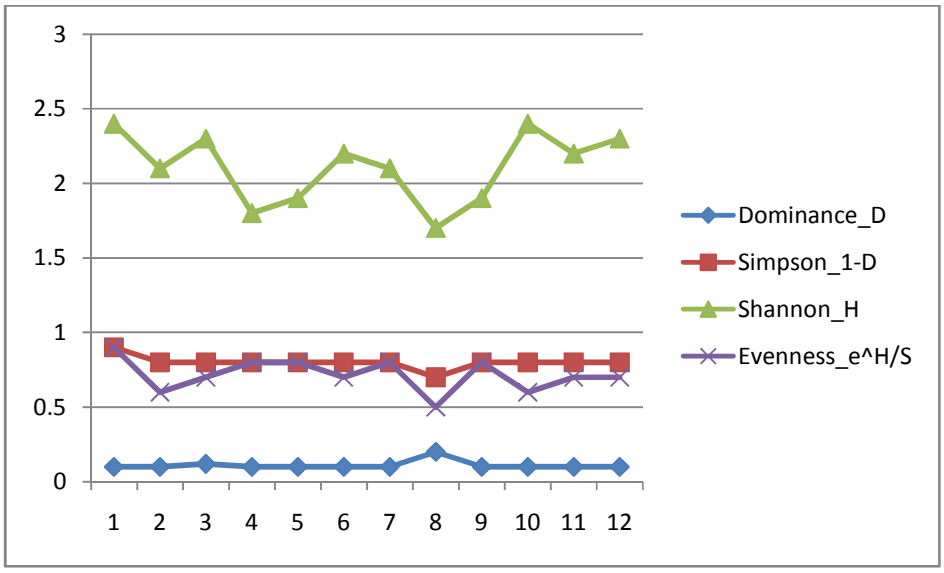
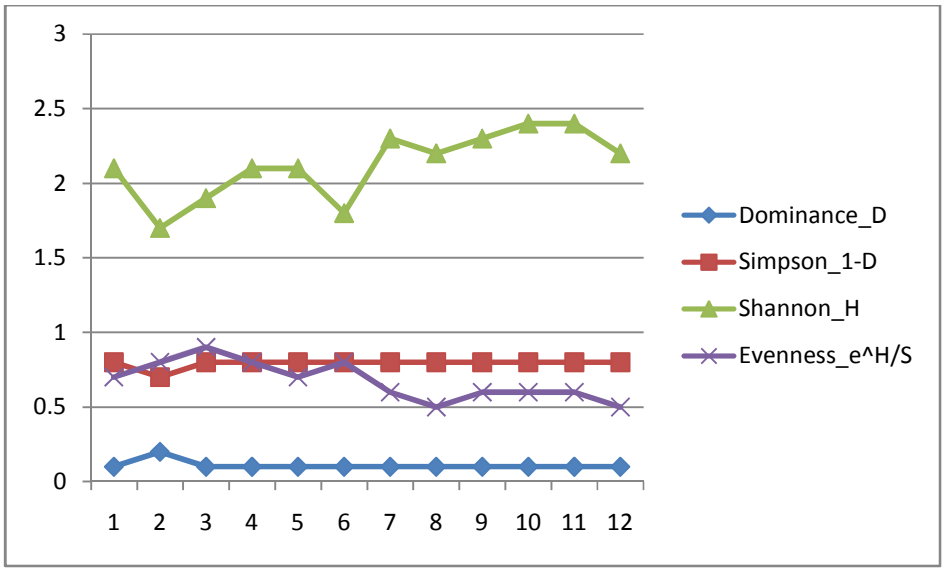


Table No. 4 Diversity Indices in thep phytoplankton population of T Narsipura taluk

0	TNS1	TNS2	TNS 3	TNS1	TNS1	TNS1	TNS1	TNS1	TNS1	TNS1	TNS1	TNS1
Taxa_S	11	7	8	10	11	8	18	16	17	18	18	17
Individuals	56^3	30^3	16^3	36^3	42^3	22^3	12^4	81^3	93^3	10^4	91^3	77^3
Dominance_D	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Simpson_1-D	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Shannon_H	2.1	1.7	1.9	2.1	2.1	1.8	2.3	2.2	2.3	2.4	2.4	2.2
Evenness_e^H/S	0.7	0.8	0.9	0.8	0.7	0.8	0.6	0.5	0.6	0.6	0.6	0.5
Brillouin	2.1	1.7	1.9	2.1	2.1	1.8	2.3	2.2	2.3	2.4	2.4	2.2
Menhinick	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Margalef	0.9	0.5	0.7	0.8	0.9	0.7	1.4	1.3	1.4	1.4	1.4	1.4
Equitability_J	0.8	0.8	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.7
Fisher_alpha	1.0	0.6	0.8	0.9	1.0	0.7	1.6	1.4	1.5	1.6	1.6	1.5
Berger-Parker	0.2	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.3

Fig. 4: T. Narsipura



The diversity indices generated by using he PAST Software for both the study areas are presented in Table 3 and Table 4. The Software generates a total of 9 diversity indices. The importance of these is described by Basavarajappa, Raju, Hosmani and Niranjana[1]. However 4 most significant diversity indices are often discussed. They include Dominance Index, Simpsons index, Shannon Index and Evenness Index.

Richness is a measure of the number of different kinds of organisms in a particular area. Species richness is the number of species present. Diversity depends not only on richness but also on evenness. Evenness compares the similarity of the population size of each species present. Evenness is the measure of a relative abundance of the different species making up the richness of the area The Shannon diversity index (H) is another index that is commonly used to characterize species diversity in a community. Like Simpson's index, Shannon's index accounts for both abundance and evenness of the species present. The diversity indices of the phytoplankton in Srirangapatna taluka are shown in Table 3 and Fig.3. The number of taxa varied from a minimum of 8 to a maxiu of 14. Total number of individuals were as high as 93000 o/l at site no 2. The dominance index was very low (0.02) The simpson index was high in most of the sites whereas the Shannon index varied to a considerable extent reaching a maximum of 2.5 (always .1.8). Dominance and richness were not well marked.

The diversity indices in T. Narasipura taluka were also not well marked. The maximum number of Taxa recorded were 18 O/L and individuals were also 93000 o/L. (Table 4, Fig. 4). The Shannon index and the Evenness index were almost similar to those in the other lake.. The only difference between the two lakes was the total number of individuals and a slight variation in the number of species. The distribution of phytoplankton in the wetlands of Srrangapatna is shown in Fig. 1. *Chroococcus turgidus* and *Merismopedia glauca* were the most dominant species among the 15 species recorded. About 21 species were recorded in T. Narasipura taluka. *Chroococcus disperses, Merismopedia tenussima* and *Oscillatoria acutisima* dominated to a certain extent.

CONCLUSION

It is assumed that species rich communities are better suited than species poor communities and further adverse effects of pollution will be reflected in the reduction of diversity[7]. It is also stated by Patrick[9] and Rosenberg[12] that enriched ecosystems display reduction in algal diversity. The diversity of the phytoplankton in the present study indicates that it is fairly poor, although 15 to 21 species appeared in each taluka respectively. Only members of the Cyanophyceae appeared to be dominant. Shannon index showed variation in both the localities.

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DYNAMICS OF ALGAL DIVERSITY IN HOMBARGALLI LAKE OF H.D. KOTE, MYSORE DISTRICT, KARNATAKA

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ABSTRACT

The dynamics and distribution of algae in a fresh water lake was studied over a period of 12 months. One way ANOVA was ued to test the significance between five groups of algae (Desmids, Diatoms, Euglenophyceae , Myxophyceae and Chlorococcales. Related physico-chemical parameters were also analysed. Euglenophyceae were predominant. Dissolved Oxygen played a significant role in the distribution of algae in this lake. The water was alkaline and phosphates played a minor role.

Keywords: Algal diversity, ANOVA, Dissolved Oxygen, Euglenophyceae

INTRODUCTION

Diversity measures are useful in lake ecosystems which harbour a large variety of algal species in general and species diversity within the genera. Hutchinson(1967) states that species diversity is often a paradox. Species diversity studies have been done by Pianka(1983), Marguran(1983),Hosmani(2010) and Hosmani and Mruthunjaya(2012). Detailed studies on algal diversity have been done by Aiyaz*et al* (2010) and Basavarajappa*et al*., (2009). Most of these studies deal with the distribution of algal species in different water bodies. However the study on algal groups is lacking and the significant relationship between different groups of algae is meagre.

MATERIALS AND METHODS

Sampling site and collection of samples

Hombargalli Lake is located about 50 kms from Mysore near Hampapura village on the Mysore-H.D. Kote Road in Karnataka. The lake has a catchment area of 2 acres. It is a rain fed lake and has a maximum depth of 10 feet when full. It supports abundant growth of aquatic vegetation and the water in it is used for agriculture and aquaculture. Human interference in the lake is very high.

Analysis of samples

Standard methods were employed for the analysis of physical and chemical parameters as described by APHA(1995).Collection, preservation, identification and enumeration of algae were done as per the methods described by Welch(1948), Hosmani and Bharathi(1980). Identification was done by consulting the monographs by Philipose(1960), Desikachary(1948) ,Gandhi(1998) and Prescott(1982). Enumeration was done as per Lackey's drop method (1938) modified by Suxena(1987) and all counts were expressed as organisms/Litter(O/L). The data obtained were subjected to the one way ANOVA for independent samples. Analysis was done separately to the algal data and chemical data.

RESULTS AND DISCUSSION

The results of the analysis are presented in Table 1. The tests performed were to determine whether there was any significant difference between the different groups of algae and the chemical variables (Table 2). According to the test of variance it was observed that Desmids and Myxophyceae showed a highly significant association ($P<0.01$) indicating that the two groups tolerated each other in the ecosystem and there was no antagonism. Diatoms and Myxophyceae also showed a similar association. Euglenophyceae and Chlorococcales were abundant and were inversely proportional and significant. The remaining groups were not closely associated. Euglenophyceae were the predominant groups of algae.

Table 1. Distribution of algae and related parameters in Hombargalli lake of H.D. Kote (Mysore District. (Algae expressed as organisms/liter; Parameters as parts per million(ppm)

Months	Desmids	Diatoms	Euglenophyceae	Chlorococcales	Myxophyceae	Oxidisable organic matter	Nitrate	Dissolved Oxygen	Albumonoid Ammonia	Phosphates	Free Carbondioxide	pH
Jan	672	1848	8820	420	168	1.25	4.43	10.46	24.0	2.0	80.72	8.60
Feb	5040	6426	15455	1092	504	1.01	8.86	6.99	14.0	2.0	15.82	6.52
Mar	3360	3356	14954	1470	378	2.32	1.32	5.33	28.0	12.0	64.92	7.82
Apr	3780	6950	11350	1654	576	1.91	4.43	4.98	16.2	2.0	56.93	7.52
May	4200	7560	2016	126	168	2.07	4.43	1.93	19.2	4.0	43.95	8.52
Jun	2520	1386	2352	168	2394	5.0	8.86	1.24	33.6	2.0	10.93	8.52
Jul	840	3360	168	1952	798	5.18	4.43	1.56	33.6	3.0	93.89	8.62
Aug	4200	1764	4746	1260	63	1.67	13.29	1.96	12.0	6.0	138.83	8.72
Sep	5250	1197	29624	126	63	2.88	4.43	3.30	9.2	6.0	114.87	7.20
Oct	6930	108	4524	1134	1071	0.5	4.43	1.30	15.0	4.0	105.1	8.52
Nov	630	210	2352	1932	84	0.5	4.47	2.79	0.0	2.0	134.8	7.52
Dec	420	756	945	84	567	5.13	4.43	3.94	13.0	2.0	125.6	7.52

Table 2. Tukey HSD Test for Chemical parameters

M1 vs M2 nonsignificant
M1 vs M3 nonsignificant
M1 vs M4 nonsignificant
M1 vs M5 P<0.01(Highly significant)
M2 vs M3 nonsignificant
M2 vs M4 nonsignificant
M2 vs M5 P<0.01(Highly significant)
M3 vs M4 nonsignificant
M3 vs M5 P<0.01(Highly significant)
M4 vs M5 P<0.01(Highly significant)
M1: Oxi disable Organic Matter (ppm)
M2: Nitrate (ppm)
M3: Dissolved Oxygen (ppm)
M4: AlbuminoidalAmmonia (ppm)
M5: Free Carbon dioxide

Tukey HSD for algal populations

M1 vs M2 non significant
M1 vs M3: P<0.05(Significant)
M1 vs M4 non significant
M1 vs M5 non significant
M2 vs M3 P<0.05(Significant)
M2 vs M4 non significant
M3 vs M4 P<0.01(Highly significant)
M3 vs M5 P<0, 01(Highly significant)
M4 vs M5 non significant
M1: Desmids(O/L))
M2: Diatoms(O/L)
M3: Euglenophyceae(O/L)
M4: Chlorococcales(O/L)
M5:Cyanophyceae(O/L)

The significance of association between the chemical parameters showed that Ox disable Organic matter was significant and correlated to Dissolved oxygen and Nitrate. Dissolved Oxygen played a very significant role in the diversity and distribution of algae in this lake. Albuminoidal ammonia and free carbon dioxide showed high significance while Phosphate had a minor role in the distribution of algae. This is in spite of large amount of agricultural waste flowing into the lake. Variations in the algal groups and the chemical parameters are represented in Fig. 2 and Fig.3.

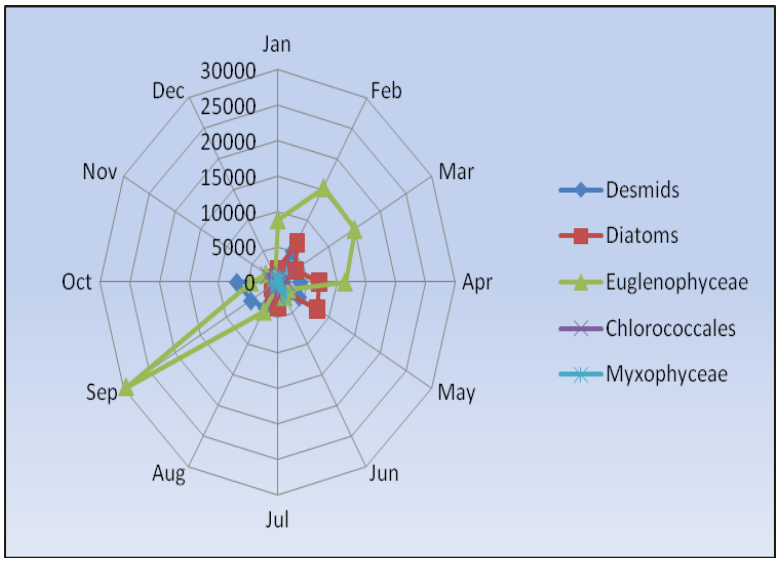

Figure 2. Distribution of Algae in Hombargallilake

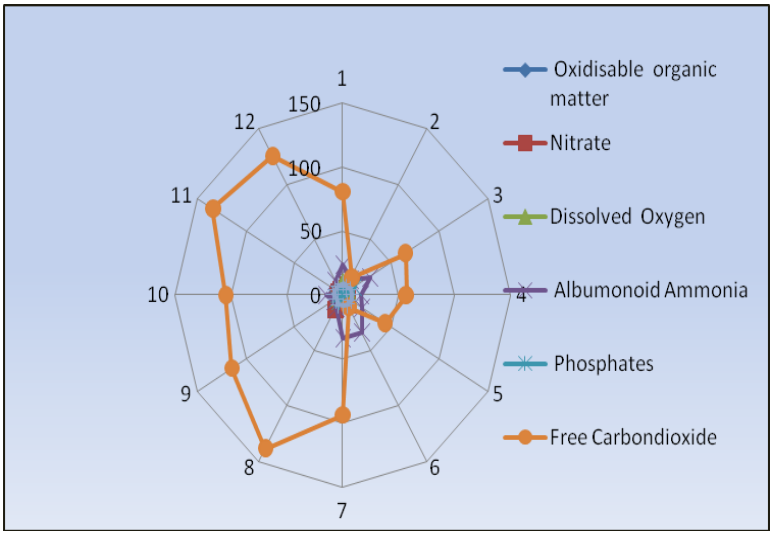

Figure 3 : Physico-chemical parameters in Hombargallilake

pH has an important role in the ecology of fresh water algae. The variation of pH was very high. The mean pH during the 12 months was 8.12 and fluctuated between 6.52 and 7.52. The last quartile showed minor variations up to 8.72. The lake water was considered to be alkaline.

CONCLUSION

The algal diversity of Hombargalli Lake of H.D. Kote is very high. Diatoms, Euglenophyceae and Chlorococcales dominate the lake to a greater extent. Desmids and Myxophyceae are less dominant. Dissolved oxygen plays a significant role in the distribution of algae in this lake.

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Diversity of Cyanophyceae in lakes of HD Kote

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Abstract

The alpha, beta and Gamma diversity of Cyanophyceae in four lakes of H D Kote taluk has been done and the Shannon's entropy has been calculated for a period of 12 months. Comparison of diversity in all four lakes indicates that Lake 1 and Lake 2 have medium alpha diversity while Lake 3 and Lake 4 have medium alpha diversity. The Shannon alpha diversity is 9.58 being high. The entropy reduces from 2.31 to 2.22 indicating that the alpha diversity in the lakes is from medium to low. Considering the diversity of Cyanophyceae month wise, in all four lakes it is observed that entropy becomes low and alpha diversity ranges from low medium during August to low during October and medium during February, March and April. The alpha diversity reduces from 1.23(August) to 1.12(July).Diversity of Cynophyceae is found to reduce from 1.23 to 1.12. Diversity measures are more useful in lake ecosystems

KEYWORDS: Cyanophyceae, Alpha, Beta. Gamma Diversity, Shannon Entropy

Introduction

Cyanophyceae are a group of plankton that occur in almost all freshwaters. Sometimes they occur seasonally and many a times they occur as permanent blooms. Cyanophyceae are also known to interact with others groups of plankton as well as during varied physical and chemical parameters that support them. The earliest works like Pearsall(1932), Philipose(1960) and Munnawar(1970) relate the abundance of Cyanophyceae to phosphates and nitrates. Ganapathi(1940) considers that low pH and dissolved oxygen content of water support the abundance of Cyanophyceae. However it is quite difficult to consider the life communities in any water body as a whole because they are so varied. Nutritional requirements of Cyanophyceae differ from species to species and sporadic appearance or disappearance is a marked feature. During an extensive study of plankton in fresh water lakes of HD Kote a large number of Cyanophyceae occurred during the 12 months of study.Diversity calculations on Cyanophyceae are not much.Hosmani(2010) has described diversity indices of plankton in lakes of Mysore district using the PAST software The richness, evenness and dominance have been determined. The present study is an attempt to describe the diversity of Cyanophyceae in four lakes situated in HD KoteTaluka of Mysore district. Alpha, beta and Gamma diversity and the Shannon's Entropy is discussed.

Materials and Methods.

H.D. Kote taluk of Mysore district is located 12^0 04' 45.84" N and 76^0 20' 18.50" E at an elevation of 688 meters above MSL.HombargalliLake (L1), Karadilake (L2), BoppanakereLake (L3) and KodligereLake (L4) are situated at 60KM away from

Mysore. They differ in shape and size, in the nature of pollution, aquatic vegetation and usage patterns. The water in these lakes is mainly used for irrigation and domestic purposes. They support abundant Cyanophyceae throughout the year. The soil types within the lake also differ considerably. Collection, identification and enumeration of the Cyanophyceae are as per the methods described by Hosmani(2010). Lackey(1938) and Suxena(1987). Monographs such as Desikachary(1959), Prescott(1982) were consulted for the identification of species. The alpha, Beta and Gamma diversities were calculated using the softwareof KlausGoepal, (2014)

Results and discussion

The results of the plankton distribution are presented in Table 1. The statistical analysis of the diversity lake wise is presented in Table 2 and diversity, month wise in Table 3. The concept of diversity includes richness, abundance and evenness. Richness is the number of differing elements and variety of characteristics. Abundance is plentiful while richness is free from variations, equal in measure or quantity. Richness has been a popular diversity index in ecology, since it quantifies how many different sets of organisms a test contains. The diversity is calculated as D=1/P max (Maximum proportional abundance. The Shannon entropy or the true diversity index explains that the more unequal or proportional abundance the smaller the Shannon entropy. Diversity of the individual sample is called alpha diversity. Diversity of all samples consolidated is gamma diversity. The difference, gamma diversity- alpha diversity is called beta diversity. Beta diversity is a measure for similarity and overlap samples of distributions or locations. This helps comparasion of organisms in different locations (Klaus Goepal, 2014).

An alpha, beta diversity matrix was developed for the Cyanophyceae in four lakes of H D Kote. The results are presented in Tables 1, 2&3. Comparison of diversity in all four lakes indicates that Lake 1 and Lake 2 have medium alpha diversity while Lake 3 and Lake 4 have medium alpha diversity. The Shannon alpha diversity is 9.58 being high. The entropy reduces from 2.31 to 2.22 indicating that the alpha diversity in the lakes is from medium to low. (Table 2).

Considering the diversity of Cyanophyceae month wise, in all four lakes it is observed that entropy becomes low and alpha diversity ranges from low medium during August to low during October and medium during February, March and April. The alpha diversity reduces from 1.23(August) to 1.12(July). These observations indicate that beta diversity in all locations is not well marked and the distribution of Cyanophyceae is almost same in all four lakes.(Table 3).

Cyanophyceae that were abundant were *Chroococcus disperses, Chroococcusturgidus, Anabaena spiroides, Merismopediaglauca* and *Microcystiscrassa .Oscillatoriaacutissima, Spirulinagigentea, Chroococcusturgidusappeared with low diversity.*

Conclusion:

Hombargalli Lake and Karadi Lake have medium alpha diversity of Cyanophyceaewhile Boppankere Lake and Kodilgere Lake have low alpha diversity of Cyanophyceae. The month of August has low alpha diversity; October has low alpha diversity, while the

months of February, March and April have medium alpha diversity. The diversity of Cyanophyceae in all four lakes is not well marked. Diversity of Cynophyceae is found to reduce from 1.23 to 1.12. Diversity measures are more useful in lake ecosystems. The diversity of a community may be described by referring to a model which can provide the closest fit to the observed pattern of species abundance

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Table 1: Distribution of Cyanophyceae in Lakes of HD Kote(Organisms/Litre)

Months	**Lake 1**	**Lake 2**	**Lake 3**	**Lake 4**
August ,2013	13430	2510	6710	5870
September, 2013	5030	36110	7550	23510
October, 2013	2510	57110	6710	21830
November, 2013	830	6710	8390	10070
December, 2013	3350	10070	16790	6710
January, 2014	8390	22670	5030	31070
February, 2014	13430	31910	63830	39470
March, 2014	11750	14270	37790	10910
April,2014	9230	29390	42830	57110
May, 2014	4200	34430	47030	23510
June, 2014	7550	36950	38630	8390
July, 2014	7550	33590	36110	5030

Table 2:. α,β, and γ Diversity of Cyanophyceae in Lakes of H D Kote

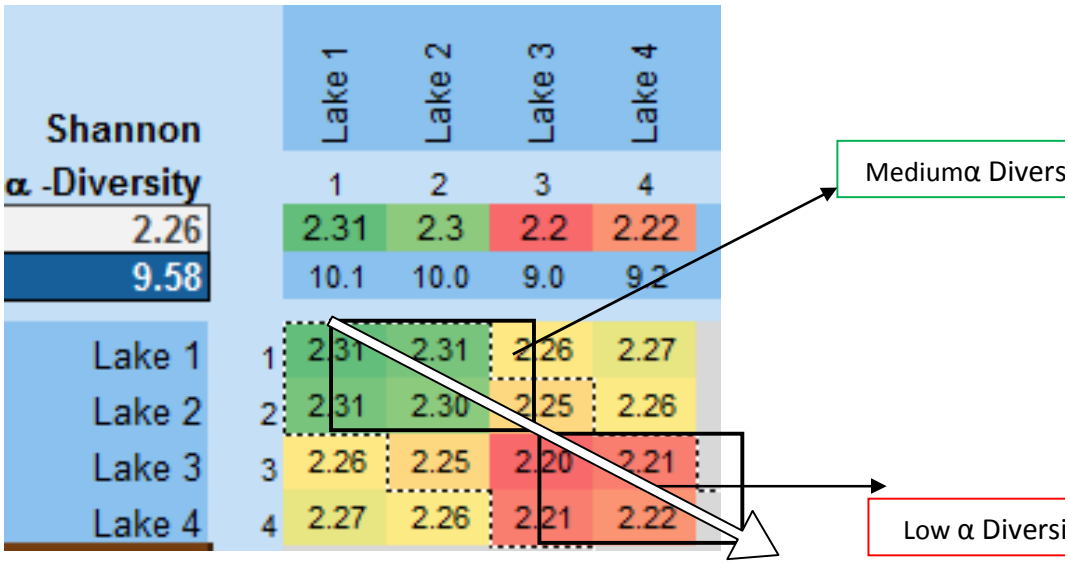

Table: 3. α,β and γ diversity ofCyanophyceae in lakes of H D Kote