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Primary productivity and phytoplankton diversity in Pilikula Lake, Dakshina Kannada dist, Karnataka, India

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Abstract
Primary production refers to estimation of the ability of an ecosystem to understand the level of Physico-chemical characteristics, Plankton production and primary productivity an attempt been done in the present study. The present study of Pilikula lake water sample physicochemical parameters were analyzed at fortnightly intervals over a period of 7 months from January to July 2017. This study revealed that the phytoplankton Abundance and Distribution, throughout the study period mainly observed that, a total of 38 species belonging to 4 genera were reported with a complete domination from Chlorophyta of 18 genus followed by Cyanophyta with 14 genus, Chrysophyta with 5 genus, and Rhodophyta with one genera. The total phytoplankton numbers varied from a minimum of 43 counts/l during February to a maximum of 5508 counts/l during May. In all, summer and monsoon months showed maximum number of Phytoplankton compared to winter months. The gross primary productivity of organic matter by the phytoplankton was found to be more during pre-monsoon and early monsoon period. A similar trend was also seen in net primary productivity and respiration rate values. During the study period, it has been noticed that net productivity was comparatively low, suggesting that major part of the organic matter produced by photosynthesis had been utilised for respiration. On the other hand, Community respiration was found to be higher during summer season and lower during winter season. However that the Pilikula lake primary production and productivity mainly depending on the biotic and abiotic factors like sunlight, organic carbon and concentration of available nutrients like Phosphorus and Nitrogen.

Keywords: Pilikula Lake, physico-chemical characteristics, primary productivity, plankton and nutrients

Introduction
Primary productivity is the rate, at which the sun's radiant energy is stored by photosynthetic and chemosynthetic activities of producers in the form of organic substances [1]. Primary productivity will decide the few physical characteristics changes in lake water *viz,* Water temperature, Colour, Turbidity, Total suspended solids and primary productivity is the backbone and phytoplankton forms the basis of aquatic food webs. In most studies, primary productivity is measured using the uptake of radio labelled CO2 in the form of $NaH_{14}CO_3$, a technique called C_{14} developed by [2]. Primary productivity as an important functional attribute of the biosphere because of its controlling effects on the rate of multiplication and growth of the living organisms of the lake ecosystem [3]. Primary productivity of aquatic ecosystem has been measured by several workers [4-7]. Phytoplanktons are the primary producers in aquatic ecosystem, and they are mainly depends on sunlight (solar energy) for photosynthesis process and also strongly influenced on physicochemical characteristics of water body because phytoplanktonic organisms are sensitive indicators. Phytoplankton helps in the growth of aquatic fauna by producing oxygen through photosynthesis process and some of the phytoplankton cause the pollution by excess growth. Phytoplankton study and monitoring are useful for control of physico-chemical and biological conditions of lake water [8]. Even if they have no immediate effect on fish yield, they are at least fairly good indicators of the biological productivity [9]. Over 90% of atmospheric oxygen is produced by phytoplankton by the process of photosynthesis. It is a fact that this phytoplankton forms a major bulk of food material for all aquatic organisms directly and to human beings indirectly [10]. Phytoplankton diversity of aquatic ecosystem has been measured by several workers various studies have been carried out in the Indian context related various aspects of phytoplankton such as seasonal distribution in

Riwada reservoir Visakhapatnam [11]. Recording these bag grounds the present study was carried out to analyses the primary productivity and plankton diversity in Pilikula lake, Mangaluru, Dakshina kannada district, Karnataka state.

2. Martials and Methods

2. a. Sampling Area

The present investigation was conducted at Pilikula lake, Mangaluru, Dakshinakannada district. The Pilikula lake is situated in the Mangaluru of a lake called Pilikula has been Moodbidri highway NH-13 (12°55'46.9"N and 74°53'44.5"E) at a distance of about 12km from the town of Mangaluru in Dakshina Kannada dist. Pilikula lake was once a large water body that served as the source of water for various wild animal living there. However, with the passage of time, the lake was affected by water pollution. The pollution increased to such a level that the huge lake shrank to become a small pond. The lake was de-silted and restored under the Pilikula project. 4 different stations were selected for water sampling Altogether, four stations were selected viz, station 1 as S1, station 2 as S2, station 3 as S3 and station 4 as S4. The station S1 was the inlet of the lake and stations S2 and S3 were on either side of middle of the lake. The station S4 was towards outlet point of the lake. The geographical locations and map of the selected stations for sampling at Pilikula lake are shown in Plate 1. Sampling was carried fortnightly over period of January to July 2017.

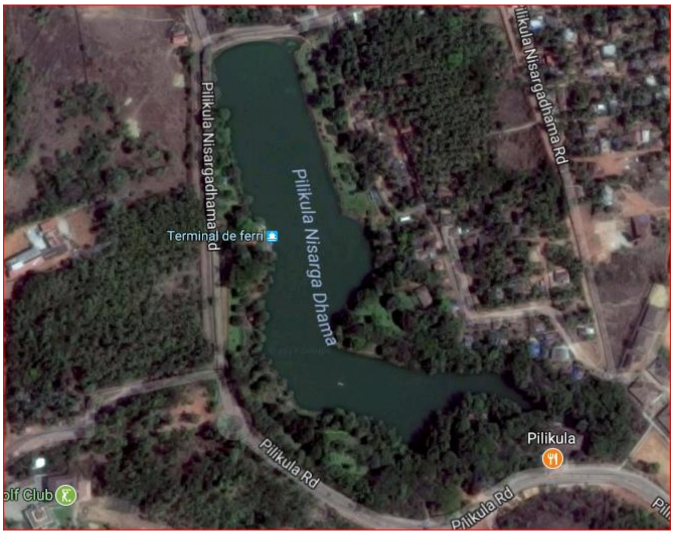

Fig 1: Map showing designated stations at Pilikula lake

Fig 2: Topographic feature of Pilikula lake

2. b. Sampling Procedure and Primary productivity

The rate of primary production of natural population of phytoplankton in the water was estimated in situ using the well-known 'Light and Dark bottle oxygen method' [12]. The water samples collected from each station were transported in three 250ml glass bottles of which, two were light bottle and third one was darkened with black paint, wrapped with black paper and finally enclosed in thick cloth bag. One of the light bottles was fixed with Winkler's reagents (Manganous Sulphate and Alkaline Iodide) for determination of initial dissolved oxygen. Later, the fixed samples were transported to the laboratory for further analysis and the values were expressed in mg/l [13]. The remaining light and dark bottles were tied to a nylon rope weighed with an anchor and suspended at respective stations filled with water. Thus, the filled bottles were incubated for three hours at the depth from where the water sample was drawn. Further, upon incubation the bottles were withdrawn and fixed with Winkler's reagent as mentioned earlier. Various parameters of primary productivity such as Gross primary productivity (GPP), net primary productivity (NPP) and consumption of organic matter during respiration as Respiration rate (RR) were estimated as per the standards procedure [12].

2. c. Plankton

Plankton sample from different stations were collected by filtering water through standards plankton net (60µm mesh size) made of nylon bolting cloth fitted to a circular metallic frame. Immediately after collection of plankton sample, it was transferred in polythene bottle and preserved in 4% formaline solution. Qualitative analysis of plankton was carried out in the laboratory using standard procedure. Qualitative analysis of plankton was carried out by drawing 1 ml of sample from each aliquots re-suspended sample. The Phytoplankton were identified, counted and recorded employing Sedgwick rafter plankton counting type of cell using compound microscope (Magnus MLX Microscope). Plankton cells were identified up to generic level while

Counted plankton was expressed in terms of number of cells/m3.

Plate 3: Collection of plankton by hand net.

3. Results and Discussion

3. a. Primary productivity

In this investigation of Pilikula lake, gross primary productivity in the lake water at S1 ranged between 0 and 123.46 mg C/m^3/hr. The minimum GPP was recorded in the month of July on 182nd day while maximum GPP was recorded in the month of June on 140th day of sampling.S2 ranged between 28.87 and 153.86 mg C/m^3/hr. The minimum GPP was recorded in the month of March on 56th day while maximum was recorded in the month of June on 140th day of sampling.S3 ranged between 0 and 163.00 mg C/m^3/hr. The minimum GPP was recorded in the month of July on 182nd day of sampling while maximum was recorded in the month of May on 112th day of sampling.S4 ranged between 28.76 and 256.37 mg C/m^3/hr. The minimum GPP was recorded in the month of January on 14th day of sampling while maximum was recorded in the month of June on 154th day of sampling. Variations of primary production, nutrient density and community structure was the fundamental to the understanding of ecosystem dynamics [14]. In the present investigation as per Figure.1 GPP, the maximum gross primary productivity were recorded on June and may months in monsoon season and lowest in pre-monsoon season due to the decrease in the water level in the tank. Net primary productivity is the storage product available for the next tropic level. During the present investigation, as per Figure. 2 NPP, in Pilikula lake, the net productivity varied between 0 to 160.96 mg C/m3/hr. The maximum net productivity value recorded in the month of July (160.96 mg C/m3/ hr), May (136.23 mg C/m3/ hr) and the minimum net productivity value recorded in the month of January (11.90mg c/m3/ hr), and in July month productivity value recorded 0 mg C/m3/ hr at the station S1 an S3 less productivity value recorded by the low sunlight and heavy rainfall. Similarly [15] recorded high net productivity value in the month of June. The nutrients of an aquatic ecosystem plays key role in the primary productivity. Phosphate and nitrate shows positive correlation with the lake productivity. Productivity was also found to be influenced by seasonal variation and was highest in summer season, because the rate of photosynthesis was peak in summer period due to high water temperature [15]. During the present investigation, as per Figure. 3 RR, in Pilikula lake the respiration rate in lake water at S4 ranged between 13.30 and 275.24 mg C/m3/hr. The minimum respiration recorded in the month of January on 14nd day while maximum respiration was recorded in the month of June on 154th day of sampling. Community respiration means deducting the net primary productivity from gross primary productivity and converted into CO2 release. [16] Recorded high respiration value in summer season at Kagzipura Lake, Maharashtra. Shallow lake water leads to a rapid change in the productivity with the change in Physico-chemical conditions of water. The high respiration of all living organisms and non-living organic matter reduce the dissolved oxygen content [17].

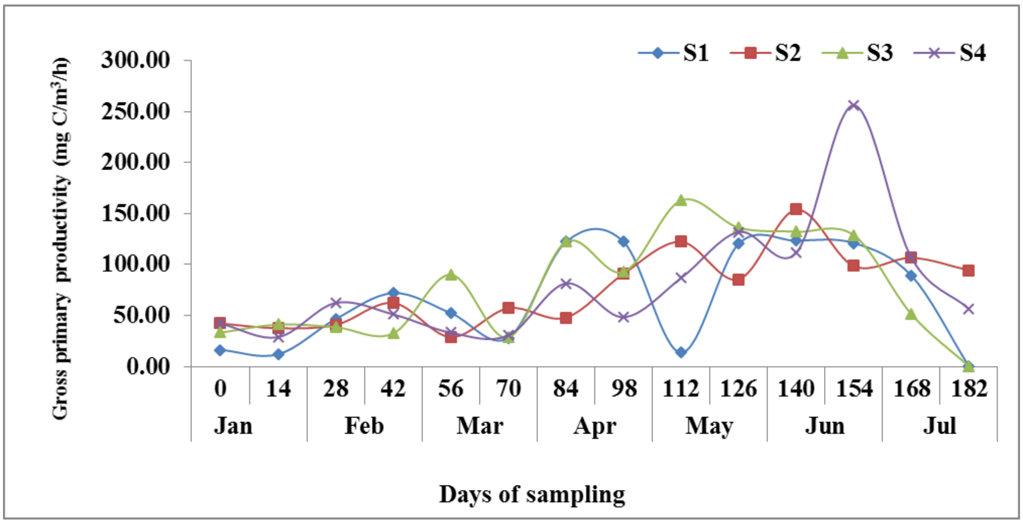

Fig 1: Gross primary productivity (mg C/m3 /hr) at different stations during the study period.

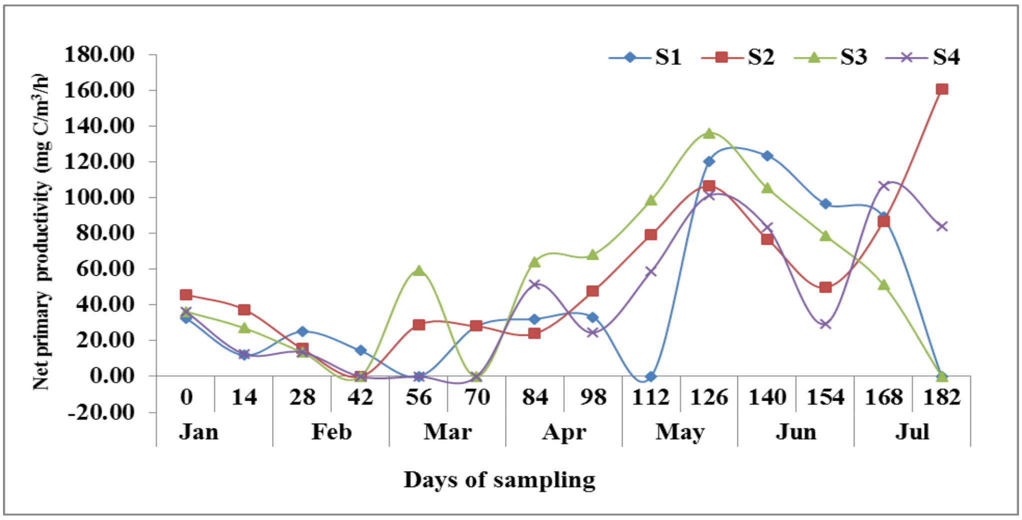

Fig 2: Net primary productivity (mg c/m^3 /hr) at different stations during the study period

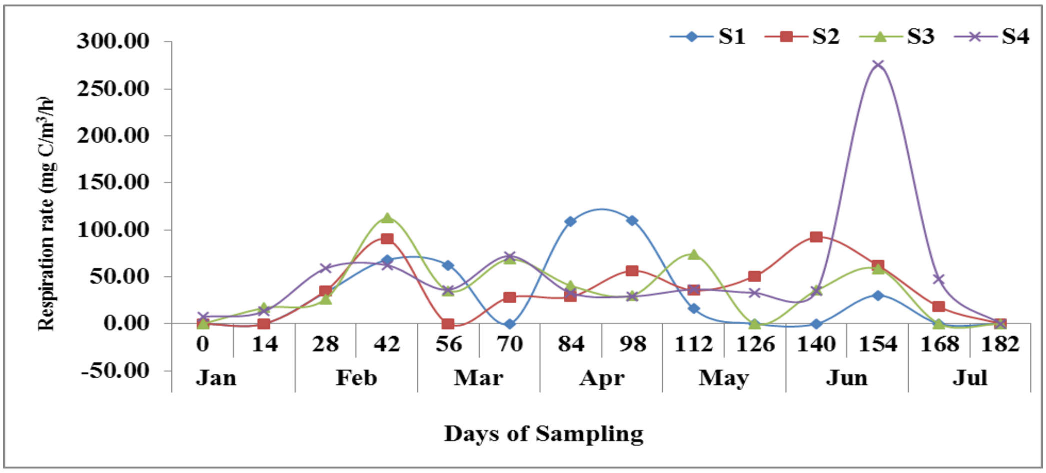

Fig 3: Community respiration rate (mg C/m^3/hr) at different stations during the study period

Table 1: The total abundance of phytoplankton in study period.

Cyanophyta	Chlorophyta	Chrysophyta	Rhodophyta
Anabaena spp.	*Bulbochaete spp.*	*Coscinodiscus spp.*	*Lemanea spp.*
Aphanizomenon spp.	*Cladophora spp.*	*Melosira spp.*	
Aphanocapsa spp.	*Desmidium spp.*	*Nitzchia spp.*	
Gomphosphaeria spp.	*Dictyosphaerium spp.*	*Tabellaria spp.*	
Homeothrix spp.	*Eudorina spp.*	*Tribonema spp.*	
Lyngbya spp.	*Hydrodictyon spp.*		
Merismopedia spp.	*Mougeotia spp.*		
Microcystis spp.	*Oocystis spp.*		
Oscillatoria spp.	*Pediastrum spp.*		
Phormidium spp.	*Rhizoclonium spp.*		
Spirulina spp.	*Scenedesmus spp.*		
Stigonema spp.	*Sphaerocystis spp.*		
Selenastrum spp.	*Spirogyra spp.*		
Tolypothrix spp.	*Stuarastrum spp.*		
	Pseudostaurastrum spp.		
	Stigeoclonium spp.		
	Tetraedron spp.		
	Ulothrix spp.		

3. b. Plankton diversity

The species of phytoplankton belonging to four classes such as Chlorophyta, Cyanophyta, Chrysophytaand and Rhodophyta were enumerated numerically. Throughout the study period, 38 species belonging to 4 genera were observed with a complete domination from Chlorophyta with 18 genus followed by Cyanophyta with 14 Chrysophyta with 5 Rhodophyta with one genera. [18] recorded the 61 phytoplankton species classified into five divisions in the following order of percentage composition; Chlorophyta 39%, Bacillariophyta 38%, Cyanophyta 13%, Euglenophyta 8% and Dinophyta 2% in Bahir Dar Gulf of lake Tana, Ethiopia. [19] Reported a total of 42 genera and species of phytoplankton in Mahesharalake in Gorakhpur. Plankton distribution and abundance are affected by season [20]. However the effects of various factors on the seasonal appearance and disappearance of phytoplankton differ significantly across the lake ecosystem [21]. The total abundance of phytoplankton at is presented in Table 1. The percentage contribution of different phytoplankton group during study period at different station is depicted in Fig. 4, 5, 6, 7.

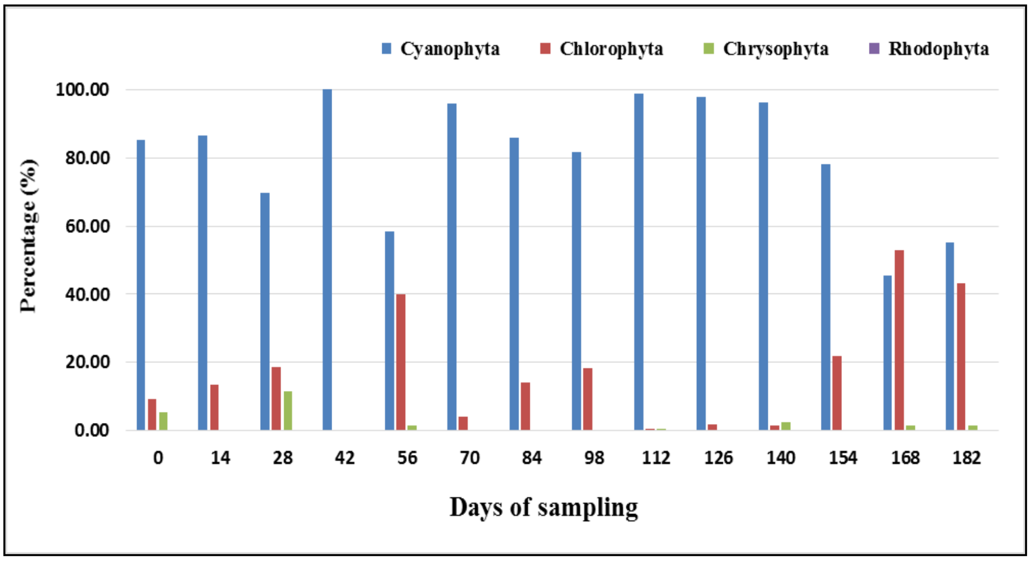

Fig 4: Percentage contribution of Phytoplankton group at station S1 during the study period.

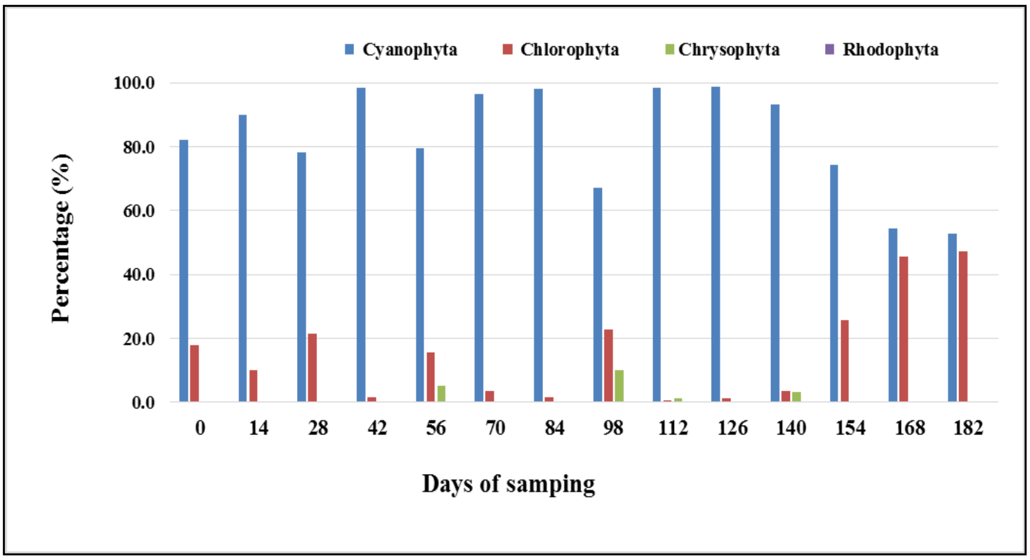

Fig 5: Percentage contribution of Phytoplankton group at station S2 during the study period.

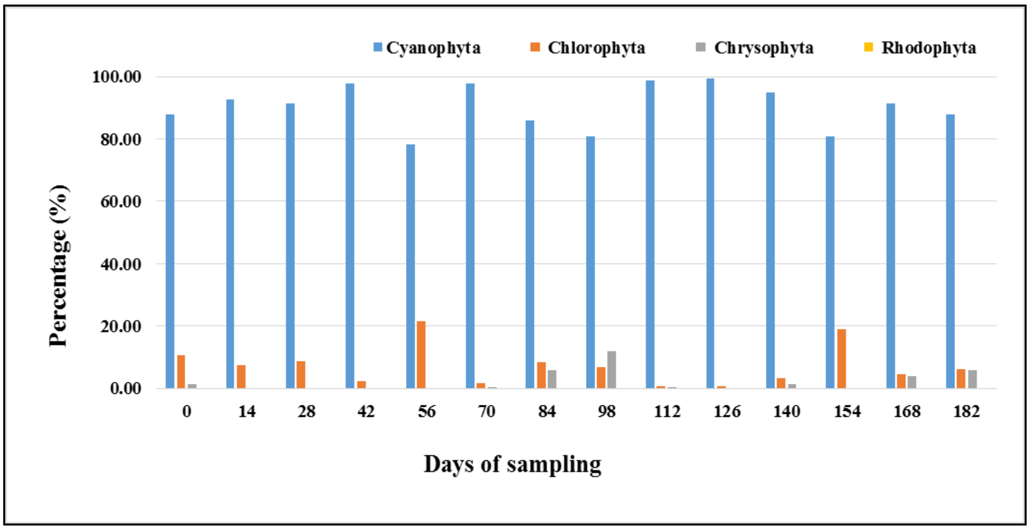

Fig 6: Percentage contribution of Phytoplankton group at station S3 during the study period.

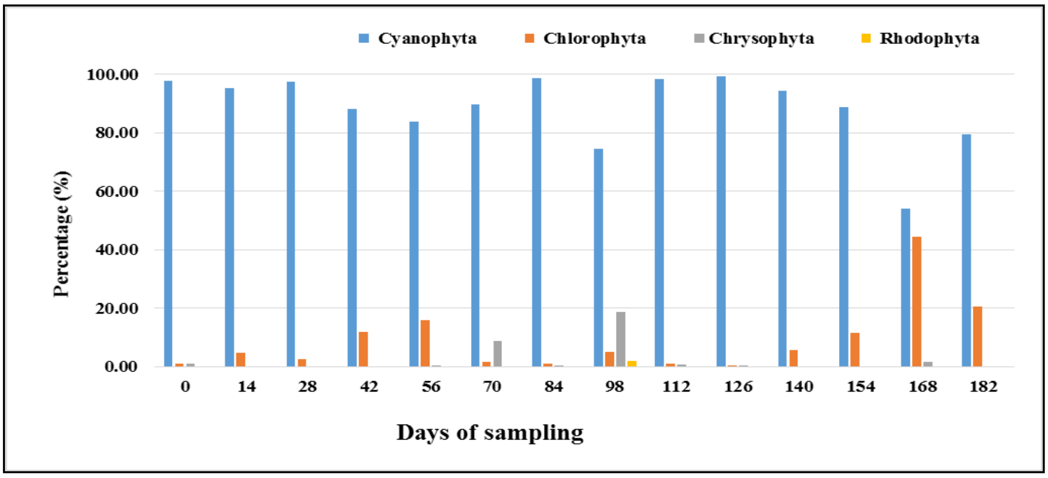

Fig 7: Percentage contribution of Phytoplankton group at station S4 during the study period.

3. c. Phytoplankton Diversity Indices

In the present investigation, species richness varied from 2 to 14. The maximum species richness in the month of April at S3 during 84th day of sampling. [22] Similar observed results of species richness while studying in Calabar River, Nigeria. Species evenness varied from 0.0379 to 0.8646. The minimum species evenness observed in the month of May at S3 on 126th day of sampling while the maximum species evenness was observed in the month of April at S2 on 98th day of sampling. The greater evenness was found in monsoon months, which could be due to favorable condition prevailed by the freshwater inflow during rainy season thereby increasing nutrient load. Similar observations were also made by [22] who worked on species evenness in Calabar River, Nigeria and while [23] in eutrophic lake, Ranchi. Species diversity varied from 0.062 to 1.914. The monsoon and post monsoon months reported greater diversity when compared to pre-monsoon season, which may be due to inflow of nutrients into the lake during rainy season. Similar observations were reported by [22] while working on Species diversity of Calabar River, Nigeria. The total individual numbers of phytoplankton varied from 43 to 5508. The greater total individual numbers was found in monsoon months could be due to favorable condition prevailed by the freshwater inflow during rainy season which carry nutrient load. Similar observations were made by [23] while working on Total individuals numbers of eutrophic lake, Ranchi.

4. Conclusion

In the present investigation shows greater diversity of phytoplankton in monsoon months when compared to pre-monsoon months, which may be due to inflow of nutrients into the lake during rainy season and also its closely related to the lake primary productivity. Highest primary productivity values were recorded on monsoon months due to inflow of nutrients. Phytoplankton and primary productivity closely related and strongly influenced on food web in aquatic ecosystem. In present investigation of Pilikula lake shows good values of primary productivity and phytoplankton diversity also recorded as rich diversity. Therefore, the Pilikula lake water body is well suitable for Aquaculture practice.

5. References

1. Odum EP. Fundamental of Ecology. W.B. Sunders, Toppan Co. Ltd., Tokyo, Japan, 2011.
2. Steemann Nielsen E. The use of radio-active carbon (C_{14}) for measuring organic production in the sea. J. Cons. 1952; 18:117-140.
3. Westlake DF. Comparison of Plant Productivity. Botanical Research. 1963; 25b:385-425.
4. Chinnaiah B, Madhu V. Primary Productivity of Darmasagar Lake in Adilabad, Andhra Pradesh, India. International Journal of Pharmacy and Life Sciences. 2010; 1(8):437-439.
5. Joseph K, Shanthi K. Assessment of the Primary Productivity of Muvattupuzha River, Kottayam, Kerala. J. Ecotoxicol Environ Monit. 2010; 20(4):355-355.
6. Patil A, Chavan N. Primary Productivity Studies in Some Freshwater Reservoirs of Sangali District, Maharashtra. Nature Environment and Pollution Technology. 2010; 9(1):101-103.
7. Vasanth kumar B, Kumar KV. Diurnal Variation of Physicochemical Properties and Primary Productivity of Phytoplankton in Bheema River, Gulberga. Recent Research in Science and Technology. 2011; 3(4):39-42.
8. Ariyadej C, Tansakul R, Tansakul P, Angsupanich S. Phytoplankton diversity and its relationship to the physico-chemical environment in the Banglang reservoir, Yala province. Songklanakarin Journal of Science and Technology. 2004; 26:595-607.
9. Sinha M, Sadguru Prakash, Khalid Ansari K. Seasonal dynamics of Phytoplankton population in relationto abiotic factors of a fresh water pond developed from wasteland of Brick-klin, Asian. J. Microbiology Biotech. Env. Sci. 2002; 4(1):43-45
10. Ajayan KV, Parameswara Naik T. Phytoplankton Primary Productivity in Lentic Water Bodies of Bhadravathi Taluk, Shimoga District, Karnataka, India. International Research Journal of Environment Sciences, 3(4):34-41.
11. Jyothi K, Narasimha Rao GM. Seasonal Distribution of Phytoplankton in Riwada Reservoir, Visakhapatnam, Andhra Pradesh, India, Notulae Scientica Biologica. 2013; 5:290-295,
12. Gaarder, Gran. 'Light and Dark bottle oxygen method, 1927.
13. APHA, AWWA, WEF. Standard Methods for the Examination of Water and Wastewater; 21st Edn. Washington D.C, 2005
14. Bootsma HA, Hecky RE. Conservation of the African Great Lakes: A limnological perspective, Conserv. Biol. (Special Issue). 1993; **7**:644-656.
15. Vijay Kumar Koli, Madhur Mohan Ranga.

Physicochemical Status and Primary Productivity of Ana Sagar Lake, Ajmer (Rajasthan), India. Uni. J Environ. Res. and Tech. 2011; 1(3):286-292.

16. Gajanan KS, Satish SM. Seasonal variation in primary productivity of two freshwater lakes of Aurangabad district, Maharashtra, India. Int. J Fauna and Bio. Studies. 2014; 1(6):07-10.
17. Prabhakar VM, Vaidya SP, Garud VS, Swain KK. Trend in primary production in Khdakwasla reservoir 13th World Lake Conference, Wuhan, China. 2009; 1(2):45-49.
18. Akoma, Osondu C. Hydrobiological Survey of the Bahir Dar Gulf of Lake Tana, Ethiopia, An International Multi-Disciplinary Journal, Ethiopia. 2010; 4(2):57-70.
19. Pallavi SP, Ajay S. A Seasonal variations of plankton population of Maheshara lake in Gorakhpur, India. World, J. zoo. 2013; 8(1):09-16.
20. Ezra AG, Nwankwo DI. Composition of phytoplankton algae in Gubi reservoir, Bauchi, Nigeria, J Aquatic Scie. 2001; 16(2):115-118.
21. Divya KS, Murthy SM, Puttaiah ET. A comparative study of the growth of phyto planktons in surface water samples and in the formation of Algal blooms. Intl. J. Innov. Res. Sci. Eng. and Techn. 2013; 2:2736-2747.
22. Emmanuel C Uttah, Chinasa Uttah, Akpan PA, kpeme EMI, ogbeche J, Usip L *et al*. Bio-survey of Plankton as indicators of water quality for recreational activities in Calabarriver, Nigeria. J Appl. Sci. Environ. Manage. 2008; 12(2):35-42.
23. Mukherjee B, Nivedita M, Mukherjee D. Plankton diversity and dynamics in a polluted eutrophic lake, Ranchi. J Environ. Bio. 2010; 31(5):827-839.