International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

International Journal of Fauna And Biological Studies

ISSN 2347-2677
www.faunajournal.com
IJFBS 2015; 2(6): 54-55
Received: 20-10-2015
Accepted: 23-11-2015

Kumari Anjana
Department of Zoology, LNMU
Kameshwar Nagar, Darbhanga, Bihar, India

Corresponding Author:
Kumari Anjana
Department of Zoology, LNMU
Kameshwar Nagar, Darbhanga, Bihar, India

Biological seasonal diversity and effect on ecosystem in planktonic primary production

Kumari Anjana

Abstract
Biological seasonal diversity and ecosystem effect is the result of the evolutionary plasticity of living organisms and increased geometrically through perhaps 2.5 billions years, proliferating by trial and error, controlled by natural selection, filling almost every one of the habitable ecological riches created in a likewise evolving world environment. Our paleontologists tell us that the numbers of species existing has fluctuated widely how widely we can never know with any certainty. The causes of these fluctuations have been subject to much speculation varying from gradual and normal climatic change to catastrophic changes even as great as the impact of a hypothetical gigantic meteor or asteroid with the terrestrial globe (Fosberg, 1986).

Keywords: Plankton, ecosystem

Introduction
The effect of biodiversity on ecosystem functioning is one of the major questions of ecology. However, the role of phytoplankton functional diversity in ecosystem productivity and stability under fluctuating environments remains largely unknown. Here we use a pond ecosystem model to study the effect of phytoplankton functional diversity on both ecosystem productivity and its stability for seasonally variable nutrient supply and temperature. Functional diversity ranges from low to high along these two environmental axes independently. Changes in diversity are obtained by varying the range of uptake strategies and thermal preferences of the species present in the community. Species can range from resource gleaners to opportunists and from cold to warm thermal preferences. The phyto-plankton communities self-assemble as a result of species selection by resource competition (nutrients) and environmental filtering (temperature). Both processes lead to species asynchrony but their effect on productivity and stability differ. The diversity of temperature niches has a strong and direct positive effect on productivity and stability due to species complementarily, while the diversity of uptake strategies has a weak and indirect positive effect due to sampling probability. These results show that more functionally diverse phytoplankton communities lead to higher and more stable ecosystem productivity but the positive effect of biodiversity on ecosystem functioning depends critically on the type of environmental gradient.

Materials and Method
For the measurement of Planktonic primary production light and dark bottle method of Gaarder and Gran (1927) was employed. The bottles were incubated for two hours twice. Before and after incubation period, dissolved Oxygen content was fixed and estimated by modified wrinkler's method. This experiment was repeated thrice in day time between 08 hours to 1600 hours and thereafter an average value of primary production was calculated. The productivity was calculated on the assumption that one atom of Carbon is assimilated for each molecules of Oxygen released. All Oxygen values were converted to Carbon values by multiplying with factor 12/31 where 12 stands for one mole of Carbon and 32 for one mole of Oxygen. By totaling the values of a water column, the photosynthetic rate under one square metre of water surface was determined in $gC/m^2/day$ (Odum 1963) [1]. A factor of 3.5 was also used as an approximate conversion of grams of Oxygen produced to Kilocalories of organic matter fixed by the plants in Photosynthesis (Odum 1975) [2].

Results

The monthly variation in Planktonic primary production in the pond under study are appended in the Table 1 which are as follows:

Gross Primary Productivity (GPP or P): It varied from 6.05 gC/m^2/day in arch and 17.90 gC/m^2/day in September. The value showed no definite trend in its rise and fall.

Annual Energy Flow: It ranged from 7689.02 in March and 2454.76 in September Kcal/m^2/year.

Net Primary Productivity (NPP): The minimum value 5.30 gC/m^2/day was observed in March and minimum 13.53 gC/m^2/day in October and it was also the range variation. No definite trend in its increase or decrease was noticed during the observation period.

Net Gross Ratio (GR): It ranged from 0.48 in November and 0.83 in August. Interestingly enough, the winter value was lower than summer value. No distinct trend in rise and fall in its content was noticed.

Community respiration (CR or R): It ranged between 2.55 in March and 8.68 in August. Higher values were recorded from June to September than other months.

Community respiration (CR as % of GPR): It ranged between 42.0% (March) to 67.4% (July). No definite trend of rise and fall was recorded.

Gross Productivity/Community Respiration (P/R): It varied from 1.45 in July and 2.58 in December. In summer value and winter value both were variable and had no definite trend.

Table 1: Biological seasonal diversity and effect on ecosystem in planktonic primary production of pond under study (from March 2009 to February 2010)

Months	GPP gC/m^2/day	GPP Kcal/m^2/day	NPP gC/m^2/day	NPP Vs GPP	CR gC/m^2/day	CR as % of GPP	P/R
March	6.05	7,689.02	5.30	0.76	2.55	42.0	2.38
April	12.83	16980.06	7.55	0.65	5.62	43.8	2.26
May	16.88	21865.66	10.58	0.73	7.35	42.5	2.26
June	12.50	17,366.39	6.78	0.55	7.45	59.3	1.69
July	11.18	15982.60	6.30	0.65	7.48	67.4	1.45
August	14.32	18,652.06	10.66	0.83	8.68	60.8	1.66
September	17.90	24534.76	12.88	0.74	8.68	47.6	2.09
October	16.86	23558.56	13.53	0.62	7.25	42.5	2.36
November	12.86	17,664.43	9.26	0.48	6.58	50.9	1.98
December	8.46	12,395.04	8.56	0.65	3.58	40.9	2.58
January	11.69	16,948.19	10.96	0.63	5.63	46.7	2.28
February	8.55	12,585.02	8.05	0.46	4.27	50.4	1.99

(GPP=Gross Primary Productivity; NPP=Net Primary Productivity, GR=Gross Ration, CR= Community Respiration)

Discussion

In the present studied in the manth pond, when the water temperature and transparency were relatively higher in the month of September-October, the productivity was the highest in June-July, in spite of high temperature, the production did not increase to higher level; instead it ranged from 12.60-11.10 gC/m^2/day whereas during the winter months, in spite of higher value of transparency, the productivity was recorded to be at lower level 8.43 gC/m^2/day perhaps due to low temperature. In this way it is obvious that a large difference between the values of these two parameters (transparency and temperature) at any given time shows lower rate of primary production to a considerable extent. Therefore, the present study indicated that temperature and light are equally important in determining the rate of production and both were limiting factors and which is in conformity with the findings of Shirodkar and Jay Kumar (1990) [6]; Sampath Kumar and Kannan (1998) [5]; Qayoom *et al.* (2004) [3] and Yadav and Shashi (2011) [4]. The quality and quantity of phytoplankton, soil, pH, Co$_2$ and Calcium content also played an important role.

Conclusion

During September-October when water temperature and transparency were relatively higher, the productivity was the highest (18.6gC/m^2/day). In winter, in spite of higher transparency, the productivity was the recorded to be at lower level. It was perhaps due to low temperature. In this way, it stated that large difference between the values of those parameters (transparency and temperature) at any given period, lowered the rate of primary production to a considerable extent which reveals that the temperature and light are equally important in determining the rate of production and proving both to be limiting factors so far as primary production factors effect and ecosystem effect is concerned.

Acknowledgement

The author are thankful to Department of Zoology, L.N.M.U Darbhanga, Bihar for providing necessary equipments to complete the entire research works.

Conflict of Interest

Authors declare that no conflict of interest regarding publication or any other activity related to this article.

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