Volume : 3 | Issue : 7 | July 2014 • ISSN No 2277 - 8179

Research Paper

Primary Productivity Studies in Nagaram Tank of Warangal District, Andhra Pradesh

Aquaculture

KEYWORDS : Aquatic Ecosystem,Nagaram Tank, Primary Productivity, Fluctuations

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ABSTRACT

Primary productivity is the most important biological parameter in. It is the manifestation of food as well as energy for flora and fauna. Primary Productivity has been used for potential index of productivity for many diverse ecosystems of the world.Primary production in aquatic ecosystem is mainly controlled by the interaction of many factors like environmental and biotic factors and the nutrient status of the water body.In aquatic ecosystem algae macrophytes and green bacteria are responsible for primary productivity (Gaarder and Graan 1927). The present investigations are Gross Primary Productivity (GPP), Net Primary Productivity (NPP) and Community Respiration (CR) in Nagaram Tank of Warangal district for a period of three years i.e., June 2007 to May 2010 were aimed at understanding the productivity potential of the tank for proper fish production. Primary Production 'in situ' was estimated by Gaarder and Gran(1927) "light and dark bottle method". The gross and net primary production and community respiration was calculated by using standard formula.

The Gross Primary Productivity of the tank followed a more or less similar trend of fluctuations and also exhibited an increasing trend through the rainy season towards summer season with distinct peaks during three years of study and lower values were observed during rainy season. It was clear that the Gross Primary Productivity changing significantly with seasons. Net primary productivity of Nagaram tank followed a more or less similar trend of fluctuations in all four stations exhibited an increasing trend towards a rainy season and winter season with distinct peaks while lower values of net primary productivity observed during rainy season. Community Respiration observation in the tank followed a similar trend of oscillation in all four stations lower values during winter season throughout the study period and exhibiting an increasing trend toward summer and rainy season.

INTRODUCTION

The measurement of the productivity are very essential for estimating the fish production potential and are one of the most important sources of energy input in fresh water ecosystem. The synthesis of basic food i.e. transformation of inorganic substances in to organic form is similar to that of terrestrial environment. It is of two types: Gross Primary Productivity (GPP) and Net Primary Productivity (NPP). During the past two decades there developed considerable interest in determining the values of primary production in global scale. The two important aspects of primary production are: (1) the determination of phytoplankton biomass and (2) measurement of the rates at which the biomass converts inorganic carbon to cell materials. The term primary production is frequently equated with primary productivity there by implying that is a measurement of the rate of the process.

Estimations of the primary production of the inland aquatic systems are most difficult,most of the studies are based on the measures of the productivity of the phytoplankton, periphyton or macrophysics. Literature pertaining to the studies on the primary productivity of fresh water bodies such as lakes and reservoirs from Indian sub continent is scanty (Sreenivasn, 1966; Dwivedy*et al.,* 1986; Sinha*et al.,* 1990 and Singh and Sharma 1999).

In last few decades, many contributions to primary productivity aspects have been carried out by several investigators.Vijaykumar*et al.,* (2000) studied on seasonal variation in the primary productivity of Gobbur tank, Gulberga, Karnataka. Saha and Mandal (2008) investigated chemical properties of water from sewage fed fish ponds in relation to primary productivity in West Bengal. Srikanth (2009) and Gowri (2009) were studied on the seasonal variations in primary productivity of certain fresh water bodies in Warangal district, Andhra Pradesh. Patil and NiranjanaChavan (2010) studied on primary productivity studies in some fresh water reservoirs of Sangli district, Maharashtra.

MATERIALS AND METHODS

The present investigation are Gross Primary Productivity (GPP), Net Primary Productivity (NPP) and Community Respiration (CR) in Nagaram tank of Warangal district for a period of three years i.e., June 2007 to May 2010 were aimed at understanding the productivity potential of the tank for proper fish production.Primary Production '*in situ*' was estimated by Gaarden and Gran (1927*)* "light and dark bottle method". The primary production study was always carried out after 1000hrs. The time of exposure (incubation period) in the present studies was for a period of 4.0hrs. The initial dissolved oxygen was determined by using the sample form the third bottle. Later, after the completion of incubation period, standard procedure to dissolved oxygen analysis, i.e. fixing the samples with manganese sulphate and alkali-iodide at the site of the study and transferred to the laboratory for further estimations.The gross and net primary production and community respiration was calculated by usingformula.

$$\text{GPP:} \quad \text{gc/m}^3\text{/hr} = \frac{DL - DD}{hr} \times 0.375$$

$$\text{NPP:} \quad \text{gc/m}^3\text{/hr} = \frac{DL - DI}{hr} \times 0.375$$

$$\text{CR:} \quad \text{gc/m}^3\text{/hr} = \frac{DI - DD}{hr} \times 0.375$$

RESULTS AND DISCUSSION:

Primary productivity is concerned with the evaluation of the capacity of an ecosystem, to the synthesis of organic matter. Primary production in aquatic ecosystem is mainly controlled by the interaction of many factors like environmental and biotic factors and the nutrient status of the water body. Primary productivity is the most important biological parameter in. In aquatic ecosystem algae macrophytes and green bacteria are responsible for primary productivity (Gaarder and Graan 1927).

Gross Primary Productivity (GPP): The Gross Primary Productivity (GPP) values of different stations from Nagaram tank during the year from June, 2007 to May, 2010 at all the stationsranged between 0.09 to 0.57gC/m3/hr. As far as seasonal variation, the minimum GPPwas recorded 0.19 ± 0.01 gC/m3/hr during the winter season of the year 2008-09 and maximum 0.49 ± 0.10 gC/m3/hr during rainy season of the year 2007-08.

The Gross Primary Productivity of the tank followed a more or less similar trend of fluctuations and also exhibited an increasing trend through the rainy season towards summer season with distinct peaks during three years of study and lower values were observed during rainy season. It was clear that the

Volume : 3 | Issue : 7 | July 2014 • ISSN No 2277 - 8179

Gross Primary Productivity changing significantly with seasons, nutritional fluctuations and viability of the producers. High primary productivity in the present study depends on the light penetration has also observed by Sreenivasan (1967).Sarada and Wesley (2006) have studied the Gross Primary Productivity of Mincoy lagoon of Lakshadweep, where the maximum GPP was recorded in premonsoon (23.14) followed monsoon season (17.8) and post monsoon period it decreased further. Several research reports are available on the relations between the productivity status and restoration of aquatic bodies (Zutshi and Vass, 1977; Singh, et,al., 1998, Govindasamy*et al.,* 2000 and Mandal*et al.,* 2005). Hujare and Mule (2007) studied the primary productivity in the perennial tanks from Kothapur district, Maharashtra. The present findings are similar with this study. Sarma*et al.,* (2007) recorded the annual gross primary productivity range was between 2.75 and 4.27 gC m-2 day -1. Higher range of primary productivity was observed in pre monsoon and in retreating monsoon. However, lower limit was observed in monsoon. Higher range of primary productivity in pre monsoon and retreating monsoon might be due to less amount of rainfall and high density of phytoplankton population.

Net Primary Productivity (NPP): The NPP values rangedbetween 0.02 to 0.38 gC/m3/hr during the year 2007-08. The minimum NPP was recorded in the month of October and maximum in January.As far as seasonal variation, the minimum NPP was recorded 0.14 ± 0.06 gC/m3/hr during the rainy season of the year 2008-09 and maximum 0.23 ± 0.04 gC/m3/hr during summer season of the 2009-10.

Net primary productivity of Nagaram tank followed a more or less similar trend of fluctuations in all four stations exhibited an increasing trend towards a rainy season and winter season with distinct peaks while lower values of net primary productivity observed during rainy season. There are quite number of reports on primary production of standing water bodies of India (Mandal*et al.,* 2005 and Patil and NiranjanaChavan, 2010). Sarma*et al.,* (2007) recorded the net primary productivity values fluctuated between 2.05 and 2.80 m-2mgl-1. Maximum range of net primary productivity in pre monsoon might be due to proliferation of phytoplankton as fresh rain helped in accumulation of organic matter from decomposed macrophytic vegetation. Ramakrishnayya (2000) have studied the primary productivity in 10 reservoirs of south Karnataka and opined that the high primary productivity status yields the higher fish productivity in the reservoirs, similar observations of high primary productivity values were observed during present study period.

Community Respiration (CR): The CR values of the tankranged between 0.13 to 0.54 gC/m3/hr. As far as seasonal variation, the minimum CR was recorded 0.15 ± 0.04 gC/m3/hr during the winter season of the year 2009-10 and maximum 0.42 ± 0.21 gC/m3/hr during summer season of the year 2007-08.

Community Respiration observation in the tank followed a similar trend of oscillation in all four stations lower values during winter season throughout the study period and exhibiting an increasing trend toward summer and rainy season. Similar observations were reported by Synudeen Sahib (2002) observed the highest values of CR in April and March at Parapper reservoir and Sasthamcotta lake respectively. Hujare and Mule (2007) in two perennial tanks from Kolhapur district.Kulkarni*et al.,* (2008) recorded the productivity of the Derala tank ranged between 100 and 275 mg/l. Patil and NiranjanaChavan (2010) studied that the productivity increased from winter and attains the peak in summer and then declines in monsoon. Highest rate of productivity during summer was probably due to bright sunlight and higher temperature. These observations also similar with the present findings on this tank. It is concluded that the water body is mesotrophic with moderate quantity of nutrients and can serve as a good habitat for fish fauna.

Table No. 1: Shows Seasonal variation of Primary Productivity (gC/m3 /hr) at Station- I during year 2007-2008

S. No.	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gross Primary Productivity	0.31	±	0.16	0.33	±	0.12	0.40	±	0.05
2	Net Primary Productivity	0.17	±	0.04	0.29	±	0.07	0.20	±	0.01
3	Community Respiration	0.26	±	0.08	0.234	±	0.04	0.42	±	0.21
	Total	0.75	±	0.28	0.86	±	0.24	1.02	±	0.27

Table No. 2: Shows Seasonal variation of Primary Productivity (gC/m3 /hr) at Station-I during year 2008-2009

S.No	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gross Primary Productivity	0.25	±	0.03	0.19	±	0.01	0.23	±	0.03
2	Net Primary Productivity	0.16	±	0.02	0.21	±	0.04	0.20	±	0.02
3	Community Respiration	0.23	±	0.03	0.18	±	0.06	0.23	±	0.10
	Total	0.64	±	0.08	0.58	±	0.11	0.66	±	0.15

Table No. 3: Shows Seasonal variation of Primary Productivity (gC/m3 /hr) at Station-I during year 2009-2010

S. No.	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gross Primary Productivity	0.41	±	0.06	0.44	±	0.11	0.45	±	0.05
2	Net Primary Productivity	0.16	±	0.04	0.21	±	0.07	0.37	±	0.40
3	Community Respiration	0.18	±	0.06	0.18	±	0.10	0.23	±	0.08
	Total	0.75	±	0.16	0.83	±	0.28	1.05	±	0.53

Table No. 4: Shows Seasonal variation of Primary Productivity (gC/m3/hr) at Station - II during year 2007-2008

S. No.	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gross Primary Productivity	0.39	±	0.05	0.47	±	0.05	0.42	±	0.11
2	Net Primary Productivity	0.19	±	0.01	0.28	±	0.08	0.22	±	0.04
3	Community Respiration	0.23	±	0.08	0.17	±	0.02	0.26	±	0.07
	Total	0.81	±	0.14	0.92	±	0.16	0.90	±	0.22

Table No. 5: Shows Seasonal variation of Primary Productivity (gC/m3/hr) at Station-II during year 2008-2009

S. No.	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gross Primary Productivity	0.20	±	0.08	0.28	±	0.01	0.22	±	0.04

2	Net Primary Productivity	0.14	±	0.06	0.21	±	0.02	0.21	±	0.03
3	Community Respiration	0.28	±	0.22	0.24	±	0.04	0.22	±	0.04
	Total	0.62	±	0.36	0.73	±	0.07	0.65	±	0.11

Table No. 6: Shows Seasonal variation of Primary Productivity (gC/m3/hr) at Station-II during year 2009-2010

S. No	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D		±	S.D
1	Gross Primary Productivity	0.45	±	0.04	0.44	±	0.06	0.47	±	0.06
2	Net Primary Productivity	0.18	±	0.02	0.21	±	0.04	0.16	±	0.00
3	Community Respiration	0.22	±	0.06	0.17	±	0.02	0.18	*	0.01
	Total	0.853	±	0.12	0.82	±	0.12	0.81	±	0.07

Table No. 7: Shows Seasonal variation of Primary Productivity (gC/m3 /hr) at Station-III during year 2007-2008

S. No	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gross Primary Productivity	0.40	±	0.06	0.45	±	0.04	0.49	±	0.09
2	Net Primary Productivity	0.20	±	0.03	0.23	±	0.15	0.22	±	0.04
3	Community Respiration	0.26	±	0.15	0.20	±	0.06	0.33	±	0.06
	Total	0.86	±	0.24	0.88	±	0.25	1.04	±	0.19

Table No. 8: Shows Seasonal variation of Primary Productivity (gC/m3 /hr) at Station-III during year 2008-2009

S. No	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gross Primary Productivity	0.27	±	0.02	0.26	±	0.09	0.29	±	0.02
2	Net Primary Productivity	0.16	±	0.01	0.19	±	0.03	0.24	±	0.03
3	Community Respiration	0.33	±	0.13	0.26	±	0.05	0.23	±	0.07
	Total	0.76	±	0.16	0.71	±	0.17	0.76	±	0.12

Table No. 9: Shows Seasonal variation of Primary Productivity (gC/m3 /hr) at Station-III during year 2009-2010

S. No	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gross Primary Productivity	0.43	±	0.04	0.45	±	0.05	0.46	±	0.08
2	Net Primary Productivity	0.20	±	0.03	0.25	±	0.03	0.28	±	0.22
3	Community , Respiration	0.20	±	0.06	0.15	±	0.04	0.18	±	0.04
	Total	0.83	±	0.13	0.85	±	0.12	0.92	±	0.34

Table No. 10: Shows Seasonal variation of Primary Productivity (gC/m3 /hr) at Station-IV during year 2007-2008

S. No	Parameters	Rainy		Winter		Summer	
		Mean	± S.D	Mean	± S.D	Mean	± S.D
1	Gross Primary Productivity	0.46	± 0.10	0.46	± 0.03	0.45	± 0.07
2	Net Primary Productivity	0.19	± 0.02	0.21	± 0.03	0.18	± 0.02
3	Community -Respiration	0.22	± 0.05	0.18	± 0.01	0.29	± 0.04
	Total	0.87	± 0.17	0.85	± 0.07	0.93	± 0.13

Table No. 11: Shows Seasonal variation of Primary Productivity (gC/m3 /hr) at Station-IV during year 2008-2009

S. No	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gros Primary Productivity	0.27	±	0.05	0.26	±	0.03	0.26	±	0.01
2	Net Primary Productivity	0.17	±	0.01	0.22	±	0.03	0.23	±	0.04
3	Community Respiration	0.28	±	0.08	0.23	±	0.05	0.23	±	0.09
	Total	0.73	±	0.14	0.71	±	0.11	0.72	±	0.14

Table No. 12: Shows Seasonal variation of Primary Productivity (gC/m3 /hr) at Station-IV during year 2009-2010

S. No	Parameters	Rainy			Winter			Summer		
		Mean	±	S.D	Mean	±	S.D	Mean	±	S.D
1	Gross Primary productivity	0.42	±	0.03	0.45	±	0.05	0.40	±	0.08
2	Net Primary Productivity	0.19	±	0.02	0.22	±	0.01	0.19	±	0.04
3	Community Respiration	0.22	±	0.05	0.16	±	0.03	0.19	±	0.06
	Total	0.83	±	0.10	0.83	±	0.09	0.78	±	0.18

Fig. 1 Showing Monthly variation of Primary Productivity at Station -1 during year 2007-2008

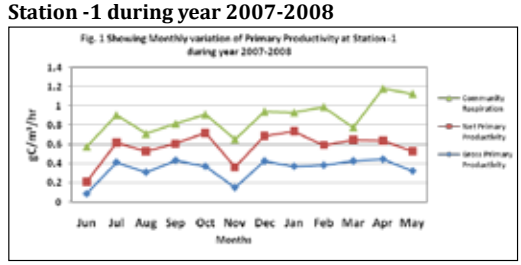

Fig. 2 Showing Monthly variation of Primary Productivity at Station -1 during year 2008-2009

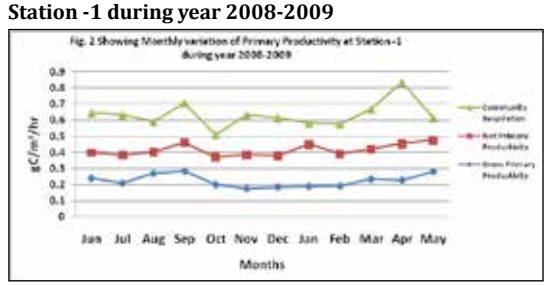

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Fig. 3 Showing sMonthly variation of Primary Productivity at Station -1 during year 2009-10

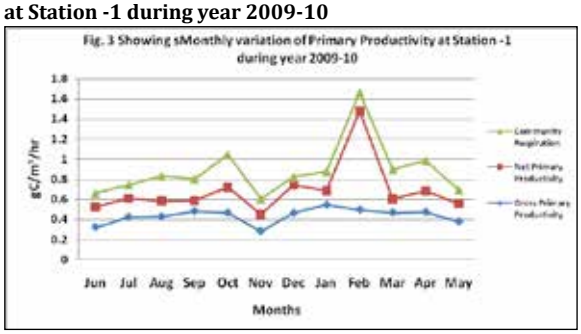


Fig. 4. Showing Monthly variation of Primary Productivity at Station - 2 during year 2007-08

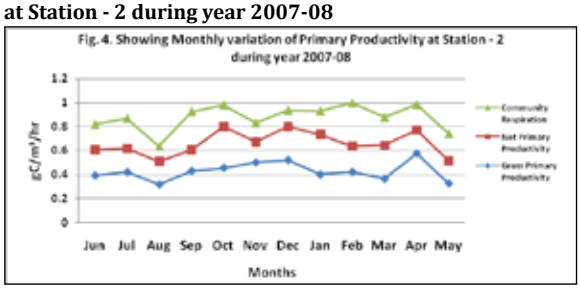


Fig. 5. Showing Monthly variation of Primary Productivity at Station - 2 during year 2008-09



Fig. 6. Showing Monthly variation of Primary Productivity at Station - 2 during year 2009-10

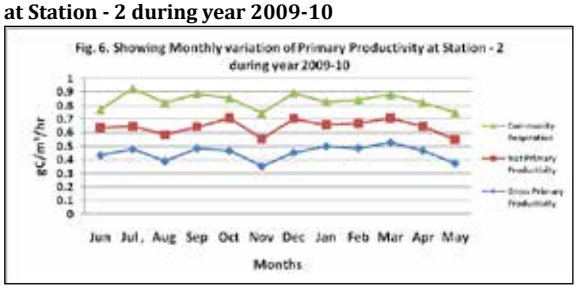


Fig. 7. Showing Monthly Variation of Primary Productivity at Station - 3 during year 2007-08

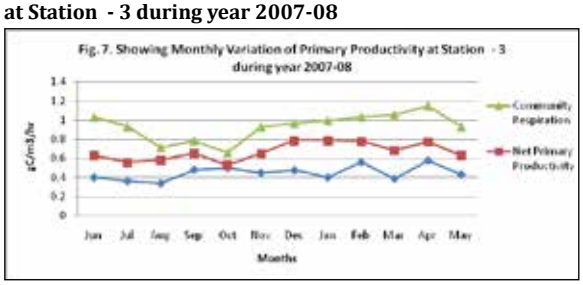


Fig. 8. Showing Monthly variation of Primary Productivity at Station - 3 during year 2008-09

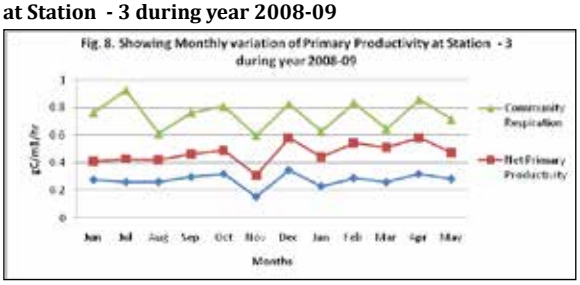


Fig.9. Showing Monthly variation of Primary Productivity at Station - 3 during year 2009-10

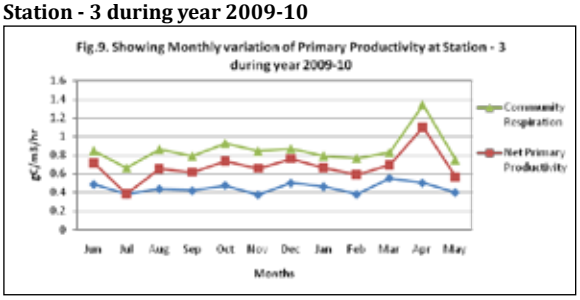


Fig. 10. Showing Monthly variation of Primary Productivity at Station - 4 during year 2007-08

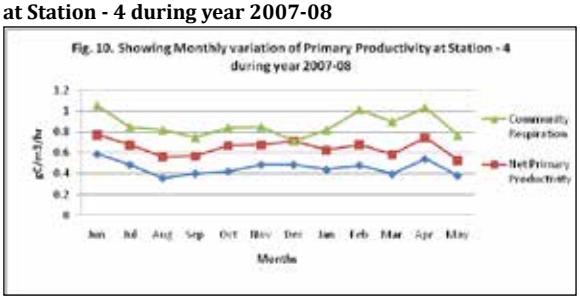


Fig. 11 Showing Monthly variation of Primary Productivity at Station - 4 during year 2008-09

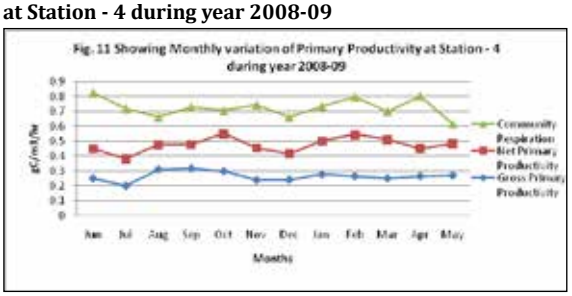
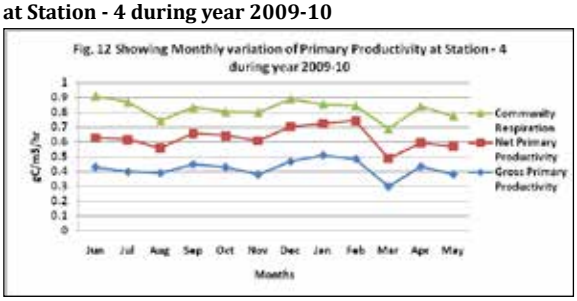


Fig. 12 Showing Monthly variation of Primary Productivity at Station - 4 during year 2009-10



REFERENCE

Dwivedi, R.K., S.J.Karamchandini, and H.C. Joshi (1986): Limnology and productivity of Kulgarhi reservoir, Madhya Pradesh. J. Inland Fish. Soc. India.18:65-70. | Gaarder, T. and H.H.Gran (1927): Investigations of the production of Plankton in the OS10 fiord. Rapp. P.V. Reun. Common. In. Wcientist. Mer. Mediterr. 42%1 – 48.. | GovindSwamy, C. Kaman. Land Jayapaul, Azaraiah (2000): Seasonal variation in Physico-chemical properties and primary production in the coastal water biotypes of Coromandel Coast, India. J. Environ. Biol. 21(1): 1-7. | Gowri, P. (2009): Studies on the Hydrobiology of perennial lakes with reference to fisheries. Ph.D, thesis submitted to Kakatiya University, Warangal, Andhra Pradesh. | Hujare, M.S and Mule, M.B., (2007): Studies on the primary productivity in the perennial tanks from Kolhapur district (Maharashtra), India. IndianJournal of Environ. andEcoplan., 14(3): 683-690. | Kulkarni, M.Y., Kulkarni, A.N. and Somvamshi V.S (2008): A Study on some aspects of Reservoir Fisheries of Derala Tank, Dist. Nanded, Maharashtra. Pro¬ceedings of Taal 2007; The 12th World Lake Conference: 568-570. | Mandal, O.P., Sinha, A.K and Sinha, K.M.P. (2005): Studies on primary productivity of a wetland. In: Fundamentals of Limnology. Edited by Arvind Kumar, pp. 230-237. | Patil.A and NiranjanaChawan (2010): Primary productivity studies in some fresh water reservoirs of Sangli district, Maharashtra Nat. Environ. andPollu. Tech, Vol. 9(1), pp. 101-103. | Ramakrishana. (2000): Limnological investigation and distribution of micro and macro invertebrates and vertebrates of Pox Sagarlake, Hyderabad. Rec. Zool. Surv. India. 98 (1): 169-196. | Saha.P.K and Mandal. L.N. (2008): Chemical properties of water from sewage fed fish ponds in relation to primary productivity, J. Inland Fish. Soc. India, 35(1) 35-41. | Sarada and S.Godwin Wesley (2006): Primary productivity of Mincon Lagoon, Lakshadweep. Ecol. Envi and Con. 12(4): pp.707-711. | Sarma. D., Dutta, A. and M. Choudhury (2007): Limnology and Fisheries Urpodbeel, Goalpara, Assam. J. Inland fish Soc. India, 39(1): 51-54. | Singh, SachchidaNand and Gupta M.L. (1998): Hydrobiological studies of some eutrophic ponds of Rotitas, Bihar, Env. Eco. 16(2): 457-462. | Singh, V.K. and A.P. Sharma. (1999): Hydrobiological characteristic and primary production in fish mannered with different organic manures. Indian. J. Fish. 46 (1): 79-85. | Sinha, O.K., S. P. Roy, and J.S.D. Munshi. (1990): Primary productivity of a Rivulet, a delelict and a managed fish pond of Dumka, Bihar. Envi.and Ecol. 8(1): 78-81. | Sreenivasan, A (1967): Tilapia mossambica – Its Ecology and status in Madras State, India. Madras. J. Fish. 3: 32 – 43. | Sreenivasan, A. (1966): The limnology of tropical impoundtnends, Hydrobiologi¬cal feature and fish production in Stenley Reservoir, Mettur dam Indian, Rev. Gen. Hydrobial51(2): 295 - 306. | Srikanth (2009): Ecological significance of freshwater fishes. Ph.D. Thesis, Kakatiya University, Warangal.(A. P). | Synudeen Sahib, S (2002): Primary productivity studies in some aquatic bodies of Kollam district, Kerala. Uttar Pradesh .J. Zool., 22(3): 247-250. | Vijaykumar, K., H. Anjinappa, Virupana, and C. Padmavathi. (2000): Seasonal variations in the Primary productivity of Gobbur tank, Gulbarga. Proc. Acad. Environ. Biol. 9 (2): 119-123. | Zutshi, D.D. and P.K. Vass. (1977): Estimates of phytoplankton production in Manssballake, Kashmir. Trop. Ecol. 18:103-108. |