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Studies on Primary Productivity of Bay of Bengal at Puri Sea-Shore in Orissa

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Abstract- Primary production refers to evaluation of the capacity of an ecosystem to build up, at the expense of external energy both radiant and chemical ,primary organic compounds of high chemical potentials for further transformation and flow to higher system levels. The highest values of gross, net primary production and biotic respirations were obtained during winter due to low water temperature, higher transparency, high dissolved oxygen values, bright and clear weather where as in summer because of high water temperature leading towards higher photosynthetic rate as well as higher metabolic rate, the primary productivity also become high and lower values during rainy season due to cloudy weather.

Index Terms- Primary production, gross primary production, net primary production, biotic respirations.

I. INTRODUCTION

Puri marine water offers one of the best lucrative fish landing center in Orissa, having high fishery potentialities and thus serves as one of the most important marine products. The composition of fish species is highly varied. The success of fishing operations depends upon the extent and efficiency of manpower (i.e. fishermen). Studies on the primary productivity in the Bay of Bengal especially in the inshore waters of mandapam, were initiated by the CIFRI in 1957 based on the production of organic matter, an assessment of the potential fishery resources in the inshore waters of the Gulf of Manner was made .Gradually, studies on Primary Productivity were extended to the South West of India and Laccadive sea during the IIOE, Considerable data on primary production.

The present study deals with Gross, net and community productivity of marginal sea water of puri sea beach.

II. MATERIALS & METHODS

Primary productivity

The water samples were collected from 50cm depth from the sea shore and observations were made in the middle of every month for a period of one year 2009 - 2010. For the estimation of primary productivity different techniques have been used by different workers viz. Radioactive Carbon (C^{14}), Chlorophyll Method and oxygen method by light and dark bottle (Gaarder and Gran, 1927) of these the last mentioned technique is relatively simple and does not require extensive instrumentation and therefore, it was used during the present investigation. Water samples were collected in triplicates around the middle of every month. The first sample bottle was used to determine the initial volume and dissolved oxygen following winklers volumetric method (Ellis *et al.,* 1948). The second bottle was painted with black colour to prevent the light penetration and photosynthesis and hence it served as a control to facilitates as the first one to measure the net production. Net production value when added to respiration value gives gross production. The last two bottles were incubated at 50cm. depth for a period of 24 hours, and the oxygen Concentration was measured. Oxygen value mgl $^{-1}$ were converted to carbon value by applying the equation suggested by Agarwal (1980).

$$\text{Production } (Mg^C) = \frac{(mgl^{-1}) \times 0.375}{PQ}$$

$$PQ = \frac{\text{Respiration}}{\text{Photosynthesis}}$$

PQ represents quotient – A compromise value of 1.25 was used which represents metabolism of sugars, some fats and proteins. The value of 0.375 represents a constant to convert the oxygen value (mgl^{-1}) to carbon value. Productivity values were expressed as $g^C\ m^{-3}\ day^{-1}$ assuming a 12 hour photo period and then converted to $g^C\ m^{-2}\ day^{-1}$ multiplied by average water depth.

Puri is one of the coastal districts of Orissa, having a coastline of 155 Kms out of the total coast line of 480 Kms of the state. Puri is present between 18,450 E to 19,400W (Latitude) and 85,480N to 84,270S (Longitude). However Sea Shore of puri bifurcate at 20.28^0N to 85.52^0E to puri in Orissa.

III. RESULTS AND DISCUSSION

Mean data of Gross and Net Primary Production along with biotic respiration and NPP/GPP ratios of three different stations are presented in table –(1 & 2) and graphically represented in figure(Fig:1-5).

Station -1 = s_1 -> Penthakata, Station – 2 = s_2 -> Sapakothi , Station – 3 = s_3 -> Ramachandi

The minimum gross production (135.52 $g^C/m^2/day$) was obtained at S_2 and the maximum (298.88 $g^C/m^2/day$) at S_1. The gross and net Primary Productions (298.88 $g^C/m^2/day$ and 190.86 $g^C/m^2/day$) were at their peaks during February. The maximum biotic respiration was obtained at S_1 (108.16 $g^C/m^2/day$) and the minimum at S_2 (41.90 $g^C/m^2/day$). The higher values of gross primary production,net primary production and biotic respirations were obtained during winter and summer seasons and the lower values were obtained during rainy season.

The weather condition affects the productivity in aquatic ecosystem. This statement hold good as the higher values of net, gross primary productions were reported from October to May when weather condition was bright and clear. Lower Production value during rainy season may be due to cloudy weather organic affluent in water, low transparency and high water current (Hutchinson, 1957). Besides, the poor nutrient concentration of phosphates and total Nitrogen may bring about the low productivity values,(Pasternak and Kasza, 1979). It appears that there is a direct correlation between temperature and production, which is in agreement with Srenivasan(1964),Hall&Moll(1975),Goldman and Wetzel(1963),Mohanty(2000),Pauly & Chirstensen (1995) and Thomas *et al.,* (1980). In the present study productivity values were high (136.0g^c/m^2/day to 298.2/g^c/m^2day) at low temperature (23.0^0C-31.0^0C).

Generally productivity is the manufacture of living substances through the interaction of constituents of the natural environments as they are self sustaining in nature. This production of organic material is done by autotroph level as the nutrients are being transferred to the higher levels of food chain. The biological producer level comprises of the chlorophyll bearing phytoplankton and photoautotroph organisms and are the primary level of synthesizing food material from inorganic food stuff in the presence of solar radiation in the aquatic environment, of the total solar energy in organic substances. The energy of carbohydrates formed, represents the gross and net primary production and is the sum of the energy present in photosynthesis.

Primary production values vary in order of $S_1>S_3>S_2$. The increased nutrient concentration and higher temperature results in higher algal population, which in turn helps in higher productions.

Table1- Monthly Variation in Primary Productivity (gC m-2 day -1) of three stations at Puri- on- sea During 2009- 2010

		Station-1				Station-2				Station-3				
Months	Weather condition	Gross Primary Productivity ($g^C m^{-2} day^{-1}$)	Net Primary Productivity ($g^C m^{-2} day^{-1}$)	Biotic respiration (CR) ($g^C m^{-2} day^{-1}$)	NPP / GPP	Gross Primary Productivity ($g^C m^{-2} day^{-1}$)	Net Primary Productivity ($g^C m^{-2} day^{-1}$)	Biotic respiration (CR) ($g^C m^{-2}$ day-1)	NPP / GPP	Gross Primary Productivity ($g^c m^{-2}$ day-1)	Net Primary Productivity ($g^C m^{-2}$ day-1)	Biotic respiration (CR) ($g^C m^{-2}$ day-1)	NPP / GPP	Tem. Of Water (oC)
April	Bright Sunny	216.34 ± 12.3	143.86 ± 8.5	72.48 ± 4.5	0.665 ± 0.39	215.3 ± 12.3	143.82 ± 8.5	71.48 ± 4.5	0. 668 ± 0.39	216.43 ± 12.3	143.84 ± 8.5	73.08 ± 4.6	0.663 ± 0.39	31.0
May	Bright Sunny	192.4 ± 11.6	118.52 ± 6.8	73.89 ± 4.6	0.616 ± 0.21	193.2 ± 11.7	128.09 ± 7.7	65.11 ± 4.1	0.663 ± 0.39	192.84 ± 11.8	122.54 ± 7.4	70.3 ± 4.4	0.613 ± 0.21	32.4
June	Bright Sunny	142.0 ± 8.4	93.88 ± 5.7	48.52 ± 2.9	0.662 ± 0.38	141.92 ± 8.3	96.36 ± 5.9	45.56 ± 2.7	0.679 ± 0.39	141.73 ± 8.3	94.42 ± 5.8	47.3 ± 2.9	0.668 ± 0.39	29.8
July	Cloudy & Rainy	139.8 ± 8.6	93.38 ± 5.7	46.42 ± 2.8	0.668 ± 0.39	139.2 ± 8.3	97.30 ± 6.0	41.90 ± 2.6	0.699 ± 0.39	139.62 ± 8.3	95.55 ± 5.9	44.07 ± 2.6	0.684 ± 0.37	30.1
August	Cloucy & Rainy	137.9 ± 8.2	87.29 ± 5.4	50.61 ± 3.0	0.633 ± 0.29	137.8 ± 8.2	84.05 ± 5.0	53.75 ± 3.4	0.610 ± 0.22	137.62 ± 8.1	86.64 ± 5.1	50.98 ± 3.1	0.615 ± 0.23	28.4
Sep.	Cloudy	136.0 ± 8.1	84.45 ± 5.3	51.55 ± 3.1	0.621 ± 0.24	135.52 ± 8.0	88.47 ± 5.3	47.43 ± 2.9	0.651 ± 0.36	135.9 ± 7.9	86.86 ± 5.1	48.68 ± 2.9	0.640 ± 0.30	29.2
Oct.	Bright	187.4 ± 11.3	103.63 ± 6.3	83.77 ± 4.9	0.553 ± 0.36	187.2 ± 11.2	103.52 ± 6.3	83.68 ± 4.9	0.553 ± 0.28	187.8 ± 11.3	103.56 ± 6.3	84.04 ± 5.0	0.552 ± 0.28	30.8
Nov.	Bright	188.2 ± 11.3	131.17 ± 8.0	57.03 ± 3.3	0.697 ± 0.47	188.0 ± 11.3	133.48 ± 8.3	54.52 ± 3.3	0.710 ± 0.49	188.4 ± 11.3	132.54 ± 8.1	55.86 ± 3.4	0.703 ± 0.48	24.0
Dec.	Bright	188.66 ± 11.3	124.70 ± 7.5	63.36 ± 3.9	0.661 ± 0.38	188.64 ± 11.3	122.99 ± 7.3	65.65 ± 4.1	0.652 ± 0.36	188.6 ± 11.3	124.25 ± 7.5	64.35 ± 4.0	0.658 ± 0.37	22.4
January	Bright	190.2 ± 11.5	122.29 ± 7.3	67.91 ± 3.9	0.643 ± 0.30	190.4 ± 11.5	122.42 ± 7.3	67.98 ± 3.9	0.663 ± 0.39	109.6 ± 6.9	122.45 ± 7.3	68.15 ± 4.0	0.648 ± 0.30	22.9
Frebuary	Bright	298.88 ± 17.3	190.54 ± 11.5	108.16 ± 6.4	0.639 ± 0.29	297.3 ± 17.2	190.86 ± 11.5	106.44 ± 6.3	0.642 ± 0.30	298.2 ± 17.3	190.72 ± 11.5	107.66 ± 6.5	0.638 ± 0.28	25.4
March	Bright	238.24 ± 13.5	155.09 ± 9.3	83.15 ± 4.9	0.651 ± 0.36	238.0 ± 13.5	155.41 ± 9.3	82.59 ± 4.8	0.653 ± 0.36	238.82 ± 13.5	155.35 ± 9.3	83.47 ± 4.9	0.650 ± 0.36	28.0

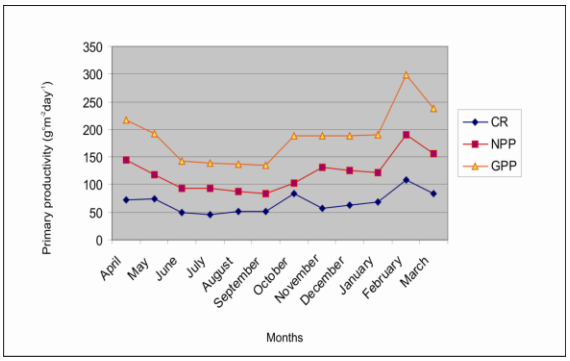


Fig. 1 (i) Monthly variations in primary productivity (GPP, NPP & CR) at S_1 of Puri-on-Sea during 2009 – 2010 (in $g^C m^{-2} day^{-1}$).

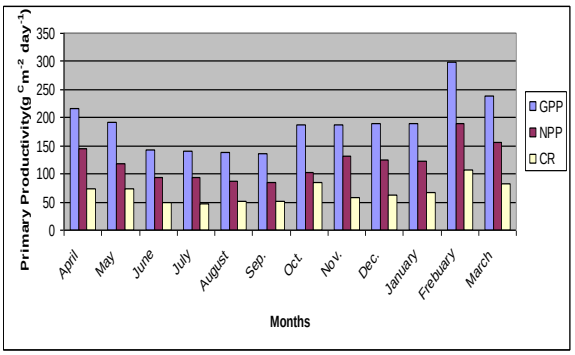


Fig.1(ii) Monthly variations in primary productivity (GPP, NPP & CR) at S_1 of Puri-on-Sea during 2009 – 2010 (in $g^C m^{-2} day^{-1}$).

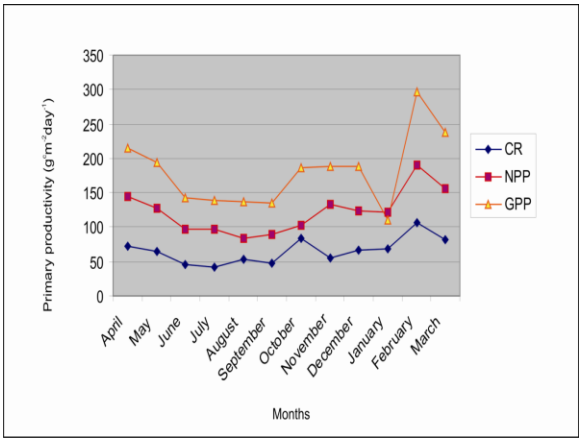


Fig. 2 (i) Monthly variations in primary productivity (GPP, NPP & CR) at S_2 of Puri-on-Sea during 2009 – 2010 (in $g^C m^{-2} day^{-1}$).

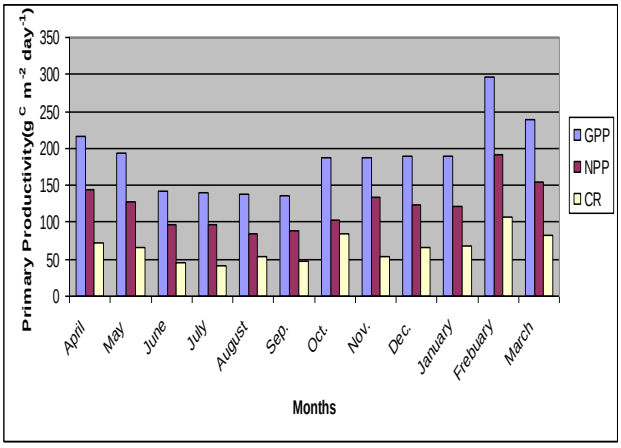


Fig. 2 (ii) Monthly variations in primary productivity (GPP, NPP & CR) at S_2 of Puri-on-Sea during 2009 – 2010 (in $g^C m^{-2} day^{-1}$).

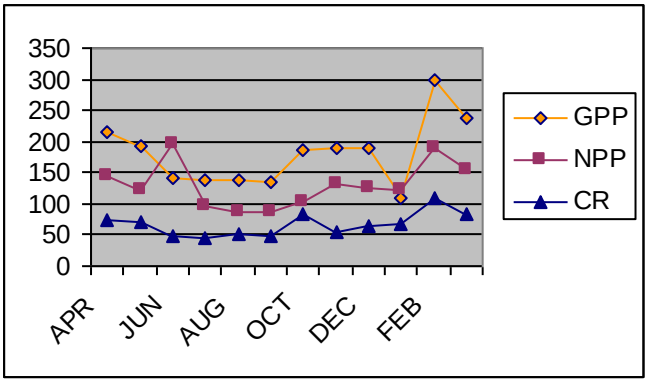


Fig 3 (i) Monthly variations in primary productivity (GPP, NPP & CR) at S_3 of Puri-on-Sea during 2009 – 2010 (in $g^C m^{-2} day^{-1}$).

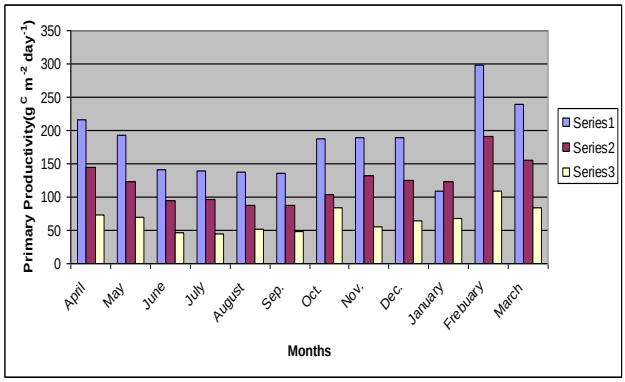
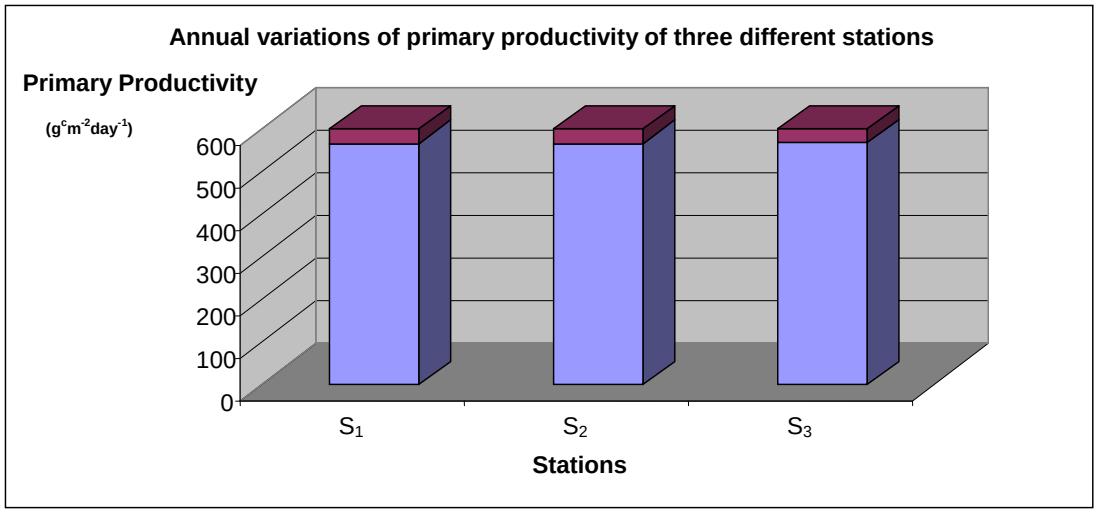


Fig 3 (ii) Monthly variations in primary productivity (GPP, NPP & CR) at S_3 of Puri-on-Sea during 2009 – 2010 (in $g^C m^{-2} day^{-1}$).

Table 2 : Shows the seasonal variations in primary productivity.

Station No.	Winter (October-January)	Summer (Feb. – May)	Rainy (June- Sep)	Annual
S_1	188.6 ± 11.35	236.8 ± 13.72	138.9 ± 8.32	564.2 ± 32.07
S_2	188.5 ± 11.32	235.9 ± 13.67	138.6 ± 8.15	563.1 ± 33.19
S_3	188.8 ± 10.2	236.2 ± 13.67	138.7 ± 8.20	563.7 ± 33.39



Station

Fig. 4 Shows annual variations of primary productivity at three different stations.

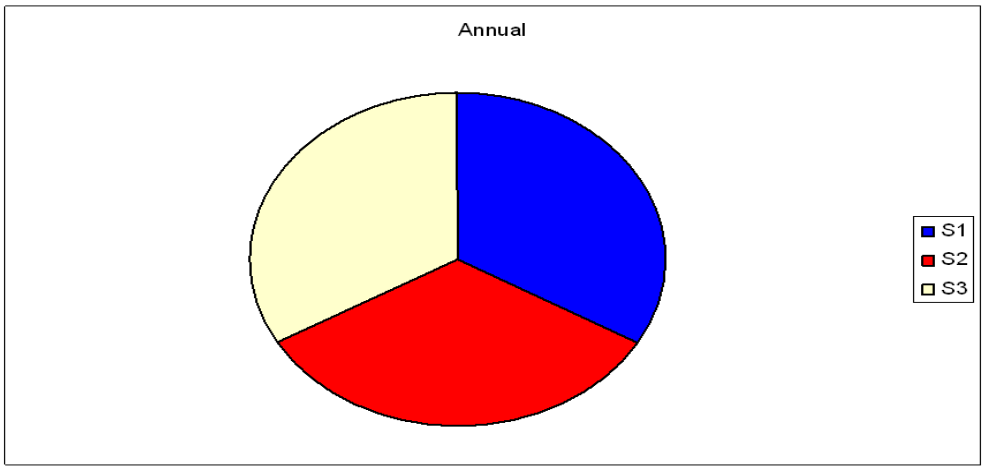


Fig 5. Annual variations of GPP at S_1,S_2,S_3 during 2009 - 2010 at Puri –on-sea.

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