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AN ECOLOGICAL STUDY ON PRIMARY PRODUCTIVITY AND ENERGY DYNAMICS OF WETLAND OF HAFIZPUR , SARAN

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ABSTRACT:

At the Site-1, net primary productivity ranged 3850 mg C/m^2/day with an annual mean±S.D. of 2769.76±983.64mg C/m^2/day . Maximum NPP (4150 mg C/m^2/day) was recorded during February and minimum (400 mg C/m^2/day) in May .Net primary productivity in the Site-2 ranged 5200 mg C/m^2/day with an annual mean±S.D. of 2231.26±1202.1 mg C/m^2/day .Maximum NPP (5200 mg C/m^2/day) was observed in February and minimum (0 mg C/m^2/day) in August. Community respiration at the Site-1 ranged 2575 mg C/m^2/day with an annual mean ±S.D. of 6618.76±626.91 mg C/m2/day .Maximum community respiration (2650 mg C/m^2/day) was recorded during October and minimum (76mg C/m^2/day) in August . At the Site-2 community respiration ranged 3625 mg C/m^2/day with an annual mean ±S.D. of 2331.26±887.21mg C/m^2/day. Maximum community respiration (3775 mg C/m^2/day) was observed in October and minimum (250 mg C/m^2/day) in May.

INTRODUCTION:

In aquatic ecosystems, production estimates relied on changes in the concentrations of oxygen or carbon dioxide measured in experimental enclosures. Increasing sophistication in the measurement, in situ, of chlorophyll concentrations and of the gases involved in photosynthesis, coupled with the development of satellite remote-sensing techniques, now permit the extrapolation of local results to the global scale. Before proceeding further, it is necessary to define some new terms. The bodies of the living organisms within a unit area constitute a standing crop of biomass.

By biomass we mean the mass of organisms per unit area of ground (or per unit area or unit volume of water) and this is usually expressed in units of energy (e.g. J m^{-2}) or dry organic matter (e.g. t ha^{-1}) or carbon (e.g. g C m^{-2}).

Biomass includes the whole bodies of the organisms even though parts of them may be dead. This needs to be borne in mind, particularly when considering wetland in which the bulk of the biomass is dead macrophytes.

The living fraction of biomass represents active capital capable of generating interest in the form of new growth, whereas the dead fraction is incapable of new growth. In practice we include in biomass all those parts, living or dead, which are attached to the living organism. They cease to be biomass when they fall off and become litter, humus or peat.

The primary productivity of a community is the rate at which biomass is produced per unit area by plants, the primary producers. It can be expressed either in units of energy (e.g. Jm^{-2} day^{-1}) or dry organic matter (e.g. kgha^{-1} year^{-1}) or carbon (e.g. gCm^{-2} year^{-1}). The total fixation of energy by photosynthesis is referred to as gross primary productivity (GPP). A proportion of this is respired away by the plants (autotrophs) and is lost from the community as respiratory heat

(RA – autotrophic respiration) between GPP and RA is known as net primary productivity (NPP) and represents the actual rate of production of new biomass that is available for consumption by heterotrophic organisms (bacteria, fungi and animals). Estimating net primary production is relatively easy on small areas or in small bodies of water, but estimating primary production on a global basis requires satellite imagery. The general approach has been to measure the amount of solar radiation and to correct it for the efficiency of light use by plants.

MATERIALS AND METHODS:

Winkler's dark and light bottle method was used to determine the pond's primary production. These bottles were carefully filled with the water samples and were incubated on spot for 24 hrs at a depth of 10 cm .

Gross Primary Productivity (GPP) was estimated by multiplying the difference of dissolved oxygen content in light and dark bottles (after 24 hours of incubation), with 0.375 as described in APHA (1998). The results were expressed in terms of organic carbon generated as mg C/m^2/day.

Net Primary Productivity (NPP) was estimated by multiplying the increment of dissolved oxygen content in light bottle from initial field DO value (after 24 hours of incubation), with 0.375 as described in APHA (1998). The results were expressed in terms of organic carbon generated as mg C/m^2/day.

Community Respiration (CR) was calculated by subtracting the NPP from GPP (APHA, 1998). The results were expressed in terms of organic carbon utilised as mg C/m2/day.

RESULTS AND DISCUSSION:

Gross primary productivity at the Site-1 ranged 4000 mg C/m^2/day widely with an annual mean ±S.D. of 3287.51±1032.08 mg C/m^2/day. Maximum GPP (4450 mg C/m^2/day) was recorded during November to February and minimum (550 mg C/m^2/day) in May. On the other hand, GPP in the Site-2 ranged 6175 mg C/m^2/day with an annual mean ±S.D. of 3562.51±1544.31 mg C/m^2/day . Maximum GPP (6475 mg C/m^2/day) was observed in February and minimum (400 mg C/m^2/day) in May .

At the Site-1, net primary productivity ranged 3850 mg C/m^2/day with an annual mean±S.D. of 2769.76±983.64mg C/m^2/day . Maximum NPP (4150 mg C/m^2/day) was recorded during February and minimum (400 mg C/m^2/day) in May .Net primary productivity in the Site-2 ranged 5200 mg C/m^2/day with an annual mean±S.D. of 2231.26±1202.1 mg C/m^2/day. Maximum NPP (5200 mg C/m^2/day) was observed in February and minimum (0 mg C/m^2/day) in August.

Community respiration at the Site-1 ranged 2575 mg C/m^2/day with an annual mean ±S.D. of 6618.76±626.91 mg C/m2/day. Maximum community respiration (2650 mg C/m^2/day) was recorded during October and minimum (76mg C/m^2/day) in August . At the Site-2 community respiration ranged 3625 mg C/m^2/day with an annual mean ±S.D. of 2331.26±887.21mg C/m^2/day. Maximum community respiration (3775 mg C/m^2/day) was observed in October and minimum (250 mg C/m^2/day) in May.

Trophic status of an ecosystem depends upon rate of energy flow which may be assessed by estimating primary production. Gross primary productivity is a measure of new organic matter created in the water body (Wetzel 2001). Bhatnagar et al. (2004) recommended 1600-9140 mg C/m^2/day GPP as optimum status and <1600 or >20300 mg C/m^2/day GPP as poor productivity of a wetland in terms of fish culture. Hence, both

sites under study are ecologically suitable for fish culture in terms of their GPP.

Table-1: Primary Productivity of Bhiara wetland, south areas in 1st year

	Apr	**May Feb**	**Jun Mar**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**
Net Primary Productivity (mg C/m2 /day)	1900	400	1000	1825	1060	1900	1060	1950	2860	4000 3160 1700
Gross Primary Productivity (mg C/m2 /day)	2500	460	1360	0	1130	1960	2800	3550	3040	3450 3460 1900
Community Respiration (mg C/m2 /day)	700	160	460	160	80	160	1750	1600	700	500 400 160

Table-2: Primary Productivity of Bhiara wetland, north areas in 1st year

	Apr	**May Feb**	**Jun Mar**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**
Net Primary Productivity (mg C/m2 /day)			1500	150	150	1575	0	600	600	1650 975 2575 4200 800
Gross Primary Productivity (mg C/m2 /day)			1950	300	750	1800	1650	1950	3375	3600 3600 4500 5475 1800
Community Respiration (mg C/m2 /day)			450	150	600	225	1650	1350	2775	1950 2625 1925 1275 1000

Table-3: Primary Productivity in Bhiara wetland ,south areas 2nd year

	Apr	**May Feb**	**Jun Mar**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**
Net Primary Productivity (mg C/m2 /day)			1800	300	1000	1820	1050	1800	1050	1940 28500 4000 3140 1600
Gross Primary Productivity (mg C/m2 /day)			2500	450	1360	0	1120	1960	2700	3550 3030 3450 3450 1900
Community Respiration (mg C/m2 /day)	700	160	460	160	80	160	1750	1500	700	400 400 160

Table-4: Primary Productivity parameters in Bhiara wetland ,north areas 2nd year

	Apr	May Feb	Jun Mar	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Net Primary Productivity (mg C/m2 /day)			1400	140	140	1575	0	400	500	1640 970 2560 4100 700
Gross Primary Productivity (mg C/m2 /day)			1800	2000	740	1700	1640	1950	3360	3500 3500 4500 5460 1700
Community Respiration (mg C/m2 /day)			450	1540	600	220	1640	1350	2760	1850 2623 1922 1274 1000

Primary productivity may be reported as net or gross. Net primary productivity represents the total amount of new organic matter synthesized by photosynthesis less the amount the organic matter used for respiration by the producers. It is the actual amount of food (organic carbon) that is available to the

next trophic level i.e. - primary consumers (Odum, 1984).

From productivity point of view, NPP of a wetland is more important than its GPP (Paul et al. 2007). The ideal value of net primary productivity in a wetland under Indian conditions is 1000-2500 mg $C/m^2/day$ (Santhosh and Singh, 2007). In the present study, both the sites have NPP within its optimum range for fish culture. However, the site-1 seems to be more productive than its counterpart, which may be due to its voided and unutilized ecological niches giving rise to its higher NPP (Huet, 1975).

The difference between GPP and NPP gives the value of community respiration. It is considered as an indirect measure of plankton abundance in water, chiefly phytoplankton (Wetzel, 2001). There are no standard values set for optimum range of community respiration desirable in a wetland (Bhatnagar et al., 2004; Santhosh and Singh, 2007). However from the present study, it can be said that the site-2 has higher abundance of fish food organisms than its site-1 counterpart, making the site-2 more productive.

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