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Energic value of phytoplankton in relation to water quality of the river Gomati at Jaunpur

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SUMMARY

Monthly variation in algal GPP, NPP, CR, per cent respiration as well as NPP : GPP and NPP : R ratio were studied at four sampling sites of the river Gomati at Jaunpur (U.P.). Maximum value of GPP was found at S1 in May while lowest at S2 in August. Usually at all the sites, NPP were lower than S1. Baning a few expectations community respiration (CR) was usually less than 50% at all stations except S4 where values invariable exceed more than 50% and reached upto 92% in June. NP : GP ratio showed an increasing trend from S1 to S4. NP : GP ratio was generally more than one except few months and sites. Thus, on the basis of productivity and community respiration, it may be concluded that river is polluted in whole stretch of the city. Therefore, there is an urgent need for an effective management action plan to save the river.

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Key words : Energic value, Phytoplankton, Productivity, Water quality, River Gomati

River, an important component of water resource, is the need for the development of an area. The flow of water plays an important role for determining the habitat conditions, distribution of abiotic and biotic constituents and horizontal movement of water mass of the river ecosystem. Algal flora consists of a diverse assemblage of nearly all major taxonomic groups. Many of the forms have different physiological requirements and show variation to physico-chemical parameters *viz*., light, temperature and nutrient regimes (Kumar, 1996). The community structure and abundance of planktonic algae are dependent on the physico-chemical nature of the river water is, primarily, synthesis of the primary producer and products are transferred to the consumers through different trophic levels.

Primary productivity has been used as potential index of productivity for many diverse ecosystem of the world (Wetzel, 1966) and gives a quantitative information about the amount of energy available to support the bioactivity of the system. The contribution of productivity studies were made by Gaarder and Gran (1927). The biological information alongwith physio-chemical information can be of great significance for river water quality monitoring because of flowing conditions which allow the pollutants to wash away leaving behind only the affected biota. Due to change in hydrochemistry of the river water as a result of pollution, the planktonic community is seriously affected (Harikrishna and Aziz, 2000; Kumar *et al.,* 2001; Pandit *et al.,* 2008; Singh *et al.,* 2010). There is a paucity of data on productivity in relation to physico-chemical properties of the river Gomati at Jaunpur. Hence, to fulfill this gap of knowledge and to provide the basic ecological information, the present investigation was undertaken to assess the effect of sewage and effluents on phytoplankton productivity of the river Gomati at Jaunpur (U.P.).

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MATERIALS AND METHODS

Four sampling sites *viz*., Kalichabad ghat (S_1), Hanuman ghat (S_2); Achaladevi ghat (S_3) and Ramghat (S_4) to cover the whole distance of the river in city, were selected for the study of algal productivity in the river. Kalichabad ghat (S_1) was considered as control site of the river, S_2 and S_3 were the mixing zone and S_4 was selected as down stream of the river. Samples were collected in the secondd week of each month from the selected sampling sites in stoper bottle and brought to the laboratory for final analysis. The bottles were labelled as initial bottle (IB), light bottle (LB) and dark bottle (DB). Dark bottles were wrapped by black carbon paper. Water samples were treated with manganous sulphate ($MnSO_4$), alkaline + iodine and sulphuric acid to fix the initial concentration of oxygen. Primary productivity and respiration were measured by estimating the changes in dissolved oxygen content by light and dark bottle method (Gaarder and Gran, 1927) and dissolved oxygen was estimated by Winkler's metod (APHA, 1985). Recorded oxygen values were converted into equivvalent carbon value and the rate of production and respiration were expressed as $MgCl^{-1}h^{-1}$.

RESULTS AND DISCUSSION

Monthly variation in phytoplankton (algal) gross primary productivity (GPP) and net primary productivity (NPP), community respiration (R), per centage respiration as well as NPP/GPP and NPP/R, ratio are given in Fig. 1-4. The GPP ranged between 0.4 ±0.05gC $l^{-1}.d^{-1}$ in August to 3.75 ±0.12gC $l^{-1}.d^{-1}$ in May at S_1, 0.20 ±0.05gC $l^{-1}.d^{-1}$ in August to 2.08 ±0.10gC $l^{-1}.d^{-1}$ in June at S_2; 0.25 ±0.05gC $l^{-1}.d^{-1}$ in Aug. to 2.18 ±0.10gC $l^{-1}.d^{-1}$ in May at S_3; 0.33 ±0.12gC $l^{-1}.d^{-1}$ in Aug to 2.78 ±0.05gC $l^{-1}.d^{-1}$ in May S_4. Maximum value of GPP was found at S_1 in May while lowest at S_2 in Aug. (Fig. 1).

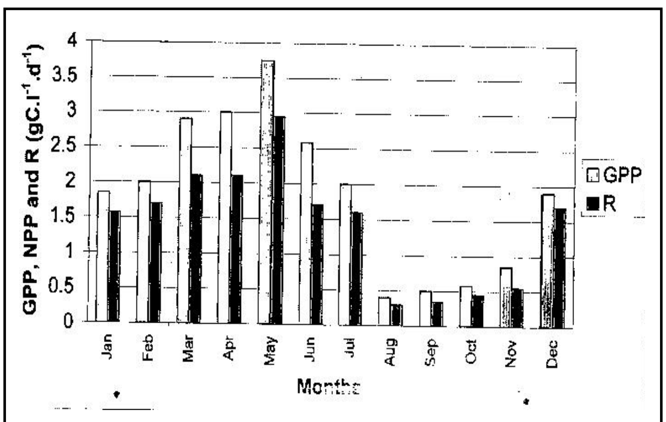

Fig. 1 : Monthly variation in algal primary productivity and respiration at S1 sampling site of river Gomati at Jaunpur

NPP of the river varied from 0.15 ±0.05gC $l^{-1}.d^{-1}$ to 2.95 gC $l^{-1}.d^{-1}$ at different stations (Fig. 1- 4). It varied from 0.3 4 ±0.02gC $l^{-1}.d^{-1}$ 1.26 ± 0.15 gC $l^{-1}.d^{-1}$ in June at S_2; 0.02 ± 0.01 gC $l^{-1}.d^{-1}$ (June) to 1.65 ± 0.01 gC $l^{-1}.d^{-1}$ in May at S_3; 0.25 ± 0.07 gC $l^{-1}.d^{-1}$ in September to 1.69 ± 0.12 gC $l^{-1}.d^{-1}$ in June at S_4 (Fig. 1-4). Usually at all the sites the NPP were lower than S_1.

The community respiration values ranged between

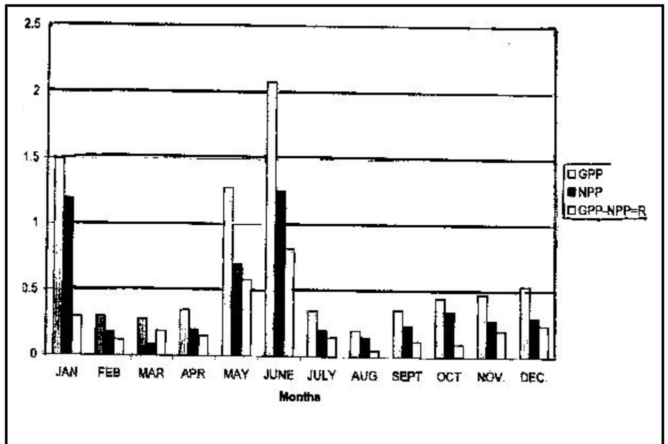

Fig. 2 : Monthly variation in primary productivity of river Gomati at S2 in Jaunpur

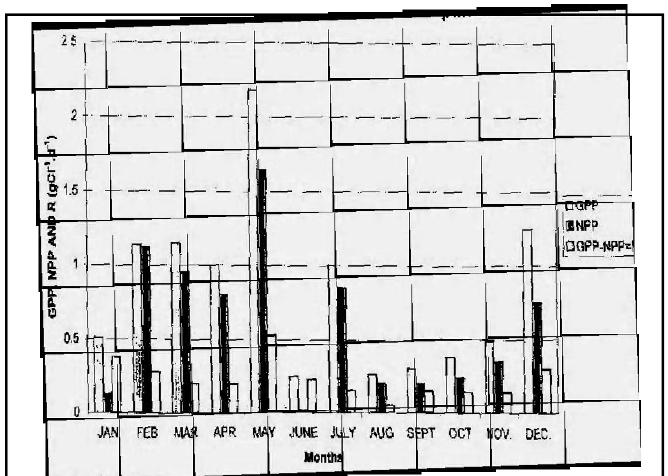

Fig. 3 : Monthly variation in algal primary productivity at sampling site S3 of river Gomati at Jaunpur

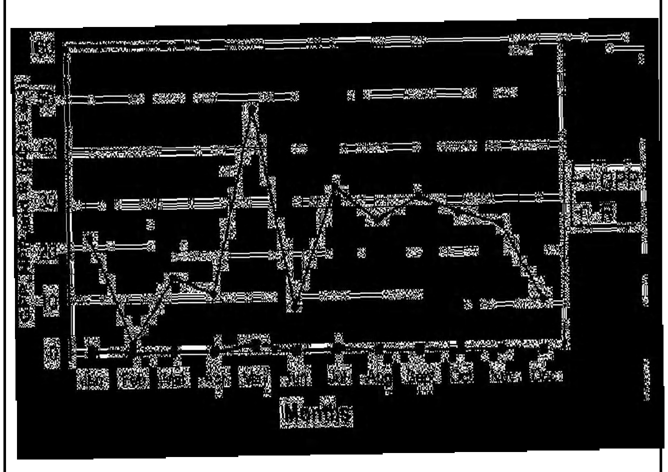

Fig. 4 : Monthly variation in algal productivity at sampling site S4 of river Gomati at Jaunpur

0.1 gC l^{-1}.d^{-1} (Aug.) to 0.9 gC l^{-1}.d^{-1} (April) at S_1; 0.05 gC l^{-1}.d^{-1} (Aug) to 0.82 gC l^{-1}.d^{-1} (June) at S_2; 0.05 gC l^{-1}.d^{-1} (Aug.) to 0.53 gC l^{-1}.d^{-1} (May) at S_3; and 0.02 gC l^{-1}.d^{-1} (Feb.) to 1.33 gC l^{-1}.d^{-1} (May) at S_4 (Fig. 1-4). Respiration values have also been expressed as per centage of GPP and ranged between 10.53% to 40% at S_1; 2.50% to 67.85% at S_2; 5.32% to 92% at S_3; 1.66% to 47.84% at S_4. It is noticeable that baring a few exceptions. It is usually less than 50% at all stations except S_4 where values invariably exceed more than 50% and reached upto 92% in June (Fig. 5).

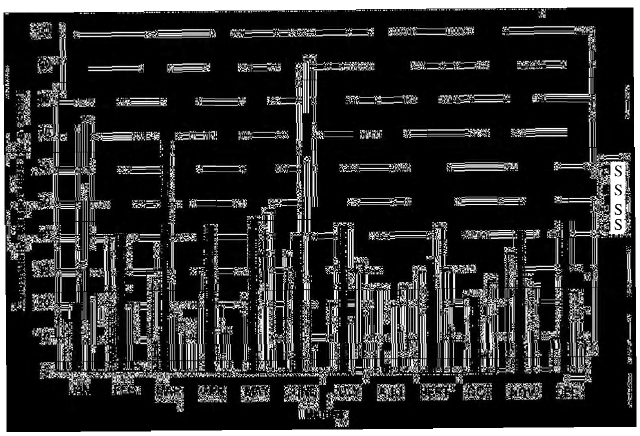

Fig. 5 : Monthly variation in community respiration (% of GPP) at different sampling site of river Gomati at Jaunpur

Monthly variation in NP/GP value ranged between 0.610 gCl^{-1}.d^{-1} in April to 0.85 gCl^{-1}.d^{-1} (February) at S_1 whereas in S_2, it ranged from 0.605 gCl^{-1}.d^{-1} (June) to 0.777 gCl^{-1}.d^{-1} (Oct); 0.579 gCl^{-1}.d^{-1} (Sept) to 0.850 gCl^{-1}.d^{-1} (July) at S_3 and 0.521 gCl^{-1}.d^{-1} (May) to 0.983 gCl^{-1}.d^{-1} (Feb.) at S_4 (Fig. 6).

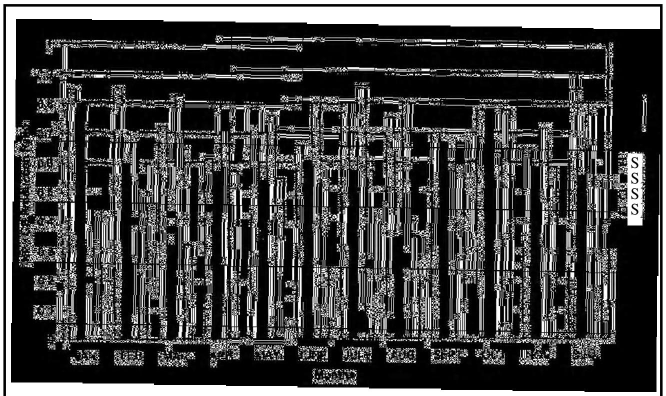

Fig. 6 : Monthly NPP and GPP (NP:GP) production ratio at different sampling sites of river Gomati at Jaunpur

NPP and respiration (R) ratio of the river water showed variation from month to month and station to station. Ratio ranged from 0.4 to 10.56 at S4 in July and June, respectively while 1.80 (Nov.) to 8.50 (Dec.) at S_1; 0.41 (Jan) at S_2; and 0.34 (Jan) to 5.6 (July) at S_3 (Fig. 7).

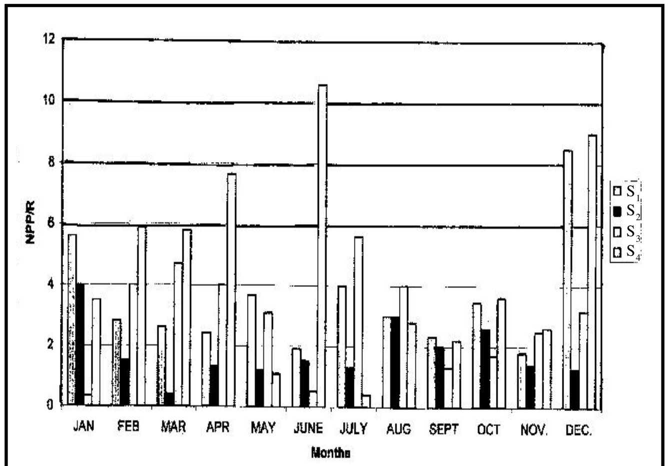

Fig. 7 : Monthly variation in NPP/R at Jaunpur

The primary productivity of an aquatic ecosystem is the rate of radiant energy which is stored by photosynthetic activity of phytoplankton (Odum, 1956). GPP, NPP and community respiration can be affected by pollution from mineral organic nutrients and may undergo seasonal changes due to variation in discharge, temperature and light intensity. Lowest and highest GPP were noticed in rainy and summer season respectively. Lower value of GPP in rainy season might be due to low light intensity and high turbidity and steep fall of phytoplankton population while after monsoon with the increase in phytoplankton concentration the rate of production also increased which is in agreement with observations of Williams and Murdoch (1966), Kumar *et al.* (2001), Pandit *et al.* (2008) and Singh *et al.* (2010). Maximum rate of productivity during summer could be possibly due to high temperature and phytoplankton density as reported earlier by Wetzel (1966), Harikrishnan and Azis (2000) and Singh *et al.* (2010). GPP and NPP values were lower at S2 and S3 than S1 though they were receiving heavy amount of sewage which was full of organic and inorganic nutrients. This might be due to combined effect of physico-chemical characteristics of municipal and domestic sewage which are unsuitable for survival and growth of algae.

The community respiration values were found lower in different sampling sites. It was noticeable that baring a few exceptions, CR was usually less than 50% at all the stations except S3 where value invariably exceeded over 50% and reached maximum (92%) of GPP in June. This indicated that CO_2 fixation was quite low and rate of respiration was quite high which could create oxygen deficient condition in river water. For healthy aquatic ecosystem, respiration should be 5-10% of GPP (Ketchen *et al.,* 1958). The rate of NPP and GPP approaches unity in a healthy ecosystem. During the present study, it was observed that at all sites the values were less than one while at S4 it was at borderline. It indicated that water quality was slightly improving at S4 which resulted comparatively better growth and survival of algae. The value of NPP/R ratio exceeding was an indicator of pollution (Sharma, 1993). It is evident that despite of optimum temperature, surplus nutrients through sewage, bright sunshine, river productivity was quite low due to potential toxic condition into the river water, the Gomati water is polluted and virtually going to be an aquatic desert.

REFERENCES

APHA (1985). Standard methods for the examination of water and waste water. 17th Ed., Washington, D.C.

Gaarder, T. and Gran, H.H. (1927). Investigation of the production of plankton in the Oslofjord. *Rapp. et. Proc. Verb. Con. Int. Explor. Mer.,* **42** : 1-48.

Harikrishnan, K. and Aziz, Abdul (2000). Primary production studies in a fresh water temple tank in Kerala. *Indian J. Env. Ecoplan*, **3** : 127-130.

Kumar, A. (1996). Impact of sewage pollution on chemistry and primary productivity of two fresh water bodies of Samtal Paragana, India. *Indian J. Ecol*., **23** : 86-92.

Kumar, A., Bohra, C., Mandal, K.K. and Kumar, S. (2001). Impact of organic pollution on primary productivity in wetland of Jharkhand, India. *Indian J. Env. & Ecoplan.,* **5** : 621-626.

Ketchen, B.H., Ryther, J.H., Yentsch, C.S. and Corwin, N. (1958). Productivity in relation to nutrients. *Rapp. P.V. Renu. Cons. Per. Int. Explor. Mer.,* **144** : 132-140.

Pandit, H.K., Singh, A.K. and Kanhere, R.R. (2008). Studies on productivity of Govindgarh lake, Rewa (M.P.), India. *Indian J. Env. Ecoplan,* **15** (1-2) : 181-184.

Singh, A., Srivastava, A. and Pandey, A.K. (2010). Impact of pollution on plankton productivity of river Gomati at Jaunpur (U.P.). *Environ. Ecol*., **28** (1) : 95-97.

Sharma, R. (1993). Limnological study on Yashwant Sagar reservoir with special reference to plankton population dynamics. Ph.D. Thesis, Devi Ahilya Vishwavidyalaya, Indore (M.P.) India.

Wetzel, R.G. (1966). Variation in productivity of Goose and Hyperentrophic sytran lakes. *Indiana Invest Indiana Lakes & Streams,* **7** : 147-184.

Williams, R.B. and Murdoch, M.B. (1966). Phytoplankton production and chlorophyll concentration in the Beaufort channel. *North Carolina Limnol Oceangor,* **11** : 73-82.

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