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# Productivity of Major Indian Aquatic Macrophytes

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## INTRODUCTION

Biological productivity of an aquatic habitat depends largely on its ability to support the growth of photoautotrophic organisms consisting mainly of higher plants and algae. During the assimilation pathway, these communities oxygenate the water and serve directly or indirectly as food for fishes. Macrophytes are important constituents for the regulation of the cycling of mineral and organic compounds in natural aquatic systems and in establishing trophic level of the food chain. The macro-vegetations also act as a substrate for the growth of several aquatic organisms.

Tropical ponds get infested with dense growth of macrophytic flora during different periods of the year. Due to their prolific spread in warm climates, the free floating plants are troublesome aquatics and affect pond life in several ways. After the onset of monsoon, several floating forms start appearing and gradually there is advent of submersed forms. Biomass study of macro-communities is necessary for fish cultivation programs and only a few studies have been conducted towards this aspect of aquatic macrophytes (Nygaard, 1956; Ambasht, 1971 and Kaul *et al.*, 1978). Keeping this into view, periodical changes in Macrophytic populaton has been studied in two waterbodies namely Mukhra and Tiwari ponds of Bhagalpur, India. The biomass study of six dominant forms (3 free floating and 3 submersed) was undertaken from November 1982 to October 1983.

## MATERIALS AND METHODS

For the analysis of macrophytic biomass, 5-10 samples were taken using a quadrat of one square meter at four week's interval. The plants were removed along with the soil and thoroughly washed in running tap water. Subsequently it was oven dried at 105C for 24 hrs. and its weight was recorded. The net production and productivity has been calculated by the method suggested by Forsberg (1960). Water depth of these waterbodies varied from 2.4 to 6.4 m.

## RESULTS AND DISCUSSION

Three characteristic communities, free floating, bottom rooted free floating leaf type, and sumbersed were recognized in the waterbodies. The hydrophytic vegetation of Bhagalpur ponds were quite rich. The submersed communities in deep water consist of *Potamogeton crispus* Linn., *Hydrilla verticillata* Royle., *Nitella hyalina* Agar. while in shallow waters *Ceratophyllum demersum* Linn., *Chara zeylanica* Willd., *Nitella acuminata* A. Br. and *Vallisneria spiralis* Linn. were common. The free floating vegetation was comprised of *Eichhornia crassipes* Solms., *Lemna minor* Linn., *Azolla pinnata* R. Br. and *Spirodela polyrrhiza* (Linn.) Schl. which were usually confined to littoral regions. The common plant inhabiting the shallowest margins of the pond is *Ipomoea aquatica* Forsk. which often reach the open waters from their normal swampy habitat by their creeping Rhizomes.

*Eichhornia crassipes* occupied the major part of the surface cover in both the studied ponds. The maximum growth of the species was reached during September and the minimum during April (Table 1). Higher biomass value of monsoon was possibly due to increased germination of seeds with the commencement of rains. After the rainy season, growth declines as the older parts of the plants begin to shed and decompose. This results in negative values of net production. The rise in phosphate and organic matter content of the sediment during rainy months seems to have an effect on the biomass of the species. The change in biomass of water hyacinth with change in temperature indicate distinct correlation with air temperature. This is contrary to the findings of Sinha and Sahai (1978).

*Azolla pinnata* was recorded from November to March and its maximum biomass was measured during February which coincides with the maxima of pH and carbonate content of bottom soil and water.

The peak in *Trapa bispinosa* biomass (29.1 g/m$^2$) was obtained during June. Total alkalinity value and total dissolved solids were also maximum during this period.

The biomass of *Ceratophyllum demersum* community was found to be minimum during April whereas maxima was noted in October. Total nitrogen content of soil was also maximum during October.

*Hydrilla verticillata* was present in Tiwari waterbody only throughout the period of study. The net annual production of which was found to be 95 g/m$^2$/yr. The maximum biomass was recorded in May whereas lowest value was obtained during November. After the summer, growth rate declined substantially leading to negative production values in winter months. Similar observation has also been made earlier by Forsberg (1960) and Jha (1968) for subaquatic macrocommunities.

The biomass values of *Potamogeton crispus* varied from 24.5 g/m$^2$ to 84.7 g/m$^2$ showing minima in January and maxima in May. Contrary to the observations of Atkins (1926), no direct relationship could be established between water phosphate and the growth of *Potamogeton crispus.* The duration of growing period seems to have much influence on biomass production, higher biomass values being recorded for the species with a long growth period and lower values for the species with short growth period.

The turnover, i.e. measure of the proportion of plant material replaced each year and which can be calculated by dividing maximum biomass from annual increment values indicated that 55% of *Azolla,* 57% of *Eichhornia,* 48% of *Trapa* and *Ceratophyllum* each, 61% of *Hydrilla* and 71% of *Potamogeton* are replaced each year during the present study. The turnover values recorded by Odum (1960) are

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Table 1. Variations in productivity (g/m$^2$/day), production (g/m$^2$) and biomass (g/m$^2$) of macrophytes from November 1982 to October 1983.

| Plants and Parameters. | Nov | | Dec | | Jan | | Feb | | Mar | | Apr | | May | | Jun | | Jul | | Aug | | Sep | | Oct |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Azolla* | | | | | | | | | | | | | | | | | | | | | | | |
| Biomass | 30.5 | | 36.1 | | 48.3 | | 69.2 | | 40.7 | | — | | — | | — | | — | | — | | — | | — |
| Net production | | 5.6 | | 12.2 | | 20.9 | | −28.5 | | | | | | | | | | | | | | | |
| Net productivity | | 0.2 | | 0.4 | | 0.7 | | | | | | | | | | | | | | | | | |
| *Eichhornia* | | | | | | | | | | | | | | | | | | | | | | | |
| Biomass | — | | — | | — | | — | | 87.5 | | 81.2 | | 102.5 | | 121.1 | | 130.1 | | 167.5 | | 188.9 | | 154.4 |
| Net production | | | | | | | | | | −6.3 | | 21.3 | | 18.6 | | 9.0 | | 37.4 | | 21.4 | | −34.5 | |
| Net productivity | | | | | | | | | | | | 0.7 | | 0.3 | | 0.3 | | 1.2 | | 0.7 | | | |
| *Trapa* | | | | | | | | | | | | | | | | | | | | | | | |
| Biomass | — | | — | | — | | — | | 15.0 | | 20.5 | | 18.9 | | 29.1 | | 27.6 | | — | | — | | — |
| Net production | | | | | | | | | | 5.5 | | −1.6 | | 10.2 | | −1.5 | | | | | | | |
| Net productivity | | | | | | | | | | 0.2 | | | | 0.3 | | | | | | | | | |
| *Ceratophyllum* | | | | | | | | | | | | | | | | | | | | | | | |
| Biomass | — | | — | | — | | — | | — | | 23.9 | | 29.8 | | 30.8 | | 35.1 | | 30.7 | | 36.9 | | 46.3 |
| Net production | | | | | | | | | | | | 5.9 | | 1.0 | | 4.3 | | −4.4 | | 6.2 | | 9.4 | |
| Net productivity | | | | | | | | | | | | 0.2 | | <0.1 | | 0.1 | | | | 0.2 | | | |
| *Hydrilla* | | | | | | | | | | | | | | | | | | | | | | | |
| Biomass | 60.6 | | 71.1 | | 74.6 | | 72.6 | | 90.1 | | 112.6 | | 155.6 | | 150.9 | | 154.2 | | 107.1 | | 96.1 | | 78.6 |
| Net production | | 10.5 | | 3.5 | | −2.0 | | 17.5 | | 22.5 | | 43.0 | | −4.7 | | 3.3 | | −47.1 | | −11.0 | | −17.5 | |
| Net productivity | | 0.4 | | 0.1 | | | | 0.6 | | 0.7 | | 1.4 | | | | 0.1 | | | | | | | |
| *Potamogeton* | | | | | | | | | | | | | | | | | | | | | | | |
| Biomass | 50.3 | | 38.3 | | 24.5 | | 27.6 | | 45.5 | | 60.9 | | 84.7 | | 74.1 | | 80.9 | | — | | — | | — |
| Net production | | −12.0 | | −13.8 | | 3.1 | | 17.9 | | 15.4 | | 23.8 | | −10.6 | | 6.7 | | | | | | | |
| Net productivity | | | | | | 0.1 | | 0.6 | | 0.5 | | 0.8 | | | | 0.2 | | | | | | | |

in conformity with present findings. Annual increment was found to be maximum in *Eichhornia* i.e. 107.77 g/m$^2$/yr, whereas minima was noted in the case of *Trapa* i.e. 14.04 g/m$^2$/yr.

Among the different hydrological factors, temperature range of monsoon between 32.8 to 35.2 C was most suitable for the prolific growth of macrocommunities. Present study also supports that the substratum and its composition influence the rooted vegetation much the same as they affect the terrestrial vegetation. Another important factor which govern them in various ways is nutritional availability. Enriched nutrition available in summer due to higher degree of decomposition and further enrichment through deposition of allochthonous material along with rain water affect the growth and germinability of macrophytes to a considerable extent.

## LITERATURE CITED


Ambasht, R. S. 1971. Ecosystem study of a tropical pond in relation to primary production of different vegetational zones. *Hydrobiologia.* 12: 57-61.

Atkins, W. R. G. 1926. Seasonal changes in the silica content of natural waters in relation to the phytoplankton. J. Mar. Biol. Assn. 14:89-99.

Forsberg, C. 1960. Subaquatic macrovegetation in Osbysjon Djursholm. Oikos. 11:183.

Jha, U. N. 1968. The pond ecosystem. Ph.D. Thesis, Banaras Hindu University, Varanasi, India.

Kaul, V., C. L. Trisal, and J. K. Handoo. 1978. Distribution and production of macrophytes in some waterbodies of Kashmir. *In:* Glimpses of Ecology (ed. Singh, J. S., Gopal, B.) Int. Sci. Publs., Jaipur, India, pp. 313-334.

Nygaard, G. 1956. On the productivity of the bottom vegetation in Lake Grane Langs. Verh. Int. Ver. Theor. Angew. Linnol. 13:144-155.

Odum, E. P. 1960. Organic production and turnover in old field succession. Ecology. 41:34-49.

Sinha, A. B. and R. Sahai. 1978. Studies on the factors affecting growth and productivity of free floating macrophytes in Ramgarh lake. *In:* Glimpses of Ecology (ed. Singh, J. S., Gopal, B.) Int. Sci. Publs., Jaipur, India, pp. 337-382.