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Original Research Paper

Studies on Phytoplankton-Zooplankton Relationship in Some Lentic Water Bodies of East Champaran, Bihar

Seema Prasad, Goutam Ranjan*, R. B. Singh and N. P. Singh**
Department of Botany, M. S. College, Motihari, Bihar, India
*Department of Zoology, T.R.M. Campus, Tribhuwan University, Birganj, Nepal
**Department of Zoology, M. S. College, Motihari, Bihar, India

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ABSTRACT

Champaran district of north Bihar bestows a wide range of wetlands together with intricate net of rivers. These all and its geographical location has given unique climatic condition to this district. Phytoplankton and zooplankton relationship in four freshwater bodies of the area, viz., Turkaulia lake, Motijheel lake, Kararia lake and Suraha lake has been studied. Rotifers were dominating over the other zooplankton. It was observed that zooplankton and phytoplankton are somehow related. In addition, some physical and chemical factors may also play an important role in maintaining such relationship, which may influence their growth.

INTRODUCTION

Champaran district of north Bihar has a wide range of wetlands and water bodies in form of small and large lakes, oxbow lakes, ponds, pools, 'chaur' and swamps. Besides, it has intricate net of rivers viz. Gandak, Budhi Gandak (Sikrahana river), Baghmati, Bakeya, Moran, etc., and canals with water present throughout the year, which is mainly used for irrigation and fish farming.

Studies in the past have been made by several workers on these water bodies, but they have limited only to phytoplankton population, zooplankton population and primary productivity. The study on the relationship between phytoplankton and zooplankton remain untouched. Considering the importance of these water bodies, the present study was undertaken to study the relationship between zooplankton and phytoplankton that exists in these water bodies.

The primary and secondary production of a water body depends upon its biotic and abiotic factors, but there are certain organisms, which are generally overlooked, may play an important role in the interaction between primary and secondary production of these water bodies. Canter & Lund (1953) revealed that certain zooplankton do not engulf whole plants, instead enter into the plant body and devour it cell by cell from within. The protozoans are taken directly or indirectly as food by the feeding zooplankton and the undigested remains of these and of algae support the growth of bacteria, while the algal fragments may be small enough to be digested by the rotifers and the crustaceans. Observations on such lines have also been made by Naumann (1923) regarding selective consumption of algal species by some rotifer species while others in the size of the cell.

MATERIALS AND METHODS

The physico-chemical characteristics of the four freshwater bodies under study were estimated as per standard methods (APHA 1995). Temperature, dissolved oxygen (DO) and pH were determined on

the spot through analyser kit and pH meter. Phytoplankton and zooplankton were enumerated and identified with the help of standard literature. Total count of plankton was made by the formula given below (Welch 1948).

$$n = \frac{(a\ 1000)c}{L}$$

Where, n = number of plankton per litre of water.
a = average number of planktons in all counts in counting unit of 1 cu. mm capacity (i.e., 1 chamber of Sedgwick-Rafter counting cell).
c = volume of original concentrate in mL (100 mL)
L = volume of original water in litres (100 L.)

RESULTS AND DISCUSSION

The results of the study are presented in Tables 1, 2 and 3. Though observations have been made on the protozoans consuming algal cells, behaviour of rotifers in such aquatic systems as well as the importance of these two groups of zooplankton on the ecology of phytoplankton, but these observations lack the proper evidence in this favour. Such observations have been made earlier by Pennak (1963), Lund (1965), Kumar Kuldip (1990) and Anand et al. (2001), but they have given more emphasis on the ecology of the zooplankton. However, Hosmani (2002) has made observations on the phytoplankton-zooplankton relationship in some freshwater bodies of Dharwar but it is scanty and needs more studies on this line to judge whether such kind of relationship exists in nature in different kinds of water bodies.

The observations made on four freshwater bodies of Champaran (North Bihar) reveal almost similar physico-chemical characteristics except some minor differences in pH, temperature, transparency and alkalinity.

Observations made on total zooplankton of the water bodies under study reveal that they are present in appreciable number in all the water bodies. Highest percentage of zooplankton was observed in Turkaulia lake followed by Motijheel, Kararia lake and Suraha lake. The percentage of occurrence of zooplankton in relation to phytoplankton reveals that it is higher in Motijheel (Table 1), Kararia lake stand 2nd in zooplankton-phytoplankton relationship, while Suraha lake had the least (minimum) number of phytoplankton in relation to zooplankton. The decline in number of phytoplankton in relation to zooplankton may be attributed to the grazing effect of zooplankton. Hosmani & Bharathi (1980) are of opinion that the feeble growth of phytoplankton might be due to oligotrophic nature of waters. However, we are of the opinion that it may be due to low content of nitrogenous and ammonium compounds in comparison to other lakes, which are needed for growth of phytoplankton, especially of Myxophyceae and to some extent of Chlorophyceae. Further, it has also been observed that the zooplankton have their own course of development (Hosmani 2002). On the observations made in these water bodies regarding the impact of zooplankton over the phytoplankton or vice versa, no clear-cut justification is made on such relationship. However, the culture experiments have shown that rotifers feed on certain algae. Lefevre (1942) has observed the impact of 20 different species of algae which support the growth of *Daphnia* culture. But such observations have been made *in vitro,* and how far it is appreciable in natural waters is yet to be observed.

In the present study, maximum population density of phytoplankton was observed during rainy season, and minimum during winter season. Zooplanktons also reveal almost similar trend of

Table 1: Percentage of zooplankton in relation to phytoplankton in the water bodies under study.

Percent Plankton	Turkaulia Lake	Motijheel Lake	Kararia Lake	Suraha Lake
Zooplankton	50.14	48.89	47.72	40.80
Phytoplankton	58.03	52.81	53.28	59.20

Table 2: Seasonal variations in zooplankton and phytoplankton population in the water bodies.

Plankton (Organisms/L)	Turkaulia Lake	Motijheel Lake	Kararia Lake	Suraha Lake
Phytoplankton				
Summer	2623	2101	2091	1437
Monsoon	4312	3167	2991	2142
Winter	892	641	598	341
Total	7827	5909	5680	3920
Zooplankton				
Summer	1461	1002	1004	844
Monsoon	1594	1184	1070	1046
Winter	870	703	580	431
Total	3925	2889	2654	2321

Table 3: Distribution pattern of phytoplankton and zooplankton population in the water bodies.

Plankton	No. of species	Turkaulia Lake	Motijheel	Karariya Lake	Suraha Lake
Phytoplankton					
Chlorophyceae	12	cc	cc	c	ccc
Bacillariophyceae	06	c	c	c	r
Euglenophyceae	03	c	c	r	r
Myxophyceae	08	ccc	ccc	ccc	cc
Chrysophyceae	01	r	r	r	c
Zooplankton					
Rotifers	10	ccc	cc	ccc	cc
Cladocera	04	cc	c	cc	c
Ostracoda	01	r	rr	r	-
Copepoda	03	cc	cc	cc	cc
Protozoa	02	r	r	c	c
Others (unidentifed)	02	r	r	rr	-

r = 25-100 (rare); c = 100-200 (common); ccc = 500-1000 & above (abundant); rr = 2-25 (very rare); cc = 200-500 (very common)

population density to that of phytoplankton in all the four water bodies except their percentage, which differs. The percentage of phytoplankton and zooplankton in Turkaulia lake was 58.03 and 50.14, in Motijheel lake 52.8 and 48.89, in Kararia lake 53.28 and 47.72, and in Suraha lake 59.20 and 40.80 respectively.

Rotifers dominate over the other zooplankton in all the four lakes under study, and their maximum number was observed during summers in all the lakes. Ostracoda was present in minimum number with total absence in Suraha lake. An interesting observation was made that when rotifers were abundant, the percentage of phytoplankton population was also higher in all the 4 lakes, which suggests that both these might have some relationship. Similar observations have also been made by Anand et al. (2001) and Hosmani (2002). Cladocera was also noticed in all the lakes and it is also

related to the phytoplankton population. Pennak (1963) is of opinion that one of the species will always be dominating during such period, but the present study is contrary to that of Pennak.

Chlorella may inhibit the reproduction of some zooplankton species (Hutchinson 1967) and rotifers fluctuate considerably from season to season, that is why the population of rotifers remain dominating in all the water bodies in all the seasons. Hutchinson has further concluded that fishes have a control over the zooplankton population and when fishes are abundant zooplankton are less and this effect may occur at all levels, resulting in increase of rotifers at the expense of Crustacea or the substitution of one species of zooplankton by another.

The present findings suggest that phytoplankton and zooplankton are related. In the present study the total phytoplankton and zooplankton ratio was 56.22 and 43.77 percent respectively. Rotifers are most abundant among the zooplankton. However, Hosmani (2002) is of opinion that they are poorly related and has recorded zooplankton and phytoplankton relationship to 6.2 and 93.8 percent only. In addition, some physical and chemical factors may also be responsible in maintaining this relationship, which in one or the other way may influence the growth of phytoplankton and zooplankton.

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