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Seasonal Dynamics of Some Zooplanktons in Two Fresh Water Ponds

KEYWORDS: Eutrophic, Physico-Chemical factors, Rotifers, Seasonal variations, Zooplanktons

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ABSTRACT *The interaction between various groups of zooplanktons is a major feature in the productivity of ponds. The seasonal abundance of one group imparts influence on the other. The success of one group results in the failure or limitation of another group, in other words one group paves way for the other. In fresh water ponds there may institute several groups of macro plankton fauna but very few can only dominate. With the coming up of summer when the temperature begins to raise, there starts a drop in the abundance of Copepods as well as Cladocerans paving way for the Rotifers to dominate the show. With the onset of rainy season, again the Copepods start dominating over both Rotifers and Cladocerans. Within the same group of zooplanktons again one genus dominates over the other for certain periods and found either in small numbers or become dormant during other periods. In present study the seasonal disparity of distribution, succession, abundance and species diversity of some zooplanktons especially that of Rotifer fauna in relation to the physico, chemical and biological factors is carried out.*

INTRODUCTION

Among all zooplanktons the species belonging to Phylum Rotifera are peculiar in having specific habits. The typical practice of food and feeding, trophy, presence of delicate and transparent semi permeable integument, the cilliary locomotary organ and carrying of mictic eggs make them unique. An animal of sometimes equal to the size of a protozoa with wide spread diversity of life style, dominates the water body at par with its arthropodan counterparts. It had been well-established that the rotifers being an important link in the food chain play a very important role in the pond ecosystem. Among zooplanktons the species belonging to Cladocera, Copepoda, Ostracoda are found to be dominant one over the other depending upon several factors in different seasons. Rotifers however also showed a numerical superiority over other groups in some seasons in the fresh water ponds. Sometimes the species diversity may be less but the abundance of a single species may go on dominating the other group. The abundance of zooplanktons has a direct relation with the hydrography, physico-chemical factors and availability of phytoplankton. Biotic factors such as quality and quantity of food, interference competition, predation and ecological conditions induce plankton communities favoring one species over another. They are more susceptible to the physico-chemical changes due to their small size and permeable integument. The temperature and pH tends to be positively related to species diversity while conductivity and salinity tend to be negatively related.

Materials and Methods

Present work was carried out on two different perennial ponds in the city of Vizianagaram between the latitude of 18°6'42" N and longitude of 83°24'29" E belonging to the state of Andhra Pradesh, India; from May-2009 up to April, 2011, for a period of two years. Among these two, the first one is a Eutrophic pond (referred as Pond-1) is highly polluted due to convulsion of domestic, municipal and industrial wastes. The other one, an Oligotrophic pond (semi clean, referred as Pond-2) which seems abit better than the previous one, since no municipal or domestic wastages were allowed to pass into this pond. Plankton samples were collected from both the ponds periodically once in a week.

Sampling and analysis

Water samples for hydrographical analysis were collected by dipping a 250 ml wide mouthed glass stopper or polythene bottle just below the surface of water in open condition. The water was immediately transported to the laboratory after replacing the stopper for chemical analysis. The collected sample was divided generally into three parts. The first part was treated with 5% procaine hydrochloride and then fixed in Schaudinn's fixative. The second part was treated with 5-10% formaldehyde and third part was treated with boiled water and then fixed in formalin. Hot water treatment gives satisfactory results as well as can fix the organism in its natural position which no other relaxing agent can do. A large number of organisms were placed in a Petri dish somewhat less than half full (Edmondson, 1959) to which an equal amount of boiling water was suddenly poured into the middle of the dish. This method worked well basically for free swimming organisms. Then these forms were stained in Haematoxyline or Alum carmine and were mounted in pure glycerin. For the observation of Mastax, Trophi and other chitinious structures, specimens were treated with KOH (or also Sodium hypochlorite) and mounted in glycerin. A mild centrifugation of preserved water sample either cool or gentle hot can also bring good result.

The methods of sample collection as well as the procedures adopted during this research work although appear old but proved to be scientifically appropriate. In deed this practice had recalled the scientific validity compared to certain new methodologies recently adopted especially for plankton studies.

Plankton analysis

For quantitative analysis of plankton a sub-sample of one ml. was quickly drawn with a wide mouthed pipette resembling that of a stempel pipette and poured into a counting cell similar to that of Sedgwick rafter cell of one ml. capacity and all the organisms of the aliquot were counted. However, when there was a bloom, counting was done only in selected squares in random from which

Volume : 4 | Issue : 10 | October 2014 | ISSN - 2249-555X

total numbers per liter of water could be calculated. Quantitative data was also taken for other important groups of zooplanktons like Cladocera, Copepods, Crustacean larvae, insect larvae etc. The classification and the identification of Rotifera, Cladocera and Copepoda was made possible with the help of literature available specifically as given by Edmondson (1959) and that of Koste (1978).

Results

The present investigation has enabled to identify a total number of 150 species in both these ponds. Out of this population over 90 types are the Zooplanktons mostly composed of Cilliophores, Mastigophores, Rotifers, Cladocerans, Copepods and Crustacean larvae. Rotifers showed numerical superiority over the other groups of zooplanktons especially in Pond- I during most of the study period. 66 rotifer species were recorded from both the Ponds. However, out of these species only few species developed adequate numbers to form sufficient bulk in the samples where as the rest of them were found in special occasions. The seasonal variations of different species of rotifers and their interaction with other groups of zooplanktons, belonging to both the ponds is given below.

Rotifer species composition

Brachionus calyciflorus Pallas, 1766: This species was recorded in both Pond-1and 2. In pond-1, it was found for both the years with the peak of abundance once in summer and again in winter. In contrast however, in Pond–2 during first year this species was recorded in the samples during September from which it gradually increased to peak in November. The population started declining from February while appeared in the samples from October to March during the 2nd year.

***Brachinous caudatus* (Haur, 1937):**

This species occurred for both the years in both the ponds. In Pond-1, it showed its peak of abundance in the month of April-May during both the years. In Pond–2, this species was present in the samples for a short period May to July and again appeared from September until November in the first year. During the 2nd year, it occurred only from the month of February up to April.

***Brachionus angularis* Gosse,1851:**

It occurred in both the ponds for both the years. In Pond- I, it occurred only during first year in the summer months from May to July and again from November to February. During the second year, it occurred only from December to March. In Pond 2, it occurred throughout for both the years with a short time absence from July to September.

***Brachionus forficula* Wierzeiskki:**

This species occurred in both the ponds. In Pond-1, it occurred during both the years. In the first year, the species were observed from May to July. In the second year, it was recorded in the samples from March to June and again from November to January. In Pond-2, the species was observed during both the years. During the first year, it occurred for a short period i.e. in February and March and again in October and November. During the 2nd year these are obtained in February and are absent from March onwards.

Brachionus quadridentatus Hermann, 1783: It occurred only in Pond-2. It was observed in the sample during both the years. In the first year, they were recorded in May and again from September to January, while in the second year they were obtained from July to January.

***Brachionus falcatus* Zacharias, 1898:**

This rotifer was observed mainly from the samples of Pond-2 but few were observed also from pond-1. In the first year, they were observed from May to October while in the second year they were found from February to April
.

***Brachionus diversicornis* (Daday):**

This rotifer was recorded from both the ponds but frequently from pond-2. They were observed from July to October in the first year but were observed from July to February in the second year for both the ponds.

***Brachionus patulus* (O.F.Muller):**

This species had been observed in Pond-2 only for both the years. During the first year, it was found from November to January and in the 2nd year from the month of September to April.

***Keratella cochlearis* (Gosse, 1851):**

It has been reported from both the ponds but more frequently in pond-2 for both the years. In pond-1 during 1st year, it was observed in August and continued until January while in the 2nd year it occurred from August to April. In the Pond–2, this rotifer occurred from July to February in the first year while in the 2nd year from September to March.

***Rotatoria rotatoria* (Pallas):**

This species was observed mainly in Pond–1 and few numbers in pond-2. In the first year, it was seen in May and gradually rose in July after which disappeared from the samples. From December again it gradually increased in number and by March it reached to its maximum. In the second year, it was found from September up to April. In pond-2, this rotifer was recorded during the summer months of April to July for both the years.

***Mytilina ventralis* (Ehrenberg, 1832):**

It was observed only in Pond- 1. During the first year it was seen only in May and again from August to November. In the second year, the species occurred from May to July and again observed in the samples from January to April.

***Platyias quadricornis* (Ehrenberg):**

It was observed only in Pond- 1.In Pond – 1 during 1st year limited members were observed in July and again observed from November to January. In the second year, few species were seen from October to January.

***Lecane luna* (Muller, 1776):**

It was seen in the plankton samples of both the Ponds for both the years but more frequent in pond-2. The species was noticed from August to October in the first year and September to November in the 2nd year in both the ponds.

***Epiphanus clavulata* (Ehrenberg):**

Large numbers of species were recorded in pond-1 but for a limited period during the study period. In the first year, this species appeared between October to February and in the second year from November to March.

***Asplanchna intermedia* Hudson, 1886:**

This rotifer occurred in Pond-2 more frequently than pond-1. Indeed it was recorded in pond-1 only during winter months starting from November to January for both the years where as obtained during other seasons in pond-2.

Volume : 4 | Issue : 10 | October 2014 | ISSN - 2249-555X

In the pond-2, it was found from September to January in the 1st year and from October to March in the 2nd year with a maximum record in December.

***Filinia longiseta* (Eherenberg, 1834):**
This rotifer had been recorded mostly from Pond-1for both the years. In the first year, the specimen occurred from December to June. In the second year it occurred from February to April.

Several other species of rotifers like *Euchlanis dilatata* Ehrb., 1832; *Lepadella ovalis* (Muller, 1786); *Polyarthra sp.*; *Pompholyx sulcata* (Hudson, 1885); *Cephalodella gibba* (Ehrb, 1838) and *Trichotria tetractis* (Ehrb, 1830) occurred commonly in both the ponds but never developed into sufficient pulses in order that they could be treated individually for seasonal studies.

Other groups of Zooplanktons
Cladocera :
This group was represented by six species found in both the ponds for most of the times, except for a short period from March to June during which their number was few. They include mostly Daphnias, Moinas composed of several species like *Diaphanosoma sarsi, Pseudosida Herrick, Latonopsis australis, Simocephalus vetulus, Ceriodaphnia cornuta and Chydorus barroisi.* Cladocerans were relatively few in Pond–2 than Pond-1. They were found abundantly in pond-1 from October to February during the 1st year but from September to December in the 2nd year.

Copepoda:
Copepods were represented mainly by Cyclopoids (mostly belonging to genera Mesocyclops) and Calanoids (belonging to genus *Heliodiaptomous, Rhinediaptomous, Phyllodiaptomous and Neodiaptomous),* which showed the seasonal variation in all the localities. In the first year the largest numbers of Calanoid copepods were found from October up to March with a peak period in December. In the 2nd year, they were observed in more number from October to February. The cyclopoid copepods were numerous in the month of December for both the years.

Crustacean Larvae:
The seasonal variation of crustacean larvae was shown in the table. In Pond–2, the largest numbers of crustaceans were seen from October 09 to February-10. In Pond-1, no significant pulse was observed where smallest numbers were observed throughout the study period.

Ostracoda:
Three groups of Ostracods were recorded during most part of study period, they are species belonging to Cypris, Heterocypris, Stenocypris and Strandesia abundantly during rainy season especially locations where weeds or algae are plenty. They were found in little numbers during summer.

The profundal fauna appeared in good numbers throughout the study period. The distribution of profundal organisms, viz., dipterans larvae, oligochaetes, crustaceans, nematodes and gastropod mollusks followed a similar pattern in both the ponds, with a little variation in summer. The dipterans larvae, oligochaetes and nematodes were found profusely in pond-1 than pond-2, however the crustacean larvae and gastropod mollusks were found in good numbers in both ponds.

In pond-2, good numbers of Turbellarians and Mastigophorans were obtained during the period July to OCTOBER whereas the Chironomous larvae and Oligochaete worms were predominate for rest of the period. The ponds also had a good distribution of Paramecium and Euglena population. The bacteria, cyano-bacteria and algal population was rich in pond-1 in comparison to pond-2.

Discussion
Studies on the seasonal conditions governing the pond life in Punjab by Prashad (1916) was more or less the first limnological report from Indian waters. Since then many workers have contributed a lot in this aspect. Knowledge of the interaction of organisms with their environment is essential to understand the productivity of any fresh water ecosystem. Most of the zooplanktons are herbivorous in nature. Zooplanktons constitute the food of many fishes and other aquatic organisms. As such they play a key role in the course of food chain. The abundance of profundal organisms in general and that of insect larvae in particular has a direct correlation with the abundance of plankton fauna (Subba Rao, 1985).

The abundance of zooplanktons has a direct relation with the hydrography, physico-chemico factors and availability of phytoplankton (Choudhury et al.,2006; Duncan, 1984). Rotifers also are no exception to this principle. Biotic factors such as quality and quantity of food, interference competition, predation and ecological conditions induce rotifer communities favoring one species over another (Pattnaik, 2010). They are more susceptible to the physicochemical changes due to their small size and permeable integument. The temperature and pH tend to be positively related to species diversity while conductivity and salinity tend to be negatively related (Athibai et al., 2007).

Most of the rotifers appeared to have potentially cosmopolitan in distribution. Tropical fresh water fauna greatly resembles the European forms especially as regards Rotifera (Pejler, 1985). The cosmopolitan nature of the inhabitants of fresh water is also generally recognized (Wallace et al.,2001).The species like *B. angularis, B. calyciflorus, B. quadridentata, B.urceolaris, Lecane luna, Lecane bulla, Filinia longiseta, Asplanchna intermedia,* and *Hexarthra* are cosmopolitan in distribution (Dhanapathi, 1976a, 77).

Rotifers showed a major pulse in all the ponds in summer months of April through July in Delhi (Sarma, 1988, Arora, 2007. Pennak (1955) has concluded that there is no seasonal periodicity among the rotifers in North-America but Walsh has shown a seasonal peak in spring for rotifers in the same area. In Russian waters the seasonal variations of rotifers are not very marked (Kutikova, 2003). May and Hare, 2005 have the opinion that in tropical waters rotifers show a summer maximum. But from the present studies it is clear that rotifers show two maxims, one in summer and the other in winter. Root cause of such fluctuation may be due to availability of rich food, conduced physicchemical factors and absence of certain other large macro predators. The seasonal morphological changes, appearance of certain external structures such as spines and instantaneous parthenogenic reproduction also supported such cause. Most interestingly however the male species of prominent rotifers are found for a brief period during rainy months between June to September in present investigation (Pattnaik, 2010, 2014).

A notable feature of the species composition of the rotifers from the present study was the simultaneous occurrence of two or more species of the same genus in a

Volume : 4 | Issue : 10 | October 2014 | ISSN - 2249-555X

single collection. For instance it was seen that Brachionus was represented by more than two species, even up to five and Keratella by more than two in many samples. In the present investigation, presence of five species of Brachionus in a single collection was obtained. The different species of Brachionus that have entered into such species composition were B.angularis, B. calyciflorus, B. forficula, B. caudatus and B. bidentata. The other genera that have entered into such species composition for certain periods were Keratella, Lecane and Fillinia. Pennak (1957) has noted that whenever two species of the same genus are present one is almost always more abundant than the other. In majority of the collections, dominance of one species over the other has been observed in the present study. It may be due to the inter specific or intra specific competition (prey-predator) among the various groups of planktons and availability of food as well.

Species of Brachionus are very hardy forms and have a wide distribution. Several species of Brachionus are characteristic to the plankton of hard water ponds in both temperate and tropical waters. In alkaline waters of every locality the species of Brachionus are very conspicuous. Some of the species belonging to Brachionus, Keratella and Asplanchna exhibit seasonal morphological changes due to several impacting factors playing as a whole on abundance and diversity of other nearby genera (Green, 2007; Pattnaik, 2014). Another feature of the rotifer population was the predominance of very few genera in the ponds. The species belonging to the genera of Brachionus, Keratella, Mytilina, Lecane, Platyias and Fillinia showed their dominance over the other species of rotifers. Occurrence of more species of the family Lecanide in some ponds showed their preference of the habitat with full of aquatic weeds (Pejler, 1994; Dhanapathi, 1977).

The rotifers dominated over other groups in both the ponds, the Calanoid and Cyclopoid copepods come next and the Cladocerans at the last. The species Neodiaptomous striglipes was the most dominant among Calanoides in both the ponds, the species of Heliodiaptomous and Phylodiaptomous come next in dominance. Among the Cyclopoids three species are found to be prominent; they are Mesocyclops leucarrta, Microcyclops varicans and Thermocyclps crasas. The first one was more dominant in pond-1 than the other two, probably due to its high ranging adaptability for pollution and eutrophication observed similar to that of ponds of Scotland (May.L et al.,1983) and certain other eutrophic ponds of Europe.

TABLE –I
ABUNDANCE OF ZOOPLANKTONS DURING 2009-10 IN POND-I

ZOOPLANTON	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10
ROTIFERS	4236	3686	2009	1678	1489	2589	3916	3480	3894	4236	4128	4263
CLADOCERANS	245	329	345	560	768	674	628	525	398	289	264	232
CELANOID COPEPODS	241	123	231	358	480	754	900	890	910	601	320	241
CYCLOPOID COPEPODS	421	320	312	358	576	890	945	962	917	872	455	434
INSECT LARVAE	25	43	61	91	89	84	69	62	58	44	32	29
CRUSTCEAN LARVAE	23	20	34	58	69	85	87	74	52	41	32	30
OLIGOCHAETES	19	14	9	10	15	18	21	26	27	28	24	20

TABLE-II
ABUNDANCE OF ZOOPLANKTONS DURING 2009-10 IN PON-II

ZOOPLANTONS	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10
ROTIFERS	3675	2864	1086	1103	1909	2786	3658	3158	2789	3216	3786	4120
CLADOCERANS	249	217	213	245	509	489	521	567	621	590	312	234
CELANOID COPEPODS	142	169	254	267	290	504	672	786	782	711	652	354
CYCLOPOID COPEPODS	191	168	354	324	390	523	786	902	890	764	704	673
INSECT LARVAE	40	52	78	89	70	86	79	87	62	50	37	28
CRUSTCEAN LARVAE	26	32	43	34	46	49	54	59	61	57	32	21
OLIGOCHAETES	10	6	8	9	10	14	16	19	20	28	22	17

Volume : 4 | Issue : 10 | October 2014 | ISSN - 2249-555X

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