

STATISTICAL ANALYSIS OF THE BIODIVERSITY OF ZOOPLANKTON POPULATION IN A FILTHY TRAPA-CUM-FISH CULTURED POND OF CENTRAL INDIA

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Abstract- The present article summarizes a statistical psychiatry of the biodiversity of zooplankton population and their seasonal fluctuation in the Gangasagar pond, Jabalpur. The current analysis reflects the miscellany of zooplankton in correlation with the physico-chemical as well as the biological environment of the fishpond. Species diversity of zooplanktons was calculated as per the formula given by Shannon and Wiener (1949) & Odum (8). Perhaps the most important factor, which leads to aggregation of zooplankton, is the availability of natural food items as trapa harvests which serves as an organic wastes in the Gangasagar pond, Jabalpur.

Keywords- Zooplankton, biodiversity, fishpond, seasonal fluctuation, trapa harvests, Shannon's – Wiener's Species diversity index

Introduction

Biodiversity refers to the number, variety and variability of living organisms in a community within an ecosystem. Plankton's serves as a useful index for purity of water and no pond can be considered in a satisfactory condition unless the aquatic biota thrives well in it. In last two to three decades most of the freshwater resources have been highly exploited. Thus it is customary to evaluate the biodiversity indices to have a clear picture of the trophic status of the lentic ecosystem. A similar attempt has been made in the present analysis by applying species diversity index to check the stability of a tropical water body. Since zooplanktons are primary consumers and chief food of fishes their diversity and richness fluctuation can be a major indicator of the pollutional status of any water body.

During the present investigation an assessment of species diversity and seasonal fluctuation in the Zooplankton population was carried out in the Gangasagar pond, Jabalpur which is a perennial water body but at present facing the crisis of encroachment due to urbanisation and industrialization. Being a shallow water pond, Gangasagar witnessed no distinction of species in the limnetic & profundal zone. The rich growth of flora followed by fauna is attributed to warm temperature and inflow of waste water through rain and discharged waste effluents from nearby areas bringing down the nutrients into the pond.

Most of the species of zooplankton exhibited significant changes in abundance at different times in correlation with various abiotic and biotic factors. Seasonal changes in temperature strongly affected the zooplankton

population growth in the Gangasagar pond. Zooplanktons showed depthwise as well as seasonal variations in their quality and quantity during the study period. Water movement due to wind & human activities also causes the polymixis of the Zooplanktons. Zooplanktons serve as a transitory herbivore in aquatic bodies and play an important role in the transfer of energy from the autotrophs to the consumers. Zooplanktons also serve as an important bioindicator to check the water quality of any aquatic habitat.

Material and Methods

During the study period monthly integrated samples were collected from specific sites and samples were analysed as per standard methods of Adoni [1] and APHA [2]. Zooplanktons were identified by drop count method. Species diversity of zooplanktons was calculated as per the formula given by Shannon and Wiener [1949] and Odum [8].

Analytical formula of Shannon's – Wiener's Species diversity index

This index was proposed by Shannon and Wiener [1949] as a measure of information content of a code. This index serves as a statistical measure of the probability of guessing the identity of an individual taken from a sample at random.

As per the formula given by Shannon and Wiener [1949]-

$$H' = - \sum (n_i / N) \log (n_i / N)$$

Or

$$H' = - \sum (P_i / P) \log (P_i / P)$$

Where,

H= Shannon's – Wiener's index of Species diversity in individuals.

ni= Number of individuals for each species

N= Total number of individuals.

Pi = Importance probability for each species (ni/N)

Result and Discussion

Zooplanktons serve as a transitory herbivore in aquatic bodies and play an important role in the transfer of energy from the autotrophs to the consumers. They also serve as an important bioindicator to check the water quality of aquatic habitat. Assessment of pollution impact on water ecosystem through assumptions of distribution, variability and diversity of different species of zooplanktons is of great concern in the present scenario. To check the functional status of the pond in correlation with zooplanktons diversity an assessment of seasonal fluctuation in physico-chemical parameters was carried out in the Gangasagar pond. Physical parameters like depth of the pond is wholly depended on the meteorological conditions of the pond. [Table – I] Water of Gangasagar is slightly alkaline with pH varying from 7.28 pH to 8.2 pH. The concentration of various constituents varies in wide range from season to season at different spots of the pond. Hardness values gradually decreased from winter to summer months & again ascended in rainy season with an increase in the water level. Higher Values of free CO₂ were recorded during monsoon period indicating acute organic pollution. Higher Values of D.O. were observed in monsoon and winter period due to increased photosynthetic activities of the pond flora. The ingredients required to cause eutrophication such as nitrate and phosphate which enter the pond through inflowing municipal wastes from nearby areas and thereby leads to algal growth in the pond.

During the study period seasonal quantitative and qualitative fluctuations of pond fauna was observed [Table- II]. Peak of zooplanktons were reported during monsoon and spring season while slack period was observed during the summer months. In the present study 5 species of Cladocera, 3 sps of Protozoa, 9 sps. of Rotifera, 5 sps of Copepoda and only 1 sps of Ostracoda were observed [Fig -1]. Present study reveals that Crustaceans represented by Cladocera, Copepoda and Ostracoda dominated among the Zooplankton population followed by Rotifers and Protozoans.

In the present study Species diversity index values ranged between - 2.474 (Monsoon) & -1.041 (Summer) during different seasons of the study period [Table- III]. The biodiversity of zooplanktons was recorded higher during monsoon and winter season while minimum values were recorded during the summer period. Ascended values of zooplanktons diversity during rainy season may be attributed to inflow of waste water while its increased values during the summer period may be due to accumulation of organic wastes and reduced fish predation in the pond. Bacteria, algae and detritus are the common food of the rotifers [9]. Rotifer population was enhanced with increased load of pollution [5]. Their

density increased during the warmer months with reduced fish predation. Similar observations were by [3,4,6]. Being a shallow pond Gangasagar witnessed no distinction of rotifer species in limnetic and profundal zone. Water movement due to wind and human activities also causes the polymixis of the rotifers. The peak period of rotifer diversity was observed during monsoon period while a peak period of rotifer density was observed during the summer months. The seasonal rainfall, consequent dilution and enrichment of ecosystem caused seasonal changes in the zooplankton populations [7]. The present study shows that the physico-chemical factors of the Gangasagar pond induce the seasonal succession among the zooplankton population of the pond.

Conclusion

To conclude, it may be well said that since huge amount of discharged waste effluents accumulates in the Gangasagar pond, an increased level of eutrophication impact was reflected during the study period. However, a well marked seasonal succession among the zooplankton population induced by the environmental factors was observed in the Gangasagar pond. Unplanned urbanisation are constantly leading to the depletion and contamination of Gangasagar pond, thereby making the water hazardous for the aquatic life. It is thus imperative that conscious effort ought to be made to indicate and check the water quality as well as degree of pollution in this important fish production centre of Jabalpur district of Central India.

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Table 1- Seasonal variations in Physico-chemical values of zooplanktons in Gangasagar pond, Jabalpur

Parameters	Monsoon	Winter	Summer
Temperature in 0C	27	16	31
Depth in cms	215	135	85
Secchi disc tranparency in cms	118	86	47
Total Hardness in mg/lit	200	256	192
Alkalinity in mg /lt	96	148	136
pH	8.2	7.68	7.28
Nitrate in mg/lit	13.29	20.37	7.97
Phosphate in mg/lit	4.9	1.4	0.5
Disolved oxygen in mg/lit	12.6	8	4.4
Carbon di oxide in mg/lit	12	4	6

Table 2– Seasonal variations in biodiversity and number of zooplanktons for each species as organisms/litre (ni), ni / N values and log ni/ N values of zooplanktons in Gangasagar pond, Jabalpur

Zooplankton Species	Monsoon	Monsoon	Monsoon	Winter	Winter	Winter	Summer	Summer	Summer
	(ni)	(ni/N)	log ni/N	(ni)	(ni /N)	logni/N	(ni)	(ni / N)	log ni / N
Cladocera									
<i>Daphnia</i>	80	0.2	-0.698	40	0.5	-0.301	0	0	0
<i>Rotaria</i>	80	0.2	-0.698	0	0	0	0	0	0
<i>Macrothrix</i>	120	0.3	-0.522	0	0	0	0	0	0
<i>Moina</i>	40	0.1	-1	0	0	0	0	0	0
<i>Moinodaphnia</i>	80	0.2	-0.698	40	0.5	-0.301	40	1	0
Total	400			80			40		
Protozoa									
<i>Arcella</i>	40	0.2	-0.698	40	1	0	40	1	0
<i>Paramseuim</i>	80	0.4	-0.397	0	0	0	0	0	0
<i>Centropyxis</i>	80	0.4	-0.397	0	0	0	0	0	0
Total	200			40			40		
Rotifer									
<i>B.Quadridentalis</i>	40	0.166	-0.778	40	0.1	-1	0	0	0
<i>B.Calycifloris</i>	40	0.166	-0.778	40	0.1	-1	80	0.18	-0.74
<i>B.Forficula</i>	0	0	0	0	0	0	80	0.18	-0.74
<i>Lecane</i>	0	0	0	80	0.2	-0.698	0	0	0
<i>Lepadella</i>	40	0.166	-0.778	0	0	0	0	0	0
<i>Monostyla</i>	0	0	0	40	0.1	-1	0	0	0
<i>Filinia</i>	40	0.166	-0.778	40	0.1	-1	0	0	0
<i>Asplanchna</i>	40	0.166	-0.778	120	0.3	-0.522	160	0.36	-0.439
<i>Horaella</i>	40	0.166	-0.778	40	0.1	-1	120	0.27	-0.564
Total	240			400			440		
Copepoda									
<i>Cyclops</i>	80	0.33	-0.477	80	0.33	-0.477	200	0.416	-0.38
<i>Nauplius</i>	80	0.33	-0.477	80	0.33	-0.477	160	0.33	-0.477
<i>Eucyclops</i>	0	0	0	0	0	0	0	0	0
<i>Diaptomus</i>	40	0.166	-0.778	40	0.166	-0.778	0	0	0
<i>Macrocyclops</i>	40	0.166	-0.778	40	0.166	-0.778	120	0.25	-0.602
Total	240			240			480		
Ostracoda									
<i>Cypris</i>	40	1	0	80	1	0	0	0	0
Total	40			80			0	0	0

Table 3- Seasonal variations in Species diversity index values of zooplanktons in Gangasagar pond, Jabalpur

Zooplankton Species	Monsoon (ni/N) log (ni/N)	Winter (ni/N) log (ni/N)	Summer (ni/N) log (ni/N)
Cladocera			
<i>Daphnia</i>	-0.139	-0.15	0.00
<i>Rotaria</i>	-0.139	0	0.00
<i>Macrothrix</i>	-0.156	0	0.00
<i>Moina</i>	-0.1	0	0.00
<i>Moinodaphnia</i>	-0.139	-0.15	0.00
Total	-0.673	-0.3	0.00
Protozoa			
<i>Arcella</i>	-0.139	0	0.00
<i>Paramseuim</i>	-0.158	0	0.00
<i>Centropyxis</i>	-0.158	0	0.00
Total	-0.455	0	0.00
Rotifer			
<i>B.Quadridentalis</i>	-0.129	-0.1	0.00
<i>B.Calycifloris</i>	-0.129	-0.1	-0.133
<i>B.Forficula</i>	0	0	-0.133
<i>Lecane</i>	0	-0.139	0
<i>Lepadella</i>	-0.129	0	0
<i>Monostyla</i>	0	-0.1	0
<i>Filinia</i>	-0.129	-0.1	0
<i>Asplanchna</i>	-0.129	-0.156	-0.158
<i>Horaella</i>	-0.129	-0.1	-0.152
Total	-0.774	-0.795	-0.576
Copepoda			
<i>Cyclops</i>	-0.157	-0.157	-0.158
<i>Nauplius</i>	-0.157	-0.157	-0.157
<i>Eucyclops</i>	0	0	0
<i>Diaptomus</i>	-0.129	-0.129	0
<i>Macrocyclops</i>	-0.129	-0.129	-0.15
Total	-0.572	-0.572	-0.465
Ostracoda			
<i>Cypris</i>	0	0	0
TOTAL	-2.474	-1.667	-1.041
H=-Σ (ni/N)log(ni/N)			

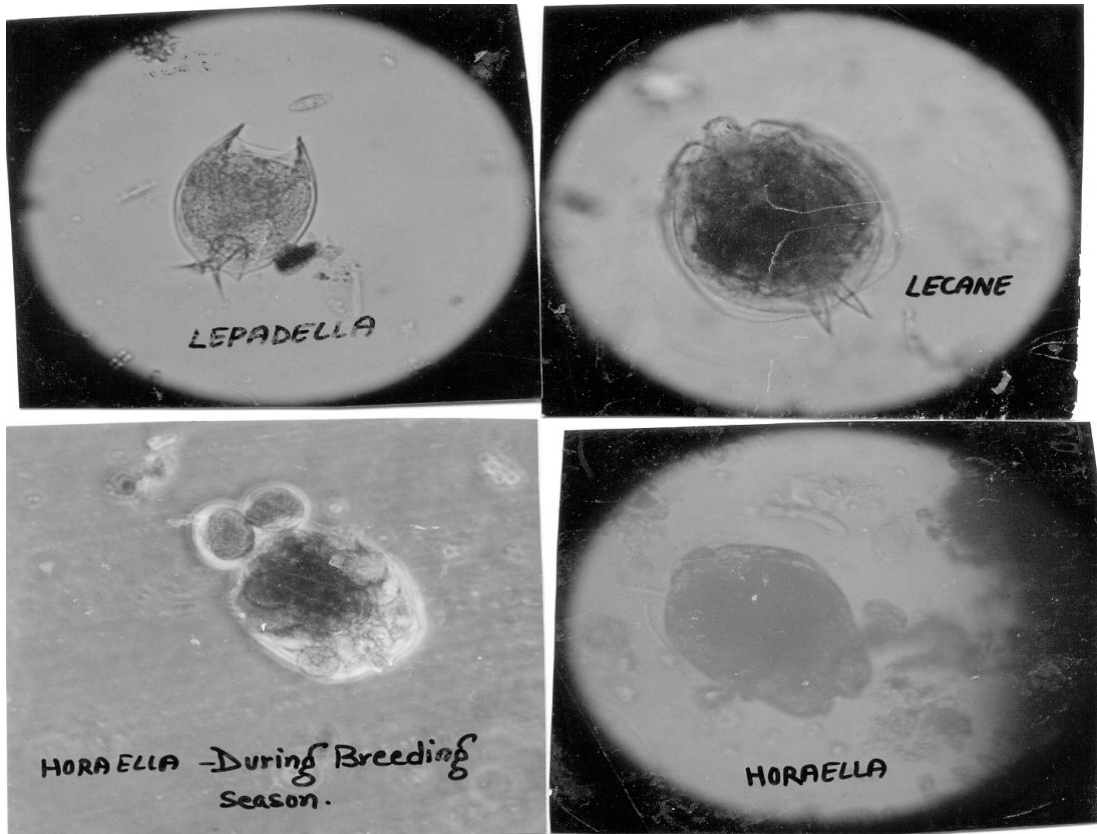


Fig. 1- Photographs of Zooplanktons of Gangasagar pond, Jabalpur (Madhya Pradesh, INDIA)

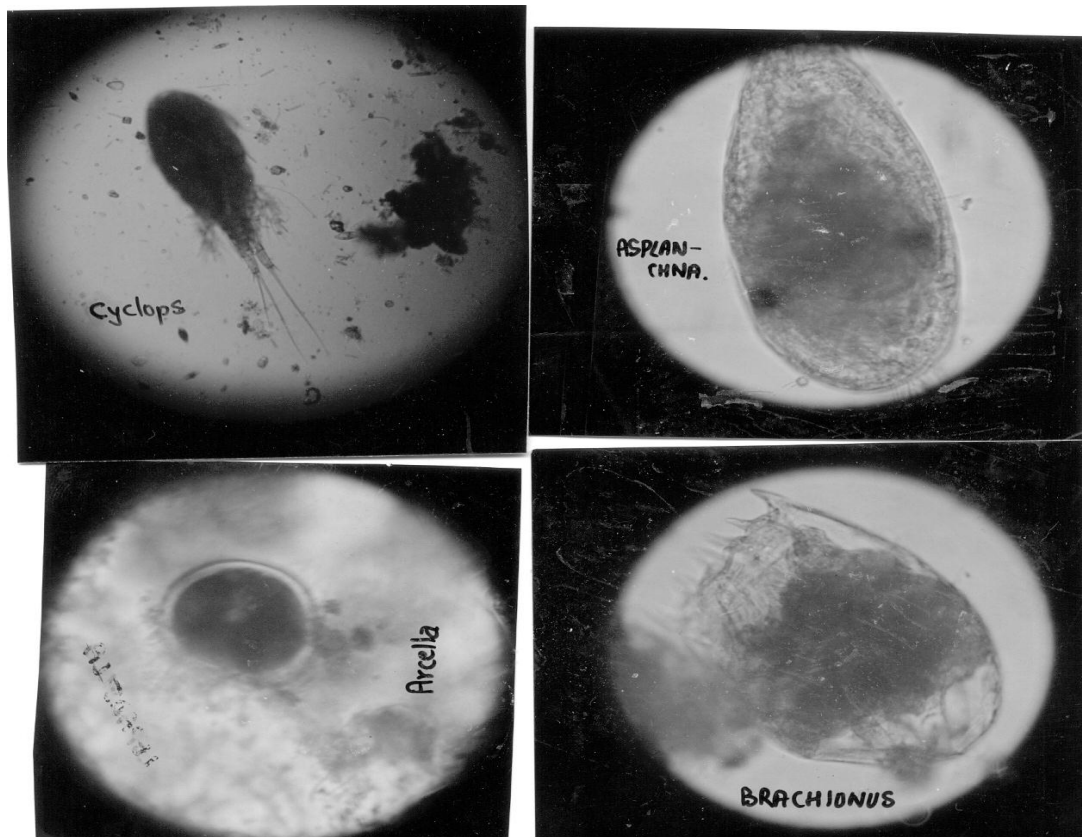


Fig. 2- Photographs of Zooplanktons of Gangasagar pond, Jabalpur (Madhya Pradesh, INDIA)