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Study of zooplankton abundance and species diversity in Bishanpur swamp of Madhepura District, Bihar, India

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Abstract- Important fin-fish and shell-fish cultures are economically supported by Zooplankton. They play a major role in transferring energy between phytoplankton and fishes. Zooplankton abundance and species diversity of Bishanpur were studied from March, 2020 to February, 2021 on monthly basis. The principal aim was to get information about the overall zooplankton diversity of this swamp. Zooplankton samples were collected using zooplankton net and preserved in 5% formaldehyde solution on the spot, then brought to the laboratory for further analysis. 18 species of zooplankton, belongs to four different classes were recorded (Rotifera, Cladocera, Copepoda and Ostracoda) in which Rotifera was the most dominant class followed by the Cladocera, Copepoda, and Ostracoda. From total 18 species, 8 belonged to Rotifera, 5 from Cladocera, 2 from Copepoda, and 2 from Ostracoda. Shannon - Weaver index was employed to analyze the species diversity.

Key words: Bishanpur Swamp, Cladocera, Copepoda, Ostracoda, Rotifera, Shannon - Weaver index, Zooplankton

INTRODUCTION

Plankton is the most important part of aquatic food chain or food web. As the primary producer, phytoplankton converts inorganic matters into organic compounds through photosynthesis, enabling transfers of energy and nutrients to zooplankton and other aquatic animals in the food chain.[1]

Generally, the sizes of Swamps are smaller than the size of the pond and their depth is also less than the depth of ponds. Therefore, swamps maintain a unique freshwater ecosystem, providing an unparalleled ecosystem service.[2] Swamp ecosystem is considered as one of the essential natural resources for phytoplanktons, zooplanktons, microinvertebrates, macroinvertebrates and other living organisms on the earth. The various types of the freshwater ecosystem include rivers, ponds, swamps, etc.

Nowadays, the significant increase in population as a result of the amount of disposal has created a major problem for its disposal. As a result, the quantity of water pollution has increased and the ponds have become eutrophicated. The purity and quality of water vary from place to place.[3]

Plankton is very sensitive and responds quickly to any changes in the environment which affect the plankton communities in terms of tolerance, abundance, diversity and dominance in the habitat. Therefore, in aquatic habitat

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it is discovered that plankton acts as pollution indicators, they are helpful to evaluate the pollution status of water bodies.[4]

Zooplanktons and phytoplanktons play an important role in swamps, ponds, lakes and reservoirs ecosystem as well as in food chain.[5] Many researchers have observed that phytoplankton and zooplankton are good markers of water contamination.[6,7] Plankton has proved to be significant in aquatic systems because changes in plankton's early response are substantial.[8,9]

Plankton growth and development are influenced by a variety of biological and non-biological elements, including light, temperature, available nutrition, oxygen content, pH, and so on.[10] The basic trophic levels are formed by phytoplanktons which are succeeded to next level by the zooplankton.[11,12] The physicochemical properties of the water body influence the zooplankton population, which also varies with the seasons.[13,14] As opposed to physical processes, analysis of both qualitative and quantitative such indicative organs lead to the discovery of one pollutant at a time, resulting in a useful alternative for consolidating the impacts of many contaminants.

The swamp under the present study is at greater risk of increasing human settlement around the swamp. It has damaged the health of this swamp due to incessant discharge of untreated sewage from nearby settlements enters them. Thus, assessment of water quality, phytoplankton and zooplankton in these swamps has become extremely important in controlling water pollution. The study was done to assess the zooplankton abundance and species diversity of the Bishanpur swamp of Madhepura district of Bihar, India by evaluating physicochemical and biological parameters.

The zooplankton community consists of both primary consumers (who eat phytoplankton) and secondary consumers (who eat other zooplankton). They serve as a direct link between the primary producers and the upper layers of the tropics, such as fish. During the larval phase nearly all fish depends for food on zooplankton and some fishes continues to feed on zooplankton for their entire lives.[15]

Zooplankton is an important link in the secondary energy transfer between the autotrophs and the heterotrophs in aquatic food webs.[16] The Physico-chemical qualities of water play a major role in the distribution and diversity of zooplankton in aquatic ecosystems.[17]

Study area

The present work deals with the study of the biodiversity of zooplankton in the Bishanpur swamp of Madhepura district in India. The annual mean temperature of this region is about 27.8°C, although monthly mean temperatures range from 18.5°C to 34°C and maximum temperature in the region often exceed 41°C. During the Monsoon (In August) maximum rainfall occurs and the average annual total above 1500 mm. Strong South-West Monsoon winds rule the summer. Winters are mild, with temperatures ranging from 11.5 to 17 degrees Celsius.

MATERIAL & METHOD

Water samples were taken from March, 2020 to February, 2021 (throughout the year). Sampling places on the Swamp's beaches, such as washing, cattle's excrement, and urine discharges, were carefully evaluated and dispersed uniformly around the swamp area. The samples were collected every time, from the same point of the swamp.

Collection and preservation of samples

For the present study water samples and planktons were collected from the selected swamp for twelve months (one year). Samples were collected regularly in the first week of every month, during early morning hours (6.00 A.M to 8.00 A.M). 50 liters of water was filtered for the quantitative analysis. The filtration process was done by the plankton net which are made up of bolting silk (150 μm) to collect zooplankton and samples were transferred to polyethylene bottles (90 ml) and then preserved with 5% neutral buffer (10 ml) formalin (aqueous solution of formaldehyde). The plankton samples varied both quantitative (by filtering) as well as qualitative (by-towing) analysis during the study period.

Biological Analysis

For the collection of plankton, nets made up of blotting silk attached with wide thick bottles were used. The net is conical and the diameter of the mouth is 20 cm. The 50 micrometer and 150 micrometer nets were used to collect the samples, the nets were carried to a depth of about 0.5 m below the surface. The filtrated samples were then collected in 200 ml capacity PET bottles. These bottles were washed in sample water before sample collection. Then these bottles are then transferred to the laboratory, University Department of Zoology, B.N. Mandal University,

Madhepura, Bihar, India for further analysis. 5 ml of 4% formalin solution was added to each 200 ml bottle within 24 hours of collection. For further analysis static samples were stored at room temperature. Approximately 4 ml of 10x, 40x from each sample were taken and monitored under a Compound Microscope.

Calculation of Plankton Diversity Index

The most widely used index for estimating the species diversity is Shannon - Weaver index (Shannon and Weaver, 1949)[18] given by the formula:-

H' = - S (ni / N) log 2 (ni / N),

Where,

H' = Shannon-Weaver index

ni = Importance value of each species (number of individuals)

N= Total of importance value

The value of this index can theoretically range from zero to infinity. However, values normally range from 0- 4.

RESULTS & DISCUSSION

In the Bishanpur swamp total 18 species of zooplankton, belongs to four different classes were recorded (Rotifera, Cladocera, Copepoda and Ostracoda) (Table-1). Rotifera was the most dominant class followed by the Cladocera, Copepoda, and Ostracoda. 8 species were recorded from Rotifera whereas 6 species were recorded from Cladocera in the Bishanpur swamp. Four species were recorded from Copepoda and Ostracoda (two species from each class). During May month species composition was maximum and it became minimum during December (Table-2).

Table 1: List of freshwater zooplankton species recorded in Bishanpur Swamp

Class	Species	Total Number
Rotifera	*Brachionus bidentata*	4173
	Brachionus budapestinesis	
	Brachionus calyciflorus	
	Brachionus caudatus personatus	
	Keratella cochlearis	
	Keratella tropica	
	Asplanchna intermedia	
	Filinia longiseta	
Cladocera	*Daphnia carinata*	3201
	Daphnia magna	
	Ceriodaphnia cornuta	
	Ceriodaphnia reticulata	
	Moina brachiata	
	Moina flagellate	
Copepoda	*Neodiaptomus schmakeri*	1242
	Mesocyclops aspericornis	
Ostracoda	*Cypris protubera*	696
	Cyprinotus nudus	

Table 2: Month wise distribution of Zooplankton groups in the swamp (number per liter n\l and percent)

Classes [redacted] Month ↓	Rotifera		Cladocera		Copepoda		Ostracoda		Total	
	n/l	%	n/l	%	n/l	%	n/l	%	n/l	%
March, 2020	511	53.34	203	21.19	156	16.28	88	9.18	958	100
April, 2020	503	52.50	254	26.51	123	12.83	78	8.14	958	100
May, 2020	486	34.34	800	56.53	107	7.56	22	1.55	1415	100
June, 2020	450	35.23	655	51.29	109	8.53	63	4.9	1277	100
July, 2020	400	55.86	203	28.35	72	10.05	41	5.7	716	100
August, 2020	378	53.31	222	31.31	66	9.3	43	6.06	709	100
September, 2020	360	61.22	106	18.02	89	15.13	33	5.6	588	100
October, 2020	318	52.38	82	13.51	112	18.45	95	15.65	607	100
November, 2020	323	57.57	78	13.9	83	14.79	77	13.72	561	100
December, 2020	122	35.05	101	29.22	83	23.85	42	12.06	348	100
January, 2021	100	19.34	221	42.74	123	23.79	73	14.11	517	100
February, 2021	222	33.79	276	41.94	119	18.00	41	6.29	658	100

Table 3: Table shows the percentage contribution of different groups of phytoplankton

Total no. of sample	Rotifera	Cladocera	Copepoda	Ostracoda
9312	4173	3201	1242	696
100%	44.81%	34.73%	13.33%	7.47%

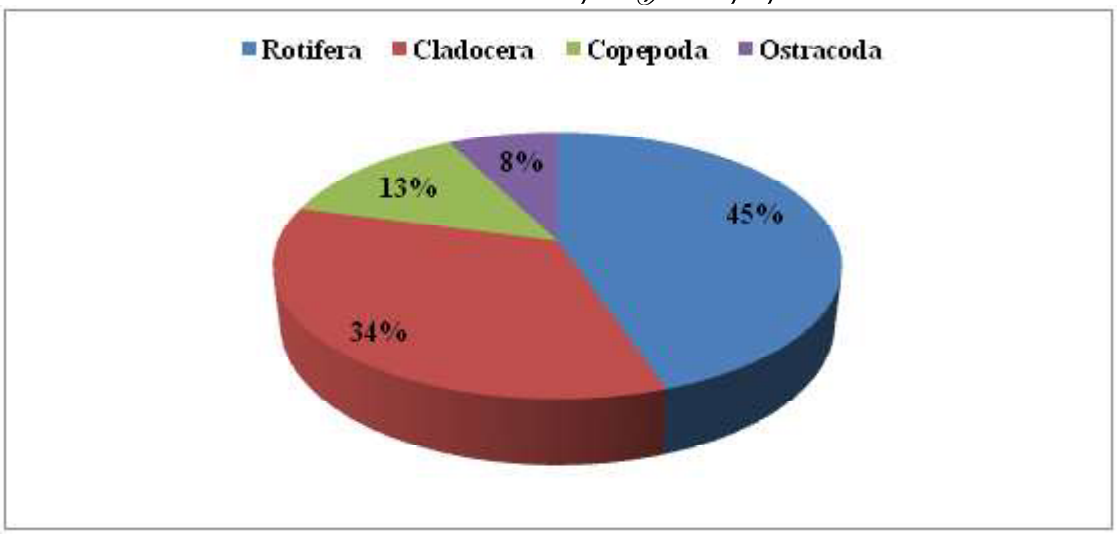

Chart 1: Showing percentage contribution of different groups of phytoplankton

Rotifera

In the present study totally, 8 species of Rotifera belonging to 4 genera (*Brachionus, Keratella, Asplanchna,* and *Filinia*) were recorded (Table 1) during the period of March, 2020 to February, 2021. A maximum Rotifera population (511n/L) was observed during March, 2020 and a minimum population (100n/L) was noticed in January, 2021 (Table 2). The Shannon Diversity Index for rotifers (H) was found to be high in March, 2020 and low in January, 2021 (Table 5).

Cladocera

Totally 06 species of Cladocera belonging to 3 genera (*Daphnia, Ceriodaphnia*, and *Moina*) were recorded during the study period. A maximum Cladocera population (800n/L) was observed during May, 2020 and a minimum population (78n/L) was noticed in November, 2020 (Table 2).

The Shannon Diversity Index (H) was found to be maximum (0.34654) in the month of May, 2020 and minimum (0.09051) was noticed in November, 2020 (Table 5).

Copepoda

In the present investigation, only 2 species of Copepoda belonging to 2 genera (*Neodiaptomus* and *Mesocyclops*) were recorded. A higher copepoda population (156n/L) was observed during the month of March, 2020 while the lowest population (66n./L) was reported in August, 2020 (Table 2). The Shannon Diversity Index (H) was found maximum (0.2658) during March, 2020 and minimum (0.15596) in August, 2020 (Table 5).

Ostracoda

In the current study period, 2 species of Ostracoda were recorded belonging to 2 genera (*Cypris* & *Cyprinotus*). The Ostracoda population was ranged between 88 and 22 n/L (Table 3) with a maximum (88n/L) recorded during March, 2020 and a minimum (22nL) in May, 2020. The Shannon Diversity Index (H) was maximum (0.26147) recorded during March, 2020 and minimum (0.10919) in May, 2020 (Table 5).

Table 4: Season distribution of Zooplankton groups in the Bishanpur swamp (number per liter n\l and percent)

Classes	Rotifera		Cladocera		Copepoda		Ostracoda		Total		Mean
Seasons	n\l	%	n\l	%	n/l	%	n/l	%	n\l	%	
Summer (April-June)	1034	31.86	1709	52.66	339	10.44	163	5.02	3245	100	811
Manson (July- September)	1138	56.51	531	26.57	227	11.27	117	5.81	2013	100	503
Winter December-January)	222	20.65	497	46.23	242	22.57	114	10.6	1075	100	268

Table 5: The species diversity indices of Zooplankton observed in Bishanpur Swamp

Class → Month ↓	Rotifera	Cladocera	Copepoda	Ostracoda
March, 2020	0.257155685	0.174906763	0.260581	0.261473
April, 2020	0.255031765	0.201064232	0.228995	0.245279
May, 2020	0.250416579	0.346543408	0.211213	0.109188
June, 2020	0.24016638	0.324652316	0.213536	0.217442
July, 2020	0.224771237	0.174906763	0.165091	0.166814
August, 2020	0.217533093	0.185072208	0.155957	0.172009
September, 2020	0.211383446	0.112847429	0.188881	0.144557
October, 2020	0.196175373	0.093873459	0.216964	0.271825
November, 2020	0.198052342	0.090512889	0.180812	0.243562
December, 2020	0.103270805	0.109049016	0.180812	0.169429
January, 2021	0.089413379	0.184550247	0.228995	0.236504
February, 2021	0.156071006	0.211316988	0.224716	0.166814
Total	2.399441091	2.209295719	2.456551198	2.404896213

CONCLUSION

Total 18 species from four classes were recorded in present study with the following percentage: Rotifera- 44.81%, Cladocera- 34.73%, Copepoda- 13.33% and Ostracoda- 7.47%. The dominant species of Zooplankton were *Brachionus budapestinesis, Brachionus calyciflorus, Filinia longiseta, Keratella cochlearis, Daphnia carinata, Cypris protubera, Moina brachiata, Ceriodaphnia cornuta.* The population of zooplankton was maximum during the summer season (April to June) and minimum in the winter season (December-January). The Shannon Diversity Index (H) of Copepoda was recorded as the maximum (2.456551198) diversity index among all four classes and it is followed by class Ostracoda (Shannon Diversity Index: 2.404896213). The Shannon Diversity Index (H) of Cladocera was recorded as the minimum (2.209295719) diversity index. The diversity of the zooplanktonic community shows high abundance in the month of May and June.

The results provide useful knowledge on plankton community for further study in Bishanpur swamp, the studying on the fluctuation of the abundance of plankton throughout the year in Bishanpur swamp to provide useful knowledge for primary productivity of this swamp area.

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