Observation on freshwater zooplankton and hydrophytes composition in different wetlands of Paschim Medinipur, West Bengal (India)

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Abstract
This study analysed diversity and ecology of Zooplankton and also Hydrophytes of wetlands, of paschim Medinipur, West Bengal, India. Zooplankton samples collected (April to December, 2014-2016) from site-I (Panskura), site-II (Gokulpur), site-III (Jakpur) of this tropical wetlands revealed a fairly rich Zooplankton fauna and hydrophytes from at this entire study site. This survey yielded 37 species of Zooplankton (Rotifera, Copepoda and Cladocera) and 7 species of hydrophytes of Paschim Medinipur wetlands. High species diversity and low densities of majority of species are hypothesized to fine niche portioning amongst different species in combination with high micro and macro scale heterogeneity.

Keywords: wetlands, zooplankton, hydrophytes, niche

1. Introduction
Zooplankton plays an imperative role in matter and energy flow in most lentic and lotic ecosystems. It is also essential in maintaining the balance of aquatic ecosystem. Zooplankton occupy an important intermediate link of food chain between phytoplankton and plantivorous fish and adjusting the water self purification capacity. The interaction between zooplankton and environment forms a special community distribution pattern. Because of environmental selectivity, plankton species composition varies from one habitat to another. Temperature and salinity are important factors in the inter-annual variability of the copepod [1]. Low dissolved oxygen concentration has little influence on zooplankton [2]. Increasing zooplankton density in rivers depends mainly on biotic factors but increasing zooplankton reproduction in river depends to a large extent on physical factors. Temperature and conductivity have the strongest impact on zooplankton abundance. Fisheries of Paschim Midnapur wetlands play an important role in the socio-economy of people living in this area in terms of their nutrition and livelihood generation. Thus the availability of plankton resources with suitable water quality enables survival and development of cultured fish by manipulating the fish culture process [3]. Seasonal fluctuation of zooplankton are of immense importance as they play imperative role in tropic dynamics of the fisheries system as the fingerlings of carps mostly feed on zooplankton [4, 5]. Thus zooplankton play vital role in energy transfer from primary producers to secondary consumers in aquatic ecosystem.

This article draws attention to the relative impact to environment condition in structuring zooplankton community in wetland of Paschim Midnapur. This study also focuses on the diversity and distribution pattern of Zooplankton to get an overview of community organization. This will be use full for formulation of long term management strategies ensuring the ecosystem health for not only the wetlands but other such ecosystems as well.

2. Material and Methods
2.1 Study Site
The present investigation was carried out from freshwater lotic ecosystems in and around certain wetlands (Table-1) of Panskura (Nayanjuli), Jakpur (pond) and Gokulpur (industrial belt) of Paschim Medinipur (Figure-1). All study ponds were sampled from 2014 to 2016 at three season – premonsoon (April-June), monsoon (July- September) and postmonsoon (October- December).

Table 1: List of the sampled localities of Paschim Medinipur

Study sites	Latitude	Longitude
Panskura (S-I)	22°23'55.5'' N	87°44'54.6'' E
Gokulpur (S-II)	22°22'53.2'' N	87°17'21.1'' E
Jakpur (S-III)	22°21'50.3'' N	87°23'20.9'' E

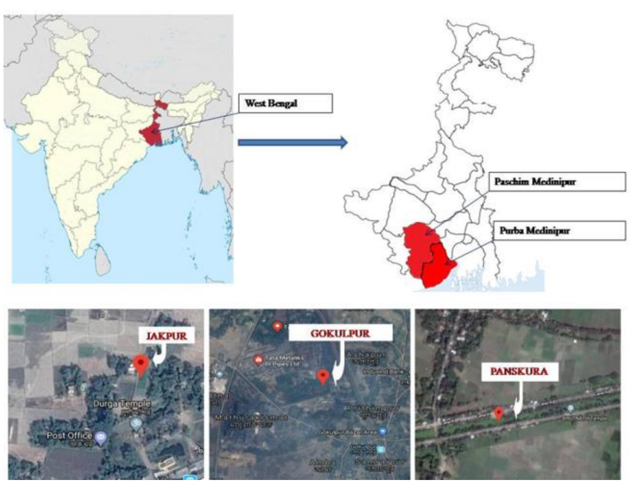

Fig 1: Map of surveyed region.

2.2 Zooplankton diversity study
For qualitative and quantitative study of zooplankton, the samples were collected from various water bodies by filtering surface water through a Nylobolt plankton net (#52µm) and were preserved in 5% formalin (Sharma, 2017). All collections were screened with a wild stereoscopic binocular microscopic; the zooplankton taxa were isolated and mounted in polyvinyl alcohol- lactophenol, and were observed with stereoscopic phase contrast microscope (Nikon E200). The different rotifer species were identified following the works of [6, 7, 8, 9, 10, 11, 12] and others were identified following standard literature [13, 14, 15, 16, 17] under research microscope. A Sedgewick rafter counting cell (size: 50 mm X 20 mm X 1 mm, cell volume: 1.0 mL) was used for numerical analysis. Sedgewick rafter counting cell was filled with sample using glass pipettes. Number of plankton present in the Sedgewick rafter cell was calculated from the following formula: Individuals/mL = {A* (n/v)}/ L
The number of cells per mm was multiplied by a correction factor to adjust the number of organisms per litter [16], Zooplankton abundance has been expressed as number of individual per liter of the sample.

2.3 Hydrophytes
Diverse species of hydrophytes were recorded on a monthly basis from April 2014 to December 2016, from three randomly selected sampling stations by walking along the margin of each wetland of the study site. Each sampling station was a stretch of about 40m. An aquascope and a rake were used for observation and collection of submerged plants. Formation of dense vegetation bed along with flowering of each species was also observed. All collected plants were kept in plastic bags and transported to the laboratory where they were washed thoroughly to remove silt, snails, epiphytes and other unwanted materials. The excess water was then drained off and healthy specimens were sorted and pressed for the preparation of herbarium. Voucher specimens of different species were kept in the laboratory. Identification was followed according to Cook (1996) [18].

2.4 Statistical analysis
Univariate description of variables based on calculation of sample statistics such as mean, SD, maximum and minimum values have been done on pooled dataset of three wetlands. The data was classified into two groups based on the presence or absence of a particular zooplankton species for each data point. Species abundance relation was calculated in terms of diversity index. The common indices calculated was Shannon-Weiner diversity index (*H*), using the software XLSTAT. *H* values more than one indicates a diversified community.

3. Result
3.1 Zooplankton diversity
In course studies 37 species of zooplankton have been recorded from the studies, among them 27 were found to be present in site-III. These 37 species of zooplankton belong to two phyla, Arthropoda and Rotifera. All together 19 Arthropoda and 18 Rotifera species were found within the samples collected from site-I, site-II and site-III (Table-2 & Fig-2).

All the 18 Rotifera species were present in site-I & site-II but 12 were found in site-III whereas 15 Arthropoda species were found in site-III and 19 species of Arthropoda phylum were found in site-I and site-II.
Among eleven families found in site-III, dominant species was *Keratela tropica, Diaphanosoma sarsi, Phyllodiaptomus annae, Daphnia magna.*
Among eleven families found in site-I and site-II,dominant species were *Heliodiaptomus contortus*, *Keratela tropica* and Eudominant species were *Paradiaptomus greeni, Phyllodiaptomus annae, Daphnia carinata. Lecane leontina Filinia terminalis*, *Cephalodela gibba, Brachionus forficula, Brachionus falcatus, Brachionus durgae, Moinodaphnia macleayi, Moina brachiata*, *Leydigia acanthocercoides, Mesocyclops leuckarti* were present in site-I and site-II but absent in site-III.
Distribution patterns of zooplankton species composition revealed discontinuous distribution in the study sites (Fig-3).
Shannon diversity index value (H') for zooplankton community 2.94 in site-I and 2.92 in site-II whereas 1.90 in site-III (Fig-4).
There was difference in zooplankton diversity between site-I, site-II and site-III during premonsoon and monsoon season (Fig-5).

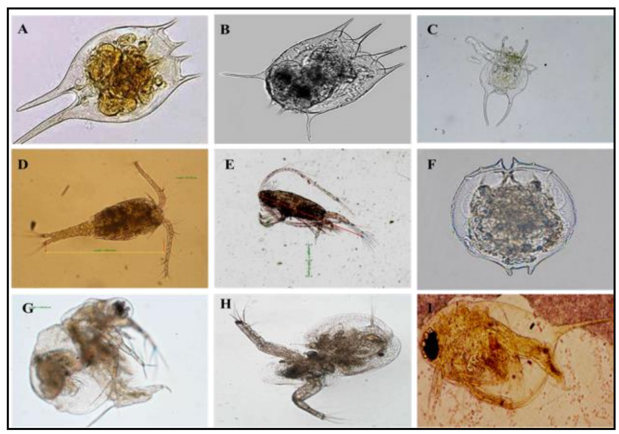

Fig 2: (A) *Keratela tropica,* (B) *Brachionus calyciflorus,* (C) *Brachionus falcatus,* (D) *Heliodiaptomus viduus,* (E) *Phyllodiaptomus annae,* (F) *Brachionus angularis,* (G) *Ceriodaphnia cornuta,* (H) *Moina micrura &* (I) *Daphnia carinata.*

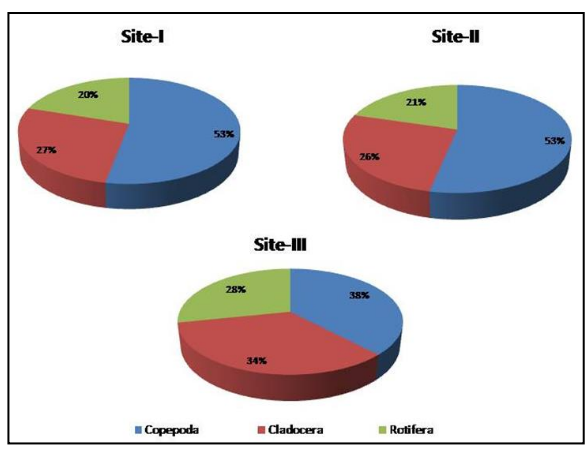

Fig 3: Distribution of zooplankton groups (% contribution) across sampling location.

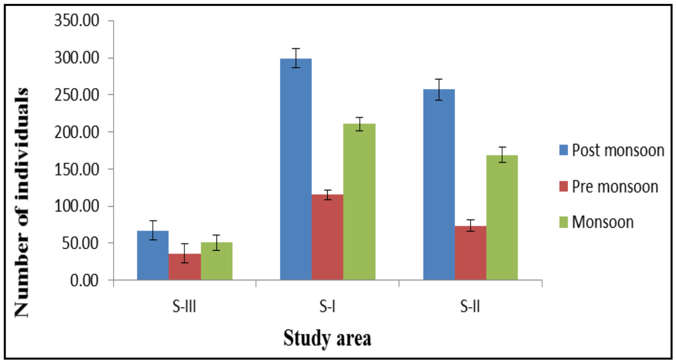

Fig 4: Seasonal variation in zooplankton diversity (Shannon Diversity Index) in different wetlands of study sites.

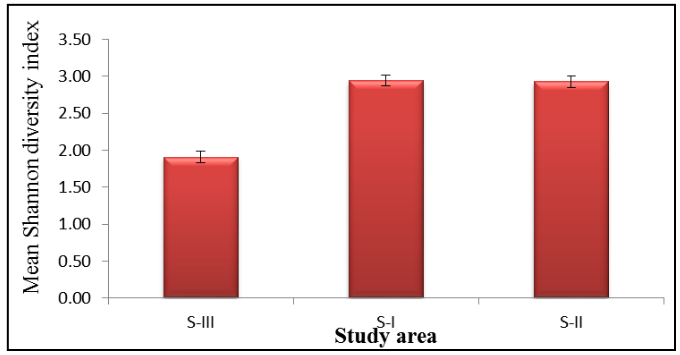

Fig 5: Seasonal variation in zooplankton composition in study sites of Paschim Medinipur wetlands.

Table 2: Zooplankton observed in course of sampling the water bodies of Paschim Medinipur wetland ponds

Phylum	Class	Sub Class	Order	Species	S- I	S-III	S-II
Arthopoda	Copepoda		Calanoida	*Heliodiaptomus contortus* (Gurney,1907)	0.062	0.034	0.064
				Heliodiaptomus viduus (Gurney,1967)	0.029	0.021	0.031
				Paradiaptomus greeni	0.200	0.145	0.209
				Phyllodiaptomus annae (Apstein,1907)	0.104	0.090	0.098
				Phyllodiaptomus blanc	0.046	0.021	0.045
			Cyclopoida	*Macrocyclops distinctus*	0.033	0.014	0.029
				Mesocyclops hyalinus	0.037	0.048	0.037
				Microcyclops varicians (Sars, 1863)	0.013	0.007	0.012
				Mesocyclops leuckarti (C	0.007	0.000	0.006
	Crustacea		Cladocera	*Ceriodaphnia cornuta* (Sars, 1885)	0.016	0.021	0.016
				Ceriodaphnia regaudi (Richard, 1894)	0.008	0.007	0.008
				Daphnia carinata (king, 1853)	0.111	0.103	0.109
				Daphnia magna (stars, 1820)	0.036	0.055	0.037
				Diaphanosoma excisum (Sars, 1885)	0.016	0.034	0.016
				Diaphanosoma sarsi (Gauthier, 1951)	0.047	0.097	0.047
				Leydigia acanthocercoides (Fischer, 1854)	0.007	0.000	0.006
				Moina brachiata (Juirne, 1820)	0.005	0.000	0.004
				Moina micrura (Kurz, 1874)	0.020	0.021	0.018
				Moinodaphnia macleayi (king, 1853)	0.005	0.000	0.004
Rotifera	Eurotatoria	Monogononta	Ploima	*Asplanchna brightwelli* (Gosse, 1850)	0.005	0.007	0.004
				Brachionus calyciflorus (Pallas, 1766)	0.010	0.014	0.008
				Brachionus caudatus (Barrois & Daday, 1894)	0.013	0.021	0.014
				Brachionus diversicornis (Daday, 1883)	0.016	0.034	0.016
				Keratela tropica (Apstein, 1907)	0.070	0.090	0.072
				Brachionus durgae (Dhanapathi, 1974)	0.007	0.000	0.006
				Brachionus falcatus (Zacharias, 1898)	0.003	0.000	0.002
				Brachionus angularis (Zacharias,1898)	0.013	0.028	0.014
				Brachionus forficula (Wierzejski, 1891)	0.003	0.000	0.004
				Cephalodela gibba (Ehrenberg, 1830)	0.007	0.000	0.006
				Cephalodela forficula (Ehrenberg, 1830)	0.005	0.007	0.006
				Filinia longiseta (Ehrenberg, 1834)	0.008	0.014	0.008
				Filinia opoliensis (Zacharias, 1898)	0.011	0.021	0.012
				Filinia terminalis (Plate, 1886)	0.005	0.000	0.004
				Lecane leontina (Turner, 1892)	0.002	0.000	0.002
				Lecane luna (O.F. Müller, 1776)	0.007	0.007	0.006
				Lecane papuana (Murray, 1913)	0.008	0.021	0.008
				Lecane nana (Murray, 1913)	0.008	0.021	0.008

Fig 3: Abundance of zooplankton species was noted as individuals per ml of water.

Species name	Abundance	Relative abundance	Growth forms	Dominants status
Alternanthera philoxeroides	0.003567783	0.35677830	Emergent	Sub-recedents
Pistia stratiotes	0.019371657	1.93716567	Free floating	Recedents
Eichhornia crassipes	0.002314456	0.23144559	Free floating	Sub-recedents
Wolffia microscopica	0.403427591	40.34275913	Free floating	Eudominant
Lemna minor	0.570052265	57.00522650	Free floating	Eudominant
Vallisneria spiralis	0.000649275	0.06492751	Submerged	Sub-recedents
Ipomoea aquatica	0.000334328	0.03343282	Rooted with floating leaves	Sub-recedents
Jussiaea repens	0.000158281	0.01582810	Submerged	Sub-recedents
Nymphaea stellata	0.000122749	0.01227485	Rooted with floating leaves	Sub-recedents

3.2 Hydrophytes diversity study

The species list of hydrophytes along with their growth forms and relative abundance is given in table no:-3. All types of growth forms were found in this study. The two eudominant species (> 10%) were *Wolffia* species and *Lemnon* species the recedents species was *Pistia* species and the sub-recedents species were *Nymphaea stellata, Jussiaea repens, Vallisneria spiralis, Ipomoea aquatic, Eichhornia crassipes and Alternanthera philoxeroides.*

4. Discussion

4.1 Zooplankton diversity

Zooplankton community is considered to be the strategic component of the aquatic ecosystem, and it maintains and orients the aquatic food webs. Thus, its positioning in the food chain with its high degree of connection to the primary producers makes it highly susceptible to different structural heterogeneity in the system.

It is essential to characterise the community structure of the zooplankton. The easiest and convenient way of analyzing community characteristics is to use diversity indices. These stations (site-I & site-II) also have a rich nutrient base for the growth of phytoplankton that in turn supports the growth of zooplankton. It is already been established that resource availability is the primary cause of clumping in a particular area, the other reason being predation. Field survey has also revealed that above mentioned region give maximum success in fishing, which also indicates the availability of resources in this are that supports the cause of clumping of zooplankton.

So, the occurrence of particular variety of plankton is crucial for proper development of the fishes and other aquatic organisms [18]. The significance of hydrophytes in the distribution and abundance of plankton has been well established as these plant provide feeding and habitat niche to a larger number of species, both in free-living and attached conditions [5].

Our current study showed that the zooplankton abundance varied seasonally in all stations. Zooplankton diversity was higher in station-I and station-II than Station-III. Higher amount of nutrient like fertilizer input in the station-I and station-II through run off during monsoon period might be reason behind. Another reason observed that the regular input of mainly domestic sewage from adjoin localities in station-I and Station-II provides a certain high level of nutrient.

Copepoda was found to be the dominant class of zooplankton in site-III. Copepoda plays major roles in pond ecosystems. Benthic copedes eat organic detritus or the bacteria that grow in ponds and their mouth parts are adapted for scraping and biting [16]. Thus copepods help to maintain the health of the aquatic system and serve as the most important food item in fresh water aquaculture [19].

Diversity of rotifer was found to be higher than other phyla in site-III. Presence of rotiferan species is an important aspect for monitoring pollution [20]. An increase in abundance of total rotifers may indicate advancing eutrophication and it can occur without a major change in species composition [21]. *Brachionus calyciflorus*, *Keratella tropica* are pollution (eutrophy) indicator species [21, 22, 20, 23] found in higher abundance in site-III. *Cereodaphania rigaudi* is indicative of eutrophication [24, 25] was present in site-III.

5. Conclusion

The observation on the zooplankton and hydrophytes species assemblage of Paschim Medinipur wetlands indicates considerable diversity in that region. Zooplankton abundance showed varied seasonal differences between natural wetlands and industrial adjoin wetlands. Anthropogenic influence and industrial effluent may causes lower diversity at site-III and dominance of pollution tolerant macrophytes species in site-III. Also various known indicator species of zooplankton exhibited dominance in site-III. These finding would prove helpful in designing more appropriate management strategy of Paschim Medinipur wetlands to ensure sustainability of fisheries and conservation of natural resources.

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