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Diversity and abundance of Macrozoobenthic communities in a Gangetic flood plain wetland of West Bengal, India

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ABSTRACT

Aquatic macrozoobenthic invertebrates are the most important group of organisms which have a crucial ecological role in the flood plain wetland ecosystems. They can indicate the habitat conditions by integrating bottom sediments and overlying water strata. The flood plain wetland locally named as Katiganga beel with an approx area of 33 ha is an open wetland of Murshidabad district of West Bengal was studied for its macrozoobenthic fauna on monthly basis from randomly selected 8 spots of the beel for two years (2019-2020). The macro zoobenthic population of the beel Katiganga was recorded which comprised of maximum 46 no. of taxa throughout the investigation period. These taxa have been classified and grouped into Annelids (10 taxa), Molluscs (24 taxa), Insects (10 taxa) and Crustaceans (2 taxa). Molluscan population was found to be maximum in both the years of study contributing about 58-59% of the total macrozoobenthic fauna followed by Annelids (21%)> Insects (17-19%) and Crustaceans (2-3%). The Shannon (H) indices were highest for Molluscs (2.764-3.138) followed by Insects (2.0-2.286), Annelids (1.724-2.277) and Crustaceans (0.4101-1.0). Higher values of Margalef Richness Index (d) in the study (2.246-4.58) for Annelids, Insects and Molluscs represented the suitability of habitat for these organisms and indicated the presence of longer food chain and complex food web in the ecosystem involving these organisms in their stable community. The flow modification due to poor connectivity with the river Ganges, water depth, pollution received from adjoining catchment area can influence the composition, abundance, and diversity of macrozoobenthos.

Key words : *Macrozoobenthic invertebrates, Wetlands, Diversity.*

Introduction

Floodplain wetlands are biologically highly productive ecosystems and play a vital role in the maintenance of ecological integrity and also provide many goods and services. Being the lentic component of floodplains, they are excellent habitat for various aquatic germplasm resources with great extent of biodiversity. Wetlands can vary in shape and size, in extent to connection with the mother riverine course (CIFRI, 2000; Ramsar Convention Secretariat, 2013; Sarkar *et al.* 2016). West Bengal has more than 150 wetlands (locally called as Beel, Charha and Baor) with about 42,000 hectares area, sharing about 22% of the total freshwater area of the state (CIFRI, 2000). The macrozoobenthic community, particularly standing stock of benthos are not only the valuable index of productivity of water body but also act as potential bio-indicator of trophic status of the ecosystem. Macrozoobenthos are particularly sensitive

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to any change of their microenvironment and have high adaptive flexibility (Heino, 2000; Arscott *et al.*, 2005; Obolewski, 2011; Jones *et al.*, 2012; Verdonschot *et al.*, 2012; Obolewski, 2013; Helton *et al.*, 2014). Many studies regarding benthic communities of the beels and reservoirs of gangetic flood plains of West Bengal (Das *et al*., 2009; Das *et al*., 2013; Malla and Rout, 2015; Ghosh and Biswas, 2017) are available in recent past, but most of the studies were concentrated on beels of Nadia District. The beels of Murshidabad District are found to be underexplored specially the Katiganga beel. So, the present study was undertaken to know the diversity, abundance and fluctuation of macro zoobenthos of the Katiganga, an open beel of Murshidabad district, West Bengal, India.

Materials and Methods

The *beel* Katiganga is an open beel situated at the Berhampur Sub-Division of Murshidabad district of West Bengal. This freshwater water body covers an area of approximately 33 ha (Fig 1). Benthic invertebrates were collected on monthly basis from randomly selected 8 spots of the beel during the two years of study period (2019-2020). Quantitative and qualitative sampling of sediment was done by an Ekman's dredge (15.2 x 15.2 cm) to obtain bottom grab. The collections were brought to the laboratory in polythene bags and 1/10 of each sample was taken out and passed through graded sieves (finally with no. 30 sieves; 28 meshes per inch; 595 openings) by washing with abundant water. The sieved materials were picked up with the help of forceps and samples were brought to the laboratory in tubes or in plastic packets and sorted in large enamel trays. All the organisms were sorted and preserved in 4% formalin or 70% alcohol. The number of organisms per square meter were calculated by using the following formula (Welch, 1948):

$$N = (O \times 10{,}000) / AS$$

Where, N = Number of macroscopic animals in one square meter of bottom

O = Number of animals actually counted

A = Transverse area of Ekman's dredge

S = Number of samples taken at each spot

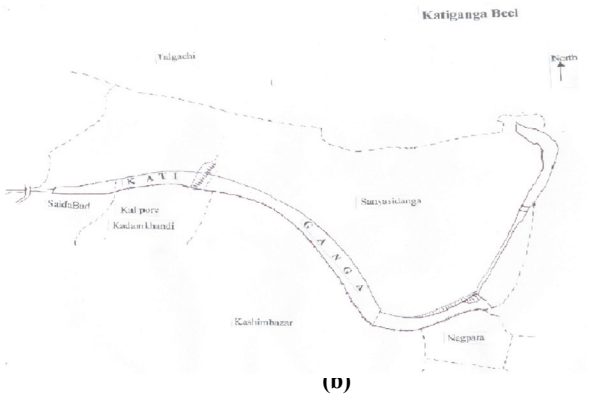
The macro-organisms were later sorted out and identified to the lowest possible taxon with appropriate taxonomic reference.

Diversity indices were calculated using the Past 4.03 software following the book by Hammer *et al*., (2001).

Results and Discussion

The macro zoobenthic population of the beel Katiganga was recorded to comprise of maximum 46 no. of taxa throughout the investigation period. These taxa have been classified and grouped into Annelids (Oligochaeta, Polychaeta and Hirudinea), Molluscs (Gastropoda, Bivalvia), Insects and Crustaceans. The Oligochaetes comprised of *Oligobdella* sp., *Branchiura sp., Chaetogaster sp., Lumbriculus sp., Dero sp., Limnodrillus sp., Pheretima sp., Tubifex sp.* with maximum abundance of *Tubifex* sp. (13.37%) in the 1st year and *Chaetogaster sp* (12.72%) in the 2nd year of the study. Mitra *et al*. (2017) reported most of the taxa of Oligochaetes in their study. Oligochaetes are ecologically very important for the beel system as they help in fertility improvement of bottom sedi-

(a)



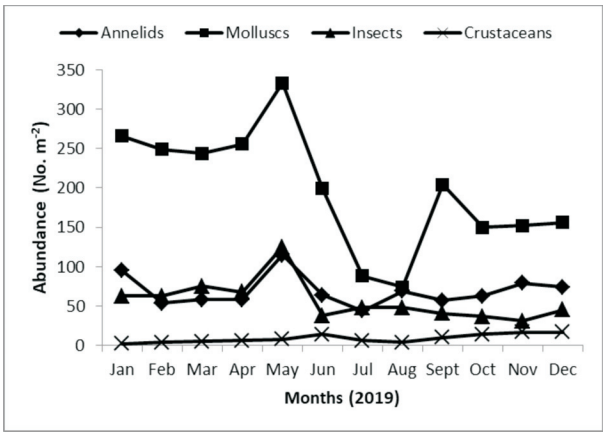
(b)

Fig. 1(a). Satellite picture of Katiganga beel. 1(B): General location of the study area (Katiganga beel, Murshidabad, West Bengal).

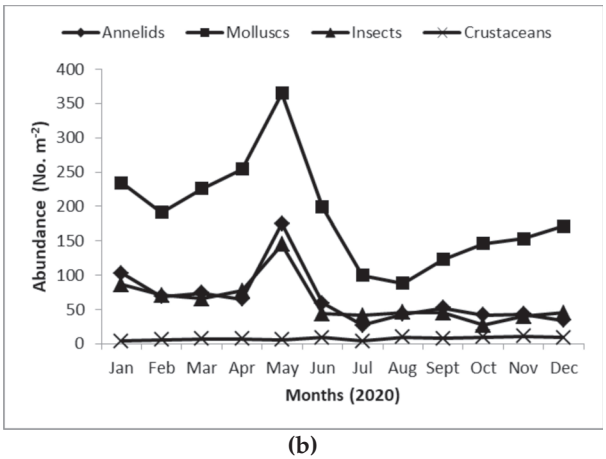
ment by the process of bioturbation due to their inherent burrowing habit (Chapman, 2001; Egeler and Römbke, 2007). They are most abundant generally in sediments rich in organic nutrients (Mir and Yousuf, 2003). Polychaetes and Hirudineans were represented by single species each as *Neanthes sp*. and *Helobdella sp.* respectively which is at per the observation of Mitra and Mishra, (2010, 2017). Polychaetes are used as bioindicator of pollution in aquatic ecosystem and play vital role in nutrient recycling (Olomukoro and Dirisu, 2014; Mitra and Mishra, 2017). Hirudinean leeches are also ecologically important but not in the sense of their direct involvement in the nutrient dynamics, but also as a regulator of other invertebrate communities of aquatic environment. *Helobdella sp.* was also reported as endemic species of India and found to be distributed in West Bengal (Mandal, 2004; Mandal and Mishra, 2017). Oligochaetes were the dominant group of annelids in Katiganga beel like the observation of Singh and Ahmad, (1989) who stated that the oligochaetes were the main annelid component of lentic waters while polychaetes were the major contributors of lotic system. Molluscan population was found to be maximum in both the years contributing about 58-59% of the total macrozoobenthic fauna. Among the molluscs, Gastropods were represented by 17 taxa namely *Radix luteola, Lymnea ovalis, Lymnea acuminate, Pleurocera acuta, Viviparus bengalensis, Pila globosa, Physa sp., Amnicola sp., Indoplanorbis sp., Gabbia orcula, Segmentina sp., Brotia costula, Camptoceras sp., Digoniostoma cerameopoma, Bellamya bengalensis, Bellamya variatus, Thiara tuberculata*. Among the 7 Bivalve taxa *Unio sp.* contributed 3.84% of the molluscan population in the 1st year and *Piscidium sp.* contributed 4.80% in the 2nd year. Almost all the taxa under the molluscan group are assessed as Least Concern of IUCN Red List Categories and Criteria (Arvind *et al.,* 2010). However flow modifications of the beels due to the loss of connectivity with river, high pollution through runoff from adjoining areas are the threat for the freshwater molluscs (Waghmare *et al.*, 2012, Verma and Saksena, 2010). Presence of *Viviparus sp.*, *Amnicola sp.*, *Lymnaea sp* is the indicator of mesotrophic condition of their habitat, i.e. water body (Malla and Rout, 2015). Molluscan, Annelid and Insect populations attained their peaks in the month of May and in the late winter months in both the years (Fig. 2A and 2B).

Insects comprised of 17-19% of the total macrozoobenthic organisms in both the years. Lepidopteran larvae (13.34%) and Ephemeropteran larvae (12.82%) were found to dominate the insects group in 1st and 2nd year of study respectively. Crustaceans contributed 2-3% in abundance of benthic population and comprised of 2 taxa only (Table 1). Community assemblage of macrozoobenthic fauna varies in time and space and water quality and productivity of system governs the diversity of these fauna (Latha and Thanga, 2010).

The use of various diversity indices is recognized as a good tool for preliminary evaluations of overall health of the ecosystem. The Shannon (H) indices were highest for Molluscs (2.764-3.138) followed Insects (2.0-2.286), Annelids (1.724-2.277) and Crustaceans (0.4101-1.0). From these values of Shannon Index, it can be showed that the studied beel falls in



(a)



(b)

Fig. 2(a) & 2(b). Monthly variation of four macro zoo benthic groups collected from the Katiganga beel during the investigated period.

Table 1. Abundance of Macrozoobenthic fauna in the investigated beel during the study period

Macrozoobenthic Organisms	2019		2020	
	Average ± SD (No.m^{-2})	Percentage	Average ± SD (No.m^{-2})	Percentage
Annelids				
Oligochaeta				
Oligobdella sp	6.25 ± 3.22	9.04	6.67 ± 7.35	10.18
Branchiura sp.	7.08 ± 3.48	10.24	6.67 ± 7.97	10.18
Chaetogaster sp.	8.42 ± 1.98	12.17	8.33±4.79	12.72
Lumbriculus sp.	5.25 ± 2.93	7.59	5.75±4.59	8.78
Dero sp.	5.5 ± 1.88	7.95	8.25±7.21	12.60
Limnodrilus sp.	7.25 ± 2.96	10.48	6.67±3.68	10.18
Pheretima sp.	8.17 ± 4.88	11.81	6.42±3.34	9.80
Tubifex sp.	9.25 ± 4.20	13.37	6±2.09	9.16
Polychaeta				
Neanthes sp.	5.17 ± 3.38	7.47	5.42±4.12	8.27
Hirudinea				
Helobdella sp.	6.83 ± 3.86	9.88	5.33±3.23	8.14
Molluses				
Gastropod				
Radix luteola	7.33 ± 2.81	3.71	6.83±4.73	3.64
Lymnea ovalis	10.75 ±7.39	5.44	12.58±8.61	6.71
Lymnea acuminata	9.58 ± 4.29	4.85	12.58±3.90	6.71
Pleurocera acuta	8.83 ± 6.15	4.47	6.66±2.74	3.56
Viviparus bengalensis	11.5 ± 7.06	5.82	11.5±9.64	6.13
Pila globosa	6.08 ±3.65	3.08	11.08±7.62	5.91
Physa sp.	7.5 ± 4.08	3.80	10.42±6.76	5.56
Amnicola sp.	7.17 ± 2.69	3.63	3.75±3.22	2.00
Indoplanorbis sp.	7.92 ± 4.91	4.01	8.5±4.60	4.53
Gabbia orcula	9.25 ± 7.28	4.68	9.16±5.20	4.89
Segmentina sp.	8.42 ± 4.08	4.26	8.42±2.35	4.49
Brotia costula	6.92 ± 2.47	3.50	5.92±2.64	3.16
Camptoceras sp.	7.08 ± 3.65	3.58	9.5±4.27	5.07
Digoniostoma cerameopoma	10.08 ± 4.94	5.10	4.25±2.90	2.27
Bellamya bengalensis	18.5 ± 8.55	9.36	5.83±1.59	3.11
Bellamya variatus	10.83 ± 5.24	5.48	8.91±7.87	4.76
Thiara tuberculata	5.42 ± 2.54	2.74	6.83±5.86	3.64
Bivalves				
Piscidium sp.	6.17 ± 3.10	3.12	9±6.37	4.80
Sphaeridium sp.	5.92 ± 3.63	2.99	6.67±2.39	3.56
Unio sp.	7.58 ± 4.23	3.84	6.17±2.37	3.29
Corbicula bensonil	5.33 ± 3.31	2.70	5.08±2.68	2.71
Lamellidens marginalis	6 ± 4.18	3.04	5.33±3.58	2.84
Radiatula sp.	7.5 ± 4.08	3.80	6.47±4.52	3.42
Parreysia corrugata	5.92 ± 3.60	2.99	6.08±6.64	3.24
Insects				
Coleopteran larvae	5.83 ± 4.32	10.26	5.25±4.71	8.59
Tricopteran larvae	3.92 ± 3.58	6.89	4.75±3.05	7.78
Lepidopteran larvae	7.58 ± 5.04	13.34	6.17±4.71	10.10
Chironomus larvae	7.08 ± 4.96	12.46	7.47±5.28	12.14
Odonata larvae	4.75 ± 2.09	8.36	7.5±3.34	12.28
Hemipteran larvae	6.5 ± 5.00	11.44	5.5±5.70	9.00
Ephemeropteran larvae	5.17 ± 1.99	9.09	7.83±2.82	12.82
Dragonfly numphs	4.33 ± 3.06	7.62	5.25±2.77	8.59
Damselfly nymphs	7.25 ± 1.48	12.76	7.17±1.95	11.73

Table 1. *Continued ...*

Macrozoobenthic Organisms	2019		2020	
	Average ± SD (No.m^{-2})	Percentage	Average ± SD (No.m^{-2})	Percentage
Mayfly nymphs	4.42 ± 2.87	7.77	4.25±4.41	6.96
Crustaceans				
Gammarus pulex	6.33 ± 4.60	71.03	4.47±2.02	58.24
Palemone sp.	2.58 ± 1.62	28.97	3.17±1.53	41.76

Table 2. Monthly variation of Diversity Indices of Macrozoobenthic groups obtained from average no. of organisms enumerated throughout the investigation period (2019-2020) in Katiganga Beel, Murshidabad, West Bengal.

Diversity Indices	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Annilids												
Taxa_S	10	10	10	10	10	10	7	10	10	10	10	10
Individuals	102	64	69	64	146	63	38	57	56	55	63	57
Dominance_D	0.108	0.1118	0	0.1152	0.1056	0	0.196	0.1222	0	0.1088	0.105	0
Simpson_1-D	0.891	0.8882	1	0.8848	0.8944	1	0.803	0.8778	1	0.8912	0.894	1
Shannon_H	2.261	2.233	2	2.229	2.276	2	1.724	2.181	2	2.26	2.277	2
Evenness_e^H/S	0.958	0.9331	1	0.929	0.9738	1	0.801	0.8859	1	0.9579	0.975	1
Brillouin	2.09	1.996	2	1.991	2.145	2	1.494	1.929	2	1.992	2.033	2
Menhinick	0.990	1.25	1	1.25	0.8276	1	1.136	1.325	1	1.348	1.26	1
Margalef	1.946	2.164	2	2.164	1.806	2	1.649	2.226	2	2.246	2.172	2
Equitability_J	0.981	0.9699	1	0.968	0.9885	1	0.885	0.9474	1	0.9813	0.989	1
Fisher_alpha	2.746	3.324	3	3.324	2.432	3	2.52	3.513	4	3.577	3.348	4
Berger-Parker	0.147	0.1406	0	0.1875	0.1507	0	0.263	0.1754	0	0.1636	0.142	0
Chao-1	10	10	10	10	10	10	8	10	10	10	10	10
Molluscs												
Taxa_S	24	24	24	24	24	24	20	18	24	24	24	24
Individuals	255	227	239	260	355	204	99	83	169	155	162	170
Dominance_D	0.048	0.0481	0	0.049	0.0468	0	0.058	0.0677	0	0.0452	0.046	0
Simpson_1-D	0.952	0.9518	1	0.951	0.9532	1	0.941	0.9322	1	0.9548	0.954	1
Shannon_H	3.105	3.099	3	3.085	3.119	3	2.897	2.764	3	3.138	3.128	3
Evenness_e^H/S	0.929	0.9239	1	0.9107	0.9425	1	0.905	0.8815	1	0.9607	0.951	1
Brillouin	2.925	2.902	3	2.908	2.978	3	2.591	2.449	3	2.874	2.874	3
Menhinick	1.503	1.593	2	1.488	1.274	2	2.01	1.976	2	1.928	1.886	2
Margalef	4.151	4.24	4	4.136	3.917	4	4.135	3.847	4	4.56	4.521	4
Equitability_J	0.977	0.9751	1	0.9706	0.9814	1	0.966	0.9564	1	0.9874	0.984	1
Fisher_alpha	6.494	6.778	7	6.45	5.814	7	7.559	7.075	8	7.945	7.787	8
Berger-Parker	0.078	0.0793	0	0.0731	0.0789	0	0.080	0.0963	0	0.0774	0.080	0
Chao-1	24	24	24	24	24	24	20.5	18.25	24	24	24	24
Insects												
Taxa_S	10	10	10	10	10	10	10	10	10	8	9	10
Individuals	75	71	74	75	137	43	47	50	46	34	38	47
Dominance_D	0.103	0.1085	0	0.1136	0.1066	0	0.12	0.1072	0	0.1453	0.121	0
Simpson_1-D	0.896	0.8915	1	0.8864	0.8934	1	0.88	0.8928	1	0.8547	0.878	1
Shannon_H	2.286	2.261	2	2.227	2.27	2	2.188	2.265	2	2.003	2.152	2
Evenness_e^H/S	0.984	0.959	1	0.9269	0.9677	1	0.891	0.9631	1	0.9263	0.956	1
Brillouin	2.07	2.037	2	2.015	2.133	2	1.898	1.978	2	1.699	1.836	2
Menhinick	1.155	1.187	1	1.155	0.8544	2	1.459	1.414	1	1.372	1.46	1
Margalef	2.085	2.111	2	2.085	1.829	2	2.338	2.301	2	1.985	2.199	2
Equitability_J	0.993	0.9818	1	0.967	0.9858	1	0.950	0.9837	1	0.9632	0.979	1
Fisher_alpha	3.099	3.173	3	3.099	2.482	4	3.889	3.759	4	3.298	3.725	4

Table 2. *Continued ...*

Diversity Indices	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Berger-Parker	0.133	0.1549	0	0.16	0.1387	0	0.148	0.14	0	0.2353	0.184	0
Chao-1	10	10	10	10	10	10	10	10	10	8	9	10
Crustaceans												
Taxa_S	2	2	2	2	2	2	2	2	2	2	2	2
Individuals	3	5	6	7	8	12	5	7	9	13	14	13
Dominance_D	0.555	0.68	1	0.5102	0.625	1	0.52	0.7551	1	0.5266	0.591	1
Simpson_1-D	0.444	0.32	1	0.4898	0.375	0	0.48	0.2449	0	0.4734	0.408	0
Shannon_H	0.636	0.5004	1	0.6829	0.5623	1	0.673	0.4101	1	0.6663	0.598	1
Evenness_e^H/S	0.944	0.8247	1	0.9898	0.8774	1	0.980	0.7535	1	0.9735	0.909	1
Brillouin	0.366	0.3219	0	0.5079	0.4165	1	0.460	0.278	1	0.5508	0.493	0
Menhinick	1.155	0.8944	1	0.7559	0.7071	1	0.894	0.7559	1	0.5547	0.534	1
Margalef	0.910	0.6213	1	0.5139	0.4809	0	0.621	0.5139	0	0.3899	0.378	0
Equitability_J	0.918	0.7219	1	0.9852	0.8113	1	0.971	0.5917	1	0.9612	0.863	1
Fisher_alpha	2.622	1.235	1	0.9354	0.8559	1	1.235	0.9354	1	0.6601	0.638	1
Berger-Parker	0.666	0.8	1	0.5714	0.75	1	0.6	0.8571	1	0.6154	0.714	1
Chao-1	2	2	2	2	2	2	2	2	2	2	2	2

the category of moderately impacted water body (Gray, 2000; Morris *et al.,* 2014; Malla and Rout, 2015). However high species diversity does not always confirms good quality of aquatic ecosystem. Therefore, species richness is also used as a biological indicator of disturbance (Kalyoncu and Gülboy, 2009). The Equitability index (J) in the present investigation for all the groups of macrozoobenthic fauna takes a value between 0 and 1 (Table 2). The lower values of Equitability index (J) signify more diversity in organisms while higher Equitability values indicate less diversity. The minimum values of equitability for all the groups were found in Monsoon season (July-August) in Katiganga Beel which differs from the observation of Abu Sayeed *et al*., 2017. The Simpson Index value also ranged between 0 and 1 for all the taxa in studied beel, and most of the times the value of Simpson Index had the higher values which indicates greater sample diversity (Hossain *et al.,* 2017). Higher values of Margalef Richness Index (d) in the study (2.246-4.58) for Annelids, Insects and Molluscs (Table 2) represented the suitability of habitat for these organisms and indicated the presence of longer food chain and complex food web in the ecosystems involving these organisms in their stable community (Hossain *et al.,* 2017). From the overall study conducted during two years in this open beel ecosystem it can be said that wetland macrozoobenthic organisms are generally influenced by the stability of the ecosystem and depth and volume of available water area along the seasons of drying and rain. Comprehensive studies on the wetland ecosystem are extremely important in determining the density, distribution and diversity of the macrozoobenthic organisms which in turn will enlighten the holistic approach towards conservation of these extremely important biotic fauna.

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