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Population dynamics of macrozoobenthos of Guthia Taal, A Wetland of district Bahraich, Uttar Pradesh (India)

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Abstract
Wetlands support vast biodiversity of flora and fauna, provide food and shelter to organisms that thrive in. Macrozoobenthos play an important role in aquatic ecosystem as primary and secondary consumers and form the trophic relationships include those that feed on them directly or indirectly like fish and bird population. They are the best indicators of the stress in the aquatic ecosystem, so it is utmost important to document the benthic diversity. During the present investigation 22 genera of macrozoobenthos were recorded. Out of 22, 9 genera belong to phylum Mollusca, 7 to Annelida and 6 to Arthropoda. The annual density shows that molluscan dominates and constituted 40.08% of the total macrozoobenthos population was followed by annelids (36.35%) and arthropods (23.57%).

Keywords: Macrozoobenthos, Guthia Taal, Wetland

Introduction
Wetlands are areas where water is primary factor controlling the environment and the associated plants and animal life. They occur where the water table is at or near the surface of the land, or where the land is covered by water. Wetlands are among the world's most productive environments. They are cradles of biological diversity, providing the water and primary productivity upon which countless species of plants and animals depend for survival (Prakash, 2020) [8]. They support high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species. Wetlands are important components of watersheds and provide many valuable functions to the environment and to society. Now-a-days wetlands and other deep water habitats is globally a subject of great ecological interest due to their socio-economic values and ecosystem services which has necessitated the need for reliable broad based information on their ecological status. The ecological functioning of these ecosystems has been greatly affected by the growing anthropogenic activities

Biodiversity is the 'foundation of human life' on earth because each organism plays an important role and helps in producing more productive with stable and balanced ecosystem which has the ability to survive in stress conditions (Prakash, 2019) [7]. Ecological balance is required for widespread biodiversity and human survival (Verma, 2017; 2018a) [21, 22]. Environmental conditions play a key role in defining the function and distribution of organisms, in combination with other factors. Environmental changes have had enormous impacts on biodiversity patterns in the past and will remain one of the major drivers of biodiversity patterns in the future (Prakash and Srivastava, 2019) [9]. The biodiversity has different levels and values (Verma, 2015; 2016a) [17, 18]. The climate change has a huge impact on biodiversity (Prakash *et al.*, 2020) [8] and farmers' practices (Mandal and Singh, 2020; Sugumaran *et al.*, 2020) [4]. Human demands on freshwater ecosystems in the past century have a threat to biodiversity around the world. As a result of this global crisis, documenting losses of biodiversity, diagnosing their causes and finding solution have become a major part of contemporary freshwater ecology.

Macrozoobenthos being diverse in nature, react strongly and often predictably to human influences in aquatic ecosystem. They act as a viable tool for biological monitoring of freshwater ecosystems as they have wide range of sensitivities to change in both water quality and habitats (Thoker *et al*., 2015) [16]. Macrozoobenthos form the basis of the trophic level and any negative effect caused by pollution in the community structure can in turn affect trophic relationships. Macrobenthic invertebrates act as food for many aquatic birds and fishes.

Different species comprise distinct functional groups that provide ecological integrity. In some cases, these functional groups may be represented by only a few species, so that any loss of species diversity could be detrimental to continued ecosystem functioning. Thus, it is increasingly becoming important to protect macrozoobenthic communities owing to their immense importance in their natural habitats.

The macrozoobenthos of freshwater wetlands provide significant support to the aquatic food web and contribute to ecosystem stability through sustenance of cultivatable fish, aquatic birds and other wild life. Their composition, abundance and distribution pattern acts as an ecosystem index, thereby indicating trophic structure, water quality and eutrophication level of the ecosystem (Mehdi *et al*., 2005) [3]. Benthic diversity of wetlands were studied by many ecologists in India including Siraj *et al*., (2010) [13] and Verma and Prakash (2018) [26] but no such information is available in fresh water body of Tarai region of eastern U.P. Several researchers including Prakash *et al.,* (2015) [10], Verma (2016b, 2019, 2020) [19, 24, 25], Verma and Prakash (2020a, 2020b) [27, 28] worked a lot on fresh water body. Keeping this mind an attempt has been made to document macrozoobenthic diversiy of Guthia Taal and their composition as well as to know the variation of the macrozoobenthic diversity with depth.

Study Area

Guthia Taal (Image 1; Image 2) is a large shallow perennial horse shoe shaped lentic water body. The total catchment area of wetland is about 75.9ha. Out of 75.9ha, 25.3 ha is situated in Guthia, 25.3ha in Rucknapur, 22.77ha in Dihawa Sher Bahadur Singh and 2.53ha in Nawgeya village, of Kaiserganj Tahsil of district Bahraich. But in summer season its water spread area becomes reduced up to 37.95ha. It is situated between the latitude 27.2537^{0}N- 81.54313^{0}E. The Taal is enriched with several type of vegetation such as *Nymphaea, Nelumbo* and Nymphya as well as aquatic birds like Duck, Saras and Bagula. The water of Taal is used for agriculture and fish culture. The sarus crane is state bird of Uttar Pradesh and prefers to reside in and around wetlands in association with human (Verma, 2016c, 2018b) [19, 23]. The abundant food attracts hundreds of resident and migratory birds including Siberian crane during winter season.

Image 1: Satellite view of Guthia Taal, a wetland of Bahraich district of U.P.

Image 1: A view of Guthia Taal studied

Materials and Methods

The sediment sample from the bottom at all stations were collected during morning time by using Peterson Grabe mud sampler, collected samples were sieved through 0.5 mm sieve (Ankar and Elmgreen, 1976) [1]; the material which retained on sieve were collected and from it benthic organisms were stored out with the help of forceps and brush and were collected in narrow mouthed plastic bottle, containing 4% formalin and 70% alcohol as preservative depending upon the type of organisms to be preserved. The soft-bodied organisms were preserved in 70% alcohol while the shelled organisms like mollusks in 4% formalin (Borror *et al.*, 1976) [2]. All macro fauna of bottle were identified with the help of available key and manuals Neetham and Needham (1962) [5], Borror *et al.*, (1976) [2] and Pennak (1989) [7] under the light microscope. The population of organisms was counted and number of individuals of a species per sample and was expressed as number/m^2.

Results and Discussion

Macrozoobenthos are good indicators of long term habitat quality rather than instantaneous conditions. During the entire study period, total 22 genera of benthos belonging to 3 phylum and 8 classes were collected from three sampling stations of the Guthia Taal. All these three phyla belong to Protostopmia group (Verma and Prakash, 2020c) [29]. The present study revealed that the phylum molluscan was in dominant position than annelids and arthropods. The collected benthos including their classes, zoological names and their annual mean density are shown in the table given.

Table 1. Macrozoobenthos recorded in the Guthia Taal during the study period.

S.N.	Class/Genera of Macrozoobenthos	Mean Density of Macrozoobenthos (Number/m^2) in different sampling stations			Mean Density of Macrozoobenthos (Number/m^2) in Guthia Taal
		S-1	S-2	S-3	
Phylum- Annelida (36.35%)					
	Class 1:Oligochaeta				
1	*Branchiura* sp.	10	5	4	19
2	*Limnodrilus* sp.	5	0	0	5
3	*Lumbriculus* sp.	10	11	10	31
4	*Tubifex* sp.	32	25	19	76
5	*Nais* sp.	0	4	3	7
	Class 2: Hirudinidae				
6	*Glassiphonia* sp	9	7	5	21
7	*Erpobdella* sp.	6	0	0	6
Diversity / Density		6/72	5/52	5/41	7/165
Phylum- Arthropoda (23.57%)					
	Class 1: Insecta				
8	*Caenis* sp.	7	9	0	16
9	*Chironomus* sp.	15	11	12	38
10	*Hydrophilus* sp.	7	9	0	16
	Class 2: Crustacaea				
11	*Gammarus* sp.	12	6	2	20
	Class 3: Arachnida				
12	*Dolomedes* sp.	6	0	5	13
13	*Acari* sp.(Water mites)	3	1	0	4
Diversity / Density		6/50	5/36	3/19	6/107
Phylum- Mollusca (40.08%)					
	Class 1: Gastropoda				
14	*Lymnaea* sp.	16	12	9	37
15	*Pila* sp.	15	15	10	40
16	*Thiara* sp.	12	0	8	20
17	*Gyraulus* sp.	0	6	4	10
18	*Tarebia* sp.	5	3	3	11
	Class 2: Pelecypoda				
19	*Corbicula* sp.	9	7	5	21
20	*Planorbula* sp.	4	3	0	7
21	*Promentus* sp.	0	2	0	2
	Class 3: Bivalvia				
22	*Lamellidens* sp.	15	10	9	34
Diversity / Density		7/76	8/59	7/48	9/182
Total Diversity/Density		19/198	18/147	15/108	22/454

In normal condition, the distribution of macro benthos fauna has been reported to be dependent on the availability and distribution of preferably food items. In fact, their capacity to exploit areas with optimum food supply might be explained by their abundance (Zahoor *et al.*, 2010) [31]. Benthic mean diversity of all the three stations is given in the table. The mean density of the wetland was estimated to be 454 nos/m^2 during twelve month of study period in bimonthly sampling. Vyas and Bhat (2010) [30] and Shrivastava (1997) [12] reported 1782 nos/m^2 and 845nos/m^2 in tropical water body and Ravishankar reservoir, respectively.

The annual density shows that molluscans dominates and constituted 40.08% of the total macrozoobenthos population was followed by annelids (36.35%) and arthropods (23.57%). In the present investigation 22 genera were identified throughout the study period. Out of 22, 7 species belonged to annelids, 6 belonged to arthropods and 9 belonged to molluscans. The pattern of dominance of various macrozoobenthic forms in terms of their mean density at Guthia Taal was as follows:

Dominance pattern of annelids was *Tubifex* sp. > *Lumbriculus* sp.> *Glassiphonia* sp. > *Branchiura* sp. >*Nais* sp. > *Erpobdella* sp. > *Limnodrilus* sp.

Dominance pattern of arthropods was *Chironomus* sp. > *Gammarus* sp. > *Caenis* sp.> *Hydrophilus* sp. > *Dolomedes* sp. > *Acari* sp.(Water mites).

Dominance pattern of molluscan was *Pila* sp.> *Lymnaea* sp.> *Lamellidens* sp.> *Corbicula* sp. >*Thiara* sp. > *Tarebia* sp. >*Gyraulus* sp. > *Planorbula* sp.> *Promentus* sp.

Among the macrozoobenthos, *Branchiura* sp., *Tubifex* sp., *Lumbriculus* sp. and *Glassiphonia* sp. of annelids; *Chironomus* sp. and *Gammarus* sp. of arthropods; *Lymnaea* sp., *Pila* sp., *Tarebia* sp., *Corbicula* sp. and *Lamellidens* sp. of molluscans were found in all three sampling stations.

The macrozoobenthic communities of three study stations belonged to more or less similar taxonomic groups, although the number of individuals within each group varied considerably. The maximum number of taxa (19) was recorded at station S1, moderate 18 at station S2 and minimum 15 at station S3. The mean population density at different stations varies between 108 -198 individuals/m^2. This variability in the diversity and density of benthos at different stations might be due to the substrate type, velocity, depth and anthropogenic activities (Thoker *et al.*, 2015) [16]. Presence of *Chironomus* sp. in all the stations is directly related to the quantity of organic matter in the water. Relatively high species density and species composition of macrozoobenthos at Station S1 seems to be correlated with macrophytic species richness because they spent much of their life cycle on host plants (Shah and Pandit, 2001) [11]. This particular site was rich in submerged macrophytes surrounded by some emergents. Siraj *et al*., (2010) [13] reported that submerged macrophytes harboured greater number and greater taxonomic diversity of benthic species.

Due to low depth, transparency increases which helps in penetration of sunlight to the bottom layer by which process of decomposition get accelerated resulting increase in benthic diversity. The findings of the present study agreed with the findings of Pani and Misra (2005) [6], Srinivasan and Hamlatha (2006) [14] and Vyas and Bhat (2010) [30].

Thus, from the present study, it was inferred that the**:**

- Benthic fauna of this wetland comprised of Oligochaeta and Hirudinidae of Annelida; Insecta, Crustacaea and Arachnida; Gastropoda, Pelecypoda and Bivalvia.
- Benthic organisms grow easily in shallow area of waterbody. These areas are suitable for growth of benthic organisms because these zones are rich in macrophytes and solid organic wastes.
- Benthic forms are an important component of food chains and energy flow pathways. Benthic community constitutes an important part of animal production and is tightly integrated into the structure and functioning of these habitats (e.g. organic matter processing, nutrient retention, food resources for vertebrates, such as amphibians, fish).
- Benthic organisms are often good indicators; Some genera of benthos showed low frequency across selected sites. This clearly indicated that they are sensitive to pollution. It can be further concluded that these macrozoobenthos can live in polluted water which can be related to the availability of food and oxygen in this stream in addition to other factors.
- The presence of the pollution indicator macrozoobenthic species, allows us to conclude that the Guthia Taal (wetland) has evolved over the years as a eutrophic ecosystem and merits urgent attention for ecorestoration and sustainable management.

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