IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB)
ISSN: 2455-264X, Volume 1, Issue 1 (Nov. – Dec. 2014), PP 11-14
www.iosrjournals.org

Analysis of Macrozoobenthos in the Pond of Nawabganj Bird Sanctuary: A Wetland Ecosystem

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Abstract
The study was conducted at a selected pond within Nawabganj Bird Sanctuary in Uttar Pradesh, focusing on the qualitative and quantitative analysis of macrozoobenthic diversity. A total of 38 genera were identified during the investigation, spanning the phyla Annelida, Arthropoda, and Mollusca. Among these, mollusks exhibited a particularly rich diversity, constituting approximately 43.63% of the total benthic population, as detailed in the provided table. Arthropods also displayed significant diversity, contributing around 28.90%, while annelids accounted for 29.39% of the total population.
Overall, the benthic population density was estimated to be 1861 individuals per square meter. Mollusks made the highest contribution, with 15 genera and a population density of 812 individuals per square meter, followed by arthropods with 12 genera and 547 individuals per square meter, and annelids with 11 genera and 538 individuals per square meter.
Key Words: *Macrozoobenthos, Semara Pond, Wetland*

I. INTRODUCTION :

Wetlands serve as crucial components of watersheds, offering a multitude of valuable functions to both the environment and society. Renowned as one of the richest sources of biological diversity, wetlands are hailed as the world's most productive environments, as stated by the Ramsar Convention Bureau (2006). Often likened to the "Kidneys of the landscape" (Kumar et al., 2011), they cover approximately 46% of the Earth's surface. However, rampant urbanization and anthropogenic pressures have led to the degradation of many wetlands, resulting in significant nutrient accumulation.

Kanpur City, nestled between 25°26' and 26°58' north latitude and 79°31' and 80°34' east longitude, sits along the banks of the sacred River Ganga at an elevation of about 126 meters above sea level. The city experiences a tropical climate characterized by three distinct seasons: summer (March to June), rainy (July to September), and winter (October to February). Temperatures fluctuate between 2°C and 48°C, with total annual rainfall ranging from 450 mm to 750 mm, according to the Kanpur City Profile (2012). Relative humidity in Kanpur spans from under 30% during the summer to 70% in the monsoon season.

Benthic invertebrates, inhabiting the bottom of water bodies, play pivotal roles in the trophic dynamics of aquatic ecosystems. The composition and distribution of benthic organisms over time serve as indicators of ecosystem health. Consequently, there is a growing global emphasis on gaining a deeper understanding of the benthic environment in recent years. Macrozoobenthic organisms act as food for many aquatic birds and fishes. Benthic organisms are also used as potent pollution indicators, so it is utmost important to document the benthic diversity .On these aspects, Benthic diversity of lentic waterbodies were studied by many ecologists in India (Gupta,1976; Dutta *et al*,1887;Shrivastava,1997; Pani and Misra,2000;Kumar,2001; Sisodia,2001;Pani and Misra,2005; Srinivasan and Hamlatha,2006; Bhat and Pandit,2009; Vyas and Bhat,2010) but no such information is available in fresh water body of North Tarai region of U.P. Keeping this mind an attempt has been made to document macrozoobenthic diversiy of Nawabganj bird sanctuary pond and their composition as well as to know the variation of the macrozoobenthic diversity with depth.

Study Area:

The selected pond is a large, shallow, perennial lentic waterbody with irregular margins and dense growth of macrophytes. Initially known as Nawabganj Bird Sanctuary, it was renamed Shahid Chandra Shekhar Azad Bird Sanctuary in 2013. Situated in the Unnao district on the KanpurLucknow highway in Uttar Pradesh, India, the sanctuary comprises a lake and its surrounding environment, forming one of the many wetlands in Northern India. The total area of this pond spans 466.66 acres, with a maximum water depth of 15 feet during the monsoon season and a minimum of 5 feet in the summer. Water supply to the pond primarily comes from nearby river drainage. The pond harbors various types of vegetation and serves purposes like agriculture and pisciculture. The pond margins are heavily infested by Eichornia crassipes, leading to organic decomposition and sedimentation. Six stations, denoted as S1, S2, S3, S4, S5, and S6, were strategically selected across the

water body based on habitat characteristics, nutrient type, and supply. S1, S2, and S3 are situated in the inshore region, while S4, S5, and S6 are located in the deepest areas of the pond.

II. Materials and Methods:

Sediment samples were collected from the bottom at all stations during the morning using a Peterson Grabe mud sampler. The collected samples underwent sieving through a 0.5 mm sieve following the method described by Ankar and Elmgreen (1976). The retained material on the sieve was then collected, and benthic organisms were carefully extracted using forceps and brushes. These organisms were stored in narrowmouthed plastic bottles containing either 4% formalin or 70% alcohol as a preservative, depending on the type of organism being preserved. Softbodied organisms were preserved in 70% alcohol, while shelled organisms like mollusks were preserved in 4% formalin, following the guidelines provided by Borror et al. (1976). Identification of all macrofauna in the bottles was carried out using available keys and manuals such as those by Neetham and Needham (1962), Borror et al. (1976), and Pennak (1989) under a light microscope. The population of organisms was quantified, and the number of individuals of each species per sample was expressed as number/m².

III. RESULTS AND DISCUSSION :

The table provides data on the abundance of macrozoobenthos taxa in different stations (S1S6) within the pond, categorized by their respective phyla (Annelida, Arthropoda, and Mollusca). The number of individuals per square meter (number/m²) is indicated for each taxon at each station.

Annelida:

The dominant genera include Tubifex sp., Lumbriculus sp., and Nais sp. The highest diversity/density is observed at S1 with 11 genera and 172 individuals/m².

Arthropoda:

Notable genera include Chironomus sp., Psphenus sp., and Cyclops sp. Station S3 exhibits the highest diversity/density with 10 genera and 145 individuals/m².

Mollusca:

Significant genera comprise Bellamya sp., Thiara sp., and Pila sp. Station S2 displays the highest diversity/density with 14 genera and 237 individuals/m².

General Analysis:

Total counts reveal fluctuations in abundance across stations and phyla. Stations S1 and S2 generally demonstrate higher diversity and density compared to other stations. Mollusca show the highest overall diversity/density, followed by Annelida and Arthropoda. The presence of certain taxa may indicate specific habitat preferences or environmental conditions within the pond. These data underscore the importance of considering multiple phyla when assessing macrozoobenthos diversity in wetland ecosystems. Overall, the analysis highlights spatial variations in macrozoobenthos distribution and emphasizes the importance of studying multiple taxonomic groups to gain a comprehensive understanding of ecosystem dynamics within the pond**.**

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). Benthic diversity of all the stations is given in the table. The benthic population of the water body was estimated to be 1897 nos/m^2 during twelve month study period in bimonthly sampling. In the the present investigation 38 genera were identified throughout the study period. Out of 38, 11 species belonged to annelids,12 belonged to arthropods and 15 belonged to molluscans. Among the macrobenthos, *Tubifex* sp.,*Aumbriculus* sp., *Lumbriculus* sp. and *Nais* sp. of annelid; *Chironomus* sp, *Spaniotoma* sp. and *Cyclops* sp. of arthropods where as *Bellamya* sp, *Vivipara* sp, *Pila* sp, and *Pissidium* sp. of molluscans were most dominant forms being present in all the six stations of selected pond. Vyas and Bhat (2010) and Shrivastava (1997) reported 1782 nos/m^2 and 845nos/m^2 in tropical water body and Ravishankar reservoir, respectively.

Table: Macrozoobenthos diversity of selective Pond

Phylum /Genera	**Number of Macrozoobenthos (number/m^2)**					
	S_1	**S_2**	**S_3**	**S_4**	**S_5**	**S_5**
Annelida						
***Tubifex* sp.**	**42**	**30**	**20**	**5**	**8**	**9**
***Aumbriculus* sp.**	**19**	**23**	**15**	**16**	**5**	**4**
***Lumbriculus* sp.**	**24**	**6**	**9**	**10**	**11**	**12**

***Poecilobdella* sp.**	**6**		**7**	**11**	**9**	
***Glassiphonia* sp.**	**9**	**8**	**9**			
***Batracobdella* sp.**	**10**	**6**	**2**	**2**		
***Branchiura* sp.**	**6**	**8**	**2**		**4**	**3**
***Limnodrillus* sp.**	**12**	**14**	**8**	**2**		
***Nais* sp.**	**25**	**15**	**17**	**3**	**7**	**3**
***Hemiclepsis* sp.**	**5**	**6**				
***Glassiphonia* sp**	**14**	**9**	**9**	**7**	**6**	**7**
Diversity / Density	**11/172**	**10/125**	**9/97**	**8/56**	**7/50**	**6/38**
Arthropoda						
***Chironomus* sp.**	**42**	**37**	**37**	**12**	**11**	**16**
***Spaniotoma* sp.**	**18**	**18**	**20**	**11**	**3**	**11**
***Polycetropus* sp.**	**6**	**8**	**16**	**2**		
***Philopotamus* sp.**	**8**	**15**	**15**			
***Tinodes* sp.**	**6**	**11**	**11**		**2**	
***Hydroptila* sp.**	**7**					
***Psphenus* sp.**	**33**	**10**	**35**			
***Caenidae* sp.**				**6**	**9**	
***Gammarus* sp.**		**12**				
***Cyclops* sp.**	**12**	**11**	**19**	**6**	**9**	**6**
***Atydae* sp.**	**8**		**14**			**9**
Daphnia	**5**					
Diversity / Density	**10/145**	**8/122**	**8/167**	**5/37**	**5/34**	**4/42**
Mollusca						
***Lymnaea* sp.**	**12**		**10**	**7**		
***Bellamya* sp.**	**32**	**20**	**25**	**10**	**15**	**14**
***Vivipara* sp.**	**9**	**11**	**10**	**3**	**5**	**7**
***Gyraulus* sp.**	**8**	**14**				
***Thiara* sp.**	**29**	**24**	**27**			
***Pila* sp.**	**24**	**29**	**38**	**14**	**12**	**18**
***Unio* sp.**	**11**	**14**	**12**		**12**	**7**
Planorbis sp.	**2**	**31**	**14**			
***Gibbia* sp.**	**7**	**14**	**9**	**13**		
***Corbicula* sp.**	**12**	**14**	**11**	**7**	**9**	**4**
***Lymnaea* sp.**	**11**	**15**	**15**		**5**	**2**
***Perreysia* sp.**	**4**	**12**	**9**	**6**	**7**	
***Pissidium* sp.**	**11**	**15**	**14**	**13**	**3**	**3**
***Melanoides* sp.**	**3**	**13**	**7**			
***Planorbis* sp.**		**11**			**3**	
Diversity / Density	**14/175**	**14/237**	**13/201**	**8/68**	**9/76**	**7/55**
Total	**35/492**	**32/448**	**30/465**	**21/161**	**21/160**	**17/135**

During the present study molluscans show rich diversity contributing about 45%, to the total benthic population as shown in table, arthropods also shoes good diversity contributing about 30% while as annelids contributing only 25% of the total population. In the present study it was observed that diversity as well as density of macrobenthos were maximum in spring months followed by summer months due to maximum decomposition of macrophytes .

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 Efitre *et al* (2001), Pani and misra (2005),Srinivasan and Hamlatha (2006) and Vyas and Bhat (201). Thus it can be concluded that shallow inshore area of waterbodies are suitable for growth of benthic organisms because these zones are rich in macrophytes and solid organic wastes.

Thus macrozoobenthos function in different ways that are important to maintaining ecosystem functions such as energy flow in food webs. In the process of maintaining energy flow, these benthic species simultaneously provide essential ecosystem services, such as nutrient cycling and aeration of sediments. Different species comprise distinct functional groups that provide ecological integrity. The present study shows that benthic organisms grow easily in shallow zones. Thus the present water body is cradle for benthic organisms especially shallower regions were macrophytes are abundant from diversity point of view habitat i.e. bottom of the body showed posses mud, sand, rocks, stones, macrophytes and solid organic wastes to which benthic organisms get attached and act as on organic debris.

IV. Conclusion

In conclusion, our study sheds light on the macrozoobenthic diversity within the pond of Nawabganj Bird Sanctuary, Uttar Pradesh. Through qualitative and quantitative analyses, we identified a total of 38 genera across the phyla Annelida, Arthropoda, and Mollusca. Notably, mollusks emerged as the most diverse group, constituting a significant portion (43.63%) of the total benthic population. Arthropods also exhibited notable

diversity, contributing approximately 28.90%, while annelids accounted for 29.39% of the total population. The estimated benthic population density of 1861 individuals per square meter underscores the robust ecological dynamics within the pond ecosystem. Mollusks were found to be the most populous, with 15 genera and a density of 812 individuals per square meter, followed by arthropods with 12 genera and 547 individuals per square meter, and annelids with 11 genera and 538 individuals per square meter.

These findings highlight the importance of preserving and managing the wetland ecosystem of Nawabganj Bird Sanctuary to sustain the rich biodiversity of macrozoobenthos. Further research and conservation efforts are warranted to safeguard these vital components of the ecosystem and ensure the long-term health and stability of the sanctuary's aquatic habitat.

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