VOLUME 10 ISSUE 1 2024

ISSN 2454 – 3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 10, No. 1, 803-810 (2024)

International Journal of Zoological Investigations
Contents available at Journals Home Page: www.ijzi.net
Editor-in-Chief: Prof. Ajai Kumar Srivastav
Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Zooplankton Dynamics of Bhagda Taal, A Wetland of Balrampur, Uttar Pradesh, India

Singh Varsha and Prakash Sadguru*

Department of Zoology, M.L.K.P.G. College, Balrampur, Uttar Pradesh, India

**Corresponding Author*

Received: 24th March, 2024; **Accepted:** 22nd April, 2024; **Published online:** 15th May, 2024

https://doi.org/10.33745/ijzi.2024.v10i01.087

Abstract: Seasonal Variation of Zooplankton Dynamics was carried out during July 2021 to June 2023 at three sampling sites of Bhagda Taal, a wetland situated in Shriduttganj Block of Utraula Tahasil of Balrampur, U.P., India. Plankton collecting net was used to collect the zooplankton samples and Sedgwick Rafter Cell was used to enumerate the Zooplankton dynamics. Zooplankton diversity of Bhagda Taal, represented by 28 genera belongs to four groups, Rotifera, Copepoda Cladocera, and Ciliates. Out of 28 genra, 9 genera, *Asplanchna sp.*, *Brachions sp.*, *Cephalodella sp.*, *Filinia sp.*, *Keratella sp.*, *Lecane sp.*, *Notholca sp.*, *Polyarthra sp.* and *Roraria sp.* belong to rotifera; 5 genera, *Cyclops sp*., *Diaptomus. sp.*, *Gammarus sp.*, *Mesocyclops sp*., and *Nauplius* larvae belong to Copepodas; 10 genera, *Alona sp.*, *Alonella sp.*, *Biapertura sp.*, *Ceriodaphnia sp*., *Chydrorus sp.*, *Daphnia sp.*, *Diaphnosoma sp.*, *Monia sp. Moinodiaphnia sp.* and *Sida sp.* belong to Cladocera. 4 genera, *Chilodonella sp.*, *Epistylis sp.*, *Paramecium sp*., and *Vorticella sp*. belong to Ciliates. Cladoceran (35.71%) constitute the maximum zooplankton species followed by Rotiferas (32.14%), Copepods (17.85%) and Ciliates (13.93%) during the study period. In terms of seasonal variations of diversity, the maximum diversity of zoo-planktonic genera of Bhagda Taal was observed during the summer season followed by the monsoon and winter seasons. The result of the present investigation showed that the most suitable seasons for the growth of Rotifers, Copepods, Cladocerans, and Ciliates were monsoon, winter & summer, winter & summer, and summer seasons, respectively.

Keywords: Bhagda Taal, Rotifera, Cladocera, Copepoda, Ciliates, Zooplankton

Citation: Singh Varsha and Prakash Sadguru: Zooplankton dynamics of Bhagda Taal, A wetland of Balrampur, Uttar Pradesh, India. Intern. J. Zool. Invest. 10(1): 803-810, 2024.

https://doi.org/10.33745/ijzi.2024.v10i01.087

Introduction

Wetlands are distinct and the most biologically diverse ecosystems that are flooded or saturated by water, either permanently or seasonally. They occur where the water table is at or near the surface of the land, or where the land is covered by water (Verma and Prakash, 2020a). Wetlands are the transitional zones that occupy intermediate position between land and open water and act as amphibious habitats between aquatic and terrestrial areas. They are considered

one of the most productive ecosystems on the earth and rank with the tropical rain forests (Cross and Vohs, 1998) and offering various vital ecological amenities that are significant to human population as well as other wildlife too. According to the most ecologists, the presence of seasonal or permanent water is an important basic factor of wetland ecosystems that support their floral and faunal population. They are cradles of biodiversity, providing the water and primary productivity upon which countless species of plants and animals depend for survival (Prakash, 2020). They support high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species.

Zooplankton represent a diverse group of heterotrophic organisms that feed on phyto-plankton, facilitating the transfer of energy from lower to higher trophic levels by metabolic processes. It plays a crucial role in cycling of energy and the recycling of nutrients in their particular environments (Kar and Kar, 2016). Despite their small size and lack of inherent mobility, zooplankton drift with the currents and wind patterns. They have transitory roles in the aquatic food web, serving as vital components in the productivity of freshwater habitats (Ramachandra *et al*., 2017). In various aquatic environments, zooplankton act as the primary natural food resource for fishes, directly influencing their survival and growth. They are also essential for the culture of fish larvae i.e., spawn and fry. Thus, they work like the building blocks of aquatic food chains and webs. The life force of many aquatic organisms, including fish, is primarily sustained by zooplankton, particularly during their larval developmental phases. The significance of zooplankton lies in its role as the key source of nutrition for most fish once they have absorbed their yolk sacs. The ability of a fish population to navigate the vulnerable larval stage with minimal mortality has been identified by numerous scientists as a pivotal factor influencing the ultimate size of the annual cohort.

Zooplankton displays noteworthy adaptability when confronted with alterations in physical or chemical conditions, as well as shifts in their habitat. Various disturbances, such as nutrient influx, acidification, and sediment deposition, can significantly affect zooplankton communities. In aquatic settings, the distribution and diversity of zooplankton are predominantly influenced by the physicochemical characteristics of the water, rendering them valuable indicators of water pollution levels. Thus, zooplankton serve as important indicators of changes or fluctuations in water quality because of their sensitivity to environmental factors. Thus, the study of zooplankton dynamics in a water body has a great importance for imposing sustainable environ-mental management policies like Environmental Impact Assessment (EPA). These are the main food for fish; almost all the fishes at their larval stages depends on it and some of them exclusively feed on zooplankton hence their qualitative and quantitative studies are of great importance.

Since plankton populations and diversities differ among aquatic ecosystems in a given area as well as between locations, they are crucial factors to consider when enforcing sustainable management practices. The inadequate knowledge of plankton and their dynamics is a major drawback for the better understanding of the life process of fresh water bodies. Even though there are many studies on diversity of zooplankton reported from various areas of India, but there is lack of knowledge regarding freshwater bodies of eastern Uttar Pradesh, India except some worth mentioning of Prakash and Ansari (2000), Prakash (2001), Prakash *et al.* (2002, 2015), and Verma and Prakash (2020a, b). So, the present study was an attempt for reporting dynamics of zooplankton of Bhagda Taal of Balrampur district of eastern U.P.

Materials and Methods

Study area:

Bhagda Taal (Fig. 1) is situated about 16 km away from M.L.K.P.G. College, towards South-East direction, in Sanjhwal Premnagar villages, of Shriduttganj Block of Utraula Tahasil of Balrampur

Fig. 1: Google map of Bhagda Taal, a wetland of Balrampur district, U.P.

U.P. It is situated between the latitude 27^0 25/ 48//N to 27^0 43/08// N, altitude and $82^0$18/48// E to $82^0$30/18// E longitude. It is a large shallow lentic waterbody with about 21 ha catchment area but due to encroachment by villagers presently its catchment area reduces up to about 15 ha. In the summer season its water spread area becomes reduced up to 7.0 to 8.0 ha. Its water is used for agriculture and fish culture. The Taal has several types of aquatic plants such as *Nymphaea, Nelumbo* and *Nymphya* along with aquatic birds like Duck, Saras and Bagula. The abundant food attracts hundreds of resident and migratory birds during the winter season. Three sampling sites were carefully chosen after preliminary observation for present investigation. These sites have been named as S1, S2 and S3 (Fig. 1). These sites have been pointed out on the basis of the magnitude of activities and disturbance.

Zooplankton samples from three sites were collected fortnightly with plankton net of bolting no. 25 with a mesh size 25 µ attached with a collection tube at the base of net during July 2021 to June, 2023, between 9.00 to 10.00 am. 50 liter of surface water was sieved through the plankton net and sample was collected inside the collection tube. The sample was transferred to plastic bottle and preserved in 4% formalin. Zooplankton productivity was measured by using Sedge Wick Rafter Plankton counting cell and quantities are expressed as unit per liter of the taal water. The diversity of zooplankton was studied under light microscope with magnification 10X initially and followed by 40X. The specimens were identified following standard literature of Needham and Needham (1962), Battish (1992), Michael and Sharma (1998) and Sharma and Sharma (2008).

Results and Discussion

The taxonomic study revealed that the zooplankton of Bhagda Taal belonged to 4 groups and these groups constituted a majority of the fauna of this wetland. However, the diversity and density of each group species varies according to season and sampling sites.

In the present study, the Zooplankton community of Bhagda Taal comprised of four groups viz., Rotifera, Copepoda, Cladocera and Ciliates. Zooplankton diversity of Bhagda Taal, represented by 28 species belonging to four groups, Rotifera, Copepoda, Cladocera and ciliates (Table 1). Out of 28 genera, 9 genera, *Asplanchna sp., Brachions sp., Cephalodella sp., Filinia sp., Keratellasp., Lecane sp., Notholca sp., Polyarthra sp.* and *Roraria sp.* belong to rotifera; 5 genera, *Cyclops sp., Diaptomus sp., Gammarus sp., Mesocyclops sp.* and *Nauplius* larvae belong to Copepodas; 10 genera, *Alona sp., Alonella sp.,*

Table 1: Zooplankton Genera encountered at three sampling sites of Bhagda Taal, a wetland of Balrampur district of U.P.

S. No.	Zooplanktonic Genera	Sampling Sites		
		S1	S2	S3
Group: Rotifera				
1	*Asplanchna sp.*	**+++**	**+**	**+**
2	*Brachions sp.*	**+**	**++**	**++**
3	*Cephalodella sp.*	**++**	**++**	**++**
4	*Filinia sp.*	**++**	**+**	**++**
5	*Keratella sp.*	**+**	**-**	**+**
6	*Lecane sp.*	**-**	**+**	**+**
7	*Notholca sp.*	**++**	**+**	**-**
8	*Polyarthra sp.*	**+**	**-**	**+**
9	*Roraria sp.*	**++**	**-**	**+**
Group: Copepoda				
10	*Cyclops sp.*	**-**	**+**	**-**
11	*Diaptomus sp.*	**++**	**+**	**+**
12	*Gammarus sp.*	+	+	+
13	*Mesocyclops sp.*	**++**	+	**-**
14	*Nauplius* larvae	+++	+	+
Group: Cladocera				
15	*Alona sp.*	++	+	+
16	*Alonella sp.*	-	+	+
17	*Biapertura sp.*	+	-	++
18	*Ceriodaphnia sp.*	**+**	**+**	**+**
19	*Chydrorus sp.*	-	+	+
20	*Daphnia sp.*	-	+	-
21	*Diaphnosoma sp..*	+	-	+
22	*Monia sp.*	+	+	++
23	*Moinodiaphnia sp.*	+	-	+
24	*Sida sp.*	+	+	++
Group: Ciliates				
25	*Chilodonella sp.*	-	**+**	+
26	*Epistylis sp.*	+	+	+
27	*Paramecium sp.*	+	-	+
28	*Vorticella sp.*	++	+	-
Total No. of Zooplankton genera		**24**	**21**	**23**
_- Absent; + Few; ++ Abundant, +++ Dominant				

Table 2: Number and Percentage composition of Zooplankton Genera of Bhagda Taal of Balrampur district of U.P.

S. No.	Groups	Total No. and %age of Genera at different Sampling Sites			
		S1	S2	S3	Total
1	Rotifera	8 (28.57%)	6 (21.42%)	8 (28.57%)	9 (32.14%)
2	Copepoda	5 (17.86%)	5 (17.86%)	3 (10.71%)	5 (17.86%)
3	Cladocera	7 (25.00%)	7 (25.00%)	9 (32.14%)	10 (35.71%)
4	Ciliates	4 (14.29%)	3 (10.71%)	3 (10.71%)	4 (14.29%)
	Total	**24 (85.71%)**	**21 (75.0%)**	**23 (82.14%)**	**28 (100%)**

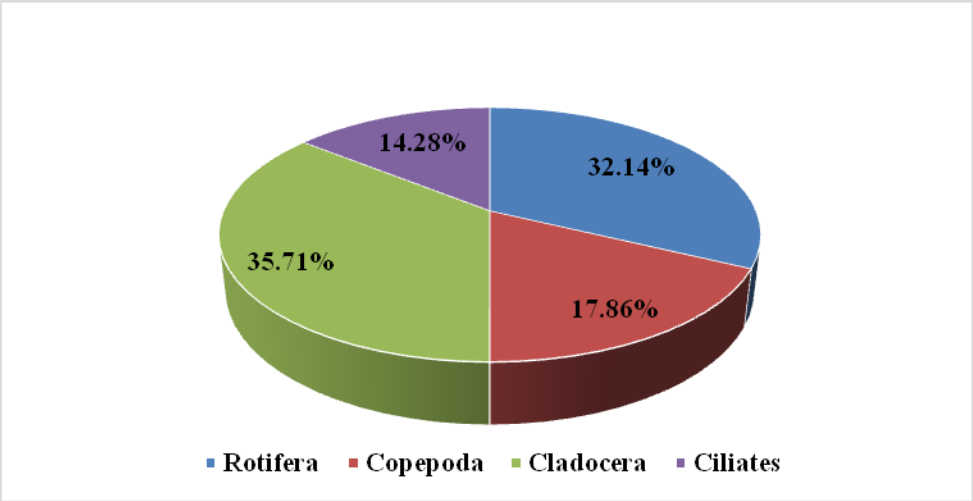

Fig. 2: Composition (%age) of different Zooplanktonic group of Bhagda Taal.

Table 3: Monthly variation in Total Zooplankton Productivity (Unit/L) at three sites of Bhagda Taal of Balrampur district of U.P.

Month	July 2021 to June 2022				July 2022 to June 2023			
	Sampling Sites			Mean	Sampling Sites			Mean
	S1	S2	S3		S1	S2	S3	
July	604	551	579	578	638	577	616	610
Aug	554	533	564	550	602	572	587	587
Sept	522	527	532	527	576	541	574	564
Oct	535	518	510	521	523	552	552	542
Nov	601	579	601	594	639	619	631	630
Dec	814	728	805	805	872	778	891	847
Jan	631	643	654	643	691	656	679	675
Feb	642	581	608	610	675	644	678	666
Mar	602	577	607	595	642	619	636	632
April	721	676	702	699	741	732	755	743
May	943	877	971	971	992	875	959	942
June	711	674	731	705	769	735	741	748
Mean	**657**	**622**	**655**	**650**	**697**	**658**	**692**	**682**
±SD	123	104	104	130	131	104	125	120
Min.	**535**	**518**	**510**	**521**	**523**	**552**	**552**	**542**
Max.	**943**	**877**	**971**	**971**	**992**	**875**	**959**	**942**

Biapertura sp., *Ceriodaphnia sp.*, *Chydrorus sp.*, *Daphnia sp.*, *Diaphnosoma sp.*, *Monia sp.*, *Moinodiaphnia sp.* and *Sida sp.* belong to Cladocera. 4 genera, *Chilodonella sp.*, *Epistylis sp.*, *Paramecium sp.* and *Vorticella sp.* belong to Ciliates. Rich diversity of zooplankton in the present study reflecting the suitability of wetland for dominant species (Arora and Mehra, 2003).

The diversity of zooplankton was not similar at all the sites and seasons. The maximum diversity was found at site S1 (24 genera) followed by site S2 (20 genera) and S3 (22 genera) (Table 2, and Fig.2). During the study period some species of zooplankton such as *Asplanchna sp.*, *Brachions sp.* and *Cephalodella sp.* of rotifers; *Diaptomus sp.*, *Gammarus sp.* and *Nauplius* larvae of Copepods; *Alona sp.*, *Ceriodaphnia sp.*, *Monia sp.* and *Sida sp.* of Cladoceran; *Epistylis sp.* of Ciliates were recorded throughout the year. Kar and Kar (2016) also reported the presence of most of these species of zooplankton throughout the year in a freshwater lake. Cladoceran (35.71%) constitute

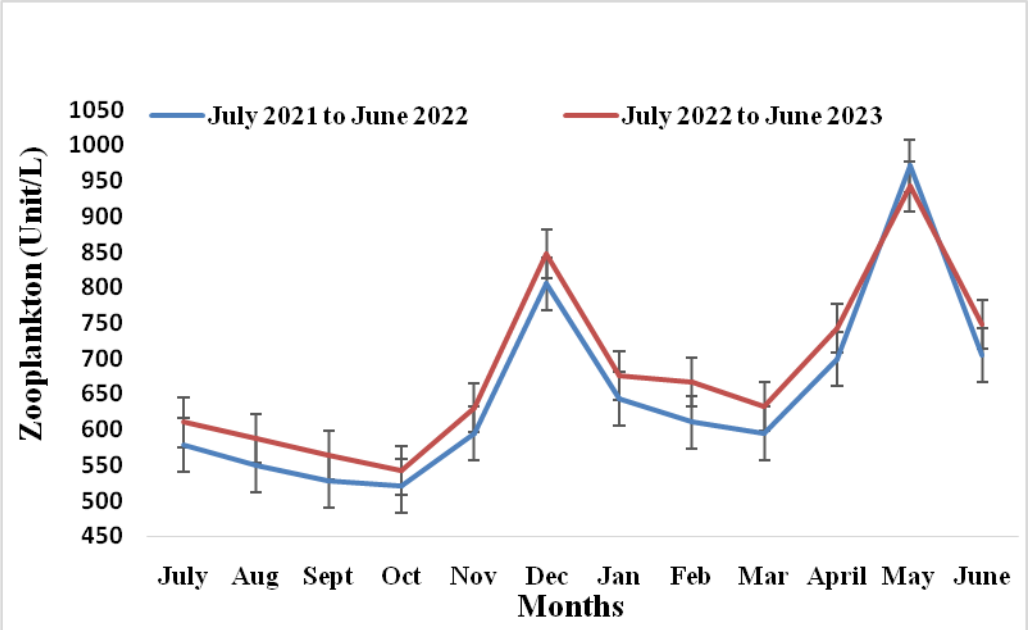

Fig. 3: Monthly variation in Total Zooplankton Productivity (Unit/L) of Bhagda Taal.

Table 4: Seasonal Variation in Total Zooplankton (Unit/L) of at three Sampling Site Bhagda Taal of Balrampur district of U.P.

Seasons	July 2021 to June 2022				July 2022 to June 2023			
	Sampling Sites			Average	Sampling Sites			Average
	S1	S2	S3	±SD	S1	S2	S3	±SD
Monsoon	554 ±35	532 ±14	546 ±31	544 ±25	585 ±48	560 ±16	582 ±26	576 ±29
Winter	672 ±96	633 ±70	667 ±95	663 ±96	719 ±104	674 ±70	719 ±116	704 ±96
Summer	744 ±143	701 ±126	753 ±154	743 ±160	786 ±147	740 ±104	772 ±135	766 ±128

the maximum zooplankton species followed by Rotiferas(32.14%), Copepods (17.85%) and Ciliates (13.93%) during the study period (Table 2, Fig. 2).

During the present study period the maximum diversity of genera in the zooplanktonic group was Rotifers >Cladocerans> Copepods >Ciliates. Similar pattern of the zooplankton group has been reported from Baghel Taal of Bahraich, U.P (Prakash and Singh, 2019) and from a Lake of Sultanpur, Haryana (Tyor *et al*., 2014) whereas Verma and Prakash (2020b) observed maximum density of Rotifers followed by copepods, cladocerans and ciliates in Semara Taal, wetlands of Siddharthnagar district of U.P. According to Kar and Kar (2016) and Mwebaza-Nadwula *et al*. (2005), the dominance of rotifera group is a common characteristic of tropical freshwater wetlands. Rotifers play an important role in the trophic tiers of freshwater ecosystem and function as living capsules of nutrition (Ramachandra *et al*., 2017). Rotifers are the dominant members of the zooplankton in most aquatic systems (Bogdan and Gilbert, 1984) and almost all fish feed on tiny rotifers during their early development (Goldman and Horne,1983). Abundance of cladocerans

indicated that this waterbody is rich in nutrients (Sivakami *et al*., 2015).

In the present study zooplankton density fluctuated between 521 to 942Units /L during the study period, respectively. The average minimum zooplankton density was recorded in October and the maximum in May (Table 3).

A bimodal pattern of zooplankton density was recorded, with the primary peak in May and a secondary peak in December (Fig. 3). Similar bimodal pattern of zooplankton fluctuations with the summer and winter peak were found in various fresh water bodies in India (Chourasia and Adoni, 1985; Rao and Krishna ,1985; Prakash and Ansari,2000; Prakash, 2001, Prakash *et al.,* 2002; Verma and Prakash, 2020b).

In the present study maximum average zooplankton density was found in summer season, moderate in winter season and minimum in monsoon season during the study period (Table 4). It was observed that maximum zooplankton production occurred during the summer months due to optimum ecological conditions. Increased density of zooplankton and gradually decreased in winter and monsoon were also reported by some other workers (Rao and Krishna, 1985; Prakash, 2001; Arora and Mehra, 2003; Angadi *et al*., 2005).

In this present study, the zooplankton community in the Taal demonstrated its productive nature and supported a diverse range of species. The zooplanktonic diversity and density was notably influenced by several physico-chemical factors of the water, including temperature, nutrient concentrations, and food abundance. These factors have the potential to constrain the growth and diversity of the zooplankton community.

Four genera of ciliates (*Chilodonella sp.*, *Paramecium sp.*, *Vorticella sp.* and *Epistylis sp*.) were recorded during the present investigation. Literature reveals that diversity and density in North Indian aquatic ecosystem are less and usually depends on trophic state, season and depth of the water column (Sivakami *et al.*, 2015). Pace and Orcutt (1981) suggests that ciliates play an important role in nutrient regeneration because of their high rates of phosphorous excretion.

Conclusion

The importance of the zooplankton is well recognized as these have vital part in food chain and play a key role in recycling of nutrients and cycling of organic matter or energy in the aquatic ecosystem. The present study on BhagdaTaal shows rich density and diversified zooplankton particularly rotifers and cladocerans which reveals that this wetland is very much suitable for fish culture as rotifers are known to be the best food for the fish larvae. In the present study, the rotifers were found as predominant group which are the indicators of eutrophication. Thus, keeping in view the importance of the study, steps should be taken for the conservation and maintenance of the freshwater wetland.

Acknowledgements

Authors are grateful to Principal and Committee of Management, M.L.K. (P.G) College, Balrampur, U.P. for providing necessary laboratory facilities.

References

Angadi SB, Shiddamallayya N and Patil PC. (2005) Limnological studies of Papnash pond, Bidar (Karnataka). J Environ Biol. 26: 213-216.

Arora J and Mehra N. (2003) Seasonal dynamics of rotifers in relation to physical and chemical conditions of river Yamuna (Delhi), India. Hydrobiologia 491: 101-109.

Bogdan KG and Gilbert JJ. (1984) Body size and food size in freshwater zooplankton. Proc Natl Acad Sci USA. 81: 6427-6431.

Battish SK. (1992) Freshwater zooplankton of India. Oxford IBH Publishing Co., New Delhi.

Chourasia SK and Adoni AD. (1985) Zooplankton dynamics of a shallow eutrophic lake. Bull Bot Sci Sagar 32: 30-39.

Cross D and Vohs P. (1988) Waterfowl Management Handbook. Fort Collins Co: US Fish and Wildlife Service, Varlop, pp. 200.

Goldman CR. and Horne AJ. (1983) Limnology. McGraw-Hill International Book Co., New Delhi, pp. 464.

Kar S and Kar D. (2016) Zooplankton diversity in a freshwater lake of Cachar, Assam. Int J Appl Biol Pharmaceut technol. 7(1): 301-305.

Michael RG and Sharma BK. (1998) Indian Cladocera (Crustacea: Branchiopoda: Cladocera). Fauna of India and adjacent countries Series-Zool. Survey. India, Calcutta.

Mwebaza-Nadwula M, Sekiranda L and Kiggundu V. (2005) Variability in zooplankton community along a section of Upper Victoria Nile, Uganda. Afr J Ecol. 43: 251-257.

Needham JJ and Needham PR. (1962) A guide to the study of freshwater Biology. Charles Cthomas Publisher, USA.

Pace ML and Orcutt JD. (1981) The relative importance of protozoans, rotifers and crustaceans in a freshwater zooplanktonic community. Limnol Oceanogr. 26: 822-830.

Prakash S. (2001) Seasonal dynamics of Plankton in a fresh waterbody at Balrampur. Geobios 28(1): 29-32.

Prakash S. (2020) Conservation status of fishes reported from Semara Taal of District Siddharthnagar (U.P.). India. Int J Fauna Biol Stud. 7(3): 21-24.

Prakash S and Ansari KK. (2000) Characteristics of zooplankton community in the Bhagwanpur Dam of tarai Region, Tulsipur, distt. Balrampur, U.P. UGC sponsored first national conference on recent trends in life management, organized by Bipin Bihari College, Jhansi, pp. 54-56.

Prakash S, Ansari KK and Sinha M. (2002) Seasonal dynamics of Zooplankton in a fresh water pond developed from the wasteland of Brick-kiln. Poll Res. 21(1): 82-83.

Prakash S and Singh D. (2019) Limnology of Baghel taal, a wetland of district Bahraich (U.P.). Iconic Res Engineer J. 3(3): 151-158.

Prakash S, Verma AK and Prakash S. (2015) Seasonal variation of Zooplankton and zoobenthos population in Alwara lake of district Kaushambi Uttar Pradesh India. J Zool Stud. 2(5): 13-16.

Ramachandra RR, Manjulatha C and Raju DVSN. (2017) Zooplankton diversity in Madduvalasa reservoir, India. Int J Life Sci Sci Res. 3(1): 771-778.

Rao DS and Krishna (1985) A note on the plankton of a freshwater impoundment in Karanataka. Indian J Fish. 32(1): 135-139.

Sharma BK and Sharma S. (2008) Zoolplankton diversity in floodplain lakes of Assam. Records Zool Survey India. 290: 1-307.

Sivakami R, Arumugam V and Premkishore G. (2015) An analysis of Zooplankton in a Lake, Pudukkottai District, Tamilnadu, India. Int J Curr Microbiol Appl. Sci. 4(5): 377-389.

Tyor AK, Chopra G and Kumari S. (2014) Zooplankton diversity in shallow lake of Sultanpur National Park, Gurgon (Haryana). Int J Appl Biol Pharmaceut Technol. 5(1): 35-40.

Verma AK and Prakash S. (2020a) Zooplankton diversity in Guthia Taal, Wetland of Bahraich (U. P.), India. Int J Zool Res. 10(2): 9-18.

Verma AK and Prakash S. (2020b) Limnological studies on Semara Taal, A wetland of District Siddharthnagar, Uttar Pradesh, India. J Fish Life Sci. 5(1): 15-19.