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E: ISSN NO.: 2349-980X **Shrinkhla Ek Shodhparak Vaicharik Patrika**

Seasonal Variation in Zooplankton Diversity of Undasa Wetland, Ujjain (M.P.)

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Abstract

The zooplankton diversity is one of the most important ecological parameters in water quality and biodiversity assessment because they are strongly affected by environmental conditions and respond quickly to changes in water quality. The study of zooplanktonic diversity variation is very important for the proper management and conservation of freshwater ecosystem and its utilization for fish culture. Hence, the present investigation was undertaken to determine the occurrence and seasonal variation of zooplankton diversity in the Undasa wetland, (Lat. 23° 13' N and Long. 75.50 E) at Ujjain district of Madhya Pradesh during May 2017 to June 2018. The planktonic samples were collected from the surface of the wetland with plankton net of 25 µ mesh size made up of bolting silk. The plankton samples were preserved for laboratory analysis. The collected samples were identified using standard keys. A total of 41 species of zooplankton were recorded which include 5 species of Protozoa, 16 species of Rotifera, 10 species of Cladocera, 8 species of Copepoda and 2 species of Ostracoda. The highest zooplankton abundance was observed in winter followed by summer and least in rainy season. Remarkable seasonal variation in composition and occurrence were found for Cladocera, Copepoda and Rotifera during the study period. Among zooplankton Cladocera was dominated in winter season, Copepoda was dominated during summer while in the rainy season Rotifera was the dominant group. The average annual diversity abundance of zooplankton has been noticed in the order of dominance as Cladocera > Copepoda > Rotifera > Protozoa > Ostracoda. Occurrence of *Vorticella* sps. *Brachionus* sps. Keratella sps. *Simocephalus* sps. *Neodiaptomus* sps. *Cyclops* and *Cypris* sps. as dominant genera indicate the progressive eutrophication of the wetland.

Keywords: *Wetland, Zooplanktonic Diversity, Bioindicator, Lentic Habitat.*

Introduction

Wetland are the most productive ecosystems in the world, the incorporation of sunlight and mineral nutrients by wetland plants results in high production of plant biomass. Cowardin *et al.* (1979) had defined that wetlands are the land transition between terrestrial and aquatic ecosystems, where water tab is usually at or near the surface or the land is covered by shallow water. A large numbers of perennial wetlands are formed in India, and it is used for irrigation, fish farming, drinking, bathing, washing, waste dumping and other activities of life. The study of freshwater fauna especially zooplankton, even of a particular area is extensive and complicated due to environmental, physical, chemical and geographical variations involving ecological, extrinsic and intrinsic factors (Maijagi and Vijaykumar, 2009). The zooplankton forms a major link in the energy transfer at secondary level in aquatic food webs between autotrophs and heterotrophs. (Deivnal *et al.* 2004). Zooplankton respond quickly to aquatic environmental change and are therefore used as indicator of overall health or condition of the habitat (Thrope and Covich 1991). This study attempted to investigate the seasonal variation in zooplankton diversity of Undasa wetland, Ujjain M.P.

Aim of the Study

Zooplankton are considered as good indicators of environmental changes and play an important role in energy flow and nutrient cycling in aquatic ecosystems. Due to increased demand on environmental monitoring programs for regional bioindicators in the water quality a need for documentation of biodiversity comes into picture. The present study is conducted with main aim to investigate the zooplankton

diversity and its seasonal variation at Undasa wetland situated in western region of Madhya Pradesh. This study will be helpful for water quality management, fishery development and wetland conservation.

Review of Literature

Considerable work has been carried out in Indian wetlands (Banerjee, 1967, Rai and Munshi, 1979; Yousuf *et al.* 1986; Kumar, 1995; Verma *et al*. 2001 and Shukla *et al.* 2001, Shrivastava *et al.* 2003, Paulose and Maheshwari 2008, Majagi and Vijaykumar 2009, Gaike *et al.* 2012, Jakhar 2013 and Manickam *et al*. 2014). Goswami and Mankodi (2012) observed zooplankton population of reservoir Nyari of Gujrat, India. Similarly Sharma and Kumari (2018) studied zooplankton community from lake Prashar Himachal Pradesh India.

Study Area

Undasa wetland is located just outside the municipal limits of Ujjain city in M.P. This is situated at 75° 50' and 23° 13' on Ujjain – Maksi road along the Pingleshwar nala. The catchment area of this wetland extends up to 11.25 sq. miles with an average storage capacity of 186.668 mcft. Its live capacity is 5.32 mq., and its dead storage capacity is 0.09 mq. It has a water speed area 183.30 hectare. and its length is 2.6 km. It is used for drinking water supplies, irrigation and bathing. This is considered as a holy waterbody and several thousands of pilgrims take holy bath.

Materials and Methods

The present study has been conducted for a period of one year from July 2017 to June 2018. Planktons samples have been collected by filtering 40 liters of water through plankton net made up of bolting silk number 14 and 25 with the help of Plankton water sampler (20 liter capacity). The samples have been preserved in 10% formalin and Lugol's solution. Quantitative estimation are being made by Sedwick Rafter cell and by using Lackey's microtransect method. The morphometric and physiographic details have been recorded from the Irrigation Departments, Govt. of M.P. The species of zooplanktons have been identified by consulting standard keys of the respective groups of organisms.

Results and Discussion

The Undasa wetland receives a considerable amount of domestic water waste and sewage from nearby urban and rural area. Wetland is also used by villagers for cattle farming. The water is used for drinking water supplies, irrigation and bathing. This is considered as holy water body and pilgrims take holy bath here in the month of August.

In the present study zooplanktonic diversity is represented by 41 species out of which 5 species belongs to Protozoa, 16 to Rotifera, 10 to Cladocera, 8 to Copepoda and 2 to Ostracoda (Table 1). The result indicates that the maximum number of genera occurred during winter (13-16) followed by summer (9-14) and monsoon season (2-13) respectively. Shrivastava *et al*. (2003) reported 27 species of zooplankton from Undasa wetland. Kumar (1995) reported 21 species of zooplankton from a freshwater wetland of Santhal Pargana (Bihar), Shukla *et al.* (2001) observed 60 species of zooplankton diversity in Gandhisagar reservoir, M.P. Paulose and Maheshwari (2008) recorded 49 species of zooplankton diversity from Ramgarh lake, Rajasthan. Thus, the Undasa wetland exhibited moderate level of zooplankton diversity when compared to other wetland areas however an increasing trend is noticed in the diversity from 1998-99 (earlier study Shrivastava *et al*. 2003) to present study. The shallow profundal area shows the growth of several aquatic plants and extensive growth of grass occurs in the peripheral stretches of this wetland due to which a large number of cattle populations come for feeding and drinking water. The excreta of these cattle fertilize wetland water and at the same time this increases the contaminants in this water body. Bio waste, chemical waste and fertilizers that enhance the yield are usually compounds containing the basic nutrients NPK for the plants (Sodium phosphorus and potassium) with added nitrogen, fertilizers enter the ground water system when they are in the soil and flow in to the water system in the region. These activities are responsible for higher growth of phytoplankton which in turn enhances zooplankton diversity.

The diversity of zooplankton is observed to vary from season to season. Maximum diversity is reported during winter season followed by summer which might be due to availability of suitable food and less predators. However, minimum diversity is reported in rainy season which may be due to the dilution effect and higher water flow. Paulose and Maheshwari (2008), Goswami and Mankodi (2012) and Sharma and Kumari (2018) also observed maximum zooplankton diversity in winter and minimum in rainy season. The annual average percentage composition of different groups of zooplanktons revealed 6.99 % Protozoa, 30.76% Cladocera, 27.97% Rotifera, 28.67% Copepoda and 5.59% Ostracoda. Annual average percentage of zooplankton from Undasa wetland showed different forms in their diversity which is attributed to water quality. Protozoan and Rotifers were less numerically while Arthropods were comparatively more. Arthropods are represented by variety of Cladocerans, Copepods and Ostracods. However, this patterns of annual percentage composition of zooplankton in this wetland is influenced by climatic conditions. Remarkable seasonal variation is observed on the occurrence of zooplanktonic diversity. During winter season the maximum contribution was made by Cladocera, (34.48%) followed by Rotifera (29.31%), Copepoda (20.68%), Ostracoda (10.34%) and Protozoa (5.17%). During summer season Cladocera lost its order of dominance and Copepoda (39.13%) emerged out as the most dominant group followed by Cladocera (28.26%), Rotifera (19.56%), Protozoa (10.86%) and Ostracoda (2.17%). Similarly, in the rainy season Cladocera and Copepoda lost there order of dominance and Rotifera (35.89%) emerged out as the most dominant group followed by Cladocera and Copepoda (28.20%), Protozoa (5.12%) and Ostracoda (2.56%). The emergence of different zooplanktonic groups as dominant order during particular season shows estability of their population. Similar variable characteristics of seasonal dominance by the different

zooplanktonic groups are recorded also in Ramgarh lake (Paulose and Maheshwari, 2008), Nagartas dam (Gaike *et al.* 2012), Perennial reservoir Toppaiyar (Manickam *et al.* 2014) and Prashar lake (Sharma and Kumari 2018).

In the present study Protozoa is represented by 5 species. None of species representing this group is observed to be perennial. *Vorticella* is dominated among all protozoan species. Shukla *et al.* (2001) recorded 11 species of protozoan diversity from Gandhisagar reservoir, M.P. India where *Arcella* and *Difflugia* species remained dominant. *Difflugia* and *Stentor* species reported earlier from Undasa wetland (Shrivastava *et al*. 2003) are not recorded from the present study. This trend is attributed to the fact that increased temperature and TDS in water trends to disturb the ecological balance. The composition of Rotifera showed third dominant group of zooplankton and is represented by 16 species. Maximum diversity is recorded during winter season and minimum in rainy season. The most dominant species among Rotifera observed in the study area are *Brachionus* sps., followed by *Keratella* sps., Higher Rotifers diversity in winter followed by summer may be due to presence of organic matter of dead and decaying vegetation and higher bacterial growth in the wetland. The lowest diversity during rainy season may be influence of copious quantity of rain water and turbidity, which drained in to the wetland. Manickam *et al*. (2014) pointed out that the Rotifera species play an important role as suspension feeders within the zooplankton community. The difference in periodicity and population density of different Rotifera species are due to biotic interactions and nutritional content of the aquatic ecosystem. In the present study occurrence of *Brachionus* and *Keratella* species as dominant among Rotifera indicates trophic status of wetland.

Table 1 : Diversity of Zooplanktons at Undasa wetland July 2017- June 2018

S no.	Genera	July	Aug.	Sept	Oct.	Nov.	Dec.	Jan	Feb.	March	April	May	June
	Protozoa												
1.	*Amoeba sps.*	+	-	-	-	-	-	-	-	-	-	+	-
2.	*Arcella sps.*	-	-	-	-	-	-	-	-	-	-	-	+
3.	*Bursaria sps.*	-	-	-	-	-	-	-	-	-	-	-	+
4.	*Paramecium sps.*	+	-	-	-	-	-	-	-	-	-	-	-
5.	*Vorticella sps.*	-	-	-	-	-	+	+	+	+	-	-	+
	Rotifera												
1.	*Asplanchna sps.*	-	-	-	+	-	-	+	+	-	-	-	-
2.	*B. plictlis*	-	-	-	-	+	+	+	-	-	+	+	-
3.	*B. angularis*	-	-	-	+	-	-	-	-	-	-	-	-
4.	*Brachionus caudatus*	-	-	+	-	-	-	-	-	-	-	-	-
5.	*B. rubens*	-	+	-	+	-	-	+	-	-	-	+	-
6.	*Brachionus calyciflorus*	-	-	-	-	-	-	-	-	+	-	-	-
7.	*Brachionus falcatus*	-	+	+	+	+	-	-	-	-	-	-	-
8.	*Brachionus forficula*	-	+	+	+	+	-	-	-	-	-	-	-
9.	*B. quadridentatus*	-	-	-	+	-	-	-	-	-	-	-	-
10.	*Keratella sps.*	-	-	+	-	+	+	-	+	-	-	-	-
11.	*Keratella quadrata*	-	-	-	-	+	-	-	+	+	-	+	+
12.	*Keratella tropica*	-	-	-	-	-	+	-	-	-	-	-	-
13.	*Monostyla sps.*	-	-	-	-	-	-	+	+	-	-	-	-
14.	*Moino daphnia*	-	-	-	-	-	-	-	-	-	+	-	-
15.	*Trichotria sps.*	-	+	-	-	-	-	-	-	-	-	-	-
16.	*Trichocerca sps.*	-	+	-	-	-	+	-	-	-	-	-	+
	Cladocera												
1.	*Bosmina sps.*	-	-	-	-	+	+	+	+	-	+	-	-
2.	*Ceriodaphnia reticulata*	-	-	-	-	-	-	-	-	+	+	+	-
3.	*Chydorus sps.*	-	-	-	-	+	-	-	+	-	-	-	-
4.	*Daphnia sps.*	-	-	-	-	-	+	-	-	+	-	-	+
5.	*Leydigia sps.*	-	-	-	+	-	+	-	-	-	-	-	-
6.	*Macrothrix sps.*	-	-	+	-	-	-	-	-	-	-	-	-
7.	*Rotaria sps.*	-	-	-	-	-	-	-	-	-	+	-	-
8.	*Scapholeberis sps.*	-	+	+	+	+	+	-	+	+	+	-	-
9.	*Simocephalus sps.*	-	+	+	+	+	+	+	+	+	+	-	-
10.	*Sida sps.*	-	+	+	+	+	+	+	+	+	+	-	-
	Copepoda												
1.	*Cyclops sps.*	-	+	+	+	-	+	+	+	+	-	+	-
2.	*Calanoid copepod*	-	-	-	-	-	-	-	-	-	+	+	-
3.	*Cyclopoid copepod*	-	-	-	-	-	-	-	-	-	+	+	+

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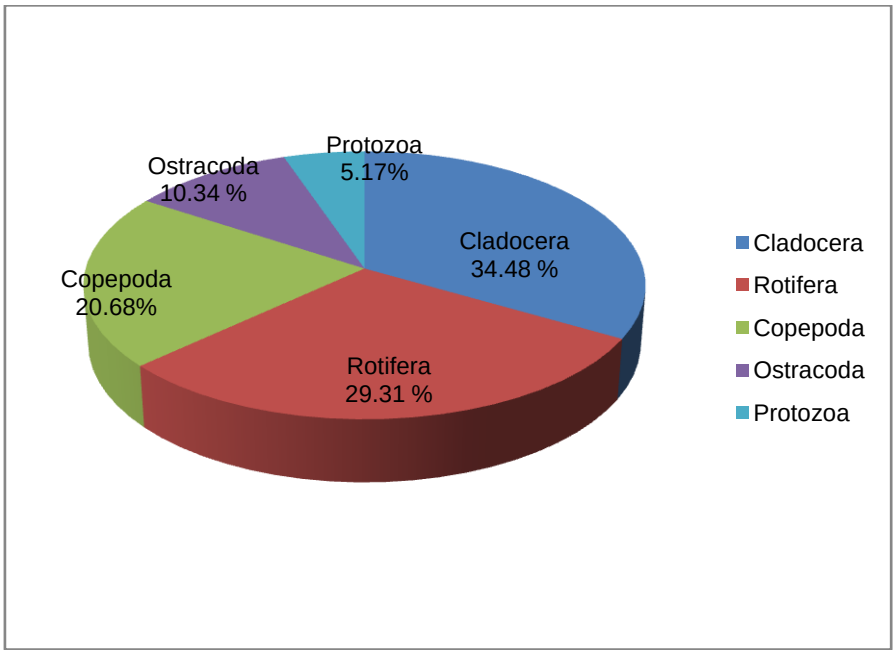
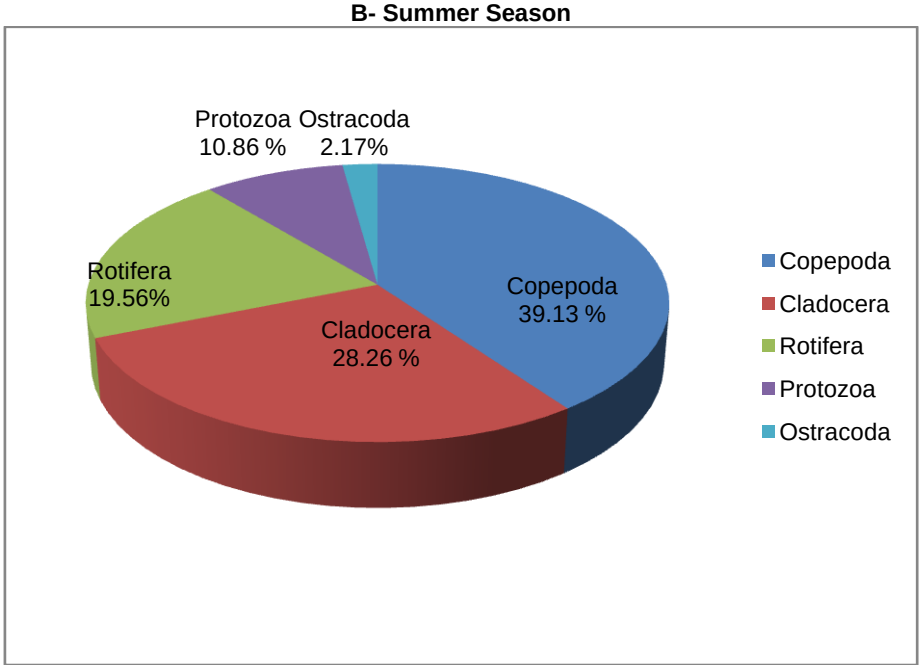
4.	*Diaptomus sps.*	-	-	+	-	-	-	-	-	-	+	+	+
5.	*Macrocyclops sps.*	-	+	+	+	+	-	+	+	+	+	+	-
6.	*Mesocyclops sps.*	-	-	-	-	+	-	-	+	-	+	-	-
7.	*Nauplius larvae sps.*	-	+	-	+	+	-	-	-	-	-	-	-
8.	*Neodiaptomus sps.*	-	+	+	-	-	+	+	+	+	+	+	+
	Ostracoda												
1.	*Cypris sps.*	-	+	-	-	+	-	+	+	+	-	-	-
2.	*Stenocypris sps.*	-	-	-	-	-	+	+	+	-	-	-	-
	Total diversity	2	13	12	13	14	14	13	16	12	14	11	9

Fig. 1 Seasonal composition of zooplanktonic diversity in Undasa wetland

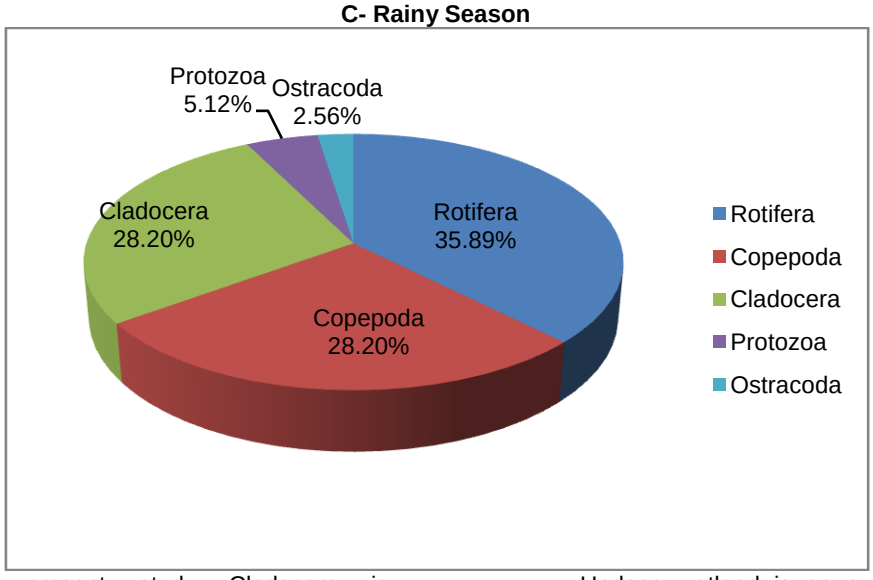
A- Winter Season



B- Summer Season



C- Rainy Season



In the present study Cladocera is represented by 10 species and showed highest composition. This group exhibited highest diversity during winter season followed by summer and lowest in rainy season. The genus *Simocephalus, Sida* and *Scapholeberis* and *Bosmina* are recorded as dominant population, Sharma and Kumari (2018) recorded 6 species of Cladocera from Prashar Lake, Himachal Pradesh with maximum in winter and minimum in monsoon season. Similar observations were made by Majagi and Vijaykumar (2009) in Karanja reservoir. Gaike *et al.* (2012) observed maximum Cladoceran population during winter season and low during summer season at Nagartas dam.

The Copepoda exhibited second rank in order of dominance and is represented by 8 species. Maximum diversity is noticed during summer followed by winter and least in rainy season. Maximum diversity of Copepoda during summer season followed by winter may be due to higher growth of blue green algae in this wetland. Copepoda domination may also be due to their feeding on diatoms, Rotifera and Cladocera (Hutchinson 1967, Manickam *et al*. 2014) and high reproduction capacity. In the present study *Macrocyclops, Neodiaptomus* and *Cyclops* speies are dominated among Copepoda population. Majagi and Vijaykumar (2009) reported *Mesocyclops* and *Neodiaptomus* as dominant species from Karanja reservoir. Ostracoda occupied least position in order of dominance and represented by 2 species i.e. *Cypris* and *Stenocypris.* Higher diversity of Ostracoda is noticed during winter and lowest during rainy season. Similar trends of seasonal variation in Ostracoda diversity is recorded in Prashar lake Himachal Pradesh (Sharma and Kumari 2018). Paulose and Maheshwari (2008) recorded 3 species of Ostracoda from Ramgarh lake Rajasthan. *Cypris* species of Ostracods are usually presented in freshwater found along with the submerged plants, the debris at the shallow edge less found in open water (Sharma and Kumari 2018). Undasa wetland represented similar habitat for shelter and growth of *Cypris* species.

Undasa wetland is an extensive perennial freshwater habitat which receives a considerable amount of domestic waste water from nearby urban and rural areas. Agricultural run off including fertilizers are also enter in to this water body. The water is used for drinking water supplies, irrigation, bathing and fish culture. Maximum diversity of zooplankton is recorded during the winter season and minimum during rainy season. The composition of zooplankton is observed to vary from season to season. It is apparent from the result that Cladocera dominated during winter season, Rotifera during rainy season and Copepoda during summer season. Zooplanktonic diversity of the wetland was influenced by microclimate, seasonal change in the particular area and various environmental factors. The occurrence of *Vorticella* sps., *Brachionus* sps., *Keratella* sps., *Simocephalus* sps., *Neodiaptomus* sps., *Cyclops* sps., and *Cypris* sps., indicates the progressive eutrophication of the wetland. For the management and conservation of Undasa wetland ecosystem regular monitoring of physicochemical and biological parameters is necessary. Dumping of rural and urban waste water along with agricultural waste into and around wetland should be prohibited. Public awareness programmes should be initiated to understand about harmful impact of anthropogenic activities as suggested by Bhasin *et al.* (2016) for the Kshipra river management and conservation.

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