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Preliminary studies on zooplankton diversity in Uma River near Mul, District Chandrapur, Maharashtra, India

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Abstract
Zooplankton are the diverse group of organisms with little or no swimming ability. They are the animal component of plankton, have a short life cycle and quickly respond to changes in their environment; hence, their abundance and community structure serve as an essential tool in providing information on the water quality of a given aquatic environment which may serve as an indicator of the ecological status of the water body. The current investigation focused on the diversity of zooplankton in Uma River, near Mul, District Chandrapur Maharashtra, India. Water samples for zooplankton were collected for one year from October 2023 to September 2024. Total 50 species of zooplankton were recorded belonging to five groups such as Rotifera contributing 22 species, Cladocera 14 species, Copepoda 05 species, Ostracoda 05 species and protozoa 04species. The findings indicate that group Rotifera was the dominant group among the zooplankton recorded during the study.

Keywords: Zooplankton, Uma River, Rotifera, Ostracoda, Mul, diversity

Introduction

The structure of riverine zooplankton communities and their species distribution patterns align with metacommunity theory, which posits interconnected local communities shaped by both environmental and spatial processes (Leibold *et al.*, 2004, Zhao *et al.*, 2017) [22, 48]. Biological conditions in rivers are primarily shaped by water flow, which serves as the strongest determinant of river biocoenosis, affecting habitat construction, food conditions, and functional traits of species (Thorp *et al.*, 2006, Allan *et al.*, 2021, Reibero *et al.*, 2022) [1, 44].

Plankton are highly sensitive to their environmental conditions, and any changes in these conditions can significantly affect plankton communities. Such changes can influence aspects such as tolerance, abundance, diversity and dominance within their habitats (Mathivanan, *et al.*, 2007) [23]. Zooplankton communities in lotic ecosystems are less diverse than in lentic waters due to food and reproductive limitations. Their presence in rivers often results from influxes from lakes, floodplains, or drift from tributaries, supported by the river continuum concept that describes gradual habitat and energy transformations along river courses (Vannote, *et al.*, 1980, Reibero *et al.*, 2022) [46]. They play a significant role in aquatic ecosystems (Park and Shin, 2007) [29] by feeding on phytoplankton regulating algal blooms and contributing to recycling nutrients as well as cycling energy within their respective environments (Sinha and Islam, 2002) [42].

Zooplankton are bio-indicators of water quality and pollution because they are strongly influenced by environmental changes and respond quickly to alternations in water quality (Sharma *et al.*, 2010; Deksne *et al.*, 2011) [7, 41]. Anthropogenic activities lead to increased nutrient concentrations, affecting autotroph activity and reducing zooplankton diversity, favoring species with high environmental tolerance. Increased organic pollutants and altered nutrient levels results in a shift towards smaller rotifers and protozoans, with fewer specialist species (Mulani *et al.*, 2009, Pantel *et al.*, 2022) [24, 28].

Rivers serve as a vital source of water for consumption and various uses in many regions. River Uma is presently under the threats of pouring of both treated and untreated effluents, the dumping of urban sewage and intrusion of agricultural runoff from agricultural fields along its banks. The aim of this study was to record the diversity of the zooplankton community of the Uma River, under the influence of diverse land uses within its catchment area.

Materials and Method

Study area

Mul is a located on Chandrapur Gadchiroli road at 20°72 [1] L and 79°67 [1] N with an elevation of 198 metres in Maharashtra State, India having hot and dry climate. Uma River also known as Mul River which is a perennial and is the main tributary of Andhari river flowing from Tadoba Andhari Tiger Reserve (Fig 1 to 3). The river water is basically used for drinking, agriculture practice and fishery activities by local fisherman community.

Fig 1: Map of Maharashtra State with map of India.

Fig 2: Map of Chandrapur District

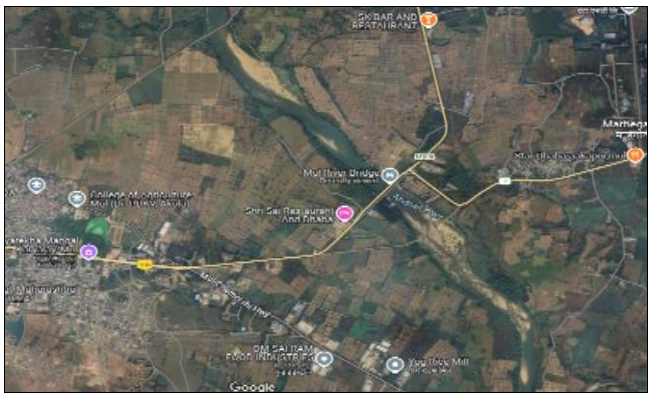

Fig 3: Satellite Image of Uma River flowing near Mul

Methodology

The samples for zooplankton were collected for one year From October 2023 to September 2024 between 7:00 am to 9:00 am in the morning. Water was collected from the surface with minimal disturbance and filtered in a No. 25 bolting silk cloth net. The filtered samples were collected in 125ml plastic bottles and preserved by adding 5ml of 4% formalin. The preserved samples were kept for 24 hours and the final volume of concentrated sample was made up to 50ml. The preserved samples were brought to the laboratory for qualitative analysis. Qualitative analysis of the zooplankton was carried out up to the species level by using standard literature (Edmondson, 1959; Battish, 1992; Murugan *et al.*, 1998; Dhanapathi, 2000) [3, 8, 12, 25]

Results and Discussion

In the present investigation, 50 species belonging to 5 groups and 24 families of zooplankton were recorded. Among which, group Rotifera was dominant with 22 species followed by group Cladocera with 14 species, Copepoda with 05 species, Ostracoda with 05 species and Protozoa with 04 species (Table no. 1). The findings in relation to diversity percentage contribution found that group Rotifera contributes (44%), Cladocera (28%), Copepoda and Ostracoda each 10% and Protozoa (8%) (Fig. 4). Dorak (2013) [10] studied zooplankton abundance in the lower Sakarya River Basin (Turkey) and recorded Rotifera as the most abundant group contributing 96.4%, followed by Copepoda and Cladocera. Kar and Kar (2016) [19] studied the population status of Zooplankton at Sat beel and recorded 40 genera and categorized them into three major groups *viz.* Rotifera, Cladocera and Copepoda. Pandit *et al.*, (2020) [26] collected an aggregate of 23 components of zooplankton comprising 6 genera of Rotifera followed by 5 genera of Protozoa, 5 genera of Cladocera**,** 4 genera of Copepoda and 3 genera of Ostracoda from the Ganga River. Similarly, Mulani *et al.*, (2009) [24] has described 6 genera of Protozoa, 36 genera of Rotifera, 5 genera of Cladocera, 8 genera of Copepoda and 3 genera of Ostracoda, in Panchganga River, Kolhapur. Similar findings were also been reported by Ferneska and Lewkosiez (1966) [13], Schindler and Noven (1971) [40] and Poojari *et al.*, (2024) [31], and Gaikwad *et al.*, (2008) [14].

Table 1: Qualitative analysis of zooplankton in Uma River

Sr. No.	class	Family	Genus	Species
1	Rotifera	Asplanchnidae	Asplanchna	brightwelli
		Brachionidae	Brachionus	bidentata
				falcatus
				Plicatilis
				quadridentata
				calcyciflorus
				caudatus
				diversicornis
			Keratella	varga
				tropica
		Epiphanidae	Epiphanes	senta
		Trochosphaeridae	Filinia	longiseta
				opaliensis
		Lecanidae	Lecane	bulla
				luna
				pyriformes
		Lepadellidae	Lepadella	ovalis
		Brachionidae	Platyias	polyacanthus
		Synchaetidae	Polyarthra	indica
		Philodinidae	Rotaria	citrinus
		Tricocercidae	Tricocerca	cylindrica
				longiseta
2	Copepoda		Cyclops	bicuspidatus

		Cyclopidae		viridis
			Eucyclops	agilis
			Mesocyclops	edax
		Diaptomidae	Diaptomus	breweri
3	Cladocera	Chydoridae	Alona	affinis
				monocantha
				rectangular
		Bosminidae	Bosmina	longirostris
		Daphniidae	Cereodaphnia	reticulata
				laticaudata
				quadrangula
			Simocephalus	vetulus
		Chydoridae	Chydorus	sphericus
			Dadaya	macrops
		Sididae	Diphanosoma	brachyurum
		Chydoridae	Leydigia	acanthocercoides
		Moinidae	Moina	brachiate
				micrura
4	Ostracoda	Candonidae	Cyclocypris	globosa
		Cyprinidae	Cyprinotus	pellucidus
			Cypris	subglobosa
			Stenocypris	fontinalis
				malcomsoni
5	Protozoa	Amoebidae	Amoeba	proteus
		Arcellidae	Arcella	difflugia
				polypora
		Difflugiidae	Difflugia	urceolata

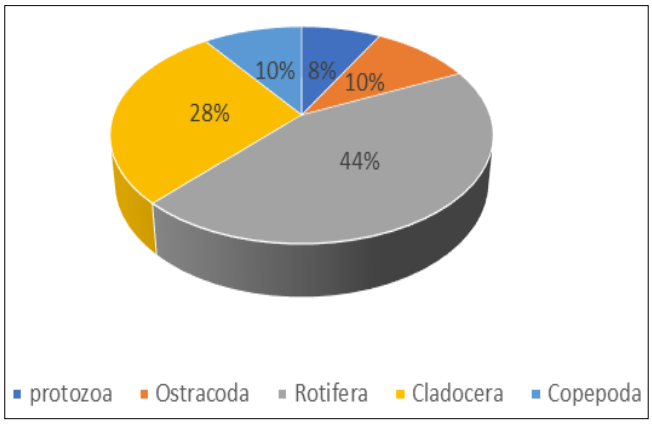

Fig 4: Percentage distribution of Zooplankton species

Protozoa are a polyphyletic group of single celled eukaryote s, either free-living or parasitic, that feed on organic matter such as other microorganisms or organic debris (Panno, Joseph (2014) [27] and Bertrand *et. al.*, 2015) [4]. In the present investigation 04 species (8%) recorded in group Protozoa**.** Sarkar and Pal (2021) [39], studied zooplankton diversity in the river Jaldhaka and recorded 05 species of Protozoa.

Rotifers help in nutrient cycling, water quality maintenance and energy transfer in aquatic ecosystem. The diversity and density of zooplankton depends upon the nutrient condition of water body, abiotic factors, DO, food chain, soil and water chemistry. Dhembare, (2011) [9] stated that to monitor the aquatic ecosystem and integrity of water the zooplankton has been used as bioindicators. In present investigation, 22 species of rotifera were recorded among zooplankton with common occurrence of genus *Branchionus, Keratella, Lecane* and *Tricocerca,* signalling elevated nutrient levels in the water. Similarly, Sampaio *et al.,* (2002) [38]; Imboobe and Adeyinka (2009) recorded rotifer genera such as *Asplanchna, Brachionus, Keratella,* and *Trichocerca* from mesotrophic to eutrophic conditions of water during the study of Tropical Forest River in Nigeria.

Copepods are group of small crustaceans found in fresh water. Some of the species are planktonic, benthic and have parasitic phase. In the present investigation, 05 species were recorded in group copepoda where *Cyclops bicuspidatus, C. viridis, Diaptomus breweri, Eucyclops agilis and Mesocyclops edax* were common. Similar findings have also been reported by Sivakumar *et al.,* (2001) [43] around Dharampuri District of Tamilnadu. The abundance of copepods in tropical eutrophic water has been already noted by Burgis (1974) [6]. Reid and Wood (1976) have suggested that copepods were abundant in open water than cladocerans although the number of species of former may be less.

The group Cladocera, commonly known as water fleas consist small, mostly freshwater crustaceans, which feed on microscopic chunks of organic matter, though some forms are predatory. Cladocera is an important component of zooplankton and form the most dominant groups as food for fish (Rao *et al.*, 1987) [33]. Cladocerans were represented by 14 species and second dominant group by contributing 28% of the total zooplankton recorded. *Moina brachiata, and Moina micrura* were found throughout the period of investigation. Saha (2004) [37] were recorded abundance of Cladocerans and Rotifers. Balamurugan *et al.,* (1999) [2] reported 07 species of Cladocerons and Biswas and Konar (2000) [5] reported six species of Cladocerons from river Damodar in west Bengal. Arvindkumar and Sing (2002) [21] recorded 03 species of Cladocera from river Mayurakshi.

Ostracods are small crustaceans with a bivalved carapace known as seed shrimps. In the present investigation 05 species of group Ostracoda which contributes (10%) of zooplankton recorded. Rai *et al.,* (2016) [32] studied the diversity of zooplankton. Vaidya (1996) [45] discussed in brief the zoogeographic distribution of freshwater ostracods of Dharwad, North Karnataka. It is observed that in India,

which is highly diverse geographically and ecologically, many localities are there to explore on these aspects. Ravi *et al.*, (2007) [34] have reported nine species belong to 06 genera of fresh water taxa from Perumal Eri Lake.

Khalifa *et al.*, (2015) [20] revealed that zooplankton is major component of aquatic ecosystem and changes in their abundance, species composition are effect to food web in aquatic ecosystem. The Common bioindicators of zooplankton include group rotifers, (*Keratella*), Cladocerans and Copepoda (cyclops) which detect changes in the environment due to the presence of pollutants which can affect the biodiversity of the aquatic environment, as well as species present in it (Walsh 1978; Peterson 1986; Gerhardt 2002; Holt & Miller 2010) [15, 16, 30, 47]. Their sensitivity to pollutants, changes in water chemistry, and eutrophication makes them valuable indicators for monitoring the health of aquatic ecosystems. (Iloba, 2002) [17]. Pollution often results in shifts in community composition or reduced diversity (Dumont, & Green, (1990) [11]. Similarly, in present investigation rotifera was observed most dominant followed by group Cladocera and Copepoda.

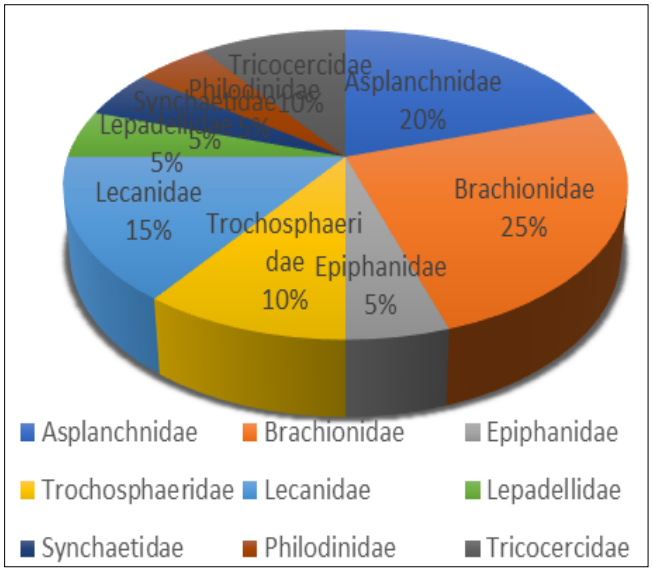

Fig 5: Family wise distribution of Group Rotifera

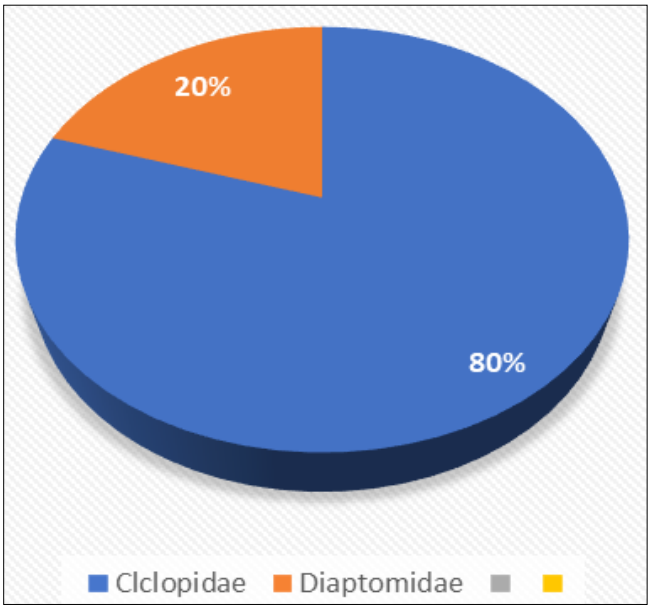

Fig 6: Family wise distribution of Group Copepoda

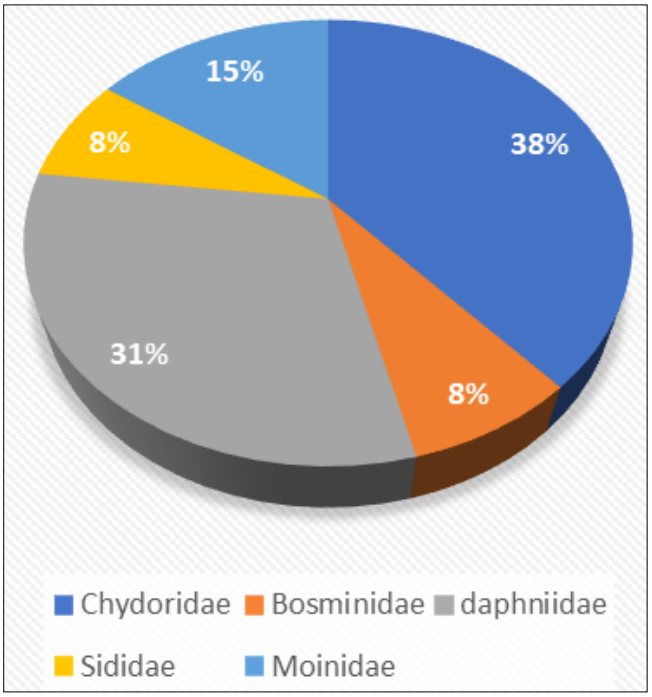

Fig 7: Family wise distribution of Group Cladocera

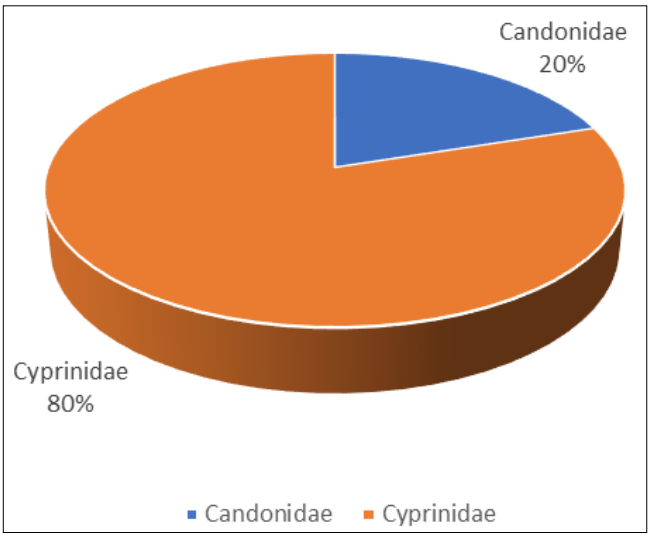

Fig 8: Family wise distribution of Group Ostracoda

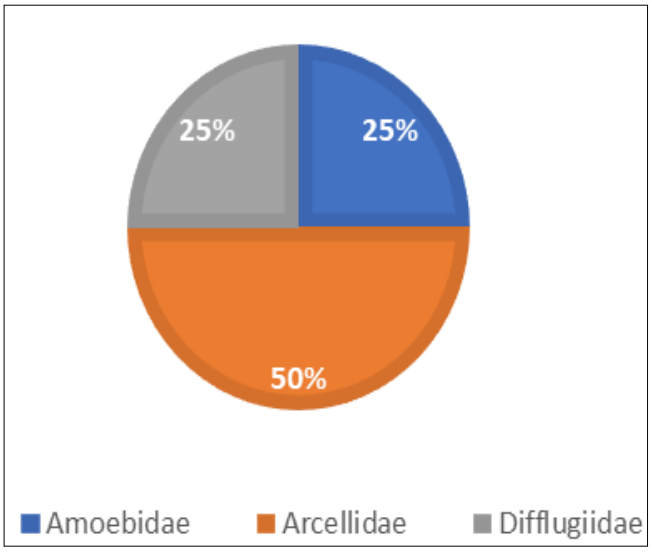

Fig 9: Family wise distribution of Group Protozoa

Conclusion

As per the findings of this investigation on the Uma River near Mul, zooplankton diversity is crucial to health of the lotic ecosystem. Of the 50 zooplankton species that we identified, 22 are from Rotifera, 14 from Cladocera, 5 species each of Copepoda and Ostracoda and only 04 from Protozoa. This study has determined that diversity of rotifers is dominant over the Cladocera, Copepoda, Ostracoda and Protozoa. Higher number of rotifers indicate the contamination of water at the sampling sites. It will not take a longer time for nature to alter the ecology of the river if the human intervention and agricultural runoff can not be stopped in future.

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Conflict of Interest

The Authors declared no conflict of Interest.

Ethics Approval Statement

The study did not involve and experiment on Humans and Animals.

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