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Diversity and distribution of zooplankton in selected stretch of river Narmada, Madhya Pradesh

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Abstract
Zooplankton diversity is one of the most important ecological parameters in water quality assessment and monitors the health of any aquatic ecosystem. Zooplankton is good indicator of the changes in water quality because they are strongly affected by environmental conditions and due to their short life cycle, these communities often respond quickly to environmental change and water quality. They occupy an intermediate link between phytoplankton and fish. Hence qualitative and quantitative studies of zooplankton are of great importance. Zooplankton formed important quantitative component of net plankton of the four parts; Rotifera dominantly contributed to their abundance while Cladocera-Copepoda>Protozoa>Ostracoda were sub-dominant groups. The water samples were collected during the January 2015 to April 2017 from five sampling sites of selected stretch of river Narmada. During entire study period, a total of 76 species were found in all five sampling stations. Among these, Rotifera are dominating group comprise of 28 species (36.84%), Cladocera comprise of 16 species (21.05%), Copepoda of 16 species (21.05%), Protozoa of 11 species (14.47%) while Ostracoda is least diverse group comprise of only 5 species (6.58%). The study aims to assess the diversity and distribution of zooplanktons in River Narmada.

Keywords: Narmada River, zooplankton, diversity and distribution

1. Introduction
Narmada river ecosystem is said to be one of the most important river ecosystem in India and life line of Madhya Pradesh. It flows from Amarkantak hills to Gulf of Cambay. It supports the local economic activities such as agriculture, fishery, ecotourism, irrigation and water supply for domestics and industries. Now a day's water quality of river ecosystem degradation by various sources becomes an important issue around the world. Usage of more land for agricultural purposes, soil, salinization and increase in the use of agricultural fertilizers, common pesticide use, and erosion have become problems threatening natural water source. Further, among the biotic parameters zooplankton density and diversity are studied. Zooplankton plays an important role in maintaining the equilibrium between living organisms and abiotic factor. Zooplanktons were also influenced by the changes in abiotic parameters as well as biotic parameters or the combination of both (Christou, 1998; Roff et. al., 1998; Escribano and Hidalgo, 2000; Beyst et al., 2001) [8, 25, 13, 7]. Although zooplanktons exist under a wide range of environmental conditions, yet many species are limited due to temperature, dissolve oxygen and other physico-chemical parameters.
The river is highly exploited for its water resource, for irrigation projects, navigation and fisheries etc. However rivers have remained source of water for consumption and utilization, in return human beings have not maintained their purity. Rivers are by and large remained sinks for the all sorts of wastage, may be termed as dumping place (Jemson and Rana, 1996; Quasim and Siddiqui, 1960) [18, 23]. Municipal wastes, domestic sewage, effluent of various kinds and so called treated effluent goes to the river and alter its ecology (Bharti and Krishnamurthy, 1992) [5]. The study aims to assess the diversity and distribution of zooplanktons in River Narmada.

2. Materials & Methods
The river Narmada is the largest west flowing river of the country which originates from an elevation of 1051 m in Maikala highlands near Amarkantak under Anuppur district (M.P) at 22^0 40'N latitude and 81^0 45'E longitude. The Narmada river flows through the main districts of Shahdol, Mandla, Jabalpur, Narsinghpur, Hoshangabad, Khandwa and Khargone and covers 1077 km in M.P. Subsequently, it forms common boundary between states of Maharashtra and M.P. and Maharashtra and Gujarat for the following 35 and 39 km respectively. The last leg of 161 km is exclusively in the state of Gujarat. The river loses its altitude by 996.5 m and enters Gujarat State at an elevation of 54.5 m.
During the study we have selected study area covered into two districts (Hoshangabad and Sehore) of Madhya Pradesh showing in the (Map-1). Samples have been collected from five locations between Sakatpur to Aamlighat (Sakatpur, Bandrabhan, Sethani-ghat, Dongarwada and Anmlighat) covering an approximate 50 kms central stretch of River Narmada.
Plankton sample was collected along with water sample for qualitative and quantitative studies. Plankton samples were collected by standard plankton nets made of belting silk number 14 (120μ) and 25 (64μ) and preserved in 5% formalin

or lugols solution. Identification of phytoplankton and zooplankton was done with the help of standard keys viz., Smith (1950) [26], Desikachary (1959) [10], Prescott (1973) [22], Edmondson (1959) [12], Needham and Needham (1962) [20], Pennak (1978) [21], Tonapi (1980) [27], APHA (1998) [4] and Adoni (1985) [3].

Quantitative analysis of plankton was procured by filtering 40 liters of water through as small plankton net of number 14 and 25, immediately in 5 % formalin. The samples were made according to drop counting methods of Adoni (1985) [3].

For the quantitative analysis, drop count method was applied and computation was done by following formula:

$$\text{Organisms /l} = A*1/L*n/v$$

Where,

A - Number of organism per drop

L - Volume of original sample (l)

n - Total volume of original sample (ml)

v - Standard volume of one drop (ml)

3. Observations

During entire study period, a total of 76 species were found in all five sampling stations. Among these, Rotifera are dominating group comprise of 28 species (36.84%), Cladocera comprise of 16 species (21.05%), Copepoda of 16 species (21.05%), Protozoa of 11 species (14.47%) while Ostracoda is least diverse group comprise of only 5 species (6.58%) details is showing in (fig 1).

A total of 76 zooplankton species were identified. Out of this, maximum 61 species were recorded at sampling site S1, 60 zooplankton species at sampling site S3, 57 zooplankton species at sampling site S4, 54 zooplankton species at sampling site S5 and minimum number of 48 zooplankton species was found at sampling site are given in (Table 1).

Table 1: Zooplankton Diversity at different sampling stations of Narmada River

S. No.		Sampling Sites				
	Species	**S 1**	**S 2**	**S 3**	**S 4**	**S 5**
	Protozoa					
1	*Arecella* sps.	+	+	+	+	+
2	*Difflugia* sps.	+	+	+	+	+
3	*Stentor* sps.	+	+		+	+
4	*Vorticella* sps.	+	+	+	+	+
5	*Coilpodium* sps.	+			+	+
6	*Centropyxis* sps.				+	
7	*Centropyxis acculeuta*		+	+		+
8	*Metopus* sps.	+		+		+
9	*Opercularia* sps.	+		+	+	+
10	*Nebelia* sps.	+	+	+		+
11	*Carchesium* sps.		+	+		
	Rotifera					
12	*Anuaeopsis fissia*	+	+	+	+	+
13	*Asplanchna brightwellii*	+			+	
14	*Asplanchnopus multiceps*	+		+	+	+
15	*Brachionus angularis*		+	+	+	+
16	*Brachionus diversiarnis*		+		+	+
17	*Brachionus caudatus*			+	+	
18	*Brachionus falcatus*	+	+	+	+	+
19	*Brachionus bidendata*				+	
20	*Brachionus calyciflorus*					+
21	*Brachionus forficula*			+		
22	*Brachionus patulus*		+			
23	*Brachionus pterodinodes*	+		+		+
24	*Brachionus quardridentatus*		+		+	
25	*Brachionus rubens*			+	+	
26	*Chromogaster ovalis*	+	+	+	+	+
27	*Filinia longiseta*	+	+	+	+	
28	*Keratella cochleris*	+		+		
29	*Keratella quadrata*	+	+		+	+
30	*Keratella tropica*	+	+		+	+
31	*Lecane bulla*	+		+	+	
32	*Lecane luna*	+		+		+
33	*Monostyla* sps.	+		+	+	+
34	*Philodina* sps.	+				
35	*Platyias quadricornis*	+	+		+	+
36	*Polyarthyra vulgaris*	+	+	+	+	+
37	*Scaridium longicaudum*	+		+	+	+
38	*Synchaeta pectinata*	+		+		
39	*Trichotria* sps.	+	+	+		

	Cladocera					
40	*Alona affinis*	+	+	+	+	+
41	*Alona quandrangularis*	+				+
42	*Alona quatata*		+	+	+	
43	*Alona rectanggula*		+	+	+	
44	*Alonella dentifera*	+	+	+	+	+
45	*Bosmina longirostris*	+	+	+	+	+
46	*Ceriodaphnia* sps.	+	+		+	
47	*Daphnia carinata*	+	+	+	+	
48	*Daphnia pulex*	+		+	+	+
49	*Daphnia oblusa*	+		+		
50	*Daphnia lumholtzi*			+	+	
51	*Daphnossoma birgei*				+	+
52	*Leydigia* sps.	+				+
53	*Moina micrara*		+			+
54	*Moindaphuinia*	+		+	+	
55	*Scapholeberis sp.*		+			
	Ostracoda					
56	*Cypris obensa*	+	+		+	+
57	*Cypris candona*	+	+	+	+	+
58	*Stenocypris* sps.	+	+	+	+	+
59	*Heterocypris* sps.	+		+		+
60	*Nauplius* sps.	+	+	+	+	+
	Copepoda					
61	*Ectocyclops phaleratus*	+		+	+	+
62	*Ectocyclops serrulatus*		+	+	+	
63	*Cyclops vicinus*	+	+	+		+
64	*Microcyclops varicans*		+			
65	*Mesocyclops leuckarti*	+		+	+	
66	*Macrocyclops distinctus*	+	+	+		+
67	*Mesoocyclops hyalinus*		+	+	+	
68	*Moindaphuinia* sps.	+		+		
69	*Neodiaptomus* sps.	+		+		+
70	*Diaptomus* sps.	+			+	
71	*Synecella calanoids*			+		
72	*Argulus japonicus*	+	+	+		+
73	*Nauplius larvae*	+	+	+		+
74	*Eucyclops sp.*	+				+
75	*Heliodiaptomus vidus*		+		+	
76	*Paradiaptomus greeni*	+		+		+
	Total	61	48	60	57	54

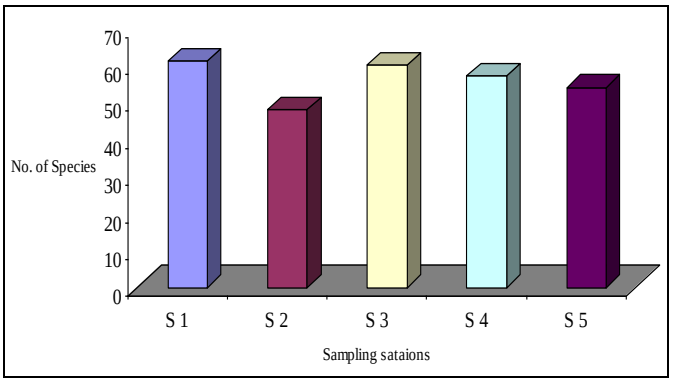

Fig 1: zooplankton diversity of river Narmada during the study

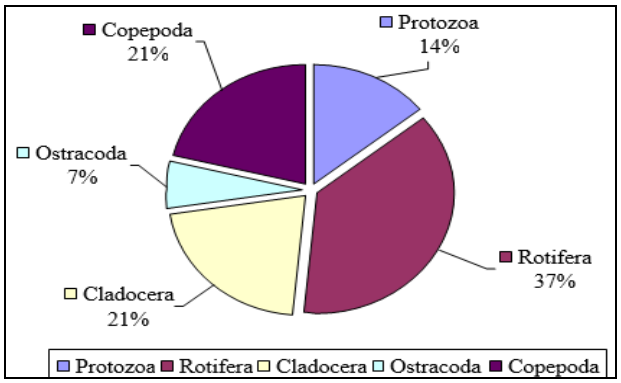

Fig 2: Group wise distribution of Zooplankton

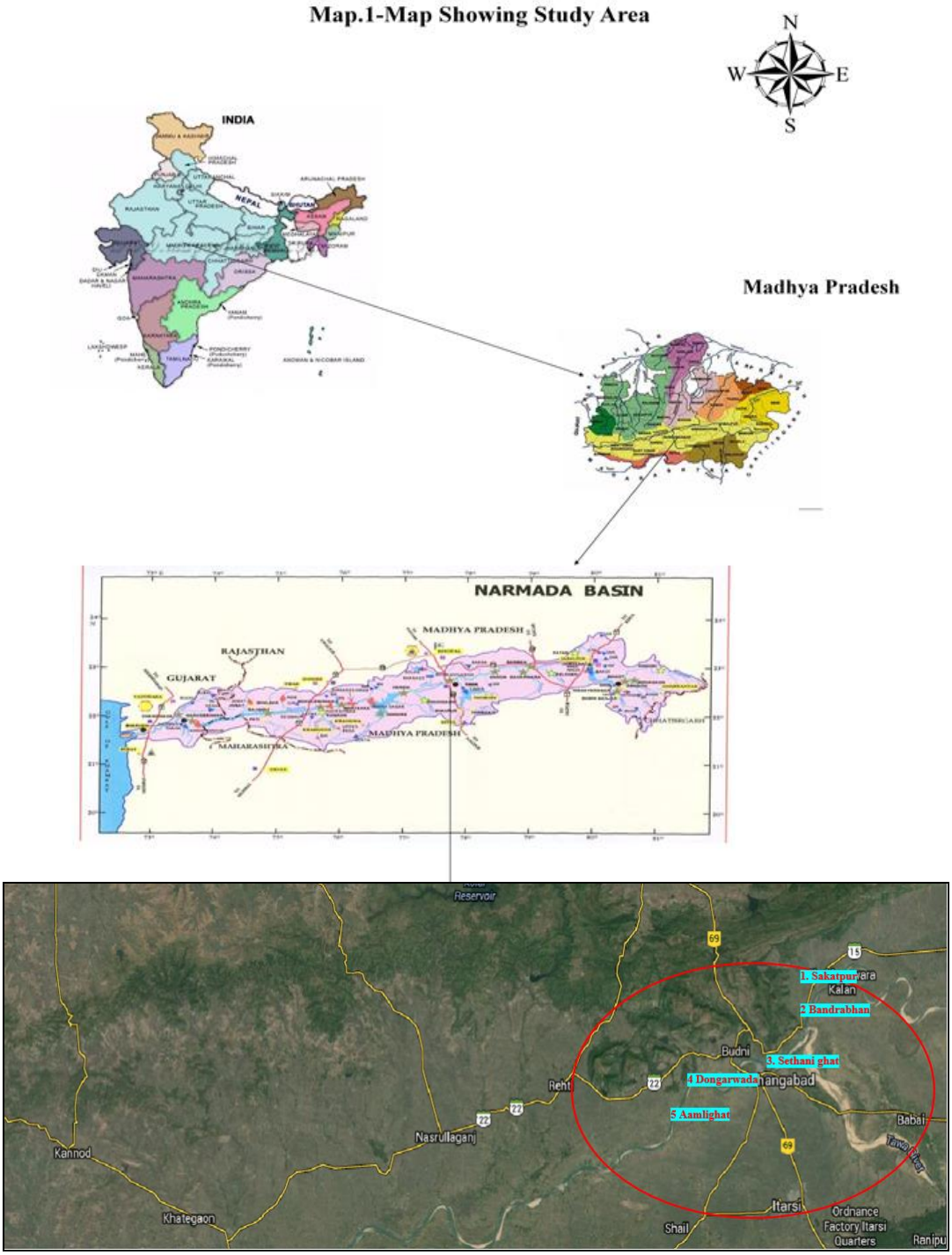

Fig 3: 1. Sakatpur, 2. Bandrabhan, 3. Sethani ghat, 4. Dongarwada, 5. Aamlighat

4. Discussion

Zooplankton organisms occupy a central position in the food webs of aquatic ecosystem. They do not only form an integral part of the lentic community but also contribute significantly, the biological productivity of the fresh water ecosystem (Wetzel, 2001) [31].

Zooplankton groups are a characteristic indicator of water quality, eutrophication and pollution levels and are an important link in the aquatic food chain (Sharma 1983, Saksena 1987) [29, 28]. Zooplankton also supports the economical important for fish population. They are the mode of energy transfer between phytoplankton and fish (Howich and Wilhm, 1984) [16]. The study of the zooplanktonic composition, abundance and seasonal variations is helpful in planning and successful fishery management (Jhingran, 1974) [17]. A number of workers such as Aayappan and Gupta (1980), Balkhi *et al.*, (1987), Fasihuddin and Kumar (1990) and Choudhary and Singh (1999) [2, 6, 14, 9] have reported different aspects of zooplankton inhabiting Indian freshwaters. A total of 76 taxa of zooplankton were accounted throughout the period of study. Rotifera was most dominant group in terms of number of taxa and their composition. The taxa of

Rotifera were highest among the zooplankton population. Zooplankton of the river was dominated by Rotifera and other zooplanktons groups like, Copepoda and Ostracoda were less considerable. Similar observations were made by Adholia (1979), Rao (1981), Dad (1981), Unni (1996) and Johal (2002) [1, 24, 11, 30, 19] who reported four major groups of zooplanktons from Betwa, Khan, Kshipra, Chambal, Narmada river and Hill streams of Himachal Pradesh. Rotifera were found to be more sensitive to environment changes as compared to Cladocera and Copepoda and are known to be characteristic indicators of water quality (Gannon and Stumberger, 1978) [15].

Spatial variations in zooplankton population were observed during the study. The highest numbers of taxa were recorded at pool sampling sites and lowest numbers of taxa were represented to run and riffle sampling sites. The above finding indicates that the pools are favorable sites for planktons (both phytoplankton and zooplankton) development and growth as may tend to be similar condition as lakes provide. Lesser flow and stagnation of water support plankton diversity and density. Hence, the finding may be attributed to the low flow conditions in pools.

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