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Seasonal variations of zooplankton community in Sina Kolegoan Dam Osmanabad district, Maharashtra, India.

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Abstract
The plankton constitutes the basic food sources of any aquatic ecosystem, which supports fish and other aquatic animals. Zooplankton diversity is one of the most important ecological parameters in water quality assessment. Zooplanktons are good indicators of the changes in water quality because they are strongly affected by environmental conditions & respond quickly to changes in water quality. Zooplankton is the intermediate link between phytoplankton and fish. Hence qualitative and quantitative studies of zooplankton are of great importance.In the present work, we provide quantitative information on the seasonal variations of zooplankton and selected physico-chemical variables a large man-made reservoir in the Osmanabad district during the year June 2009- May 2010. In the study period we have recorded rotifers showed 5 species, Cladocera by 4 species and Copepods represents 2 species where as Ostracoda showed 2 species. Among zooplankton, particularly Cladocera was the dominant group.

Keywords: Rotifera, Cladocera, physico-chemical parameters, seasonal fluctuations and Sina Kolegoan Dam.

INTRODUCTION

The zooplankton includes assemblage of taxonomically unrelated microscopic organisms with common ecological habitat, which are drifting in the epilimnion layer. It is important group as it occupies an intermediate position in the aquatic food web because it is found that many zooplanktons feed up on algae; the producers in the aquatic ecosystems and in turn are being fed by numerous carnivorous fishes. Thus the zooplanktons are the microscopic free-swimming animalcule components of aquatic ecosystems, which are primary consumers in the food web. Thus the zooplankton plays an important role in transferring the energy to the consumers and act as links in the food web of aquatic ecosystems.

They are also indicating the tropic status of a water body and some of them are also acting as bio indicators of organic and inorganic pollution of the aquatic environment. Hence with the sense of research on the aquatic ecosystems, the knowledge of their abundance, diversity, density and horizontal and vertical distribution is also essential to understand the tropic nature of the water body and succession of the different living organisms in them.

The density and diversity of the zooplankton in fresh water ecosystem is controlled by several factors. Temperature, Dissolved oxygen and organic matter are important factors which controls the growth of zooplanktons, Hannazato and Yasuno, (1985) [8]; Bhati and Rana, (1987) [4]. Several researchers have used the different zooplankton groups to evaluate the tropic status and pollution potential of the water body. Zooplanktons are also as biological indicators of eutrophication.

Therefore, their potential value as indicators of alterations in the water quality of reservoirs in these regions needs to be assessed. Also, there is an increasing demand by environmental monitoring programs for bioindicators of water quality. This study attempted to investigate the structure and composition of the zooplankton community in SinaKolegoan Dam

STUDY AREA

Sina Kolegoan project reservoir located at Rosa, tahsil Paranda Dist. Osmanabad, Marathwada region, Maharashtra state, It is 6 kms away from Paranda town from west side. Reservoir lies in between 18^0-53'-N latitude and 76^0-27'-E longitude. An earthen dam is of 19.81meters in height and 2188.40 meters in length on Sina river. Reservoirs have 319.92sq.kms. Catchment area and gross water storage capacity 25.181 McM.Government of Maharashtra constructed reservoir on Sina river at dated 20 thNovember 1990 for irrigation, drinking water and water supply for Bhairavnath sugar factory at Sonari village. Reservoir has two canals viz left canal and right canal. The length of left canal is 12.87 kms, head discharge capacity is 1.77 m^3/s and area under irrigation is 3965 hectare. The length of right canal is 9.65 kms; discharge capacity 1.75 m^3/s, irrigation area is 3965 hectare.Near about 20 villages are benefited for irrigation, drinking water, fishing and agriculture by this canal.

MATERIALS AND METHODS

Monthly zooplankton samples were obtained from each of these sites for the period June 2009 to May 2010. Currently, water samples were taken for measuring selected physico-chemical variables.Monthly zooplankton collections were made employing a

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modified HaronTrantor net with a square metallic frame of 0.0625 m^2 area. The filtering cone was made up of nylon bolting silk plankton net (No.25 mesh size 50 µ) was used for collection of zooplanktons. Care was taken to avoid trapping of floating debris while towing the net. The net was hauled for a distance of 10 meters. Collected samples were transferred to labeled vial bottles containing 5% formalin.At the time of sampling, we measured the surface water temperature and pH and secchi depth. Analysis of other variables (dissolved oxygen, free Co2, were conducted in the laboratory using standard procedures. These replicated samples were observed and identified under research microscope using suitable keys, standard texts and monographs given by Pennak, (1978) [12]; Tonapi, (1980) [15]; Sehgal, (1983) [14]; Trivedy, (1984) [16]; APHA, (1985) [1]; Battish, (1992) [3]; Kodarkar, (1998) [10] and Dhanapati, (2000) [6].

RESULTS AND DISCUSSION

Plankton population on which the whole aquatic life depends directly or indirectly is largely governed by the interaction of a number of physical, chemical and biological conditions and tolerance to one or more of these conditions (Reid and Wood 1976). No individual factor like physical or chemical is singly responsible for the fluctuations of phyto or zooplanktonic populations. Number of physical, chemical and biological environmental factors affecting simultaneously must be taken into consideration in understanding the fluctuating of plankton population (Davis, 1954).The physiochemical parameters such as temperature, light, pH, organic and inorganic constituents and the interrelationship with their organisms play an important role in determining the nature and pattern of fluctuation of population densities of zooplankton in an environmental unit. The importance of these factors has been stressed by several workers including Arora. (1966) [2], John *et. al*. (1980) [9],Rajendra.(1992) [13], Kumar and Datta, (1994) [11].Kodarkar. (1998) [10] and Desilva, (1996) [5].

In the present investigation, all the mean data of selected physico chemical parameters (i.e., Temperature, pH, Electrical conductivity, Transparency, Turbidity, DO, Free CO2, Alkalinity, Total dissolved solids, Hardness and chloride) obtained from the weekly analysis of water samples from four predetermined sites of the Dam are summarized in Table no.1. During the study period, water temperature ranged from a minimum of 23.4 ^{O}C (November, 2009) and maximum of 31.2 ^{O}C (May, 2010). pH of the reservoir indicated an alkaline condition. High values pH (7.8) was observed in May while the low value in June, July and September (7.3). Turbidity ranged from a minimum of 27.2 NTU (July) and maximum of 74 NTU (December). Transparency ranged from a minimum of 8.2 (December) and maximum of 28.7 (July).

Table 1. Monthly variation of physico-chemical parameters of SinaKolegoan Dam June 2009 - May 2010

Parameters	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Temp.	29.2	23.6	27.4	28	26.4	23.4	23.4	23.6	28.6	31.2	30.8	31.2
pH	7.3	7.3	7.4	7.3	7.5	7.4	7.4	7.6	7.6	7.7	7.4	7.8
Turb.	27.5	27.2	27.5	27.5	33.5	39.5	74	70.2	68.1	59.3	45.8	43
Trans.	25.00	28.7	24.5	22.5	17.5	12.00	8.2	9.5	21.7	24.2	26.5	25.2
EC	139.6	142.4	139.1	132.4	131.8	119.2	124	146	153.6	181.6	174.7	165.1
TDS	0.34	0.43	0.48	0.54	0.63	0.72	0.79	0.78	0.84	0.87	0.91	0.93
D.O	2.9	3.2	3.4	3.7	4.6	4.7	4.9	4.5	4.7	4.4	4.6	4.3
Free CO2	5.7	5.6	5.4	5.6	5.0	4.8	4.5	3.0	3.7	3.6	4.0	4.1
Alk.	34.6	36.0	38	32	25.2	23.3	22.1	37	52.3	55	43.8	43.8
Hard.	124	129	186	121	112	110	93	86	132	140	143	153
Chlorides	34.5	36	38.7	32	25.2	23.3	22.1	37	52.5	55	43.8	43.8

Electrical conductivity ranged from a minimum of 119.2µmho/cm (November) and maximum of 181.6 µmho/cm (March). Total dissolved solids ranged from a minimum of 0.34 Mg/lit (June) and maximum of 0.93 Mg/lit (May). D.O ranged from a minimum of 2.9 Mg/lit (June) and maximum of 4.9 Mg/lit (December). Free carbon dioxide ranged from a minimum of 3.0Mg/lit (January) and maximum of 5.7 Mg/lit (June). Alkalinity ranged from a minimum of 22.1 Mg/lit (December) and maximum of 55 Mg/lit (March). Hardness ranged from a minimum of 86 Mg/lit (January) and maximum of 153 Mg/lit (May) and Chloride ranged from a minimum of 22.1 Mg/lit (December) and maximum of 55 Mg/lit (March).

Monthly and seasonal abundance of zooplankton for one year of investigation presented in Table No. 2,3,4,5, 6 and Fig 1. The zooplankton of Sina kolegoan Dam consists of Rotifers, Cladocera, Copepoda and Ostracoda; the total 13 species were recorded from the reservoir during the present study, in which 5 taxa of rotifera, 4 taxa of cladocera,2 taxa of copepoda and 2 taxa of ostracoda contributed to zooplankton diversity in the reservoir. The total zooplankton population was dominated by Cladocera (37%), Copepods (32%), Ostracods (25%),Rotifera(6%) are showed in Graph No.1. respectively.

In the present investigation 5 species belonging to rotifera has been identified in Dam *Brachinous falcatus, Brachinous caudatus, Brachinous rubens* were more dominant among the rotiferans. High population was observed during summer season followed by winter and lowest population observed during rainy season (Table No.6). *B. falcatus, B. caudatus, B. rubens, Keretella tropica, Lacane* sp. were absent in June, July, Aug, Sept. i.e. in Rainy season (Table No.2). Low diversity of species and lower richness during monsoon period was due to reflection of environmental stresses (Thomas, 1999 [17]).

Table 2. Monthly variation of Rotifers (Org/lit) in Sinakolegoan Dam during June 2009 - May 2010

Rotifers	Jun	Jul.	Aug	Sept	Oct	Nov	Dec	Jan.	Feb	Mar	Apr.	May	Mean
B. falcatus	2	6	Nil	Nil	28	32	48	56	67	76	79	83	47.7
B. caudatus	Nil	Nil	Nil	Nil	4	12	22	10	16	14	Nil	Nil	13
B. rubens	10	Nil	Nil	Nil	2	4	4	6	8	6	8	7	6.1
Keratella tropica	Nil	Nil	Nil	Nil	36	24	20	28	27	46	68	42	36.3
Lacane sp.	4	Nil	Nil	Nil	8	6	10	12	9	16	18	20	11.4
Mean	5.33	6	0	0	15.6	15.6	22.4	22.4	25.4	35.5	43.25	38	22.9

Cladocera population of Sina kolegoan Dam is maximum in rainy season followed by winter season and least during summer season in both the years (Table No.6). In the present study, total 4 species of Cladocera were identified.*Moina* sp and *Moina micrura* were more dominant. (Table No.3). The maximum population of cladocera in summer attributed to favourable temperature and availability of food in the form of bacteria, nanoplankton (eg.small eukaryotic protists; Small Diatoms; Small Flagellates; Pyrrophyta; Chrysophyta; Chlorophyta; Xanthophyta) and suspended detritus while in monsoon the factors like water temperature, Dissolved oxygen, turbidity and transparency play an important role in controlling the density and diversity of cladocera (Edomondson, 1965; Baker,1979). The occurrence of species of Cladocera like *Ceriodaphnia, Moina* indicates best conditions of temperature for their development.

Thus the diversity and density or distribution of plankton is mainly affected by wind flow, inflowing streams, dilution, qualitative variation of water, physico-chemical alteration of water, depth of water, shoreline, current plankton swarms and action of predators & diurnal migration of plankton Welch, (1952 [18]).

Table 3. Monthly variation of Cladocera (Org/lit) in Sinakolegoan Dam during June 2009 - May 2010

Cladocera	Jun	Jul.	Aug	Sept	Oct	Nov	Dec	Jan.	Feb.	Mar.	Apr.	May	Mean
Moina sp.	21	29	32	35	32	30	20	26	36	34	25	22	28.5
Moina micrura	32	25	15	14	12	14	13	11	12	14	13	10	15.41
Ceriodaphnia sp.	21	38	12	23	6	5	12	8	6	7	2	2	11.83
Alonella sp.	11	26	17	4	15	13	11	14	15	8	2	Nil	12.36
Mean	21.2	29.5	19	19	16.2	15.5	14	14	17.2	15.7	10.5	11.3	17.02

Copepods population of Sinakolegoan dam were maximum during rainy season followed by winter and less in summer (Table No.6). The seasonal mean values recorded were 19.5 (Table No.4) *Mesocyclops* Sp. were dominant in the Dam. The summer peak may be due to the abundance of diatoms and blue green algae, minor peak may be attributed to the abundance of phytoplankton in the present study.

Table 4. Monthly variation of Copepods (Org/lit) in Sinakolegoan Dam during June 2009 - May 2010

Copepods	**Jun**	**Jul.**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar.**	**Apr**	**May**	**Mean**
Cyclops sp.	30	34	28	22	15	16	14	16	16	12	10	11	18.6
Mesocyclopes sp.	32	48	30	25	20	18	17	12	11	11	11	10	20.4
Mean	31	41	29	23.5	17.5	17	15.5	14	13.5	11.5	10.5	10.5	19.5

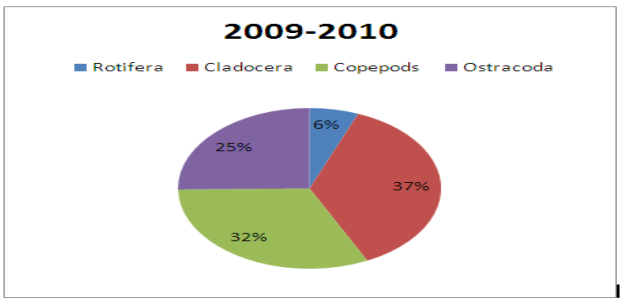
Ostracods seasonal mean values recorded were 20.9 (Table No.5). *Cyprinotus* sp. and *Cypris* sp. were dominant. *Cyprinotus* sp. was absent in rainy and winter season. In the present investigation, the Ostracods populations of Sinakolegoan dam were maximum during summer season followed by rainy and least during winter season (Table No.6). The temperature of water and availability of food affect the population of Ostracoda.

Table 5. Monthly variation of Ostracoda (Org/lit) in Sinakolegoan Dam during June 2009 - May 2010

Ostracoda	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov.**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Mean**
Cyprinotus sp.	16	18	Nil	Nil	Nil	Nil	Nil	26	10	15	12	25	17.4
Cypris sp.	26	20	Nil	Nil	Nil	Nil	Nil	28	22	26	18	28	24
Mean	21	19	0	0	0	0	0	27	16	20.5	15	26.5	20.7

Table 6. Seasonal abundance of different groups of zooplankton and their concentration, June 2009 to May 2010 (Org./l.)

Sr.No.	Group	Rainy	Winter	Summer
1	Rotifera	11.13	76	142.15
2	Cladocera	89.3	59.7	54.7
3	Copepoda	124.5	64	46
4	Ostracoda	40	27	78



Graph 1. Variation of Zooplankton composition of Sinakolegoan Dam during June 2009 - May 2010

CONCLUSION

Depending on the study it can be concluded that the diversity and density of zooplanktons from SinaKolegoan Dam exhibited by four major groups (Rotifera, Cladocera, Copepod and Ostracoda) with 13 genera showed seasonal variability in density due to different parameters which impact on them. The temperature, higher standing crop of primary producers leading to availability of food in the form of bacteria, nanoplankton and suspended density least predation due to higher quantity of water, higher alkalinity and less quantity of water (dilution effect). Simultaneously dissolved oxygen and hardness of water were also favorable for planktonic growth. Rotifera density was least in the monsoon seasons. This was due to dilution effect, high turbidity and less photosynthetic activity by the primary producers. Maximum population of Cladocera and Copepoda observed in summer season and Ostracoda dose did not show any seasonal remarkable fluctuations, representing their preferred avoidance behavior and occurrence at the bottom of the water. Thus study has determined that abundance of zooplankton has been governed by the cumulative effect of physico-chemical and biological variables.

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