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SEASONAL CHANGES IN ZOOPLANKTON COMMUNITY STRUCTURE IN A SUBTROPICAL FRESH WATER RESERVOIR OF MAHARASHTRA (INDIA)

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ABSTRACT

In several studies it found that seasonal variation in physical and chemical factors has great influence on population density, diversity as well as community structure of zooplanktons. The similar study was made at a subtropical freshwater reservoir at Kurnur dam in Solapur district Maharashtra India to know whether the locational factors influence the physical chemical properties of thus affecting the Zooplankton community structure. Various physico chemical parameters like temperature, transparency, TDS, water hardness, nutrient load like phosphate, nitrate, sulphate etc were considered to correlate seasonal variation in zooplankton community structure. Among Zooplanktons Rotifera dominated throughout the year over Copepoda, Cladocera and Ostracoda. Zooplanktons dominated in month of May and October and they were counted less in October and December. October low can be compared with habitat dilution with external runoff in the reservoir while temperature is important factor for winter low in December. Thus temperature is the important physical factors that govern the community either directly by influencing the population growth rate or indirectly is by influencing other physicochemical parameters. Besides rainfall and quality of runoff influx influence the zooplankton community structure.

KEY WORDS: *Zooplanktons, Freshwater, Maharashtra, India.*

INTRODUCTION

A lake is self sustained ecosystem where phytoplankton's are autotrophs that use solar energy to synthesize food, which is consumed by zooplanktons. Zooplanktons are further consumed by small fishes which are further eaten by large fishes. Therefore the fish production is associated with phytoplankton production. **(Ryder et al., 1974)[1].** Therefore some of the studies have given emphasis to phytoplankton. Phytoplankton diversity is unimodal function of productivity in freshwater lakes **(Dodson et al. 2000)[2].** According to Odum there is close association of physico chemical factors with quality of flora and fauna of that ecosystem **(Odum et al., 1971)[3].**

Phytoplankton and Zooplanktons form a highly diverse group microorganisms, and several studies have been made to understand maintenance of species diversity**.** In a comparison with species diversity and availability of resources Huisman found that oscillations and chaotic fluctuations in species abundances allow the coexistence of many species on a handful of resources (**Huisman and Weissing 1999)[4].** According to Hutchinson the large number of species in most plankton communities from the

perspective of principle of competitive exclusion suggest that in a homogeneous, well-mixed environment species that compete for the same resources cannot coexist **(Hutchinson 1961)[5].**

The Physicochemical factors plays important role in abundance of Zooplanktons, in a study of Sina Kolegaon Dam, Osmanabad district of Maharashtra the density of rotifers is found to be less in rainy season due to dilution of habitat, turbidity of water and less photosynthetic activity by primary producers. Copepoda nad Cladocers are abundant in rainy season but Ostracoda which are bottom dwellers did not show any remarkable fluctuation **(Swati Jadhav, et al, 2012)[7]**. In a similar study at Rishi lake of Karanja (Lad) Maharashtra zooplanktons were found in highest numbers in summer season and lowest in rainy season which show the influence of physico chemical factors **(Kedar G.T. et al 2008)[8]**. In a study of lake at Pune university campus Rotifera show high dominance and temporal community similarities. This study also positively correlates abundance of Rotifera with rainfall and temperature and negatively with pH and conductivity **(Vanjare, Pai 2013)[9].** Several studies are made on marine water ecosystem where the seasonal fluctuation in physico-chemical(Physical and Chemical) factors are almost uniform. The objective of this study is to give major emphasis on studies of plankton community structure under influence of different climate.

Site Selection and Study Area

Fig 1.1 Kurnur Dam, Dist. Solapur

Kurnur Dam which is also known as Bori Dharan. It is a small gated dam exactly located at 17°37'0"N latitude and 76°13'2"E longitude. It is a earthfill dam which was constructed at confluence of Harna and Bori river which are the tributaries of Bhima river. The dam covers the catchment area of 1,254 km^2 from Akkalkot and Tuljapur Tehasil.

Kurnur Dam located in drought prone rain shadow region of Western Ghats in Marathwada region. The volume of water in the reservoir depends upon favour of monsoonal rainfall in catchment area. As there is no certainty in monsoonal rainfall and drought in catchment area therefore there is no certainty of annual inflow of water. In 2013 there was drought like situation in from February to May because of absence of rainfall from western disturbance locally known as ' *Awakali* ' , the volume of water in reservoir reached below the level of dead storage. The important economic activity in the catchment area is agriculture and there is no industrial belt in its catchment area besides some settlements are present on the bank of Harna river who are the main source domestic sewage.

Because of drought prone area dry land agriculture is practiced in the catchment area, frequent tilling, use of fertilizers and pesticides that can be said agricultural runoff which influence the quality of discharge of water in the reservoir.

MATERIAL AND METHODS

The study was carried to correlate and analyse physico chemical factors and Zooplanktons. The samples were collected according to standards and procedure for examination of water and waste water American Public Health Association **(APHA-1989)[10]** and 17th edition of Beuro of Indian standard methods of Sampling and Test (Physical and Chemical) for water and waste water **(BIS-3025)[11]** as a

manual for analysis. The water samples were collected at confluence of Harna, Bori and Lendaki river through suction pump method. The Field Parameters that includes Temperature, pH that need to be analysed immediately after sample collection were collected on site only. General parameters that were to be analysed in laboratory which includes Total Hardness, Turbidity, TDS(Total Dissolved Solids) BOD, COD etc. Cations and anions include Ca, Mg, Sulphates, Nitrate, Phosphate are analysed as per procedure mentioned in USGS manual and EPA government manuals **(USGS Manual and eps.gov)[12](epa.gov manual)[13]**. For the collection of Zooplanktons 80 mesh size net was used and 50 litter of water was filtered though net to collect planktons in sample bottle tied at the end. The net was properly rinsed to assure full sample collection from filtered water.

RESULTS AND DISCUSSION

The rainfall in the basin is important factor that governs various physico-chemical factors. Some of the parameters are to be collected immediately while collecting sample like temperature, pH, Electric conductivity and Nitrate concentration etc. In 2013 from the graph of rainfall status in Tuljapur tehasil, it is observed that there was absolutely no pre-monsoon (*Awakali*) rainfall in months of March to May (Graph 1.1) as compared to normal and this is accompanied by evaporation losses, which lead to decreases of water level in the reservoir below dead storage. Because of this organic and inorganic pollutants stated to get accumulate making water turbid with typical smell. In monsoonal season the rain fall followed almost normal course with typical high in the month of July and low in the month of August thus bringing added mineral nutrients from agricultural runoff.

Temperature (Table 1.1) is a simple parameter that can be easily measured with help of glass thermometer. It normally follow the diurnal range of temperature. The temperature is recorded during morning hours while collecting water sample almost at same time through the year. From temperature graph it can be concluded that temperature of water is maximum during May and minimum in December. **Turbidity and Electric conductivity (EC) (Table 1.1)** follow the rainfall and maximum during rainy season with the addition of water. **pH (Table 1.1)** decreases with addition of rain water, it means during summer season at warmer temperature the ph is high which decreases with influx of fresh water during monsoon but even though it never reach below 7 or acidic level that is the fluctuation is within the range of basic pH. **Dissolved Oxygen (DO) (Table 1.1)** follows the pattern of combined effect of temperature and rainfall. In summer the dissolved oxygen decreases while the monsoonal rain running through various rapids enhance concentration of DO in water. **Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) (Table 1.2)** though follow the same pattern but too low values of BOD over COD indicates the level of organic pollution in the reservoir from domestic sewage, human intervention and that too in summer season when quantity of water in reservoir was less**.**

Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and Total Solids (TS) (Table No. 1.2) seems to follow the rainfall rather then temperature there fore premosoon tillage and agriculture runoff in rainy season may be responsible for increased TDS, TSS and TS. In comparison to TDS, Total Suspended Solids is very less therefore the graph of TDS and TS appears to be same. **Calcium (Ca), Magnesium (Mg) and Total Hardness (TH) (Table No. 1.3)** also follow the rainfall pattern as they are contributed by dissolution of soil particles. The concentration of **Nitrate (Table 1.1) and Nitrite (Table No. 1.3)** inversely related. Nitrate concentration is related with bacterial and algal concentration that convert them in to either nitrate, ammonia fixing bacteria etc. **Nitrate** concentration is maximum during rainy season and minimum during summer season. The **Phosphate (Table No. 1.3)** concentration is maximum during summer when volume of water is less due to evaporation losses and other losses. It means during rainy season the concentration of Phosphate is diluted and with gradual accumulation its concentration gradually increases. **Sulphate (Table No. 1.3)** concentration gradually

decreases in summer which reach minimum level in May and increases with influx rainwater which peak in August after that it start deplete gradually both in winter and summer. The concentration **Chlorine (Table No. 1.3)** also follow the rainfall. It is maximum in rainy season in proportion to influx of water in the reservoir and gradually depletes in winter and further in summer reaching minimum level in March April.

Among zooplanktons Rotifera, Copepoda, Cladocera and Ostracoda are studied . Rotifera dominates the community, 43 species of Rotifera are counted from collected water samples. Brachinus species dominate among the Rotifera (Table 2.2). Among zooplanktons 10 species of Copepodes (Table No. 2.3), 18 Cladocera (Table No. 2.4), and 12 species of Ostracoda (Table No. 2.5), are studied from the collected samples. Rotifera dominated the community through the year. In summer season especially in the month of May all the zooplanktons counted highest in number that is organisms per litter. In winter season that is in December organisms count is less (Table No. 2.1). In June is the month of onset of monsoon, and because of rainfall in catchment area (Graph. No.1.1) habitat is diluted by influx of rain water therefore the organisms count shows drastic low.

Table. 1.1- Physico-chemical parameters of water samples collected in 2013 at Kurnur Dam,

Months	Temp	pH	Turbidity	EC	DO	Nitrate
January	23	8.07	7.8	380	4.88	0.17
February	24	7.5	7.8	425.11	4.34	0.23
March	29	7.67	8.53	482.91	3.95	0.11
April	31	7.8	8.67	480.74	3.88	0.06
May	33	7.6	10	462.74	3.73	0.09
June	27	7.43	10.5	589.67	5.38	0.69
July	26	7.1	15.83	669.81	7.68	1.84
August	24	7.4	15.97	647.07	6.67	1.34
September	26	7.3	14.73	662.2	7.16	1.58
October	23	7.57	12.87	546.44	6.23	1.12
November	21	7.7	8.9	474.13	5.45	0.73
December	20	7.6	8.28	467.79	4.75	0.43

Table. 1.2- Physico-chemical parameters of water samples collected in 2013 at Kurnur Dam,

Months	BOD	COD	TDS	TSS	TS
January	3.19	26.02	275.67	8.97	284.33
February	3.57	29.13	308	9.49	317.54
March	5.8	47.22	350.33	9.49	359.43
April	5.68	46.3	348.33	10.81	359.18
May	5.38	43.82	335.33	10.94	346.27
June	4.71	38.41	427	13.45	440.75
July	3.44	28.09	485.33	24.13	509.5
August	2.31	18.93	469	21.77	490.67
September	2.1	17.17	479.83	20.35	500.21
October	2.77	22.66	396	16.08	412.06
November	3.51	28.63	343.67	11.21	354.79
December	3.99	32.61	339.67	10.35	349.33

Table. 1.3- Physico-chemical parameters of water samples collected in 2013 at Kurnur Dam,

Months	Ca	Mg	TH	Nitrite	P	S	Cl
January	121.73	93.21	214.94	0.31	2.58	13.98	17.4
February	136.18	101.29	237.48	0.3	2.48	13.15	18.42
March	154.71	115.21	269.91	0.32	2.58	12.47	15.39
April	154.01	117.12	271.13	0.33	2.58	12.24	17.53
May	148.24	111.31	259.55	0.32	2.58	10.78	17.75
June	188.91	136.37	325.28	0.22	1.93	14.42	21.88
July	214.57	150.9	365.48	0.03	0.37	15.76	39.3
August	207.29	148.5	355.79	0.11	1.01	17.18	35.29
September	212.14	152.95	365.09	0.07	0.74	16.54	33.1
October	175.05	133.08	308.14	0.15	1.38	14.92	31.22
November	151.89	122.47	274.36	0.21	1.93	13.25	21.75
December	149.86	113.7	263.57	0.27	2.3	12.81	19.87

Table. 2.1- Zooplanktons count from water samples collected in 2013 at Kurnur Dam, (Organisms/lit)

Months	Rotifera	Copepoda	Cladocera	Ostracoda
January	122	65	52	66
February	126	87	68	89
March	140	112	74	126
April	152	127	101	137
May	167	141	116	152
June	177	113	98	123
July	102	73	51	60
August	142	81	56	80
September	125	55	43	64
October	134	51	42	53
November	118	46	40	49
December	116	39	31	51

Table. 2.2 List of Rotifers observed from the sample collected from Kurnur Dam in 2013

Brachionus angularis	*Filinia longiseta*	*Keratella sp.*
Brachionus calyciflorus	*Keratella tropica*	*Kertella valga*
Brachionus caudatus	*Lecane bulla*	*Lecane bidentata*
Brachionus quadridentatus	*Notholca acuminata*	*lecane depressa*
Brachionus ureceolaris	*Rotaria spp.*	*Lecane pyriformis*
Epiphanes clovulata	*Trichocera spp.*	*Lepadella ovalis*
Euchlanis dilatata	*Asplanchna sp.*	*Lepadella patella*
Filinia opoliensis	*Brachionus falcatus*	*Monostyella sp.*
Keratella cochlearis	*Brachionus forficula*	*Notomata copeus*
Keratella procura	*Brancionous calciflorus*	*Proales decipiens*
Brachionus diversicornis	*Cephalodella exigna*	*Pseudoharringia similis*
Brachionus folculus	*Cephalodella forficula*	*Testudinella sp.*
Brachionus spp.	*Colurella adriatica*	*Testudinella patina*
Filina spp.	*Dicranophorus dolerus*	*Trichocerca tigris*
Tripleuchlanis spp		

Table. 2.3 List of Copepoda observed in the sample collected from Kurnur Dam in 2013

Cyclops sp.	*Cyclops viridis*	*Diaptamus spp.*	*Eudiaptomus gracilis Sars*
Mesocyclop sps	*Megacyclops sp.*	*Paracyclops fimbriatus*	*Mesocyclops leuckarti*
Nauplius larvae		*Heliodiaptomus contortus*	

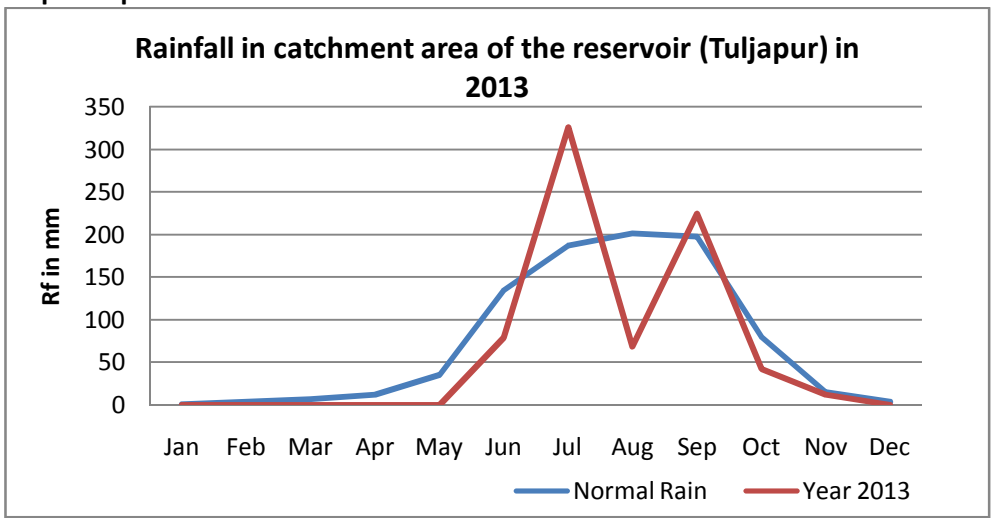
Table. 2.4 List of Cladocera observed in the sample collected from Kurnur Dam in 2013

Alona	*Alona guttata Sars*	*Macrothrix goeldii (Richard)*	*Biapertura affinis (Leydig)*
Bosmina	*Bosmina longirostris*	*Ceriodaphnia pulchella Sars*	*Grimaldina brazzai (Richard)*
Daphnia sp	*Trophocyclops*	*Macrothrix spinosa (King)*	*Daphnia cucullata Sars*
Cypris	*Flurcularia sp*	*Ilyocryptus sordidus (Lievin)*	*Scapholeberis kingi Sars*
Biapertura	*Moina mircura*		

Table. 2.5 List of Ostracoda observed in the sample collected from Kurnur Dam in 2013

Candocypris spp.	*Candona*	*Centrocypris*	*Cyprides*
Cyprinotus	*Cypris spp.*	*Darwinula*	*Ilyocypris*
Limnocythere	*Metacypris*	*Potamocypris*	*Stenocypris spp.*

Graphical presentation 1.1- Amount of rainfall in catchment area of the reservoir.



CONCLUSION

In flux of rain water through agricultural runoff is one of the crucial factor that governs the physico chemical factors of the reservoir. Influx of water relies on quantity as well as spatial and temporal distribution of rainfall in monsoonal season. The common effect is habitat dilution. In summer season from February to May the quantity of water in the reservoir is less but Rotifera, Copepoda, Cladocera and Ostracoda predominate in terms of quantity than other seasons. In summer season zooplankton community is dominated by Rotifera followed by Ostracoda and then Copepoda and least is Cladocera. Growth rate of population may be highest in summer (May) which may be because of high temperature and lowest in winter season (December) because of low temperature. In winter season

also Rotifera followed by Ostracoda and then Copepoda dominate the community while Cladocera is least. Thus temperature is the important physical factors that govern the community either directly by influencing the population growth rate or indirectly that is by influencing other physicochemical parameters. Besides rainfall and quality of runoff influx influence the zooplankton community structure.

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