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Zooplankton Abundance In Relation To Physico-Chemical Properties of Freshwater-Assessment of a Perennial Lake at Urban Area of Warangal Urban District, Telangana State.

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***Abstract**: The present study was aimed to investigate the seasonal variation in Zooplankton communities in relation to the physico-chemical properties of Mamnoor Lake, located in Warangal urban District, Telangana State. The study was carried out for a period of one year from February 2015 to January 2016 to evaluate the relationship and influence between different water quality parameters and the abundance of zooplankton population. The Physico-chemical parameters such as Water temperature, pH, Electrical conductivity, Dissolved oxygen, Transparency, Turbidity, Total Dissolved Solids, Chlorides, Ammonia, Biological Oxygen Demand, Phosphates and Nitrates were analyzed. All the values of these parameters were found within the prescribed standard limits. Therefore this lake has rich number of species biodiversity of aquatic animals. Four different groups of zooplankton were identified in this study which include Rotifera, Cladocera, Copepoda and Ostracoda. Among these, Rotiferans were the most dominant group consisting of twelve genera. Almost all groups of zooplankton were found at a higher number during the dry atmosphere and have a positive correlation with dissolved oxygen, hardness and transparency. However it has been negatively or inversely correlated with pH, temperature and salinity. The present study provides an excellent opportunity to prepare a comprehensive physico-chemical and biological status of this urban lake. Therefore it can be now concluded that this urban lake is highly potential to take up commercial fisheries.*

***Keywords**: Mamnoor Lake, Physico-chemical parameters, Zooplankton Diversity.*

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I. Introduction

Water is the most vital resource for all kinds of life as it forms a medium in which physical and chemical transformations especially those of biological significance takes place and is considered as precious component on the earth. This unique component of nature plays an important role in life from molecules to man. Water is an elixir of the body, a primary need of all living organisms. It is a valuable commodity available in very limited quantities to man and other living beings. The fresh water must be recognised as the Blood of Society (Wetzel, 2000). Freshwater ecosystems have been critical to sustaining life and establishing civilizations throughout history. Human beings relay on freshwater not only for drinking water but also for the purpose of Agriculture, Transportation, Energy production, Industrial purposes, Waste disposal, and the production of fish and other edible organisms. Fresh water is a basic human need as well as an important natural resource. Protection or the improvement of water quality is a great concern to Governments around the world.

The quality of water has been getting vastly deteriorated due to unscientific waste disposal, improper water management and carelessness towards environment. This has led to scarcity of potable water affecting the human health (Agarkar, 2001). Many natural water bodies in India receive millions of liters of fresh water for agricultural runoff with different concentrations of pollutants in various farms. Water resources are declining day by day at the faster rate due to rapid urbanization and population load. Deterioration of the water quality is a global problem (Mahananda *et al.,* 2010). Water quality continues to be degraded by nonpoint pollutant sources. As part of the industrial development in most places, fresh water bodies are dumped with highly toxic chemicals along with effluents to a dangerous level. Massive amount of domestic waste water from cities and industrial effluents from industries are discharged into rivers contaminating rivers, lakes and reservoirs. Such anthropogenic pollutants are the main sources of heavy metal contamination in rivers, lakes and reservoirs. These contaminants entering the aquatic ecosystem may not directly damage the organisms. They can be deposited into aquatic organisms through the effects of bio-concentration, bioaccumulation and the food chain process (Eromosele *et al.,* 1995 and Chernoff and Dooley, 1979). The level of pollutants being detected in the tissues of organisms is the only direct measure of the proportion of the total toxicant delivery to biota, and

therefore indicates the fraction that is likely to enter and affect aquatic ecosystem (Phillips, 1980). Without the knowledge of water quality, it is difficult to understand the biological phenomena at length.

The water quality parameters influence each other and govern the distribution and abundance of flora and fauna (Shinde *et al*, 2010). Physico-chemical parameter study is very important to get exact idea about the quality of water. Therefore there is a need to study that rate of interrelationship among key water quality parameters in relation to water quality management and productivity. Monitoring of these parameters is essential to identify magnitude and source of any pollution load. These characteristics can identify certain condition for the ecology of living organisms and suggest appropriate conservation and management strategies. Hence regular monitoring of Physico- chemical and biological water quality parameters is essential to determine status of water body.

II. Study Area

Most of the Fresh water bodies in Warangal and around the city such as ponds, lakes, tanks and streams have become polluted as a consequence of increasing industrialization, urbanization and other developmental activities for the last ten years.

Mamnoor lake located at latitude 79°- 35 - ′31 " West 79°- 36- ′31 " East and longitude 17°- 54- ′54 " South 17°- 56 - ′65 " North. The Ayacut of the lake is 72.48 Hectors (179 Acres). It has a Godavari Basin and Submergence area of 33 Acres. Length of Bund is 1070 mt. Weir and Sluice is present in this lake. This lake shows good diversity of Icthyofauna along with other fauna.

Fig.No:1. Satellite Map of Mamnoor lake

III. Material and Methods

3.1. Sampling Programme

To assess the water quality parameters and the suitability of water for fish culture, the water samples were collected at four identified sampling stations and a composite sample was prepared in order to minimize the error. The water samples have been analyzed for a period of one year from February, 2015 to January, 2016.The water samples were collected during early hours of the day usually in the first week of every month. Prior to sample collection, all the sampling bottles were thoroughly washed, sun-dried and rinsed with the same water to be collected in the pond. The sampling bottles were labeled with dates and collection sites and they were kept in a cool container maintaining temperature below 25˚C till the analysis completed. For the analysis of chemical parameters the water samples were collected in plastic cans and brought to the laboratory, physico-chemical parameters were analysed as the procedure given in APHA(2005), Kodarkar (1992), Bhalerao (1998) and Khana (2004).

3.2. Plankton Collection

Plankton analysis

Plankton are the microscopic plants (Phytoplankton) and animals (zooplankton) in and around the euphotic zone in an aquatic ecosystem. Biological methods used for the plankton analysis are sample collection, preservation, counting and identification of the aquatic organisms and processing and interpretation of biological data.

Collection of Plankton:

During the period of investigation, monthly samples were collected by a plankton net made of silk bolting cloth silk no. 25 (Mesh size 56 µm). Water sample (50 liter) was filtered through the net from littoral and open water zones and carefully transferred to 50 ml bottle and preserved in 4% formalin. Preserved samples were examined under a binocular microscope with different magnification. Quantitative analysis was done on a Sedgwick Rafter Counter cell by taking 1 ml sample. Taxonomic identification was carried out with the help of standard literature by Pennak(1978), Michael(1986), Kodarkar (1992) and Dhanapathi(2000).

Sedgwick Rafter Cell Method: The rectangular cavity slide (50x20x1mm) contains exactly 1 ml (1000mm^3) of water sample. The sample was shaken well and 1ml of sample was transferred quickly to the cavity with the help of graduated pipette. The cover slip was properly adjusted so that air bubbles do not remain inside. Binocular microscope was focused and slide examined.

Plankton Ind. / Lit = n x c x 1000/ Volume of sample.

Where,

n – No. of Plankton

c – Concentration of Sample.

Qualitative and quantitative plankton analyses were done up to the genus and planktonic organisms were numerically counted, identified and confirmed by following using various monographs, books and other published literature Ward, Henry Baldwin and Whipple, Chon (1945).Needham, G. James and Needham, R. Paul.(1972), Patil and Gouder (1982), Pace, M. L. et. al., (1990), Battish (1992) and Ndebele M. M. R. (2012). After an accurate identification of each genus, the density of zooplankton was calculated as per the Lackey's drop method (Lackey, J. B.1938).

IV. Results and Discussion

4.1. Physico-chemical Parameters

The ecological, physico-chemical and biological parameters of Mamnoor Lake in Warangal district have been choosed to investigate and to understand the status of this perennial water body for its suitability for fish culture practices. The comprehensive study includes estimation of physico-chemical parameters, Distribution of Zooplankton. The study has been conducted for a period of one year i.e., February 2015- January 2016. The physico-chemical parameters in water play a significant role in seasonal distribution and species composition of plankton. The data on the Physico-chemical characteristics of Mamnoor Lake is presented in Table-1. The physiological activities and life processes, such as feeding, reproduction, movements and distribution of organisms are greatly influenced by water temperature. In the present study, the recorded higher water temperature in the Mamnoor Lake can be corroborated with higher density of zooplankton. A rise in temperature leads to the fast chemical and biochemical reactions, and the kinetics of the biochemical oxygen demand is regulated to some extent by water temperature (Khuhawar and Mastoi, 1995). This study indicated that the density of zooplankton was well correlated with water temperature of lakes. The water is generally alkaline in nature due to the presence of carbonates and bicarbonates. The pH variation is also attributed to anthropogenic activities like washing of clothes with detergents and mixing of sewage. In the present study, the lowest mean value (6.85)was observed in the month of February and the highest (7.62) was in the month of June. Marganwar *et al.,* (2012) observed pH range 7.8 to 8.7 in Ambazari Lake at Nagpur, Maharashtra. Similar observations were made by Shib Abir (2014) in Rudrasagar Lake at Tripura. The Transparency of natural waters is an indicator of productivity. During the present investigation the Transparency of water was found suitable for both irrigation and fish culture. However Mane and Pawar (2007) stated that Transparency refers to the clarity of water and it limits the growth of organisms thus more transparency more rate of penetration of sunlight . The less transparency found during monsoon season may be attributed to the entry of silt and other material that enter into the lake through run-off rain water. Dutta *et al.,* (2001) reported an increase in suspended matter and consequent decrease in Transparency during Monsoon. Kadam *et al.,* (2007) and Manjare *et al.,* (2010) have also noticed similar observations in different water bodies at Maharashtra. Seasonal variations of Electrical conductivity is always mainly due to fluctuations in the ionic precipitation and the dilution effects of the rains. In the present study, the lowest was 0.22 µmhos/cm in the month of September and the highest was 0.43µmhos/cm which was observed in the month of April. Sanap *et al.,* (2006), Devika *et al.,* (2006), Mishra *et*

al., (2007), Gupta *et al.,* (2009) and Sreeja and Geesha (2010) have noticed similar findings in various freshwater bodies elsewhere in India. According to Gautam (1990); Zaman and Fakruzzaman (1996), The DO is one of the most important parameters that reflects the physical and biological processes prevailed in water. DO level in water is depending upon the atmospheric air pressure, photosynthetic activity, temperature, salinity and turbulence. The solubility of oxygen increases with decrease in temperature. DO fluctuations occur due to its utilization for decomposition of organic matter and respiration of organisms including zooplankton, phytoplankton and other water plants. These results indicated that, the density of zooplankton was not correlated with water DO of this lake. The higher DO recorded in the Mamnoor lake suggest that there may be good numbers of phytoplankton, which might be supported for zooplankton production. In this study, the recorded higher TDS in the Mamnoor lake can be corroborated with higher density of zooplankton. Moreover, the TDS represents the presence of both organic and inorganic nutrients of the water. Seasonal variations in density of zooplankton have also been reported. In the present investigation, maximum free CO_2 was found in summer and minimum in winter. Similarly , Bandela *et al.,* (1998) have recorded maximum CO_2 level in summer and minimum in winter. Datta and Bhagabati (2007) recorded maximum CO_2 in the month of April and June and minimum in the month of October and December from Ox-Bow lakes of Assam. Telkhade *et al.,* (2008) reported the maximum CO_2 value in the month of March. The Biological Oxygen Demand (BOD) enables to determine the relative oxygen requirements especially of waste waters, polluted waters and effluents. In the present study, the lowest value of 4.50mg/l observed in the month of February and the highest of 15.15mg/l recorded in the month of January. In the present study BOD values were high in winter season and low during summer season and moderatly high during rainy season similar observations were made earlier by Tiwari *et al.,* (1988), Mishra *et al.,*(1999). Jain and Dhanija, (2000) who have identified BOD as an important parameter in aquatic ecosystems to establish the status of pollution. Narasimha Ramulu and Benarjee (2011) have stated that BOD values were minimum in Pre monsoon and maximum in Post monsoon season. The Total Hardness of water is mainly due to the presence of various salts of calcium and magnesium. The salts contribute to the Total hardness of freshwater. The lowest of 104.50mg/l found in the month of December and the highest was 174.25mg/l in the month of May in this study. Chloride is considered to be an important factor as it is one of the essential ions in assessing the status of natural water bodies (Hutchinson, 1957). In the present investigation values of chlorides ranged between 21.0 to 69.19mg/l. High values of chlorides in Pre monsoon could be due to their concentration as a result of evaporative water loss. Lower values in monsoon could be attributed to dilution effect and renewal of water mass after Pre monsoon stagnation. Ammonia is introduced into the pond through dead phytoplankton, left over feed, dead and decayed organic matter. From the values of present study, It is observed that the levels of Ammonia in this pond water was higher than the desired range which may adversely affect on the aquatic biota. Phosphates were observed in the present study, the lowest mean value of 1.22mg/l found in the month of January and the highest of 2.38mg/l found in the month of August. Nitrates were observed, the lowest of 0.44 mg/l in the month of January and the highest of 0.722 mg/l recorded in the month of September. In the present investigation, nitrates were high during monsoon season and low during pre monsoon season. Gohram (1961) observed the high nitrate in monsoon, which is linked to heavy runoff, the organic matter from the catchments. In the present study observed Sodium was ranged from 4.47 ppm to 7.57 ppm and Potassium ranged from 1.31 ppm to 2 ppm.

Table No.1. Monthly Variation of Physico–Chemical parameters at Mamnoor Lake during the year 2015 -2016

Month	Tem	pH	Tran	EC	DO	Co_2	TA	BOD	TDS	TH	CL	NH_4	Na	K	No3	Po_4
Feb.15	27.42	6.85	76.00	0.30	6.25	3.84	201.00	4.50	258.25	129.75	65.90	0.85	4.47	1.56	0.39	1.49
Mar.15	28.67	7.20	86.87	0.36	5.23	5.03	171.50	5.85	380.50	150.25	58.91	0.93	5.82	1.31	0.49	1.63
Apr.15	29.67	7.22	84.00	0.43	6.44	5.18	180.25	4.72	393.50	167.25	66.35	1.07	6.35	1.41	0.55	1.87
May.15	30.75	7.37	70.25	0.39	4.04	4.57	174.75	3.82	424.50	174.25	69.19	0.94	6.57	1.49	0.60	2.19
Jun.15	29.50	7.62	57.00	0.34	9.25	4.86	129.50	7.47	227.00	127.75	30.04	1.14	6.77	1.75	0.62	2.04
Jul.15	27.80	7.42	33.25	0.36	11.66	4.17	171.25	8.60	188.50	144.25	26.78	1.13	6.85	1.97	0.72	2.33
Aug.15	27.40	7.35	30.62	0.31	10.06	3.77	133.00	6.37	162.50	129.50	21.00	1.19	7.25	2.00	0.83	2.38
Sep.15	27.25	7.37	41.25	0.22	10.06	3.23	109.50	9.67	182.50	132.25	27.95	1.24	7.57	1.97	0.72	2.27
Oct.15	26.82	7.12	42.75	0.29	5.93	2.88	204.75	11.47	205.50	121.75	32.16	1.28	7.00	1.68	0.62	2.26
Nov.15	25.67	7.40	44.50	0.36	7.24	3.07	220.00	12.70	181.00	128.25	35.79	0.95	6.55	1.62	0.62	2.05
Dec.15	23.50	7.50	57.50	0.27	5.85	2.80	261.00	13.25	204.50	104.50	57.82	0.90	6.37	1.54	0.50	1.30
Jan.16	21.52	7.45	70.50	0.33	6.80	3.62	267.25	15.15	209.50	108.00	62.59	0.89	6.15	1.46	0.44	1.22

4.2. Zooplankton

Zooplankton species composition and their number in three different seasons were presented in Table.2. Four different groups of zooplankton were identified in this study which includes Rotifera, Cladocera, Copepoda and Ostracoda. Among these groups, Rotiferans were the most dominant group consisting of twelve genera. In an aquatic ecosystem, zooplankton plays an important role not only in converting plant food to animal food but also provide an important food source for higher organisms including fish. This fluctuation is greatly influenced by the variation in the temperature along with many other factors. Among the several factors temperature seems to exhibit the greatest influence on the periodicity of zooplanktons (Byars, 1960 and Battish and Kumari, 1996). During the present investigation, the total zooplankton population was dominated by Rotifers in this lake, followed by Copepodes, Cladocerans and Ostracods. The total zooplankton population of this lake has rotifera (38.37%), cladocera (20.78%), copepoda (22.34%) and ostracoda (18.49%).

4.2.1. Rotefera: In the present investigation 12 species belonging to rotifera has been identified in Mamnoor Lake. *Lecane bidenata, Brachionus falcatus, Filinia longiseta, Asplanchna intermedia, Keratella tropica* were more dominant among the rotiferans. High population was observed during Post monsoon season followed by Pre monsoon season and lowest population observed during monsoon season. Fluctuations in zooplankton density have been attributed to turbidity. Welch (1952), Roy (1955), Tandon and Singh (1972) have shown a direct relationship between rotifera population and water temperature. Dissolved oxygen has been correlated with abundance of rotifers.

4.2.2. Cladocera: In the present investigation the cladoceran populations of Mamnoor Lake were maximum during in Post monsoon season followed by pre monsoon season and least during monsoon season. The total 7 species of cladocera were identified in the present study. *Ceriodaphnia cornuata, Dapnia carinata, Dapnia sarsi* were more dominant and observed in this year of total study and they are seasonally fluctuated. Micheal (1969) noted the highest peaks of cladocerans during dry season. Seenayya (1973) also observed the maximum peaks of cladoceran during Pre monsoon.

4.2.3. Copepods: In the present investigation the copepods population of Mamnoor Lake were maximum during Post monsoon season followed by Pre monsoon season and least during monsoon season. The total 6 species of copepods were identified in the present study. *Nauplius larva, Mesocyclops leukarti, Copepoda naplii, Mesocyclops hyalinus* were more dominant and observed in this year of total study and they are seasonally fluctuated.

4.2.4. Ostracoda: In the present investigation the Ostracods population of Mamnoor Lake was maximum during monsoon season followed by Post monsoon season and lowest during pre monsoon season. The total 4 species of Ostracods were identified in the present study. *Hemicypris fossucula, Heterocypris spp* were more dominant and observed in this year of total study and they are seasonally fluctuated. Chandrasekhar (1996), reported higher population of Ostracods during monsoon in Saroornagar lake of Hyderabad.

V. Conclusion

From the present study, It may be concluded that the study was under taken for the first time in this lake and the study reveals that all the physico-chemical parameters are at nearly permissible limit at all four stations in this lake. This lake was not considered to be more polluted. This lake has shown rich biodiversity of aquatic fauna. Therefore, it is suggested that the immediate measures are necessary to be initiated to avoid further contamination of lake due to anthropological activities. At present, water of this lake is most suitable for fish culture practices and irrigation purpose.

Table No.2. Shows Monthly variation of Zooplankton Population (Org/Lit.) in Mamnoor Lake during the year 2015-2016

S.No.	Name of the Species	Pre Monsoon				Monsoon				Post Monsoon				Total
	ROTIFERA	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	
1	*Asplanchna brightwelli*	0	4	5	6	2	3	1	4	4	6	5	9	49
2	*Asplanchna intermedia*	3	4	0	6	5	5	4	5	8	10	9	7	66
3	*Brachionus angularis*	4	2	0	3	5	4	0	3	6	9	10	8	54
4	*Brachionus calciflorus*	5	4	4	0	3	0	1	2	2	7	6	5	39
5	*Brachionus caudatus*	3	5	0	4	2	0	3	0	5	6	3	5	36
6	*Brachionus falcatus*	9	11	4	2	0	2	3	3	9	11	12	10	76
7	*Filinia longiseta*	5	3	4	0	1	3	8	4	9	12	8	10	67
8	*Keratella tropica*	4	5	0	2	2	0	3	6	7	10	10	12	61
9	*Keratella cochlearis*	3	2	5	4	3	4	0	1	6	11	9	6	54
10	*Lecane bidenata*	6	9	8	5	6	0	5	4	9	9	13	15	89

11	*Lepadeili ovalis*	2	0	6	5	3	6	0	0	8	6	9	7	52
12	*Testudinella patina*	5	3	2	0	3	4	0	1	7	5	6	8	44
	Total	49	52	38	37	35	31	28	33	80	102	100	102	687
	CLADOCERA													
1	*Acropenus harpae*	5	3	5	7	3	0	4	1	7	5	4	8	52
2	*Alona rectangular*	2	1	0	4	3	5	6	3	5	3	2	4	25
3	*Ceriodaphnia cornuata*	6	4	5	8	3	0	6	2	9	7	11	10	71
4	*Daphnia carinata*	4	6	2	8	4	3	0	4	8	7	11	13	70
5	*Daphnia sarsi*	5	3	6	7	4	0	5	2	7	9	6	9	63
6	*Moinodaphnia micrura*	2	0	1	0	3	5	4	0	5	8	6	9	43
7	*Pseudosida bidenata*	3	4	0	3	1	0	2	3	6	8	5	7	42
	Total	27	21	19	37	18	9	27	15	47	47	45	60	366
	COPEPODA													
1	*Copepoda naplii*	5	6	5	7	4	0	2	3	6	8	11	9	66
2	*Cyclops viridis*	4	0	6	3	0	0	2	4	7	6	5	8	45
3	*Diaptomus marshianus*	5	0	4	3	0	2	4	0	7	9	10	6	50
4	*Mesocyclops leukarti*	9	7	6	10	7	4	2	0	6	11	8	6	76
5	*Mesocyclops hyalinus*	6	7	5	8	0	5	3	2	9	6	7	8	66
6	*Nauplius larva*	11	8	9	13	5	6	0	7	8	10	8	12	97
	Total	40	28	35	44	16	17	13	16	43	50	49	49	400
	OSTRACODA													
1	*Cypris subglobosa*	2	0	2	1	4	8	12	11	8	6	5	4	63
2	*Hemicypris fossucula*	5	7	4	9	6	10	19	12	7	6	4	8	97
3	*Heterocypris sps*	4	7	5	3	8	13	15	10	9	5	9	7	95
4	*Llycypris gibba*	4	6	3	6	3	8	10	9	8	4	8	7	76
Total	**Total**	15	20	14	19	21	39	56	42	32	21	26	26	331

Table No.3. Monthly and Seasonal Variation in the Zooplankton (Group wise) population at Mamnoor Lake during the year 2015-2016

Name of the Group	Premonsoon				Monsoon				Postmonsoon				Min	Max
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan		
Rotifera	49	52	38	37	35	31	28	33	80	102	100	102	**28**	**102**
Cladocera	27	21	19	37	18	9	27	15	47	47	45	60	**9**	**60**
Copepoda	40	28	35	44	16	17	13	16	43	50	49	49	**13**	**50**
Ostracoda	15	20	14	19	21	39	56	42	32	21	26	26	**14**	**56**
Total	**131**	**121**	**106**	**137**	**90**	**96**	**124**	**106**	**202**	**220**	**220**	**237**	**90**	**237**
Seasonal wise Total	**495**				**416**				**879**				**90**	**237**

Fig.No:2. Monthly and Seasonal variation in Zooplankton Population at Mamnoor Lake during the year 2015-2016.

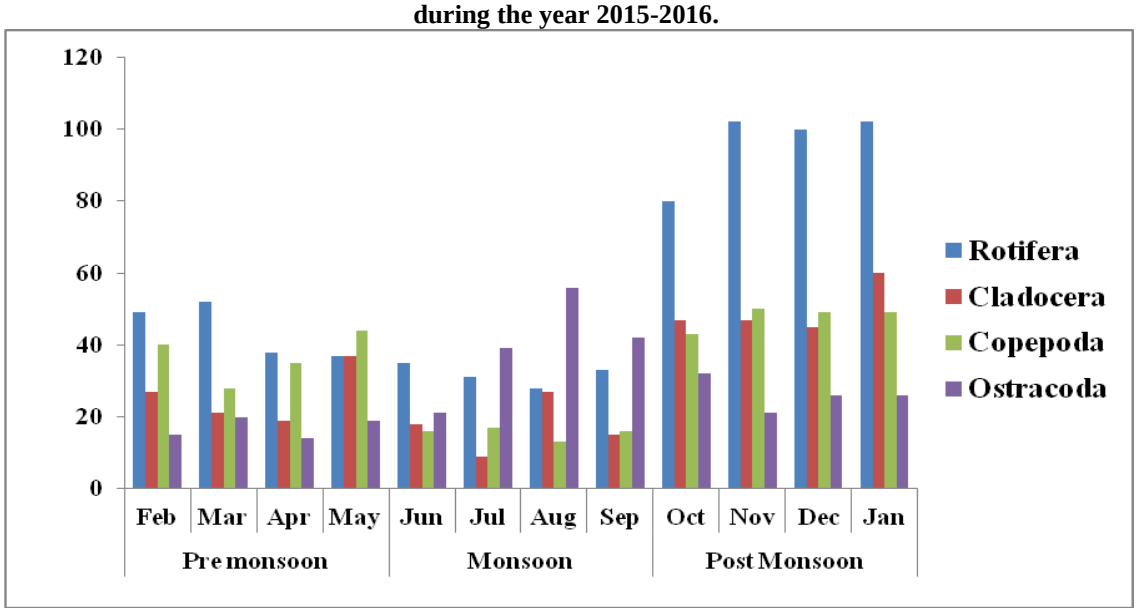
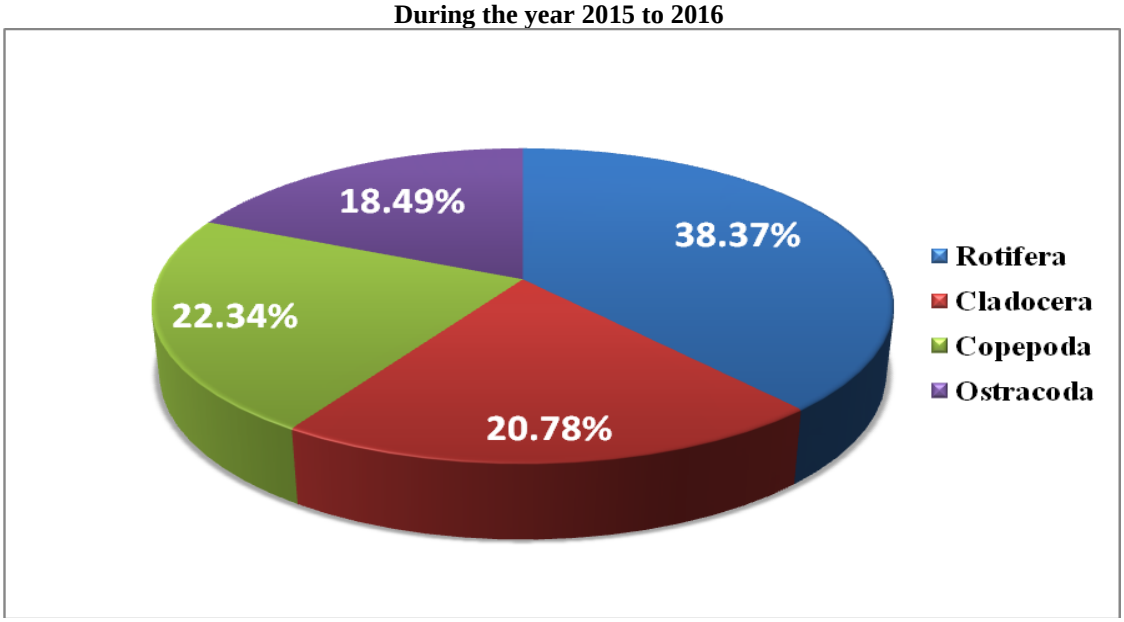


Fig.No:3. Group wise Distribution of Zooplankton population in Mamnoor Lake During the year 2015 to 2016



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