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INSIGHTS INTO THE ZOOPLANKTON BIODIVERSITY IN WATERS OF SUNAPPAREDDI LAKE: HOSUR, TAMIL NADU, INDIA

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Abstract: **Planktonic communities act as primary sources and therefore could serve as good reflectors of water contaminants. They are responsive to alterations in parameters for both chemical and biological entities and therefore can be used easily in designing monitoring strategies for lake managements. Sunappareddi lake, in Hosur Krishnagiri district of Tamil Nadu, provides water as a source of irrigation, industrialization and human consumption in the region. A study was conducted during the period of 2016-18 to evaluate the zooplankton ecology of the lake that was being used for many purposes. Evaluation of zooplankton pollution was done in terms of the population of Rotifera, Cladocera, Copepoda and Ostracoda. Our results indicated that high zooplankton abundance was observed in water body studied that hinted toward high eutrophication, severe contamination and ecological threat during the study period. This warrants improvisation of both rural and urban anthropological practices to salvage the lake from malpractices.**

Keywords: **Pollution, lake, Rotifera, Cladocera, Copepoda, Ostracoda.**

1. INTRODUCTION

The aquatic ecosystems is a mix of both abiotic and biotic components (Lampert W, Sommer U, 1997, Chauhan, A. and Verma, S.C. 2015). Abiotic parameters highlight the water pollution in terms of run offs acquired through domestic, sewage, agricultural and anthropogenic activities. Assessment of the biotic components that constitute the aquatic ecology mirrors a holistic picture of aquatic pollution (Jeppesen, E et al., 2011). Well integrated into the food web at different tropic levels (Deivanai, K et al., 2004), they can detect even minor change in water quality that is reflected in their life cycle, content and inhabitant status in the ecosystem (Kanwal BPS, Pathani SS, 2012; Fernando CH 2002).

Zooplanktons highlights the biodiversity in any water system because of the innumerable species that comprise them react differently to the water contamination (Poongodi R. et al, 2009; Renuga K and Ramanibai R, 2010). They act as good indicators of water pollution and aquatic ecology (Khan *et al*., 2016). What makes zooplanktons ideal for water quality assessment is their response to varying changes in the environment, variable response based on their vast biodiversity and sensitivity to anthropogenic activities leading to eutrophication and discharge of water from various sources as industrial, agricultural or domestic (Caroni R. and Irvine K, 2010). (Jose EC, et al., 2015). Zooplanktons further connect the food web for various fish species (Battish SK., 1992; Dodson SI., 2000). Their abundance is directly correlated to the fish abundance and monitoring them as biological indicators of pollution could act as a yardstick warning for the fisheries in particular when the pollution affects the food chain. Zooplankton monitoring assists in analysis of water quality and

causes development of cause-effect relationships between water quality and environmental data and judgment of the adequacy of water quality for various uses (Fernando CH., 2002; Bhavan, PS et al., 2015).

Freshwater zooplankton species are generally Rotifera, Cladocera, Copepoda and Ostracoda (Altaff K., 2004).). Since they are highly sensitive to changes in water quality, qualitative and quantitative variation in their number could act as good indicator of ecological stresses and therefore help in assessment of the quality of water (Caroni R., & Irvine K 2010; Dhanasekaran M et al., 2017). Water quality can be assess with Rotifer abundance which is highly propagated with favorable water quality indices. Similarly Cladocerans are highly sensitive and react to even minute water contaminations as reflected in their population density. Copepods and Ostracods are also extremely sensitive to alterations in water quality. Amongst the four zooplanktonic species sensitivity to water contamination is usually in the order of Rotifera, > Cladocera, > Copepoda and Ostracoda (Dodson SI et al., 2000, Bhavan et al. 2015).

Therefore in the present study investigations were made to assess the zooplankton ecology in waters of Sunappareddi lake of Hosur. Investigation of water quality of Sunappareddi lake is essential as it provides for activities such as irrigation, industrial and human consumption in the region. Furthermore it also receives sewage contamination from Bangalore region of Karnataka that percolates to downstream regions to Sunappareddi lake.

2. MATERIALS AND METHODS

Study Site and its Environmental Conditions

The present study was carried out in Hosur town which falls under the northwestern region of Krishnagiri district of Tamil Nadu. It is bordered on either side by both Karnataka and Andhra Pradesh. Krishnagiri district has a pleasant climate with dry atmospheres. The dry season lasts from January to March, summer falls between April and May, southwest monsoon season starts from June to Sept and from October to December is the northeast monsoon season. The major water supply towards Hosur taluk comes from river Ponnaiyar that basically originates in Nandidurg hills in Karnataka, where it is referred to as Dhakshina Pinakini. Travelling from Devanahalli and Hoskote taluks of Karnataka, Ponniyar River enters Tamil Nadu state near Bagalur village of Hosur taluk. It has a total population of 245,354 with population density of 3,400/km^2 (8,800/sq mi). Hosur receives rainfall from both the northeast and the southwest monsoons. It has an average rainfall of 822.4 mm and month wise distribution is around 18.7 mm during January -February, 182.5mm - March to May; 349.8 mm - southwest monsoon and 271.4 mm during the northeast monsoon. Hosur falls under a heavy rainfall region as shown in **Fig 1.**

Qualitative and Quantitative analysis of Zooplanktons

Water samples were collected during the early hours of the day (7 am to 10 am) from the littoral water surface, by using a 25-µm mesh. The plankton net used for sampling was conical shaped having a reducing cone and with a vial at its tapering end. The sample collections of zooplanktons for qualitative studies were done by towing the plankton net in surface water horizontally and obliquely. Quantitative analysis (10 litres of water) was done by collecting a known volumes of water in plastic buckets and pooling together for final sample volume that was filtered through the net. Filtered samples were transferred to a well-labeled 1000 mL plastic container and preserved by using 4% formalin. The collected water sample bottles were carried to the laboratory and kept aside overnight. The qualitative study of the zooplanktons were conducted by using the methods given by (Needham and Needham 1966), Adoni et al. (1985), Pennak (1978), Tonopi (1980), Battish (1992), Ranga Reddy (1994) and Dhanapati (2000). Quantitative studies were done by using the 'Sedgwick-Rafter counting cell'. Samples were properly agitated to distribute the organisms evenly and by using a pipette, 1 mL of the sample was transferred onto the cell. The cover slip was placed properly, avoiding any air bubble. The planktons were allowed to settle down and counting was done under a compound light microscope by taking good number of replicates to later calculate the average count per millilitre to express results in Ind./L (Welch, 1948).

3. RESULTS

Zooplankton species found in sunappareddi lake (2016-18)

In 2016 among the 23 taxa found, 8 belonged to Rotifera, 8 belonged to Cladocera, 5 belonged to Copepoda an 2 belonged to Ostracoda. Common species of **Rotifera** again were: *Brachionuscalyciflorus, Brachionuscaudatus personatus, Brachionusdiversicornis, Brachionusfalcatus, Brachionusquadridentatus, Brachionusrubens, Keratellacochlearis, Keratellatropica, Asplanchnabrightwelli and Filinialongiseta.* Likewise common species of

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Cladocera were *Diaphanosomasarsi*, *Daphnia carinata*, *Daphnia magna*, *Ceriodaphniacornuta*, *Moinabrachiata*, *Moinamicrura*, *Moinodaphniamacleayi and Alonarectangula.* **Copepoda** species included *Heliodiaptomusviduus*, *Sinodiptomusindicus, Mesocyclopsaspericornis, Mesocyclopshyalinus and Thermocyclopshyalinus.* **Ostracods** included *Cyprisprotubera*, *Cyprinotusnudus*, *Eucyprisbispinosa and Hemicyprisanomala* as shown in **Table 1**.

Monthly variation of the zoplanktonic species was highest for the month of May (68-70) individuals/L and lowest in December (8-9) individuals/L as shown in **Fig. 2a**.

The percentage abundance of zooplanktons was as follows: Rotifers (46%), Cladocera (39%), Copeod (17%) and Ostracod (1%) as shown in **Fig. 2b**

In 2017 amongst the 22 taxa found, 8 belonged to Rotifera, 8 belonged to Cladocera, 5 belonged to Copepoda an 1 belonged to Ostracod. Common species of Rotifera, Copepoda, Cladocera and Ostracods were similar to as 2016 as shown in **Table 2**.

Monthly variation of the zoplanktonic species was highest for the month of May (85-90) individuals/L and lowest in Febuary (5-9) individuals/L as shown in **Fig. 3a**.

The percentage abundance of zooplanktons was as follows: Rotifers (44%), Cladocera (26%), Copepod (30%) and Ostracod (0%) as shown in **Fig. 3b.**

In 2018 amongst the 22 taxa found, 9 belonged to Rotifera, 7 belonged to Cladocera, 5 belonged to Copepoda an 1 belonged to Ostracod. Common species of Rotifera, Copepoda, Cladocera and Ostracods were similar to as 2016-17 as shown in **Table 3**. Monthly variation of the zoplanktonic species was highest for the month of May (48-49) individuals/L and lowest in Febuary (4) individuals/L as shown in **Fig. 4a**. The percentage abundance of zooplanktons was as follows: Rotifers (42%), Cladocera (43%), Copeod (14%) and Ostracod (1%) as shown in **Fig. 4b**

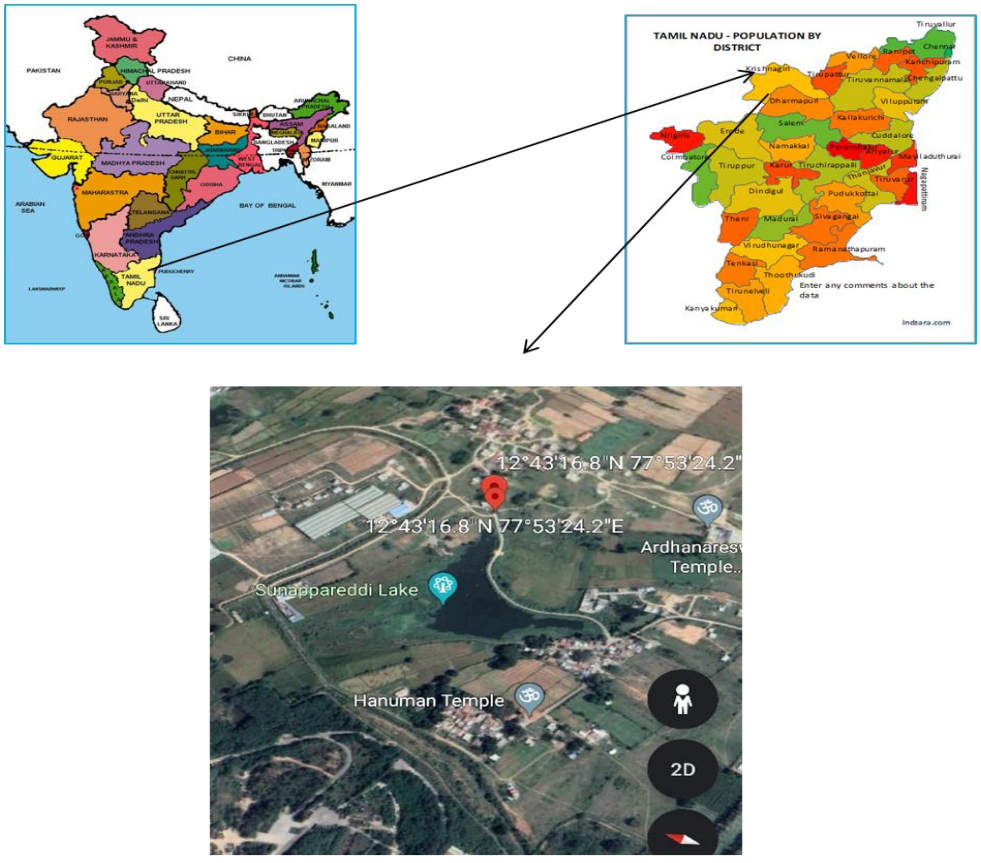

Fig. 1: Location of Sunappareddi lake (Hosur town of Krishnagiri district of Tamil Nadu)

Hosur coordinates (12.4316N Latitude and 77.532.45E Longitude).

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TABLE 1: MONTHLY VARIATION OF ZOOPLANKTON SPECIES OF SUNAPPAREDDI *LAKE 2016*

	MONTHS												
GROUPS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
ROTIFERA													
Brachionuscalyciflorus	1	1	1	7	1	3	1	1	2	3	1	1	23
Brachionuscaudatus personatus	4	1	-	2	1	24	1	2	2	-	1	-	38
Brachionusdiversicornis	-	-	-	-	-	-	-	-	-	-	-	-	
Brachionusfalcatus	-	4	1	19	21	3	2	1	1	1	-	1	54
Brachionusquadridentatus	-	-	-	2	-	-	-	-	-	1	-	-	3
Brachionusrubens	2	1	1	6	-	-	8	-	1	1	-	-	20
Keratellacochlearis	--	-	-	-	1	-	-	-	-	-	-	-	1
Keratellatropica	-	-	-	-	2	1	-	8	-	-	-	-	11
Asplanchnabrightwelli	-	-	-	2	-	-	-	-	1	-	-	-	3
Filinialongiseta	1	1	-	-	1	-	1	-	1	-	1	1	7
													160
CLADOCERA													
Diaphanosomasarsi	-	2	-	1	18	1	1	1	2	-	1	-	27
Daphnia carinata	8	1	1	1	15	1	1	2	-	1	-	1	32
Daphnia magna	-	-	1	4	6	2	1	3	4	1	8	-	30
Ceriodaphniacornuta	-	-	1	1	-	1	-	-	-	-	-	-	3
Moinabrachiata	12	-	-	-	-	-	-	1	2	1	3		19
Moinamicrura	6	-	-	-	-	-	-	-	1	1	1	1	10
Moinodaphniamacleayi	--	-	-	-	-	-	-	-	-	-	-		
Alonarectangula	1	-	-	1	-	-	-	-	1	-	-	--	3
													124
COPEPOD													
Heliodiaptomusviduus	1	-	-	-	-	1	-	-	1	-	-	-	3
Sinodiptomusindicus	-	-	-	1	-	-	-	1	-	-	-	1	3
Mesocyclopsaspericornis	1	-	23	-	-	1	-	-	-	1	-	1	27
Mesocyclopshyalinus	1	-	2	1	1	3	1	6	1	-	1	-	17
Thermocyclopshyalinus	1		1	-	-	-	1	1	1	1	1	-	7
													57
OSTRACOD													
Cyprisprotubera	-	-	-	-	1	-	-	-	-	-	-	-	1
Cyprinotusnudus	-	-	-	-	-	-	-	-	-	-	-	-	
Eucyprisbispinosa		2	-	-	-	-	-	-	-	-	-	-	2
Hemicyprisanomala	-	-	-	-	-	-	-	-	-	-	-	-	
													3
													344

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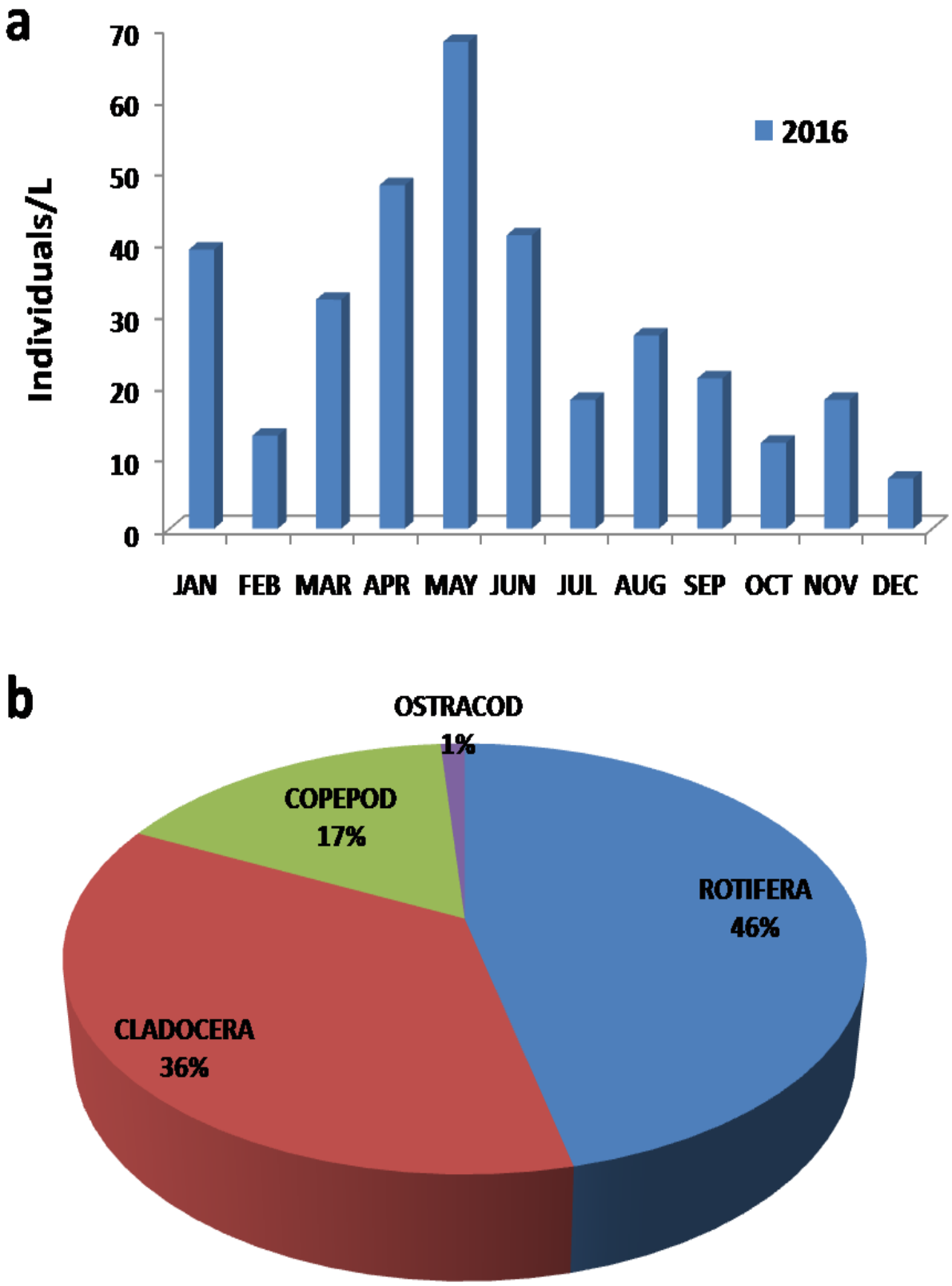

Fig 2: Sunappareddi lake 2016: (a) Monthly variation of zooplankton species (b) Percentage composition of zooplankton species

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TABLE 2: MONTHLY VARIATION OF ZOOPLANKTON SPECIES OF SUNAPPAREDDI LAKE 2017

	MONTHS												
GROUPS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
ROTIFERA													
Brachionus calyciflorus	8	-	-	12	9	6	1	-	-	2	-	-	38
Brachionus caudatus personatus	-	4	1	8	6	1	-	3	1	1	1	-	26
Brachionus diversicornis	-	-	-	1	-	1	-	-	-	-	-	-	2
Brachionus falcatus	-	2	-	14	12	13	2	2	1	2	-	1	48
Brachionus quadridentatus	-	6	-	8	-	-	1	-	-	1	1	-	17
Brachionus rubens	2	1	-	1	-	-	1	-	1	4	1	-	11
Keratella cochlearis	--	-	-	-	-	-	-	-	-	-	-	-	
Keratella tropica	-	-	-	-	4	5	-	-	-	1	-	-	10
Asplanchna brightwelli	1	-	-	2	8	-	-	1	1	-	-	-	13
Filinia longiseta	-	-	1	-	-	1	1	-	-	-	-	-	3
													168
CLADOCERA													
Diaphanosoma sarsi	4	1	-	1	11	1	-	1	-	-	1	1	21
Daphnia carinata	2	1	-	5	4	1	1	2	-	1	-	-	17
Daphnia magna	-	1	1	8	2	2	-	4	2	1	3	-	24
Ceriodaphnia cornuta	-	-	-	-	-	1	-	-	-	-	-	-	1
Moina brachiata	1	-	-	-	-	4	-	-	2	1	3	1	12
Moina micrura	5	-	-	4	-	-	1	-	1	2	1	-	14
Moinodaphnia macleayi	--	-	-	-	-	-	-	-	-	-	-		
Alona rectangula	2	-	-	1	-	1	-	-	3	-	1	--	8
													97
COPEPOD													
Heliodiaptomus viduus	-	-	-	-	11	21	-	-	1	-	1	-	34
Sinodiptomus indicus	-	-	-	-	-	-	-	1	-	-	-	-	1
Mesocyclops aspericornis	1	-	4	-	14	1	-	2	-	1	-	1	24
Mesocyclops hyalinus	1	-	2	1	8	11	1	12	1	-	-	-	37
Thermocyclops hyalinus	1		1	-	2	-	12	1	-	-	1	-	18
													114
OSTRACOD													
Cypris protubera	-	-	-	-	-	-	-	-	-	-	-	-	
Cyprinotus nudus	-	-	-	-	-	-	-	-	-	-	-	-	
Eucypris bispinosa		1	-	-	-	-	-	-	-	-	-	-	1
Hemicypris anomala	-	-	-	-	-	-	-	-	-	-	-	-	
													1
													380

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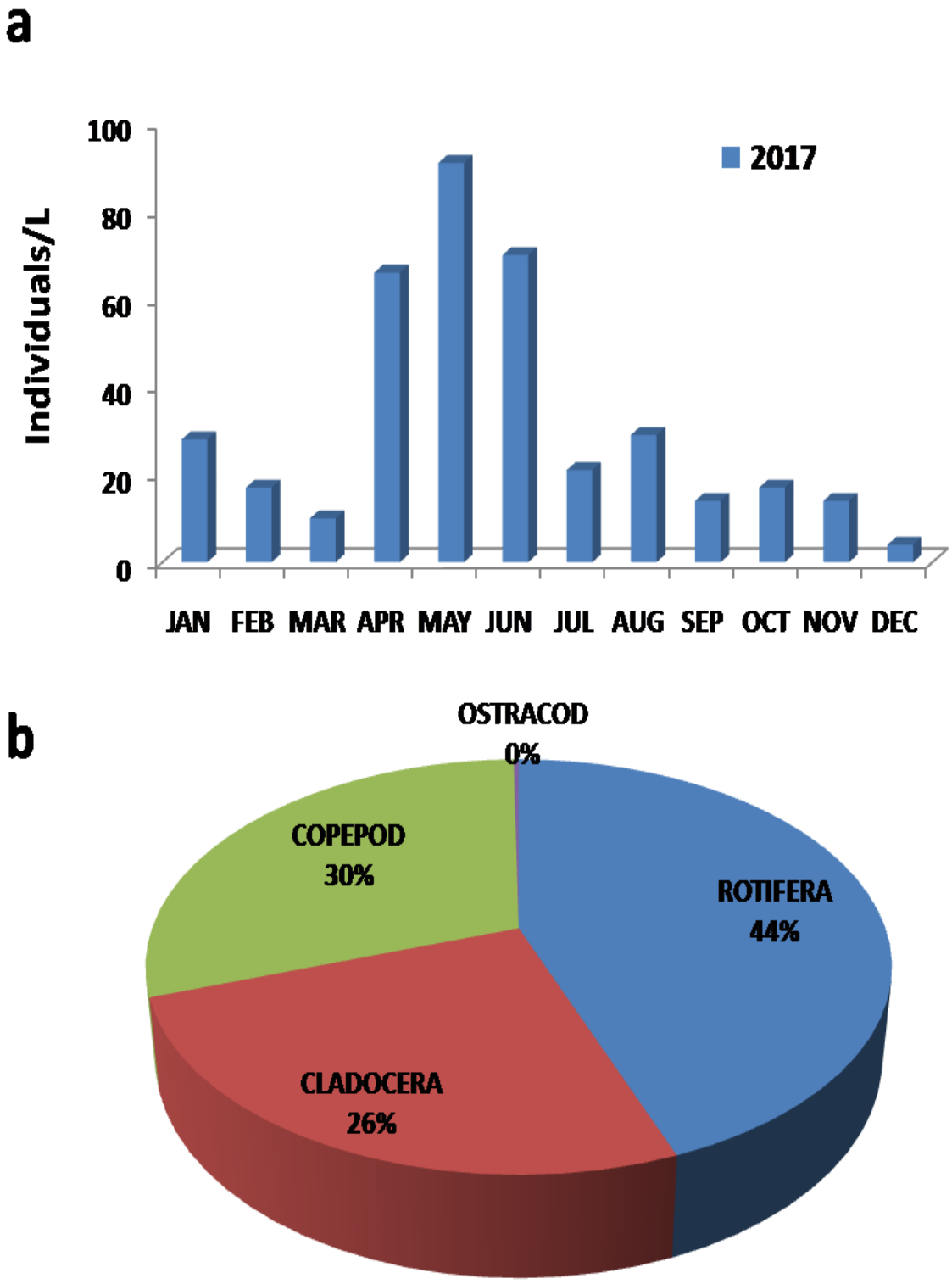

Fig 3: Sunappareddi lake 2017: (a) Monthly variation of zooplankton species (b) Percentage composition of zooplankton species

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TABLE 3: MONTHLY VARIATION OF ZOOPLANKTON SPECIES OF SUNAPPAREDDI LAKE 2018

	MONTHS												
GROUPS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
ROTIFERA													
Brachionuscalyciflorus	1	1	2	7	1	13	3	1	4	3	1	1	38
Brachionuscaudatus personatus	2	1	-	1	4	3	1	2	2	1	-	1	17
Brachionusdiversicornis	-	-	-	-	-	-	-	-	-	-	-	-	
Brachionusfalcatus	1	3	1	9	12	3	2	1	1	1	-	-	25
Brachionusquadridentatus	4	-	-	2	-	-	-	-	-	1	-	-	7
Brachionusrubens	2	1	1	1	-	4	1	-	1	1	2	-	14
Keratellacochlearis	--	-	-	-	1	-	1	-	1	-	-	-	3
Keratellatropica	-	-	-	-	4	1	-	-	-	-	-	-	5
Asplanchnabrightwelli	1	-	-	2	-	-	-	-	1	-	-	-	4
Filinialongiseta	-	-	-	-	4	-	1	-		-	1	-	6
													102
CLADOCERA													
Diaphanosomasarsi	9	2	1	1	6	1	1	1	2	-	1	-	25
Daphnia carinata	8	1	1	1	5	1	1	2	1	1	-	-	22
Daphnia magna	-	-	1	4	6	2	1	4	4	1	4	-	27
Ceriodaphniacornuta	-	-	1	2	-	1	-	1	-	-	-	-	5
Moinabrachiata	2	-	-	-	1	-	-	1	2	1	3		10
Moinamicrura	4	-	-	-	1	-	-	-	1	2	1	1	10
Moinodaphniamacleayi	--	-	-	-	-	-	-	-	-	-	-		0
Alonarectangula	1	-	-	1	-	-	-	-	2	-	-	--	4
													103
COPEPOD													
Heliodiaptomusviduus	1	-	-	-	-	4	-	-	1	-	-	-	6
Sinodiptomusindicus	-	-	-	1	-	-	-	1	-	-	-	1	2
Mesocyclopsaspericornis	1	-	8	-	-	1	-	-	-	1	-	1	2
Mesocyclopshyalinus	-	-	2	1	1	3	1	6	1	-	1	-	16
Thermocyclopshyalinus	1		-	-	-	-	2	-	1	1	1	-	6
													34
OSTRACOD													
Cyprisprotubera	-	-	-	-	2	-	-	-	-	-	-	-	2
Cyprinotusnudus	-	-	-	-	-	-	-	-	-	-	-	-	0
Eucyprisbispinosa		-	-	-	-	-	-	-	-	-	-	-	0
Hemicyprisanomala	-	-	-	-	-	-	-	-	-	-	-	-	0
													2
													241

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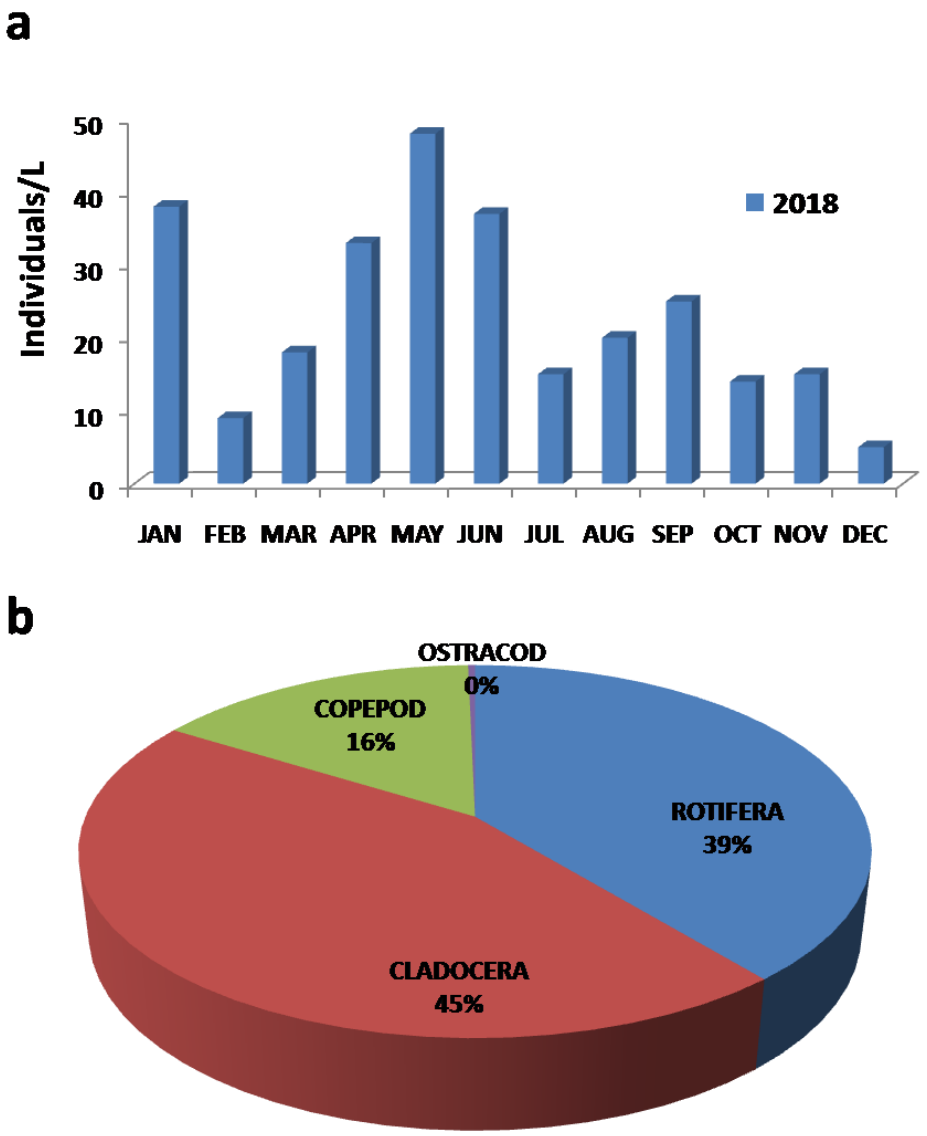

Fig 4: Sunappareddi lake 2018: (a) Monthly variation of zooplankton species (b) Percentage composition of zooplankton species

4. DISCUSSION

Pollution in aquatic ecosystems can be assessed by using the planktonic communities that act as good reflectors of water contaminants. Plankton estimations (both phytoplanktonic and zooplanktonic) in the water bodies act as the bridge between the living structures and the abiotic factors that govern the ecology of lakes (Ramchandra and Solanki 2007). Since they respond well to both chemical and biological entities they can be used for monitoring lake management strategies (Benson-Evans et. al., 1999). Zooplanktons sensitivity to environmental fluctuations, changes in water quality, make them good indicators of ecological stresses (Sharma and Tiwari, 2008). They act as a link for freshwater tropic web chains, fish culture and anthropogenic activities and therefore can be predictive of chronic changes in lake ecology.

The current study was undertaken in locations of Sunappareddi lake of Hosur, Krishnagiri District of Tamil Nadu to investigate the impact of seasonal changes on zooplankton biodiversity in it. Water from the lake was selected for zooplankton analysis because it provides a provision for work to fishermen and local people for their irrigational purposes. Water samples were analyzed for zooplanktons (qualitatively and quantitatively).

The results of our study were a compilation of three years data (2016-18) and point out that observation made for Sunappareddi lake identified Rotifera, Cladocera, Copepoda and Ostracoda as the major species present. Holistically the survey from 2016-18 found that the order of abundance identified in the lake was **Rotifera**, **Cladocera, Copepoda** and then **Ostracoda**. Monthly variation of the zooplankton species was highest for the month of May and lowest in November-December probably due to the high water levels from monsoon rains as compared to the winter season. Similar results have also been reported by many authors such as Bhavan *et al.*, 2015 and Manickam, Bhavan, & Santhanam, 2017. Amongst the four zooplanktonic species sensitivity to water contamination in our study was in the order of Rotifera, > Cladocera, > Copepoda and Ostracoda. Similar results have been shown by (Dodson SI et al., 2000, Bhavan et al. (2015). Verma, AK. 2020; conducted fresh water studies of Muntjibpur pond of Prayagraj in Uttar Pradesh in relation to planktons. Ramachandra *et al.*, 2017 studied the zooplankton diversity in Madduvalasa reservoir. Kar and Kar, 2016 conducted similar studies of zoolpankton diversity in a freshwater lake of Cachar, Assam. Sirajunisa V. 2014 conducted biodiversity studies on Aathivayal lake, Kottaipattinam, Pudukkottai district, with reference to bioremediation of heavy metals. Smitha,P *et a.l*, 2013 studied the zooplankton diversity of Chikkadevarayana canal in reference to physico-chemical characteristics and Srivastava, SK 2013 also studied this association of monthly variations in the occurrence of zooplankton in a freshwater body in Ramgarh lake in Gorakhpur district of Uttar Pradesh.

After analysis of the data during 2016-18, it could be concluded that high zooplankton abundance was observed in Sunappareddi which displayed high Rotifer, Cladocera and Copepod abundance that hint toward high eutrophication, severe contamination and ecological threat in it during the study period. Both rural and urban anthropological practices need to be improvised to salvage the lakes and rivers from malpractices.

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