J Krishi Vigyan 2021, 9 (2) : 214-220 DOI : 10.5958/2349-4433.2021.00040.4

Status of Zooplankton Diversity in Lake Kharungpat, Manipur, India

M A Salam*, Abdul Malik, H Pokhrel, L P Mudoi, S K Bhagabati and Rajdeep Datta

Department of Aquatic Environment Management
College of Fisheries, Raha, Assam Agricultural University, Jorhat, India

ABSTRACT

The zooplankton provide a direct link between primary producers and higher tropic levels. The present study was conducted during September, 2019 to August, 2020 in lake Kharungpat of Manipur which is situated towards the southern lowlands of the central valley of Manipur in the Kakching district. *Cladocera, Copepoda and Rotifera* were three major zooplankton groups identified with a percentage composition of 47.72, 33.87 and 18.41 percent, respectively. A total of 16 species under 13 families and 8 orders were identified in which *Cyclops* spp., and *Brachionus* spp. *Daphnia* spp. was observed highly abundant followed by *Trichocerca* spp. and *Moina* spp. Site wise biodiversity indices calculated showed that the Dominance index 'D' was found maximum in Site 2 (0.0997) followed by Site 1 (0.09947), Site 5 (0.09826), Site 3 (0.09628) and Site 4 (0.09315). The Simpson index was found highest in Site 4 (0.9068) followed by Site 3, Site 5, Site 1 and Site 2 with an index value of 0.09037, 0.9017, 0.9005 and 0.9002, respectively. The Shannon index value for Site 1, Site 2, Site 4 and Site 5 were 2.535, 2.538, 2.557, 2.552 and 2.525, respectively. The Evenness richness index showed maximum value in Site 3 (0.8059) followed by Site 4 (0.8017), Site 2 (0.7906), Site 1 (0.7888) and Site 5 (0.7809). The ecological conservation and management of the lake by giving due emphasis on zooplankton community structure should be taken up to managed the lake.

Key Words*:* Diversity, Lake Kharungpat, Manipur, Zooplankton.

INTRODUCTION

The zooplankton plays a key role in the energy transfer of an aquatic ecosystem, lake, reservoirs and ponds ecosystem and food chain (Manickam *et al,* 2014). The zooplankton population is comprised of both primary (feed on phytoplankton) and secondary consumers (which eat on other zooplankton). The filtering ability of zooplankton has a significant consequence for lake eutrophic state. The species population, composition and diversity of zooplankton have been potentially affected by various factors in an aquatic ecosystem. Thus, the community structure and heterogeneity of zooplankton is of an important focus for the aquatic ecological researchers. A diversified and abundance zooplankton density is desirable for proper and management and maintenance of a lake's aesthetics. The insufficient information of plankton and their dynamics is a major hindrance for the better understanding of the life process of fresh water environment.

Lake Kharungpat ranks third among freshwater lake of Manipur, situated in Kakching district which is around 3.5 to 4 km from Kakching town and about 35 km from the Imphal, the capital city of Manipur. It lies between longitudes 93° 90' to 93° 97' E and latitudes 24°53' to 24° 60' N. The lake is situated at 781m above mean sea level with an area of 18 sq. km., (MARSAC, 2020). Adequate information about the various components, influencing various parameters and the delicate dynamics sustained by them is of supreme importance to formulate appropriate environmental management strategies and protect the rich biodiversity of the lakes. Thus,

*Corresponding Author's Email: salam555@rediffmail.com

for stable management of the lake which have greatly influenced the progress of human societies since times, has to be investigated in detail, especially to know the ecological dynamics of the lake. Accordingly, a detailed study was planned for gaining a better insight of zooplankton diversity of lake Kharungpat in Manipur.

MATERIALS AND METHODS

The present study was conducted during September, 2019 to August, 2020 in lake Kharungpat of Manipur which is situated towards the southern lowlands of the central valley of Manipur in the Kakching district. Five numbers sampling site namely Site 1 (Longitude 93º 92' E and Latitude 24º 58' N), Site 2 (Longitude 93º 91' E and Latitude 24º 56' N), Site 3 (Longitude 93º 93' E and Latitude 24º 54' N), Site 4 (Longitude 93º 96' E and Latitude 25º 55' N) and Site 5 (Longitude 93º 96' E and Latitude 24º 58' N) were selected to make the study statistically sound. The sampling site were selected in such a way that the distance between sampling site uniformly covered the entire area of the lake.

Collection of water samples for zooplankton analysis were carried out monthly from the selected five number sampling site along with the sampling of water by filtering 50 litres of water through plankton nets having 60µm mesh size. The collected samples were preserved immediately using 4% neutralized formalin solution for further quantitative and qualitative analysis. The samples were collected following the standardized method presented in Edmondson and Winberg (1971). And analysed qualitatively and quantitatively. For numerical abundance and qualitative analysis of zooplankton, all the macro-plankters present were first separated and counted under low magnification. For examination of micro-zooplankton, a subsample of 1ml was drawn and examined under high magnification and counted up to genera and species level (Adoni, 1985; Edmondson and Winberg, 1971).

Biodiversity analysis

Species diversity comprised of species evenness and richness. Species evenness represent the distribution of abundance of species among the species whereas species richness is indicated by the species numbers. The following diversity indices have been calculated by using a computer-based software 'PAST version. 2.02' to assess the zooplankton diversity of the lake Kharungpat.

RESULTS AND DISCUSSION

Cladocera, Copepoda and Rotifera were three major zooplankton groups identified during with a percentage composition of 47.72, 33.87 and 18.41 per cent, respectively. Monthly zooplankton groups distribution of the lake showed that the average total was maximum (3705 numbers per liter) in the month May, 2020 with a percentage composition of 65.05 per cent (Cladocera), 26.46 per cent (Rotifera) and 8.50 per cent (Copepoda). (Table 1). Cladocera, Rotifera and Copepoda were the three major zooplankton groups with a percentage composition of 47.72 per cent, 33.87 per cent and 18.41 per cent, respectively. Occurrence of similar group of zooplankton were reported by Sharma *et al* (2000); Bhattacharyya (2002); Ana *et al* (2012); Manickam *et al* (2015); Das and Kar (2016) and Karthika *et al* (2017). Domination of zooplankton groups by Cladocera was also observed in floodplain lake of the Barak Valley, Assam (Das and Kar, 2016). Availability of more species of zooplankton have been reported from different lakes by Sharma (2009); Tyor and Tanwar (2014); Manickam *et al* (2015); Dhanasekaran *et al* (2017); Manickam *et al* (2018) and Sharma and Kumari (2018).

Among the three major zooplankton groups identified, Cladocera (47.72%) was found to be the most dominant groups throughout the study period followed by Rotifera (33.87%) and Copepoda (18.41%). Higher zooplankton density recorded during January to May, 2020 may be attributed due presence of higher density of phytoplankton during these months. Byars (1960) reported that

Table 1. Monthly zooplankton groups distribution of lake Kharungpat during 2019-2020.

Group / Month	Cladocera		Rotifera		Copepoda		Average Total
	Average No/l	%	Average No/l	%	Average No/l	%	
September	250.80	35.14	240.60	33.71	222.40	31.16	713.80
October	482.40	63.17	197.80	25.90	83.40	10.92	763.60
November	362.60	40.55	380.40	42.54	151.20	16.91	894.20
December	934.60	50.13	604.40	32.42	325.20	17.44	1864.20
January	626.00	23.41	940.40	35.17	1107.20	41.41	2673.60
February	1051.20	45.38	1162.00	50.16	103.40	4.46	2316.60
March	2002.00	63.52	822.00	26.08	327.60	10.39	3151.60
April	881.40	49.08	694.40	38.67	220.00	12.25	1795.80
May	2410.00	65.05	980.20	26.46	314.80	8.50	3705.00
June	366.40	42.99	390.60	45.83	95.20	11.17	852.20
July	552.80	35.15	434.20	27.61	585.80	37.25	1572.80
August	1179.40	59.06	437.40	21.91	380.00	19.03	1996.80

the temperature could be one of the most important determining factors for seasonal zooplankton distribution but during the present study no such relations was observed. Similar observation was also reported from floodplain lakes hence the present finding was supported by the findings reported by Singh (2000) and Bhattacharyya (2002). The zooplankton population structure observed in lake Kharungpat was in the descending order of Cladocera > Rotifera > Copepoda which matched with the trend observed by Das and Kar (2016) in the floodplain lake of Assam.

A total of 16 species under 13 families and 8 orders were identified during 2019-2020 in which *Cyclops* spp., and *Brachionus* spp. *Daphnia* spp. was observed highly abundant followed by *Trichocerca* spp., and *Moina* spp. (Table 2).

Cladocera

The minimum Cladocera density was 188 numbers per liter in September, 2019 and the maximum density recorded was 3350 numbers per liter in the month of May, 2020 (Table 3). Six species have been identified under the Cladocera group namely *Daphnia* spp., *Moina* spp., *Bosmina* spp., *Macrothrix* spp., *Daphnosoma* spp., and *Chydorus* spp.

Rotifera

Mesocyclops spp., *Cyclops* spp., *Neodiaptomus* spp., *Diaptomus* spp., was the four species along with Nauplius larvae recorded under the Rotifera group in lake Kharungpat during 2019-2020. The data (Table 4) revealed that the Rotifera density in lake Kharungpat fluctuated monthly from 57.0 to 365.0. The monthly average Rotifera density was highest during February, 2020 (1162.00 ±42.446 number per liter).

Copepoda

The monthly average Copepoda density was found to be the highest in the month of January, 2020 with a monthly fluctuation ranging from 31.0 to 323.0 (Table 5). The recorded minimum and maximum Copepoda density with a value of 67.0 numbers per liter and 1295.0 numbers per liter were observed in the month of June, 2020 and January, 2020.

Table 2. Relative abundance of identified planktons in Lake Kharungpat during 2019-2020

Zooplankton		
Class	**Species**	**RA**
Copepoda		
	Mesocyclops spp.	+
	Cyclops spp.	+ + +
	Neodiaptomus spp.	+
	Diaptomus spp.	+
	Nauplius larvae	+
Rotifera		
	Trichocerca spp.	+ +
	Brachionus spp.	+ + +
	Asplanchna spp.	+
	Keratella spp.	+
	Lecane spp.	+
Cladocera		
	Daphnia spp.	+ + +
	Moina spp.	++
	Bosmina spp.	+
	Macrothrix spp.	+
	Daphnosoma spp.	+
	Chydorus spp.	+

Note; RA=Relative Abundance, + = Sparse, ++=Abundant, +++=Highly Abundant

Table 3. Monthly variation in Cladocera abundance (number/l) as observed in lake Kharungpat during 2019-2020.

Month	Minimum	Maximum	Monthly Average	Monthly Fluctuation	Standard Error
September (2019)	163.00	295.00	222.40	132.00	±23.612
October	71.00	102.00	83.40	31.00	±5.878
November	114.00	210.00	151.20	96.00	±16.551
December	285.00	376.00	325.20	91.00	±16.169
January (2020)	972.00	1295.00	1107.20	323.00	±58.894
February	78.00	137.00	103.40	59.00	±10.562
March	286.00	410.00	327.60	124.00	±21.449
April	185.00	269.00	220.00	84.00	±14.352
May	250.00	388.00	314.80	138.00	±23.115
June	67.00	129.00	95.20	62.00	±10.370
July	505.00	665.00	585.80	160.00	±29.382
August	315.00	422.00	380.00	107.00	±19.811
Annual average	274.25	391.50	326.35	117.25	±20.845

Sample size (n) = 5

Table 4. Monthly variation in Rotifera abundance (numbers/l) as observed in lake Kharungpat during 2019-2020.

Month	Minimum	Maximum	Monthly Average	Monthly Fluctuation	Standard Error
September (2019)	165.00	324.00	240.60	159.00	±29.870
October	120.00	251.00	197.80	131.00	±29.796
November	358.00	415.00	380.40	57.00	±9.801
December	529.00	661.00	604.40	132.00	±23.714
January (2020)	813.00	1178.00	940.40	365.00	±64.986
February	1014.00	1247.00	1162.00	233.00	±42.446
March	715.00	951.00	822.00	236.00	±39.682
April	594.00	845.00	694.40	251.00	±46.885
May	846.00	1164.00	980.20	318.00	±54.606
June	315.00	463.00	390.60	148.00	±25.005
July	383.00	511.00	434.20	128.00	±23.391
August	351.00	524.00	437.40	173.00	±31.590
Annual average	516.92	711.17	607.03	194.25	±35.148

Sample size (n) = 5

Table 5. Monthly variation in Copepoda abundance (numbers/l) as observed in lake Kharungpat during 2019-2020.

Month	Minimum	Maximum	Monthly Average	Monthly Fluctuation	Standard Error
September (2019)	188.00	285.00	250.80	97.00	±17.385
October	434.00	542.00	482.40	108.00	±19.340
November	283.00	410.00	362.60	127.00	±22.435
December	745.00	1217.00	934.60	472.00	±88.323
January (2020)	458.00	926.00	626.00	468.00	±82.820
February	491.00	1364.00	1051.20	873.00	±155.489
March	1558.00	2547.00	2002.00	989.00	±181.533
April	668.00	1263.00	881.40	595.00	±105.496
May	1460.00	3350.00	2410.00	1890.00	±337.027
June	280.00	479.00	366.40	199.00	±32.632
July	433.00	614.00	552.80	181.00	±31.571
August	785.00	1864.00	1179.40	1079.00	±197.072
Annual average	648.58	1238.42	924.97	589.83	±105.927

Sample size (n) = 5

Table 6. Site wise biodiversity indices calculated on Zooplankton species of Lake Kharungpat during 2019-2020.

	Site 1	Site 2	Site 3	Site 4	Site 5
Dominance_D	0.09947	0.09977	0.09628	0.09315	0.09826
Simpson_1-D	0.9005	0.9002	0.9037	0.9068	0.9017
Shannon_H	2.535	2.538	2.557	2.552	2.525
Evenness_e^H/S	0.7888	0.7906	0.8059	0.8017	0.7809
Brillouin	2.533	2.535	2.554	2.549	2.522
Menhinick	0.1023	0.1065	0.1007	0.1102	0.1189
Margalef	1.485	1.496	1.48	1.507	1.53
Equitability_J	0.9145	0.9153	0.9222	0.9203	0.9108

Biodiversity Indices

The biodiversity indices of zooplankton population showed that the Dominance index 'D' was found maximum in Site 2 (0.0997) The Simpson index was found highest in Site 4 (0.9068) The Shannon index value for Site 1, Site 2, Site 4 and Site 5 were 2.535, 2.538, 2.557, 2.552 and 2.525, respectively. The Evenness richness index showed maximum value in Site 3 (0.8059) followed by Site 4 (0.8017), Site 2 (0.7906), Site 1 (0.7888) and Site 5 (0.7809). The highest dominance index 'D' was recorded in Site 2 (0.09977) and lowest value in Site 4 (0.09315). This showed that Site 2 has higher dominance of zooplankton as compared to other Sites during the study period. Higher diversity of zooplankton may be due to higher food chain of the lake ecosystem, which thereby creates high stability and inter specific among the zooplankton community of the lake ecosystem. Shannon diversity index in ranged between 2.80 to 3.16 have been reported by Sharma and Kumari (2018) in lake Prashar, Himachal Pradesh. Hence, the finding was in the ranged reported by Sharma and Kumari (2018). The Shannon index value of the present study was observed to be in higher side as reported by Ajah (2013). Higher value may be due to stable of the lake ecosystem.

The present recorded value of dominance index, Evenness index, Margalef index and Shannon index was in conformity with the observation from the Ikot Okpora lake, Nigeria, Obubra lake, Nigeria and Ejagham lake, Nigeria reported by Offem *et al* (2011). The Shannon diversity index, Simpson's diversity index, Evenness, Margalef index and Menhinick index value of the present study was in the ranged reported by Manickam *et al* (2015) and Gaedke (1993).

CONCLUSION

Depletion of zooplankton from the aquatic ecosystem will adversely disturb the regular food web pattern which will lead to destruction of the lake natural ecology. The ecological conservation and management of the lake by giving due emphasis on zooplankton community structure should be taken up to managed the lake. Presence of zooplankton species like *Keratella* sp., *Brachionus* sp., *Moina* sp., *Mesocyclops* sp. revealed that there is a high possibility of leading the lake to eutrophication. Such information could be utilized by the decision makers to formulated a management measures for effective conservation and sustainable utilization of the water body.

REFERENCES

Adoni (1985). *Workbook on Limnology*, Indian MAB Committee, Department of Environment, Govt. of India. 216 pp.

Ajah P O (2013). The Limnology of Ohana Lake, a Potential Manmade Aquaculture System in Nigeria. *J Appl Sci* **3**: 232-246.

Ana X P, Dub Z H, Zhangb J H, Lib Y P and Qia J W (2012). Structure of the zooplankton community in Hulun Lake, China. *Procedia Envir Sci* **13**:1099 – 1109.

Bhattacharyya B K (2002). *Trophic structure and fishery potential of selected flood plain wetlands (Beels) of Brahmaputra Valley of Assam.* Ph. D. Thesis, Central Institute of Fisheries Education, Mumbai. 1-244.

Byars J A (1960). A freshwater pond in New Zealand, *Aust J Mar Freshwater Res* **2** (2): 222-240.

Das P and Kar D (2016). Biodiversity of zooplankton in a flood plain lake of the Barak Valley, Assam (North-East, India). *Int J Ad Res* **4** (4): 906-910.

Dhanasekaran M, Bhavan P S, Manickam N and Kalpana R (2017). Physico-chemical characteristics and zooplankton diversity in a perennial lake at Dharmapuri (Tamil Nadu, India). *J Entomol Zool Stud* **5**(1): 285-292.

Edmondson W T and Winberg G G (1971). A manual on methods for the assessment of secondary productivity in freshwaters. *Blackwell Scientific Publication, Oxford*. 357 pp.

Gaedke U (1993). Ecosystem analysis based on biomass size distributions: A case study of a plankton community in a large lake. *Limnol. Oceanogr* **38** (1): 112-127.

Karthika M, Shabana S and Ramasubramanian V (2017). Assessment of water quality and zooplankton diversity in the freshwater ecosystem (Lake) - in India. *Int Res J Envir Sci* **6** (11): 23-33.

Manickam N, Bhavan P S, Santhanam P, Muralisankar T, Srinivasan V, Radhakrishnan S, Vijayadevan K, Chitrarasu P and Jawahar Ali A (2014). Seasonal variations of zooplankton diversity in a perennial reservoir at Thoppaiyar, Dharmapuri District, South India. *Austin J Aquac Mar Biol* **1**(1): 1-7.

Manickam N, Bhavan P S, Santhanam P, Muralisankar T, Srinivasan V, Vijayadevan K and Bhuvaneswari R (2015). Biodiversity of freshwater zooplankton and physicochemical parameters of Barur Lake, Krishnagiri District, Tamil Nadu, India. *Malaya J Biosci* **2** (1): 1-12.

Manickam N, Bhavan P S, Santhanam P, Bhuvaneswari R, Muralisankar T, Srinivasan V, Asaikkutti A, Rajkumar G, Udayasuriyan R and Karthik M (2018). Impact of seasonal changes in zooplankton biodiversity in Ukkadam Lake, Coimbatore, Tamil Nadu, India, and potential future implications of climate change. *J Basic Appl Zool*. **79**: 15-24.

MARSAC (2020). Manipur Remote Sensing Application Centre, Government of Manipur.

Offem B O, Ayotunde E O, Ikpi G U, Ada F B and Ochang S N (2011). Plankton-based assessment of the trophic state of three tropical lakes. *J Envir Prot*. **2**: 304-315.

Sharma B K, Sharma S and Hussain M D (2000). Species composition of zooplankton in a tropical flood plain lake, Assam (N. E. India). *Rec Zool Surv India* **98** (3): 85-93

Sharma R C and Kumari R (2018). Seasonal variation in zooplankton community and environmental variables of sacred Lake Prashar Himachal Pradesh, India. *Int J Fish Aquat Stud* **6**(2): 207-213.

Singh D N (2000). Seasonal variation of zooplankton in a tropical lake. *Geobios* 27: 97-100.

Received on 30/04/2021 *Accepted on 20/05/2021*