

A Study on Ichthyofaunal Diversity of Lake Kharungpat, Manipur, India

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ABSTRACT

Biodiversity has been defined as the variability among living organism from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems. The fish diversity of lake Kharungpat comprised of 29 species under 20 genera, 11 families and 6 orders. The study revealed that, among the identified fish species *Amblypharyngodon mola*, *Esomus dandricus*, *Puntius sophore* and *Channa orientalis* was found to be highly abundant. The recorded six orders comprised namely, Cypriniformes, Siluriformes, Anabantiformes, Perciformes, Gobiiformes and Synbranchiformes. The Cypriniformes formed one of the most dominant order as compared to all other orders recorded in the present study comprising of 52 % of the total fish species of the lake. Cyprinidae family was the most dominant comprising of 52 % of the total fish species. The study observed that, maximum ichthyofaunal diversity was recorded in the month of July, 2020 (29 species). The maximum and minimum value of Simpson index was recorded during December, 2019 and August, 2020 with an index value of 0.9278 and 0.6778, respectively. The observed Shannon index value showed maximum in September, 2019 (2.843). The present finding indicated a less healthy environment of the lake. Proper actions are needful by the concerned agencies with respect to the fish diversity of the lake and maintenance of sustainable fish production without sacrificing the lake's ecosystem with the help of full participation of community.

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Authors' Contribution

SKB and RD conceptualized and supervised the study, and executed the methodology. MAS collected and compiled the data. HRS and GO collected and analysed the data and wrote the manuscript.

Key words

Ichthyofaunal, Diversity, Lake Kharungpat, Simpson index, Shannon index, *Amblypharyngodon mola*, *Esomus dandricus*, *Puntius sophore*, *Channa orientalis*.

INTRODUCTION

Lakes are dynamic inland aquatic eco-system, supporting and maintaining a balanced community of living organisms having a diversified species population and functional organization supporting a distinct biotic integrity. Due to various anthropogenic activities and non-judicious utilization of resources causes environmental problems thereby degrading the ecosystem sustained by lakes. The freshwater ecosystem occupies only 0.2% of the surface of the earth accounting to a volume of $2.04 \times 10^5 \text{ km}^3$ (Singh *et al.*, 2010). Biodiversity has been defined as the variability among living organism from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.

Manipur, one of the states of North East India, is a hill state located between $23^\circ 50' \text{ N}$ to $25^\circ 42' \text{ N}$ latitudes and $92^\circ 58' \text{ E}$ to $94^\circ 45' \text{ E}$ longitudes situated at an elevation of 790 m above sea level with a total area of $22,327 \text{ km}^2$.

Hill areas cover about 92 % ($20,540.84 \text{ km}^2$) of the area of the state enclosing a valley area of $1,800 \text{ km}^2$. The freshwater lakes of Manipur are degraded due to excessive influx of sediments through erosion from catchment area, discharge of untreated sewage, accumulation of agricultural runoff and over-exploitation activities (Sharma, 1999). Due to high level of degradation, most of the lakes in the state have already reached to the stage of wetlands (Sharma, 1999). Lake Kharungpat ranks third among freshwater lakes 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 latitudes $24^\circ 53' \text{ N}$ to $24^\circ 60' \text{ N}$ and longitudes $93^\circ 90' \text{ E}$ to $93^\circ 97' \text{ E}$. The lake is situated at 781 m above mean sea level with an area of 18 km^2 .

With a view to develop a sound management strategy to protect and conserve the biodiversity of the lakes in the state, gathering of adequate information regarding various physico-chemical and biological parameters determining the water quality and lake environment is required. Thus, a thorough investigation and study of the lakes is of prime importance. Accordingly, a detailed study was planned for gaining a better insight of ichthyofaunal diversity of Lakh Kharungpat in Manipur. The findings would enable in formulating a better ecosystem management for sustaining

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the lakes' biodiversity and their long-term utility not only in Lake Kharungpat but also in other lakes of the state and country as a whole.

MATERIALS AND METHODS

The present study was conducted during September, 2019 to August, 2020 in Lake Kharungpat of Manipur. Five sampling sites namely Site 1 (24° 58' 59" N and 93° 92' 72" E), Site 2 (24° 56' 28" N and 93° 91' 75" E), Site 3 (24° 54' 25" N and 93° 93' 64" E), Site 4 (25° 55' 36" N and 93° 96' 55" E) and Site 5 (24° 58' 21" N and 93° 96' 60" E) were selected in such a way that the distance between sampling site uniformly covered the entire area of the lake to make the study statistically sound (Fig. 1). The fish faunal composition of the lake was observed monthly throughout the study period. The main fishing gear employed to catch fish were gill net, cast net, dip net, traps etc. Local fish farmers, fish traders were also contacted to

gather more information on type of species caught, species composition, size, species occurrence frequency *etc.* of the lake. The collected fish were photographed immediately and identified at the spot and fish specimens which could not be identified on the spot were brought to the laboratory. The fish specimens collected were preserved in 5% formalin and kept for identification. The fish specimens were identified using the species identification key as described by Vishwanath (2002) and Vishwanath *et al.* (2007).

Species diversity comprised of species evenness and richness. Species evenness represents 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 ichthyofauna diversity of the Lake Kharungpat.

Table I.- Ichthyofauna of Lake Kharungpat during 2019-20.

S. No.	Order	Family	Fish species	Relative abundance
1.	Cypriniformes	Cyprinidae	<i>Amblypharyngodon mola</i> (Hamilton-Buchanan)	+++
2.			<i>Esomus dandricus</i> (Hamilton-Buchanan)	+++
3.			<i>Puntius sophore</i> (Hamilton-Buchanan)	+++
4.			<i>Puntius sarana</i> (Hamilton-Buchanan)	++
5.			<i>Cirrhinus mrigala</i> (Hamilton-Buchanan)	+
6.			<i>Catla catla</i> (Hamilton-Buchanan)	+
7.			<i>Ctenopharyngodon idella</i> (Valenciennes)	+
8.			<i>Cyprinus carpio</i> (Linnaeus)	+
9.			<i>Cyprinus carpio specularis</i> (Linnaeus)	+
10.			<i>Hypophthalmichthys molitrix</i> (Valenciennes)	+
11.			<i>Labeo rohita</i> (Hamilton-Buchanan)	+
12.			<i>Pethia ticto</i> (Hamilton-Buchanan)	+
13.			<i>Labeo gonius</i> (Hamilton-Buchanan)	+
14.			<i>Labeo bata</i> (Hamilton-Buchanan)	+
15.			<i>Labeo Calbasu</i> (Hamilton-Buchanan)	+
16.	Siluriformes	Claridae	<i>Heteropneustes fossilis</i> (Bloch)	++
17.			<i>Clarias magur</i> (Hamilton-Buchanan)	+
18.	Anabantiformes	Channidae	<i>Chana striatus</i> (Bloch)	++
19.			<i>Chana punctatus</i> (Bloch)	++
20.			<i>Channa orientalis</i> (Schneider)	+++
21.	Perciformes	Anabantidae	<i>Anabas testudineus</i> (Bloch)	++
22.		Belontiidae	<i>Trichogaster fasciatus</i> (Bloch)	+
23.		Osphronemidae	<i>Trichogaster labiosa</i> (Day)	+
24.		Cichlidae	<i>Oreochromis mossambicus</i> (Peters)	++
25.		Ambassidae	<i>Chanda nama</i> (Hamilton-Buchanan)	+
26.			<i>Chanda ranga</i> (Hamilton-Buchanan)	+
27.	Gobiiformes	Gobiidae	<i>Glossogobius giuris</i> (Hamilton)	+
28.	Synbranchiformes	Synbranchidae	<i>Monopterus albus</i> (Zuiew)	+
29.		Mastacembelidae	<i>Mastacembelus armatus</i> (Lacepede)	+

+, sparse; ++, abundant; +++, highly abundant.

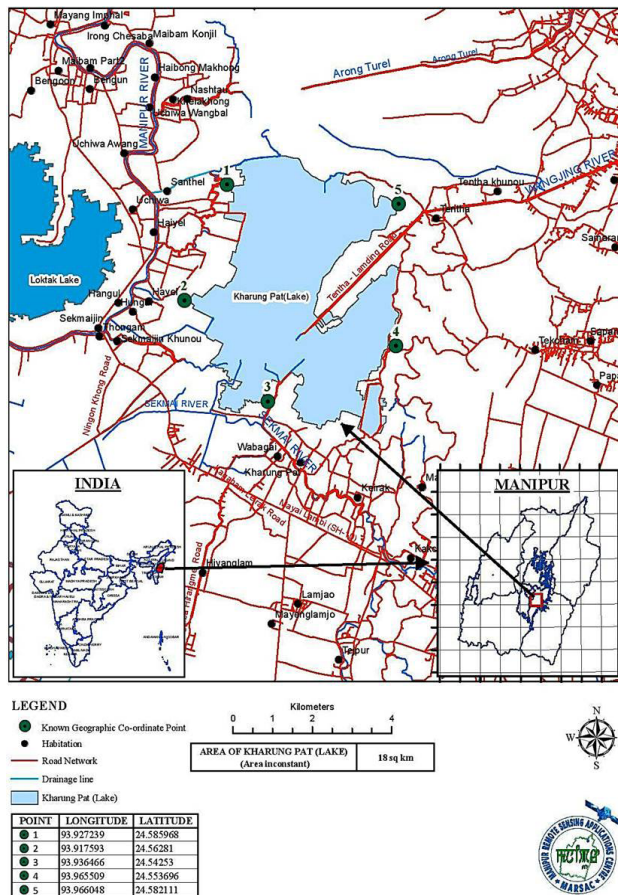


Fig. 1. Map of Lake Kharungpat showing the sampling sites.

RESULTS AND DISCUSSION

The fish diversity of Lake Kharungpat comprised of 29 species under 20 genera, 11 families and 6 orders. The Ichthyofauna diversity of the lake is shown in Table I. The present study revealed that the fish species abundance in Lake Kharungpat during the study period ranged from 11 to 29. The lowest species abundance was observed in June, 2020 (11 species). The lowest species abundance during the month June, 2020 may be due to less fishing activities during this month. The study revealed that among the identified fish species *Amblypharyngodon mola*, *Esomus dandricus*, *Puntius sophore* and *Channa orientalis* was found to be highly abundant followed by *Puntius sarana*, *Heteropneustes fossilis*, *Chana striatus*, *Chana punctatus*, *Anabas testudineus* and *Oreochromis mossambicus*.

The recorded six orders comprised namely, Cypriniformes, Siluriformes, Anabantiformes, Perciformes, Gobiiformes and Synbranchiformes. The Cypriniformes formed one of the most dominant order as

compared to all other orders recorded in the present study comprising of 52 % of the total fish species of the lake followed by the order Perciformes (21 %), Anabantiformes (10 %), Siluriformes (7 %), Synbranchiformes (7 %) and Gobiiformes (3 %) (Fig. 2). The order Cypriniformes dominated the fish fauna of the lakes (Dubey *et al.*, 2017; Mishra *et al.*, 2018).

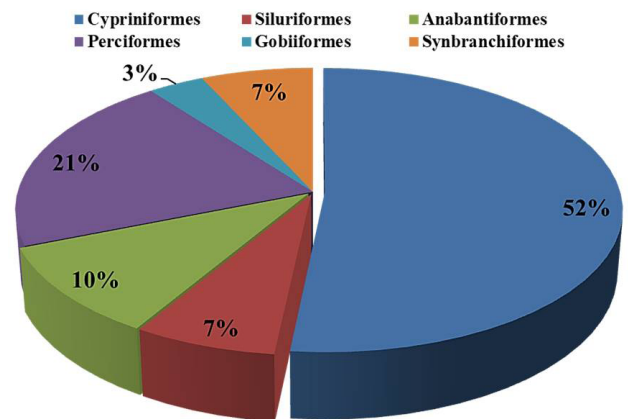


Fig. 2. Percentage composition of different fish fauna orders of Lake Kharungpat during 2019-2020.

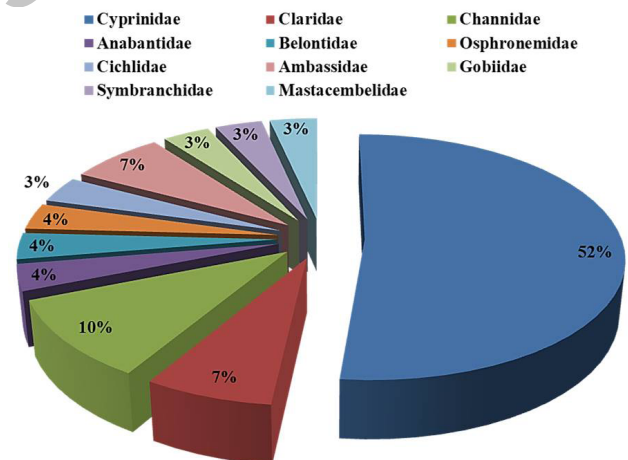


Fig. 3. Percentage composition of different fish fauna families of Lake Kharungpat during 2019-2020.

The fish fauna identified from the lake Kharungpat were represented by eleven families namely, Cyprinidae, Clariidae, Channidae, Anabantidae, Belontiidae, Osphronemidae, Cichlidae, Ambassidae, Gobiidae, Symbranchidae and Mastacembelidae among which Cyprinidae family was the most dominant comprising of 52 % of the total fish species (Fig. 3). The family Cyprinidae dominated the fish fauna in Keenjhar Lake, Pakistan (Korai *et al.*, 2008) and in Dianshan Lake, China (Kindong

et al., 2018). The Cyprinidae family was followed by Channidae (10 %), Claridae (7 %), Ambassidae (7 %), Anabantidae (4 %), Belontiidae (4 %), Osphronemidae (4 %), Cichlidae (3 %), Gobiidae (3 %), Symbranchidae (3 %) and Mastacembelidae (3 %).

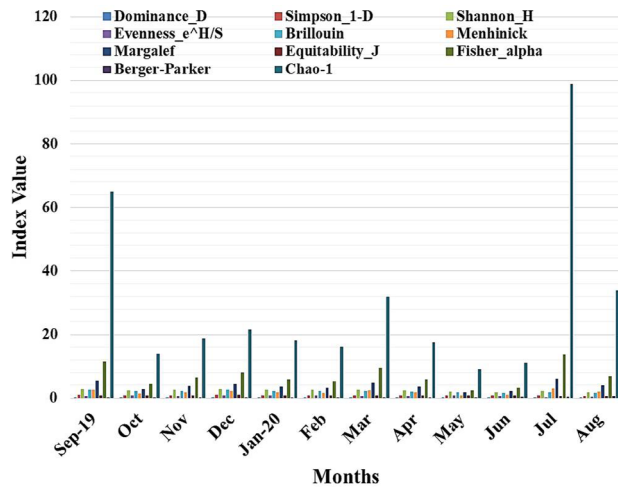


Fig. 4. Index value of different indices of Lake Kharungpat during 2019-2020.

The biodiversity indices of ichthyofauna calculated in percentage of the lake Kharungpat during the study period from September, 2019 to August, 2020 are given in Table II. The study observed that, maximum ichthyofaunal diversity was recorded in the month of July, 2020 (29 species) followed by September, 2019 (26 Species), March, 2020 (23 species), December 2019 (21 species) and August, 2020 (19 species). The individual value indicated

the species percentage recorded during the study month.

Monthly biodiversity indices calculated revealed that, the Dominance index 'D' was found highest in August, 2020 (0.3222) and lowest index value was observed in the month December, 2019 (0.0722) (Fig. 4). The maximum and minimum value of Simpson index was recorded during December, 2019 and August, 2020 with an index value of 0.9278 and 0.6778, respectively. The observed Shannon index value showed maximum in September, 2019 (2.843) with a minimum index value of 1.846 observed in August, 2020. For a healthy environment Shannon's index value ranged between 2.5 to 3.5 (Khan *et al.*, 2004). The present finding value indicated a less healthy environment of the lake. Similar observation was also reported by Gautam *et al.* (2016).

High value of Evenness index was recorded in May, 2020 (0.7853) and lowest value in the month of July, 2020 (0.3116). Evenness index is a measure of the relative abundance or how evenly distributed different fish species which indicated the richness of a particular area. The finding revealed that, the fish species present in the lake were evenly distributed only during May, 2020.

The calculated Brillouin index showed maximum value in September, 2019 (2.509) and minimum value in August, 2020 (1.619). The Shannon's and Brillouin index value have always showed a similar index value and they are often correlated estimates of a diversity. Shannon index value of the present finding are comparable with those reported by Sharma and Singh (2017) with index value 3.408 to 3.779 in the lake Dodi Tal, and Sarmah and Baruah (2015) with index value 2.51 to 3.21 in Monrikhaboloo beel.

Table II.- Monthly biodiversity indices (%) of ichthyofauna of Lake Kharungpat during 2019-2020.

	Sep-19	Oct	Nov	Dec	Jan-20	Feb	Mar	Apr	May	Jun	Jul	Aug
Taxa_S	26	14	18	21	17	16	23	17	9	11	29	19
Individuals	100	100	100	100	100	100	100	100	100	100	100	100
Dominance_D	0.074	0.143	0.113	0.072	0.095	0.098	0.121	0.141	0.170	0.245	0.267	0.322
Simpson_1-D	0.925	0.857	0.887	0.928	0.905	0.901	0.879	0.859	0.829	0.755	0.733	0.678
Shannon_H	2.843	2.326	2.502	2.789	2.529	2.516	2.523	2.307	1.956	1.847	2.201	1.846
Evenness_e^H/S	0.660	0.731	0.678	0.775	0.738	0.774	0.542	0.591	0.785	0.576	0.312	0.333
Brillouin	2.509	2.106	2.244	2.489	2.281	2.273	2.232	2.072	1.807	1.682	1.883	1.619
Menhinick	2.6	1.4	1.8	2.1	1.7	1.6	2.3	1.7	0.9	1.1	2.9	1.9
Margalef	5.429	2.823	3.692	4.343	3.474	3.257	4.777	3.474	1.737	2.171	6.08	3.909
Equitability_J	0.873	0.881	0.865	0.916	0.893	0.907	0.805	0.814	0.89	0.770	0.654	0.627
Fisher_alpha	11.41	4.43	6.405	8.107	5.881	5.378	9.354	5.881	2.397	3.154	13.71	6.951
Berger-Parker	0.15	0.32	0.25	0.1	0.15	0.2	0.25	0.25	0.3	0.45	0.5	0.55

The highest and lowest value of Menhinick index observed was 2.9 and 0.9 in the month of July, 2020 and May, 2020, respectively. The Margalef value was high in July, 2020 (6.08) with its lowest value of 1.737 in May, 2020. The observed Equitability index value showed maximum in December, 2019 (0.9161) with its minimum value in December, 2020 (0.6268). The maximum and minimum Fisher alpha index value was recorded during July, 2020 and September, 2019 with a value of 13.71 and 11.41, respectively. Similarly for Berger Parker index value maximum recorded value was 0.55 (August 2020) and minimum was 0.1 (December, 2019).

CONCLUSION

The present finding diversity indices values indicated a less healthy environment of the lake. Threatened fish species owing to deteriorative nature and changing condition of the lake should be properly conserved through stock enhancement. Regular restocking of fish seed programme has to be undertaken in convergence mode. Regular awareness programme on proper and judicious use of resources and conservation and protection of lake ecosystem and habitat improvement programmes has to be organised.

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Statement of Conflict of interest

The authors declare that there is no conflict of interest.

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