

Faunal Diversity of Durgadahalli Lake of Tumakuru, Karnataka State, India

Keywords: Zooplanktons; Arthropods; Mollusca; Amphibia; Reptilia; Physico-chemical parameter; Durgadahalli Lake

Abstract

The aquatic organisms are the good indicators of health of an aquatic ecosystem and represent the balanced ecosystem. The present study was conducted to understand the current status of faunal diversity in Durgadahalli Lake, located in the North-East of Tumakuru district, at distance of 15 km from Tumakuru city in Karnataka. It lies at 13° 13' 56" N latitude and 77° 25' 30" E longitude. It receives water mainly from rain-fall with an average of 620 mm and from Jayamangalli river. The Lake comparatively smaller with rich aquatic faunal diversity and recorded 20 species of zooplankton, 9 species of aquatic insects belonging to Hemiptera, Coleoptera, Odonata and Diptera, One molluscan shell, 2 amphibia species (frog) and one reptilian species (turtle). The water collected and analyzed from five selective sampling stations of the Lake from 2016 to 2019. Not many reports are available on Durgadahalli Lake with respect to faunal diversity. Keeping it in mind, we have selected Durgadahalli Lake for the present study on ecology and aquatic faunal diversity. .

Introduction

Biological diversity is a part of our daily lives and livelihood having numerous values in agriculture, medicine, food and industry. Biodiversity maintains the evolutionary processes and ecological balance, millions of species which constitute biodiversity have their own intrinsic value. "Biodiversity means totality of genes, species and ecosystem in a region" [1]. Out of the total ecosystem network, freshwater ecosystems are receiving more attention worldwide because of their overwhelming economic importance. The food chain in Lake ecosystem is very simple, phytoplankton and aquatic vegetation serve as primary producers, zooplankton as primary consumers, small fishes as secondary consumers and large fishes as tertiary consumers. Plankton is the most sensitive floating community which is being the first target for water pollution, thus any undesirable change in aquatic ecosystem first affects diversity as well as biomass of this community. The phylum Arthropoda is the largest phylum of kingdom Animalia, which includes insects, and two-thirds of all named species on Earth are arthropods. The class Insecta includes 11 different orders, out of which 4 orders namely Hemiptera, Coleoptera, Odonata and Diptera include common freshwater insects.

In the freshwater environment, phylum Mollusca plays a vital role in the aquatic ecosystem functioning [2]. Molluscs commonly found in ponds, Lakes, paddy fields, quiet water pools etc., and remain attached to submerged vegetation, rocks, sticks, bricks etc. Molluscs are good indicators of water quality and status of aquatic system [3]. There are estimated 5000 species with valid descriptions in and 10000 undescribed species [4]. 370 species are reported from British India, Myanmar and Ceylon [5,6] consolidated the information on freshwater molluscs and published a "Handbook of



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Freshwater Molluscs of India" with 195 species recorded from India and neighboring areas. Amphibians are the organisms which live both on land and in aquatic media. In the universe, amphibians are represented by three living orders namely Anura, Urodela and Apoda. The order Anura comprises of frogs and toads with 6706 species, order Urodela has salamanders and newts with 693 species and order Apoda have limbless amphibians with 205 species worldwide. Thus, 7604 species of amphibians are known globally, of which 386 species belongs to 59 genera and 15 families of all three living orders. 345 species of frogs and toads, 2 species of salamanders and 39 species of caecilians or limbless amphibians are known from India. Reptiles are found in all kinds of environments except severe cold regions. Out of 566 species of reptiles, 3 species of crocodiles, 33 species of Testudineous, 234 species of lizards and 296 species of snakes are known from India

Materials and Methods

Study Area

Durgadahalli Lake located in the North-Eastern part of Tumakuru taluk, at a distance of 15km from Tumakuru city in Karnataka. It lies at 13° 13' 56" N latitude, 77° 25' 30" E longitude with water spread area of about 15.60 hectares and its average depth is 1.8 to 2.0 meters along the bund (Figure 1). It receives water mainly from rain-fall and from



Figure 1: Durgadahalli lake.

river Jayamangalli. The water is mainly used for agriculture, domestic and drinking as well as culture fishes. The total catchment area of is 17.25sq.km and height 10.4 to 10.6m. The average rain-fall of 620mm and soil type is sand/gravel.

Methodology

Water Analysis: Water samples were collected from selected sites of the Lake. The sampling was usually carried out from 8:00 am to 10:00 am, once in a quarter from 2016-2019. The water samples were collected directly from the surface layer in plastic canes to avoid unpredictable changes. The physicochemical analysis of samples was done in the lab by adapting the procedure prescribed by [7] and [8].

Faunal Diversity: The D-frame and O-frame aquatic nets were used for collection of aquatic animals (Arthropoda, Mollusca, Fishes, Amphibia). The size of the mesh or sieve (pore size of the net) varies from 20-500µm depending upon the size of the organism. The collection from lentic habitats was usually done by sweeping the net vigorously and carefully lifted with the entire mass of macrophytes or sediments. The flat side of the D-frame net was placed on the bottom of the Lake and the vegetation was disturbed by vigorous dragging the net, which facilitated the different aquatic fauna to be swept into the net. Same techniques were used for collection of different fauna along the catchment area of the Lake, by always sweeping the net upstream and letting the current to carry the animals into the net.

Results and Discussion

Water analysis

In Durgadahalli Lake, water temperature ranged between 25.5°C to 25.83°C i.e., not much variable. The pH was slightly acidic, neutral or alkaline in nature depending on season and time of water collection throughout the study period and ranged from 6.9 to 7.3. The range of biological oxygen demand (BOD) and dissolved oxygen (DO) varied between 3.06 to 3.15mg/l and 7.23 to 7.32mg/l respectively. The chemical oxygen demand (COD) ranged from 30.67 to 30.92mg/l, the electrical conductivity from 252.7 to 254.17µs/cm in Lake. Turbidity ranged from 8.35 to 8.867NTU. Total hardness, total suspended solids, total dissolved solids and total solids ranged from 42.33 to 42.75mg/l, 14.083 to 15.2mg/l, 170.33 to 170.833mg/l and 185.75 to 189.167mg/l respectively. The water dissolved metals such as Nickel, Chromium, Arsenic, Lead, Cadmium, Zinc, Iron, Manganese, Copper was recorded below detection level (BDL) with little bit muddy and slight fishy odour. The results of water analysis showed that, it is good for growth and survival of aquatic organisms. Noun predictable change was seen in the water throughout the study period (Tables 1,2).

Environmental factors like water quality, altitude and nutrient supplements influenced the diversity of aquatic fauna and also showed great impact on species richness [9]. The same pattern was also reported by [10]. The species richness was found to be low at higher elevation and high at lower elevation, which is similar to results of present study in Durgadahalli Lake. Water temperature is another factor that provides favorable conditions for high algal production which directly influences herbivore fish [11-17] considered water temperature as the most important factor of environmental variability. The agricultural runoff around the Lakes increased concentration of

ammonia and nitrogen released from the synthetic fertilizers which impact the aquatic life [18,19].

Diversity of Fauna

In this study, a total of 20 species of zooplanktons were recorded from the Durgadahalli Lake. Out of which 14 are rotifers, 4 cladocerans and 2 copepods. Among the rotifers, family Brachionidae (11 species) with Genus Brachionu shaving 08 species represented the maximum diversity. The families Hexarthridae, Filiniidae and Asplanchnidae are represented with one species each. In cladocera, families Daphniidae (02 species), Moinidae (01 species) and Chydoridae (01 species) are recorded in this Lake. In copepoda, family Diaptomidae has two species (Table 3). Most commonly occurring species in this Lake included Brachionus angularis, Brachionus caudatus, Keratella tropica, Filinia longiseta, Ceriodaphnia cornuta and Moina micrura. The rotifer showed highest number of species as well as copepod showed lowest number of species of zooplankton in the study area. The Jaccard similarity index (J) for Diversity of zooplankton is 0.4583 (Table 6). Similar results were also reported in Ameenpur tank, Ameenpur village, Medak district, Telangana by [20] reported family Rotifera found to be abundant followed by order Cladocera and Copepoda respectively. [21] reported rotifers to be more predominant than other zooplankton communities, especially family Brachionidae and Lecanidae in the chosen pond at Medak district. They observed a significant relationship between Physico-chemical parameters and zooplankton indices. [22] reported Rotifera representing highest number of species followed by Cladocera, Copepoda, Ostracoda and Insecta respectively. [23] investigated the Osmansagar reservoir in Telangana and reported highest population density of zooplankton which was due to rotifer and copepods where rotifers were most dominant followed by Cladocerans and Copepods.

There are nine different Insects were reported in Durgadahalli Lake, genus Hydrometra and Peritopus belonging to families Hydrometridae and Vellidae respectively (Table 4). Genus Lacconectus of family Dytiscidae and genus Ochthebius of family Hydraenidae are found in Durgadahalli Lake (Table 4). The identified species are Libellago andamanensis, Gomphidia kodaguensis and Trameatransmarina belonging to families Chlorocyphidae, Gomphidae and Libellulidae respectively (Table 4). Genus Brilia and Chironomus of family Chironomidae (Table 4) were also reported in study area. The Jaccard similarity index (J) for Diversity of insects is calculated as 0.256 (Table 6). The diversity and distribution of this groups helps to understand the functional aspects of community structure and provide the baseline data for effective conservation and management of aquatic ecosystem. [24,25], mentioned approximately 4,656 species of aquatic and semi-aquatic bugs belonging to 20 families and 326 genera inhabit freshwater globally, and more than 1,100 species remain undescribed [26]. Out of which India is represented by 318 species under 82 genera and 18 families [27-30], Hungerford and Matsuda [31,32] and Thirumalai (1999) observed and reported similar results. [33,34] also reported diversity of aquatic insects belonging to Hemiptera, Odonata, Coleoptera and Diptera.

In the present study reported shell of Unio, identified as Lamellidens consobrinus [35] (Figure 2) belonging to class Bivalvia, order Unionida and family Unionidae (Table 5). Jaccard similarity

Table 1: Season wise Physico chemical analysis of Durgadahalli Lake from 2016-19.

SL. No	Water parameters	Unit	2016-17			2017-18			2018-19		
			Winter (Dec to Feb)	Summer or pre-monsoon (March to May)	Monsoon or rainy (June to Sep)	Winter (Dec to Feb)	Summer or pre-monsoon (March to May)	Monsoon or rainy (June to Sep)	Winter (Dec to Feb)	Summer or pre-monsoon (March to May)	Monsoon or rainy (June to Sep)
1	pH	pH unit	7	6.9-7.0	7.1-7.2	7.1	7	7.1-7.3	7	7.1-7.2	7
2	Biological Oxygen Demand (BOD) (3days @27°C)	mg/l	3.2	3	3	3.25	3	3.05	3.4	3.05	3
3	Dissolved Oxygen (DO)	mg/l	7.35	7.15	7.45	7.35	7.1	7.25	7.5	7.1	7.35
4	Chemical Oxygen Demand (COD)	mg/l	28.505	31.5	32	28.75	32.5	31.5	28.5	31.5	32.5
5	Conductivity	µs/cm	247.625	265.5	245	247	267.5	248	246.5	265	247
6	Nitrate Nitrogen	mg/l	0.9	1	0.89	1	1.1	1	1	1.05	1.05
7	Ammonical Nitrogen	mg/l	0.195	0.225	0.425	0.2	0.275	0.45	0.25	0.225	0.475
8	Turbidity	NTU	7.5	8.05	9.5	7.6	8.2	9.5	8.75	9.35	8.5
9	Total Hardness	mg/l	39.5	43	44.5	39.25	44	45	40	43	44.5
10	Calcium (CaCO ₃)	mg/l	23.5	24.5	22.5	23.5	25.5	24	22.5	24.5	26
11	Chloride (Cl)	mg/l	16.5	17.5	14.5	16.7	18	15.75	17.4	17.75	16.25
12	Sodium (Na)	mg/l	29	31.5	23	29.6	32	22.5	29.25	32	22.5
13	Potassium (K)	mg/l	7.5	8.4	7.5	7.75	8.9	7.6	7.5	8.8	7.85
14	Sulphate (SO ₄)	mg/l	11	10.5	8.5	10.5	11	8.75	10.75	10.25	9
15	Total Suspended Solids (TSS)	mg/l	13	14.5	18	13	14	16.6	12.5	14.25	15.5
16	Total Dissolved Solids (TDS)	mg/l	164	185	162	165	186	160	162.5	182.5	167.5
17	Fluoride (F)	mg/l	0.17	0.2	0.145	0.2	0.21	0.18	0.195	0.21	0.18
18	Total solids	mg/l	182.75	194.5	180	183	199.5	181.5	181	200	186.5
19	Carbonate (CO ₃)	mg/l	0.6	0.65	0.45	0.6	0.85	0.525	0.65	0.95	0.55
20	Bicarbonate (HCO ₃)	mg/l	4.5	4.4	4.15	4.6	4.35	4.25	4.6	4.25	4.2
21	Colour		Little bit muddy	Little bit muddy	Little bit muddy	Little bit muddy	Little bit muddy	Little bit muddy	Little bit muddy	Little bit muddy	Little bit muddy
22	Odour		Slight Fishy	Slight Fishy	Slight Fishy	Slight Fishy	Slight Fishy	Slight Fishy	Slight Fishy	Slight Fishy	Slight Fishy
23	Temperature	°C	26.25	25.25	25	26.25	25.4	25.75	25.5	26.25	25.75

Table 2: Correlation Coefficient of Physico-Chemical characteristics of Durgadahalli Lake from 2016-2019.

	pH	BOD	DO	COD	EC	NO ₃ -N	NH ₃ -N	Turbidity	TH	Ca	Cl	Na	K	SO ₄	TSS	TDS	F	TS	CO ₃	HCO ₃	°C
pH	1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
BOD		1	-0.219	-0.33	-0.437	0.05	0.05	0.158	-0.212	0.282	0.469	0.23	0.467	0.331	-0.306	-0.333	0.05	-0.231	0.316	0.661	0.204
DO			1	-0.38	-0.038	0.05	0.05	-0.499	-0.372	-0.636	-0.624	-0.385	-0.814	0.031	-0.004	-0.333	0.05	-0.537	-0.693	-0.331	-0.072
COD				1	0.349	0.05	0.05	0.34	0.911	0.552	0.023	-0.156	0.243	-0.29	0.714	0.407	0.05	0.482	0.189	-0.219	-0.371
EC					1	0.05	0.05	-0.343	0.136	0.119	0.167	0.524	0.006	0.422	-0.115	0.907	0.05	0.794	0.063	-0.349	-0.212
NO ₃ -N						1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
NH ₃ -N							1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Turbidity								1	0.547	0.261	0.29	-0.173	0.528	-0.594	0.494	-0.218	0.05	0.044	0.4	0.12	0
TH									1	0.583	0.105	-0.338	0.293	-0.443	0.818	0.162	0.05	0.286	0.179	-0.16	-0.192
Ca										1	0.672	0.154	0.653	0.192	0.204	0.259	0.05	0.466	0.522	0.353	0.177
Cl											1	0.610	0.803	0.4	-0.278	0.286	0.05	0.556	0.677	0.561	0.25
Na												1	0.540	0.698	-0.609	0.659	0.05	0.658	0.560	0.414	-0.136
K													1	0.165	-0.035	0.282	0.05	0.475	0.813	0.593	-0.027
SO ₄														1	-0.645	0.433	0.05	0.296	0.154	0.381	-0.028
TSS															1	-0.148	0.05	-0.107	-0.247	-0.247	-0.276
TDS																1	0.05	0.854	0.295	-0.138	-0.326
F																	1	0.05	0.05	0.05	0.05
TS																		1	0.527	-0.079	-0.073
CO ₃																			1	0.478	0.065
HCO ₃																				1	-0.154
°C																					1

Bold letters indicate significant at the 0.05 level

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Table 3: Zooplankton diversity of Durgadahalli of Tumakuru.

SL. No	Name of the species
Rotifera : Brachionidae	
1	Brachionus angularis Gosse, 1851
2	Brachionus calyciflorusPallas, 1766
3	Brachionus caudatus Barrois & Daday, 1894
4	Brachionus dichotomus reductus Koste & Shiel, 1980
5	Brachionus diversicornis (Daday, 1883)
6	Brachionus falcatus Zacharias, 1898
7	Brachionus forficula Wierzejski, 1891
8	Brachionus quadridentatus quadridentatus Hermann, 1783
9	Keratella cochlearis (Gosse, 1851)
10	Keratella tropica (Apstein, 1907)
11	Platyas quadricornis (Ehrenberg, 1832)
12	Hexarthridae Hexarthra intermedia Wiszniewski, 1929
T13	Filiniidae Filinia longiseta (Ehrenberg, 1834)
14	Asplanchnidae Asplanchna brightwellii Gosse, 1850
Cladocera	
15	Daphniidae Ceriodaphnia cornuta Sars, 1885
16	Daphnia (Ctenodaphnia) lumholtzi Sars, 1885
17	Moinidae Moina micrura Kurz, 1875
18	Indialona ganapati Petkovski, 1966
Copepoda	
19	Tropodiaptomus orientalis (Brady,1886)
20	Neodiaptomus intermedius Flossner, 1984

Table 4: Diversity of insects in Durgadahalli Lake

Order	Family	Genus	Species
Hemiptera	Hydrometridae	<i>Hydrometra</i> Latreille, 1797	-
	Vellidae	<i>Perittopus</i> Fieber,1861	-
	Dytiscidae	<i>Lacconectus</i> Motschulsky, 1855	-
	Hydraenidae	<i>Ochthebius</i> Leach,1815	-
Odonata	Chlorocyphidae	<i>Libellago</i> Chaudoir,1878	<i>L. andamanensis</i> Chaudoir, 1878
	Gomphidae	<i>Gomphidia</i> Fraser, 1923	<i>G. kodaguensis</i> Fraser,1923
	Libellulidae	<i>Tramea</i> Brauer,1867	<i>T. transmarina</i> Brauer, 1867
Diptera	Chironomidae	<i>Brillia</i> Kieffer,1913	-
		<i>Chironomus</i> Meigen, 1803	-

Table 5: Diversity of different fauna in Durgadahalli Lake.

Sl. No	Common name	Scientific name
1	Shell of unio	Lamellidens consobrinus (Lea, 1860)
2	Indian skittering frog	Euphlyctis cyanophlyctis(Schneider, 1799)
3	Indian bull frog	Hoplobatrachus tigerinus(Daudin, 1803)
4	Indian flapshell turtle	Lissemys punctata (Lacepede, 1788)

Table 6: Diversity indices calculated for the faunal diversity found in Durgadahalli Lake.

SL. No	Diversity indices	Durgadahalli Lake
1	Jaccard Similarity index (J) for Zoo plankton	0.4583
2	Jaccard similarity index (J) for Diversity of insects	0.256
3	Jaccard similarity index (J) for Diversity of Mollusca, Amphibia, Reptilia.	0.4

index (J) for Diversity of Mollusca is 0.4 (Table 6). Two species of frogs namely Euphlyctis cyanophlyctis [36] (Figure 3) and Hoplobatrachus tigerinus [37] of family Dicroglossidae commonly known as Indian skittering frog and Indian bull frog (Table 5) respectively were recorded. Jaccard similarity index (J) for Diversity of Amphibia is 0.4 (Table 6). Indian flap shell turtle identified as Lissemys punctata [38,39] (Figure 4) belonging to order Testudinus and family Trionychidae (Table 5). Jaccard similarity index (J) for Diversity of Reptiles is 0.4 (Table 6).

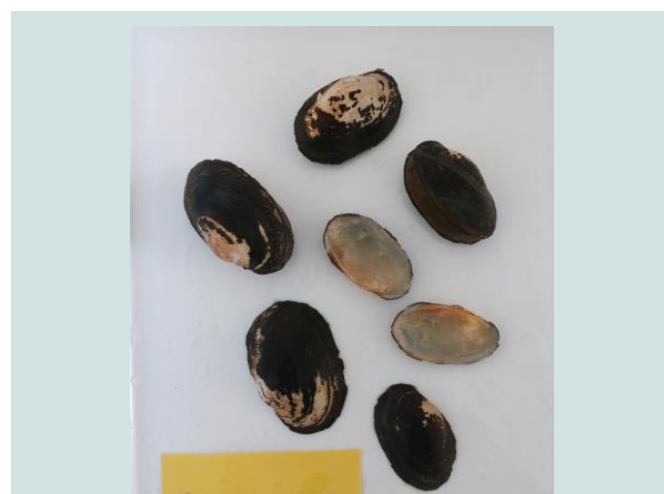


Figure 2: Lamellidens consobrinus.



Figure 3: Euphlyctis Cyanophlyctis.



Figure 4: Lissemys punctate.

Conclusion

The water of Durgadahalli lake is good for growth and survival of aquatic organisms. There is no such unpredictable change seen in the water throughout the study period, it is evidenced by identification of diversity of aquatic organisms. Planktons are the crucial source of food for many aquatic organisms like molluscs, fishes and other aquatic animals. Zooplankton is an important component in the aquatic food web acting as a trophic link between small particles and planktivorous fish [40-45]. Plankton are also good indicators of the health of the aquatic environment [46-48]. The phylum rotifera was the dominant, followed by cladocera and copepoda, family high number of species. The result influencing the diversity of other aquatic fauna because of the aquatic food chain. Major threats to global freshwater biodiversity are grouped into five categories like overexploitation, water pollution, flow modification, destruction or degradation of habitat and invasion by exotic species.

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