UTTAR PRADESH JOURNAL OF ZOOLOGY

42(22): 138-149, 2021
ISSN: 0256-971X (P)

ICHTHYOFAUNAL DIVERSITY OF KINNERASANI RESERVOIR IN BHADRADRI KOTHAGUDEM DISTRICT OF TELANGANA, INDIA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Telat Yanik, Professor, Atatürk University, Turkey.
Reviewers:
(1) Eliane Da Silva Fernandes, Universidade Estadual De Maringá, Brazil.
(2) H. K. S. de Zoysa, Rajarata University of Sri Lanka, Sri Lanka.
(3) Radu Daniela, Romania.

Received: 30 August 2021
Accepted: 01 November 2021
Published: 05 November 2021

Original Research Article

ABSTRACT

The Ichthyofaunal diversity of Kinnerasani reservoir in Telangana state was observed in the present study. Sixty-one fish species belong to 8 orders, 19 families and 40 genera were observed. Of those, order Cypriniformes was dominant with 24 species which contributed to 39.34% of the total species, followed by Perciformes with 14 (22.95%), Siluriformes 13 (21.31%), Channiformes 04 (6.55%), Beloniformes and Anguilliformes with 02 (3.27%), Osteoglossiformes and Cyprinodontiformes with 01 species each (1.64%). Out of the reported 19 families Perciformes contributed by 06 (31.57%) families and Siluriformes with 05 (26.31%). The present communication provides baseline data of fish species and discusses the diversity indexes and conservation status.

Keywords: Diversity; Ichthyofauna; Kinnerasani reservoir; Conservation status.

1. INTRODUCTION

Fish are a major source of protein in human nutrition and particularly to food security and livelihoods. Globally, India occupies about 7.7% fish diversity. Of those, 1,668 species are marine and 994 are freshwater (Froese & Pauly) [1]. Diversity and distribution of freshwater fishes in India engaged in large number of ponds, tanks, seasonal streams, lakes, reservoirs, rivers and other man-made water bodies which spread over an area of 111,690 km² (Bassi et al.) [2]. In peninsular India, Godavari and Krishna are perennial rivers and drained through the state of Telangana by their numerous tributaries. Fish faunal studies have been carried out in the rivers of Telangana by many biologists (Day [3]; Rahimullah [4,5]; Mahmood & Rahimullah [6]; Chacko [7]; David [8]; Jayaram [9,10,11,12]; Barman [13];

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Talwar & Jhingran [14]; Menon [15]; Devi & Indra [16]; Laxmappa and Ravinder [17]; Srivastava et al. [18]). As of now, compare to the riverine fish faunal studies, only a few studies are available on the reservoir fisheries of Telangana (Rahimullah [19,5]; Mahmood & Rahimullah [6]; Chandrasekhar [20]; Rao et al. [21]; Shyamsundar et al. [22]; Prasad et al. [23]).

Kinnerasani reservoir is one of the significant reservoirs in the state of Telangana, created by the construction of a Dam on Kinnerasani River in 1966 at Yanambail village of Paloncha Mandal in Bhadradri Kothagudem district (GOI [24]; NEERI [25]). Kinnerasani River is one of the tributaries of river Godavari and flows through Warangal and Khammam districts of Telangana State. The total catchment area of this reservoir is 1320 sq.km which provides irrigation facilities to the farmers and water to Kothagudem Thermal Power Station (KTPS) located at Paloncha for thermal power generation (NEERI, [25]). The reservoir has ten islands with wide marshy fringed vegetation which is useful for marsh crocodiles as breeding grounds. Kinnerasani Wildlife Sanctuary was established in 1977 to provide a safe haven to the wild residents like vulnerable marsh crocodiles and deers with numerous endangered fauna (Suthari et al. [26]; NEERI [25]). Due to the anthropogenic activities, river Kinnerasani receives pollution as untreated domestic sewage and treated industrial effluent discharges (NEERI, [25]). Kinnerasani reservoir has boundaries with 21 villages/towns with about 86,092 of population size (Census, 2011 [27]). Meanwhile nearly 350 fishermen families are dependent on Kinnerasani reservoir for their livelihood. In this context, over exploitation of fish and water pollutants effect fish faunal diversity of the Kinnerasani reservoir. Through this contribution, we provide baseline information on the fish fauna of the Kinnerasani reservoir.

2. MATERIALS AND METHODS

2.1 Study Area

Kinnerasani reservoir (17^0-41'-00" N &80^0–39'-30'' E) is located in Yanambail village of Paloncha Mandal in Bhadradri Kothagudem district, Telangana State, India (Fig. 1). The reservoir region represents very warm and dry conditions, during March–May and temperatures drop observed in December – January months (Reddy et al. [28]).

2.2 Methods

The study was carried out from March, 2019 to February, 2020. We select three stations along the reservoir course and the fish were collected from the respected stations i.e. station-1: Punukuduchelaka; station-2: Gattumalla and station-3: Yanambilu. Fish samples were collected using cast nets (mesh size of 6–12 mm), gill nets (mesh size of 40–90 mm), and other traditional methods (square-shaped cage traps and conical shape traps) with the aid of local fishermen. Collected fresh specimens were photographed, labelled, and preserved in 4–10% formalin solution based on the fish size (Jayaram [12]). Fish were identified up to the species level followed by Nelson [29]; Talwar & Jhingran [14]); Jayaram [30]); Jayaram & Dhas [31]; Jayaram & Sanyal [32]; and Jayaram [12]. Nomenclature of fishes was done followed by Fricke et al. [33]. Conservation status of the fish species was observed based on Conservation Assessment and Management Plan for Freshwater Fishes (CAMP) and the IUCN Red List of Threatened Species (CAMP, 1998 [34]; IUCN, 2021 [35]).

2.3 Statistical Analysis

The mathematical expression of Shannon-Wiener Diversity Index [36] as Shannon-Wiener Index denoted by

$$H = -SUM [(p_i) \times \ln(p_i)]$$

Whereas, **SUM**= summation
p*i* = proportion of total sample represented by species *i*
Divide no. of individuals of species *i* by total number of samples
S = number of species, = species richness
Hmax = ln(S) Maximum diversity possible
E = Evenness = H/Hmax

3. RESULTS

The results of the present study revealed that the occurrence of sixty-one fish species belongs to 8 orders, 19 families and 40 genera. Taxonomic composition of Kinnerasani reservoir fish including their order, family, genus, species, common name, IUCN and CAMP status were recorded in the present investigation and was given in Table 1.

In the present investigation the number and percentage composition of families, genera and species under different orders are shown in Table 2 and Fig 2. Order Cypriniformes was dominant with 24 species which contributed to 39.34% of the total species followed by Perciformes with 14 (22.95%), Siluriformes 13 (21.31%), Channiformes 04 (6.55%), Beloniformes and Anguilliformes with 02 (3.27%), Osteoglossiformes and Cyprinodontiformes with 01 species each (1.64%). Recorded families out of 19,

Perciformes contributed 06 (31.57%) families followed by Siluriformes 05 (26.31%), Cypriniformes and Beloniformes each with 02 (10.52%), Osteoglossiformes, Cyprinodontiformes, Anguilliformes and Channiformes each with 01 (05.26%). Recorded genera out of 40, Cypriniformes contributed 15 (37.5%) species followed by Perciformes 11 (27.5%), Siluriformes 08 (20.00%), Beloniformes with 02 (5.00%), Osteoglossiformes, Anguilliformes, Channiformes and Cyprinodontiformes each with 01 (2.50%).

Fig 1. Location of the research area

Table 1. List of fishes and their order, family, genus, species, population status, IUCN and CAMP status at Kinnerasani reservoir

Order / Family	No.	Scientific Name	population status	IUCN status (2021-2)	CAMP Status
Osteoglossiformes/	I				
1. Notopteridae (1)	1	*Notopterus notopterus*	C	LC	LRnt
Cypriniformes/	II				
2. Cyprinidae (22)	2	*Catla catla*	C	LC	VU
	3	*Labeo ariza*	C	LC	NE
	4	*Labeo calbasu*	A	LC	LRnt
	5	*Labeo fimbriatus*	M	LC	LRnt
	6	*Labeo rohita*	C	LC	LRnt
	7	*Cirrhinus mrigala*	C	LC	LRnt
	8	*Cirrhinus reba*	A	LC	VU
	9*	*Ctenopharyngodon idella*	R	DD	DD
	10	*Garra gotyla gotyla*	R	LC	VU
	11*	*Cyprinus carpio*	M	VU	DD
	12	*Osteobrama cotio cotio*	A	LC	LRnt
	13	*Puntius chola*	A	LC	VU
	14	*Puntius ticto*	A	LC	LRnt
	15	*Puntius sarana sarana*	A	LC	VU
	16	*Puntius sophore*	A	LC	LRnt
	17	*Rasbora daniconius*	M	LC	DD
	18	*Rasbora elanga*	M	LC	NE
	19	*Chela bacaila*	A	LC	LRlc
	20	*Salmostoma phulo*	C	LC	NE
	21	*Amblypharyngodon microlepis*	A	LC	NE
	22	*Amblypharyngodon mola*	A	LC	LRlc
	23	*Danio devario*	C	LC	LRnt
3. Cobitidae (2)	24	*Lepidocephalus guntea*	M	LC	DD
	25	*Schistura corica*	R	LC	DD

Order / Family	No.	Scientific Name	population status	IUCN status (2021-2)	CAMP Status
Cyprinodontiformes/	III				
4. Aplocheilidae (1)	26	*Aplocheilus panchax*	C	LC	DD
Siluriformes/	IV				
5.Bagridae (6)	27	*Mystus bleekeri*	A	LC	VU
	28	*Mystus cavasius*	A	LC	LRnt
	29	*Mystus tengara*	A	LC	DD
	30	*Mystus vittatus*	A	LC	VU
	31	*Spherata seenghala*	A	LC	DD
	32	*Spherata oar*	A	LC	DD
6.Siluridae (2)	33	*Ompok bimaculatus*	C	NT	EN
	34	*Wallago attu*	C	VU	LRnt
7.Schibeidae (2)	35	*Eutropiichthys vacha*	C	LC	EN
	36	*Pseudeutropius atherinoides*	C	DD	EN
8.Claridae (2)	37	*Clarias batrachus*	R	LC	VU
	38*	*Clarias gariepinus*	R	LC	DD
9.Heteropneustidae (1)	39	*Heteropneustes fossilis*	M	LC	VU
Anguilliformes/	V				
10. Anguillidae (2)	40	*Anguilla bengalensis bengalensis*	M	NT	EN
	41	*Anguilla bicolor bicolor*	R	NT	DD
Beloniformes/	VI				
11. Belonidae (1)	42	*Xenentodon cancila*	C	LC	LRnt
12. Exocoetidae (1)	43	*Hyporhamphus gaimardi*	C	DD	DD
Channiformes/	VII				
13. Channidae (4)	44	*Channa marulius*	M	LC	LRnt
	45	*Channa orientalis*	C	VU	VU
	46	*Channa punctata*	C	LC	LRnt
	47	*Channa striata*	C	LC	LRlc
Perciformes/	VIII				
14. Gobiidae (2)	48	*Glossogobius giuris*	A	LC	LRnt
	49	*Gobiopsis macrostoma*	R	LC	LRnt
15. Mastacembelidae (2)	50	*Mastacembelus armatus*	A	LC	VU
	51	*Mastacembelus pancalus*	A	DD	DD
16. Anabantidae (3)	52	*Trichogaster faciatus*	M	LC	DD
	53	*Colisa lalia*	C	LC	NE
	54	*Anabas testudineus*	M	LC	VU
17. Nandidae (1)	*55*	*Nandus nandus*	M	LC	LRnt
18. Cichlidae (4)	*56**	*Oreochromis mossambicus*	C	VU	DD
	*57**	*Oreochromis variabilis*	R	DD	DD
	58	*Etroplus suratensis*	C	LC	DD
	59	*Etroplus maculatus*	M	LC	DD
19. Ambassidae (2)	*60*	*Chanda nama*	C	LC	DD
	61	*Ambassis ranga*	M	LC	DD

*A= Abundant (76-100%); C = Common (51-75%); M = Moderate (26-50%); R = Rare (1-25%) of the total catch. EN-Endangered; VU- Vulnerable: LRnt- Lower risk near threatened; LRlc- Lower risk least concern; LC- Least concern; DD-Data Deficient; NE- Not evaluated, NT: Near threatened. *Exotic fishes' Nos: 9, 11, 38, 56, 57.*

In the present investigation the number and percentage composition of families, genera and species under different orders are shown in Fig. 2.

In the present investigation, the number and percent composition of genera and species under various families were found and recorded in Table3, Fig 3. The generic composition of fishes belonging to different families shows that thirteen genera under Cyprinidae contributed to 32.5%, three genera under Anabantidae contributed to 7.50%, two genera of each under Cobitidae, Bagridae, Siluridae, Schilbeidae, Gobiidae, Cichlidae and Ambassidae contributed to 05.00% each and one genera under Notopteridae, Aplocheilidae, Clariidae, Heteropneustidae, Anguillidae, Belonidae, Exocoetidae, Channidae, Mastacembelidae, and Nandidae contributed to 02.50% each. The species composition of fishes

belonging to different families revealed that 22 species belong to family Cyprinidae that represented to 36.06%, 6 species to family Bagridae that contributed to 9.83%, four species each to families Channidae and Cichlidae contributed to 06.55%, three species to family Anabantidae constituted 04.92%, two species of each to family Cobitidae, Siluridae, Schilbeidae, Clariidae, Anguillidae, Gobiidae, Mastacembelidae, and Ambassidae making to 03.28%, one species to families Notopteridae, Aplocheilidae, Heteropneustidae , Belonidae, Exocoetidae and Nandidae contributed 01.64% each of total fish species.

The number and Percentage composition of Population Status is 19 species were abundant which contributed to 31.15%, 21 species are common which contributed to 34.43%, 13 species are moderate which contributed to 21.31% and 8 species are rare which contributed to 13.14% in the total catch. (Fig. 4).

Table 2. Number and percent composition of families, genera and species of fishes under various orders

S.No	Orders	% of families in an order	% of genera in an order	% of species in an order
1	Osteoglossiformes	5.26	2.50	1.64
2	Cypriniformes	10.52	37.50	39.34
3	Cyprinodontiformes	5.26	2.50	1.64
4	Siluriformes	26.31	20.00	21.31
5	Anguilliformes	5.26	2.50	3.28
6	Beloniformes	10.52	5.00	3.28
7	Channiformes	5.26	2.50	6.55
8	Perciformes	31.57	27.50	22.95

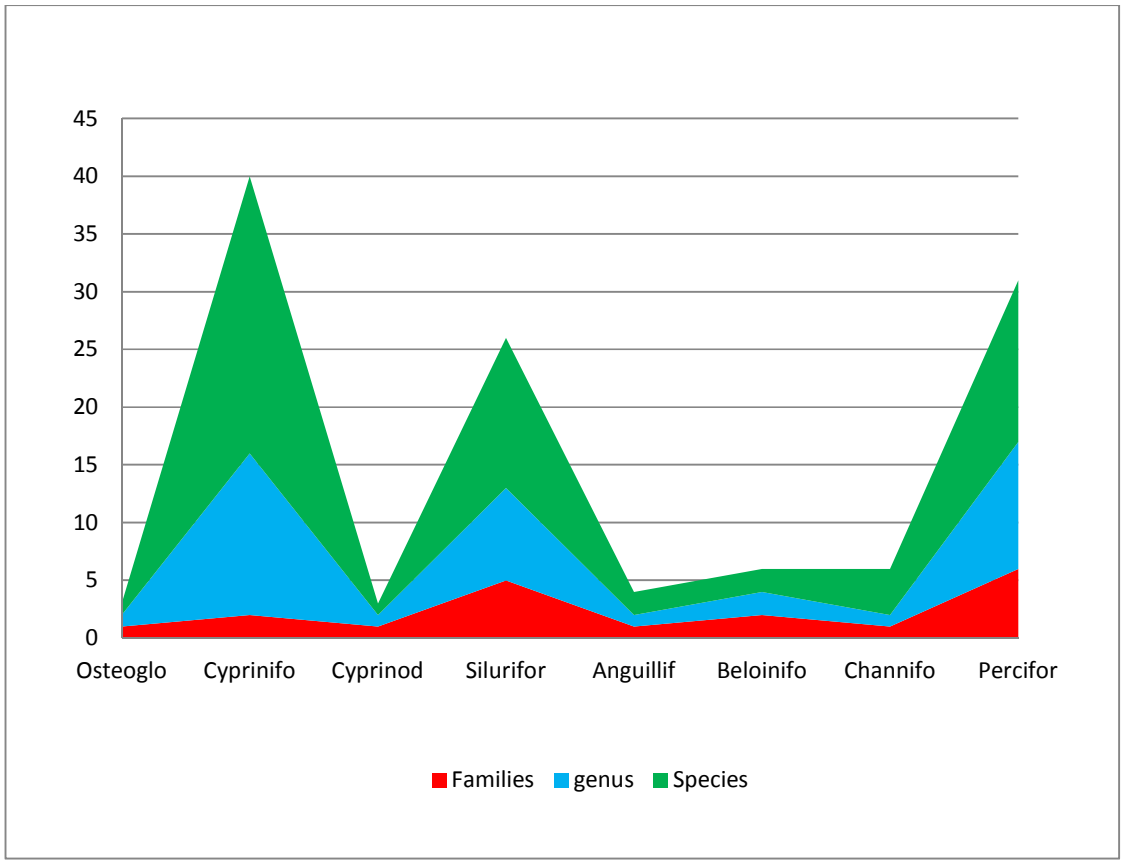

Fig. 2. Percent composition of families, genera and species

Table 3. Number and percentage composition of genera & species under various families

S.No	Families	% of genera in a family	% of species in a family
1	Notopteridae	2.5	1.6
2	Cyprinidae	32.5	36.0
3	Aplocheilidae	2.5	1.6
4	Cobitidae	5.0	3.2
5	Bagridae	5.0	9.8
6	Siluridae	5.0	3.2
7	Schilbeidae	5.0	3.2
8	Clariidae	2.5	3.2
9	Heteropneustidae	2.5	1.6
10	Anguillidae	2.5	3.2
11	Belonidae	2.5	1.6
12	Exocoetidae	2.5	1.6
13	Channidae	2.5	6.5
14	Gobiidae	5.0	3.2
15	Mastacembelidae	2.5	3.2
16	Anabantidae	7.5	4.9
17	Nandidae	2.5	1.6
18	Cichlidae	5.0	6.5
19	Ambassidae	5.0	3.2

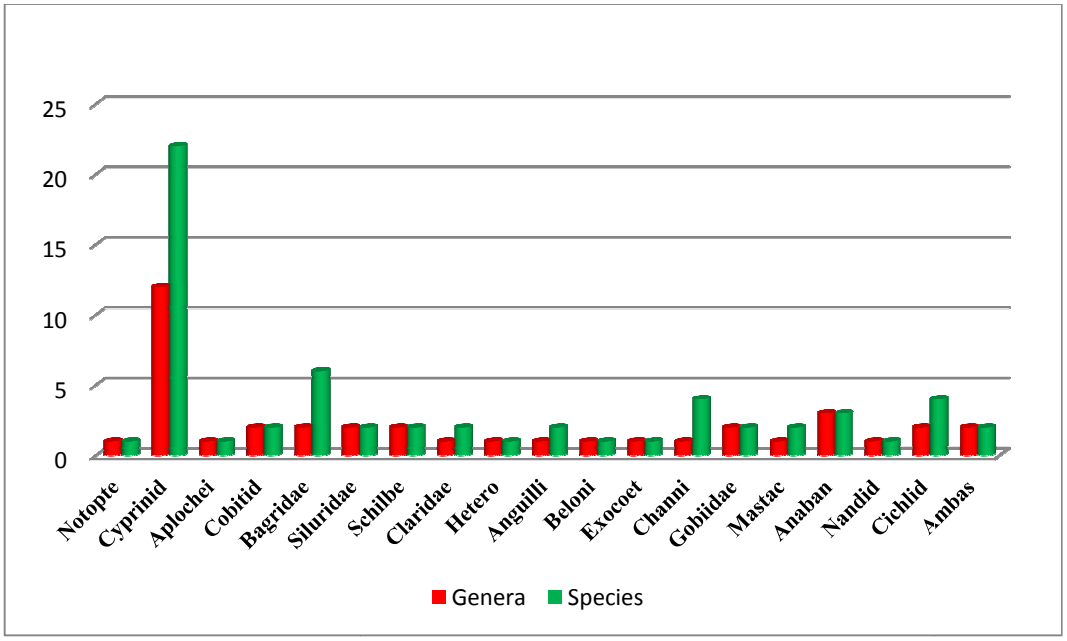

Fig. 3. Percentage composition of genera and species under various families

Table 4. Percentage occurrence of fish species in Kinnerasani reservoir under the conservation status CAMP (1998) and IUCN (2021.2)

Category		EN	VU	NT	LRnt	LRlc	LC	DD	NE
CAMP (1998)	No. of species	04.0	12.0	Nil	17.0	03.0	Nil	20.00	05.00
	% contribution	6.55	19.67	Nil	27.86	4.91	Nil	32.78	8.19
IUCN (2021-2)	No. of species	Nil	04.0	03.00	Nil	Nil	49	05.0	Nil
	% contribution	Nil	6.55	4.91	Nil	Nil	80.32	8.19	Nil

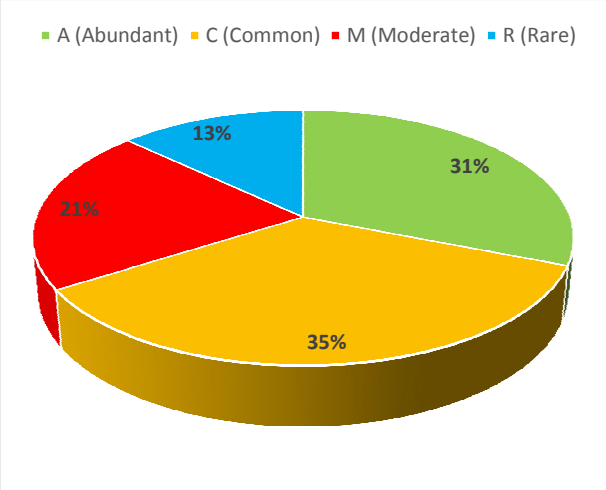

Fig. 4. Population Status

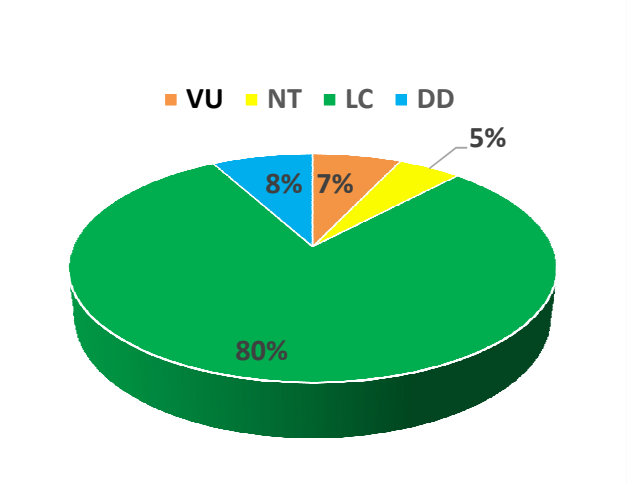

Fig. 5. IUCN (2021-2)

According to IUCN, [35] forty nine species contributed to 80.32% are Least Concern (LC), three species (*Ompok bimaculatus*, *Anguilla bengalensis bengalensis* and *Anguilla bicolor bicolor*) contributed to 4.91% are Near Threatened (NT), five species (*Ctenopharyngodon idella, Pseudeutropius atherinoides, Hyporhamphus gaimardi, Mastacembelus pancalus* and *Oreochromis variabilis*) contributed to 8.19% are Data Deficient (DD), and four species (*Cyprinus carpio, Wallago attu, Channa orientalis* and *Oreochromis mossambicus*) contributed to 6.5% are Vulnerable (VU) (Table 4. & Fig. 5).

According to CAMP, 1998 [34] status, 17 species of fish are each with Low Risk near threatened (LRnt) contributed to 27.86%, five species are Not Evaluated (NE) contributed to 8.19%, twelve (19.67%) species of fish are Vulnerable (VU), twenty species (32.78%) are Data Deficient (DD), four (6.55%) species of fish are Endangered (EN) and three species of fish (4.91%) are Low Risk least concern (LRlc). (Table. 4, Fig. 6).

Shannon-Wiener diversity index of fish species in Kinnerasani reservoir was analyzed. Richness of fish species was found highest in the months of July and August 2019 and lowest observed in May 2019. Shannon-Wiener Index (H) ranged from 1.24 to 1.84. The maximum diversity was recorded in the months of July and August 2019, the lowest recorded in January and February 2020. Evenness was reported highest in January 2020 and lowest in May 2019. These results indicate the good diversity index in the Kinnerasani reservoir (Table. 5, Fig. 1.1, 1.2, 1.3, and 1.4 of Plate 1).

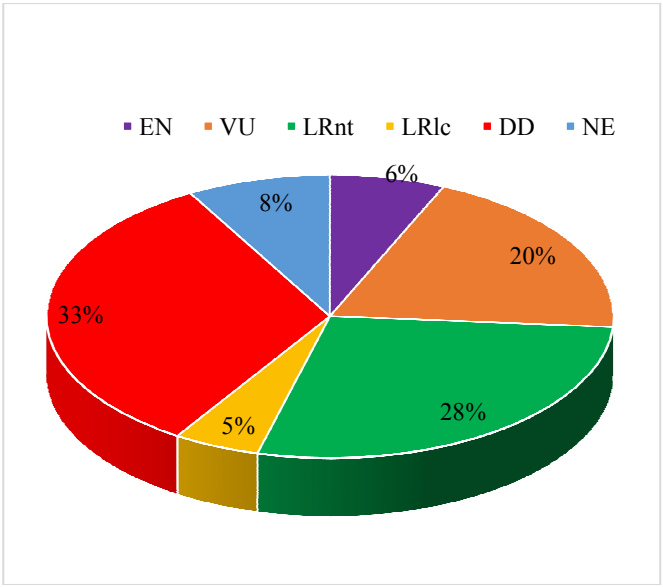

Fig. 1.1. CAMP Status (1998)

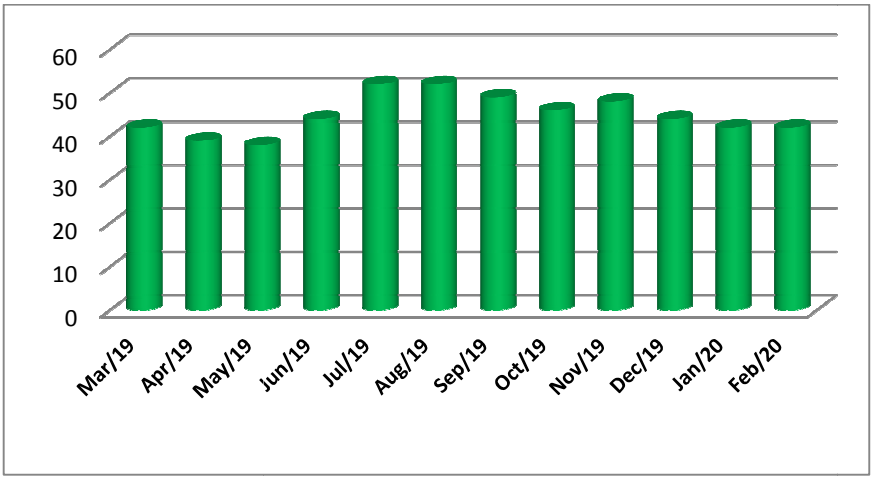

Fig. 1.2. Species richness

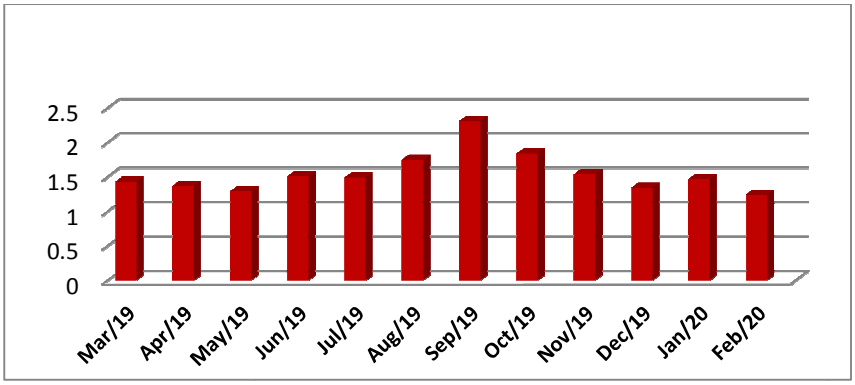

Fig. 1.3. Shannon-Weiner diversity(H)

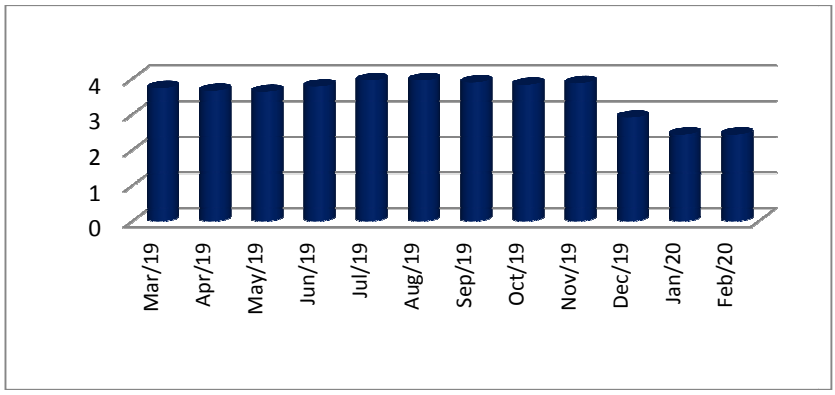

Fig. 1.4. Maximum diversity possible ln(S)

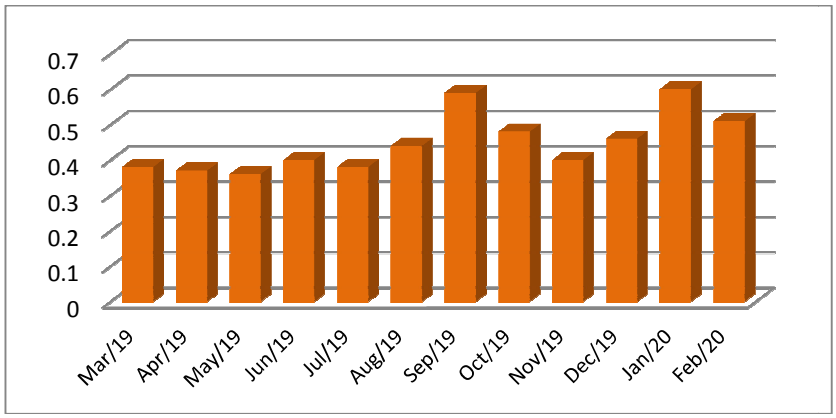

Fig. 1.5. Evenness (E)

Plate-1

Table 5. Fish Population Shannon-Weiner diversity index

Fish Population / Monthly	Mar 2019	Apr 2019	May 2019	Jun-2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020
Species richness	42	39	38	44	52	52	49	46	48	44	42	42
Shannon-Weiner diversity (H)	1.43	1.37	1.29	1.51	1.49	1.75	2.31	1.84	1.54	1.34	1.47	1.24
Maximum diversity possible **ln(S)**	3.73	3.66	3.63	3.78	3.95	3.95	3.89	3.83	3.87	2.91	2.43	2.43
Evenness **E**	0.38	0.37	0.36	0.40	0.38	0.44	0.59	0.48	0.40	0.46	0.60	0.51

4. DISCUSSION

The Kinnerasani reservoir harbours 61 fish species belonging to 40 genera, 19 families and 8 orders. Of these Cypriniformes are dominant with 24 species which contributed to 39.34% of the total species followed by Perciformes with 22.95%, Siluriformes 21.31%, Channiformes 6.55%, Beloniformes 3.27%, Osteoglossiformes, Cyprinodontiformes and Anguilliformes each 1.64%. The present study is the first of its kind for the Kinnerasani reservoir on fish diversity. As of now very scanty work has been carried out in Telangana region and only few biologists published their works in early sixties (Rahimullah [5]; David [8]). In recent times Laxmappa and Ravinder [17] reported 165 species of fishes from freshwaters of Telangana that proportion of 11 orders, 29 families and 74 genera, of those 58%

represented by Cyprinoids, 20% belongs to Siluroids and the remaining 22% belongs to different small groups. In the present study Cyprinoids exhibited similar dominance in the assemblage.

Prasad et al. [23] reported that 57 species of fish belonging to 42 genera, 20 families and 11 orders from Manjeera Reservoir of state Telangana, which resembles the results of the present study with reference to the dominance of Cypriniformes with 24 species alone. In addition to the reservoir studies, Srivastava et al. [18] reported 166 species of fish from rivers of state Telangana with 11 orders and 30 families. Of those Cypriniformes was dominant with 96 species followed by Siluriformes, Perciformes, Beloniformes, Cyprinodontiformes, Synbranchiformes, Osteoglossiformes and Anguilliformes.

The earlier works on fish faunal diversity from different parts of Indian reservoirs have resembled the present study with reference to the dominance of Cypriniformes. Pisca et al. [37] on Ibrahimbagh reservoir, Hyderabad, reported fish genera belonging to four orders and 28 species; Rama Rao K. [38] reported 53 species in Lower Manair Dam, of which Cypriniformes order was dominant with 23 species; Thirumala et al. [39] on assemblage composition of fish species from Bhadra reservoir, among the reported 33 species, family Cyprinidae was the most dominant with 54.55% followed by Bagridae and Siluridae of each represented as 9.09%, Channidae with 6.06 %, Mastacembelidae, Ambassidae, Cichlidae, Clariidae, Notopteridae, Cobitidae and Heteropneustidae each with 3.03 % respectively.

In the present study IUCN and CAMP status of fish species have been assessed to identify and convey the necessity and scale of conservation problems in the Kinnerasani reservoir. As per the IUCN categories, most (S=49) native species were of Least Concern (80.32%), three specie were assessed as Near Threatened (4.91%), five species contributed as Data Deficient (8.19%) and four species accounted as Vulnerable (6.55%) in the diversity. The works of Rama Rao et al. [40] on Ichthyofaunal diversity of Jammikunta Mandal of Telangana in freshwater perennial tanks, found that 82.14% species are Least Concern (LC), 3.57% species are Data Deficient (DD); 5.36% species are Near Threatened (NT), 3.57% species are Not Evaluated (NE), 3.57% species are Endangered (EN) and 1.78% species of fish is Vulnerable (VU) and the similar results were observed in the present investigation.

In the present study Most fish species in the Kinnerasani reservoir are native, and only 8.1% of the fish diversity was represented by exotic species including *Ctenopharyngodon idella, Cyprinus carpio, Clarias gariepinus*, *Oreochromis mossambicus, Oreochromis variabilis*.

In the studies of Rama Rao and Leela [41] the percentage composition of population status was analyzed to 32.81% common, 29.69% abundant, 21.86% moderate, and 15.63% rare species were identified in the Lower Manair Dam. Likewise, Kinnerasani reservoir fish populations also exhibited as 35%common, 31% abundant, 21 % moderate and 13% rare in the population composition. Rama Rao [42] reported the fish species diversity (H) ranged from 2.24 to 3.31. The highest diversity was recorded in the month of September and the lowest in February from the Manair Dam. The similar results were observed in the present study that comprise 2.31 in the month of September and 1.24 in February from Kinnerasani reservoir.

Bhukaswan [43] has emphasized that the reservoir fish composition is mainly affected by public fishing in South East Asia and Indian subcontinent. Meanwhile the level of human impact on biodiversity has been increasing globally because of increase in per capita consumption, trade, agriculture and allied sectors, land settlement, industrial developments and exponential growth of human population. In the present study we also observed the illegal fishing by the traditional fisher men and treated/untreated release of waste water into the reservoir by small and medium industries through domestic sewage that still threat to the fish faunal diversity. On the other hand, it is supposed that constant release of upland agriculture runoff which contains residues caused by excessive use of pesticides and inorganic fertilizers may also lead to water pollution in the Kinnerasani reservoir.

5. CONCLUSION

Owing to lack of earlier baseline information on fish faunal diversity from Kinnerasani reservoir, this work establishes a prime source to biodiversity conservation as of now. Most significantly the present study indicates considerable share in supporting fish faunal biodiversity in the reservoir fisheries despite impacts like habitat destruction, illegal fishing and release of pollutants in the reservoir waters. For future studies this work would be useful to quantify the rate of decline in fish diversity and illustrate the scale of emerging impacts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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