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MORPHOLOGICAL CHARACTERIZATION OF FISH FAUNA (CYPRINIDAE) FROM SUKKUR BARRAGE SINDH PAKISTAN

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ABSTRACT

Cyprinidae is dominant and the largest family of fresh water fishes commonly called "carp or minnow". It is the most diversified family among fish fauna in the world comprises 220 genera including 2420 species belonging to order cypriniformes. The 13 reported species of family Cyprinidae belonging to genus labeo, where 5 species of this genus were recorded from river Indus Sindh Pakistan. The present study was conducted from River Indus (Sukkur barrage) Sindh Pakistan to analyze the taxonomic status of family Cyprinidae from September 2023 to March 2024. Five different stations were selected to collect specimens with the help of fisherman using nets including cast net, pond net, and gills net. The examination of collected specimens was based on Morphometric measurements of different body parts. The morphometric analysis was done using measuring tap, Ruler or slide calipers was used to measure the body parts into centimeters, and weight of collected specimens were measured using Digital weight balance. The data were processed in Excel computer program. A total of 500 specimens of fish fauna were collected during study period, among them Cyprinidae was the dominant having 325 specimens belongs to Cyprinidae family viz; 3 species two genus *Labeo catla* (Thala), *Labeo rohita* (Rohu) and *Cirrhinus mrigala* (Morakhi) have been recorded from collected specimens. Morphometric measurements include 11 traits (Total Length, Fork Length, Standard Length, Head Length, Eye Diameter, and Fins Length (DFL, PFL, PFL, AFL, CFL) all lengths measured in (cm) and weight calculated in (g). The results of species composition with percentage of species were estimated as *Labeo catla* (16.62%), *Labeo rohita* (39.070%) and *Cirrhinus mrigala* (44.31%). While as per the IUCN records the all three fish species were declared as least concern. The present study provided the baseline information for the future generations.

1. INTRODUCTION

Morphometric attributes of Fish fauna are extensively used in the authentication of fish species, its population and find out taxonomic status of species existing in water bodies like lakes, Barrages and Rivers. The Indus River is the Pakistan's most important and primary river with enormous fish ad fisheries resources, originating from Tibetan Plateau near Manasarovar Lake (China). It flows through the Ladakah region of Jammu and Kashmir, then moves towards Gilgit Baltistan, Hindu Kush Mountain and Korakaram ranges. In its southern course, the Indus river courses through almost the whole areas of Pakistan before pour into Arabian Sea at Karachi in Sindh, length wise it stretches (3,200) km and has a total drainage approximately (1,165,000) square km, with (453,000) located in Pakistan, annual flow of River Indus is around (243) cubic kilometers, which is twice to Nile river flow and thrice to cumulative flow of Euphrats and Tigris (Yu *et al.*, 2013).

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Pakistan symbolizes the largest canal system and approximately (27977) fish species were documented and represents (515) families and (62) orders, (Helfman *et al.,* 2009). Some morphometrics analyses of *Cirrhinus mrigala, Labeo catla, Labeo rohita* and some specimens of fishes were recorded from distinct water bodies of India, Pakistan Bangladesh (Gosh *et al.,* 1968; Hoque and Islam, 1985; Narejo *et al.,* 2000; Lashari *et al.,* 2004; Narejo, 2010). The status of three major carp *C. mrigala, L. rohita* and *L. catla* was scrutinized at Downstream of River Indus consisting of (77) fish species which holds (6) exotic and (71) indigenous species (Sheikh *et al.,* 2017). But few studies were reported from Indus River Sukkur (Sukkur barrage) Sindh specifically on the family Cypernidae.

The family Cypernidae is amongst significant families of the fish fauna because it consists of commercially important and tasty fish species such as *Cirrhinus mrigala, Labeo rohita* and *Labeo catla,* belongs to order cypriniformes (Rehman, 1989; Muhammahamd *et al.,* 2017). The studies of very minute morphological characters are important for describing the possible deviations among the phenotypic contrasting characters among intra species of this genus. Different morphometric parameters are used to record the systematic and taxonomic status globally. Morphometery of fish species and its statistical association plays central and crucial role in taxonomic and systematic research and growth volatility (Balae *et al.,* 2017). The population of fish fauna its growth and economic value is also affected by decline in aggregate population of fish and fisheries (Limburg *et al.,* 2011). The 'River Indus' is the principal and major asset for the fishes and fisheries resources, which also support the economy of Pakistan. Therefore the current study and research was proposed to explore the diversity of Pisces of Indus River Sukkur Barrage Sindh Pakistan.

2. MATERIALS AND METHODS

Sampling sites and Collection of samples:
The specimens were cached from Sukkur barrage River Indus Sindh Pakistan. Five different stations were selected to collect specimens with the help of fisherman once in a month using nets including cast net, pond net, and gills net (Hassan *et al.,* 2020a). After collection the fish specimen were instantly shifted into Ice boxes and brought to laboratory at Department of Zoology Shah Abdul Latif University for further processing.

Species Identification and Morphometric measurements of traits:
The morphometric analysis was done using Ruler or slide calipers to record the measurements of the various structures of the body into millimeters and in centimeters, to calculate the weight of specimens' digital weight balance was used and the specimens were preserved in 10% formalin, identification of fish fauna were done with specific standard keys (Jingran and Talwar, 1991). Every individual fish specimens was taken out from storage box and washed with tape water and morphometric measurements were taken into mm or cm. Total 11 morphometric traits were measured including (Total body length, Standard Length, Fork Length, Eye Diameter, and Head Length. Fins Length: Dorsal Fin Length, Pectoral Fin Length, Pelvic Fin Length, Anal Fin Length and Caudal Fin Length) (Table.1 and Fig. 2)

3. RESULTS AND DISCUSSION

The present study was conducted from River Indus (Sukkur barrage) Sindh Pakistan to analyze the taxonomic status of family Cyprinidae from September 2023 to March 2024. A total of 500 specimens of fish fauna were collected during study period among them Cyprinidae was the dominant species among all collected specimens having 325 specimens belongs Cyprinidae family. The 03 species with two genuses *Labeo catla* (Thala), *Labeo rohita* (Rohu), *Cirrhinus mrigala* (Morakhi) have been recorded from collected specimens (Table 2). While as per the IUCN records the all three fish species were declared as least concern (Table 6). The results of species composition with percentage of each species was calculated as *Labeo catla* (16.62%), *Labeo rohita* (39.070) and *Cirrhinus mrigala* (44.31%) (Table 3). Stastical analysis of Morphometric measurements include 11 traits which were measured in (cm) and weight in (g) (Table 4). The phenotypic characteristics of *L. catla* were observed as *L. catla* is also known as *Catla catla* and commonly known as Thala fish belongs to family Cyprinidae and economically important and edible fish with big and broad head, large protruding jaw with thick lips, whitish scales present on belly, Dorsal side of body having grayish scales, Dorsal , Caudal, and anal fins are grayish in colour while pectoral and pelvic fins are pink redish at the base, Eye colour is pure black, the *C. mrigala* commonly known as Morakhi or this species belongs to family Cyprinidae, most popular throughout the Asia, and phenotypic characteristics are body elongated, upper lips curved downward, having blunt snout, Head is small having silver scales, Eyes are reddish in colour, dorsal side of the body had grayish scales while belly

having silver and shiny scales, caudal, dorsal fins are grayish while pelvic, anal fins, and pectoral fins orange pinkish in colour specially at the time of breeding season, males are more colorful and bright but usually small in size and their anal fin rod shaped, while females having traditional fan shaped anal fin and well developed gonopodium, and third species was *Labeo rohita* commonly known as Rohu 'Rui' Ruee or Tapra fish it is large omnivore and edible fish with conspicuously arched and depressed head with blunt snout, eyes are small, lower lips are frill like long and circular, dorsal side of the body contain dark grey scales with light black grey outline, Dorsal and caudal fins are dark red and maroon in colour while the fins on the pectoral and anal region are red in colour belly is swollen at anal fin and gonopodium is well developed in females, while lateral side of belly having silver scales (Table 5) shows the comparative study of present study with already reported species on the basis of morphometric traits.

Multiple studies have been conducted on fish fauna to explore its abundance in River Indus and its tributaries. These studies reports various number of Pisces fauna species comprises of (11) members of cyprinids, (8) members of cat fish species from Manchar lake (Jafri et al., 1999; Khan et al., 2008). *Cirrhinus reba*, *Labeo rohita*, *Cirrhinus mrigala* and *Labeo calbasu* are common fish fauna of river Indus which are noted from various vicinities of Punjab Pakistan (Rafique, 2000; Rafique and Khan, 2012). Family Cyprinidae is the most diverse having lots of species found in River Indus drainage system having (70) species (Rafique, 2000), current status also validate these findings with three species associated with family Cyprinidae and most speciose (Tlwar and Jhingran, 1991). *Cirrhinus mrigala*, *Catla catla*, *Labeo rohita* are the most commercially crucial carps of South East Asian region and India they were found to be frequently and opulent in this study reported, (51) fish fauna of Keenjhar Lake, includes thirty species which are popular as game fishes and possess high economic value (Korai et al., 2008).
There was substantial monthly variation in relative abundance (%) of fish fauna (Fig. 2).The relative abundance and frequency is higher in the months of winter as compare to summer season. This could may be due to seasonal effect or fish may hide itself under natural shelters, fish capture rely on behavior of fish and feeding habits, Species richness and its abundance variations in different months of sampling collection have been observed in various research papers by different scholars (Ornellas and Coutinho,1998; Pires et al., 1999; Reichard et al., 2002). Fish fauna biometry assists in authentication of specimens' population and relationship, management, growth and conservation of fishes (Bano et al., 2022; Chowdary et al., 2022), there are certain environmental factors such as water current, temperature, seasonal change, turbidity of water, habitat of fish its reproductive cycle, timing of capture influence on fish capture and over all its population (Walters and Martell, 2002), in contrast to observing these factors in present research these elements analyzed that they effect on overall population of fish fauna abundance and occurrence in river Indus Sukkur Barrage Sindh Pakistan.

4. CONCLUSION

The present study was the part of ongoing studies on Ichthyodiversity fauna from Sukkur Barrage Sindh Pakistan having increased number of fish species. In summary amongst the assessed fish fauna diversity from River Indus Sukkur Barrage Sindh Pakistan the Cyprinidae family being most dominant and abundant at study area. The richness, (%) occurrence frequency is varied with seasonal change and month. Future research work is required to find out and evaluate the factors affecting the richness of fish fauna in particular season.

5. CONFLICT OF INTEREST

All authors have declared that there is no conflict of interest regarding the publication of this article.

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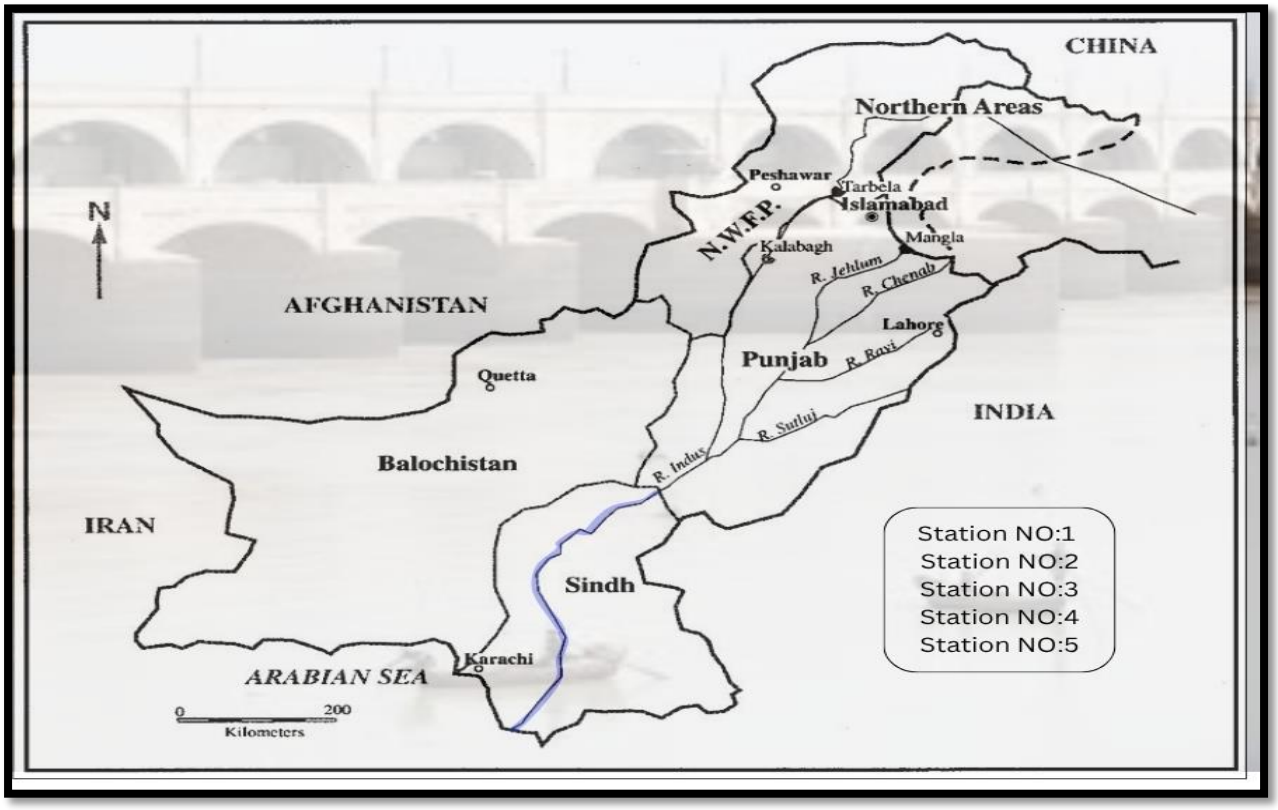

Figure 1. Map of Sindh showing Study Area

Table 1. Descriptive account of Morphometric Analyzed in study

Morphometric Trait	Acronyms	Description
Total Length	**TL**	Measurement from the region of snout to posterior end of caudal fin
Fork Length	**FL**	Distance from tip of snout to the point of bifurcation of caudal fin
Standard Length	**SL**	Distance from snout region to end of vertebral column
Head Length	**HL**	Distance from the edge of snout to the posterior edge of gill cover
Eye Diameter	**ED**	Maximum length between anteroposterior margin of eye
Dorsal Fin Length	**DFL**	Length between anterior and posterior edge of dorsal fin along the fin base
Pectoral Fin Length	**PFL**	Length between anterior and. posterior edges of pectoral fin along the fin bottom
Pelvic Fin Length	**PFL**	Length between Posterior and anterior edge of pelvic fin along the fin root
Anal Fin Length	**AFL**	Length between anterior and. posterior edge of Anal fin along the fin base
Caudal Fin Length	**CFL**	Length between anterior and posterior edge of caudal fin along the fin base

Table 2 Total specimens collected during study period

Genera	*Labeo*		*Cirrhinus*		*Labeo*		
Species	***L. catla***		***C. mrigala***		***L. rohita***		
Month of Collection	♂	♀	♂	♀	♂	♀	
September	07	0	10	08	06	09	**All specimens collected from Sukkur barrage**
October	09	0	13	09	10	07	
November	06	0	08	06	06	07	
December	04	0	10	07	12	08	
January	03	0	12	10	17	10	
February	15	0	15	14	11	12	
March	10	0	10	12	07	05	
Total numbers	**54**	**00**	**78**	**66**	**69**	**58**	**325**

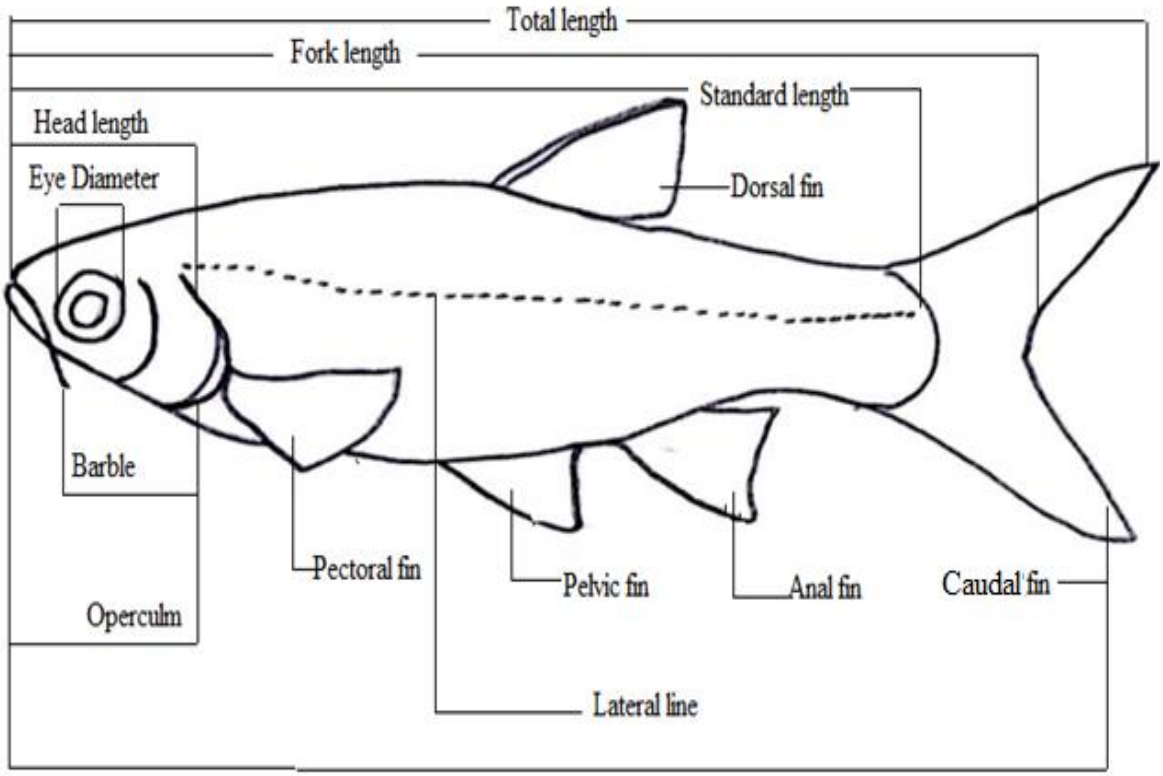

Figure 2. Showing the morphometric traits of fish family Cyprinidae

Table 3 Species composition, relative abundance and percentage occurrence of species

Family	*Species*	*Common name*	*N by sex*		*% by no*
			Male	*Female*	
Cyprinidae	*Labeo catla*	Thala	54	00	16.615%
	Cirrhinus mrigala	Morakhi	78	66	44.307%
	Labeo rohita	Rohu	69	58	39.076%

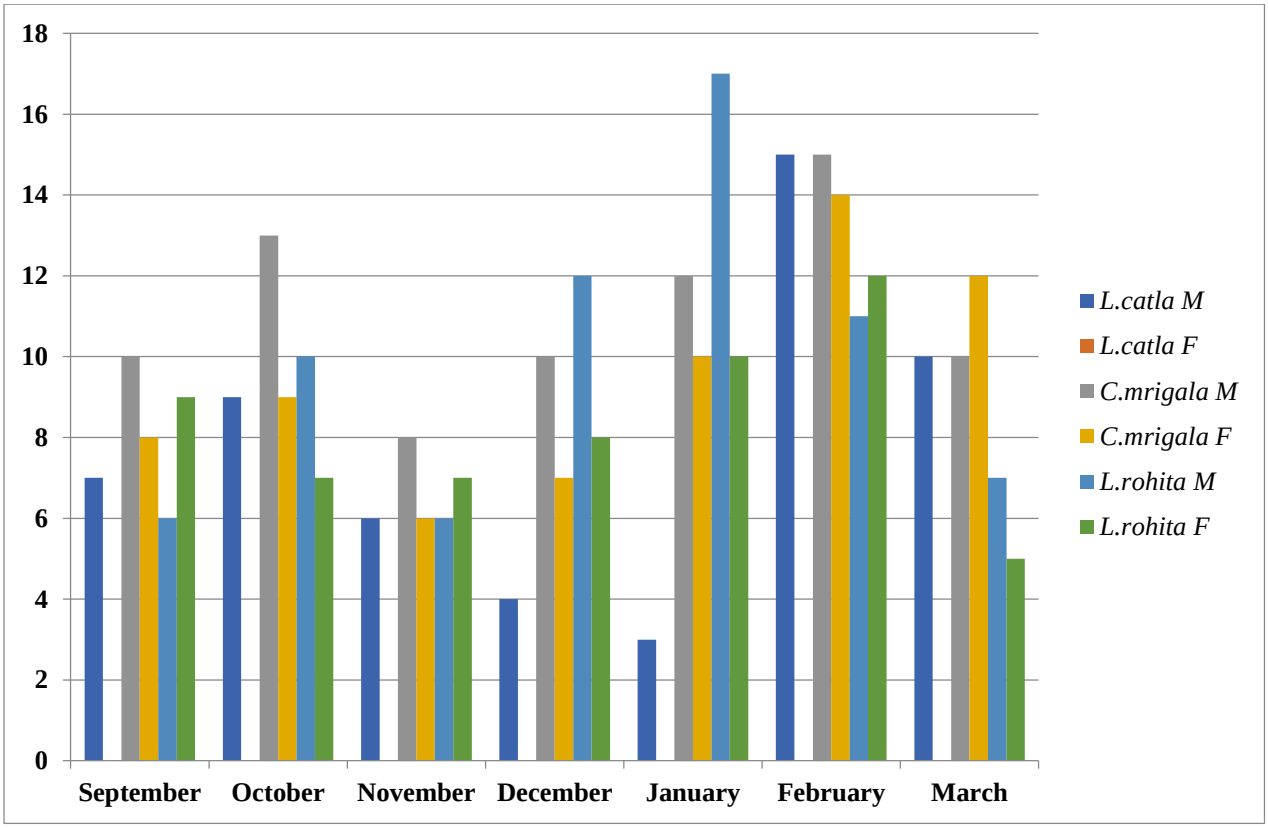

Figure 3. Shows Month Wise Data Collection of specimens from study Area 2023-2024

Table 4 Mean, maximum, minimum, range value of the morphometric characteristics of collected specimens from River Indus Sukkur Barrage Sindh Pakistan.

Species	*No. of fishes*	*TL (cm)*	*FL (cm)*	*SL (cm)*	*HL (cm)*	*EY (cm)*	*DFL (cm)*	*PFL (cm)*	*PEFL (cm)*	*AFL (cm)*	*CFL (cm)*	*WT (g)*
Labeo catla (M)	54	25.77 ±4.31	22.89 ±3.95	21.12 ±4.34	4.67 ±1.14	0.75 ±0.23	6.40 ±1.51	4.94 ±1.19	4.82 ±1.15	3.90 ±1.26	3.90 ±1.26	291.55 ± 138.45
Cirrhinus mrigala (M)	78	24.30 ±3.76	21.29 ±3.86	17.46 ±4.25	3.62 ±0.94	2.67 ±1.11	3.68 ±0.77	3.57 ±0.85	4.04 ±0.65	3.99 ±0.68	4.32 ±0.56	243.24 ±113.02
Cirrhinus mrigala (F)	66	25.25 ±4.20	22.01 ±4.45	18.08 ±4.57	3.87 ±0.911	3.01 ±1.01	4.31 ±0.85	3.92 ±1.01	4.45 ±2.41	3.98 ±0.64	4.19 ±0.70	331.34 ±148.39
Labeo rohita (M)	69	21.52 ±4.61	18.69 ±4.35	16.32 ±4.48	4.65 ±0.80	0.66 ±0.24	3.98 ±0.64	3.61 ±0.57	3.75 ±0.45	3.42 ±0.45	4.79 ±0.69	296.30 ±150.55
Labeo rohita (F)	58	24.74 ±5.49	22.39 ±5.43	20.08 ±5.22	4.07 ±1.17	0.76 ±0.22	4.36 ±0.88	3.37 ±o.59	3.81 ±0.70	3.86 ±0.66	4.93 ±1.10	348.32 ±160.98

Abbreviations: *TL=total length, SL= (standard length), HL (head length), EY= (eye diameter), DFL= (dorsal fin length), PFL= (pectoral fin length), PEFL= (pelvic fin length), AFL= (Anal fin length), CFL= (Caudal fin length), WT= (weight), M=(male), F=(female)*

Table 6 Status of studied species as per IUCN Red list of threatened species in the River Indus Sukkur Barrage Sindh Pakistan

Order	Family	Species	IUCN Red list of threatened species	Reference	Occurrence
Cypriniformes	Cyprinidae	*Labeo catla* (Hamilton, 1822)	Least concern	(Dahanukar, 2010)	Indigenous species
		Cirrhinus mrigala (Hamilton, 1822)	Least concern	(Dahanukar, 2010)	Indigenous species
		Labeo rohita (Hamilton, 1822)	Least concern	(Tenzin, 2010)	Indigenous species

Table 5 Comparison of the observed species in present study of family Cyprinidae with already described species of same family

CHARACTERISTICS	*CATLA ALREADY REPORTED*	*CATLA PRESENT STUDY*	*MRIGAL ALREADY REPORTED*	*MRIGAL PRESENT STUDY*	*ROHU ALREADY REPORTED*	*ROHU PRESENT STUDY*	REFERENCES
BODY SHAPE	➢Wider Body	✓Wider Body	➢ Depth Slender	✓ Slender robust	➢Body Moderate	✓Body Moderate	Abro*et al*., 2023;
MOUTH	➢ Upturned mouth ➢ Circular mouth gap/ opening ➢Lower lip folded but not fringed ➢Lower lip and upper lip ends at same point.	✓Mouth upturned ✓large protruding jaw with thick lips ✓Lower lips and upper lips ends at same point	Mouth inferior D-shaped /rectangle ➢Lower lip neither folded nor fringed Extending upper lip which covers the lower lip	✓ Mouyh inferior ✓ upper lips curved downward, having Pointed snout, ✓ Lower lips are frill like long and circular, upper lip covers lower lip	➢ Terminal mouth ➢ Square mouth gap Lower lip fringed and folded ➢Extend in upper lip which covers the lower lip	✓ Mouth terminal ✓ Lower lip fringed ✓ Upper lip extending which covers the lower lip	Muhammad *et al*., 2016; Muhammad *et al*., 2018; Sarder *et al*., 2011)
EYE	➢A red spot on lower part of eye bal	✓Eye color is pure black	➢ No any red spot	✓ Eyes are reddish in color	➢ No such red spot	✓Pure Red color	
FIN COLOR	➢ All fins are darkish in color	✓ Dorsal, Caudal, and anal fins are grayish in color while pectoral and pelvic fins are pink reddish at the base	Pectoral, pelvic and anal fins are orange in color	✓ Dorsal and Caudal fin grayish while pelvic, pectoral and anal fins are pinkish orange in color	Pelvic fins are red in color and other fins are darkish in color	✓ Dorsal and caudal fins are dark red and maroon in color while the pectoral, pelvic and anal fins re red	
HEAD SIZE/ SHAPE	Larger head	✓ large and broad head	Isosceles head	✓ Head is small	Equilateral head	✓ Arched and depressed Head with blunt snout	
SCALE SIZE/SHAPE	Larger scale	✓ Large scales	Exposed portion of scale is rectangular shaped	✓Rounded or hexagonal	➢Exposed portion of scale is diamond shaped	✓ Round or Oval	
BODY COLOR	Dorsal side blackish in color while ventral region silvery	✓ Silvery And blackish or grayish	Silvery	✓ Silvery and shiny golden	Slight golden appearance with darker dorsal side	✓ Golden appearance with darker black dorsal side	