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Morphological description and taxonomic account of *Labeo* species (Cypriniformes, Family: Cyprinidae) from Gujarat, India

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Abstract

The present survey was conducted out in all the major freshwater aquatic systems of Gujarat from February 2014 to May 2015 as a part of total diversity documentation of freshwater fishes from the state. The examination of the morphometrics, meristic counts and morphological observations has been used for this study and identification of each of the species of *Labeo sp.* was done as per the available standard keys. It is the most diverse genus of the family Cyprinidae consisting around 108 species around the world. A total of 10 species viz., *Labeo bata*, *Labeo boga*, *Labeo boggut*, *Labeo calbasu*, *Labeo dussumieri*, *Labeo gonius*, *Labeo nigripinnis*, *Labeo pangusia*, *Labeo potail* and *Labeo rohita* have been recorded. Also observations showed that most of the species have been caught and recorded from lotic water systems except *Labeo rohita*, which is also commonly used as one of the IMC carps.

Keywords: *Labeo* spp., taxon, diversity, morphology, Gujarat

1. Introduction

India is an exceptional hotspot of freshwater fish diversity with a high degree of endemism contributing to the world's biological resources. Understanding of species and communities reveal crucial facts necessary to the management of ecosystem and habitat [1]. Also the conservation of the freshwater fishes has never been adequately addressed in Gujarat which has been mainly due to prime focus on the marine fisheries and lack of scientific data, perception about the criteria to be used for the characterization and designating conservation status of freshwater fishes. Fishes of the genus *Labeo* are cyprinids belonging to the *Labeo* lineage in the subfamily Cyprininae [2]. Cyprininae have a large distribution (Africa, Northern America, Southern Central America to Guatemala, Asia and Europe), but the *Labeos* occur only in Africa and South-East Asia. The *Labeo* lineage is the second most important group of cyprinid fishes after the Barbiinae, and in Asia, it represents about 19.6% of the cyprinid species composition [3]. The genus *Labeo* (Cuiver, 1816) with approximately 103 species around the world is arguably the most dominating group of the Cyprinidae family. This genus is represented by 28 species widely distributed throughout South and South-East Asia [4]. In many regions, an increasing importance of *Labeo* as food fish is noted [5, 6]. Also being widely cultivated as a part of aquaculture, some of the species of this genus are reared for ornamental purpose, some as food species, some for extracting oil and some are considered to be of medicinal value also. This genus is a column and bottom feeder and feeds on algae, small fishes and crustaceans.

Labeos can be distinguished from the other genera of this family because of their unique characters bearing thick-lipped and sucking mouth on the underside of the head with two to four small barbels. The diagnostic characters of the genus *Labeo* are well known and accurate [7, 8]. Here, we are presenting the results of a systematic and taxonomic account of the *Labeo* species documented from Gujarat.

2. Materials and Methods

The present study was carried out during the freshwater ichthyofaunal diversity assessment in the state of Gujarat from February 2014 to May 2015.

2.1 Collection of specimens

Survey was conducted all throughout the freshwater sources of the state. Sampling was done in all the sources in various sources using cast netting and gill nets for a period of 15 months.

On site photographs were taken for observation of appropriate morphometric measurements and coloration.

2.2 Species identification

The studies of very minute morphological characters are important for elucidating possible difference among the phenotypic variation among intra species of this genus. Morphometric measurement of fishes and the study of statistical relationship among them are essential for taxonomic study, systematics and growth variability [9]. The identification was done using standard available keys like Day's volume I and II [10], Inland Fishes of India and Adjacent Countries [11], Freshwater Fishes of India [12] and Leibniz Institute of Marine Sciences (IFM-GEOMAR) in Kiel, Germany managed website www.fishbase.org [13], a global species database for fishes.

The GPS locations were noted for cartographical references. For each of the specimen, 8 measurements including Total length (TL), Standard length (SL), Fork length (FL), Head length (HL), Snout length (SL), Dorsal fin base length (DFL), Eye diameter (ED), Caudal peduncle length (CPL) and height of Caudal peduncle (CPH) have been taken using callipers and 9 meristic counts were made for the fin formula which is composed of as follows: branchiostegal rays, dorsal fins, pectoral fins, ventral fins, anal fins, caudal fins, lateral line scales and scales of lateral transverse.

2.3 Preparation of list

A checklist of various *Labeo* species retrieved during the data collection from Gujarat in the entire period was prepared.

2.4 Storage of specimens

All the specimens have been given proper voucher numbers and are stored in glass jars containing 4% formalin in the museum of Department of Zoology, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat for future scientific references and studies.

3. Results and Discussions

A complete review of all the found species of the genus *Labeo*, with detailed morphological descriptions and morphometric analyses based on sufficiently large samples, has never been undertaken by past ichthyologists in Gujarat. Specimens of *Labeo* have been quite poorly represented in the ichthyological collections of Gujarat as most of the collected specimens were marine and also because of their large size and similar morphological features; species were often described on the basis of single museum specimens, either in a poor state of preservation, or in an early stage of development, in which proportional dimensions and morphological characters diagnostically important are often substantially different from the adult. Lack of insight of the overall degree of diversity within the genus *Labeo* resulted in the failure of all past accounts to provide a framework for a systematic organization of the genus. As a consequence, the taxonomy of the genus *Labeo* is in a state of considerable confusion, and its revision is long overdue in the state of Gujarat.

The present survey work has described 10 species of *Labeo* sp., viz., *Labeo bata*, *Labeo boga*, *Labeo boggut*, *Labeo calbasu*, *Labeo dussumieri*, *Labeo gonius*, *Labeo nigripinnis*, *Labeo pangusia*, *Labeo potail* and *Labeo rohita*. A comprehensive list with the proper voucher numbers, the morphometric measurements is listed in Table 1.

1. *Labeo bata* (Hamilton, 1822)

Description: The dorsal profile is slightly more convex than that of the abdomen and its greatest width of the head equals its length excluding the snout. The lips are thin, continuous and the lower one is reflected from off the mandible and with a shallow groove along its hind edge. There is a presence of tubercle inside the lower jaw above the symphysis. They have a short pair of maxillary barbels. Teeth are pharyngeal, plough shaped or molariform. The dorsal fin is as high as the long head with a concave upper edge and the pectoral fin is almost as long as the head and reaches the ventral which is rather shorter. The caudal fin was observed to be deeply forked.

Fin Formula: B.iii, D. 10 (2/8 – 3/10), P. 16, V. 7, A. 7, C. 18, L. I. 35, L. tr. 6.

Ecology: It is a benthopelagic and potamodromous species, which inhabits rivers. It is a herbivorous column feeder.

2. *Labeo boga* (Hamilton, 1822)

Description: It has a narrow mouth and snout moderately projects beyond the jaws and has no lateral lobe. The lips are rather thick and the lower being reflected from off the mandible and internally roughened. A thin layer of cartilage to inner surface of lower lip and snout is covered with large pores. There are two minute maxillary barbels. The colour of the body is orange with a reddish tinge in the fins.

Fin Formula: B. iii, D. 12(2/9-3/10), P. 16, V. 8, A. 7, C. 18, L. I. 37, L. tr. 7.

Ecology: It inhabits large rivers and their tributaries, above tidal influence and attains a length of 30 cm and it spawns in flooded rivers.

3. *Labeo boggut* (Sykes, 1839)

Description: The inter-orbital space is convex. They have a thick projecting snout extending beyond the jaws with a few minute pores on them. Lower labial fold is complete and lower lip fimbriated. Gill rakers are very short and widely set. A short maxillary barbel is present. The upper edge of the dorsal fin is concave and it commences nearer to the snout than the root of the caudal. The pectoral is as long as the head while the ventral does not extend to the anal and the caudal is deeply forked. It is silvery in colour with darker superiorly.

Fin Formula: B. iii, D. 11, P. 16, V. 9, A. 7, C. 18, L. I. 63, L. tr. 12.

Ecology: It is found in rivers and reservoirs and attains a total length of 29 - 31 cm [13]. In some areas of its distribution, there is habitat degradation caused by organic and inorganic pollution [14].

4. *Labeo calbasu* (Hamilton, 1822)

Description: The width of the head equals its length excluding the snout. The mouth is rather narrow with obtuse and depressed snout. The lips are thick and fringed and each has a distinct inner fold. They have very short gill rakers. Four pairs of barbels are present. The dorsal fin commences in advance of the ventrals and midway between the snout and the base of the deeply forked caudal. Colour is blackish but occasionally the upper lobe of the caudal is white.

Fin Formula: B. iii, D. 16, P. 18, V. 8, A. 6, C. 18, L. I. 42, L. tr. 7.

Ecology: It occurs in rivers and ponds; in slow-moving waters of rivers and it is essentially a bottom feeder that feeds on plants, filamentous algae and diatoms [15, 16].

5. *Labeo dussumieri* (Valenciennes, 1842)

Description: The width of the head equals its length behind the angle of the mouth. The mouth is of moderate width and inferior, surrounded by fleshy, fringed lips, having a distinct inner fold above and below with no lateral lobe. Presence of numerous pores on the snout and it extends posteriorly as far as the orbits and below the nostrils. There are four minute barbels and shot gill rakers. The dorsal fin with concave upper edge commences midway between the end of the snout and end of the base of the anal fin. The caudal is deeply forked. The colour of the body is greyish and scales are having a reddish centre edged with a darker side.

Fin Formula: B. iii, D. 15, P. 16, V. 9, A. 6, C. 18, L. I. 54, L. tr. 8.

Ecology: It is known to inhabit streams above the tidal reach^[17], flood plain areas^[18], backwaters^[17] and reservoirs^[19]. On the basis of the feeding ecology and diurnal migrations *L. dussumieri* has been identified as litoral (periphyton) feeder^[18].

6. *Labeo gonius* (Hamilton, 1822)

Description: The dorsal profile is more convex than that of abdomen. The greatest width of the head equals its length excluding the snout. The mouth is rather narrow and there is presence of numerous pores in the snout. In the lips, there is a distinct fold in the total circumference, both of which are fringed. A cartilaginous covering is present to the inner side of both jaws. There are short rostral and maxillary barbels. Teeth are in the form of plough shaped. The dorsal fin commences much nearer the snout than the base of the caudal fin with concave upper edge. The pectoral fin is nearly as long as the head and a deeply forked caudal.

Fin Formula: B. iii, D. 16, P. 16, V. 8, A. 7, C. 18, L. I. 78, L. tr. 16.

Ecology: It inhabits rivers. This species breeds during monsoon season (July and August) and is a very prolific breeder^[21-23]. It also breeds in paddy fields in some areas.

7. *Labeo nigripinnis* (Day, 1877)

Description: The dorsal profile is somewhat elevated and abdomen is almost straight. The greatest width of the head equals its length behind the middle of the eyes. Snout is projected over the mouth which is inferior and equals to one-third of the length of the head

Fin Formula: B. iii, D. 11, P. 16, V. 8, A. 7, C. 18, L. I. 40, L. tr. 8.

Ecology: It was largely found inhabiting the large ponds and less in rivers.

8. *Labeo potail* (Sykes, 1839)

Description: Eyes are situated in the commencement of the posterior half of the head, from 4 to 6 diameters in the length of the body. The inter-orbital space is convex and its width equals half the length of the head. Mouth is narrow, its width

being equal to 1/3 of the length of the head. The snout overhangs in front of the mouth with a slightly protruded lateral lobe and a deep groove exits across the chin. There is a cartilaginous layer to the inner side of both the jaws. It only has a maxillary pair of barbels.

Fin Formula: B. iii, D. 13, P. 16, V. 9, A. 7, C. 18, L. I. 37, L. tr. 8/7.

Ecology: *Labeo potail* is a benthopelagic species, which inhabits rivers and streams in the upper reaches^[13]. Habitat quality where the species is found is declining due to alterations caused by anthropogenic activities including organic and inorganic pollution^[24, 25].

9. *Labeo pangusia* (Hamilton, 1822)

Description: The greatest width of the head equals 2/3 of its length. The mouth is narrow, its width equal to 3 3/4 in the length of the head. Snout obtuse, projecting over the jaws and having a very distinct lobe, the snout is covered with large pores. A cartilaginous covering the inner surface of both lips is present. Gill rakers are short and closely set. A short maxillary pair of barbel is present in the labial fold. Teeth are pharyngeal and plough shaped. The dorsal fin commences nearer the snout than the base of the caudal, it is nearly or quite as high as the body and in the adult, and the upper edge is concave. Pectoral does not quite reach the ventral, nor the ventral latter than the anal. The caudal is deeply forked. The colour is usually dull green, becoming lighter on the sides and beneath, sometimes the base of each scale has a dark mark.

Fin Formula: B. iii, D. 14, P. 14, V. 9, A. 7 (2/5), C. 18, L. I. 40, L. tr. 8.

Ecology: It inhabits mountain streams, rivers, lakes and ponds^[10, 26].

10. *Labeo rohita* (Hamilton, 1822)

Description: The diameter of the eyes is 4 to 6 in the length of the head, 1 1/2 to 2 diameters from end of the snout and 3 are apart. The inter-orbital space is flat. Dorsal profile more convex than that of the abdomen, it is a little concave over the orbit. The greatest width of the head equals its length excluding the snout. The snout is obtuse and depressed, scarcely swollen but projects beyond the jaws. Lips are thick and fringed and with a distinct inner fold above and below. The gill rakers are stiff and are half as long as the eye. There is a short and thin maxillary pair of barbel.

Fin Formula: B. iii, D. 13, P. 18, V. 9, A. 8, C. 18, L. I. 44, L. tr. 8.

Ecology: Rohu is the natural inhabitant of freshwater sections of the rivers and thrives well in all fresh waters below an altitude of approximately 549 m. It is a bottom feeder and prefers to feed on plant matter including decaying vegetation and attains maturity towards the end of the second year in ponds. The spawning season of rohu generally coincides with the southwest monsoon. Spawning takes place in flooded rivers.

Table 1: Species type and morphometric measurements of each of the species

Sr No	Species type	Voucher number*	GPS coordinates	IUCN status**	MEASUREMENTS (in cm)							
					Total length (TL)	Standard length (SL)	Fork length (FL)	Snout length (SL)	Dorsal fin base length (DFL)	Eye diameter (ED)	Length of caudal peduncle (CPL)	Height of caudal peduncle (CPH)
1	<i>Labeo bata</i>	ZL-CH-OST-059	23°18'95" N 73°89'28" E	LC	25.3	23.8	24.8	1.5	4	0.5	1.5	2.8
2	<i>Labeo boga</i>	ZL-CH-OST-050	21°17'25"N 72°83'7"E	LC	17.4	16.7	16.9	1.3	2.2	0.4	0.7	1.3
3	<i>Labeo boggut</i>	ZL-CH-OST-061	22°20'25"N 73°03'6"E	LC	18.5	17.3	17.9	1.3	3.2	0.4	1.2	1.7
4	<i>Labeo calbasu</i>	ZL-CH-OST-062	22°20'30.69" N 73°03'04.51" E	LC	14.7	14.1	14.3	1.2	2.3	0.4	0.6	1.2
5	<i>Labeo dussumieri</i>	ZL-CH-OST-063	22°20'30.69" N 73°03'04.51" E	LC	16.2	15.6	15.9	1.2	1.9	0.4	0.6	1.2
6	<i>Labeo gonius</i>	ZL-CH-OST-064	22°20'30.69" N 73°03'04.51" E	LC	17.5	16.8	17.1	1.3	2.9	0.5	0.3	1.4
7	<i>Labeo nigripinnis</i>	ZL-CH-OST-066	22°20'25"N 73°03'6"E	NE	19.2	18.4	18.7	1.6	3.1	0.5	0.6	1.4
8	<i>Labeo potail</i>	ZL-CH-OST-068	21°17'25"N 72°83'7"E	EN	23.7	22.1	22.5	1.3	3.5	0.7	1.6	2.6
9	<i>Labeo rohita</i>	ZL-CH-OST-069	22°40'27"N 73°12'18"E	LC	28.7	27	27.5	1.4	2.6	0.7	1.7	2.9
10	<i>Labeo pangusia</i>	ZL-CH-OST-070	22°09'42.39"N 73°28'35.41"E	NT	21.3	19.8	20.3	1.6	2.1	0.5	1.5	1.6

*Voucher numbers: ZL – Zoology; CH – Chordata; OST – Osteichthyes.

**IUCN Status: LC – Least Concern; NE – Not Evaluated; EN – Endangered; NT – Not Threatened.

The species recorded and described in the study were mostly in the category of Least Concern (LC) except the species *Labeo nigripinnis*, *Labeo potail* and *Labeo pangusia* which belongs to the category of Not Evaluated (NE), Endangered

(EN) and Not Threatened (NT) respectively (<http://www.iucnredlist.org/>) [27]. This suitably describes the wide presence of *Labeo* sp. among all the water sources of Gujarat.

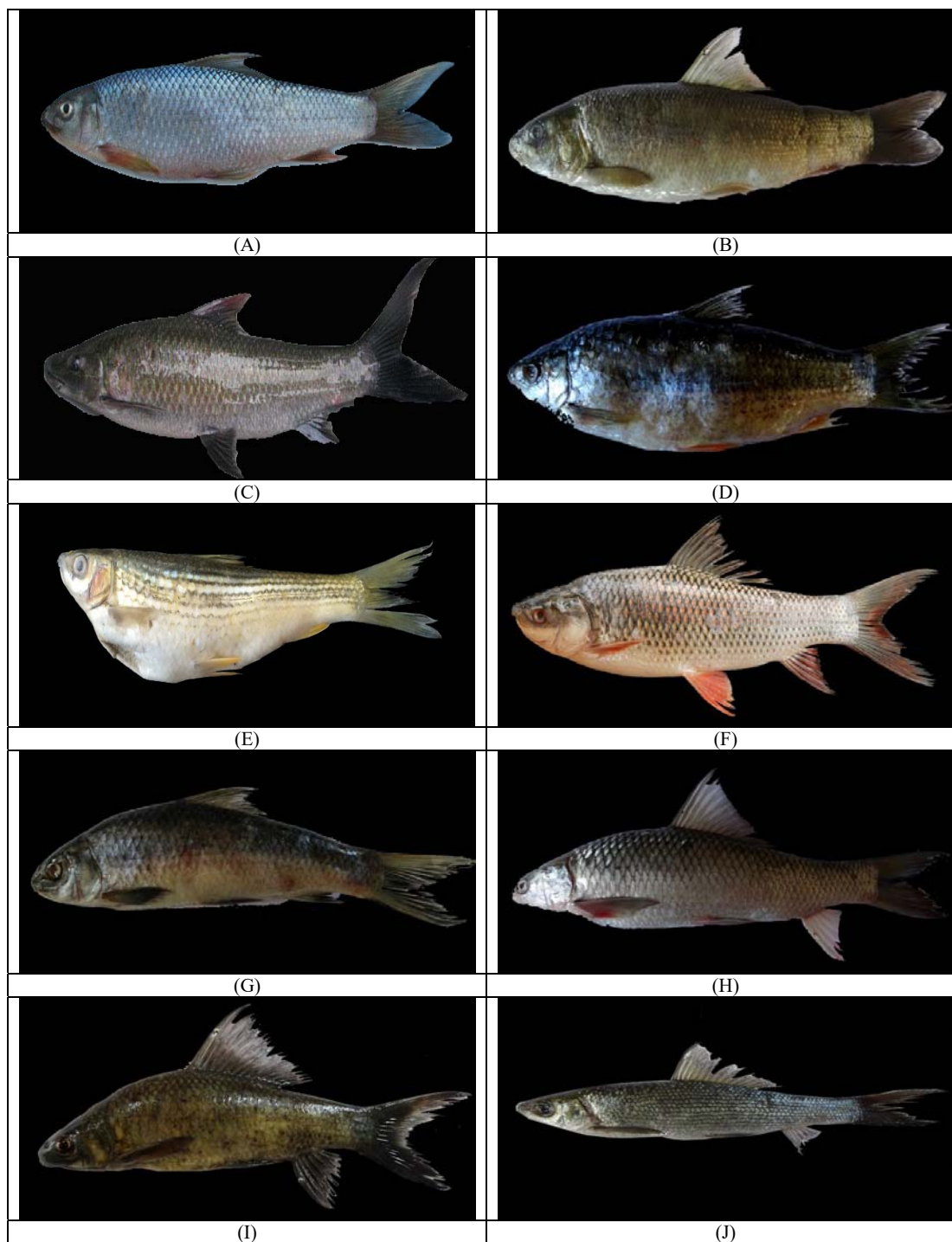


Fig 1: Photographic plate of the collected fish specimens: (A) *Labeo pangusia*; (B) *Labeo boga*; (C) *Labeo boggut*; (D) *Labeo bata*; (E) *Labeo dussumieri*; (F) *Labeo rohita*; (G) *Labeo nigripinnis*; (H) *Labeo potail*; (I) *Labeo calbasu*; (J) *Labeo gonius*.

4. Conclusion

The paper reveals the diversity and distribution of 10 species of *Labeo* genus in Gujarat for the first time. It was observed that the distribution of fishes were scattered mostly in the central and southern part of the state as per the survey though the fact that such occurrence of species in water bodies of different parts of Gujarat also cannot be ruled out. The reason for such a type of distribution may be attributed to the

existence of semi perennial rivers in these parts. *Labeo rohita*, being available as a prime entity of aquaculture, was also found among wild varieties in natural water bodies. It is to be noted that *Labeo nigripinnis* was the only species which was found in lentic systems, ponds and reservoirs. This work was part of a survey work for the ichthyofaunal diversity for the freshwater fishes of Gujarat but more such diversity, ecology and distribution work for *Labeo* genus in Gujarat can be

executed to know about the present condition and status of this largely dominated group of cyprinid fishes.

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