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Diversity of *Puntius* (Cyprinidae: Cypriniformes) from Lower Anicut, Tamil Nadu

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ABSTRACT

Lower Anicut is one of the major fishing point in the Cauvery river system in Tamil Nadu which is selected for the present study. The aim of the study is to find out the taxonomic diversity and biometric characters differences in the genus *Puntius* from Lower Anicut (Kollidam river), Tamil Nadu. The Kollidam river inhabits naturally ornamental and edible fishes like *Puntius* species. 50 individuals of *Puntius* species were collected from this site. The specimens are preserved and stored in laboratory. Thereafter recorded the biometric (morphometric and meristic) characters of *Puntius sophore*, *Puntius filamentosus*, *Puntius sarana*, *Puntius ticto* and *Puntius conchoni*. The morphometric measurements and meristic counts of all individuals of the *Puntius* species were taken into account for identification. In the present study, 45 - morphometric (Standard length = $Nbc/SL*100$ and Head length = $HLc/HL*100$) and 31-meristic characters were recorded for five species of the genus *Puntius*. The various statistical values were made by using Microsoft Office Excel.

Key words: Diversity of genus *Puntius*, Biometric study, Taxonomic characters.

INTRODUCTION

The aquatic resource of the seven South Indian states – Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Pudhucherry, Goa and parts of Maharashtra cover about 20 % of rivers and canals, 38.6 % of reservoirs, 50 % of tanks and ponds and 63 % of swamps and derelict water source of India⁴. Generation of proper database on germplasm resources is a vital safeguard of our biodiversity and evolves a plan for their proper utilization. However, the fast flowing streams and rivers have been an excellent habitat and environment to enabling the evolution of rich fishes. Diversity of the Southern and Central division of Western Ghats constitutes one of the few sites in the world showing a high degree of endemism with respect to freshwater fishes. According to the fish diversity of Cauvery river system has been reported by^{29,3} have worked on the fish diversity of Grand Anicut, Tiruchirappalli Tamil Nadu.

The barbs belong to genus *Puntius* under the order Cypriniformes and most abundant as to individuals in the fish fauna widely distributed in South Asia. Cyprinidae is one of the largest family among the freshwater fishes which includes Carps, (*Labeo rohita*, *Catla catla*, *Cirrhinus cirrhosus*, *Labeo calbasu* etc.), Barbs (*Puntius* sp.) and a large variety of minnows (*Esomus danricus*, *Amblypharyngodon mola* etc.). The name “*Punti*” is extensively used in Bangladesh⁴¹. Herein, the morphometric and meristic characters are mainly helpful easy and exact identification of fish species in laboratory as well as at natural places³¹. Besides, some weed fishes are found in most of the water bodies. Among them the four species of genus *Puntius* viz., *Puntius conchoni*, *P.chola*, *P.sophore* and *P.ticto* are easily available in natural water bodies of Central India^{1,47,48,17,35,59}. In addition, it is an important small indigenous fish species of Bangladesh and very much famous food fish⁴¹ and can also be used as aquarium fish¹⁶.

The *Puntius* is widely distributed throughout the Indian sub-continent, India, Nepal, Bangladesh, Pakistan, Sri Lanka, Myanmar and Thailand⁵⁶.

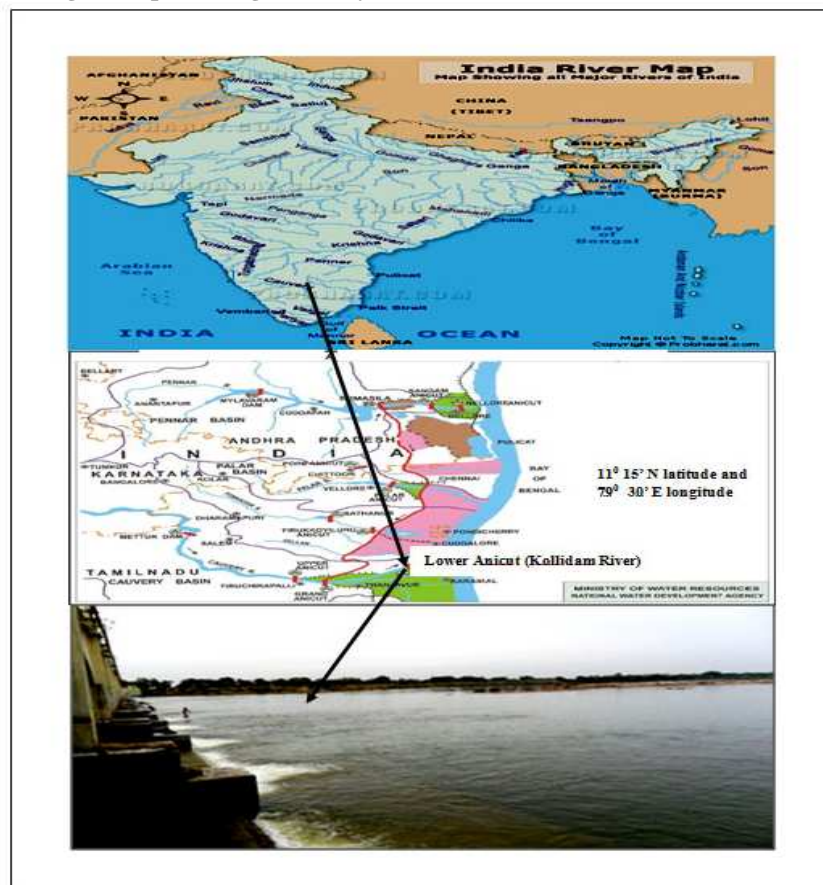
Roberts⁴⁶, described the genus to have the following combination of characters: barbels variable, rostral and maxillary, maxillary only or absent; dorsal fin with last simple ray serrate or entire, branched rays usually eight; anal fin with last simple ray serrate or entire, branched rays usually five; lateral line complete or incomplete, lateral line scales 17-36; cephalic cutaneous papillae minute or absent; pharyngeal teeth in three rows, usually 2,3,5/5,3,2; colour pattern extremely variable; size ranging from less than 10 to 30 cm. Nearly, about 80 % of ornamental fishes are from freshwaters and the rest from brackish and marine waters. There is a need to survey in the potentiality of water bodies including wetlands to providing these ornamental fish species. Mainly wetlands are valuable ecosystems that act as nurseries and feeding grounds for many fish species including ornamental fishes. These wetlands are home to an amazingly diverse and group of unique ornamental fishes¹¹. However, the aim of the present study to find out the taxonomic diversity and biometric variations in the genus *Puntius* from Lower Anicut, Tamil Nadu.

MATERIALS AND METHODS

The Kollidam river inhabits ornamental and edible fishes like *Puntius* species. 50 individuals of *Puntius* species were collected from Lower Anicut 11° 15' N latitude and 79° 30' E longitude (Figure 1). 21 specimens of *Puntius sophore*, 10 specimens of *Puntius filamentosus*, 7 specimens of *Puntius sarana*, 6 specimens of *Puntius ticto* and 6 specimens of *Puntius conchonius* were collected from this site. The specimens were captured by case nets (2-4 cm squares size) and were brought to the laboratory in ice box. Specimens were mopped by filter paper to remove excess of water from their body surface, thereafter recorded the biometric characters. *Puntius* individuals were identified at species level following by⁵⁶. Morphometric measurements and meristic characters were followed by^{25,15,28,32}. Body measurements were expressed as percentage of standard length (% SL); head measurements were expressed as percentage of head length (% HL).

In the present study, 45 - morphometric ($\text{Standard length} = \text{Nbc}/\text{SL} * 100$) and Head length $= \text{HLc}/\text{HL} * 100$) and 31-meristic characters were considered for five species of the genus *Puntius*. The various statistical values were made by using Microsoft Office Excel.

Fig.1: Map showing the study area of Lower Anicut (Kollidam River)



RESULTS

The taxonomic importance in river ecosystems of diversity for the genus *Puntius*. The minimum and maximum of each meristic variable and morphometric variables were obtained from all specimens. All calculations were carried out using statistical software Microsoft Word Excel.

I. Systematic position

- 1) **Kingdom** : Animalia
Phylum : Chordata
Class : Actinopterygii
Order : Cypriniformes
Family : Cyprinidae
Genus : *Puntius*
Species : *Puntius sophore* (Hamilton, 1822)
Common name: Pool barb
Vernacular name: Saani podi in Tamil

- 2) **Kingdom** : Animalia
Phylum : Chordata
Class : Actinopterygii
Order : Cypriniformes
Family : Cyprinidae
Genus : *Puntius*
Species : *Puntius filamentosus* (Valenciennes, 1844)
Common name : Black-spot barb and Indian Tiger barb
Vernacular name : Chevalli, Moacha-Kendai in Tamil

- 3) **Kingdom** : Animalia
Phylum : Chordata
Class : Actinopterygii
Order : Cypriniformes
Family : Cyprinidae
Genus : *Puntius*
Species : *Puntius sarana* (Hamilton, 1822)
Common name: Olive barb
Vernacular name : Panjala podi in Tamil

- 4) **Kingdom** : Animalia
Phylum : Chordata
Class : Actinopterygii
Order : Cypriniformes
Family : Cyprinidae
Genus : *Puntius*
Species : *Puntius ticto* (Hamilton, 1822)
Common name : Two spot barb, Firefin barb and ticto barb
Vernacular name : Saani podi in Tamil

- 5) **Kingdom** : Animalia
Phylum : Chordata
Class : Actinopterygii
Order : Cypriniformes
Family : Cyprinidae
Genus : *Puntius*
Species : *Puntius conchonius* (Hamilton, 1822)
Common name : Rosy barb and Red barb
Vernacular name : Saani podi and salli podi in Tamil



Fig: 2 *Puntius sophore*



Fig: 3 *Puntius filamentosus*



Fig: 4 *Puntius sarana*



Fig: 5 *Puntius ticto*

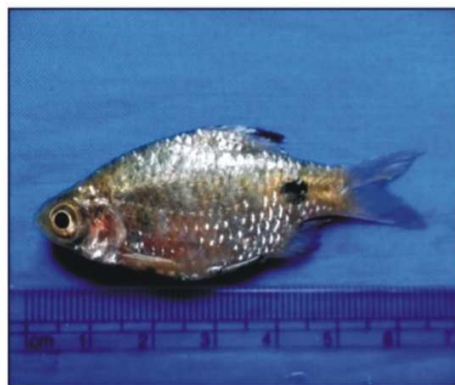


Fig: 6 *Puntius conchonius*

II. Biometric analysis of *Puntius* species

Puntius sophore - Body is elongated, deep and compressed. Concave type of anal and no barbels. Caudal fin deeply forked (Figure-2). Body colour was silver bright and bright reddish strip along with the entire mid body from snout to caudal fork in breeding season. Colour in life, beautiful silvery, black gray-green to brownish. Abdomen white colour and a deep black round blotch at base of caudal fin.

Minimum and maximum ranges of body characters

The values of the different body characters are represented in Table-1.

Snout– Urocentrum(94.0 ± 98.6), Maximum body depth(22.7 ± 36.5), Pre-occiput length(16.0 ± 27.0), Occiput - Dorsal origin(29.4 ± 37.1), Occiput - Pectoral insertion(22.0 ± 30.9), Occiput - Pelvic insertion(36.3 ± 52.7), Pre-Dorsal fin length(37.1 ± 50.9), Post Dorsal fin length(43.9 ± 54.4), Dorsal fin base length(13.6 ± 21.5), Dorsal spinous height(22.0 ± 32.7), Dorsal insertion - Pelvic insertion(30.0 ± 36.4), Dorsal origin - Pectoral insertion(31.1 ± 41.8), Dorsal origin - Anal origin(32.4 ± 44.2), Dorsal origin - Anal insertion(33.7 ± 48.0), Dorsal insertion - Pectoral insertion(28.4 ± 47.2), Dorsal insertion - Caudal origin(24.1 ± 32.8), Pre-pelvic fin length(37.8 ± 47.1), Pelvic fin length(20.4 ± 37.5), Pelvic fin insertion - Anal origin(19.4 ± 30.9), Pre-pectoral fin length(20.2 ± 33.9), Pectoral fin length(16.2 ± 29.0), Pectoral insertion - Pelvic insertion(20.9 ± 28.3), Pectoral insertion - Anal origin(36.4 ± 47.1), Peduncle depth(6.7 ± 18.0), Peduncle length(11.6 ± 20.0), Pre-anal fin length(54.5 ± 66.0), Anal fin length(14.2 ± 25.4), Anal fin base length(6.4 ± 13.2), Caudal fin length(14.5 ± 19.3), Caudal fin height(26.4 ± 38.1).

Minimum and maximum ranges of head characters

Head length(21.5 ± 29.6), Head length of Nostril(26.6 ± 33.3), Head length of Pupil(64.2 ± 77.7), Head length of Occiput(85.7 ± 100.0), Orbit width or Eye Diameter(26.6 ± 38.8), Inter Orbital Distance(33.3 ± 50.0), Pre-nasal length(14.2 ± 27.7), Inter nasal width(21.4 ± 33.3), Upper jaw length(21.4 ± 37.5), Lower jaw length(20.0 ± 31.2), Lower jaw – Isthmus(62.5 ± 75.0), Snout length or Pre-Orbital length(25 ± 38.8), Snout–Opercle(53.3 ± 66.6) and Gape width(25.0 ± 37.5).

Puntius filamentosus - Body elongate and Lateral line are complete; Horizontal oval type of spot on the caudal peduncle. Concave type of anal and no barbels, (Figure-3). Colour of caudal fin lobes tip side black colour formed. Colour in life at various stages distinctly different and adults uniformly silvery to greenish silvery.

Minimum and maximum ranges of body characters

The values of the different body characters are represented in Table-1.

Snout–Urocentrum(91.6 ± 97.1), Maximum body depth(25.4 ± 39.0), Pre-occiput length(16.6 ± 21.2), Occiput - Dorsal origin(21.5 ± 32.8), Occiput - Pectoral insertion(17.6 ± 25.7), Occiput - Pelvic insertion(31.3 ± 48.3), Pre-Dorsal fin length(33.3 ± 53.2), Post Dorsal fin length(39.2 ± 54.4), Dorsal fin base length(15.6 ± 21.2), Dorsal spinous height(23.5 ± 30.3), Dorsal insertion - Pelvic insertion(21.5 ± 34.8), Dorsal origin - Pectoral insertion(23.5 ± 36.0), Dorsal origin - Anal origin(23.5 ± 47.1), Dorsal origin - Anal insertion(31.3 ± 50.0), Dorsal insertion - Pectoral insertion(33.3 ± 50.8), Dorsal insertion - Caudal origin(29.4 ± 35.4), Pre-pelvic fin length(25.4 ± 54.8), Pelvic fin length(17.6 ± 24.2), Pelvic fin insertion - Anal origin(15.6 ± 26.2), Pre-pectoral fin length(18.3 ± 27.1), Pectoral fin length(16.6 ± 24.1), Pectoral insertion - Pelvic insertion(19.6 ± 29.5), Pectoral insertion - Anal origin(35.2 ± 57.3), Peduncle depth(12.5 ± 16.6), Peduncle length(10.0 ± 15.7), Pre-anal fin length(71.6 ± 80.6), Anal fin length(15.6863 ± 21.2), Anal fin base length(8.3 ± 12.9), Caudal fin length(29.4 ± 42.6) and Caudal fin height(23.5 ± 46.7).

Minimum and maximum ranges of head characters

Head length(25.0 ± 29.4), Head length of Nostril(31.5 ± 35.2), Head length of Pupil(38.0 ± 53.3), Head length of Occiput(52.3 ± 73.3), Orbit width or Eye Diameter(23.8 ± 38.8), Inter Orbital Distance(21.0 ± 38.8), Pre-nasal length(13.3 ± 29.4), Inter nasal width(20.0 ± 33.3), Upper jaw length(1.3 ± 29.4), Lower jaw length(14.2 ± 27.7), Lower jaw – Isthmus(42.8 ± 61.1), Snout length or Pre-Orbital length(23.5 ± 29.4), Snout – Opercle(52.3 ± 66.6) and Gape width(21.0 ± 33.3).

Puntius sarana - Body is elongated and lateral lines are complete; mouth moderate with sub-terminal; Barbels are two pairs, with reddish brown, rostral ones as long as orbit, maxillary pair much longer. Dorsal fin spine is serrated; Concave type of anal fin, (Figure-4). Colour in life, olive black, and flanks silvery with golden reflections. One black round spot located in caudal peduncle and another in operculum.

Minimum and maximum ranges of body characters

The values of the different body characters are represented in Table-1.

Snout-Urocentrum(95.1±96.8), Maximum body depth(33.7±40.4), Pre-occiput length(20.2±23.8), Occiput - Dorsal origin(32.5±38.2), Occiput - Pectoral insertion(23.7±34.0), Occiput - Pelvic insertion(40.0±45.2), Pre-Dorsal fin length(51.2±55.2), Post Dorsal fin length(47.5±51.1), Dorsal fin base length(15.4±19.0), Dorsal spinous height(25.0±28.2), Dorsal insertion - Pelvic insertion(28.7±34.5), Dorsal origin - Pectoral insertion(36.1±39.2), Dorsal origin - Anal origin(37.8±41.6), Dorsal origin - Anal insertion(40.0±42.8), Dorsal insertion - Pectoral insertion(42.6±47.0), Dorsal insertion - Caudal origin(29.7±31.7), Pre-pelvic fin length(50.0±53.6), Pelvic fin length(18.7±23.1), Pelvic fin insertion - Anal origin(21.9±25.5), Pre-pectoral fin length(24.3±28.5), Pectoral fin length(22.5±26.8), Pectoral insertion - Pelvic insertion(22.3±26.2), Pectoral insertion - Anal origin(44.6±48.2), Peduncle depth(14.1±16.6), Peduncle length(11.9±14.6), Pre-anal fin length(72.3±78.8), Anal fin length(17.6±21.4), Anal fin base length(9.5±12.9), Caudal fin length(30.8±34.5) and Caudal fin height(36.2±46.8).

Minimum and maximum ranges of head characters

Head length(25.0±28.5), Head length of Nostril(41.6±50.0), Head length of Pupil(65.2±75.0), Head length of Occiput(91.3±100.0), Orbit width or Eye Diameter(33.3±40.0), Inter Orbital Distance(47.8±59.0), Pre-nasal length(17.3±27.2), Inter nasal width(25.0±30.4), Maxillary length(25.0±34.7), Rostral length(20.8±27.2), Upper jaw length(33.3±40.0), Lower jaw length(29.1±35.0), Lower jaw – Isthmus(59.0±66.6), Snout length or Pre-Orbital length(25.0±30.4), Snout – Opercle(60.8±72.7) and Gape width(33.3±45.0).

Puntius ticto - Body is elongated. Mouth is terminal and small size; no barbels. Dorsal fin spine serrated. Lateral line origin and end of body located in two black round spots. First spot occurred in 3, 4 lateral line scales and another in 16, 17, 18 lateral line scales. Concave type of anal fin, (Figure-5). The black colour of the small bands spread in entire tip of the body scales and tip of the caudal fin.

Minimum and maximum ranges of body characters

The values of the different body characters are represented in Table-1.

Snout-Urocentrum(92.1±97.1), Maximum body depth(39.3±44.1), Pre-occiput length(17.6±21.0), Occiput - Dorsal origin(30.3±34.2), Occiput - Pectoral insertion(27.2±29.4), Occiput - Pelvic insertion(44.4±50.0), Pre-Dorsal fin length(52.6±55.5), Post Dorsal fin length(45.4±53.3), Dorsal fin base length(17.6±21.0), Dorsal spinous height(20.5±26.6), Dorsal insertion - Pelvic insertion(36.6±40.0), Dorsal origin - Pectoral insertion(36.0±44.4), Dorsal origin - Anal origin(41.1±45.7), Dorsal origin - Anal insertion(42.1±50.0), Dorsal insertion - Pectoral insertion(48.8±55.8), Dorsal insertion - Caudal origin(27.2±31.5), Pre-pelvic fin length(48.8±54.2), Pelvic fin length(21.0±25.7), Pelvic fin insertion - Anal origin(24.2±28.5), Pre-pectoral fin length(27.2±31.4), Pectoral fin length(21.2±26.6), Pectoral insertion - Pelvic insertion(21.2±28.5), Pectoral insertion - Anal origin(40.0±48.5), Peduncle depth(12.1±18.4), Peduncle length(12.1±14.7), Pre-anal fin length(69.6±75.5), Anal fin length(21.2±25.7), Anal fin base length(9.0±13.3), Caudal fin length(29.4±37.1) and Caudal fin height(36.3±42.8).

Minimum and maximum ranges of head characters

Head length (27.2±31.4), Head length of Nostril (33.3±40.0), Head length of Pupil (69.2±77.7), Head length of Occiput (88.8±100.0), Orbit width or Eye Diameter (44.4±45.4), Inter Orbital Distance (50.0±55.5), Pre-nasal length (18.1±23.0), Inter nasal width (27.2±33.3), Upper jaw length (27.2±33.3),

Lower jaw length (27.2±33.3), Lower jaw – Isthmus (72.7±81.8), Snout length or Pre- Orbital length (30.0±38.4), Snout – Opercle(66.6±76.9) and Gape width (33.3±40.0).

Puntius conchoni - Body deeply compressed with large and reflective scales; Concave type of anal fin and no barbels, (Figure-6). The body colour in black-olive back; with present in yellowish olive appeared of belly. Conspicuous black spot near the base of the anal fin. Caudal near side one black spot around spread in yellow colour present. Tip of dorsal fin and anal fin side spread in black and brown – reddish colour appeared.

Minimum and maximum ranges of body characters

The values of the different body characters are represented in Table-1.

Snout–Urocentrum(92.1±97.5), Maximum body depth(39.3±45.0), Pre-occiput length(18.1±24.4), Occiput - Dorsal origin(30.3±36.7), Occiput - Pectoral insertion(26.8±32.5), Occiput - Pelvic insertion(43.9±50.0), Pre-Dorsal fin length(50.0±53.0), Post Dorsal fin length(40.8±50.0), Dorsal fin base length(18.1±22.5), Dorsal spinous height(18.3±30.0), Dorsal insertion - Pelvic insertion(32.3±42.5), Dorsal origin - Pectoral insertion(36.8±40.8), Dorsal origin - Anal origin(41.4±47.5), Dorsal origin - Anal insertion(42.1±48.5), Dorsal insertion - Pectoral insertion(44.8±54.5), Dorsal insertion - Caudal origin(26.8±35.0), Pre-pelvic fin length(51.5±57.1), Pelvic fin length(21.0±27.5), Pelvic fin insertion - Anal origin(20.4±30.0), Pre-pectoral fin length(26.8±32.5), Pectoral fin length(21.2±30.0), Pectoral insertion - Pelvic insertion(21.2±29.4), Pectoral insertion - Anal origin(40.8±50.0), Peduncle depth(12.1±20.0), Peduncle length(12.1±15.0), Pre-anal fin length(69.6±75.5), Anal fin length(20.4±26.4), Anal fin base length(9.0±15.0), Caudal fin length(30.3±38.2) and Caudal fin height(36.3±45.0).

Minimum and maximum ranges of head characters:

Head length (27.2±32.5), Head length of Nostril (33.3±41.6), Head length of Pupil (66.6±75.0), Head length of Occiput (88.8±100.0), Orbit width or Eye Diameter (33.3±45.4), Inter Orbital Distance (46.6±55.5), Pre-nasal length (18.1±25.0), Inter nasal width (26.6±33.3), Upper jaw length (26.6±33.3), Lower jaw length (20.0±33.3), Lower jaw – Isthmus (58.3±66.6), Snout length or Pre- Orbital length (33.3±38.4), Snout – Opercle (66.6±76.9) and Gape width (33.3±38.4).

III. Meristic analysis of *Puntius* species

31 meristic characters were analyzed in five *Puntius* species and its counts were given in Table 2. The number of black spots, position and their dorsal fin spine and rays were distinguishing character in these fishes.

Puntius sophore: 2 spots were noted and first black spot located in centre of the caudal peduncle each side on the lateral line 20-23rd scales and another black spot located on 4-6 branched rays base of dorsal fin. Smooth type of dorsal fin spine.

Fin formula: D. 12 (III/9); A. 8-9 (III/5-6); V. 9(I/8); P. 14-15 (I/13-14); L.1.25-26.

Puntius filamentosus: One black blotch was observed in 17-19th lateral line scale sides. Caudal fin 1-4th upper and lower lobe tip side red and black colour presented. Dorsal fin spine serrated.

Fin formula: D. 12 (III/9); A. 9 (III/6); V. 10 (I/8-9); P. 14-15 (I/13-14); L.1.22-23.

Puntius sarana: Noted on two black blotch and first blotch present in each sides of caudal peduncle. And another blotch present each side of operculum. Dorsal fin spine Serrated.

Fin formula: D. 12 (III/8-9); A. 8-9 (III/5-6); V. 8(I/7); P. 14-17 (I/13-16); L.1.30-32.

Puntius ticto: Noted 2 spots, the first spot located in operculum each side of 3-5th scales and 16 -21st scales. Dorsal fin spine serrated. Incomplete lateral line.

Fin formula: D. 12 (III/9); A. 9-10 (III/6-7); V. 9(I/8); P. 13-14 (I/12-13); L.1.24-25.

Puntius conchoni: Having one black spot and surrounding of black spot side appeared in yellowish. The spot located in each side of 17-20th lateral line scales. Dorsal fin, anal fin tip of side black colour spread and dorsal fin spine serrated. Incomplete lateral line.

Fin formula: D. 11 (III/9); A. 8(III/5); V. 9(I/8); P. 13-14 (I/12-13); L.1.26-27.

Table 1. Morphometric characters of *Puntius* species

Sl. No	Characters	<i>Puntius sophore</i>		<i>Puntius filamentosus</i>		<i>Puntius sarana</i>		<i>Puntius ticto</i>		<i>Puntius conchoniis</i>	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	Standard length(=Nbc/SL*100)										
1	Snout – Urocentrum	94.0	98.6	91.7	97.1	95.1	96.8	92.1	97.1	92.1	97.6
2	Maximum body depth	22.7	36.5	25.5	39.1	33.8	40.5	39.4	44.1	39.4	45.0
3	Pre-occiput length	16.0	27.0	16.7	21.3	20.2	23.8	17.6	21.1	18.2	24.5
4	Occiput - Dorsal origin	29.4	37.1	21.6	32.9	32.5	38.3	30.3	34.3	30.3	36.7
5	Occiput - Pectoral insertion	22.0	30.9	17.6	25.7	23.8	34.0	27.3	29.4	26.8	32.5
6	Occiput - Pelvic insertion	36.4	52.7	31.4	48.44	40.0	45.2	44.44	50.0	43.9	50.0
7	Pre-Dorsal fin length	37.1	50.9	33.3	53.2	51.3	55.3	52.6	55.6	50.0	53.1
8	Post Dorsal fin length	43.9	54.5	39.2	54.4	47.6	51.2	45.5	53.3	40.8	50.0
9	Dorsal fin base length	13.6	21.6	15.7	21.2	15.5	19.0	17.6	21.1	18.2	22.5
10	Dorsal spinous height	22.0	32.7	23.5	30.3	25.0	28.2	20.6	26.7	18.4	30.0
11	Dorsal insertion - Pelvic insertion	30.0	36.48	21.56	34.84	28.75	34.52	36.66	40	32.35	42.5
12	Dorsal origin - Pectoral insertion	31.2	41.8	23.5	36.1	36.2	39.3	36.8	44.4	36.8	40.8
13	Dorsal origin - Anal origin	32.5	44.2	23.5	47.1	37.8	41.7	41.2	45.7	41.5	47.5
14	Dorsal origin - Anal insertion	33.8	48.0	31.4	50.0	40.0	42.9	42.1	50.0	42.1	48.6
15	Dorsal insertion - Pectoral insertion	28.4	47.3	33.3	50.8	42.7	47.1	48.9	55.9	44.9	54.5
16	Dorsal insertion - Caudal origin	24.2	32.89	29.4	35.5	29.8	31.7	27.8	31.6	26.8	35.0
17	Pre-pelvic fin length	37.9	47.2	25.5	54.8	50.0	53.7	48.9	54.3	51.5	57.1
18	Pelvic fin length	36.0	30.7	35.3	24.3	18.8	23.2	21.1	25.7	21.1	27.5
19	Pelvic fin insertion - Anal origin	19.5	30.9	17.6	26.2	21.9	25.5	24.2	28.5	20.4	30.0
20	Pre-pectoral fin length	20.3	33.9	15.7	27.1	24.4	28.6	27.3	31.4	26.8	32.5
21	Pectoral fin length	16.2	29.1	18.3	24.2	22.5	26.8	21.2	26.7	21.2	30.0
22	Pectoral insertion - Pelvic insertion	20.9	28.4	16.7	29.5	22.3	26.3	21.2	28.6	21.2	29.4
23	Pectoral insertion - Anal origin	36.5	47.2	19.6	57.4	44.7	48.2	40.0	48.6	40.8	50.0
24	Peduncle depth	6.7	18.0	12.5	16.7	14.1	16.7	12.1	18.4	12.1	20.0
25	Peduncle length	11.7	20.0	10.0	15.7	11.9	14.6	12.1	14.7	12.1	15.0
26	Pre-anal fin length	54.5	66.0	71.7	80.6	72.3	78.8	69.7	75.6	69.7	75.5
27	Anal fin length	14.3	25.5	15.7	21.2	17.6	21.4	21.2	25.7	20.4	26.5
28	Anal fin base length	6.5	13.2	8.3	12.9	9.6	12.9	9.1	13.3	9.1	15.0
29	Caudal fin length	14.5	19.3	29.4	42.6	30.8	34.5	29.4	37.1	30.3	38.2
30	Caudal fin height	26.5	38.2	23.5	46.8	36.3	46.8	36.4	42.9	36.4	45.0
	Head length(=HLc/HL*100)	21.6	29.6	25.0	29.4	25.0	28.6	27.3	31.4	27.3	32.5
31	Head length of Nostril	26.7	33.3	31.6	35.3	41.7	50.0	33.3	40.0	33.3	41.7
32	Head length of Pupil	64.3	77.8	38.1	53.3	65.2	75.0	69.2	77.8	66.7	75.0
33	Head length of Occiput	85.7	100.0	52.4	73.3	91.3	100.0	88.9	100.0	88.9	100.0
34	Orbit width or Eye Diameter	26.7	38.9	23.8	38.9	33.3	40.0	44.4	45.5	33.3	45.5
35	Inter Orbital Distance	33.3	50.0	21.1	38.9	47.8	59.1	50.0	55.6	46.7	55.6
36	Pre-nasal length	14.3	27.8	13.3	29.4	17.4	27.3	18.2	23.1	18.2	25.0
37	Inter nasal width	21.4	33.3	20.0	33.3	25.0	30.4	27.3	33.3	26.7	33.3
38	Maxillary barbel length	0	0	0	0	25.0	34.8	0	0	0	0
39	Rostral barbel length	0	0	0	0	20.8	27.3	0	0	0	0
40	Upper jaw length	21.4	37.5	21.3	29.4	33.3	40.0	27.3	33.3	26.7	33.3
41	Lower jaw length	20.0	31.3	14.3	27.8	29.2	35.0	27.3	33.3	20.0	33.3
42	Lower jaw – Isthmus	62.5	75.0	42.9	61.1	59.1	66.7	72.7	81.8	58.3	66.7
43	Snout length or Pre- Orbital length	25.0	38.9	23.5	29.4	25.0	30.4	30.0	38.5	33.3	38.5
44	Snout – Opercle	53.3	66.7	52.4	66.7	60.9	72.7	66.7	76.9	66.7	76.9
45	Gape width	25.0	37.5	21.1	33.3	33.3	45.0	33.3	40.0	33.3	38.5

*Nbc=Number of body characters, SL=Standard Length, HLc=Head length of characters, HL=Head length

Table 2. Meristic characters of *Puntius* species

S. No.	Characters	<i>Puntius sophore</i>	<i>Puntius filamentosus</i>	<i>Puntius sarana</i>	<i>Puntius ticto</i>	<i>Puntius conchonius</i>
I	FIN SPINE AND RAY COUNTS:					
1.	UDFR	3	3	3	3	3
2.	BDFR	9	9	8-9	9	8
3.	UAFR	3	3	2-3	3	3
4.	BAFR	5-6	6	5-6	6-7	5
5.	UVFR	1	1	1	1	1
6.	BVFR	8	8-9	7	8	8
7.	UPFR	1	1	1	1	1
8.	BPFR	13-14	14	14-16	12-13	12-13
9.	CFULR	10	10	10	10	10
10.	CFLLR	9	9	9	9	9
II	SCALES COUNT:					
11.	LLS	25-26	22-23	30-32	24-25	26-27
12.	PDS	8-9	6-7	11	7-8	9
13.	Tr.SR	7-8	7	8-9	9	9
14.	UTr.SR	4½/4	4½	4½/5½	5½	4½
15.	LTr.SR (Anus)	3½/3	2½	3½/3½	3½	4½
16.	CPS	11-12	11-12	11-13	15-16	12-13
17.	PAS	17-18	17-19	15-17	22-23	22-23
18.	AS	1	1	1	1	
III	NATURE OF LATERAL LINE:					
19.	Convex	-	-	-	-	-
20.	Concave	-	√	-	√	-
21.	Straight	√	-	√	-	√
22.	Complete	√	√	√	-	-
23.	Incomplete	-	-	-	√	√
IV	POSITION OF MOUTH:					
24.	Terminal	√	√	√	-	-
25.	Sub – terminal	-	-	-	√	√
V	NATURE OF DORSAL FIN SPINE:					
26.	Smooth	√	-	-	-	-
27.	Serrate	-	√	√	√	√
VI	NATURE OF BARBLES:					
28.	One pair Rostral barbles	-	-	√	-	-
29.	One pair Maxillary barbles	-	-	√	-	-
30.	Two pair Rostral barbles	-	-	-	-	-
31.	Two pair Maxillary barbles	-	-	-	-	-

UDFR-Unbranched Dorsal Fin Rays, **BDFR**-Branched Dorsal Fin Rays, **UAFR**-Unbranched Anal Fin Rays, **BAFR**-Branched Anal Fin Rays, **UVFR**-Unbranched Ventral Fin Rays, **BVFR**- Branched Ventral Fin Rays, **UPFR**-Unbranched Pectoral Fin Rays, **BPFR**- Branched Pectoral Fin Rays, **CFULR**-Caudal Fin Upper Lobe Rays, **CFLLR**-Caudal Fin Lower Lobe Rays, **LLS**-Lateral Line Scales, **PDS**-Pre Dorsal Scales, **Tr.SR**-Transverse Scales, **UTr.SR**-Upper transverse scale rows, **LTr.SR**-Lower Transverse Scale Rows (Anus), **CPS**-Circumpeduncular Scales, **PAS**-Pre Anal Scales, **AS**-Anal Scales, √-Present.

DISCUSSION

The use of morphological characteristics and phenotypic variation of this fish of Arctic charr by⁹ emphasized the high accuracy of morphological measurements of the fish, thus published information on morphological characteristics of the fish of the genus *Puntius*¹⁸ within the past decades must be used and taken into account as a scope of identification,^{55,28,37,46,56}. There has been some published information being accumulated during the past decade on morphological identification the genus *Puntius*¹⁸, with the works^{43,44}, claimed that the genus *Puntius* could be split into three genera due to its morphological

characteristics and out of three names of the genera as *Barbodes*, *Systemus* and *Hypsibarbus*. It seems more likely that the three additional genera of this fish to establish some controversial view points among taxonomists and scientists to perceive and accountable.

This could possibly be attributable to perhaps some inadequate and accurate amounts of available explanations where it led to an ambiguous explanation, perhaps the failure in using computer programmes to establish appropriate evidences to different the fish species since there were no intensive and conceivable evidences produced on morphological characteristics of the new genera distributed, particularly with the facts presented evidences on similarity correlation coefficients including clusters of a dendrogram structure of similarity coefficients and it is noticeable that the fish of the three new genera found within his text possessed exactly the same number of nearly the same numbers of many characteristics such as the pelvic fin and dorsal fin, pre-dorsal scales and scales above lateral lines, whilst other organs possessed a very small difference where the small differences could have been influenced by natural habitations⁴⁶.

These workers did taxonomically explain a wide range of many characteristics of the fish of the genus *Puntius*¹⁸. It seems more likely that the differences due to morphological characteristics among the three genera of the fish, which^{43,44}, identified could actually be the fish of a single genus of the *Puntius*¹⁸ where he failed to provide vividly the distinctive characteristics of the fish as given by many previously stated authors and his given definitions among the three new genera were not relatively cleared. Bleeker (1863) divided the genus *Puntius* into three sub genera, *Puntius*, *Barbodes* and *Capoeta*, based solely on the number of barbels. Though this classification has been followed by some authors, this subdivision is not acceptable because of the limited phylogenetical significance of the number of barbels as indicated in this study. The values of the LLR equations clearly revealed that the lengths of the body parts are proportional to the total length which agreed with⁵⁸. The findings of present investigation are similar to the findings of 7,19,22,14.

Many organisms can modulate their morphology in response to environmental cues. Such plasticity is thought to an important adaptive strategy for populations experiencing variable environmental conditions⁴⁹ and it is likely that phenotypic plasticity plays an important role in diversification⁶¹. Previous studies^{52,13} have shown that morphometric characters are often more suitable than meristic characters are often more suitable than meristic characters for describing intra-specific differences. In another study²⁶. Stated that the discrete nature of meristic data contributed to low ability to discriminate among *Halobatrachus didiactylus* populations. The present study focused discrimination among species and has shown that variation in meristic characters combined with coded characters can be more effective than morphometric characters for differentiating 5 *Puntius* species (2, 3, 4, 5, 6). As meristic counts are discrete in nature, they were efficient for developing a dichotomous key for *Puntius* species in Sri Lanka as they gave sharp demarcations between individual species. Some meristic characters overlapped among species however, and were therefore of limited use for distinguishing the species.

Indeed, the decrease in maximum sizes of individuals of *P. sophore* landed in major three rivers signaling the need for urgent measures to conduct extensive studies on these species to provide more information for their management and conservation. In addition, the maximum weight of *P. sophore* observed in this study (18.80 g) was also lower than the maximum recorded value of 70.0 g in Maharashtra, India². Information on biometric aspects of *P. sophore* from Bangladesh is quite insufficient²³. The present study recorded the maximum size of *P. sophore* in the Rupsha River as 10.20cm TL, which was lower than the maximum record value of 18.00 cm TL in India¹⁶.

The recognition of additional genera within *Puntius* as previously understood makes it imperative that the identity of *Puntius sophore*¹⁸. The type species of *Puntius*, be stabilised. Hamilton's description and figure of *P. sophore* do not allow this species to unambiguously distinguished from other valid species, e.g., *P. chola*, *P. dorsalis*. However,²³ reported the maximum TL for *P. sophore* from the Mathabhanga River as 10.20 cm, northwestern Bangladesh and⁴² found maximum length as 9.02 cm TL in the Chalan beel, north-central Bangladesh, while⁵³ recorded the maximum length of this fish as 10.00 cm TL from

Nepal, which is in accordance with the present study. Nevertheless,⁵¹ recorded the maximum size of this fish as 6.00 cm SL (standard length), which is lower than any population of Bangladesh, Indian and Nepal. Maximum length is necessary to estimate the population parameters important for fisheries resource planning and management²⁴. Size differences might be attributed to the variation of environmental factors, particularly water temperature and food availability²⁴.

Information on biological aspects of *Puntius sophore* from Bangladesh is quite insufficient²³. No previous records of length frequency distribution of this species could be traced from the related literature, inhibiting the comparison with previous result.

Fishes of the genus *Puntius*¹⁸, commonly called barb, are Prolific and known to occupy a broad variety of freshwater niches in tropical Asia³¹. Despite a revision of the genus by³⁰, several taxonomic problems persisted in the *P. filamentosus* Group until the work of^{39,40}. One such was the identity of *P. mahecola*, long misidentified or considered a junior synonym of *P. filamentosus*. This resulted in some authors confusing the two species^{30,36,56}. Raj⁴⁵, sought to differentiate the two species by the presence or absence of barbels, and a few other authors too, tried unsuccessfully to resolve this confusion⁵⁰, but none referred to the type specimens of the two species and freshly-collected topotypes until⁴⁰, who showed *P. mehecola* to be distinct from *P. filamentosus*, and indeed not even closely related. Members of the *P. filamentosus* Group have a characteristic juvenile coloration of three black bars on the body, with adult males having *P. filamentosus* extensions of their branched dorsal-fin rays.

Until now, the *P. filamentosus* Group has included seven species two of which (*P. singhala* and *P. srilankensis*) are endemic to Sri Lanka. We have not in the present study examined Sri Lankan material but have relied on data provided in³⁹. The 4th lateral row scale above the 4th lateral-line scale and 7th lateral-line scale of *P. rohani* sp. nov. Was compared with those of *P. filamentosus* collected from Chembarampakkam Lake and found to be very different. The scales of *P. rohani* sp. nov. (3 ex.). Have longer and fewer radii meeting at the focus, which is not reticulate, while the scales of *P. filamentosus* (5 ex.) Chembarampakkam had numerous short radii meeting at a largely reticulated focus.

The report highlighted some barb among them *Puntius sophore*, *Puntius sarana*, *Puntius ticto*, *Puntius conchoni*, *Puntius gelius*, *Puntius chola* etc. were dominant. Bhuiya⁶, reported 9 barb from Kishoreganj district of Bangladesh. The present studies revealed that most of the barb were available in ditches, rivers, streams, haor and also in flood plains. Most of the species were abundant in the streams and rivers. Some of the barb were very common in most of the study sites. *Puntius sophore*, *Puntius chola*, *Puntius conchoni* were almost common in all types of water bodies. There is hardly found in any rivers, canals, lakes, beels or haors and ponds in Bangladesh where the family Cyprinidae is not represented⁴¹ but variations were also found in the availability and distribution of barb of this family.

Puntius sarana was rare and only reported from river and beels of Kishoreganj and ponds of different polyculture system on Mymensingh. *Puntius sarana* was declared as a critically endangered barb²⁷. This fish may be restricted to some of the major floodplains and the rivers in Bangladesh. Hossain²¹ reviewed the availability of small fish resources like *Puntius* sp. and others in the rivers, floodplains and upland areas of Bangladesh which is more similar to this study.

Morphology in teleost fish has been shown to be particularly labile in response to multifarious habitat effects^{34,12}. Present study also shows that the morphology of a species in the same river but different localities could differ. This may lead to form in different populations as the movement of individuals among the most localities is difficult. These populations subject to local selection pressures leading ultimately to increased fitness termed local adaptations¹⁰. This could even result genetic divergence of populations. Future studies on genetic compound of these phenotypes would result a better picture of phenotypic plasticity of *Puntius* species.

Several approaches have been used to estimate the growth of fish, including length-frequency analyses, mark-recapture experiments, and growth checks of hard parts like scales, otoliths, and vertebrae³³. However, the most commonly used method of growth determination is the identification and tracing in time of length-frequency distributions of modes (cohorts)⁵.

The main morphometric and meristic data are reported in table 1 and 2, respectively. Body of *Puntius sarana* is deep and moderately compressed, with a devoted dorsal. Mouth is terminal. There are 2 pairs of barbels with the rostral equal to the length of orbit and a longer maxillary. Cycloid types of scales present⁶².

Hamilton¹⁸ described *P.ticto* from Gangetic basin. He observed the pelvic fin of the species to have one undivided ray in front and two behind. Similar observations were also made in the present study. Hora²⁰ observed variations in *P.ticto* and treated *P.punctatus* of Peninsular India and *P.stoliczkanus* of the Irrawady as its junior synonyms. Silas⁵⁴, however, regarded *P.punctatus* and *P.stoliczkanus* as subspecies of *P.ticto*. Jayaram³⁰ did not give subspecies status to *P.punctatus* and *P.stoliczkanus* as the fishes showed great variation in morphology. He also considered *P.ticto* to be widely distributed and not restricted to any definite geographical region.

Most of the wetland areas may be presumably recognized as natural water resources of freshwater reservoirs where annual rainwater derives from the monsoon filled them from year to year and aided more living creatures to survive, particularly the fishes from numerous species apart from the genus *Puntius*¹⁸. It can be concluded that the fish specimens to collected were homogenous and heterogeneous. It is clearly mentioned that number of dorsal fin, ventral fin, anal fin and caudal fin rays of particular *Puntius* species remained constant in all the fish specimens having different body length. It shows that in present study, the meristic counts are independent of body size and there is no change in meristic counts with increase in body length. This corroborates with the studies in other fishes by^{60,57,38}.

This study have been report highlighted to the species were *Puntius sophore*, *Puntius filamentosus*, *Puntius sarana*, *Puntius ticto* and *Puntius conchoniis*. The species were taxonomic diversity of the must be importance in Kollidam river ecosystems. The barbs reported that the morphometric and meristic variables were obtained all specimens from the Lower Anicut in Tamil Nadu. It shows that in present study, the meristic counts are independent of body size and there is no change in meristic counts. This corroborates with the studies in other fishes.

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