



International Journal of Fisheries and Aquatic Studies

E-ISSN: 2347-5129

P-ISSN: 2394-0506

(ICV-Poland) Impact Value: 5.62

(GIF) Impact Factor: 0.549

IJFAS 2020; 8(1): 44-49

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www.fisheriesjournal.com

Received: 20-11-2019

Accepted: 24-12-2019

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Esomus bengalensis (Cypriniformes: Cyprinidae), a new species of flying barb from West Bengal, India

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Abstract

A new species of flying barb, *Esomus bengalensis* is collected from Mayurakshi River at Tilpara barrage, Suri, West Bengal with distinguishable differences from its congeners in respect to caudal peduncle length, head length, number of Predorsal scale, absence of lateral line etc. PCA and heatmap are generated to establish its separate identity in Rasborine family.

Keywords: Black streak, caudal peduncle depth, lateral line, Mayurakshi River, mouth

Introduction

Genus *Esomus* Swainson, (Flying barb) is characterized by elongate, compressed body with small head and mouth that is obliquely directed upwards without a symphysial knob and two pairs of barbels of which maxillary pair is very long. So far eight species have been reported from different parts of the world of which four species are of Indian viz. *E. danricus*, *E. barbatus*, *E. thermoicos* and *E. manipurensis*. Among these, *E. danricus* is widely distributed in India^[1-4], *E. barbatus* and *E. thermoicos* are restricted to south India^[3,4], *E. manipurensis* is found only in north east India^[5].

Among these four Indian species, *E. danricus* and *E. thermoicos* bear broad lateral band on both sides of the body (from operculum to caudal fin base). *E. barbatus* has no lateral band though *E. manipurensis* possesses a lateral black streak on the posterior portion of the body.

On July 14, 2019, in a collection of small fishes (dominant species, *Puntius* sp. and *Amblypharyngodon mola*) from the Tilpara barrage of Mayurakshi river, the first author collected two specimens of *Esomus* sp. which have no lateral band but with distinct maxillary and rostral barbels. The present paper reports on the description of a new species, *Esomus bengalensis* of the family Cyprinidae (Subfamily: Danioninae, Order: Cypriniformes).

Materials and Methods

Specimens were preserved in 70% alcohol and before preservation colouration of fresh specimens were noted. Thirty one measurements were taken with a dial caliper to the nearest 0.1 mm. Counts and measurements were made on the left side of the specimens wherever possible using binocular stereozoom microscope. All lengths were taken parallel to the body axis except body depth which was taken perpendicular to the body axis. Fin rays and scales were counted under binocular dissecting microscope. Measurements of body parts including head length, are presented as percentage of standard length (SL) and subunits of the head are given as percentage of head length (HL).

In order to separate different *Esomus* species from each other we have performed principle component analysis (PCA) and drawn Heatmaps using the data presented in the Table 2. PCA was employed using the average or mean data of eight morphometric characters viz. body depth (BD), caudal peduncle depth (CPD), head length (HL), snout length (Lsn), caudal peduncle length (CPL), eye diameter (ED) and inter orbital width (IOW) of five species of *Esomus*, viz. *E. danricus* (*E. dan*), *E. manipurensis* (*E. mani*), *E. thermoicos* (*E. ther*), *E. barbatus* (*E. bar*) and *E. bengalensis* (*E. bengal*) (In parenthesis, short form of each species used in PCA and Heatmap). Heatmap is a technique to visualize data through variations in colour. In tabular format, Heatmaps are helpful for cross examining multivariate data, by placing variables in the rows and columns and coloring the blocks within the table. The data contained within a block is based on the relationship between the two variables connecting the

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row and column. Here categorical data is colour coded and numerical data presented in colour scale that blends from one colour to another, in order to represent the differences in high and low values. The default colour gradient sets the lowest value in the Heatmaps to dark value, the highest value to a bright red and mid range values with a corresponding transition between these extremes. The dendrogram along both sides of Heatmaps show how the variables (species) and the rows (characters) are independently clustered.

Esomus bengalensis sp. Nov. (Plate 1.)

Type material

Holotype: 14. VII. 2019 Mayurakshi river, Tilpara barrage, Suri, Birbhum district, West Bengal, India. 46 mm SL, Hamilton Museum of Fresh Water Fishes (formerly Fresh Water Fish Museum), Department of Zoology, Rampurhat College, Rampurhat-731224, West Bengal, India.

Paratype: Same locality; 50mm SL (1), All other details are same as holotype.

Diagnosis

First of all *E. bengalensis* can be separated from other two Indian species of *Esomus*, *E. danricus* and *E. thermoicos* by the absence of lateral band from end of orbit to the base of the caudal fin. In *E. manipurensis*, there is a black streak in the posterior region of the body. In *E. barbatus* there is no band or streak on the flank. But in the present species, a mid-lateral black streak is observed in the posterior part of the body. Moreover, it can be distinguished morphologically from *E. barbatus* and *E. manipurensis* by several points.

Body elongate, though dorsal profile is straight except head, but ventral profile is distinctly arched (concave) up to anal fin origin. Diameter of eye (in snout) is almost same to *E. barbatus* but comparatively smaller in respect to *E. manipurensis* (93.75 – 100% vs. 120.48 – 149.25%) and number of midline scales are less (28 vs. 30 – 32). Number of branched ventral finrays is only seven (six in *E. manipurensis* and eight in *E. barbatus*). Length of caudal fin (in TL) is similar to that of *E. manipurensis* but comparatively higher in respect to *E. barbatus* (22.31 – 24.24% vs. 17.51 – 20.96%). Length of pectoral fin in HL is intermediate in between two species (119.05 – 122.73% vs. 100 – 112.36 and 149.25 – 166.67%). Length of dorsal fin is smallest (66.66 – 75.76% TL vs. 80 – 82.64% TL in *E. barbatus* and 94.34 – 105.26% in *E. manipurensis*). Maxillary barbel crossed pectoral fin origin (same as in *E. barbatus*) but in *E. manipurensis* it exceeded ventral fin origin. In *E. bengalensis* lateral line is totally absent but in other two species lateral line is complete (*E. barbatus*) or incomplete (*E. manipurensis*). Length of caudal peduncle is minimum in the present species as compared to other two species (13.04 – 13.20% SL vs. 17.86 – 24.86% SL). Least height of caudal peduncle in its length in *E. bengalensis* is 1.00 – 1.08 but in other four species it ranges from 1.60 (*E. manipurensis*) to 2.11 (*E. thermoicos*).

Description

Biometric data of *E. bengalensis* is presented in Table 1. Dorsal profile of the body is almost straight from the posterior portion of the head up to dorsal fin origin, but ventral profile is distinctly arched up to anal fin origin. Body is oblong, swollen, roundish up to vent. Body depth is 6.53 – 6.66 in its total length (19.78 – 20.20% SL). Mouth opening is small and directed upwards (like *Chela* sp.). Jaws are protrusible; symphyial knob well developed; head flat, small and its

length 4.80 – 5.0 times in TL and 3.65 – 3.79 in SL; snout small, its length 3.79 – 3.94 times in HL; eye circular, dorso-lateral in position, located in the middle of the head, not visible from ventral surface. The diameter of the eye is ranged from 4.12 – 4.20 times in the length of the head. Orbit is with a black eye brow; operculum triangular with a brownish spot. Posterior end of operculum bears a scale like ovoid structure. Dorsal fin origin is ahead of anal fin origin and ends in the midline of anal fin length. First fin ray of both pectoral and ventral fin are long and pointed. Pectoral fin touches the origin of ventral fin though the later does not touch the vent. Anal fin is placed in a notch just behind the vent and never touches caudal peduncle. Pectoral to ventral fin distance is 2.96 – 3.03 and ventral to anal fin distance is 3.85 – 4.51 in SL. Two pairs of barbels – maxillary and rostral are present. Rostral barbel is short and just exceeds the orbit but the maxillary barbel is long and its thin apical end runs beyond the middle of pectoral fin. Caudal fin forked, large and 23.97 – 24.24% TL, least height of caudal peduncle is 1.0 – 1.08 times in its length. Lateral line absent.

D ii6, P 10, V 8, A i5, C 19.

Midline scale 28, Pre-dorsal scale 17, Circumpeduncular scale 12, Lateral transverse scale 7.

Table 1: Biometric data of *Esomus benghalensis*

Parameters	Holotype	Paratype	Mean
Total length (TL in mm)	60.5	66.0	63.25
Fork length (FL in mm)	55.0	60.0	57.5
Standard length (SL in mm)	46.0	50.0	48.00
% SL			
Pre dorsal length	69.56	70.00	69.78
Pre pectoral length	21.74	26.40	24.07
Pre ventral length	56.52	56.00	56.26
Pre anal length	78.26	78.00	78.13
Dorsal fin length	18.26	20.00	19.13
Length of dorsal fin base	9.78	10.00	9.89
Pectoral fin length	32.61	32.40	32.50
Length of pectoral fin base	8.69	7.80	8.24
Ventral fin length	22.61	21.60	26.23
Length of ventral fin base	4.78	4.40	4.59
Anal fin length	20.65	20.20	20.42
Length of anal fin base	10.00	9.60	9.80
Body depth at anus	19.78	20.20	19.99
Max. body depth	27.39	26.00	26.69
Head length (HL)	27.39	26.40	26.89
Head width	12.61	14.00	13.30
Head depth	15.43	18.00	16.71
Caudal peduncle length	13.04	13.20	13.24
Caudal peduncle depth	13.04	12.20	12.62
Anal fin origin to ventral fin origin	22.17	26.00	24.08
Ventral fin tip to vent	2.39	4.00	3.19
Pectoral fin to ventral fin distance	33.69	33.00	33.34
Length of maxillary barbel	36.96	32.00	34.48
Length of rostral barbel	8.91	8.00	8.45
% HL			
Snout length	25.40	24.24	24.82
Eye diameter	23.81	24.24	24.02
Inter orbital distance	22.22	27.88	25.05
Inter narial distance	19.84	24.24	22.04

Colouration

Upper one- third portion of the flank bear scales with distinct black margin but in the lower two-third portion, scales are inconspicuous and the colour is bluish white. No lateral band,

but a black streak at the posterior one-third of the body runs from caudal peduncle to anal fin origin and becomes faint at the anterior.

Etymology

Latin name genitive case meaning “bengal” in reference to its occurrence.

Distribution and Habitat

E.bengalensis is known for the type locality in the Mayurakshi river in West Bengal. Mayurakshi is the western

tributaries of Bhagirathi. The fish was collected from the Tilpara barrage (87°32'00"E, 23°55'00"N) (Figure 1.) of Mayurakshi river. The river is swift flowing with a mixed rocky and sandy bottom though silt is deposited in the barrage area. At this locality a good number of other species are available like *Barilius barna*, *B. bendelisis* (Cyprinidae), *Arius arius*, *A. gagora* (Ariidae), *Ompok pabda*, *O. pabo*, (Siluridae), *Xenentodon cancila* (Belonidae), *Gagata rhodobarbus*, *G.cenia*, *Bagarius bagarius*, *Glyptothorax botius*, *G. telchitta*, (Sisoridae) and *Amblyceps mangois* (Amblycipitidae).

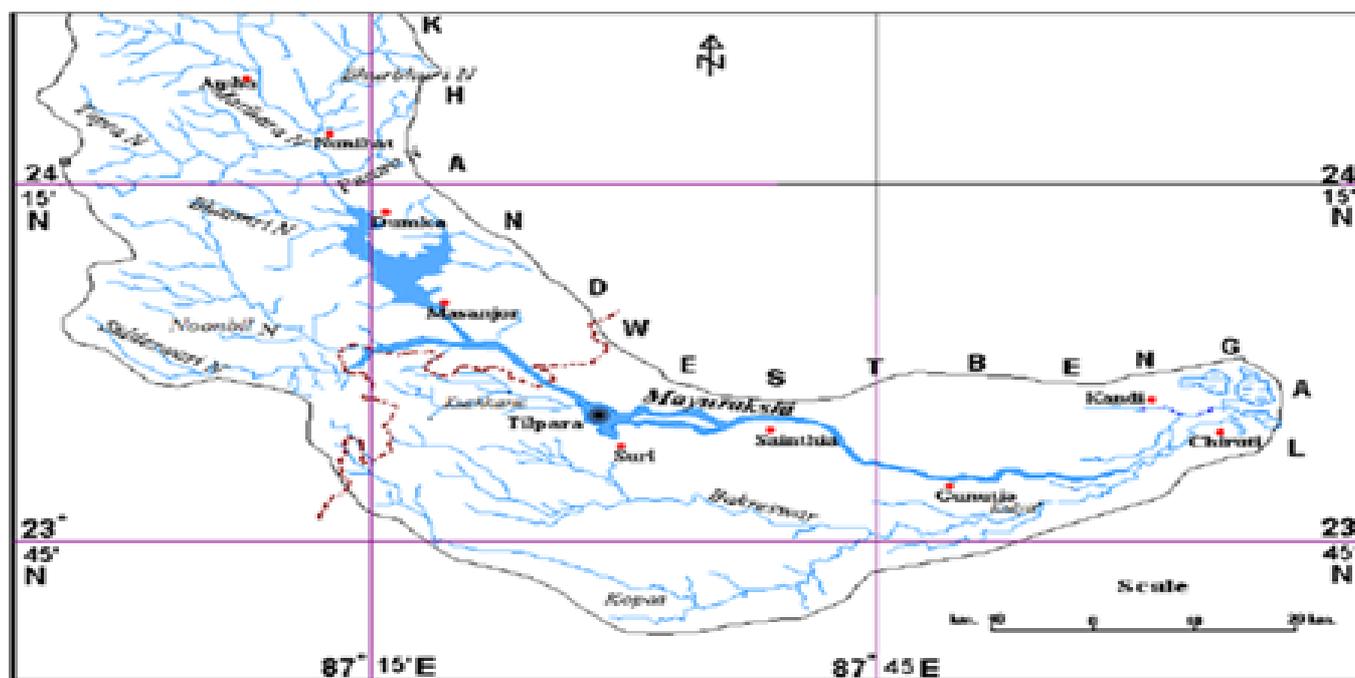


Fig 1: Sampling site at Tilpara Barrage (•) of Mayurakshi river

Discussion

Distribution of different species of *Esomus* except *E. danricus*, are restricted to particular geographical area, as for example *E. thermoicos* is found only in Southern India [4], *E barbatus* in Peninsular India (Godavari, Krishna and Cauvery river system [1, 3, 4] and *E. manipurensis* from Manipur [5]. But *E. danricus* is distributed throughout India including type locality from West Bengal [3, 4, 6-8]. The present species is also restricted in distribution and is collected from a river (Mayurakshi river) of West Bengal.

Among all these five species, *E. bengalensis* can be distinguished from other four species by several characters. Head length of *E. bengalensis* is longer compared to its congeners (26.89% SL vs. 22.94-24.43% SL). Body depth of *E. bengalensis* and *E. manipurensis* is almost equal (26.69% SL and 26.23% SL respectively) but the value is much lower in other three species. Eye diameter of the present species is within the range of other two species, *E. thermoicos* and *E. barbatus* (6.46, 6.69 and 6.16% SL respectively) except *E. danricus* and *E. manipurensis* in which it is slightly higher (7.02 and 7.35% SL respectively). Snout length of *E.*

bengalensis is higher as compared to that of *E. thermoicos* and *E. manipurensis* (6.68% SL vs. 5.85 and 5.13% SL respectively). Among all the five species of *Esomus*, length of caudal peduncle is minimum in *E. bengalensis* (13.02% SL vs. 19.81% SL in *E. danricus* and 23.65% SL in *E. manipurensis*). Caudal peduncle depth of the present species and *E. manipurensis* is almost equal (12.62 and 12.81% SL respectively) but in other three species, values are slightly lower (10.25 – 11.35% SL). Caudal peduncle depth in its length is minimum in *E. bengalensis* (1.04) compared to other species where the value ranges from 1.60 – 2.00 in *E. manipurensis* to 2.11 in *E. thermoicos*.

Among all the five species, number of predorsal scale is maximum in *E. thermoicos* (19 – 20) but in other four species it ranges from 16 – 17 including the present species (*E. bengalensis*, 17). Lateral line scale though absent, midline scale of *E. bengalensis* is 28 only whereas, in other species, it ranges from 27 – 30 in *E. danricus* to 32 – 34 in *E. thermoicos*. Circumpeduncular scale of the present species is 12 while in all other species excluding *E. manipurensis*, it is 14.

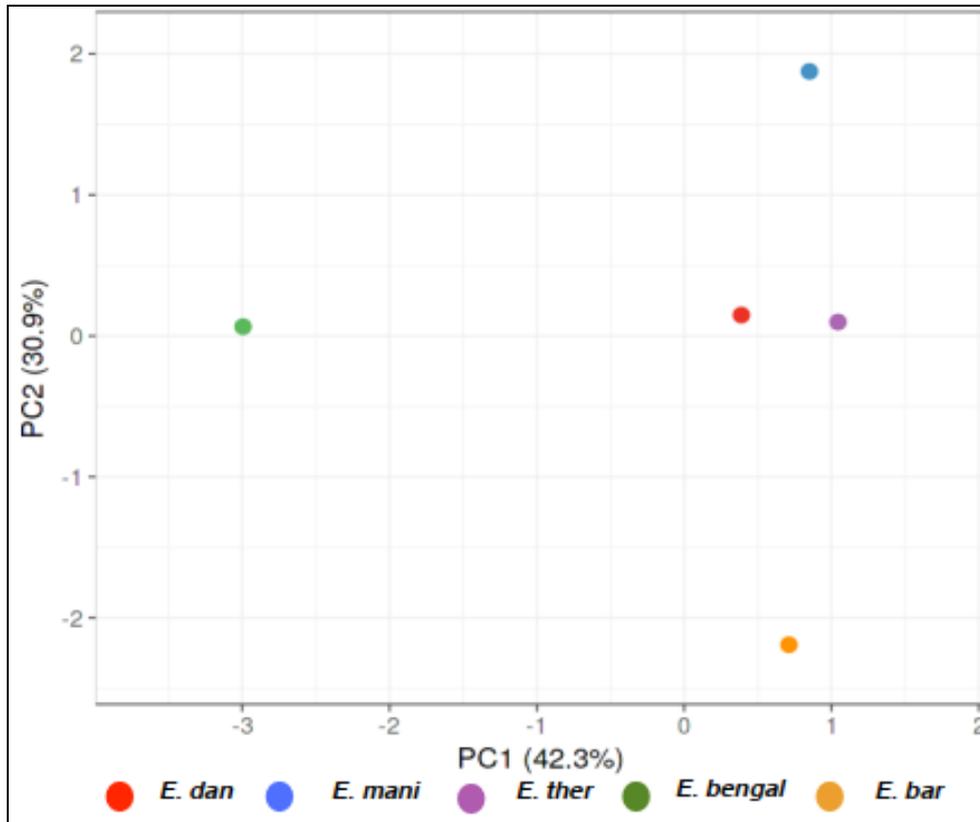


Fig 2: *E. bengalensis* is separated from other species of *Esomus* along first principal component, PC1 and PC2 contributed to 42.3% and 30.9% variation respectively.

PCA provides a summarization of morphometric variation of eight characters among five species of *Esomus* including the new species, *E. bengalensis* (Fig. 2.). Principal Component 1 explains 42.3% variation among species whereas, PC2 explains 30.9%. Despite forming a discrete group on PC1 vs.

PC2, *E. barbatus* overlaps with *E. danricus* on PC1 axis and *E. bengalensis* overlaps with *E. danricus* and *E. thermoicos* on PC2 axis. The five distinct point recovered in the PCA reveals that there are five *Esomus* species in India.

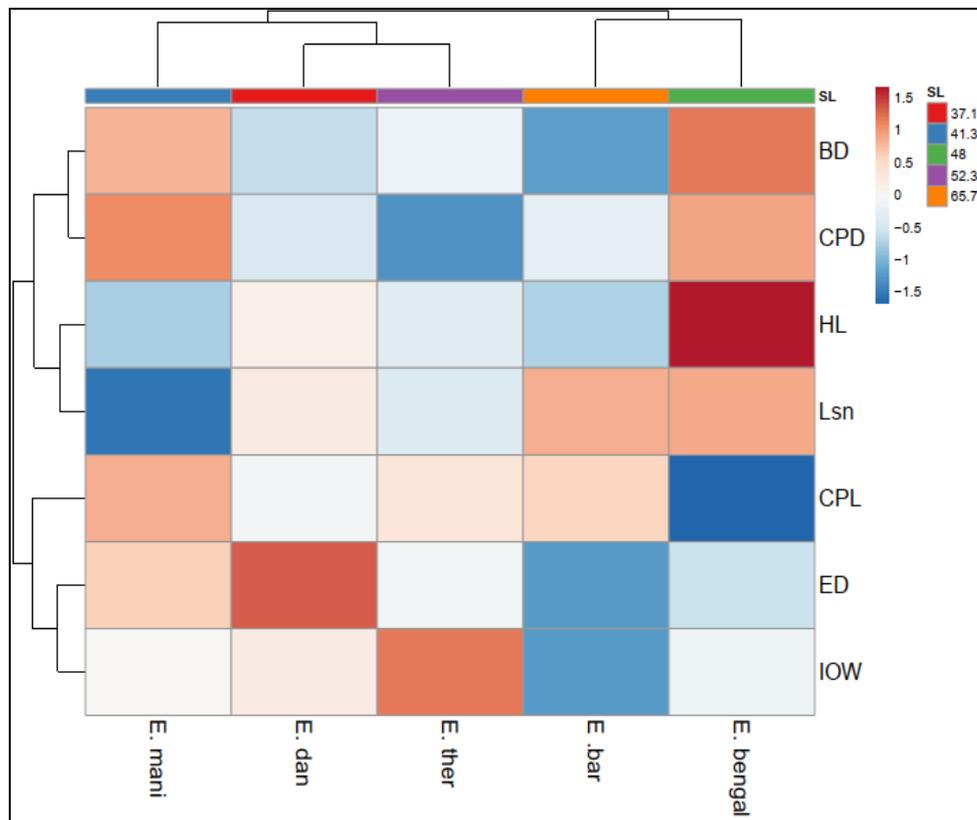


Fig 3: Heatmap generated using indices (along each row) for five different Indian species of *Esomus* sp. using Clust Vis.

From Heatmap, it is clear that *E. bengalensis* is distinctly separated from all other species atleast on the basis of body depth and head length. Moreover all the species are separated from each other by one or more characters and also have some similarities among them. As for example, *E. danricus* can be distinguished from other species by eye diameter (with higher value) and *E. barbatus* and *E. bengalensis* can't be separated from each other by snout length (almost have same colour block) (Fig. 3.).

Dendrogram analysis shows that *E. barbatus* and *E. bengalensis* are closely related species as *E. danricus* and *E.*

thermoicos. But *E. manipurensis* though close to *E. danricus* and *E. thermoicos*, distantly separated from former two species. On the basis of morphometric characters, three paired characters viz. BD-CPD, HL-Lsn and ED-IOW are closely related and CPL is related to last pair only (Fig. 3).

On the basis of PCA, heatmap analysis and other morphometric characters, it can be concluded that *E. bengalensis* is distinctly separated and identified from other congeners of *Esomus* sp. of India and should be treated as a new species under the genus *Esomus* without any doubt.

Table 2: Comparative study on five Indian flying barb, *Esomus* sp. (Abbreviation used for PCA and heatmap)

Characters	Species				
	<i>E. danricus</i>	<i>E. barbatus</i>	<i>E. thermoicos</i>	<i>E. manipurensis</i>	<i>E. bengalensis</i>
Standard length (SL)	37.12	65.75	52.30	41.35	48.00
Head length (HL)	24.43	23.02	23.65	22.94	26.89
Body depth (BD)	24.43	23.70	24.99	26.23	26.69
Eye diameter (ED)	7.35	6.16	6.69	7.02	6.46
Inter orbital width (IOW)	8.78	7.30	9.79	-	8.45
Length of snout (Lsn)	6.24	6.66	5.85	5.13	6.68
Length of caudal peduncle (CPL)	19.81	22.64	21.59	23.65	13.12
Depth of caudal peduncle (CPD)	11.19	11.35	10.25	12.81	12.62



A. Lateral view of the fish

B. Dorsum of anterior portion



C. Showing pectoral and ventral fins

D. Showing maxillary barbel



E. Showing posterior black streak

F. Ventral view

Plate 1: Different views of *Esomus bengalensis* sp. Nov.

Key to five Indian species of *Esomus* sp.

1. Lateral line present2.
Lateral line absent or incomplete3.
2. Lateral line single4.
Lateral line double..... *E. manipurensis*.
3. Sides with broad lateral band*E. danricus*.
Sides without broad lateral band*E. bengalensis*.
4. Sides with black broad lateral band and

- Predorsal scale 19 – 20..... *E. thermoicos*.
Sides without any band and
Predorsal scale 17.....*E. barbatus*.

Comparative materials

- Data from the following references of *Esomus* sp. in India
1. *Esomus danricus*: data from Hamilton, F. (1822); Hora, S. L. and Mukherji, D. D. (1928); Murty, V. S. (1977);

- Talwar, P. K. and Jhingran, A. (1991); Jararam, K. C. (1999); Nath, P. and Dey, S. C. (2000); Rema Devi, K. *et al.* (2008).
2. *Esomus barbatus*: data from Hora, S. L. and Mukherji, D. D. (1928).
 3. *Esomus manipurensis*: data from Tilak, R. and Jain, S. (1990).
 4. *Esomus thermoicos*: data from Hora, S. L. and Mukherji, D. D. (1928).

Acknowledgement

Authors are likely to express their gratitude to Mr. Sukdeb for his help in collection of specimens, Mr. Sangram Halder, Librarian, for his technical assistance, Prof. Pradip De, Prof. Ranjit Kapuri and Dr. Rajyasree Roy of Dept. of Zoology, Rampurhat College for their cooperation and Mr. Soumendranath Bhakat of Lund University, Sweden for technical support for PCA and Heatmap.

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