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A new species of the Asian catfish, *Pseudolaguvia flavipinna* (Teleostei: Erethistidae) from West Bengal, India

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Abstract
Pseudolaguvia flavipinna, a new species of erethistid catfish is described from Mayurakshi River, a Western tributary of Bhagirathi River system of India. It differs from congeners in having yellowish fin tip and two dark black bands on the body. It can be further distinguished from other congeners of West Bengal by longer preanal, prepelvic, caudal fin length and head length. Though caudal peduncle length is shorter but caudal peduncle depth is maximum compare to other species. PCA and heat map showed that *P. flavipinna* is distinctly separate from other five species of *Pseudolaguvia* of West Bengal.

Keywords: Yellow fin, Sisoroidea, Mayurakshi river, black band

Introduction
Genus *Pseudolaguvia*, a small Asian catfish of the family Erethistidae superficially resemble members of the sisorid genus *Glyptothorax* in morphology but differs in size, having a prominent median depression in the thoracic adhesive apparatus and serrated anterior margin of pectoral fin spine.
So far nineteen species of *Pseudolaguvia* have been found in streams and rivers of the Ganges and Brahmaputra in Nepal, India and Bangladesh, Ayeyarwady and Sittang River drainages in east central Myanmar and in the rivers of Western Ghats, peninsular India [1-5]. Among them five species are reported from West Bengal (north Bengal) viz. *P. ferula* [1], *P. shawi* [6], *P. foveolate* [7], *P. Ribeiroi* [6], and *P. nubila* [8].
Rivers of south Bengal belong to the Gangetic River System is least studied ichthyologically. So it is not surprising to find new species of different fresh water fish families restricted to these drainages. While carrying out ichthyological surveys in different rivers of Birbhum (a district of West Bengal, India) from 2015-2017, the author recovered specimen of an unnamed *Pseudolaguvia* species accidentally from a heap of small fishes collected from Mayurakshi River, at Tilpara Barrage, Suri ($87^0$32'00"E, $23^0$55'00"N) on July 11, 2017. Later five more specimens were recovered in later months from the same spot. The present paper reports the description of *P. seudolaguvia flavipinna,* a new species of the family erethistidae.

Materials and Methods
Specimens were preserved in 70% alcohol immediately after collection. Before preservation colouration of the fresh specimens were noted carefully. Measurements and counts of each specimen were taken within two days of preservation. Measurements were made with a dial caliper to the nearest 0.1 mm. Counts and measurements were made on the left side of specimens wherever possible using binocular stereo zoom microscope after scraping out mucous cover. 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).
Mean and standard deviation (SD) of each parameter was calculated separately.
In order to separate different *Pseudolaguvia* species from each other I have performed principal component and heat map analysis using the data presented at Table 2.
Principal component analysis (PCA) is a statistical process where a high-dimensional multi-variate dataset is linearly transformed into a set of uncorrelated low-dimensional linear variables called principal components (1). In PCA, first few (usually first two) principal components (PC1, PC2 and so on) often explain large amount of variation.

Heatmap is a graphical presentation of data-matrix where individual values contained in a matrix are represented as colours. The data contained within a block is based on the relationship between the two variables connecting the 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 value. Both PCA and heat map analysis was performed using online graphical user interface lustVis (2). The raw data (Table 2) was uploaded in ClustVis and pareto scaling method was used to process the dataset. Pareto scaling method divides the values by the square root of standard deviation. PCA was performed using singular value decomposition (SVD) algorithm iteratively until estimates of missing values converge. Heatmap was generated using heatmap R package implemented within Clust Vis [9, 10].

***Pseudolaguvia flavipinna* sp. nov.** (Plate 1)

Type material:

Holotype: 11. VII. 2017. Mayurakshi River, Tilpara Barrage, Suri, Birbhum district, West Bengal, India. 22 mm SL, Hamilton Museum of Fresh Water Fishes, Department of Zoology, Rampurhat College, Rampurhat-731224 West Bengal, India.

Paratype: Same locality, 20.5-23.4 mm SL (5), July to September, 2019. All other details are same as holotype.

Diagnosis

Pseudolaguvia flavipinna differs from congeners by colouration of fin tip which is yellowish including other morphological features. Two broad vertical black bands, first band below dorsal fin base and the second band terminate along adipose dorsal fin. A black slender rectangular spot is present on the base of caudal fin before fork formation**.**

In *P. flavipinna*, rayed dorsal fin inserted far behind the pectoral fin origin. Pre anal and pre pelvic fin length longer from its congeners like *P. ferula, P. shawi*, *P. foveolata* and *P. ribeiroi* (77.3% SL vs ≤70 in case of pre anal and 54.5%SL vs < 52 in case of pre pelvic (Table 2). Pelvic fin length is shorter than that of *P.nubila* (15.0% SL vs 15.8-18.5% SL). Adpressed pelvic fin not reaching base of anal fin. Length of dorsal fin base longer (17.3% SL vs 7.9-16.7% SL. Dorsal fin spine length is also longer (18.2% SL vs 11.3-17.7% SL. *P. flavipinna* differs from *P. nubila* in having shorter adipose fin length(11.4% SL vs 14.2-15.9% SL) (Table2).

Compared to other five species *P. flavipinna* possesses longer caudal fin length (31.8% SL vs 19.5-26% SL) though caudal peduncle length is shorter (13.6% SL vs 16.0 – 20.7% SL). But caudal peduncle depth is maximum (12.7% SL vs 6.1-11.1% SL in other species). It is further distinguished from other species in having longer head length (30.9% SL compared to 26.4-29.0% SL in other species).

Snout length of *P. flavipinna* is shorter (44.1% HL) whereas, in other species it ranges from 50.7-55.6% HL. Inter orbital distance is maximum in the present species (35.3% HL vs 25.4-34.7% HL in case of other species). Nasal barbel short, equal to eye diameter and never extend up to orbit.

Thoracic adhesive apparatus is long (27.4% SL) with a median depression encircled by a yellowish border.

Description

Biometric data of *Pseudolaguvia flavipinna* is presented in Table 1. Head and anterior part of the body depressed and broad.Dorsal profile almost horizontal up to origin of dorsal fin then sloping gently. Ventral profile flat up to anal fin base. Occipital process not reaching to the base of dorsal fin.

Table 1: Biometric data for *Pseudolaguvia flavipinna* (n=6).

Characters (Abbreviation) %SL	Holotype	Range	Mean ± SD
Pre dorsal length (pdl)	45.5	44.0-46.4	45.0 ± 1.51
Pre anal length (panl)	77.3	72.2-78.4	76.2 ± 2.32
Pre pelvic length (pvl)	54.5	54.5-56.4	54.9 ± 1.01
Pre pectoral length (ppl)	23.2	22.8-24.4	23.2 ± 1.10
Length of dorsal fin base (dfbasel)	17.3	16.9-18.1	17.0 ± 1.21
Dorsal spine length (dfspinl)	18.2	17.9-18.9	18.1 ± 1.01
Length of anal fin base (afbasel)	14.5	13.6-15.1	13.9 ± 2.10
Pelvic fin length (pelfl)	15.0	15.0-16.2	15.2 ± 1.31
Pectoral fin length (pecfl)	22.7	22.1-14.2	23.1 ± 0.24
Pectoral spine length (pecfspinl)	18.2	17.9-19.1	18.1 ± 1.45
Caudal fin length (cafinl)	31.8	31.2-32.4	31.4 ± 0.08
Length of adipose fin base (ladifbase)	11.4	11.1-12.2	11.6 ± 0.07
Caudal peduncle length (cpl)	13.6	13.0-14.5	14.0 ± 0.02
Caudal peduncle depth (cpd)	12.7	12.6-14.4	13.1 ± 1.24
Body depth at anus (bdatanus)	19.1	18.6-24.4	21.2 ± 3.03
Head length (hl)	30.9	30.1-32.4	31.2 ± 2.01
Head width (hw)	27.3	25.8-28.4	26.8 ± 2.12
Head depth (hd)	22.7	22.4-24.1	22.6 ± 2.19
Dorsal to adipose fin	13.6	13.6-14.1	13.9 ± 0.08
Length of adhesive apparatus	27.9	26.2- 28.7	27.4 ± 0.8
Breadth of adhesive apparatus % HL	12.2	11.0- 12.8	11.9 ± 0.9
Snout length (snoutl)	44.1	43.6-46.5	45.0 ± 1.78
Inter orbital distance (iod)	35.3	34.9-35.4	35.1 ± 0.08
Eye diameter (ed)	13.2	12.8-13.3	13.0 ± 0.02
Nasal barbel length (nblel)	13.5	13.3-15.1	14.1 ± 1.67
Maxillary barbell length (mblel)	72.3	71.0-76.4	73.0 ± 3.15
Inner mandibular barbell length (inmblel)	29.4	28.0-32.1	30.5 ± 2.05
Outer mandibular barbell length (outmblel)	44.1	42.6-46.1	43.9 ± 3.08

Eye is ovoid, dorsolateral in position, located posterior to the middle of head length and orbit with free margin. Eye is not visible from ventral surface of the head. Branchiostegal membranes united at isthmus. Gill openings narrow extending to the base of pectoral fin. Caudal peduncle length and depth are almost equal (1.07 times in caudal peduncle length). Urogenital opening in the middle of adpressed pelvic fin. Skin tuberculate throughout body, very distinct in non band region. Lateral line is complete and mid lateral in position. Distinct thoracic adhesive apparatus which is long and slender located in between isthmus and pelvic fin origin. The apparatus consists of longitudinal unculiferous ridges with prominant central median depression bordered by yellow margin. Black melanophores are present in the left side of depression. Maximum length and breadth of the adhesive apparatus is 27.4% SL and 11.9% SL respectively (Table 1).

Mouth small, inferior with papillate lips and longer upper jaw. Lips thick, fleshy post labial groove on lower jaw as depression. Teeth on jaws pointed and tooth band narrow.

Barbels four pairs. Nasal barbell very short subtended by flap of skin at base not extend to orbit. Maxillary barbell is annulated with black and white, slender with broad skin flap base, and never exceed outer mandibular barbel, Both mandibular barbels originate from the same line ventrally and yellowish white in colour. Outer mandibular barbel is not reaching pelvic fin base but touching the orbital margin, while inner mandibular barbel is short and not reaching the orbital margin.

Dorsal fin inserted in one third of total body length; with 4i rays (6). Dorsal fin spine flattened, straight and strong. Anterior margin of dorsal spine is rugose but its posterior margin is with a few small spine. First fin ray of dorsal fin is longest.

Pectoral fin with stout, blade like spine, sharply pointed at tip and with 6 rays (5). Both anterior and posterior margin of spine serrated. In the anterior margin 6 large and 5-6 small spines while in the posterior margin 4-6 large and a few small spines are present. Large spines are in the apical portion.

Pelvic fin origin at vertical through middle of dorsal fin base. Tip of adpressed pelvic fin not reaching anal fin origin. Pelvic fin with i 5 rays (5) and straight margin.

Adipose fin very short inserted anterior to the midline in between last dorsal fin ray and caudal peduncle. End of adipose fin and anal fin tip on same vertical line. A wide gap is present in between rayed dorsal fin and adipose fin.

Anal fin short, not reaching caudal fin base, and with iii 5 i rays (6).

Caudal peduncle deep, slightly longer in length than depth. Caudal fin deeply forked with i 7 7 i (5) principal rays, upper and lower lobes pointed, lower lobe slightly longer. Both the lobes are curved inward so the tips touch with each other at rest.

Colouration

In 70% alcohol: dorsal and lateral surface of head and body dark blackish brown fading to lighter grayish brown on lateral surfaces of head and dorsal. Ventral surfaces creamy white upto pelvic fin origin. Two broad vertical black bands on body: first band below dorsal fin base and second band below adipose fin base. The first band is broad up to dorsal fin base above and below it is in the form of black border in the middle of the pelvic fin. The second band is as broad as adipose fin base with a '<' shaped incison along the lateral line. A few melanophore are sparsely distributed in the ventral surface near pelvic fin origin and in the median groove of adhesive organ. In the caudal fin, a black rectangular spot is present just before fork. Dorsal fin blackish brown with yellow fin tip. Adipose fin continued with black band. Anal fin deep brown in the middle. Middle of pelvic fin black but anterior and posterior portion yellow. Caudal fin yellow though apical portion light brown in colour.

Etymology

Latin name, genitive case, meaning "yellow fin" in reference to yellow fin in this species.

Distribution and habitat

P. flavipinna is known for the type locality in the Mayurakshi River in West Bengal. Mayurakshi river is the Western tributaries of Bhagirathi. The species was collected from the Tilpara Barrage of Mayurakshi River ($87^0$32'00''E, $23^0$55'00"N) where river is swift flowing with a mixed rocky and sandy bottom. (Fig.1.) At this locality other fish species collected are *Barilius barila, B. tileo* (Cyprinidae); *Arius arius, A. gagora* (Ariidae); *Mystus vittatus, M. tengara, M. gulio, M. cavasius, M. bleekeri* (Bagridae); *Wallago attu, Ompok pabda, O. pabo* (Siluridae); *Xenentodon cancila* (Belonidae); *Bagarius bagarius, Gagata sexualis, Glyptothorax botius, G. telchitta, G. cavia* (Sisoridae) and *Amblyceps mangois* (Amblycipitidae).

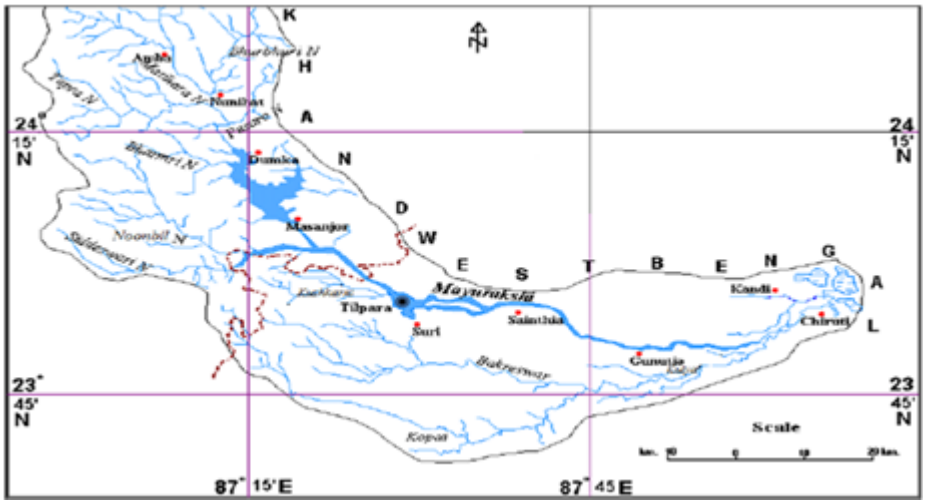

Fig 1: Sampling site at Tilpara Barrage(•) of Mayurakshi river

Comparison of species

Comparison of six species of *Pseudolaguvia* on the basis of 26 morphometric characters is presented in Table 2. The present species shows a few morphometric similarities to other species viz. pelvic fin length (to *P. ribeiroi*), anal fin base length (to *P. shawi* and *P. ferula*), dorsal fin spine length (to *P. ferula*) and head length (to *P. shawi*) as well as dissimilarities by a number of characters like body depth at anus, head depth, head width, preanal length, caudal peduncle length, caudal peduncle depth, caudal fin length etc.

Table 2: Comparative morphometric characters of six species of *Pseudolaguvia* sp. (- data not available) (Abbreviation from Table 1).

Characters	Species					
	P. flavipinna	***P. nubila***	***P. shawi***	***P. foveolata***	***P. ribeiroi***	***P. ferula***
sl	21.97	27.6	23.1	30.0	24.6	23.33
1. pdl	45.0	38.6	45.0	38.7	45.5	38.0
2. panl	76.2	67.7	69.7	66.6	70.3	68.4
3. pvl	54.9	50.95	51.9	49.7	51.2	50.6
4. ppl	23.2	23.45	25.5	22.7	23.6	22.8
5. dfbasel	17.0	16.2	13.4	15.3	16.7	10.5
6. afbasel	13.9	17.65	13.9	11.3	15.9	13.8
7. dfspinl	18.1	17.85	14.3	11.3	15.0	18.1
8. pelfl	15.2	17.1	16.0	19.0	15.4	13.9
9. pecfl	23.1	25.2	24.2	27.3	22.4	25.4
10. pecfspinl	18.1	20.0	18.6	21.3	18.3	21.8
11. cafinl	31.4	22.8	19.5	21.3	26.0	24.5
12. ladifbase	11.6	15.0	17.7	24.0	13.0	12.3
13. cpl	14.0	18.0	16.0	20.7	17.9	19.1
14. cpd	13.1	10.1	7.4	5.0	6.9	7.3
15. bdatanus	21.2	15.5	14.3	11.0	14.6	13.1
16. hl	31.2	30.7	29.44	26.7	29.27	27.8
17. hw	26.8	20.7	22.94	20	22.76	18.1
18. hd	22.6	17.1	17.75	14.3	18.29	15.1
% head length						
1 snoutl	45.0	48.55	51.5	52.5	55.6	48.0
2 iod	35.1	28.7	32.4	28.8	34.7	28.5
3 ed	13.0	12.40	13.2	10.0	9.7	10.2
4 nblel	14.1	19.75	-	23.8	-	8.8
5 mblel	73.0	72.4	-	72.5	-	72.6
6 inmblel	30.5	33.5	-	42.5	-	26.6
7 outmblel	43.9	53.5	-	67.5	-	44.7

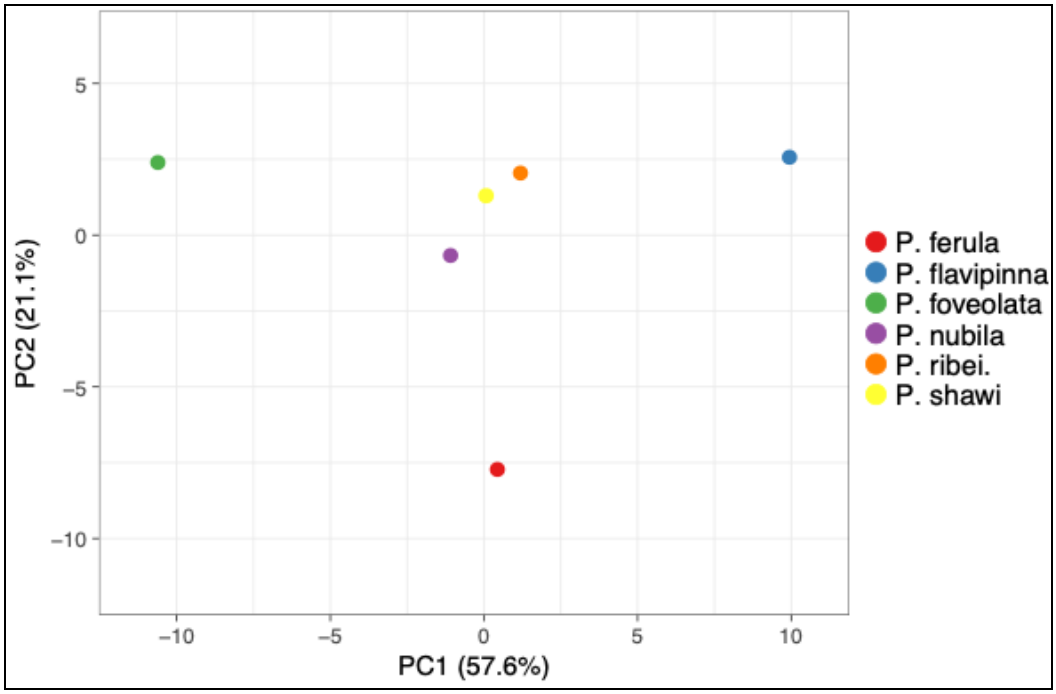

Fig 2: *P. flavipinna* is separated from other species along first two principal components. PC1 and PC2 contributed to 57.6% and 21.1% carnation respectively.

PCA provides a summarization of morphometric variation of 26 characters among six species of *Pseudolaguvia*, including the new species *P. flavipinna* (Fig. 2). Principal component 1 explains 57.6% variation among species and PC 2 explains 21.1%. The six distinct points recovered in the PCA reveals that there are six *Pseudolaguvia* species.

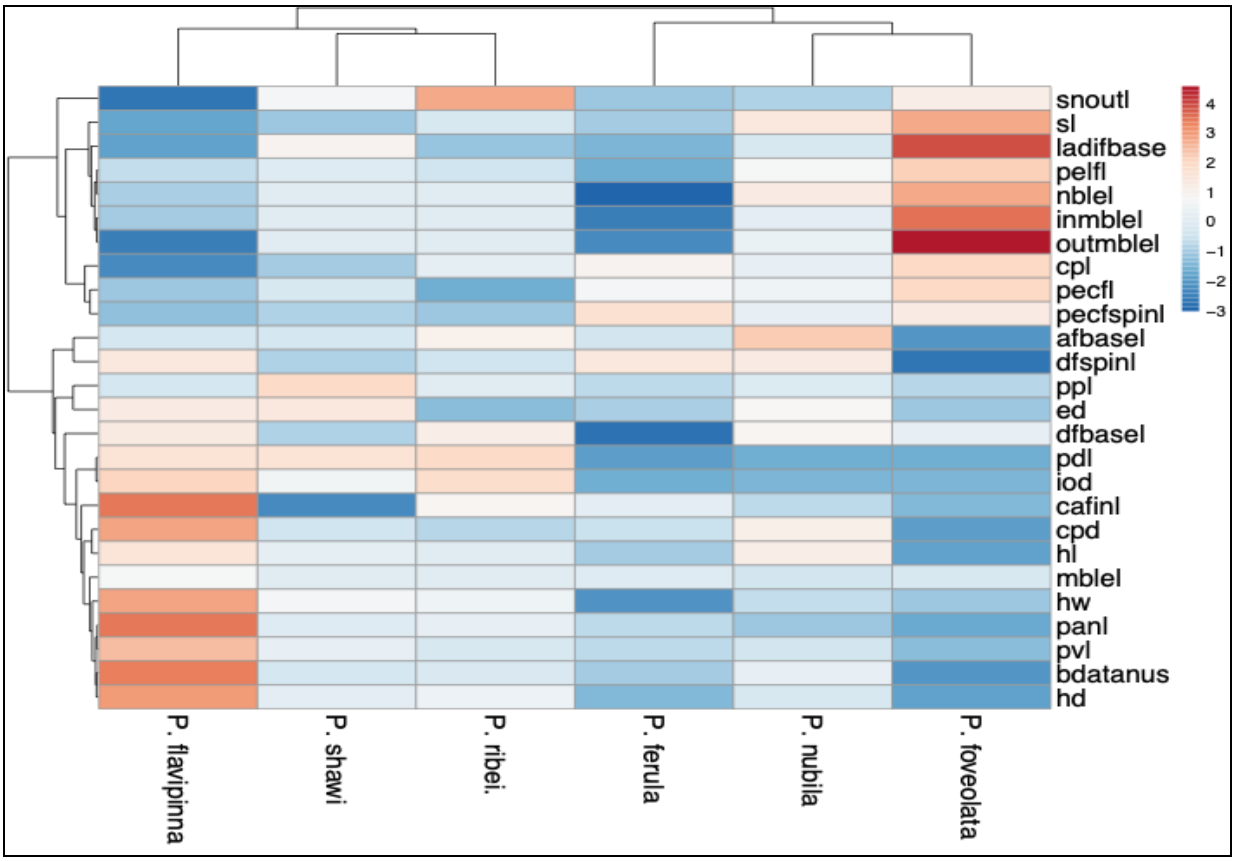

Fig 3: Heatmap generated using indexes (along each row) for six different species using Clust Vis.

From heatmap, it is clear that *Pseudolaguvia flavipinna* is distinctly separated from other five species atleast on the basis of seven characters viz. caudal fin length, caudal peduncle depth, head width, head depth, preanal length, prepelvic length and body depth at anus (Fig. 3).

Dendogram analysis shows that *P. shawi* and *P. ribeiroi* are closely related species as well as *P. foveolata* and *P. nubila* are also close together. But *P. flavipinna* and *P. ferula* are distantly related to above mention two groups (Fig. 3).

A key to six species of *Pseudolaguvia* sp.

1. Longer preanal length (>75% SL)…….*P. flavipinna*
   Shorter preanal length ……..……2
2. Shorter dorsal fin base (< 10% SL) ……*P. ferula*
   Longer dorsal fin base …….……3
3. Shorter caudal fin length (< 20% SL) ……*P. shawi*
   Longer caudal fin length ……..…….. 4
4. Larger eye (> 10% HL) ……*P. nubila*
   Smaller eye ……..5
5. Shorter predorsal length (<40% SL) ……*P. foveolata*
   Longer predorsal length ……...*P. ribeiroi*

Discussion

Presence of thoracic adhesive apparatus formed by longitudinal skin folds facilitating life in fast flowing torrential water, has been reported from three erethistid genera, *Conta*, *Laguvia* and *Pseudolaguvia* and the sisorid genus *Glyptothorax* [11-17]. But only in *Pseudolaguvia* the adhesive apparatus possess a distinct median depression.

Seasonal occurrence has been reported in *P. shawi*. which is mostly abundant during the months of September and October [6]. Here also *P. flavipinna* is also recovered in the months of August, September.

Among other species recovered from West Bengal, colour pattern of *P. flavipinna* is different from other species: yellowish fin tip and presence of two distinct dark bands on the body. *P. foveolata*, *P. ribeiroi* and *P. shawi* possess sharply contrasting creamy bands on brown body but in *P. flavipinna*, the dark brown or blackish bands are very distinct in contrast to body colour.

On the basis of PCA, heat map and other morphometric characters, it can be concluded that *P. flavipinna* is distinctly separate from other congeners of West Bengal and should be treated as a new species of the genus *Pseudolaguvia*.

Distribution of different species of *Pseudolaguvia* is restricted to particular geographic area as this small benthic catfish are less dispersed. Reduced lability may account for the fact that the species are also syntopic in distribution [1]. So occurrence of *P. flavipinna* is not an exception.

Comparative material

Pseudolaguvia foveolata: UMMZ244867, holotype 30.0 mm SL; India. West Bengal, Tista River at Tista barrage 26º45”10”N 88º34’11”E.

P. ribeiroi: UMMZ243649 (8), 16.4-23.2 mm SL; India. West Bengal, Schutunga River (tributary of the Manasi River) at Ansole. 26º22’24”N 89º11’17”E.

P. shawi: UMMZ 243652 (8), 17.2-28.3 mm SL; West Bengal, Reidak River at Shipra, just outside Buxa Tiger Reserve. Sankosh River drainage, 26º31’12”N 88º42’32”E.

P. ferula: MSUMNH109 (1), 19.71 mm SL; from Siltousa River, Jalpaiguri, West Bengal.

P. nubila: MSUMNH111 (1), 26.50 mm SL; CMA53 (2), 23.23-25.71 mm SL: Kajaldoba Anthojora stream, Jalpaiguri, West Bengal.

Plate 1: Lateral view of *Pseudolaguvia flavipinna* (A), and ventral view of the fish showing adhesive apparatus (B).

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