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Channa assamensis, a new species of freshwater snakehead (Teleostei: Channidae) from the Indo-Bhutan drainage of lower Brahmaputra basin of Assam, Northeast India

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ABSTRACT

A new species of snakehead is described from the Indo-Bhutan hill streams, a special habitat zone of channids within gachua-complex. Its maximum standard length of about 150 mm and superficially resembles *C. pomanensis* in appearance, however, differs from their congeners by possessing 4-5 regular transverse black bands on dorsolateral position above the lateral line (vs. 7 unequal transverse black bands in *C. pomanensis* and 8-9 oblique bands in *C. brahmacharyi*) and a series of ventrolateral black oblique spotted bars arranged below the lateral line, orange-greyish pectoral with 4-5 semicircular black bars, orange-greyish caudal with dark brown streaks, prominent white distal margin of unpaired fins, swollen cheek, head narrow and compressed, branchial tooth plates two on first-gill arch, two large cycloid scales in lower jaw, maxilla extend to posterior margin of eye, dorsal-fin rays 34-37, anal-fin rays 22-24, pectoral fin-rays 14-15, lateral-line scales 42-46, cheek scales 5, pre-dorsal scales 12, pre-ventral scales 12-13, circumpeduncular scales 20-21, and vertebrae 39-44.

Keywords: *Channa* new species, Taxonomy, Gachua group, Indo-Bhutan foothills

1. INTRODUCTION

The family Channidae is commonly known as snakehead freshwater fishes naturally distributed in parts of Asia and Africa, and comprises three genera i.e., Channa, Parachanna, and Aenigmachanna (Adamson and Britz, 2018). The genus Channa Scopoli 1777 includes the total number of valid snakehead species from 47 to 56 (Rüber et al., 2020; Fricke et al., 2022). Out of them, 11 species are found in the northeastern Indian states after the discovery of Channa aristonei from Meghalaya (Praveenraj et al., 2020) and the Eastern Himalayan region also

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possesses a remarkable diversity of endemic snakeheads with the exist of 19 endemic Channa (Praveenraj et al., 2020).

The recent study of barcoding snakeheads highlights unexpected yet undisclosed diversity in the Channa: C. sp. Assam, C. sp. Bhutan foothills, C. sp. Rakhine Yoma, C. sp. Northeast India, C. sp. Tenasserim, C. sp. Mogaung (Conte-Grand et al., 2017). The Eastern Himalayan biodiversity hotspot plays a vital role in snakehead diversity, harboring several narrow-range endemics, all members of the Channa gachua group Conte-Grand et al., (2017) and predominantly northeast states anchoring high-level endemism (Rüber et al., 2019). The species Channa amphibeus McClelland 1845 reported from Assam also needs extensive exploration for further verification and elucidation of the habitat characterization of channids in this region categorized as a burrow or hole dwellers with the species, namely C. barca, C. aurantimaculata, C. stewartii, C. bleheri, and swamp dwellers preferring free living and crawling life in water and mud surfaces, namely C. punctata, C. gachua, C. striata, and C. marulius (Goswami et al., 2006).

The present species are collected from the torrential hill streams of the Indo-Bhutan border area of the Chirang District (26040′0″N, 90035′0″E) and the Baksa District (26050′0″N, 91030′0″E) of Assam, India. The elevation ranges between 61 m above MSL on the southern boundary to 110 m above MSL along the Bhutan foothills. During the study, eleven specimens of the channid are selected to be compared with other members of Channa gachua group. The details study, of morphological-based taxonomic comparison isolated the species as unreported species, hence describing it as Channa assamensis, emerges as a new species in present communication. However, the new species is under the adverse impacts on its population along with other co-occurring species in their wild habitat, and urgent need to identify it as native ornamental fish.

2. MATERIALS AND METHODS

Methods of measurements follow those of (Britz, 2008). Measurements were taken with digital calipers to the nearest 0.1 mm. Vertebrae number were counted from radiographs. Fin-ray counts for unpaired fins were also obtained from radiographs, and by using a binocular microscope under transmitted light. Branchial tooth plate count was done instead of the 'gill-raker count' following (Greenwood, 1976). Count was made on the first-gill arch starting from the hypobranchial to the epibranchial of the specimens. Collected specimens were preserved in 10% formaldehyde solution. The specimens examined in this study are deposited in the Museum of Zoological Survey of India (ZSI), Shillong, Meghalaya, India. The morphometric data were represented in percentage with the standard length (SL) and the head length (HL) of the specimen in mm. Altitudes were expressed in metres above mean sea level, through satellite map and geographic coordination by using a GPS tracker and through Google Maps. Taxonomic comparison of the new species, with its congeners was done on the basis of original descriptions of different authors and other literature sources.

Abbreviations

V/F/NERC/ZSI, Vertebrate/Fish/North Eastern Regional Centre/Zoological Survey of India; MSL, Mean Sea Level; GPS, Global Positioning System; SL, Standard length; HL, Head length.

***Channa assamensis*, new species (Figure 1 a, b, c, d)**

Holotype

V/F/NERC/ZSI/4421, 77.0 mm SL; India, Assam from the Kanamakra River at Amguri in the Chirang District, 26040′0" N, 90035′0"E, altitude 110 m, S. Pathak, 23rd August 2015.

Paratypes

V/F/NERC/ZSI/4418, 1 ex., 150.0 mm SL; India, Assam from the Pagladia River at Subankhata in the Baska District, 26050′0″N, 91030′0″E, altitude 61 m, N. N. Sarma, 25th December 2015; V/F/NERC/ZSI/4419, 2, 3 exs., 122.0 mm SL & 99.0 mm SL; India, Assam from the Kanamakra River at Amguri in the Chirang District, 26040′0" N, 90035′0"E, S. Pathak, 5th September 2014; V/F/NERC/ZSI/4420, 4, 5 exs., 90.0 mm SL & 75.0 mm SL; India, Assam from the Kanamakra River at Amguri in the Chirang District, 26040′0"N, 90035′0"E, altitude 110 m, S. Pathak, 28th November 2016; same data as holotype.

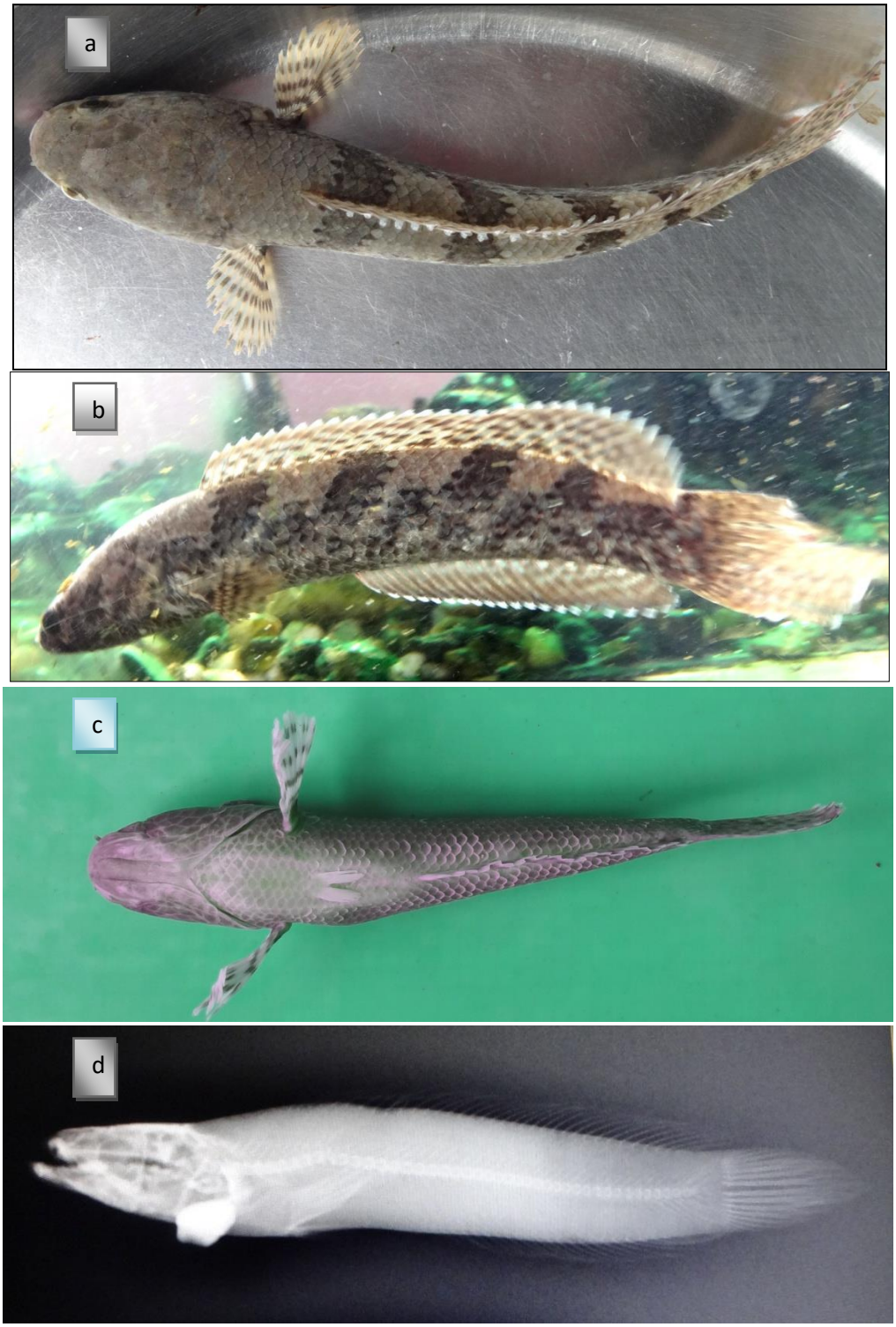

Figure 1 *Channa assamensis*, V/F/NERC/ZSI/4421, 77.0 mm SL, holotype (in life) a. Dorsal view, b. Lateral view, and c. Ventral view (in preserved); d. Radiograph of *Channa assamensis*, V/F/NERC/ZSI/4418, 1, 150.0 mm SL, paratype

Diagnosis

Channa assamensis belongs to the Gachua group having an elongated body with a large mouth, an inter-orbital region with broad and flattened, U-shaped isthmus, posterior end of head possessing indistinct black patch and distinguished from its congeners having 4-5 regular transverse black bands in dorsolateral position above the lateral line, a series of ventrolateral black oblique spotted bars arranged below the lateral-line; Dorsal-fin origin after 3-4 scales vertically above the pectoral-fin origin, dorsal-fin rays 34-37, anal-fin rays 22-24, pectoral-fin rays 14-15, lateral-line scales 42-46, pre-dorsal scales 12, pre-ventral scales 12-13, cheek scales 5, circumpeduncular scales 20-21, branchial tooth plates two on first-gill arch, maxilla extend to the posterior margin of eye,

cephalic sensory pores solitary, and concentrated in the lower mandibular region at anterior margin, vertebrae 39-44, transverse scale rows above lateral-line 3½-4½ at dorsal origin, transverse scale rows between lateral-line and anal-fin origin 6½-8½, two large cycloid scales on each side of the under surface of the lower jaw, pelvic-fin length less than 50 percent of pectoral-fin rays, lateral-line scales dropping one row at 11th -14th , scale rows on preopercular to the posterior end of the orbit 5, preorbital head depth 20-25 % HL, postorbital head depth 31-37.5 % HL, head depth 40.4-51.7 % HL, head width 62.5-72.4 % HL, and head length 29.2-32.0 % SL.

Description

Morphometric and meristic data are presented in Tables 1 and 2, respectively. The dorsal profile of the body is apparently straight from anterior to posterior, elongated and cylindrical anteriorly, ventral surface flattened from thorax to anal region, flank gradually compressed towards caudal peduncle, 4-5 more or less equal transverse bands across dorsolateral position above the lateral line, head dorsoventrally depressed, broader than body and snake-like with a fairly rounded snout, eyes moderate, situated laterally, nearer to tip of snout than the extremity of opercles, separated by a broad interorbital space, mouth large, oblique, mouth gap extending to the middle of the eye and maxilla to the posterior margin of the eye or slightly behind it, lips thick and fleshy, lower jaw slightly preceded the upper jaw, and two large cycloid scales present on each of the underside of it.

Table 1 Morphometric data of Channa assamensis (n=6) holotype and paratypes

	Holotype: V/F/NERC/ZSI/4421	Range	Mean ±SD
Standard length in mm	77.0	75.0-150.0	103.8±28.4
In percent of standard length			
Head length	31.1	29.2-32.0	30.5±1.1
Head depth	14.2	12.6-15.1	13.9±0.9
Head width	20.7	20.0-21.2	20.3±0.4
Body depth	20.7	16.0-20.7	18.3±1.9
Body width	19.4	16.1-19.4	17.9±1.1
Preorbital head depth	6.4	6.0-7.3	6.6±0.5
Postorbital head depth	10.3	8.1-12.0	10.0±1.3
Postorbital head length	20.7	20.0-20.7	20.2±0.2
Snout length	6.4	5.0-8.0	6.5±1.0
Eye diameter	6.4	4.9-6.6	5.4±0.7
Interorbital space	9	8.0-9.3	8.7±0.5
Upper jaw length	10.3	9.8-11.6	10.7 ±0.6
Lower jaw length	11.6	10.6-13.3	12.2±1.0
Dorsal fin base length	55.8	53.5-55.8	54.8±0.7
Pectoral fin length	19.4	15.1-20.0	18.6±1.8
Pelvic fin length	8.4	8.0-9.0	8.3±0.3
Anal fin base length	36.3	36.0-40.4	37.9±1.9
Pelvic to anal distance	15.5	15.5-18.6	17.0±1.1
Pectoral-fin base to pelvic-fin distance	7.7	7.0-9.8	7.8±1.0
Predorsal length	35	35.0-38.0	36.3±1.1
Prepectoral length	32.4	30.6-34.0	32.2±1.2
Prepelvic length	38.9	35.3-38.9	37.5±1.3
Preanal length	53.2	50.5-53.3	52.4±1.2
Caudal fin length	20.7	19.1-22.9	20.4±1.3
Caudal peduncle length	9	9.0-12.2	10.2±1.1

Caudal peduncle depth	10.3	10.0-12.0	10.9±0.7
In percent of head length			
Head depth	45.8	40.4-51.7	45.7±3.6
Snout length	20.8	20.0-25.5	22.1±2.4
Eye diameter	20.8	16.1-20.8	18.0±2.1
Interorbital space	29.1	25.0-31.0	28.7±2.1
Head width	66.6	62.5-72.4	67.0±3.4
Preorbital head depth	20.8	20.0-24.5	21.6±1.8
Postorbital head depth	33.3	30.5-37.5	33.4±2.9
Postorbital head length	66.6	62.5-69.4	66.4±2.5
Upper jaw length	33.3	33.3-39.4	35.6±2.7
Lower jaw length	37.5	36.1-44.8	40.2±3.6

Table 2 Meristic data of Channa assamensis (n=6) holotype and paratypes

	Holotype	Paratypes				
Predorsal scales	12	12	12	12	12	12
Preventral scales	12	12	12	12	12	12
Dorsal fin rays	34	35	34	34	34	37
Pectoral fin rays	14	14	14	14	14	15
Caudal fin rays	iii8iii	iii8iii	iii9iii	iii9iii	iii9iii	iii9iii
Pelvic fin rays	5	5	5	5	5	5
Anal fin rays	23	22	22	22	24	23
Lateral line scales	44	42	43	45	44	46
Bands on body	5	5	5	5	5	5
Lateral line scales dropping one row	13	11	11	14	11	12
Large scales on lower jaw	2	2	2	2	2	2
Scale rows from preopercle to posterior orbit	5	5	5	5	5	5
Transverse scale rows above lateral line	4½	4½	4½	3½	4½	4½
Transverse scale rows between lateral line and anal-fin origin	6½	8½	7½	7½	8½	7½
No. of pharyngeal tooth plate	3	3	3	3	3	3
Cephalic sensory pores	single	single	single	single	single	single
Circumpeduncular scales	21-22	21-22	21-22	21-22	21-22	21-22
Branchial tooth plates	2	2	2	2	2	2
No. of total vertebrae	39	39	40	42	42	44

Post-ophthalmic area is moderately swollen, opercles extending from the base of pectoral-fin origin to gular region anteriorly and deeply furrowed, gular plate elongated, smooth and rounded without scales, nostril tubular, solitary cephalic sensory pores scattered mainly in the preorbital area on dorsal side and few concentrated at anterior mandibular region along with single pores on the ventral side of the head. Dorsal fin-base is extensive, more than one-third of the standard length with 34-37 fin rays. The anal fin-base is shorter than the dorsal fin-base with 22-24 fin rays. The pectoral fin is oval with 14-15 fin rays. The pelvic fin is small with five rays, and caudal fin moderately elongated with 14-17 rays including procurrent rays.

Coloration

In life condition dorsum of the head and body is light grey colored with 4-5 transverse black bands across the dorsal along the flank above the lateral line arranged from slightly behind the dorsal-fin origin, a dark brown to dusky transverse streak present at the occipital region, a white ventral surface, and a series of ventrolateral black oblique spotted bars arranged below the lateral line and more distinctive at posterior, the outer edge of the dorsal and anal fins with a special white distal margin in a fashion of zigzag

serrations from anterior to the posterior end. The dorsal and anal-fin is speckled with brownish streak throughout their length. The tip of the snout is pinkish. The pelvic-fin is dusky white. The pectoral-fin is orange-greyish with 4-5 semicircular black bars, and the caudal-fin is orange-greyish possessing dark brown streaks. The specimens preserved in 10% formaldehyde solution turned uniformly grayish to brownish or dull blackish throughout the body.

Habitat

Channa assamensis is a species of burrowing and crawling habit, a type of channid species living in torrential streams and other in running waters with pebbles and sandy bottoms surrounded by thick aquatic vegetation. The fishes are primarily carnivorous in feeding nature, living with other stream habitat fish species.

Distribution

The species is presently known from the Kanamakra River at Amguri of the Chirang District and the Pagladia River at Suvankhata of the Baksa District, the Indo-Bhutan border area of Assam.

Etymology

The new species is named after the unique type locality of Brahmaputra drainage of Assam.

Remarks

Channa assamensis is distinguished from all other channids from Brahmaputra River and its tributaries by having 4-5 unique transverse black bands on the dorsolateral position above the lateral line and a series of ventrolateral black oblique spotted bars arranged below the lateral line, prominent white distal margin of unpaired fins, torrential stream habitation and restricted distribution pattern. Further, the species is expected as ornamental fish with other channids.

3. DISCUSSION

Gachua group is characterized by Vishwanath and Geetakumari, (2009) and *Channa assamensis* is closely related to the Gachua group members due to the presence of its U-shaped isthmus, single sensory pores arrangement, presence of two big cycloid scales on each side of the lower jaw and semicircular bands on pectoral-fin. *Channa assamensis* is distinguished from the *C. gachua* by the number of branchial tooth plates on first-gill arch (2 vs. 9) shown in Figure 2, and the number of vertebrae 39-44 vs. 43, dorsal-fin rays 34-37 vs. 32-37, pectoral-fin rays 14-15 vs. 15-17, anal-fin rays 22-24 vs. 21-27, caudal-fin rays 14-15 vs. 12, lateral-line scales 42-46 vs. 39-48, and two large cycloid scales on each side of the lower jaw undersurface vs. one or two. *Channa assamensis* differs from *C. aurantimaculata, C. barca* and *C. stewartii* based on morphometric and meristic variations by (Mushikasinthorn, 2000).

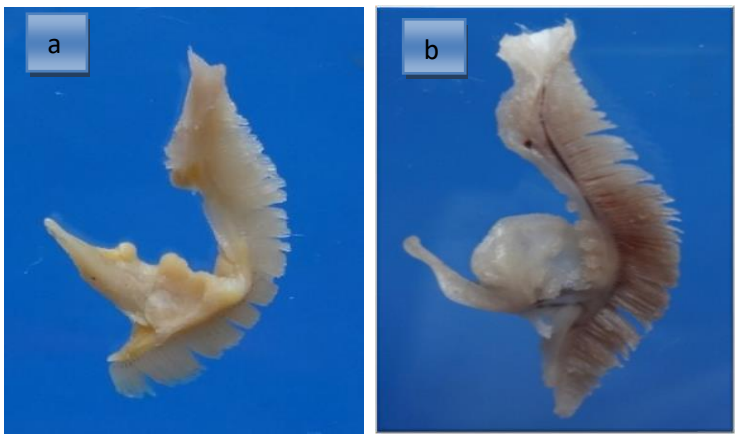

Figure 2 Branchial tooth plates of a. *Channa assamensis*, V/F/NERC/ZSI/4418, 1, ex.150.0 mm SL, paratype compared with b. *Channa gachua* 152.0 mm SL (uncatalogued) from the Pagladia River at Subankhata in the Baska District (26050′0″N 91030′0″E) of Assam, India

Channa assamensis is closely similar to *C. pomanensis* as reported by Gurumayum and Tamang, (2016) from Arunachal Pradesh in general appearance, having a deeply compressed head, a brown to dusky cross band across the occipital region, slightly protruding

the lower jaw, and two cycloid scales on each side of the lower jaw underside. But it differs from *C. pomanensis* based on unequal transverse dark band on the flank (4-5 vs.7), anal-fin rays (22-24 vs. 25-26), lateral-line scales (42-46 vs. 47-51), and number of vertebrae (39-44 vs. 42-45). *Channa assamensis* further differs from *C. pomanensis* by having transverse scale rows from anal-fin origin to lateral-line 6½ - 8½ vs. 7½ -8½, transverse scale rows from dorsal origin to lateral-line 3½ - 4½ vs. 4½ -5½, where such characteristics are similar to that of *C. melanostigmata* and *C. stewartii* by (Geetakumari and Vishwanath, 2011).

Channa assamensis is distinguished from *C. melanostigmata* by having fewer vertebrae (39-44 vs. 50-51), fewer circumpeduncular scales (21-22 vs. 27-28), fewer pre-dorsal scales (12 vs. 13-14), fewer branchial tooth plates (2 vs. 7), fewer lateral-line scales (42-46 vs. 46-47), fewer transverse black bands on the flank (4-5 vs. 12-14 alternate black & white), fewer black bars on pectoral-fin (3-4 vs. 5-6), fewer lateral-line scales dropping one row at (11th -14th vs. 15th -17th). *Channa assamensis* is distinguished from *C. stewartii* by having the number of pre-dorsal scales (12 vs. 13), pectoral-fin rays (14-15 vs. 17), pelvic-fin rays (5 vs. 6), lateral-line scales (42-46 vs. 45-53), and branchial tooth plates (2 vs. 3) on first-gill arch.

It is further distinguished from *C. pardalis* as reported by Knight, (2016) from Meghalaya with a uniform greyish body that possesses 4-5 dark transverse bands vs. 7-8 oblique bands with dark spots on the flank. *Channa assamensis* is distinguished from *C. aristonei* as reported by Praveenraj et al., (2020) from Meghalaya by having 4-5 regular transverse black bands on the flank vs. a uniform bluish-green body with a series of maroon-red rounded blotches on the dorsolateral. *Channa assamensis* resembles *C. quinquefasciata* Praveenraj et al., (2018a) but differs from *C. quinquefasciata* by having fewer or equal black transverse bands on the flank (4-5 vs. 5*)*, higher dorsal-fin rays (34-37 vs. 33-35), higher caudal-fin rays (14-15 vs. 12), and higher lateral-line scales dropping one row at 11th -14th vs. 10th -13th.

Channa assamensis differs from *C. lipor* as reported by Praveenraj et al., (2019a) from Meghalaya by having fewer black transverse bands on flank (4-5 vs. 6), higher dorsal-fin rays (34-37 vs. 29-32), higher anal-fin rays (22-24 vs. 20), *higher* pectoral-fin rays (14-15 vs. 12-14), higher lateral-line scales dropping one row at 11th -14th vs. 10th -11th, and higher lateral-line scales (42-46 vs. 35-40). *Channa assamensis* differs from *C. bipuli* as reported by Praveenraj et al., (2018b) from Assam by having light grey dorsum vs. unique bluish dorsum, presence of dark brown streaks on caudal fin rays vs. absent. *Channa assamensis* differs from *C. royi* Praveenraj et al., (2018) by having fewer black transverse bands on the flank (4-5 vs. 7-9), and higher pre-dorsal scales (12 vs. 6-7). *Channa assamensis* differs from *C. aurantipectoralis* as reported by Lalhlimpuia et al., (2016) from Mizoram by having fewer lateral-line scales (42-46 vs. 51-64), and fewer circumpeduncular scales (21-22 vs. 28).

Channa assamensis differs from *C. stiktos* as reported by Lalramliana et al., (2018) from Mizoram by having fewer pre-dorsal scales (12 vs. 13-14), fewer lateral-line scales dropping one row at 11th -14th vs. 14th -16th, and fewer lateral-line scales (42-46 vs. 47-49). *Channa assamensis* differs from *C. brahmacharyi* as reported by Chakraborty et al., (2020) from Meghalaya by having fewer black transverse bands on the flank (4-5 vs. 8-9), fewer anal-fin rays (22-24 vs. 23-26), fewer circumpeduncular scales (21-22 vs. 24-25), fewer vertebrae (39-44 vs. 45), and fewer scales in transverse series above lateral-line up to the base of dorsal-fin (3½ - 4½ vs. 6). *Channa assamensis* differs from *C. amari*, *C. andrao*, *C. asiatica*, *C. bleheri*, *C. brunnea*, *C. burmanica*, *C. hoaluensis*, *C. ninhbinhensis*, *C. orientalis* by present of pelvic fin vs. absent.

Channa assamensis differs from *C. ornatipinnis* and *C. pulchra* as reported by Britz, (2008) from Myanmar by having fewer anal-fin rays (22-24 vs. 23-26), fewer lateral-line scales (42-46 vs. 44-48) and fewer lateral-line scales dropping one row at 11-14th vs. 14-17th. *Channa assamensis* differs from *C. rara* as reported by Britz et al., (2019) from Maharashtra by the absence of one or more ocelli in the posterior part of the dorsal-fin in adult and 6-7 dark concentric bands on pectoral-fin vs. 4-5 semicircular bands on pectoral fins. Outer edges of the dorsal and anal-fin of *C. assamensis* in stretched condition give a prominent appearance of zigzag serrations. But, the degree of similarity in the white distal margin of dorsal and anal-fin makes a variation in *C. gachua, C. stewartii, C. melanostigma, C. pomanensis C. quinquefasciata, C. lipor, C. brahmacharyi, C. aristonei*, with relation to *C. assamensis* and the margin serration of fins is much higher in the latter species.

The present study records the occurrence of *C. assamensis* in torrential stream areas from the Chirang District (26035′0″N, 90030′0″E) and the Baksa District (26050′0″N, 91030′0"E) of Assam at Northern Bank of the River Brahmaputra shown in (Figure 3). During the study, rampant catching from wild stock and habitat alteration are identified as the major causes for declining the population status of this channid species with other co-occurring species. The present species has shown a restricted distribution pattern for, which it can be considered as rare. Hence, the present study concentrates on the conservation of the *C. assamensis* which is otherwise threatened by the extremely restricted habitation zones.

Figure 3 Satellite map showing the Indo-Bhutan border comprising the streams at the study area in the Chirang District (26035′0″N, 90030′0″E) and the Baksa District (26050′0″N, 91030′0"E) of Assam, India. (Source: Image from Google Earth)

Comparative Material

Comparative data obtained from the literatures of different authors and made discussion on their contributions in the new discoveries of snakeheads, viz. C. amphibeus McClelland 1845: 274-279 (type locality: Tributaries of Teesta at the foothill of the Bouton mountains), C. aurantimaculata Musikasinthorn, (2000) (Type locality: Dibrugarh, Assam & Arunachal Pradesh), C. barca Hamilton 1822: 67, 367 (Type locality: Brahmaputra River near Goalpara, Assam & Pabitora Wildlife Sanctuary, Morigaon), C. bleheri Vierke 1991:22 (Type locality: Dibrugarh, Assam & Dikrong River, Arunachal Pradesh, C. stewartii Playfair 1867:14 (Type locality: Cachar, Assam & Deopani River, Arunachal Pradesh) composed from the description of Vishwanath and Geetakumari, (2009); C. melanostigma (Type locality: Arunachal Pradesh: Lohit district, Lohit River, Brahmaputra drainage, collected by holotype- MUMF-Per 39, 134.8 mm SL and & paratype-MUMF-Per 40-46, 6, 82.1-143.0 mm SL) composed from the description of Geetakumari and Vishwanath, (2011), C. gachua Hamilton 1822, 1ex, 152.0 mm SL (tototype, uncatalogued) from Pagladia River at Subankhata in the Baska District, 26050′0″N 91030′0″E by N.N.S Museum, Assam used for tooth plate count; Literature verified on C. asiatica (Linnaeus 1758), C. orientalis (Bloch & Schneider 1801), C. burmanica (Choudhuri 1919), C. bleheri (Vierke 1991), C. hoaluensis (Nguyen 2011); C. ninhbinhensis (Nguyen 2011), C. andrao (Britz, 2013), C. amari Dey et al., (2019), and C. brunnea (Praveenraj et al., 2019b).

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Conflicts of interests

The authors declare that there are no conflicts of interests.

Ethical approval

The Animal ethical guidelines are followed in the study for species observation & identification.

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Data and materials availability

All data associated with this study are present in the paper.

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