Copeia

Copeia 108, No. 4, 2020, 938–947

A New Species of Snakehead (Teleostei: Channidae) from East Khasi Hills, Meghalaya, Northeastern India

Jayasimhan Praveenraj[1], Tejas Thackeray[2], Sadokpam Gojendro Singh[3], Arumugam Uma[4], N. Moulitharan[5], and Bankit K. Mukhim[6]

A new species of colorful snakehead from Meghalaya, northeastern India is distinguished from all its congeners by possessing a uniform bright blue to bluish-green body, bright-blue dorsal, anal, and caudal fins, submarginally black with white distal margin, series of brown to maroon-red, rounded, oblong or clover-shaped blotches or spots on dorsolateral, postorbital, and ventrolateral region of head, continued on body forming oblique pattern or randomly distributed. The new species superficially resembles *C. pardalis* and *C. bipuli* in appearance, but it can be distinguished from both in having brown to maroon-red, rounded, oblong or clover-shaped blotches or spots on head and sides of the body (vs. possession of well-defined, black to brown, rounded to oblong spots), fewer pre-dorsal scales (7 vs. 8–9), more caudal-fin rays (15 vs. 13), and more vertebrae (49 vs. 45). The new species differs from both *C. pardalis* and *C. bipuli* by Kimura's two-parameter (K2P) distance of 4.2–4.8 and 4.9–6.0% in the coxI gene sequence. A key to the snakehead Gachua group of the Eastern Himalayan region is provided herein.

THE family Channidae is represented by 53 species in three genera, *Channa* with 48 valid species distributed from the Middle East to South-East and Far-East Asia, *Parachanna* with three species restricted to tropical Africa, and *Aenigmachanna* with two species from the laterite areas of Western Ghats of India (Britz et al., 2019a, 2019b; Kumar et al., 2019; Praveenraj et al., 2019a; Sudasinghe et al., 2020a, 2020b). The Eastern Himalayan region possess a remarkable diversity of endemic snakeheads. A total of 19 endemic *Channa* out of 48 species exist in the Eastern Himalayan region, of which 11 species occur in the northeastern India states.

In recent years, interest in snakehead taxonomy has increased, as many aquarium traders and hobbyists brought new species to the attention of researchers; some of the well-known species include *Channa andrao*, *C. bipuli*, *C. bleheri*, *C. brunnea*, *C. lipor*, *C. pardalis*, and *C. quinquefasciata*. Many of these Eastern Himalayan region species of *Channa* possess minimal morphometric and meristic difference from their congeners and were described based on differences in coloration and genetic analysis (Praveenraj et al., 2018a, 2018b, 2019a, 2019b).

Recently, a colorful species of *Channa* was brought to our attention by a fish hobbyist from Meghalaya, Northeast India. The specimen resembled *C. pardalis* and *C. bipuli* in morphology and coloration. The authors collected fresh specimens of the same from the same locality. Morphological, osteological, and genetic features reveal that this represents a species distinct from *C. pardalis*, *C. bipuli*, and all other congeners, and it is herein described as a new species. A working key for the Gachua group of the Eastern Himalayan region is provided.

MATERIALS AND METHODS

Specimens examined in this study are deposited in the Bombay Natural History Society, Mumbai, India (BNHS), the Zoological Survey of India, Kolkata, India (ZSI FF), the Central Island Agricultural Research Institute, Port Blair, India (CIARI/FF), and in the personal collection of J. Praveenraj, Chennai, India (JPC). Morphometric measurements and meristics follow Musikasinthorn (1998), except that the predorsal scale count is given as the number of scales between the rosette-like scale arrangement and the origin of the dorsal fin. Measurements were made with a digital caliper to the nearest 0.1 mm. Subunits of the body and of the head are presented as percent of standard length (SL) and of head length (HL), respectively. Numbers in parentheses after a count denote the frequency of that count. Osteological preparations were made following the alizarin-staining method described by Potthoff (1984), and osteological nomenclature follows Murray (2012). Total vertebrae and teeth were counted from two cleared and stained specimens of the new species (CIARI/FF-61).

Genetic analysis.—DNA was extracted from a clipping of the right pectoral fin of three specimens of the new species (BNHS FWF 1018, 1040, 1042) and two specimens each of *C. pardalis* (BNHS FWF 1058, CIARI/FF-57) and *C. bipuli* (BNHS FWF 1057, CIARI/FF-56) using the QIAGEN blood and tissue kit. Amplification of 630 bp of the partial cytochrome

[1] Fisheries Science Division, Indian Council of Agricultural Research, Central Island Agricultural Research Institute, Port Blair 744101, Andaman and Nicobar Islands, India; Email: jpr948@gmail.com. Send reprint requests to this address.
[2] Thackeray Wildlife Foundation, Bandra, Mumbai 400051, India; Email: tejasthackeray@gmail.com.
[3] Indian Council of Agricultural Research, Research Complex for NEH Region, Umiam, Meghalaya 793103, India; Email: ind.goj@gmail.com.
[4] Department of Aquatic Animal Health Management, Dr. M.G.R. Fisheries College and Research Institute, Tamil Nadu, Dr. J. Jayalalithaa Fisheries University, Ponneri 601204, India; Email: uma@tnfu.ac.in.
[5] Department of Fisheries Resources Management, Dr. M.G.R. Fisheries College and Research Institute, Tamil Nadu, Dr. J. Jayalalithaa Fisheries University, Ponneri 601204, India; Email: moulitharan769677@gmail.
[6] Krishi Vigyan Kendra Ri-Bhoi, Indian Council of Agricultural Research, Research Complex for NEH Region Umiam, Meghalaya 793103, India; Email: Bankitkuparmukhim@gmail.com.

Submitted: 16 January 2020. Accepted: 9 August 2020. Associate Editor: D. Buth.
 DOI: 10.1643/CI2020007 Published online: 23 December 2020

oxidase unit I (coxI) gene was done following the PCR conditions and primers used by Praveenraj et al. (2019b). The amplified PCR products were sequenced using COX-F and COX-R primers in ABI 3500 DNA analyzer (Eurofins Pvt. Ltd., Bangalore). The homology of the generated sequence was checked with BLAST (Altschul et al., 1990) to find the closest sequences available in GenBank (https://www.ncbi.nlm.nih.gov). Sequences generated as part of the study are deposited in GenBank under accession numbers MT040625, MT040627, MT158324 for the new species, MT160362–63 for *C. pardalis*, and MN900751–52 for *C. bipuli*. Gene sequences were aligned using MUSCLE (Edgar, 2004). The genetic distances among the sequences of the various species of *Channa* were determined by Kimura's two-parameter (K2P) model (Kimura, 1980) in MEGA X (Molecular Evolutionary Genetics Analysis; Kumar et al., 2018). Additional sequences for *C. pardalis* and *C. bipuli* were retrieved from the work of Praveenraj et al. (2018b). The maximum likelihood (ML) phylogenetic tree was constructed using the coxI dataset of 43 sequences of various species of *Channa* including seven sequences generated in the present study. Sequences of one species of *Parachanna* (MF496973) were used as an outgroup (see Supplemental Table 1 for GenBank accession numbers; see Data Accessibility). The best fit nucleotide substitution model was selected from 24 models, based on the one with the lowest BIC scores (Bayesian information criterion), which was considered to describe the best substitution pattern (Nei and Kumar, 2000). jModelTest (Posada, 2008) suggested the best fit nucleotide substitution model to be the Hasegawa-Kishino-Yano model (HKY) with gamma distribution and assumption that a certain fraction of sites are evolutionarily invariable (+I) [(G+I), AICc = 14760.253, *lnL* = –7294.851, (+I) = –0.58, (+G) = 1.50]. The phylogenetic tree was constructed based on the maximum likelihood fits in MEGA X, and its reliability was estimated using bootstrap values run for 1,000 iterations.

Channa aristonei, new species

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Figures 1–3A

Holotype.—BNHS FWF 1017, 136 mm SL, India, Meghalaya, East Khasi Hills, streams at Puriang, 25°33′47.5″N, 92°06′24.5″E, J. Praveenraj and team, 1 December 2019.

Paratypes.—BNHS FWF 1018, 1, 155 mm SL (DNA barcoded), BNHS FWF-1040–1042, 3, 122–131 mm SL (122 and 131 mm SL DNA barcoded); CIARI/FF-61, 2, 133–142 mm SL (133 and 142 mm SL used for osteology), same collection data as holotype.

Diagnosis.—A member of Gachua group, as defined by Britz (2008), but distinguished from all known species of *Channa*, except *C. pardalis* and *C. bipuli*, by possessing a striking blue to bluish-green body, bright-blue dorsal, anal, and caudal fins, submarginally black with white distal margin; head and lateral surfaces of body with numerous or few, brown to maroon-red, rounded, oblong or clover-shaped blotches or spots forming oblique pattern or randomly distributed (Figs. 2, 3A). *Channa aristonei* resembles *C. pardalis* and *C. bipuli* in general appearance, but live specimens are readily distinguished by the presence of brown to maroon-red, rounded to oblong or mostly clover-shaped blotches on head and sides of the body forming oblique pattern or distributed in a random manner (vs. possession of only black or brown, oblong to rounded spots forming oblique pattern or randomly distributed in *C. pardalis*; minute black spots on the cheek, interorbital region, and sides forming oblique pattern or randomly distributed in *C. bipuli*); presence of two to three narrow, black semi-circular bands in the pectoral fin (vs. four to five narrow, black semi-circular bands in *C. pardalis* and *C. bipuli*; Figs. 2, 3A). Further, the new species differs from *C. pardalis* and *C. bipuli* by having fewer pre-dorsal scales (7 vs. 8–9), more caudal-fin rays (15 vs. 13), and more vertebrae (49 vs. 45).

Description.—For general appearance, see Figures 1, 2, and 3A. Morphometric data are presented in Table 1. Body elongate, round in cross section anteriorly, laterally compressed towards caudal peduncle. Body profile at origins of dorsal and anal fins almost straight, head gently curved anteriorly. Head widest between posterior margins of eye and the opercle. Mouth large, maxilla extending beyond posterior margin of eye, lips fleshy. Lower jaw protruding slightly beyond upper jaw with two large cycloid scales on either underside of it. Snout broadly rounded, cheek region bulging out behind eye in adult males, moderate in sub-adults and females. Premaxilla with 4–5 rows of minute, conical, recurved teeth. Dentary with two rows of teeth, inner row with 25 medium-sized to large, stout, pointed, conical teeth; succeeding outer rows with medium-sized, villiform teeth terminating in three to four rows at jaw symphysis. Palatine with three rows of teeth, inner row with 19 stout, recurved, conical teeth; outer two rows with small, conical teeth. Fifth ceratobranchial with four rows of teeth, arranged haphazardly, outer row with 15 stout, pointed teeth, succeeding inner rows with numerous, irregularly arranged, minute, conical teeth.

Count of the holotype denoted by an asterisk. Dorsal-fin rays 36 (4), 37 (1), 38* (1), 39 (1); anal-fin rays 24 (2), 25 (3), 26* (2); pectoral-fin rays i 12* (1), i 13 (4), i 14 (2); principal caudal-fin rays 15 (7); pelvic-fin rays i 5 (7). Lateral-line scales 47* (2), 48 (2), 49 (1), 50 (2) in total, 12 (2), 13 (3), 14 (1), 15* (1) forming pre-drop, single scale forming drop, 32* (2), 33 (1), 34 (1), 36 (2), 37 (1) in post drop. Scales from dorsal-fin origin to pre-drop 3.5(2)–4.5*(5), anal-fin origin to post drop 6.5(5)–7.5*(2). Pre-dorsal scales 7 (7). Cheek scales 6 (1), 7*(6). Circumpeduncular scales 20 (1), 22 (3), 24* (3). Vertebrae 49 (2).

Color in life.—In life (Figs. 2, 3A), body uniformly bluish-green, in some specimens top of head olive-green progressively becoming bluish ventrally. Dorsolateral, postorbital, and ventrolateral region with brown to maroon-red, rounded, oblong or clover-shaped blotches or spots, continued on sides forming oblique pattern or randomly arranged. In adult specimen, complete absence of blotches on the head, replaced with olive-green patches (Figs. 2B). In some specimens, the clover-shaped blotches form 8–9 distinct, oblique patterns extending to the anal-fin base (Figs. 2C). Ventrolateral and ventral aspect of head bright-blue. Both lips bright-blue. An orange to red patch beneath the eye. Opercular membrane and isthmus bluish. Dorsal-fin rays olive-green, fin membrane bluish followed by black submargin and white distal margin. Anal-fin rays and membrane

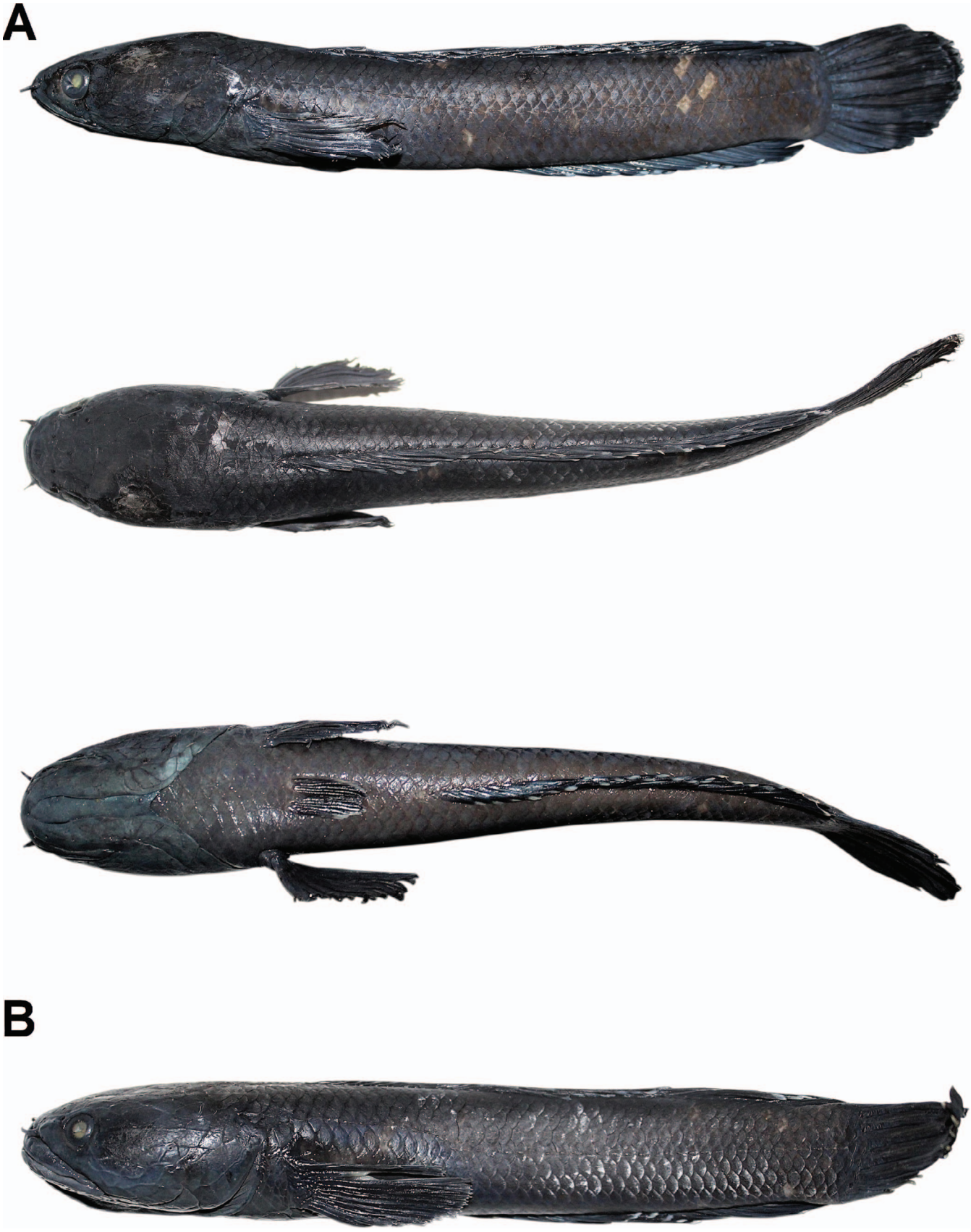

Fig. 1. *Channa aristonei*. (A) Holotype, BNHS FWF 1017, 136 mm SL; lateral, dorsal, and ventral views; (B) paratype, BNHS FWF 1018, 155 mm SL.

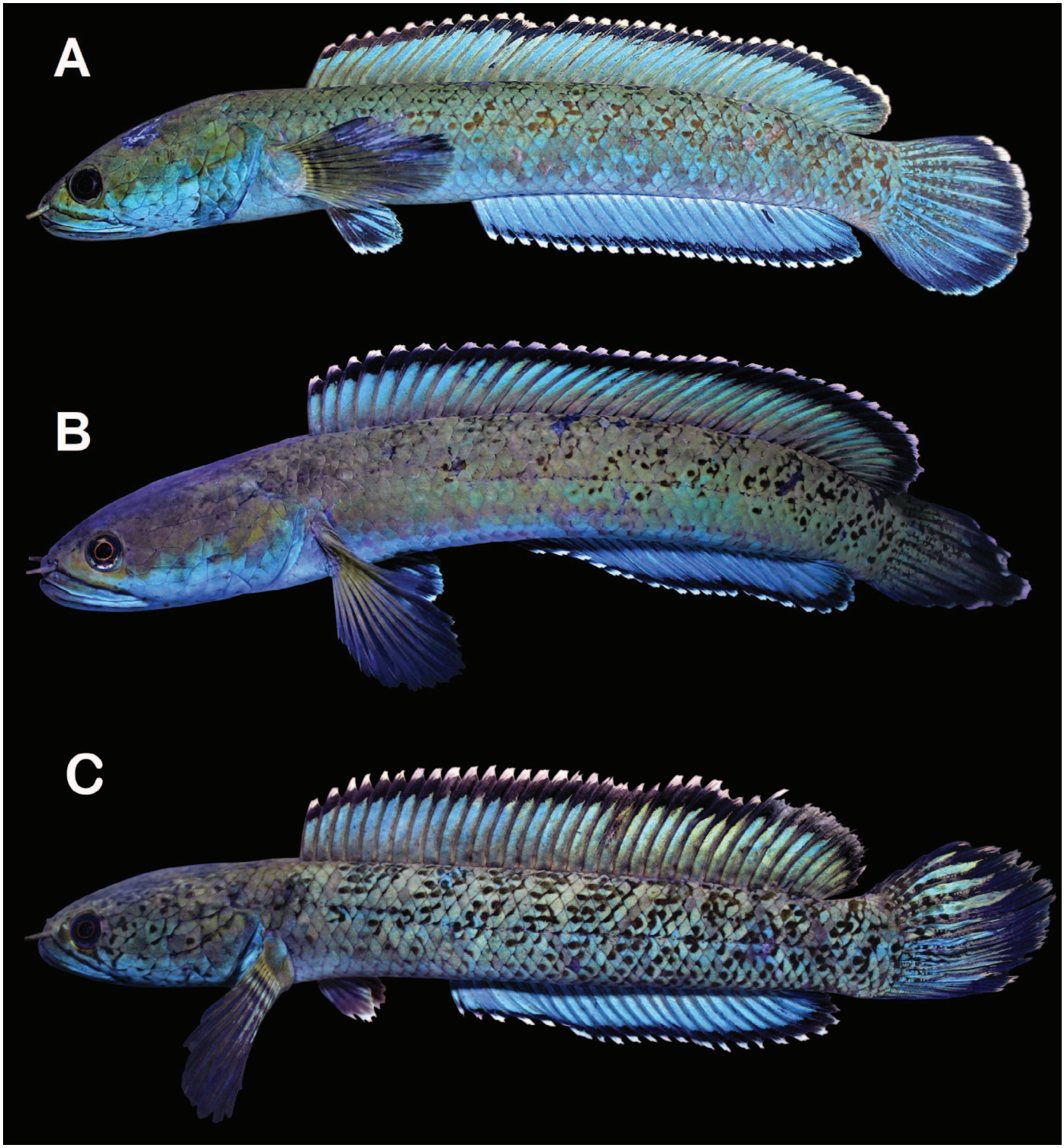

Fig. 2. *Channa aristonei*. (A) Holotype, BNHS FWF 1017, 136 mm SL; (B) paratype, BNHS FWF 1018, 155 mm SL; (C) paratype, BNHS FWF 1042, 131 mm SL.

bluish, followed by black sub-margin and white distal margin. Caudal-fin rays bluish, 6–7 red bars running transversely on the rays, interradial membranes bluish, black sub-marginally and white distal margin. Pectoral-fin base with bright-blue blotch anteriorly; three narrow, semi-circular rows of black bands being narrower than the pale-orange interspace. Pelvic-fin rays black, membrane bluish with whitish margin.

Color in alcohol.—(Fig. 1) Body uniformly dark gray, head, cheek, and opercular area dark-gray, becoming lighter towards throat. Brown to maroon-red blotches on body appears creamy-white. Branchiostegal membrane dark gray, isthmus and the ventral region pale-gray. Pectoral fin dark-gray with three faint black semi-circular bands which are rarely visible. Pectoral-fin base with a black blotch anteriorly.

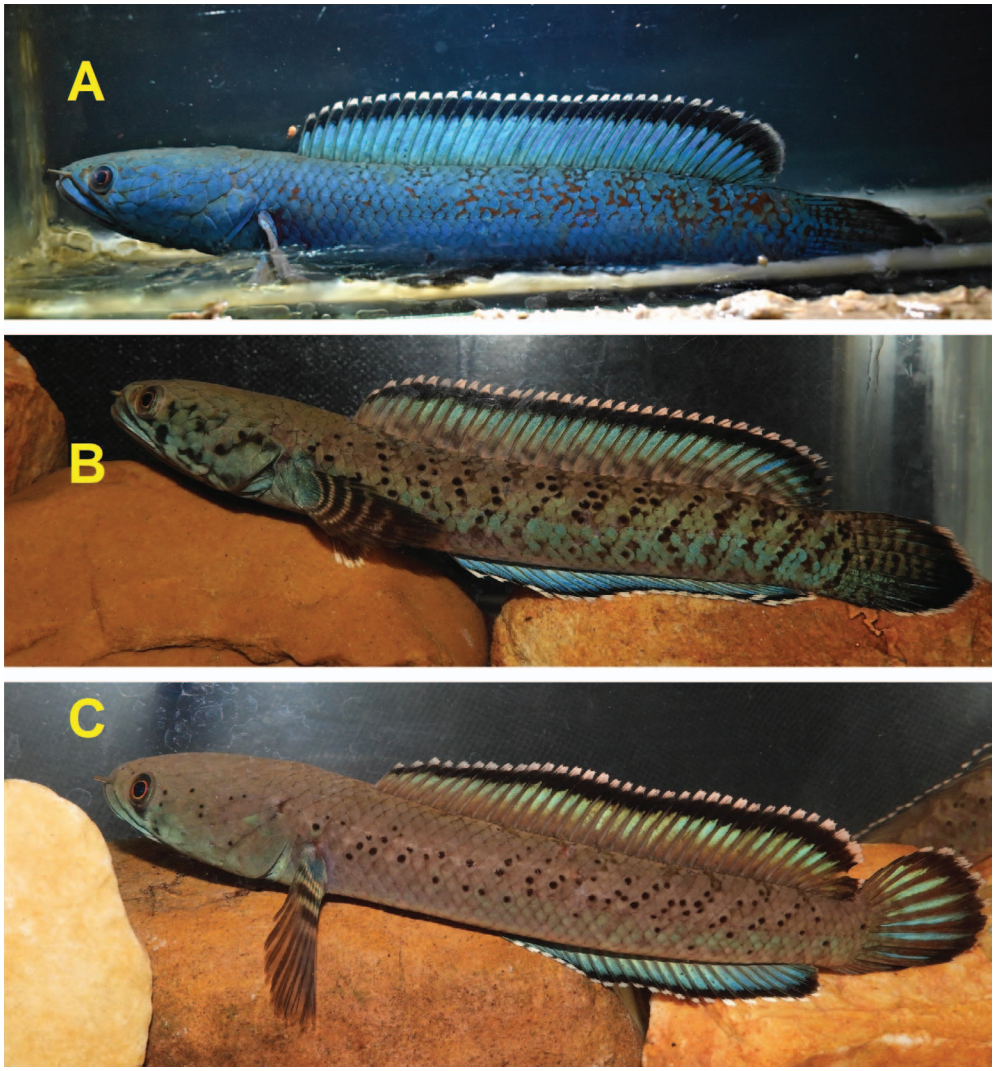

Fig. 3. (A) *Channa aristonei*, 150 mm SL, uncatalogued specimen (Photo credits: M. R. Aristone); (B) *Channa pardalis*, CIARI/FF-57, 120 mm SL; (C) *Channa bipuli*, CIARI/FF-56, 119 mm SL.

Dorsal, anal, pelvic, and caudal fins dark-gray with white margins.

Distribution and habitat.—Known from the streams at Puriang, East Khasi Hills, Meghalaya (Fig. 4). The habitat is a clear, slow-flowing hill stream, having rocky substrate, and *Eriocaulon* sp. as the only aquatic vegetation. The water temperature was 18°C at the time of survey. Co-occurring species in the habitat were *C. lipor*, *Danio meghalayensis*, and *Tor* sp.

Etymology.—This species is named after Aristone M. Ryndongsngi from Meghalaya, in recognition of his discovery of this new species and assistance to the authors during the field work.

Comparisons.—The new species is readily distinguished from other members of the Gachua group viz. *C. barca*, *C. amphibeus*, and *C. aurantimaculata* by the absence of any black/orange spots or blotches on the body (vs. presence), in having fewer dorsal-fin rays and anal-fin rays (36–39 vs. 45–50; 24–26 vs. 28–36), and fewer lateral-line scales (47–50 vs. 51–64, respectively). It differs from *C. stewartii*, *C. ornatipinnis*, *C. pulchra*, and *C. stiktos* by the possession of brown to maroon-red, rounded, oblong to clover-shaped blotches or spots on the body (vs. well-defined black spots in all the aforementioned species; see Britz, 2008; Vishwanath and Geetakumari, 2009; Lalramliana et al., 2018), body being blue to bluish-green (vs. greenish-gray, brown, beige to grayish), in having fewer circumpeduncular scales (20–24 vs. 25–28), and more vertebrae (49 vs. 44–45). Further, it differs from *C. melanostigma* by the absence black bands on body (vs. presence of broad, black bands on the sides; see Geetakumari and Vishwanath, 2011), fewer vertebrae (49 vs. 50–51), and fewer circumpeduncular scales (20–24 vs. 27–28). It is distinguished from *C. pomanensis* and *C. quinquefasciata* in having a blue to bluish-green body, devoid of oblique bands (vs. greenish-tan, chrome-yellow to pale-gray body with oblique bands), and more vertebrae (49 vs. 43–45). It differs from *C. aurantipectoralis* by the presence of black semi-circular bands on the pectoral fin (vs. yellow pectoral fin without any bands, see Lalhlimpuia et al., 2016), in having fewer lateral-line scales (47–50 vs. 51–64), and fewer transverse scale rows (3.5–4.5/1/6.5–7.5 vs. 5.5–6.5/1/7.5–8.5). It also differs from *C. lipor*, a co-occurring species from the same habitat, by its larger size (>160 mm SL vs. 110 mm SL), in having more anal-fin rays (24–26 vs. 20), more lateral-line scales (47–49 vs. 35–40), and more vertebrae (49 vs. 40). *Channa aristonei* is readily distinguished from *C. gachua* by its coloration (blue to bluish-green vs. tawny-brown), in having

Table 1. Morphometric data of *Channa aristonei* ($n = 7$). Ranges include values of holotype.

Morphometric characters	Holotype	Range (includes paratype and holotype; $n = 7$)	Mean ± SD
Standard length (mm)	136	122–155	
Percent of standard length			
Head length	28.7	26.4–29.6	28.7±1.0
Head depth	13.5	11.5–14.8	13.1±1.3
Head width	17.5	17.1–21.3	18.7±1.7
Body depth	13.2	11.3–14.0	13.0±0.8
Body width	11.0	10.6–12.6	11.2±0.7
Predorsal length	32.5	30.7–34.4	32.4±1.1
Preanal length	50.0	48.6–51.4	49.7±1.0
Prepectoral length	29.5	28.3–32.4	30.4±1.4
Dorsal-fin base length	58.7	57.1–60.5	58.9±1.2
Anal-fin base length	41.8	38.0–41.8	39.8±1.3
Pectoral fin length	19.8	19.1–21.9	20.4±1.2
Caudal peduncle length	11.4	11.4–14.2	12.9±0.9
Caudal peduncle depth	10.5	9.8–10.6	10.3±0.3
Snout length	6.4	6.1–8.0	6.9±0.7
Eye diameter	4.6	4.1–5.0	4.4±0.3
Preorbital depth	7.9	8.0–9.1	8.0±0.9
Postorbital depth	10.3	9.3–11.6	10.3±0.8
Postorbital length	20.8	17.6–29.0	20.3±3.6
Interorbital width	8.6	7.7–9.1	8.6±0.5
Upper jaw length	11.7	10.7–12.7	11.4±0.7
Percent of head length			
Snout length	22.2	21.8–27.1	24.0±1.9
Eye diameter	16.2	13.9–17.3	15.4±1.4
Head depth	47.1	40.2–50.5	45.7±4.3
Head width	60.9	59.9–73.1	65.0±5.1
Preorbital depth	27.4	24.5–31.2	27.7±2.6
Postorbital depth	35.9	33.4–40.0	36.0±2.3
Postorbital length	72.4	64.4–99.9	71.9±12.6
Interorbital width	30.1	28.7–31.1	29.9±0.9
Upper jaw length	40.6	37.4–43.6	39.8±2.0

Fig. 4. Type locality of *Channa aristonei*, India, Puriang, East Khasi Hills, Meghalaya, 25°33′47.5″N, 92°06′24.5″E.

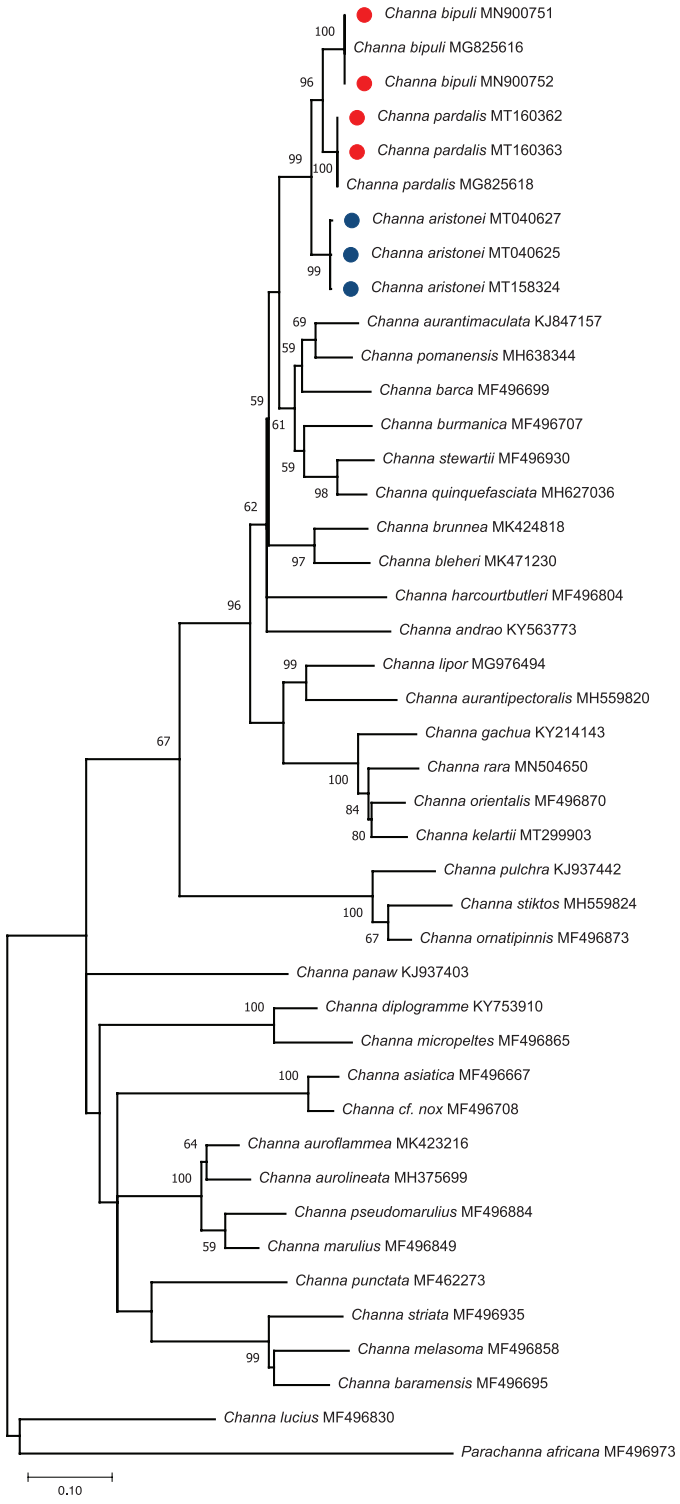

Fig. 5. Phylogenetic position of *Channa aristonei* based on the maximum likelihood analysis. Values along nodes are percent bootstraps for 1,000 iterations. Blue circle denotes the GenBank accession number for paratypes of *C. aristonei* (BNHS FWF 1018, 1040, 1042); red circle denotes the GenBank accession numbers for *C. bipuli* (BNHS FWF 1057, CIARI/FF-56) and *C. pardalis* (BNHS FWF 1058, CIARI/FF-57) generated in the present study. Sequences of *Parachanna* sp. (MF496973) are used as an outgroup. See Data Accessibility for tree file.

more anal-fin rays (24–26 vs. 22), more lateral-line scales (47–49 vs. 39–40), and more vertebrae (49 vs. 42). The adults of *C. aristonei* differs from *C. rara* by the absence of any ocellus in the posterior part of the dorsal fin (vs. presence, see Britz et al., 2019b), in having the pectoral fin with only 3 black semi-circular bands (vs. 6–7 brown semi-circular bands), and fewer anal-fin rays (24–26 vs. 22). *Channa aristonei* differs from *C. harcourtbutleri* in having the body coloration being blue to bluish-green (vs. purplish black), more pre-dorsal scales (7 vs. 4), and a deeper postorbital depth (33.4–40.0 vs. 30.9–35.0% HL; see Ng et al., 1999). *Channa aristonei* differs from other members of the Gachua group viz. *C. andrao*, *C. bleheri*, *C. burmanica*, *C. orientalis*, and *C. brunnea* by the possession of pelvic fins (vs. absent).

Remarks.—The species is shy in nature, hides in crevices among the submerged rocky boulders, and comes out only for feeding. Well-conditioned specimens when housed in water temperature less than 20°C acquires uniform bright-blue body color with maroon-red blotches on the lateral body (Fig. 3A), and immediately takes up golden-green to greenish-gray when stressed or housed in warm temperature.

Genetic analysis.—The maximum-likelihood phylogenetic tree reveals *C. aristonei* to be closely related to *C. pardalis* and *C. bipuli*, forming a separate sister clade to both (Fig. 5). *Channa aristonei* differs genetically from *C. pardalis* and *C. bipuli* by a K2P distance of 4.2–4.8 and 4.9–6.0% in the coxI gene. It also differs from other congeners of the Gachua group distributed in the Brahmaputra River basin, Western Ghats, India, and northern and southern Rakhine State of Myanmar by a higher K2P distance of 10.5–21.5%.

Discussion.—The discovery of *C. aristonei* increases the number of species of *Channa* to 49, which currently comprises a total of 19 endemic species from the Eastern Himalayan region. Recently, two new snakeheads were described from Meghalaya viz. *C. pardalis* and *C. lipor*; with the addition of *C. aristonei*, there are a total of five species, the other two being *C. gachua* and *C. stewartii* reported by previous authors.

Conte-Grand et al. (2017) noted that in channids color pattern information from live specimens greatly helps in distinguishing taxonomic groups within the Gachua group; it is evident that *C. aristonei* is readily distinguished from all its congeners only by its striking color pattern. *Channa aristonei* possesses overlapping meristic characters with *C. pardalis* and *C. bipuli*, but live specimens are readily distinguished from both by the possession of brown to maroon-red, oblong to clover-shaped blotches or spots on body, compared to well-defined, rounded to oblong, black to brown spots. *Channa aristonei* differs in meristics from both *C. pardalis* and *C. bipuli* only in possessing fewer pre-dorsal scales, more caudal-fin rays, and more vertebrae. Genetically the closest congeners of *C. aristonei* are *C. pardalis* and *C. bipuli*, forming a separate clade in the phylogenetic tree, and it varies from both by K2-P sequence distances of 4.2–4.8 and 4.9–6.0%, respectively, in the coxI gene.

Channa aristonei possesses maroon-red blotches on the postorbital region and body like *C. andrao* but differs from it by the possession vs. absence of pelvic fins.

The discovery of *C. aristonei* from Meghalaya, part of the Eastern Himalayan region, further highlights Northeast India as a hotspot for snakehead diversity as previously emphasized by many researchers (Conte-Grand et al., 2017; Rüber et al., 2019).

KEY TO THE GACHUA GROUP OF THE EASTERN HIMALAYAN REGION

A key for diagnosing the Gachua group of the Eastern Himalayan region is provided. The key will be useful for diagnosing species in fresh and preserved condition. Asterisk (*) denotes species described or recorded from Meghalaya.

1a. Pelvic fin present, one or two large cycloid scale on each side of lower jaw under-surface. Pectoral fin with or without black semi-circular bands, its interspace orange, brown, chrome-yellow, or gray (except black, all colors turn white or pale-gray after preservation) 2

1b. Pelvic fin absent. Pectoral fin with 3–6 narrow to broad, black discrete bands, or coalescing to form an irregular pattern with pale-orange to ochre interspace (except black, all colors turn white or pale-gray after preservation) 3

2a. Pectoral fin with 3–7 black, semi-circular bands with white, orange, yellow, ochre, or chrome-yellow color interspace 6

2b. Pectoral fin devoid of any semi-circular bands. Body golden-yellow with seven dark-brown oblique bands on lateral side. Dorsal fin bluish, submargin orange, distal margin white. Lateral-line scales 51–64. Bands on the body inconspicuous after preservation ..... ***C. aurantipectoralis***

3a. Caudal fin with orange to ochre blotches/spots, or coalescing to form broad transverse bands (white in preserved specimen) 4

3b. Caudal fin without blotches or spots 5

4a. Preanal scales 17–20, 3 scale rows between the dorsal-fin origin and lateral line ..... ***C. bleheri***

4b. Preanal scales 22–26, 4–5 scale rows between the dorsal-fin origin and lateral line ..... ***C. brunnea***

5a. Lateral-line scales 42–43 ..... ***C. andrao***

5b. Lateral-line scales 51 ..... ***C. burmanica***

6a. Body blue to bluish-green, grayish-blue, grayish-beige, or greenish-brown with numerous rounded or oblong, black or brown spots or brown to red blotches scattered on the body. Black spots conspicuous, blotches replaced with creamy-white scales after preservation 7

6b. Body brownish-orange, tawny-brown, chrome-yellow, pale-gray, greenish-tan, or greenish-golden. Body without spots but sides of the body with large irregular, orange and black blotches, or with oblique brown or black bands (blotches and bands conspicuous or faint in preserved specimen) 15

7a. Spots or blotches on head and sides of the body 8

7b. Spots on head absent, but restricted to sides of the body forming oblique pattern above lateral line or distributed randomly; lateral-line scales 45–49. Spots conspicuous in preserved specimen ..... ***C. stewartii****

8a. Rounded to oblong spots or bands on lips 9

8b. Spots or bands absent on lip 10

9a. Lateral-line scales 81, dorsal-fin rays 50 ..... ***C. amphibeus***

9b. Lateral-line scales 60–64, anal-fin rays 32–36. Pectoral fin with numerous spots ..... ***C. barca***

10a. Spots on top of head, postorbital, and ventrolateral region of head 11

10b. Spots or blotches on top of head absent, but present on dorsolateral, postorbital, and ventrolateral region 12

11a. Large black spots on dorsal, postorbital, and ventrolateral region of head, sides with numerous black spots and 10–12 cream-colored chevron markings along anal-fin base. Pectoral fin with 4–7 semi-circular black bands. Spots visible in preserved specimen ..... ***C. stiktos***

11b. Small black spots on dorsal, postorbital, and ventrolateral region of head, sides with fewer black spots and absence of any chevron markings. Pectoral fin with 3 (rarely 4) semi-circular black bands. Spots visible in preserved specimen ..... ***C. bipuli***

12a. Presence of spots or blotches on the anterior third or middle of dorsal fin, pectoral fin with 4–7 white semi-circular bands 13

12b. Absence of any spots or blotches on the dorsal fin, pectoral fin with 3–4, black semi-circular bands with pale-orange interspace (pale-orange turns gray after preservation) 14

13a. Two or three black blotches on dorsal fin; pectoral fin with 5–7 semi-circular, narrow white bands alternating with black to brownish bands; lateral-line scales 46–48; head length 28.0–30.3% SL ..... ***C. ornatipinnis***

13b. Dorsal fin blotches only one; pectoral fin with 4 semi-circular, narrow white bands alternating with black to brownish bands; lateral-line scales 43–46; head length 31.0–32.0% SL ..... ***C. pulchra***

14a. Brown or maroon-red, rounded to oblong or clover-shaped blotches or spots on dorsolateral, postorbital, and ventrolateral region, continued on the sides of the body, forming oblique lines or randomly distributed densely or sparsely. Some specimens with only maroon-red scales on the sides of the body. Dorsal, anal, and caudal fin with white distal margin in live and preserved specimen. Body uniformly gray and the blotches turning creamy-white after preservation ..... ***C. aristonei*, new species***

14b. Brown to black, rounded to oblong spots on postorbital and ventrolateral region continued on the sides of the body forming oblique lines. Dorsal, anal, and caudal fin with white distal margin in live and preserved specimen. Body gray with conspicuous black spots in preserved specimen ..... ***C. pardalis****

15a. Sides of the body with broad, black, orange or dark-brown oblique or irregular bands or blotches. Adult size 150–200 mm SL 16

15b. Sides of the body with narrow, brown to dark-brown oblique bands. Adult size 100–130 mm SL 20

16a. Presence of spots on the dorsal- and anal-fin membrane. Caudal fin with transverse bands 17

16b. Absence of any spots on dorsal- and anal-fin membrane 19

17a. Rounded to elongated spots forming 3–4 horizontal bars on dorsal fin 18

17b. Spots on the fin membrane merges to form thin horizontal rows of lines in a wavy pattern. Body golden-brown to golden-yellow with 13–14 alternating black and yellow blotches on upper half of lateral side. Lateral-line scales 51–54, dorsal-fin rays 45–47. Yellow blotches appearing creamy-white after preservation ..... ***C. aurantimaculata***

18a. Body chrome-yellow to pale gray with 5 black, broad oblique bands. Dorsal fin with 3 rows of black spots horizontally along the whole length. Dorsal-fin rays 33–35, lateral-line scales 42–45, vertebrae 43 ..... ***C. quinquefasciata***

18b. Dorsal fin with 4–5 rows of spots. Dorsal-fin rays 36–37, lateral-line scales 46–47, vertebrae 50–51 ..... ***C. melanostigma***

19a. Body black to purplish-black, sides of body with black oblique bands against dark gray background. Head distinctly flatter, post orbital depth 30.9–35.0% HL ..... ***C. harcourtbutleri***

19b. Body brownish-green to tan, sides of body with numerous brown scales forming 7 broad oblique bands. Postorbital depth 32.6–47.3% HL ..... ***C. pomanensis***

20a. Body orange-brown with 7 dark-brown oblique bands on sides. Presence of transverse bands on the caudal fin. Lateral head profile pointed. Anal-fin rays 20 ..... ***C. lipor****

20b. Body pale-brown, with 7 pale-brown oblique bands. Absence of transverse bands on the caudal fin. Lateral head profile rounded. Anal-fin rays 22–24 ..... ***C. gachua****

MATERIAL EXAMINED

Channa aurantimaculata: JPC-15, 2, 128–153 mm SL (128 mm SL cleared and stained), Dibrugarh, Assam.

Channa barca: JPC-14, 224 mm SL, Khamrup district, Assam.

Channa bipuli: ZSI FF 7651, 5, 81–112 mm SL; BNHS FWF 1057, 96.0 mm SL (DNA barcoded); CIARI/FF-56, 5, 102–135 mm SL (115 mm SL, DNA barcoded), Gharbhanga forest, Assam.

Channa gachua: CIARI/FF-25–27, 3, 52.1–95.1 mm SL (52.1 mm SL cleared stained and DNA barcoded; 95.1 mm SL DNA barcoded), India, West Bengal, North 24 Parganas, Ganrapota; CIARI/FF-46, 109 mm SL, Tamil Nadu, Salem, Cauvery River; CIARI/FF-47, 106 mm SL, Andhra Pradesh, Tada; CIARI/FF-48–50, 3, 61.0–112 mm SL, Maharashtra, Dhapoli district, Dhahagoan; CIARI/FF-51, 109 mm SL, Tiruvallur district, Ponneri; JPC-53–56, 4, 75.0–100 mm SL, Nongpoh, Meghalaya.

Channa harcourtbutleri: ZSI F9439/1, holotype, 46.8 mm SL, Myanmar, southern Shan State, Inle Lake; ZSI F9451/1, 2, 39.1–53.0 mm SL, Myanmar, southern Shan State, Thumakam (Hsamongkam).

Channa lipor: ZSI FF 7661, 3, 69.2–79.0 mm SL (69.2 mm SL DNA barcoded); CIARI/FF-44–45, 2, 72.0–110 mm SL; JPC-19–23, 5, 52.1–108 mm SL, Ri-Bhoi district, Umraling River, Meghalaya.

Channa pardalis: CIARI/FF-43, 114 mm SL (DNA barcoded); ZSI FF 7652, 124 mm SL, Nongstoin, West Khasi Hills, Meghalaya; BNHS FWF 1058, 97.0 mm SL (DNA barcoded); CIARI/FF-57, 5, 107–200 mm SL (107 mm SL, DNA barcoded), Umraleng, Rhi-Bhoi District, Meghalaya.

Channa pomanensis: JPC-9–10, 2, 149–152 mm SL, Poma River, Arunachal Pradesh (149 mm SL DNA barcoded).

Channa quinquefasciata: ZSI FF 7906, 3, 144–183 mm SL (183 mm SL DNA barcoded); JPC-16, 2, 89.2–165 mm SL (89.2 mm SL cleared and stained and DNA barcoded), Howlong bridge, Torsa River, North Bengal.

Channa stewartii: CIARI/FF-38, 118 mm SL, West Bengal, Jalpaiguri district, Jaigaon; CIARI/FF-42, 118 mm SL (cleared and stained), India, Assam, Tinsukia; JPC-57, 105 mm SL, Nongpoh, Meghalaya.

Published information used: Data from Ng et al. (1999), Britz (2008), Vishwanath and Geetakumari (2009), Geetakumari and Vishwanath (2011), Lalhlimpuia et al. (2016), Lalramliana et al. (2018), and Britz et al. (2019b) were used for comparison.

DATA ACCESSIBILITY

Supplemental material is available at https://www.copeiajournal.org/ci2020007.

ACKNOWLEDGMENTS

We greatly acknowledge Jeris, Meghalaya, for the assistance during the field trips. We thank K. Rahul, Bombay Natural History Society, Mumbai, for registration of the specimens. We also acknowledge B. R. Arijit, Kolkata, for shipping the additional specimens of the new species. We are also grateful to K. Sujesh, Aqualine exports, Chennai, and B. Das, Assam, for providing the comparative specimens used in this study. We greatly appreciate C. Dunlop, London, P. Jordan, England, and P. Antler, Germany, for sharing the photographs and information on *Channa ornatipinnis* and *C. pulchra*. We acknowledge the Head, Department of Aquatic Animal Health Management, TNJFU, for carrying out the sedation procedure of the fish specimens ethically.

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