

DISCOVERY OF *CHITALA LOPIS* (ACTINOPTERYGII: NOTOPTERIDAE) FROM THE PASAK RIVER, CHAO PHRAYA RIVER SYSTEM, CENTRAL THAILAND

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ABSTRACT

Specimens of a featherback, *Chitala lopis* (Actinopterygii: Notopteridae), were collected from the Pasak River (Chao Phraya River system), central Thailand, representing the first record of the species from the Pasak River as well as the Chao Phraya basin based on voucher specimens. All previous records of *C. lopis* from the Chao Phraya basin (Bueng Boraphet) were based on testimonies of assistants of the Siamese Bureau of Fisheries and a local fisherman published in 1945 and 1992, respectively. Detailed morphological descriptions and features of the examined specimens are provided and discussed in comparison with data for specimens from other basins provided in previous works. In addition, we give results of interview surveys of eleven fishermen and three fish sellers in the Pasak River basin, including the vicinity of the collection locality of the specimens as well as an upstream area of the Pasak Chonlasit Dam, to provide evidence of the status of *C. lopis* in the Pasak River basin.

Keywords: Chao Phraya Basin, *Chitala*, *Chitala lopis*, Notopteridae, Pasak River

INTRODUCTION

The Asian featherback genus *Chitala* Hamilton, 1822 (family Notopteridae) is characterized by extremely compressed head and body; extremely long anal fin base; vestigial ventral fins; feather-like dorsal fin with narrow base; craniodorsally strongly concaved head; large mouth with posteriorly extended maxilla (well beyond posterior margin of eye); and large body size (ROBERTS, 1992; RAINBOTH, 1996). The genus is distributed in freshwaters of southern Asia from Indochina (excluding Myanmar), Malay Peninsula, Sunda Islands (Sumatra, Borneo and Java) to the Indian subcontinent (the Indus, Ganges-Brahmaputra, and Mahanadi River basins) and all species are important food fishes for local communities (SMITH, 1945; TALWAR & JHINGRAN, 1991; ROBERTS, 1992; KOTTELAT *ET AL.*, 1993; TAKI *ET AL.*, 2021). *Chitala ornata* was introduced to Laguna Lake of the Philippines and to Florida of USA, and became well-established in these places (FULLER *ET AL.*, 1999; CASTRO *ET AL.*, 2018; ROBINS *ET AL.* 2018). Some researchers have recognized six species of the genus, viz., *C. chitala* Hamilton, 1822, *C. ornata* (Gray, 1831), *C. lopis* (Bleeker, 1851), *C. blanci* (d' Aubenton, 1965), *C. borneensis* (Bleeker, 1851) and *C. hypselonotus* (Bleeker, 1852) as valid (KOTTELAT, 2013; FRICKE *ET AL.*, 2022), while

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TAKI *ET AL.* (2021) treated the last two species as junior synonyms of *C. lopis* and thus recognized only the first four species as valid. Among members of *Chitala*, *C. lopis* is taxonomically the most problematic species, which apparently needs revision. KOTTELAT & WIDJANARTI (2005) suggested that at least two (*C. borneensis* and *C. lopis*) and maybe up to four species (*C. borneensis*, *C. hypselonotus*, *C. lopis*, and *C. sp.* [unnamed species]) are included in what is presently recognized as *Chitala "lopis"* in Southeast Asia. The latter hypothesis is also reflected in the checklist of inland fishes of Southeast Asia by KOTTELAT (2013). Clarification of the taxonomy of *Chitala "lopis"* or *Chitala lopis sensu lato* is only possible by examination of fresh and well-preserved materials of the species from principal river basins covering its distributional range and comparison with type materials of all synonyms. At present, we follow ROBERTS (1992) and TAKI *ET AL.* (2021) and recognize four species, *C. chitala*, *C. ornata*, *C. lopis* and *C. blanci*, as valid species of the genus.

C. lopis is one of the most widely-distributed species of the genus, ranging from Indochina (the Mekong, Chao Phraya, and MaeKlong River basins), Malay Peninsula (the Tapi, Pahan, and Perak River basins), Sumatra (the Batang Hari and Musi River basins), Borneo (the Baram, Lundu, Sambas, Kapuas, Barito, Kahayan, and Mahakam River basins) to Java (WEBER & DE BEAUFORT, 1913 [as *Notopterus chitala* and *N. borneensis*]; ROBERTS 1992, 1993; ROBERTS & WARREN, 1994; KOTTELAT *ET AL.*, 1993; TAKI *ET AL.*, 2021). It can be distinguished from other congeners by its generally plain silvery body (without black wavy oblique bands) with a black blotch at axil of pectoral fin and its large size, reaching 1.5 m in length, which is the largest among all notopterids (ROBERTS, 1992; KOTTELAT, 2001; TAKI *ET AL.*, 2021). Actually, its distribution in the Chao Phraya River basin is mainly based on two verbal records of assistants of the Siamese Bureau of Fisheries and a local fisherman (both are from Bueng [swamp] Boraphet at Nakhon Sawan Province, Central Thailand) reported by SMITH (1945) and ROBERTS (1992), respectively. Subsequently, KAW-ANANTAKUL *ET AL.* (2000, 2003) briefly noted that the species was rare in the Chao Phraya River basin and found and reported from the swamp before 1977 and also used to be found in the Pasak River, a large tributary of the Chao Phraya River in central Thailand, in the first and second (revised) editions of their book on the fishes of the Bueng Boraphet, without providing any sources or supporting evidence. All subsequent works that have noted the distribution of *C. lopis* in the Chao Phraya River basin seem to be based on these sources and do not provide any new information or evidence (e.g., VIDTHAYANON *ET AL.*, 1997; KOTTELAT, 2001; SAENJUNDAENG, 2014; VIDTHAYANON, 2017 [as *C. cf. borneensis*]; TAKI *ET AL.*, 2021). On the other hand, KAW-ANANTAKUL *ET AL.* (2000, 2003) stated that *C. lopis* was already extirpated in the Bueng Boraphet. Furthermore, UKKATAWEWAT (2004) commented that *C. lopis* was no longer found in the upper MaeKlong and Chao Phraya rivers. So far, no specimen of *C. lopis* has been collected to support or confirm its actual distribution and continued existence in the Chao Phraya basin.

During ichthyological surveys in the Pasak River (Chao Phraya River system) in Lopburi and Saraburi provinces, central Thailand, during 21–23 July 2022, we encountered a local villager who collected a large individual (ca. 900 mm in total length) of a notopterid fish at Hin Son Sub-district (Tambon), Kaeng Khoi District (Amphoe), Saraburi Province (Figs. 1, 2). We obtained a photograph of the individual and some remains (body skins of and some bones of the head region) of it. Subsequently, from the same vicinity, four individuals of the same species were collected on 2 November 2022 by a local fisherman, which we identified as *C. lopis*. These specimens are the first record of the species based on voucher materials from

the Pasak River as well as from the Chao Phraya River basin. In this report we provide detailed descriptions of the specimens of *C. lopis* collected from the Pasak River and review the status of the species in the Pasak River basin in the past and present based on interview surveys.

MATERIALS AND METHODS

Counts and measurements follow HUBBS & LAGLER (1958) and NAKABO (2002) except for the following: prepectoral, prepelvic and preanal lengths were measured from the snout tip to the anterior insertion of pectoral, pelvic and anal fins, respectively; height of anal fin was measured as the longest ray of the anal fin; maximum body depth was measured at the anal fin origin; maximum body width was measured at the widest portion of the body; orbit-preopercular distance was measured as the shortest distance from the orbit to the posterior end of preopercular; orbit-maxillary distance was measured as the shortest distance from the orbit to the posterior end of maxillary; preorbital and post orbital head depth were measured at the anterior and posterior eye margins, respectively; maximum head depth and width were measured at the posterior end of gill cover; head depth at nape was measured at the highest point of the skull (top of supraoccipital); head depth and width at the cranium end were measured at the dorso-posterior end of the exposed cranium (just before a fleshy area with scales of the dorsal side of the head). A scale immediately in front of the dorsal and anal fin origin was counted as one-half in scale-row counts above and below the lateral line. Fin rays were counted with a binocular microscope or taken from radiographs. Scales, fin rays, abdominal scutes, dentitions and bone structures were observed by staining with Cyanine Blue powder ($C_{29}H_{35}IN_2$) dissolved in 60–70% ethanol, which is a harmless stain for specimen observation, prepared by following the methods of AKIHITO *ET AL.* (2002: 1270). Abdominal scutes were counted from radiographs. Vertebral counts were taken from radiographs, including urostyle, and follow the methods of ROBERTS (1989). Terminology of bones follows GREGORY (1933), HILTON (2003) and CAMP *ET AL.* (2009). Descriptions of dentition were mainly based on remains of bones in the head region of THNHM-F 022040. Materials examined in this study are deposited in the Thailand Natural History Museum, National Science Museum, Pathum Thani, Thailand (THNHM) and Research Laboratory of Ichthyology, Faculty of Fisheries, Kasetsart University, Bangkok, Thailand (RLIKU). Interview surveys were conducted during 21–22 July and 8–9 November 2022 in the Pasak River basin of Saraburi and Lopburi provinces, Thailand, to obtain information on the status of *C. lopis* in the past and present (Figs. 1, 2). In total, we interviewed 11 local fishermen, six of them from Ban Wang Muwang Village, Hin Son Sub-district, Kaeng Khoi District, Saraburi Province (where the specimens examined in the present study were collected), which is situated downstream of the Pasak Chonlasit Dam (PCD), attached to the Pasak River main stream, and five fishermen from Ban Khok Salung Village, Khok Salung Sub-district, Phathana Nikhom District, Lopburi Province, upstream of the PCD. We also interviewed three fish sellers from each of three local private fish landing markets: at Ban Manao Wan Village, Manao Wan Sub-district, and Ban Khao Phra Village, Nong Bua Sub-districts, Phathana Nikhom District, and Ban Nam Thod Village, Kaeng Phak Kuud Sub-district, Tha Luwang District, Lopburi Province (all situated in upstream of the PCD, surrounding and attached to the PCD reservoir) (Fig. 1). Ages of interviewees ranged from 37 to 70 years. Most of the interviewed fishermen were experienced and had been

catching fish in the Pasak River basin frequently and continuously for 25 to 46 years. After obtaining basic background information (name, age, hometown, length of stay in their present address, length of conducting fishing or selling of fish, etc.), we showed color photographs of three species of featherbacks or knifefishes, *Notopterus notopterus* (local names: Pla Chalad or Pla Tong), *Chitala ornata* (local name: Pla Krai) and *C. lopis* (local name: Pla Satu) in TAKI *ET AL.* (2021: 42–45), one by one, and asked whether they knew those fishes or not, and if so, what would they call them, without giving any prompts or hints. If the interviewees knew anything about *C. lopis*, we asked further questions including the following: 1) When did you see or catch this fish for the first time? 2) How often have you seen this fish? Additional questions about ecology, habitats and methods of catching *C. lopis* or presumed *C. lopis* were also asked.

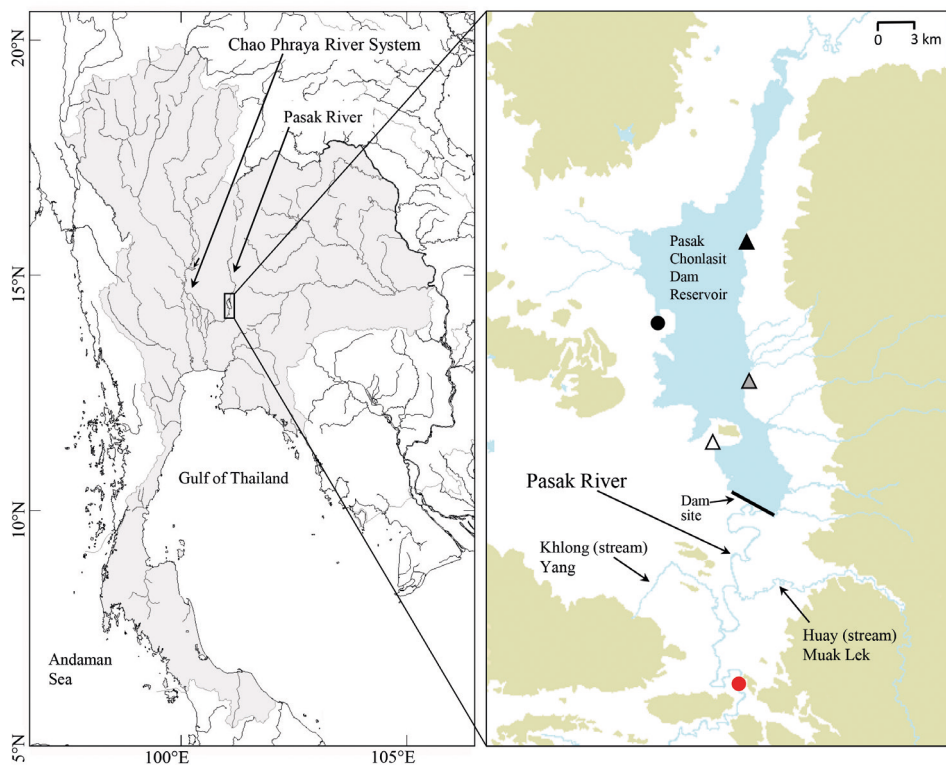


Figure 1. A collection locality of specimens of *Chitala lopis* examined in the present study and also the site of an interview survey (red circle) at the Pasak River (main stream) at Ban Wang Muwang Village, Hin Son Sub-district, Kaeng Khoi District, Saraburi Province, Thailand (14° 43' 27" N, 101° 04' 31" E), and other sites of interview surveys (Khok Salung Village [black circle]; Manao Wan Village [gray triangle]; Ban Khao Phra Village [open triangle]; Ban Nam Thod Village [black triangle]), and their surrounding environments. The gray color area and a small black arrow on the left map indicate Thailand and Bueng Boraphet swamp, respectively. Blue lines and areas on the right map indicate the mainstream of the Pasak River, its tributaries, the Pasak Chonlasit Dam (PCD) reservoir, and surrounding small water bodies. Brownish green areas of the right map indicate upland regions ranging from 100 to 300 m asl. Maps created by Prachya Musikasinthorn.



Figure 2. Landscapes in the vicinity of the collection locality of specimens of *Chitala lopis* examined in the present study. A, the Pasak River (mainstream) at Hin Son to Tha Khlo Sub-district, Kaeng Khoi District, Saraburi Province, Thailand, looking upstream from the Ban Wang Muwang–Tha Sao Bridge, Hin Son Sub-district; B, a narrow rocky channel with cliffs and a pool with sandy bottom at Ban Wang Muwang Village, Hin Son Sub-district (looking downstream); C, a wide and relatively strait portion of the river with thick bushes and sunken trees at both banks at Ban Wang Muwang Village (the exact locality of all of the examined specimens of the present study except THNHM-F 022040) (looking upstream); and, D, a deep pool with steep cliffs at Tha Khlo Sub-district (looking upstream). Note abundance of deep pools at curves of the meandering slow-to-relatively-fast-running river bordered by sheer cliffs with large rocks, and sandy and rocky bottoms, which presumably provide suitable habitat for *Chitala lopis* as well as other large native freshwater fishes. Photos by Prachya Musikasinthorn.

RESULTS

Chitala lopis (Bleeker, 1851)

(Figs. 3–9, Tables 1 and 2)

Material examined: THNHM-F 022037, 457 mm in standard length (SL), Pasak River (main stream) at Ban Wang Muwang Village, Hin Son Sub-district, Kaeng Khoi District, Saraburi Province, Thailand (14° 43' 27" N, 101° 04' 31" E), 2 November 2022, a local fisherman; THNHM-F 022038, 386 mm SL, data as for THNHM-F 022037; THNHM-F 022039, 405 mm SL, data as for THNHM-F 022037; RLIKU 1880, 301 mm SL, data as for THNHM-F 022037; THNHM-F 022040 (dried skins and remains of bones in head region), ca. 900 mm in total length (TL), Pasak River (main stream) at Ban Wang Muwang Village Hin Son Sub-district, Kaeng Khoi District, Saraburi Province (14° 43' 27" N, 101° 04' 31" E), 20 July 2022, Rachapoom Keadnaikaw.

Description

Meristic and morphometric characters of examined specimens are shown in Tables 1 and 2, respectively.

Dorsal fin rays 10 or 11. Anal fin rays 122–127. Pectoral fin rays 15 or 16. Pelvic fin rays 3. Caudal fin rays 13–15 (vi–vii + 2–4/4–5). Cheek scales 18–22. Pored lateral line scales 167–172. Scale rows above lateral line 31.5–40.5. Scale rows below lateral line 49–59. Abdominal scutes 52–58. Total vertebrae 82–85, abdominal + caudal = 17 + 65–68. Supraneurals 22 or 23. Branchiostegal rays 7. Gill rakers on first gill arch 14.

Body extremely compressed (maximum body width 9.5–10.7% SL) and deep (maximum body depth 27.6–29.7% SL) with strongly humped back (very convex predorsal profile in lateral view), prepelvic profile straight in lateral view, cross-section pointing down tear-drop shape, tapering posteriorly with upward arched tail portion (Figs. 3–5). Body depth greatest at anterior origin of anal fin (Figs. 3–5). Body width greatest at vertical through base of 10–12th anal fin ray from anterior. Anal fin with extremely long base (length of anal fin base 72.4–73.4% SL), its depth gradually increasing from first ray (unbranched) (length 2.4–3.2% SL) and almost in equal depth from 9–11th ray (8.1–8.6% SL), and becoming deepest around under dorsal fin (8.7–9.2% SL) posteriorly and connected with caudal fin, covered by dense scale sheets with numerous tiny scales except at its margin, its anterior origin starting within distal half of pectoral fin. Caudal fin round and small (caudal fin length 6.4–7.7% SL), connected with anal fin. Pectoral fin moderately large (pectoral fin length 13.0–14.0% SL) and posterior margin round, inserted dorso-horizontally at lower half of body, and its posterior tip reaching to vertical through around 3rd anal fin ray base. Pelvic fins triangle-shape, very small and vestigial (pelvic fin length 1.4–1.8% SL), united at their bases, attached to both sides of anterior portion of anus (Fig. 5D, F). Dorsal fin fan-shaped with very short base (dorsal fin height 11.9–13.2% SL; length of dorsal fin base 3.4–3.7% SL), inserted at around middle of body, far posterior to vertical through anterior origin of anal fin. Lateral line, with discontinuous pored lateral-line scales alternating by overlapping non-pored scales from above and below, running and gently descending from behind upper-most part of gill cover to middle of end of caudal peduncle (just before caudal fin base). Scales on body tiny, cycloid. Two rows (right and left) of blade-shaped abdominal scutes present from behind isthmus to front of pelvic fin origin with a row of flesh in between scute rows (Fig. 5D, E). A genital papilla presents behind anus (Fig. 5D, F).

Head moderately long (head length 26.0–26.8% SL), extremely deep, concave and steep in lateral view (maximum head depth 97.0–103.8% in head length [HL], 25.4–27.3% SL; head depth at nape 57.9–72.4% HL, 15.5–19.0% SL; postorbital head depth 23.9–26.7% HL, 7.6–8.4% SL; preorbital head depth 23.5–24.7% HL, 5.1–5.6% SL), extremely compressed laterally (maximum head width 30.0–35.7% HL, 8.0–9.4% SL; head width at nape 27.0–29.8% HL, 7.2–7.8% SL; postorbital head width 23.9–26.7% HL, 6.4–7.0% SL; preorbital head width 23.5–24.7% HL, 6.3–6.5% SL) (Fig. 5A–C). Dorsal contour of head (craniodorsal profile) steeply descending anteriorly from top (end of gill cover) to around end of lower jaw in angle of ca. 40°, then in angle of ca. 10° to snout tip (Fig. 5B). Snout moderately pointed in lateral view, somewhat pointed or relatively round in dorsal and ventral views (Fig. 5A–C). Mouth subterminal, and large (upper jaw length 38.6–40.4% HL), maxilla extending far beyond vertical through posterior margin of eye (distance from orbit to posterior end of maxillary 4.4–5.1% HL) (Fig. 5A). Eye relatively small (orbit diameter 11.6–12.4% HL)



Figure 3. *Chitala lopis*, THNHM-F 022037, 457 mm SL, fresh condition, the Pasak River at Ban Wang Muwang, Kaeng Khoi, Saraburi, Thailand. Lateral view, photographed on black (A) and white (B) backgrounds. Note that posterior portions of anal and caudal fins are partly wanting. Photos by Prachya Musikasinthorn.

situated at anterior portion of head (post orbital head length 74.2–76.5% HL), near snout tip. Anterior nostril tubular. Gill membranes free from isthmus, united to each other at their bases. Lower edge of preopercular sharp and serrated. Cheek and lateral portions of head (except preopercle surface), including snout, covered by numerous tiny scales similar in size to those on body (Fig. 5A, B). Dorsal side of head without scales, neurocranium exposed, covered by relatively thick skin (Fig. 5A, B). Temporal fossa present at dorso-lateral end of head of each side (Fig. 5B).

Coloration.—In fresh specimens (Figs. 3–7): Dorsal side of head and body metallic-sparkling brownish or greenish gray. Lateral side of head and body metallic-sparkling silver or metallic-sparkling silvery pale white. Several transverse silvery streaks along scale rows on dorsal side of body. Ventral side of body metallic-sparkling silver or metallic-sparkling silvery pale white. Ventral side of head white. Upper portions of fleshy rims and portions surrounding orbits yellow. Pectoral and pelvic fins pale white. A black blotch at naked (scaleless) area of axil of pectoral fin, covering posterior portion and lower edge of pectoral fin base (faint, obscure or shrunken in some specimens [386 and 405 mm SL]). Dorsal fin grayish

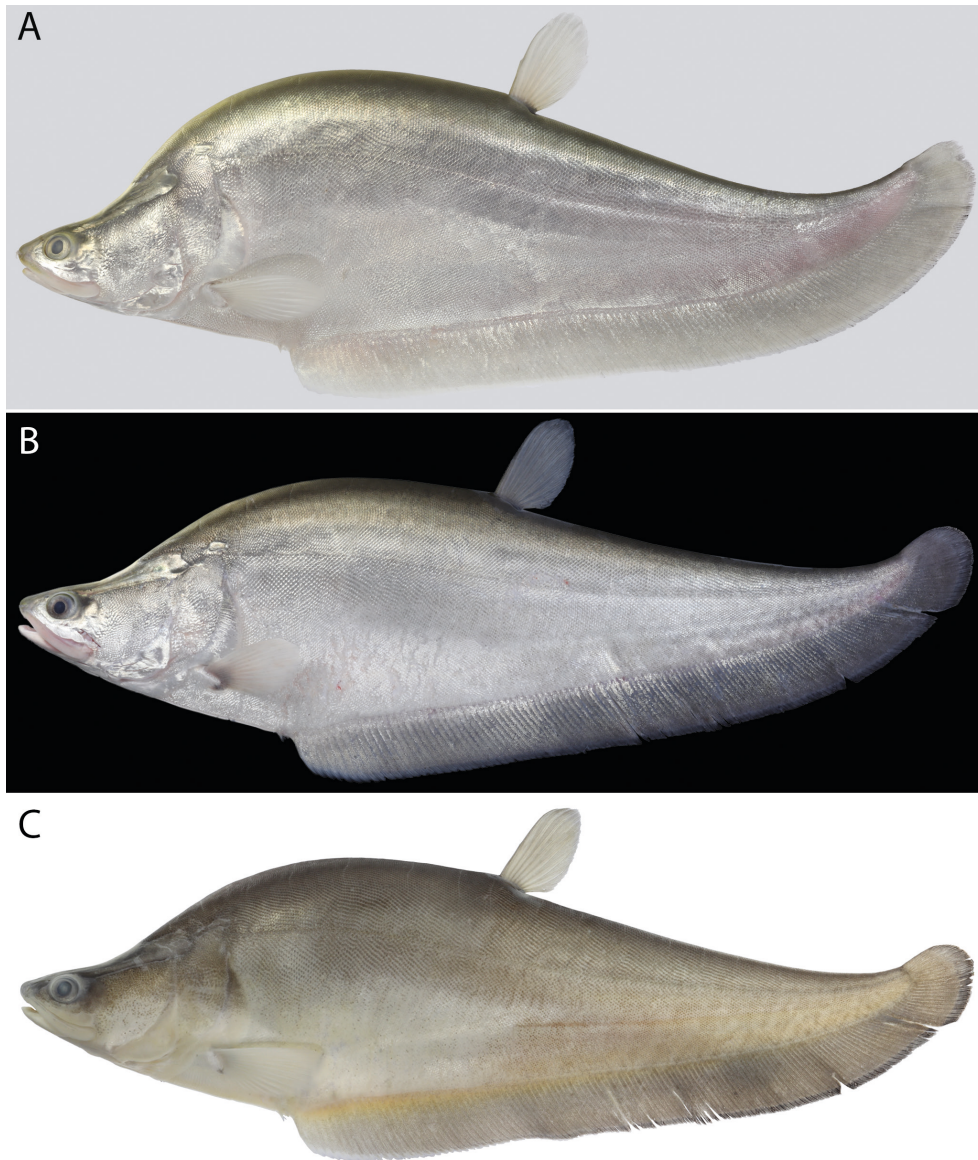


Figure 4. *Chitala lopsis*, the Pasak River at Ban Wang Muwang, Kaeng Khoi, Saraburi, Thailand. Lateral view. A, THNHM-F 022039, 405 mm SL, fresh condition (right side reversed), note the black spot at the pectoral fin axil, faint and hardly recognizable when the fin is folded. B, RLIKU 1880, 301 mm SL, fresh condition, and C, preserved condition in alcohol (right side reversed), note oblique rows of dusky spots in posterior portion of the body. Photos by Prachya Musikasinthorn.

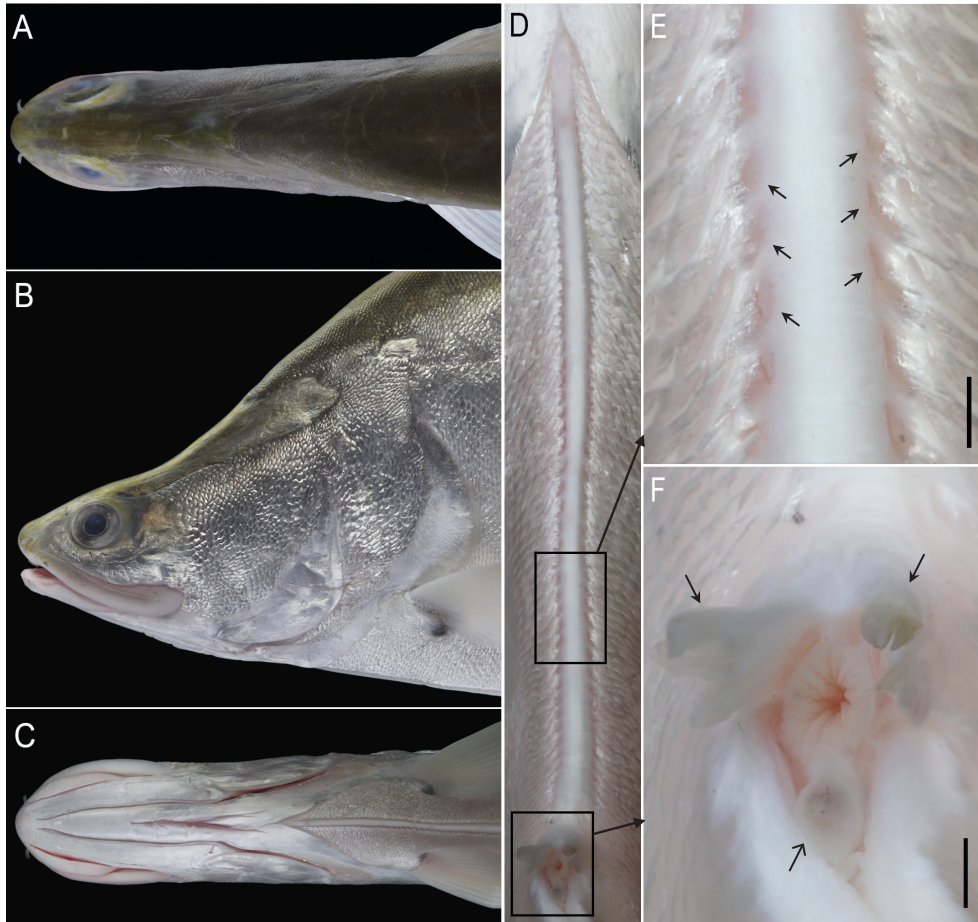


Figure 5. *Chitala lopis*, THNHM-F 022037, 457 mm SL, fresh condition, close-up of head (dorsal [A], lateral [B] and ventral [C] views), and ventral view (somewhat inclining anteriorly) of abdominal region (D) showing blade-shape abdominal scutes (black stealth arrows) (E) and tiny pelvic fins (black stealth arrows) attached to both sides of anterior portion of the anus, and the genital papilla (black open arrow) behind the anus (F). Scales indicate 1 mm. Photos by Prachya Musikasinthorn.

white, somewhat dusky. Several (405 mm SL) to many (301 and 457 mm SL) faint small dusky spots scattered on anal fin (absent in 386 mm SL and ca. 900 mm TL specimens). Proximal portion of anal fin metallic-sparkling silver, gray or emerald-greenish in some specimens. Distal portion of anal fin light gray to dark gray, possessing a black band (much prominent at posterior portion) at margin. Several (405 mm SL) to many (301 and 457 mm SL) tiny black spots in vertical rows at posterior portion of anal fin observed in some specimens. Caudal fin light gray to dark gray with black margin (faint in some specimens [386 and 405 mm SL]). The smallest specimen (301 mm SL) possessing relatively broad (widest recognizable portion subequal to orbit diameter) faint dusky oblique (posteriorly declined) bars at anterior portion of posterior half of body which gradually breaking up into rows of dusky spots posteriorly.

Table 1. Meristic characters of *Chitala lopis* (N = 4; see Material examined). Numbers in parentheses under frequencies indicate the number of specimens associated with the various counts.

Characters	Frequencies	Mean±SD
Simple dorsal-fin rays	2 (4)	2.0±0.0
Branched dorsal-fin rays	8 (3), 9 (1)	8.3±0.5
Simple pectoral-fin rays	1 (4)	1.0±0.0
Branched pectoral-fin rays	14 (1), 15 (3)	14.8±0.5
Total pelvic-fin rays	3 (4)	3.0±0.0
Simple anal-fin rays	2 (4)	2.0±0.0
Branched anal-fin rays	120 (1), 122 (1), 124 (1), 125 (1)	122.8±2.2
Principal caudal-fin rays	8 (1), 9 (2)	8.7±0.6
Pored lateral-line scales	167 (2), 168 (1), 172 (1)	168.5±2.4
Scale rows above lateral-line to dorsal fin origin	31.5 (1), 34.5 (1), 37.5 (1), 40.5 (1)	36.0±3.9
Scale rows below lateral-line to anal fin origin	49 (1), 50 (1), 59 (1)	52.7±5.5
Cheek scales	18 (2), 20 (1), 22 (1)	18.7±1.2
Abdominal scutes	52 (1), 53 (1), 55 (1), 58 (1)	54.5±2.6
Total vertebrae	82 (1), 83 (1), 85 (2)	83.8±1.5
Abdominal vertebrae	17 (4)	17.0±0.0
Caudal vertebrae	65 (1), 66 (1), 68 (2)	66.8±1.5
Branchiostegal rays	7 (3)	7.0±0.0
Supraneurals	22 (3), 23 (1)	22.3±0.5
Gill rakers on the first gill arch	14 (2)	14.0±0.0

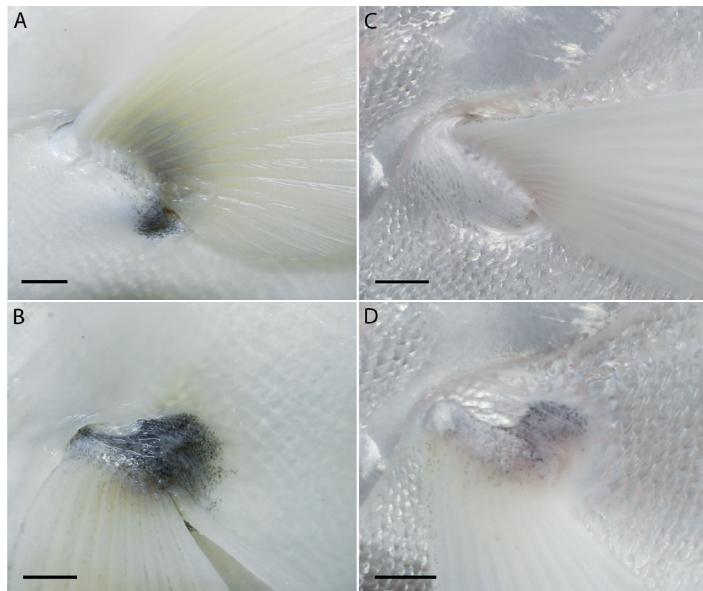


Figure 6. Variations of the black blotch at axil of pectoral fin of *Chitala lopis* observed in the present study. A prominent type (THNHM-F 022037, 457 mm SL, freshly preserved): A, a pectoral fin folded to body; B, a pectoral fin unfolded downward. A faint type (THNHM-F 022039, 405 mm SL, fresh condition, right side reversed): C, a pectoral fin folded to body; D, a pectoral fin unfolded downward. Each scale indicates 5 mm. Photos by Prachya Musikasinthorn.

Table 2. Morphometric characters of *Chitala lopis* (see Material examined).

Characters	RLIKU	THNHM-F	THNHM-F	THNHM-F	Range	Mean±SD
	1880	022038	022039	022037		
Total Length (mm)	326.0	412.9	434.2	487.2		
Standard Length (mm)	301.4	386.0	404.8	456.8		
In % of standard length:						
Head length	26.0	26.3	26.8	26.2	26.0–26.8	26.3±0.3
Postorbital head length	19.3	19.6	20.4	20.0	19.3–20.4	19.8±0.5
Orbit-preopercular distance	12.0	13.0	12.9	13.0	12.0–13.0	12.7±0.5
Orbit-maxillary distance	4.4	4.7	4.9	4.7	4.4–5.1	4.8±0.3
Preorbital head depth	5.5	5.6	5.3	5.1	5.1–5.6	5.4±0.2
Postorbital head depth	8.4	7.8	7.8	7.6	7.6–8.4	7.9±0.3
Head depth at cranium end	14.5	14.9	14.2	14.9	14.2–14.9	14.6±0.3
Head depth at occiput	16.8	15.7	15.5	19.0	15.5–19.0	16.7±1.6
Maximum head depth	25.4	27.3	26.3	25.4	25.4–27.3	26.1±0.9
Preorbital head width	6.3	6.5	6.3	6.4	6.3–6.5	6.4±0.1
Postorbital head width	6.4	7.0	6.4	6.7	6.4–7.0	6.7±0.3
Head width at cranium end	7.1	7.4	7.1	7.3	7.1–7.4	7.3±0.1
Head width at occiput	7.2	7.8	7.2	7.4	7.2–7.8	7.4±0.3
Maximum head width	8.3	9.4	8.0	8.7	8.0–9.4	8.6±0.6
Snout length	3.9	4.0	3.8	3.5	3.5–4.0	3.8±0.2
Orbit diameter	3.2	3.2	3.1	3.1	3.1–3.2	3.2±0.1
Interorbital width (fleshy width)	3.6	3.3	3.3	3.2	3.2–3.6	3.3±0.2
Interorbital width (bony width)	3.0	2.9	2.9	2.7	2.7–3.0	2.9±0.1
Upper jaw length	10.0	10.6	10.5	10.2	10.0–10.6	10.3±0.3
Width of gape	5.6	5.2	5.3	5.5	5.2–5.6	5.4±0.2
Maximum body depth	28.0	29.7	28.4	27.6	27.6–29.7	28.4±0.9
Maximum body width	10.1	10.7	9.9	9.5	9.5–10.7	10.1±0.5
Predorsal length	55.4	57.5	56.8	55.8	55.4–57.5	56.4±0.9
Prepectoral length	22.0	21.6	21.7	21.9	21.6–22.0	21.8±0.2
Prepelvic length	31.8	30.2	30.0	30.1	30.0–31.8	30.5±0.9
Preanal length	33.0	31.6	31.1	31.4	31.1–33.0	31.8±0.8
Pectoral fin length	13.6	14.0	13.4	13.0	13.0–14.0	13.5±0.4
Pelvic fin length	1.4	1.4	1.4	1.8	1.4–1.8	1.5±0.2
Height of dorsal fin	11.9	12.4	13.2	12.7	11.9–13.2	12.5±0.5
Height of anal fin	8.7	9.2	8.8	8.7	8.7–9.2	8.8±0.2
Length of dorsal-fin base	3.4	3.7	3.7	3.4	3.4–3.7	3.6±0.2
Length of anal-fin base	72.4	73.4	71.8	73.0	71.8–73.4	72.7±0.7
Caudal fin length	7.7	6.4	7.2	6.9	6.4–7.7	7.1±0.5
Head length (mm)	78.41	101.5	108.4	119.6		
In % of head length:						
Postorbital head length	74.2	74.4	76.3	76.5	74.2–76.5	75.4±1.2
Orbit-preopercular distance	46.2	49.1	48.3	49.5	46.2–49.5	48.3±1.5
Orbit-maxillary distance	17.1	19.3	18.5	18.0	17.1–19.3	18.2±0.9
Preorbital head depth	21.1	21.4	19.8	19.6	19.6–21.4	20.5±0.9
Postorbital head depth	32.4	29.7	29.1	29.2	29.1–32.4	30.1±1.5
Head depth at cranium end	55.6	56.6	53.2	57.0	53.2–57.0	55.6±1.7
Head depth at occiput	64.6	59.6	57.9	72.4	57.9–72.4	63.6±6.5

Table 2 (continued).

Characters	RLIKU	THNHM-F	THNHM-F	THNHM-F	Range	Mean±SD
	1880	022038	022039	022037		
Maximum head depth	97.6	103.8	98.2	97.0	97.0–103.8	99.2±3.2
Preorbital head width	24.6	24.7	23.5	24.4	23.5–24.7	24.3±0.5
Postorbital head width	25.7	26.7	23.9	25.6	23.9–26.7	25.5±1.2
Head width at cranium end	27.6	28.3	26.6	27.9	26.6–28.3	27.6±0.7
Head width at occiput	27.8	29.8	27.0	28.4	27.0–29.8	28.3±1.1
Maximum head width	31.8	35.7	30.0	33.2	30.0–35.7	32.6±2.4
Snout length	15.2	15.0	14.1	13.3	13.3–15.2	14.4±0.9
Orbit diameter	12.4	12.3	11.6	11.7	11.6–12.4	12.0±0.4
Interorbital width (fleshy width)	13.7	12.4	12.4	12.4	12.4–13.7	12.7±0.7
Interorbital width (bony width)	11.4	11.2	10.8	10.5	10.5–11.4	11.0±0.4
Upper jaw length	38.6	40.4	39.3	38.8	38.6–40.4	39.2±0.8
Width of gape	21.7	19.7	19.8	20.8	19.7–21.7	20.5±0.9



Figure 7. A large individual of *Chitala lopis* (ca. 900 mm TL) caught in the Pasak River at Ban Wang Muwang, Kaeng Khoi, Saraburi, Thailand, by a local on 20 July 2022: A, in fresh condition; B, dried skins of right (above) and left (below) sides. The major portions of the fish were already cooked and eaten by local villagers when the authors encountered them. Only the dried skins and remains of bones of the head region were retrieved (see Figs. 8–9) and deposited in THNHM as reference material (THNHM-F 022040). C, an exact collection locality of the individual (THNHM-F 022040), a deep pool with many sunken trees at inner edge of a curve in the river, a typical habitat of *C. lopis* (according to local fishermen). Photos by Ratchaphum Kerdnaikao (A) and Prachya Musikasinthorn (B, C).

The similar faint oblique rows of small dusky spots on posterior portion of body also observed in another specimen (457 mm SL) while bodies of the rest of the examined specimens without markings (plain).

In alcohol (Fig. 4C): Similar to fresh coloration, but all silvery sparkles and yellowish color on head, body and fins lost. Upper portions of fleshy rims and portions surrounding orbits white. Dorsal side of body and head blackish gray. Proximal portion of anal fin light orangish brown. The faint oblique rows of small dusky spots became much distinct after preservation.

Dentition.—A patch of about 14 small conical teeth on prevomer (Fig. 8B, C). Parasphenoid with an elongate oval-shape patch of minute conical teeth anteriorly and a similar-shape smaller patch of minute conical teeth on a posterior parasphenoid midline (ridge) (Fig. 8B, C). Two to three rows of minute conical teeth embedded in each premaxilla. A row of inward-curved medium-sized conical teeth at outer margin, followed by an inner row of small conical teeth, becoming 2–3 rows at anteriormost and posteriormost portions, and a band of numerous tiny conical teeth at innermost portion of each of maxilla (Fig. 8D–G). Each dentary with 14 inward-curved large canine-like teeth at outer margin, and 4–5 irregular rows or a band of small conical teeth at anteriormost portion, plus a broad band of small to minute conical teeth which gradually reducing their size inward scattered broadly at inner portion (Fig. 9A, B, D). A fused dermopalatine and ectopterygoid with a row of inward-curved large, stout conical teeth at outer margin, and a band of small to minute conical teeth gradually reducing their size inward at inner portion (Fig. 9E–G). Basihyal with 14 strongly inward-curved very large (largest of all teeth in mouth) to large canine-like teeth at margin of a cartilage attached to anterior portion, gradually reducing in size posteriorly, and about 10 small to tiny short conical teeth at inner posteriormost portion, plus a small conical tooth at center (Fig. 9H, I). Dorsal surface of basihyal itself entirely covered by a broad band of numerous minute conical teeth (Fig. 9H, I).

Interview Surveys

Of the eleven local fishermen that we interviewed, five of them (age 38–60 years old) from Ban Wang Muwang Village near the Pasak River reported that they knew, having seen and caught, Pla Satu (*Chitala lopis*) before and also described its features correctly. All of them clearly distinguished Pla Satu from Pla Krai and Pla Chalat, the other sympatric notopterids in the Pasak River, by several characters including the black spot at the axil of the pectoral fin, plain silvery body, strongly concaved head, the black margin of the anal fin, and large body size. They said that they saw individual(s) of Pla Satu for the first time 28–45 years ago when they were 5–15 years old, and have seen it continuously and constantly in the Pasak River, except for one fisherman who saw it for the first time two years ago after he began fishing in the river three years ago. Four experienced fishermen reported that their average catch of Pla Satu over the last 10 years was around 8.0–9.5 per year. The maximum size caught was about 1 m and 13 kg. The species is one of the three largest predatory fishes in the Pasak River. The other large species they caught were Pla Khang (*Hemibagrus wyckioides*, maximum size caught about 1.2–1.5 m and 40–50 kg) and Pla Khao (*Wallago attu*, maximum size caught about 1.5 m and 12–16 kg). They also commented that Pla Satu spawns in pairs in deep, curved portions of the river where water is relatively slow flowing over sunken trees (Fig. 7C). A large parent (ca. 80 cm TL) guarding its palm-sized fry was seen by one of them in the river in July 2020. The fishermen at Ban Wang Muwang Village use hooks and lines to catch both Pla Satu and Pla Krai by using small live fish or shrimp as bait placed at night.



Figure 8. Neurocranium (skull) (dorsal [A], lateral [B, right side reversed] and ventral [C] views) showing its extremely narrow, elongate and concave shape, and the dentitions on prevomer (white stealth arrows) and parasphenoid and parapsphenoid (white open arrows) (Note that the nasal [anterior-most bone on each side] and the tip of left side epiotic are missing); and maxillary (left side) (lateral [D], dorsal [E], ventral [F] and mesial [G] views) showing its elongate shape and dentition of *Chitala lopis* (stained by Cyanine Blue solution), THNHM-F 022040, ca. 900 mm TL, Photos by Prachya Musikasinthorn.

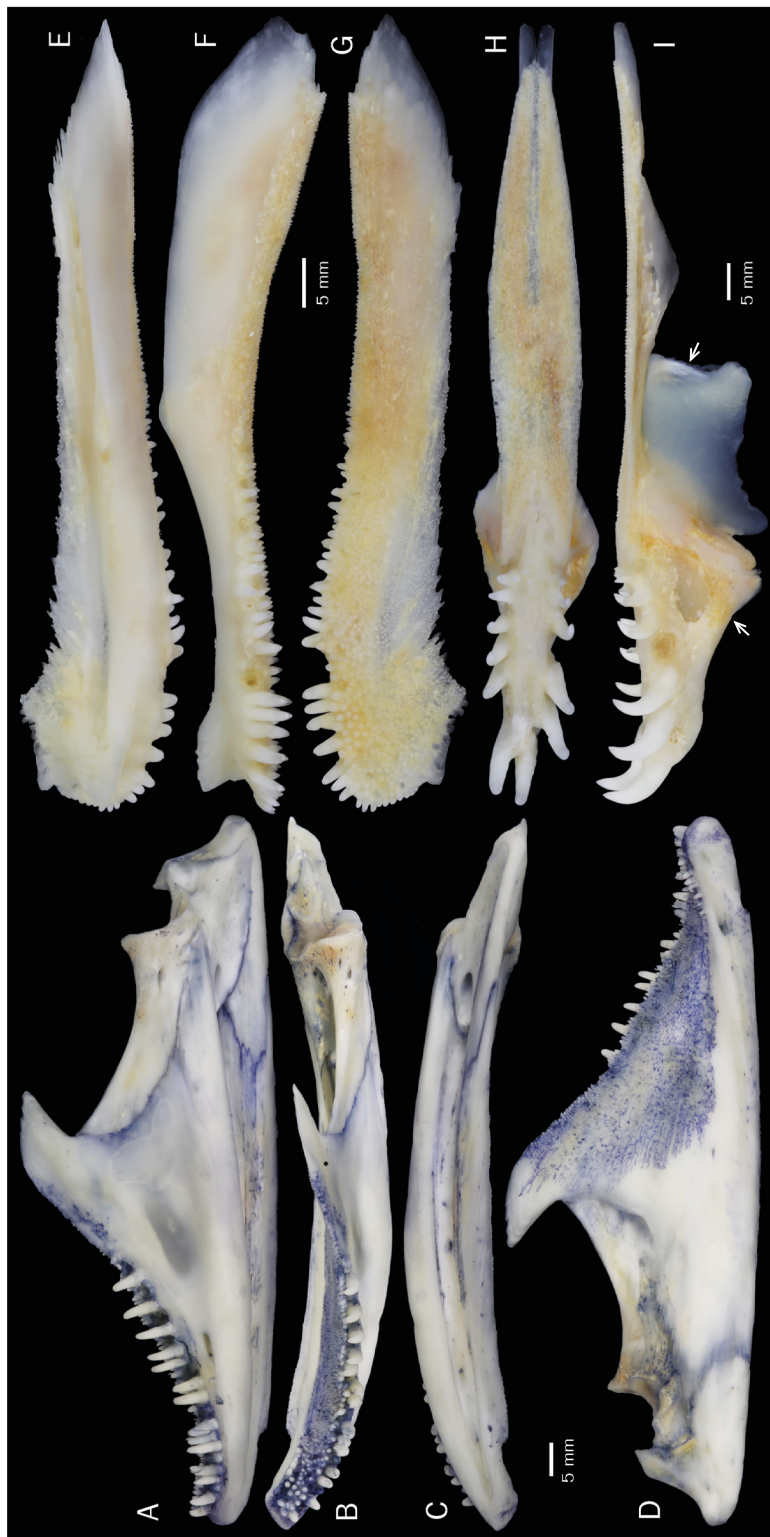


Figure 9. Dentary (left side) (lateral [A], dorsal [B], ventral [C] and mesial [D] views) showing its thick, robust and stout appearance and dentition (stained by Cyanine Blue solution); a fused dermopalatine and ectopterygoid (right side) (dorsal [E], lateral [F] and ventral [G] views, right side reversed) showing its dentition; and basihyal with cartilages (indicated by white arrows) at anterior portion and ventral side (dorsal [H] and lateral [I] views) of *Chitala lopis*, THNHM-F 022040, ca. 900 mm TL. Note several extraordinarily large-to-medium size canine-like teeth embedded on a cartilage attached to anterior portion of basihyal. Photos by Prachya Musikasinthorn.

The six interviewees (38–60 years old), from Ban Khok Salung Village mostly fished in the PCD reservoir. Five of them had heard of “Pla Satu” and its presence in the Pasak River from other persons (e.g., other fishermen, father, grandfather) before. They had heard about the fish 30–40 years ago, but could not describe it accurately. They said that they had caught individuals of Pla Krai (*Chitala ornata*) which did not have spots on the body as seen in photographs of *C. lopis* in TAKI ET AL. (2021: 44, photo A and C). One 70-year old fisherman of Khok Salung Village said that he caught an individual of Pla Krai which did not have spots on the body, about the length of his upper arm (ca. 40 cm TL, weight ca. 1 kg) in about 1994 at a small dam reservoir attached to the Pasak River. Another fisherman from the same village also said that he had caught two individuals of Pla Krai which also did not have spots (ca. 80–90 cm TL, weight 4–5 kg) in the PCD reservoir during 2017–2018. The remaining fisherman could not provide any information about *C. lopis*.

Of the three fish sellers that we interviewed at each fish landing market in the vicinity of the PCD reservoir, only one, at Ban Manao Wan Village, knew about and had seen Pla Satu. When we showed photographs of notopterids in TAKI ET AL. (2021: 42–45), she immediately pointed to the photograph of an individual of *C. lopis* (photo A) and said it was Pla Satu, and was able to explain its features correctly. She (50 years old) testified that she saw Pla Satu for the first time when she was in primary school about 40 years ago, and after that she saw individuals of it caught from the Pasak River many times before the PCD was built in 1998. She said that all Pla Satu brought to her fish landing market, which she started about 2011, were caught downstream of the dam, mostly at Tha Sao, Tha Sabok and Hin Son sub-districts in Kaeng Khoi District, Saraburi Province. She also said that the price of Pla Satu at her market was 70–80 baht/kg which is almost the same as Pla Krai, and the largest individual she had seen at her market was 80–100 cm TL, about 8 kg. Two other fish sellers at the markets in Ban Khao Phra and Ban Nam Thod villages, who had started their businesses in 1998 and 2015, respectively, said that they did not know the name Pla Satu, and stated that they have never seen individuals of Pla Krai without spots on the body so far.

DISCUSSION

Before the present discovery of *Chitala lopis* from the Pasak River, which is a part of the Chao Phraya River system, no specimen of *C. lopis* had been collected from the basin. A specimen from the Chao Phraya River basin in Uthai Thani Province, Thailand, deposited at the North Carolina Museum of Natural Sciences (NCSM) as “*Chitala lopis*” (NCSM 82193, 250 mm SL), was examined by us based on its photographs and re-identified as *Notopterus notopterus*. The possibility of occurrence of *C. lopis* (as *C. borneensis*) in the Chao Phraya basin was first pointed out by SMITH (1945) who wrote “in Bung Borapet [= Bueng Boraphet] assistants of the Siamese Bureau of Fisheries have observed, but have been unable to secure, fish that did not seem to be either of the local forms [neither *Notopterus notopterus* or *Chitala ornata*] and for which the bung fishermen have the name *pla satu*, not applied to any other species. If another species actually occurs, it must be rare and is possibly *Notopterus borneensis* Bleeker, of Borneo and Sumatra.” Later, ROBERTS (1992) concluded that *C. lopis* apparently occurs, or occurred until very recently, in Bueng Boraphet by quoting a testimony which he obtained from a local fisherman there as follows: “In March 1990 at Nakorn Sawan, where fish from Bung Borapet are marketed, I met a fisherman with a large catch of *C. ornata* from Bung Borapet and enquired whether he knew of a second species of *Chitala* in the bung.

He immediately replied, without any further prompting or information from me, that there was indeed a second species of large notopterid, that it was known as pla tu, and that it was distinguished from *C. ornata* by having a black spot on the base of the pectoral fin and no spots on the tail. Asked about its size compared to *C. ornata*, he indicated that it was much larger, attaining a length of 1.5 m and a weight of 20 to 30 kg, ... He indicated that this species was relatively rare in Bung Borapet, and had not been caught there since the bung was drained by the Department of Water Works around 1984 to 1985.” Subsequently, KAW-ANANTAKUL ET AL. (2000, 2003) noted briefly in their explanation of *C. lopis* that the species was rare in the Chaophraya River basin and found and reported from the swamp before 1977 and also used to be found in the Pasak River, without providing any sources, supporting evidence or specimens. Since then, the reports in SMITH (1945), ROBERTS (1992) and probably also KAW-ANANTAKUL ET AL. (2000, 2003) influenced and were followed by subsequent works as bases of distribution of *C. lopis* in the Chao Phraya basin, including some non-academic publications which have no citations of them (ROBERTS, 1993; ROBERTS & WARREN, 1994; VIDTHAYANON ET AL., 1997; KOTTELAT, 2001; UKKATAWEWAT, 2004; VIDTHAYANON, 2004, 2017 [as *C. cf. borneensis*]; SAENJUNDAENG, 2014; PANITVONG, 2020; TAKI ET AL., 2021). Neither voucher specimens, nor concrete evidence relating to distribution of *C. lopis* in the Chao Phraya basin, is mentioned in those reports.

In comparisons of morphological characters including coloration of the specimens of *C. lopis* collected from the Pasak River to those of previous references, WEBER & DE BEAUFORT (1913) (as *Notopterus chitala* and *N. borneensis*, data based on specimens collected from the Greater Sunda Islands) and ROBERTS (1992), reported five meristic and one morphometric character that are non-overlapping (Table 3) with those reported here. These are as follows: pelvic fin rays (3 vs. 4–6 in WEBER & DE BEAUFORT [1913] and 3 in ROBERTS [1992]); lateral line scales (275–326 vs. ca. 200 in WEBER & DE BEAUFORT [1913] and no data in ROBERTS [1992]); lateral transverse scale rows (89–91 vs. ca. 75 in WEBER & DE BEAUFORT [1913] and no data in ROBERTS [1992]); abdominal scutes (52–58 vs. 37–45 in WEBER & de Beaufort [1913] and 43–49 in ROBERTS [1992]); branchiostegal rays (7 vs. 8–9 in WEBER & de BEAUFORT [1913] and 8 in ROBERTS [1992]); and eye diameter in HL (8.1–8.6 vs. 4.5–7.5 in WEBER & de BEAUFORT [1913] and no data in ROBERTS [1992]). Interestingly, from the comparisons, we found some incongruences not only between our data and those of the two studies, but also between data of the two studies (e.g., pelvic fin ray counts). These differences might possibly indicate intraspecific variation including geographic variation, ontogenetic changes, allometry, as well as paucity of examined specimens in each study, but also may possibly indicate the presence of multispecies within *C. lopis*, as suggested by KOTTELAT & WIDJANARTI (2005). It is noteworthy that WEBER & DE BEAUFORT (1913) noted eye diameter of *C. lopis* (as *Notopterus chitala* and *N. borneensis*) from Sumatra and Borneo which they examined as “longer than snout” while the specimen examined in the present study all clearly had shorter eye diameter than snout length (see Table 2). We would also like to note that it seems that importance of meristic and morphometric characters as distinguishing characters between species of notopterids has been overlooked and underestimated (e.g., ROBERTS, 1992), and it has not been investigated properly by using modern methods. It should be done together with analysis of color patterns, although such an endeavor is beyond the scope of the present study. Intensive investigation of variation in meristic and morphometric characters based on adequate numbers of specimens from principal river basins throughout the distributional range of *C. lopis* (including specimens of the Mekong population which has never been studied) is needed to clarify this problem.

Table 3. Comparisons of data of meristic and morphometric characters of *C. lopis* between the specimens examined in the present study and previously published data.

Characters	Weber & de Beaufort (1913)	Roberts (1992)	This study
Dorsal fin rays	8–10	8–11	10–11
Anal fin rays	110–135	117–127	122–127
Pectoral fin rays	15–17	15–17	15–16
Pelvic fin rays	4–6	3	3
Caudal fin rays	not available	15	13–15
Lateral line scales*	ca. 200	not available	275–326
Lateral transverse scale rows**	75	not available	89–91
Cheek scales	12–22	not available	18–22
Abdominal scutes	37–45	43–49	52–58
Branchiostegal rays	8–9	8	7
Gill rakers on the first gill arch	not available	13–14	14
Total vertebrae	not available	79–85	82–85
Upper jaw (maxillary) length (in HL)	2.25–2.5	not available	2.5–2.6
Head length (in TL)	4–5	not available	4.0–4.2
Maximum body depth (height) (in TL)	3.75–4.5	not available	3.6–3.9
Pectoral fin length (in HL***)	1.5–2	not available	1.7–1.8
Eye diameter (in HL)	4.5–7.5	not available	8.1–8.6

* Including both with and without pore.

** Transverse series of scales in a vertical line through origin of anal.

*** A membranous portion of gill cover was excluded.

ROBERTS (1992) defined color variations (ontogenetic color changes) of *C. lopis* into four phases as follows: maculosus color phase (entire body, anal, and caudal fins covered with numerous small round spots [150–270 mm SL]; lopis color phase (no marks whatever on body or fins [250 mm SL]); borneensis color phase (numerous very small round dark spots on the body, especially anteriorly, with some specimens having a few oblique wavy bars on posteriormost part of body and anal fin [300–600 mm SL]); and, hypselonotus color phase (no marks on body or fins except for a black round spot on pectoral fin base [over 600 mm SL]). Of the specimens of *C. lopis* from the Pasak River examined in the present study (including a photograph of THNHM-F 022040 [Fig. 7A]), only three (THNHM-F 022038, 022039 [Fig. 4A] and 022040 [Fig. 7A]) can be included in “hypselonotus color phase” of ROBERTS (1992), while the remaining two specimens (RLIKU 1880 [Fig. 4B, C] and THNHM-F 022037 [Fig. 3]) cannot be included in any of ROBERTS’s color phase categories. They have dusky spots scattered on the posterior portions of their bodies and anal fins, which in the smaller specimens, relatively broad faint dusky oblique (posteriorly declined) bars were observed just posterior to the middle of the body, gradually breaking up into dusky spots posteriorly. Their general color pattern is somewhat similar to that of the borneensis color phase, but differs in that the dusky spots are observed only in the posterior portion of the body, and the spots are in oblique (posteriorly declining) rows on their bodies and fins rather than irregularly “scattered”. We presumed that the smaller specimen exhibited a transitional color pattern from juvenile to sub-adult, and the color pattern observed in the larger specimens was its preceding condition. The incongruence of the three specimens which agreed with the hypselonotus color phase with the remaining two specimens is presumed to be due to environmental

factors in their habitats (e.g., turbulence of water), as already noted by ROBERTS (1992), or to sexual dimorphism. We could not determine the sex of the examined specimens in the present study, but the greater maximum depth of head and body and maximum body width of the two hypselonotus color phase specimens suggested that they may not belong to the same sex (see Table 2). Additionally, although the black band contrasting with its background (more prominent at posterior portion) at the margin of anal fin has never been described as a diagnostic character of *C. lopis* so far (stated as “brown” in WEBER & DE BEAUFORT [1913] [as *Notopterus borneensis*]), we found it useful in recognizing the species, in combination with other characters. The black band is usually absent or undistinguishable from its background in the other Indochinese congeners (*C. blanci* and *C. ornata*). The band can also be observed in the photograph of the species published in TAKI *ET AL.* (2021: 44, photo B).

KOTTELAT & WIDJANARTI (2005) proposed a hypothesis, that there are four species included in *Chitala “lopis”* which occur in Southeast Asia. Their distributions and color patterns are as follows: *Chitala lopis* (endemic to Java?; juveniles and adults plain?); *Chitala borneensis* (Sumatra [Jambi, Palembang], Borneo [Sarawak, Sambas, Barito] and Malay Peninsula; juveniles with scattered small blotches, becoming organized into oblique rows or stripes in adults; adults probably never plain); *Chitala hypselonotus* (Sumatra and Borneo; juveniles with oblique cross bars, adults plain with a black dot at pectoral fin base); and *Chitala* sp. (a still unnamed species) (Malay Peninsula, central Thailand, lower Mekong; juveniles with a few small scattered blotches on body, adults plain with a black spot at pectoral fin base). They also proposed their “more conservative hypothesis” which recognized two species: *C. lopis* (including *C. hypselonotus*) and *C. borneensis* (including *Chitala* sp.). Although the specimens from the Pasak River examined in the present study mostly agree with the features ascribed to “*C. hypselonotus*” of KOTTELAT & WIDJANARTI (2005), we do not follow both of their hypotheses, for the following reasons: 1) color patterns observed on the specimens of *C. lopis* from the Pasak River were remarkably variable between individuals of different and similar sizes, as we have described above (i.e., distinctness of black blotch at axil of pectoral fin, dusky spots on body and anal fin), even though they belong to the same local population. These differences should be reexamined as possibly representing variation due to sexual dichromatism, as we suggested above; 2) as the authors also mentioned, the data provided in KOTTELAT & WIDJANARTI (2005) are very limited and detailed observations, and comparisons of other meristic and morphometric characters, are necessary to solve taxonomic problems such as the status of *C. lopis*, as we noted above. This is also clearly indicated by the total incongruence of the proposed distribution of their “*C. hypselonotus*” (Sumatra and Borneo) and that of the examined specimens of the present study. In conclusion, to avoid further taxonomic confusion, we believe it is better to recognize all populations of *C. lopis* (*C. “lopis”* of KOTTELAT & WIDJANARTI [2005] or *C. lopis* sensu TAKI *ET AL.* [2021]), including those in mainland Southeast Asia, as a single widely-distributed species until detailed comparisons based on sufficient material can be carried out.

Our interview surveys revealed that local fishermen in the Pasak River basin recognize Pla Satu, or *C. lopis*, and have been catching it for at least 40–45 years. Judging from their experiences and those of their elders they heard about when they were young, *C. lopis* has occurred naturally in the Pasak River much prior to that, and is not the result of anthropogenic introduction. The non-spotted Pla Krai caught by two fishermen upstream of the PCD were presumably *C. lopis* or Pla Satu, since Pla Krai, or *C. ornata*, always possesses a series of ocelli in the posterior portion of the body or tail, even very large individuals (ROBERTS, 1992; TAKI *ET AL.*, 2021; PM personal observations) (see Fig. 10). The rarity of eye-witness

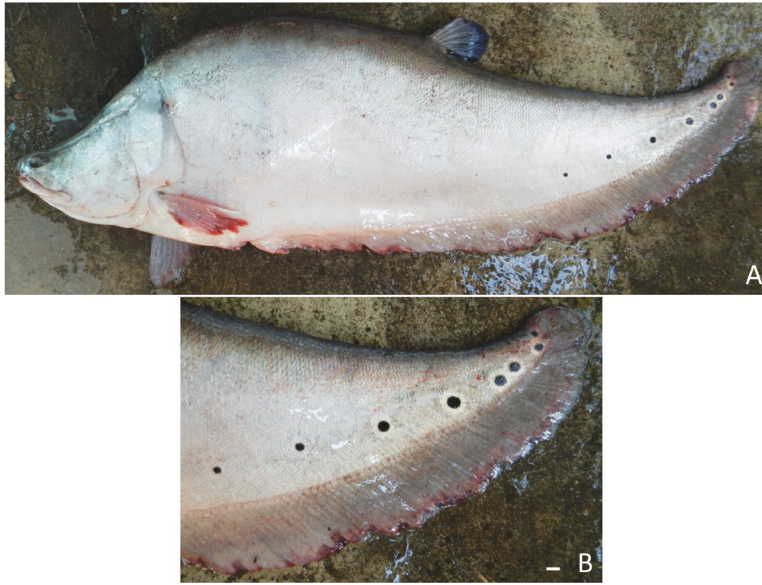


Figure 10. A live large individual of *Chitala ornata*, ca. 950 mm TL, caught from the Pasak Chonlasit Dam reservoir, Lopburi, by a local fisherman on 8 November 2022, the only other species of *Chitala* sympatric with *C. lopis* in the Pasak River basin. Photos show the series of relatively small but vivid black ocelli, each surrounded by a brightly colored ring, in the posterior portion of body. A, lateral view. B, close up of the ocellated posterior portion (tail) of body. The scale indicates 10 mm. Photos by Prachya Musikasinthorn.

evidence of *C. lopis* in areas upstream of the PCD is probably due to environmental alternation of the area by construction of the PCD. From the information on habitats and ecology of *C. lopis* obtained from fishermen at Ban Wang Muwang Village, the species lives and reproduces in fluvial habitats such as slow-to-moderately-flowing rivers. The two individuals of *C. lopis* found in the PCD reservoir around 2017–2018 were presumably the result of accidental migration from upstream areas or relics of a population confined to the reservoir from the time when the dam was built. The absence of records of *C. lopis* in several surveys of fish fauna conducted in the PCD reservoir (e.g., CHOOKAJORN *ET AL.*, 2002; CHAMASON & JANEKITKARN, 2005; WONGRAT, 2007) also supports this hypothesis. *C. lopis* also was not reported in fish surveys conducted in the Pasak River by the Department of Fisheries (DOF), the Electricity Generating Authority of Thailand (EGAT), and the Royal Irrigation Department (RID) which conducted environmental impact assessment studies for construction of the PCD (ROYAL IRRIGATION DEPARTMENT, 1993; CHOOKAJORN *ET AL.*, 2002). It is surprising that a gigantic, locally utilized food fish species such as *C. lopis* has not been reported from the lower Pasak basin for so long a time, in an area which is not very remote from urban centers, even though the frequent catches of *C. lopis* in the Pasak River at Hin Son Sub-district reported by local fishermen indicate that the species is not rare and its population is not a recent introduction.

The population of *C. lopis* reported in the Pasak River is the only population of the species known in the Chao Phraya basin at present. Further investigation of this spectacular species within the Pasak River basin is desirable to evaluate its conservation status and the need for conservation action to insure its sustainable use both as food and angling in local communities. Ecologically, *C. lopis* appears to be a typical apex predator which could potentially play

an important role in the ecosystem, and its loss could profoundly affect the structure and dynamics of the riverine ecological community (WINEMILLER *ET AL.*, 2016). Comparison with specimens from other populations in the Mekong and Maeklong River basins and in the Malay Peninsula and Sunda Islands, and further investigations using both morphological and genetical (molecular) approaches including examination of type materials of *C. lopis* and its synonyms, are also needed to clarify its taxonomic and biogeographic status.

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