

THE LABYRINTH FISHES (TELEOSTEI: ANABANTOIDEI, CHANNOIDEI) OF SUMATRA, INDONESIA

Tan Heok Hui

Department of Biological Sciences, National University of Singapore,
Kent Ridge, Singapore 119260, Republic of Singapore
Email: dbsth@nus.edu.sg

Peter K. L. Ng

Department of Biological Sciences, National University of Singapore,
Kent Ridge, Singapore 119260, Republic of Singapore
Email: dbsngkl@nus.edu.sg

ABSTRACT. – Three families (Anabantidae, Helostomatidae, Osphronemidae) and 32 species of anabantoids, and nine species of channids (Channidae) are recorded from Sumatra and adjacent islands. Three new species are described. *Betta cracens*, new species, differs from other members of the *B. pugnax* group in having the most slender body (body depth 21.2-24.2% SL), more anal fin rays (27-29) and lateral scales (32-33). *Betta fusca* is redescribed and a lectotype is designated. An allied species, *Betta raja* is described, differing from *B. fusca* in having a longer head (HL 33.9-37.4% SL, vs. 33.2-33.8), more lateral scales (30-32, vs. 29) and a relatively longer pelvic fin. *Betta rubra* is redescribed from type and recent material. *Luciocephalus aura*, new species, is described from Jambi province; where it is syntopic with *L. pulcher*, but differs in having different body and fin patterns, most prominently the presence of numerous iridescent green spots on central stripe (vs. absence of green spots). The taxonomy of *Luciocephalus pulcher* is also clarified and a neotype is designated. The taxonomy of *Channa maruloides* and *C. melanoptera* is discussed.

KEY WORDS. – Taxonomy, Anabantoidei, Channoidei, new species, Sumatra.

INTRODUCTION

The ichthyofauna of Sumatra is relatively poorly known when compared to Borneo or Malaysia. The definition of Sumatra in this context includes all the surrounding islands (Riau Archipelago, the islands Nias, Banka and Biliton), but excludes the political boundary that includes the Anambas and Natunas islands in the Riau Archipelago (sensu Whitten et al., 1987). For the inland fishes of the Anambas and Natuna islands, please refer to Tan & Lim (2004). With regards to the air breathing labyrinth fish fauna (Anabantoidei and Channoidei), recent collections in central Sumatra, Banka and Pulau Bintan (Riau Archipelago) from 1993 to 1997 have resulted in the discovery of eight new species of *Betta* and a new species of *Parosphromenus* (Osphronemidae) from this area, viz., *Betta burdigala* Kottelat & Ng, 1994; *B. chloropharynx* Kottelat & Ng, 1994; *B. miniopinna* Tan & Tan, 1994; *B. schalleri* Kottelat & Ng, 1994; *B. spilotogena* Ng & Kottelat, 1994; *B. simorum* Tan & Ng, 1996; *B. renata* Tan, 1998; *B. falx* Tan & Kottelat, 1998b; and *Parosphromenus bintan* Kottelat & Ng, 1998.

The intra-relationships of the suborder Anabantoidei were

recently revised (Britz, 1994a, 1995, 2001; Britz et al., 1995) and several families have been shown to be monophyletic, and Belontiidae and Luciocephalidae are synonymised with Osphronemidae (Britz, 1994a; Kottelat & Whitten, 1996).

The suborder Anabantoidei is represented in mainland Sumatra by three families (Anabantidae, Helostomatidae, Osphronemidae) and 32 species; and the suborder Channoidei is represented by one family (Channidae) and nine species (Table 1). In addition, two species have been introduced - *Betta splendens* and *Trichogaster pectoralis*. Herein, two new species of *Betta* from the *B. pugnax* group are described - *B. cracens* and *B. raja*. The lesser known *B. fusca* and *B. rubra* are redescribed and a lectotype is designated for *B. fusca*. *Luciocephalus pulcher* is redescribed, a neotype is designated and *L. aura*, new species, is described from the Jambi province.

MATERIAL AND METHODS

Material examined are deposited in Natural History Museum, London (ex British Museum of Natural History, BMNH); the

collection of Maurice Kottelat, Cornol (CMK); Museo Civico di Storia Naturale “Giacoma Doria”, Genova (MSNG); Research and Development Centre for Biology (ex Museum Zoologicum Bogoriense), The Indonesian Institute of Sciences (MZB); Naturhistorisches Museum Basel (NMBA); Naturhistorisches Museum Bern (NMBE); Nationaal Natuurhistorisch Museum, Leiden (ex Rijksmuseum van Natuurlijke Historie, RMNH); Instituut voor Systematiek & Populatiebiologie, Universiteit van Amsterdam (ZMA); and the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore (ZRC). Material examined are listed by Province (from north to south) and followed by the collection abbreviation and catalogue number with the number of specimens in brackets. Full locality data is quoted only for new species and redescriptions of poorly known taxa.

All measurements are taken from the left side of body (whenever possible) with a pair of dial calipers (0.05 mm). Taxonomy of the various taxa follow that of Tan & Ng (2005) (present volume), Kottelat et al., 1993, and Lee & Ng (1994). The synonymy is listed only for literature citation of species from Sumatra. Species sold for food are denoted by *, species in the aquarium trade are denoted by †. A list of the species of anabantoids and channoids of Sumatra and their localities by province and island is provided in Table 1, based on literature and collections. Material examined is listed by locality, catalogue number and the number of specimens in brackets; more details are provided for new taxa and redescriptions. Abbreviations used are SL: standard length, TL: total length, HL: head length.

TAXONOMY

SUB-ORDER ANABANTOIDEI

FAMILY ANABANTIDAE

Anabas testudineus (Bloch) *

Anabas macrocephalus - Günther, 1861: 376; Volz, 1905: 125; 1907: 125.

Anabas oligolepis - Weber & de Beaufort, 1912: 539.

Anabas scandens - Volz, 1905: 124 ; 1907: 124; Weber & de Beaufort, 1915: 270.

Anabas testudineus - Bleeker, 1879: 7; Weber & de Beaufort, 1912: 539; 1922: 334; Fowler & Bean, 1927: 4; de Beaufort, 1939: 193; SH Tan & HH Tan, 1994: 357.

Material examined. – **Sumatra Utara** - ZRC 42472 (4). **Riau** - ZRC 39045 (6). **Jambi** - ZRC 41695 (2).

FAMILY HELOSTOMATIDAE

Helostoma temminckii Cuvier *

Helostoma temminckii - Bleeker, 1879: 15; Volz, 1905: 125; 1907: 125; Weber & de Beaufort, 1912: 540; 1922: 340; Hardenberg, 1933: 308.

Helostoma temminckii - Günther, 1861: 377; Regan, 1910: 773; Fowler & Bean, 1927: 4.

Material examined. – **Jambi** - ZRC 42342 (1); ZRC 41736 (5).

FAMILY OSPHRONEMIDAE

Belontia hasselti (Cuvier & Valenciennes) *

Polyacanthus einthoveni - Volz, 1905: 125 ; 1907: 125.

Polyacanthus einthoveni - Günther, 1861: 378.

Polyacanthus hasselti - Günther, 1861: 378; Volz, 1905: 125 ; 1907: 125; Weber & de Beaufort, 1922: 338; Fowler & Bean, 1927: 4; de Beaufort, 1939: 193.

Polyacanthus hasseltii - Bleeker, 1879: 12; Regan, 1910: 772; Weber & de Beaufort, 1912: 540.

Material examined. – **Sumatra Utara** - ZRC 42479 (1). **Jambi** - ZRC 41737 (1); ZRC 46212 (16). **Sumatra Selatan** - ZRC 43247 (2). **Bangka** - ZRC 31015-16 (2). **Biliton** - ZRC 46301 (1).

Betta Bleeker

For the genus *Betta*, the species are listed by species groups according to Tan (1998), Tan & Kottelat (1998a) and Tan & Ng (2005)(present volume).

Betta bellica species group

Betta bellica Sauvage

Betta bellica - Kottelat et al., 1993: 161; Tan & Ng, 1996: 144, fig. 4B; Tan & Ng, 2005: 58 (present volume).

Betta fasciata - Regan, 1910: 782, pl. 77, Fig. 4.

Material examined. – **Sumatra Utara** - BMNH 1889.12.26:30 (lectotype of *B. fasciata*); ZRC 42468 (10); ZRC 42478 (4). **Riau Archipelago** - ZRC 44057 (14).

Remarks. – *Betta bellica* is found only in Sumatra Utara and Riau Archipelago, whereas *B. simorum* is found in Riau, Jambi and Sumatra Selatan. *Betta bellica* differs from *B. simorum* in the following characters: lower anal fin ray count (mode 31, vs. 32); lower dorsal fin ray count (mode 12, vs. 11); lower lateral scale count (mode 33, vs. 34); lower postdorsal scale count (mode 8, vs. 9); shorter pelvic fin (23.6-38.8% SL, vs. 31.3-48.3; reaching end of 8th anal ray, vs. 14th); shorter pelvic fin flange (ending halfway pelvic filament, vs. two-thirds); non-overlap of adpressed pelvic fin branched rays with anal fin origin (vs. overlap); and a less sloping lateral head profile (vs. more sloping with a slight concavity (see Tan & Ng, 1996).

Betta simorum Tan & Ng †

Betta bellica (non Sauvage, 1884) - Kottelat et al., 1993: 161 (part), pl. 75.

Betta simorum Tan & Ng, 1996: 151, figs. 3C, 4C.

Table 1. Distribution of Anabantoids (Anabantidae, Helostomatidae, Osphronemidae) and Channoids (Channidae) of Sumatra (based on literature and collections)

	Aceh	Sumatra Utara	Nias	Sumatra Barat	Riau	Riau Archipel.	Jambi	Sumatra Selatan	Banka	Biliton	Bengkulu	Lampung
Anabantidae												
<i>Anabas testudineus</i>	+	+	+	+	+	+	+	+	+	+		+
Helostomatidae												
<i>Helostoma temminckii</i>	+	+		+	+		+	+			+	+
Osphronemidae												
<i>Belontia hasselti</i>	+	+			+		+	+	+	+		
<i>Betta bellica</i>		+				+			+			
<i>B. burdigala</i>									+			
<i>B. chloropharynx</i>					+	+	+		+			
<i>B. coccina</i>												
<i>B. cracens</i>												
<i>B. edithae</i>												
<i>B. falx</i>	+	+										
<i>B. fusca</i>	+	+										
<i>B. hipposideros</i>					+							
<i>B. imbellis</i>												
<i>B. miniopinna</i>					+	+						
<i>B. pugnax</i>			+		+	+	+					
<i>B. raja</i>												
<i>B. renata</i>												
<i>B. rubra</i>	+	+										
<i>B. schalleri</i>												
<i>B. simorum</i>					+				+			
<i>B. spilotogena</i>												
<i>Luciocephalus aura</i>												
<i>L. pulcher</i>	+				+	+	+	+	+	+		
<i>Osphronemus goramy</i>		+		+	+							
<i>Parosphronemus bintan</i>												
<i>P. deissneri</i>									+	+		
<i>P. sumatranus</i>									+	+		
<i>Sphaerichthys osphromenoides</i>												
<i>S. cf. selatensis</i>					+					+		
<i>Trichogaster leerii</i>	+	+			+	+	+	+	+	+		+
<i>T. trichopterus</i>	+	+		+	+	+	+	+	+	+		+
<i>Trichopsis vittata</i>		+										
Channidae												
<i>Channa bankanensis</i>												
<i>C. cyanospilos</i>	+				+	+	+	+	+	+		+
<i>C. gachua</i>		+		+								
<i>C. lucius</i>	+	+		+	+	+	+	+	+	+		
<i>C. marulioides</i>		+		+	+	+	+	+	+	+		
<i>C. melasoma</i>	+				+	+	+	+	+	+		
<i>C. micropeltes</i>	+	+	+		+	+	+	+	+	+		
<i>C. pleurophthalma</i>		+			+	+	+	+	+	+		
<i>C. striata</i>		+		+	+	+	+	+	+	+	+	
Total no. of species	12	17	3	7	20	19*	26*	20	18*	16	6	5

*reflects extensive collection done

Material examined. – Holotype - **Jambi** - MZB (holotype), 63.8 mm SL.

Paratypes - **Jambi** - ZRC 38549 (4 paratypes); CMK 11182 (5 paratypes); ZRC 39118 (19 paratypes).

Others - **Riau** - ZRC 39249 (2), 50.3-52.1 mm SL. **Sumatra Selatan** - ZMA 121.825 (3). **Kalimantan Barat** - ZRC 46185 (8).

Remarks. – *Betta simorum* is restricted to the southern half of Sumatra and was recently recorded from the Kapuas basin in Kalimantan Barat (pers. observ.). It is closely allied to *B. bellica* (see Tan & Ng, 1996).

Betta coccina species group

***Betta burdigala* Kottelat & Ng**

Betta burdigala Kottelat & Ng, 1994: 70, fig. 4.

Material examined. – Holotype - **Banka** - ZRC 35162 (holotype), 23.8 mm SL.

Paratypes - ZRC 35163-35164 (2 paratypes), CMK 9597 (2 paratypes).

Remarks. – *Betta burdigala* is restricted to the island of Banka. It differs from *B. coccina* in the following characters: lack of lateral iridescent blotch (vs. presence); white pelvic fin tip (vs. black); more dorsal fin rays (14-15, vs. 9-12); more subdorsal scales (11-11½, vs. 7-8); fewer anal fin rays (24-26, vs. 27-29); fewer predorsal scales (15-16, vs. 18-21); smaller total length (131.0-132.3% SL, vs. 132.7-138.5); greater postorbital length (16.7-17.4% SL, vs. 14.3-15.5); greater dorsal fin base length (26.8-28.6% SL, vs. 15.2-20.4). *Betta burdigala* differs from *B. miniopinna* in the following characters: red body colour (vs. black); presence of iridescent green spots on median fins (vs. absence); more dorsal fin rays (14-15, vs. 10-11); more subdorsal scales (11-11½, vs. 8); fewer anal fin rays (24-26, vs. 27-28); fewer predorsal scales (15-16, vs. 18); greater dorsal fin base length (26.8-28.6% SL, vs. 16.0-24.6); greater postdorsal length (16.7-17.4% SL, vs. 12.3-13.3); smaller predorsal length (52.8-54.9% SL, vs. 56.2-65.4); and a greater preanal length (42.5-45.5% SL, vs. 37.9-42.6).

***Betta coccina* Vierke †**

Betta coccina Vierke, 1979: 288 (type locality: Jambi); Kottelat et al., 1993: 161; Tan & Ng, 2005: 80 (present volume).

Material examined. – **Riau Archipelago** - CMK 7290 (10); ZRC 21051-52 (2); ZRC 44056 (36). **Jambi** - ZRC 38257 (2); ZRC 38611 (4); ZRC 39672 (7).

Remarks. – *Betta coccina* belongs to the *B. coccina* group and is also found in Peninsular Malaysia. It differs from *B. burdigala* in the following characters: presence of lateral iridescent blotch in males (vs. absence); black pelvic fin tip (vs. white); fewer

dorsal fin rays (9-12, vs. 14-15); fewer subdorsal scales (7-8, vs. 11-11½); more anal fin rays (27-29, vs. 24-26); more predorsal scales (18-21, vs. 15-16); greater total length (132.7-138.5% SL, vs. 131.0-132.3); smaller postorbital length (14.3-15.5% SL, vs. 16.7-17.4); smaller dorsal fin base length (15.2-20.4% SL, vs. 26.8-28.6). *Betta coccina* differs from *B. miniopinna* in the following characters: presence of lateral iridescent blotch in males (vs. absence); red body colour (vs. black); black pelvic fin tip (vs. white); presence of iridescent green spots on median fins (vs. absence); greater postorbital length (14.3-15.5% SL, vs. 12.3-13.3); smaller pelvic fin length (7.8-8.8% SL, vs. 8.7-12.0).

***Betta miniopinna* Tan & Tan**

Betta miniopinna HH Tan & SH Tan, 1994: 42, fig. 1; SH Tan & HH Tan, 1994: 357.

Material examined. – Holotype - **Riau Archipelago** - ZRC 32504 (holotype), 24.1 mm SL.

Paratypes - ZRC 32505 (1 paratype); MZB (1 paratype); ZRC 32503 (1 paratype).

Others - ZRC 37510 (10).

Remarks. – *Betta miniopinna* is restricted to Pulau Bintan of the Riau Archipelago. *Betta miniopinna* differs from *B. burdigala* in the following characters: black body colour (vs. red); absence of iridescent green spots on median fins (vs. presence); fewer dorsal fin rays (10-11, vs. 14-15); fewer subdorsal scales (8, vs. 11-11½); more anal fin rays (27-28, vs. 24-26); more predorsal scales (18, vs. 15-16); smaller dorsal fin base length (16.0-24.6% SL, vs. 26.8-28.6); smaller postdorsal length (12.3-13.3% SL, vs. 16.7-17.4); greater predorsal length (56.2-65.4% SL, vs. 52.8-54.9); smaller preanal length (37.9-42.6% SL, vs. 42.5-45.5). *Betta miniopinna* differs from *B. coccina* in the following characters: absence of lateral iridescent blotch (vs. presence); black body colour (vs. red); white pelvic fin tip (vs. black); absence of iridescent green spots on median fins (vs. presence); and a smaller postorbital length (12.3-13.3% SL, 14.3-15.5% SL); greater pelvic fin length (8.7-12.0% SL, vs. 7.8-8.8).

Betta edithae species group

***Betta edithae* Vierke**

Betta edithae - Witte & Schmidt, 1992: 324, 326; Kottelat et al., 1993: 162; SH Tan & HH Tan, 1994: 357.

Material examined. – **Riau Archipelago** - ZRC 37551 (4); ZRC 34721-42 (22); ZRC 34877 (7); ZRC 42512 (13); ZRC 42513 (26); ZRC 42514 (2); ZRC 42515 (13). **Sumatra Selatan** - ZRC 46193 (24). **Banka** - ZRC 31031-44 (14); ZRC 30899-65 (17); ZRC 35159-61 (3). **Biliton** - ZRC 46182 (3).

Remarks. – *Betta edithae* belongs to its own species group. It has a widespread distribution and is found in Kalimantan

Timur, Kalimantan Selatan, Kalimantan Tengah, Kalimantan Barat, Sumatra Selatan, Banka, Biliton and Pulau Bintan (of the Riau Archipelago) (Witte & Schmidt, 1992; Tan & Tan, 1994; Kubota et al., 1996; M. Kottelat, pers. comm.). The specimens from Pulau Bintan are slightly different from the topotypes from Banjarmasin in the following characters: chin-bar interrupted or joined by thin black mark in the middle, end of chin-bar towards throat rounded (vs. uninterrupted chin-bar without rounded ends); greater preanal length (48.2-51.8% SL, vs. 45.6-47.2); and a smaller adult size (40 mm SL, vs. 55 mm SL of holotype). From preliminary examinations, the series from Palembang (Sumatra Selatan) is similar to the Bankan population.

Betta foerschi species group

***Betta rubra* Perugia**

(Fig. 1)

Betta rubra Perugia, 1893: 242; Volz, 1905: 127 (part); 1907: 127 (part); Regan, 1910: 781, pl. 77, Fig. 1; Kottelat et al., 1993: 163; Tan & Ng, 2005: 58 (present volume).

Material examined. – Lectotype - **Sumatra Barat** - MSNG 13019a (lectotype), 28.6 mm SL.

Paralectotypes - MSNG 13019 (4 paralectotypes), 26.9-31.4 mm SL; Siboga; E. Modigliani, 1886. **Sumatra Utara** - BMNH 1893.5.29:1 (1 paralectotype), 33.3 mm SL; Lake Toba; E. Modigliani.

Others - **Aceh** - MZB 4784 (3), 23.4-35.0 mm SL, ZRC 42497 (2), 33.4-35.4 mm SL; Aceh Barat, Alur Sungai Iamueselatan; H. B. Munaf & M. Toha, 13 Dec.1982.

Diagnosis. – *Betta rubra* can be differentiated from the other members of *B. foerschi* group in having the following unique set of characters: presence of 5-7 irregular dark vertical bars on body; a pair of vertical parallel reddish bars on opercle; presence of broad chin-bar, which merges with anterior part of second postorbital stripe, forming a triangular dark mark below eye; more anal fin rays than *B. foerschi* (27-29, vs. 26); fewer lateral scales than *B. foerschi* ($28^{1/2}$ -30, vs. 31); greater total length than *B. foerschi* (131.6-142.3% SL, vs. 127.2-133.5); smaller caudal peduncle depth than *B. foerschi* and *B. strohi* (13.1-16.3% SL, vs. 17.5-20.1; 45.1-50.6% HL, vs. 52-70); slightly smaller body depth at dorsal-fin origin than *B. foerschi* and *B. strohi* (23.2-27.1% SL, vs. 26.6-28.9; 74.2-86.5% HL, vs. 97-102); greater pelvic fin length than *B. foerschi* (28.1-38.4% SL, vs. 21.4-28.5); smaller dorsal-fin base length than *B. strohi* (9.6-12.5% SL, vs. 12.6-15.8); and a smaller interorbital width than *B. foerschi* and *B. strohi* (6.3-9.9% SL, vs. 9.6-13.4; 22.7-29.5% HL, vs. 30-44).

Description. – General appearance as illustrated in Figs. 1a, b; meristic and morphometric data of *B. rubra* is listed in Table 2. Body relatively slender (body depth 23.2-27.1% SL), head relatively short (head length 27.3-33.9% SL). Dorsal and anal fins pointed, caudal fin lanceolate; dorsal fin placed relatively far back (predorsal length 62.9-67.9% SL); anal-fin base length about half of standard length (48.3-55.9% SL);

pelvic fin rounded with short filamentous ray (28.1-38.4% SL); pectoral fin rounded.

Preserved coloration. – See Figs. 1a, b for general appearance. Dorsum of body dark brown, ventrum lighter brown. Dorsum of head brown with black spots. Mouth with lower lip black. Distinct pre- and postorbital dark brown stripes on head, postorbital stripe interrupted by vertical parallel reddish bars on opercle, opercle with distal dark brown margin. Broad dark brown chin-bar present, which merges with anterior part of second postorbital stripe, forming a triangular dark brown mark below eye. Body with irregularly spaced blackish vertical 5-7 bars, more distinct on ventral half of body. Caudal peduncle spot faint. Fins brownish, sometimes reddish. Dorsal, caudal and anal fins without transverse bars on interradial membrane. Pectoral fin rounded, and hyaline. Pelvic fin rounded, with reddish filamentous second ray.

Distribution. – *Betta rubra* is currently known only from Lake Toba area near Medan in Sumatra Utara; Aceh Barat in Aceh; and Siboga in northern part of Sumatra Barat.

Remarks. – The recent collection (MZB 4784) had been mislabeled as *B. picta* and had been badly preserved. All specimens were darkly stained, fins broken and folded (Fig. 1b). As such, no colour information on relatively fresh specimen can be made. The placing of *B. rubra* in the *B. foerschi* group is tentative pending properly preserved fresh collections (viz., Tan & Ng, 2005) (present volume). The specimens from Genova (MSNG 13019) were in good condition, but the opercle and pelvic, anal, caudal and dorsal fins were tinged pinkish-red. On closer examination under a microscope, the seemingly red coloration was found to be due to either a side effect from early preservation chemicals or a dye used previously. Nevertheless, this taxon is valid from its unique suite of characters.

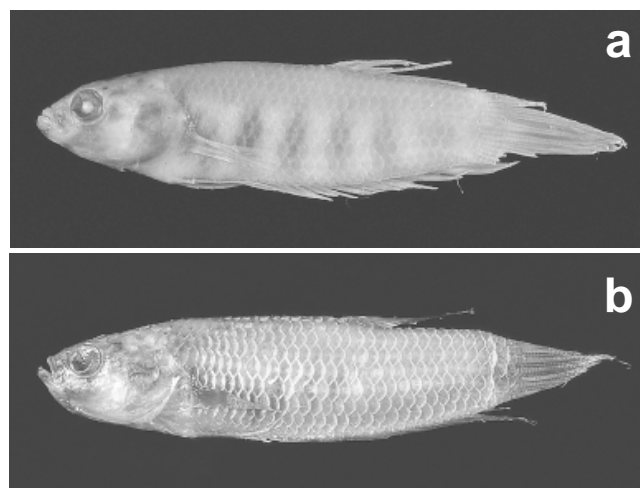


Fig. 1. *Betta rubra* - a. MSNG 13019 (lectotype), 29.4 mm SL, Siboga; b. ZRC 42497, 33.4 mm SL, Aceh Barat (right side, reversed).

Betta picta species group

***Betta falx* Tan & Kottelat**

Betta trifasciata (non Bleeker, 1850) - Günther, 1861: 388 (part); Volz, 1905: 127; 1907: 127.

Betta pictum (non Valenciennes, in Cuvier & Valenciennes, 1846) - Weber & de Beaufort, 1912: 541.

Betta picta (non Valenciennes, in Cuvier & Valenciennes, 1846) - Bleeker, 1879: 26 (part); Weber & de Beaufort, 1922: 360 (part); Kottelat et al., 1993: 163 (part).

Betta falx Tan & Kottelat, 1998b: 564.

Material examined. – Holotype - **Jambi** - MZB 9308 (holotype), 32.7 mm SL.

Paratypes - **Jambi** - ZRC 40974 (20 paratypes); ZMA 121.673 (6 paratypes); MZB 9307 (4 paratypes); RMNH 33087 (5 paratypes); ZRC 38571 (44 paratypes); CMK 11119 (44 paratypes); ZRC 38254 (3 paratypes); ZRC 42496 (10 paratypes); MHNG 2593.95 (5 paratypes).

Others - **Sumatra Utara** - ZMA 121.590 (29), ZRC 40975 (2); ZMA 121.692 (5); ZMA 121.688 (2). **Jambi** - ZRC 42511 (3).

Remarks. – *Betta falx* is closely related to *B. picta* from Java (see Tan & Kottelat, 1998b). It differs from *B. picta* in the following characters: lower dorsal fin ray count (mode 8 vs. 9); lower lateral scale count (mode 27 vs. 28); dorsal fin origin above 11-12th lateral scale (vs. 12-14th); anal fin origin below modal 6th lateral scale (vs. 7th); lower predorsal scale count (mode 19, vs. 20); slightly greater anal-fin base length (46.5-50.3% SL, vs. 42.6-48.4); in life - male with distal margins of anal and caudal fins reddish (vs. bluish); iridescent greenish-blue opercle scales (vs. yellow-gold); preserved material - male with distinct dorsal transverse bars (vs. faint); male with distinct dark anal distal margin wide (vs. narrow); male without elongated median caudal fin rays (vs. presence); female with distinct caudal transverse bars (vs. very faint or absent); dorsal head view narrow (vs. broad); thick preorbital black stripe (vs. narrow); and the distance between posterior part of anal fin to lower part of caudal narrow (vs. wide).

Betta pugnax species group

***Betta cracens*, new species**

(Fig. 2)

Material examined. – Holotype - **Jambi** - MZB 9309 (holotype), 47.4 mm SL; Sungai Berliung Bata, Bertam, ca. 1 km into turnoff to Permata Biru Indah, 10 km from Jambi towards Palembang after main bus terminus, from fish collectors, coll. H. H. Tan & H. H. Ng, 18 Jul.1997.

Paratypes - ZRC 41717 (6 paratypes), 32.8-57.4 mm SL, CMK 14415 (2 paratypes), 38.2-39.8 mm SL; same data as holotype. — ZRC 42498 (2 paratypes), 31.2-51.3 mm SL; Sungai Berliung Bata, Bertam, ca. 1 km into turnoff to Permata Biru Indah, 10 km from Jambi towards Palembang after main bus terminal, coll. H. H. Tan, 29 Jul.1997.

Diagnosis. – *Betta cracens* can be differentiated from the

other members of the *B. pugnax* group in having the following unique combination of characters: most slender body in the species group (body depth at dorsal-fin origin 21.2-24.2% SL); anal fin rays 27-29 (mode 28); lateral scales 32-33 (mode 33); thin dark blue edge on anal fin in male and female; predorsal length 65.0-67.1% SL; head length 30.8-31.7% SL.

Description. – The general appearance is illustrated in Figs. 2a, b; meristic and morphometric data of *B. cracens* in Table 2. Body slender (body depth 21.2-24.2% SL), head short and blunt (head length 30.8-31.7% SL; head width 17.1-19.9% SL and 53.8-64.0% HL). Dorsal, caudal and anal fins pointed; dorsal fin placed relatively far back (predorsal length 65.0-67.1% SL); caudal fin with distal part of rays extended slightly beyond interradial membrane, median rays elongated; anal-fin base length more than half of standard length (53.4-55.7% SL); pelvic fin rounded with relatively long filamentous ray (36.1-43.4% SL); pectoral fin rounded.

Live coloration. – See Fig. 2a for general appearance. Dorsum of body brown, ventrum lighter brown. Dorsum of head brown, male with iridescent green opercle, female without iridescent opercle. Distinct pre- and postorbital black stripes on head, lower lip black, chin-bar present in both sexes and juvenile. Male with some body scales on dorsal half with blue iridescence, rest of body scales with faint dark brown posterior edge, more distinct on belly scales. Body with 5-7 faint irregularly spaced vertical brown bars. Female and juvenile with indistinct central and second central stripes, and indistinct caudal peduncle spot. Fins brownish, dorsal and caudal fins with dark brown dorsal transverse bars in male, only dorsal fin with transverse bars in female. Both male and female with thin dark blue edge on anal fin. Pectoral fin hyaline. Pelvic with bright whitish distal tip.

Preserved coloration. – See Fig. 2b for general appearance. Dorsum of body dark brown, ventrum lighter brown to whitish. Dorsum of head dark brown, male with distal part of opercle after eye black. Distinct pre- and postorbital black

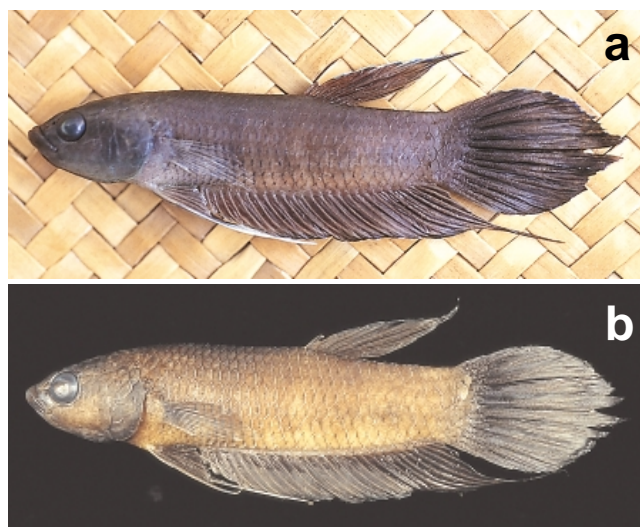


Fig. 2. *Betta cracens* - a. ZRC 41717 (paratype), 57.4 mm SL, freshly preserved, Jambi (Bertam); b. ZRC 41717 (paratype), 57.4 mm SL, Jambi (Bertam).

Table 2. Meristics and morphometrics of *Betta cracens*, *B. fusca*, *B. raja* and *B. rubra*.

	<i>Betta cracens</i>	<i>Betta fusca</i>	<i>Betta raja</i>	<i>Betta rubra</i>
Sample size	6	2	20	4
Standard length (mm)	38.2-57.4	53.1-59.7	45.9-63.9	33.1-35.0
MERISTICS				
Vertebrae	2-3 + 8 + 20-21 (total 31-32, 31) (n = 11)	2-3 + 8 + 19 (total 29-30, 29 or 30) (n = 2)	2-3 + 8 + 18-19 (total 28-30, 29) (n = 20)	2 + 8 + 18-19 (total 28-29, 29) (n = 4)
Anal fin rays	I-II, 26-27 (total 27-29, 28)	0-I, 23-25 (total 24-25, 24 or 25)	II, 23-26 (total 25-28, 26)	II-III, 24-26 (total 27-29, 27)
Dorsal fin rays	0-I, 8-9 (total 8-9, 8 or 9)	0-II, 7-8 (total 8-9, 8 or 9)	I-II, 7-10 (total 8-11, 9)	0-II, 7-8 (total 8-9, 9)
Caudal fin rays	ii,5+6,ii	ii,6+6,ii	ii,5+6-7,i (ii,5+7,i)	ii-iii,5+6,i-iii
Pelvic fin rays	I, 1, 4	I, 1, 4	I, 1, 4	I, 1, 4
Pectoral fin rays	13	12	12-13 (13)	13
Anal fin rays below dorsal-fin origin	-	9	10-13 (11)	-
Anal fin rays at pectoral fin end	-	5-6	6-9 (8)	-
Anal fin rays at pelvic fin end	-	11-12	11-17, females 15 and above, males	-
Subdorsal scales	5 ¹ / ₂ -6 (5 ¹ / ₂ or 6)	5 ¹ / ₂ -6	6-7 (6 ¹ / ₂)	5-6 (6)
Transverse scales at dorsal-fin origin	9 ¹ / ₂ -10 (9 ¹ / ₂)	10	10-10 ¹ / ₂ (10)	8 ¹ / ₂ -9 ¹ / ₂ (9 ¹ / ₂)
Lateral scales	32-33 (33)	29	30-32 (31)	28 ¹ / ₂ -30 (29)
Lateral scales below dorsal-fin origin	16-19 (17 or 18)	16	14-16 (15)	15-16
Lateral scales above anal-fin origin	6-7 (7)	6	5-7 (6)	6-8 (6)
Predorsal scales	23-24 (23 or 24)	22-23	20-22 (22)	22-24 (24)
Postdorsal scales	11-12 (11 or 12)	11	10-11 (11)	10-11
MORPHOMETRICS - % SL				
Total length	138.9-145.8	138.6	138.5-159.4	131.6-142.3
Predorsal length	65.0-67.1	68.5-70.2	63.2-69.9	62.9-67.6
Postdorsal length	20.4-24.6	22.2-23.5	20.0-24.6	20.3-23.3
Caudal peduncle depth	15.1-16.7	19.2-20.4	18.3-23.2	13.1-15.3
Preanal length	42.0-46.1	49.0-50.3	46.1-52.4	41.7-47.4
Head length	30.8-31.7	33.2-33.8	33.9-37.4	27.3-33.6
Body depth at dorsal-fin origin	21.2-24.2	30.9-31.7	28.1-33.5	23.2-25.8
Pelvic fin length	36.1-43.4	38.6-39.2	37.4-69.8	28.1-38.4
Anal-fin base length	53.4-55.7	47.8-51.4	48.9-54.8	49.2-52.8
Dorsal-fin base length	10.5-11.6	13.7-13.9	11.0-15.3	10.0-12.2
Body length	68.5-71.3	70.4-70.8	62.8-70.7	-
Head width	17.1-19.9	19.8-23.6	18.5-22.3	-
% HL				
Orbit diameter	24.7-28.2	23.8-26.7	24.0-28.7	24.5-25.8
Postorbital length	46.3-50.7	48.3-50.5	45.1-53.9	49.5-57.1
Interorbital width	32.7-37.1	33.5-34.2	32.2-39.6	22.7-29.5
Snout length	24.0-25.8	25.0-26.7	26.3-29.8	17.9-24.7
Head width	53.8-64.0	59.7-69.8	51.8-62.0	-
% Postorbital length				
Orbit diameter	50-58	47-55	46-64	-
Interorbital width	67-75	68-70	67-78	-
% Predorsal length				
Head length	46.3-48.4	47.2-49.4	50.4-55.7	-

stripes on head, chin-bar present but may be obscured by blackened opercle scales. Body scales with black posterior edge, more prominent on belly scales. Body with irregularly spaced 5-7 vertical dark brown bars. Female and juvenile with indistinct central and second central stripes with caudal peduncle spot indistinct. Fins brownish, dorsal and caudal fins with dorsal transverse black bars in male, dorsal with transverse black bars in female, anal fin with thin distal black edge. Pectoral fin hyaline. Pelvic fin dark brownish, with hyaline filamentous second ray.

Distribution. – *Betta cracens* is currently known only from

the swamp forest habitat in the Bertam area south of Jambi town.

Field notes. – The type locality is a freshwater swamp forest, part of it having been converted to rubber tree plantation. The water lily, *Barclaya motleyi* (Nymphaeaceae) grows in large mats at certain stretches of the stream line. Water depth varied from 5 to 80 cm, pH 5.8. Syntopic species present: *Puntius banksi*, *Rasbora einthoveni*, *R. pauciperforata* (Cyprinidae), *Hemiramphodon pogonognathus* (Hemiramphidae), *Betta pugnax*, *Sphaerichthys osphromenoides*, *Trichogaster trichopterus* (Osphronemidae), *Channa gachua* and *C. lucius* (Channidae).

Etymology. – From the Latin *cracens* meaning slender, graceful; alluding to the slender body, as compared with the other members of the *B. pugnax* group.

Remarks. – *Betta cracens* can be differentiated from the other members of the *B. pugnax* species group in the following characters: most slender body (body depth at dorsal-fin origin 21.2-24.2% SL, vs. 24.8-36.9); higher anal fin ray count than all members (mode 28, vs. 24-27); higher lateral scale count than all members (mode 33, vs. 27-31); lower dorsal fin ray count than *B. pugnax*, *B. schalleri* and *B. prima* (mode 8-9, vs. 10-11); lower subdorsal scale count than *B. schalleri*, *B. pulchra*, *B. breviobesus* (mode 5½-6, vs. 6½-7); higher predorsal scale count than all members except *B. fusca* (mode 23-24, vs. 17-22); more postdorsal scales than *B. prima* (11-12, vs. 9-10); smaller total length than *B. enisae* (138.9-145.8% SL, vs. 143.0-155.2); smaller predorsal length than *B. fusca*, *B. prima* and *B. enisae* (65.0-67.1% SL, vs. 67.3-70.3); smaller caudal peduncle depth than *B. fusca* and *B. raja* (15.1-16.7% SL, vs. 18.3-23.2); smaller preanal length than all members except *B. pugnax* and *B. pulchra* (42.0-46.1% SL, vs. 46.1-54.8); smaller head length than all members except *B. pugnax* (30.8-31.7% SL, vs. 32.7-37.7); greater anal-fin base length than *B. fusca*, *B. prima*, *B. enisae*, *B. schalleri* and *B. pulchra* (53.4-55.7% SL, vs. 47.8-53.5); smaller dorsal-fin base length than *B. fusca*, *B. schalleri* and *B. pulchra* (10.5-11.6% SL, vs. 12.3-15.9); smaller head width than *B. fusca* (17.1-19.9% SL, vs. 19.8-23.6); smaller snout length than *B. raja* (24.0-25.8% HL, vs. 26.3-29.8); smaller orbital diameter than *B. prima*, *B. enisae* and *B. schalleri* (50-58% postorbital length, vs. 57-76); and a smaller head length than *B. prima*, *B. breviobesus* and *B. raja* (46.3-48.4% predorsal length, vs. 49.8-58.5).

Betta cracens can be differentiated from its syntopic species *B. pugnax* in having the following characters: more anal fin rays (27-29, vs. 23-24); fewer dorsal fin rays (8-9, vs. 10); more lateral scales (32-33, vs. 29-30); dorsal-fin origin above 16-19th lateral scale (vs. 13-14th); more predorsal scales (23-24, vs. 18-19); more postdorsal scales (11-12, vs. 10); greater predorsal length (65.0-67.1% SL, vs. 63.0-64.2); smaller caudal peduncle depth (15.1-16.7% SL, vs. 17.6-19.0); smaller preanal length (42.0-46.1% SL, vs. 50.4-52.6); smaller head length (30.8-31.7% SL, vs. 34.1-34.9); smaller body depth (21.2-24.2% SL, vs. 27.8-27.9); greater anal-fin base length (53.4-55.7% SL, vs. 46.8-46.9); smaller dorsal-fin base length (10.5-11.6% SL, vs. 14.4-14.7); and a greater body length (68.5-71.3% SL, vs. 65.3-67.2).

***Betta fusca* Regan**
(Fig. 3)

Betta fusca Regan, 1910: 780, pl. 76, Fig. 2; Weber & de Beaufort, 1922: 356 (part); Kottelat et al., 1993: 162.

Betta pugnax (non Cantor, 1850) - Perugia, 1893: 243 (part); Volz, 1905: 127 (part); 1907: 127 (part).

Material examined. – Lectotype - **Sumatra Utara** - BMNH 1908.17.13:18 (lectotype), 59.7 mm SL male; Medan; coll. Morton.

Paralectotype - **Sumatra Utara** - BMNH 1908.17.13:19 (1 paralectotype), 53.1 mm SL; sama data as lectotype.

Diagnosis. – *Betta fusca* can be differentiated from the other members of the *B. pugnax* group by the following set of characters: large head (head length 33.2-33.8% SL); anal fin rays 24-25; lateral scales 29; body depth 30.9-31.7% SL; predorsal length 68.5-70.2% SL; preanal length 49.0-50.3% SL; body length 70.4-70.8% SL.

Description. – The general appearance is illustrated in Fig. 3; meristic and morphometric data of *B. fusca* in Table 2. Body relatively stocky (body depth 30.9-31.7% SL), head long and stocky (head length 33.2-33.8% SL; head width 19.8-23.6% SL and 59.7-69.8% HL). Dorsal, caudal and anal fins pointed; dorsal fin placed relatively posteriorly (predorsal length 68.5-70.2% SL); caudal fin with distal part of rays extended slightly beyond interradial membrane, median rays elongated; anal-fin base length about half of standard length (47.8-51.4% SL); pelvic fin rounded with relatively long filamentous ray (38.6-39.2% SL); pectoral fin rounded.

Preserved coloration. – See Fig. 3 for general appearance. Dorsum of body dark brown, ventrum lighter brown to yellow. Dorsum of head dark brown, male with distal part of opercle after eye dark brown, almost black. Distinct pre- and postorbital dark brown stripes on head, chin-bar absent. Body scales with dark brown to black posterior edge, more prominent on belly scales. Body with central and second central stripes, and caudal peduncle spot indistinct. Fins brown, dorsal fin with dorsal transverse bars, anal and caudal transverse bars absent. Pectoral fin proximal part darkish, rest hyaline. Pelvic fin brownish, with hyaline filamentous second ray.

Distribution. – *Betta fusca* is currently known only from the type series. Regan (1910) reported the type locality as ‘Sumatra’ and that they had been collected by W. Morton. Their exact locality is not known, but Morton collected around Medan. In the narrative of his travel (Morton, 1908: 165-174), he mentioned having collected in ‘Tanjong Slamet’, ‘Bahsoemboe near Tebing Tinggi’, and foothills of ‘Mt. Surbo Dolok’. The bulk of Morton’s collection is preserved in Musée d’Histoire Naturelle, Lausanne, Switzerland; from Morton’s text, it seems that some material was also deposited in Naturhistorisches Museum, Zürich, Switzerland, but no Morton fish material could be located in these two collections.



Fig. 3. *Betta fusca* - BMNH 1908.17.13:18 (lectotype), 59.7 mm SL, Medan (caudal fin missing).

(M. Kottelat, pers. comm.). Attempts had been made to collect fresh material from Medan area, but we were not successful.

Remarks. – *Betta fusca* can be differentiated from the other members of the species group in having the following characters: fewer anal fin rays and dorsal fin rays than *B. schalleri* (24-25, vs. 27; and 8-9, vs. 10-11); fewer anal fin rays than *B. pugnax*, *B. pulchra*, *B. breviobesus* and *B. cracens* (mode 24-25, vs. 26-29); fewer dorsal fin rays than *B. pugnax* and *B. prima* (mode 8-9, vs. 10); fewer subdorsal scales than *B. schalleri* ($5\frac{1}{2}$ -6, vs. $6\frac{1}{2}$ -7); fewer subdorsal scales than *B. pulchra* and *B. breviobesus* (mode $5\frac{1}{2}$ -6, vs. 7); fewer lateral scales than *B. schalleri* and *B. cracens* (29, vs. 31-33); more lateral scales than *B. enisae* (29, vs. 26-28); more predorsal scales than *B. pugnax*, *B. schalleri*, *B. pulchra* and *B. breviobesus* (22-23, vs. 17-21); more postdorsal scales than *B. prima* (11, vs. 9-10); fewer vertebrae than *B. prima* (total 29-30, vs. 28); greater predorsal length than *B. schalleri*, *B. pulchra*, *B. breviobesus* and *B. cracens* (68.5-70.2% SL, vs. 60.8-67.5); smaller preanal length than *B. prima* and *B. enisae* (49.0-50.3% SL, vs. 50.1-54.8); greater preanal length than *B. cracens* (49.0-50.3% SL, vs. 42.0-46.1); smaller head length than *B. schalleri*, *B. prima* and *B. enisae* (33.2-33.8% SL, vs. 34.5-37.7) and smaller head length than *B. breviobesus* (47.2-49.4% predorsal length, vs. 51.2-56.1); greater head length than *B. cracens* (33.2-33.8% SL, vs. 30.8-31.7); smaller body depth at dorsal-fin origin than *B. schalleri* and *B. enisae* (30.9-31.7% SL, vs. 26.2-28.9); greater body depth than *B. cracens* (30.9-31.7% SL, vs. 21.2-24.2); greater pelvic fin length than *B. prima* (38.6-39.2% SL, vs. 30.1-37.2); greater dorsal-fin base length than *B. enisae* and *B. cracens* (13.7-13.9% SL, vs. 8.7-12.1); smaller anal-fin base length than *B. schalleri*, *B. prima*, *B. enisae*, *B. breviobesus* and *B. cracens* (47.8-51.4% SL, vs. 50.0-55.7); smaller orbital diameter than *B. pugnax*, *B. prima* and *B. pulchra* (23.8-26.7% HL, vs. 26.0-38.5) and smaller orbital diameter than *B. schalleri*, *B. prima* and *B. enisae* (47-55% postorbital length, vs. 57-76); smaller interorbital width than *B. pulchra* (33.5-34.2% HL, vs. 34.3-41.8) and smaller interorbital width than *B. prima* and *B. enisae* (68-69% postorbital length, vs. 70-84). *Betta fusca* shares with both *B. schalleri* and *B. raja* in not having the following three characters: chin-bar, caudal transverse bars, anal and caudal fin distal dark margins.

The larger specimen (BMNH 1908.17.13:18, 59.7 mm SL) has been chosen as the lectotype although its caudal fin is broken off. This is because the seemingly complete smaller specimen (BMNH 1908.17.13:19, 53.1 mm SL) has damage to the posterior half of its anal fin base, and it is scarred and may lack several anal fin rays.

***Betta raja*, new species †**
(Fig. 4)

Betta pugnax (non Cantor, 1850) - Volz, 1905: 127 (part); 1907: 127 (part); Kubota et al., 1996: 40.
Betta taeniata (non Regan, 1910) - Volz, 1905: 127 (part); 1907: 127 (part).

Material examined. – Holotype - **Jambi** - MZB 9315 (holotype),

56.3 mm SL male; Sungai Ayer Merah, feeder stream to Danau Souak Padang ca. 15 mins. by boat upstream (1°36'45.7"S 103°27'00.0"E), coll. H. H. Tan & S. H. Tan, 21 Nov.1996.

Paratypes - **Jambi** - ZRC 42499 (12 paratypes), 19.8-58.1 mm SL, MZB 9314 (4 paratypes), 32.5-57.5 mm SL; same locality as holotype. — CMK (9 paratypes), ZRC 42501 (10 paratypes), 27.8-57.6 mm SL; Sungai Bakong, tributary to Danau Arang Arang (1°37'31.0"S 103°47'20.6"E), coll. H. H. Tan & H. H. Ng, 25 Jul.1997. — ZRC 42502 (14 paratypes), 47.5-63.8 mm SL; Danau Rasau, opposite Kampung Rantau Panjang, coll. H. H. Tan et al., Jun.1996. **Sumatra Selatan** - ZRC 42500 (20 paratypes), 35.1-63.9 mm SL, ZMA 121.823 (5 paratypes), 36.3-50.7 mm SL, BMNH (5 paratypes), 37.5-50.7 mm SL; Sungai Sentang, ca. 20 mins. walk through rubber plantation and swamp forest after 4.8 km drive in, 12 km from Jambi to Bayung Lencir (216 km to Palembang), near Desa Sukajaya, coll. H. H. Tan, 27 Jul.1997.

Others - **Riau** - ZRC 9074 (1), 46.7 mm SL; Sungai Bengkwan, tributary of Batang Kuantan (Indragiri), 4 hours downstream from Rengat; H. H. Ng et al., 15 June 1995 [JMB9504]. — ZRC 42503, 7 ex., 46.2-55.9 mm SL; [JMBAQMT]. — ZMA 121.824 (1); Taluk; J. P. Kleiweg de Zwaan, 1907. — ZMA 121.686 (22), 29.3-54.2 mm SL; Taluk; J. P. Kleiweg de Zwaan. **Sumatra Barat** - ZMA 121.687 (2), 33.7-41.5 mm SL; Sidjoengjoeng (=Sijunjung); J. P. Kleiweg de Zwaan, 1907. **Jambi** - CMK 11033 (2); Danau Pinang, lake connected to Sungai Pijoan, 1 hour by boat upriver of Pijoan (19 km west of Jambi on road to Bungo); M. Kottelat & H. H. Tan, 28 May.1994. — ZRC 38529 (3), 28.3-45.4 mm SL, CMK 11087 (1); Sungai Bakung, north tributary of Sungai Kembang which joins Danau Arang Arang and Kampung Kumpeh Hulu in Arang Arang; M. Kottelat & H. H. Tan, 29 May.1994. — ZRC 38612 (6), 36.0-63.8 mm SL, CMK 11159 (7); Danau Rasau, a blackwater lake draining to Batang Hari, opposite Kampung Rantau Panjang; M.

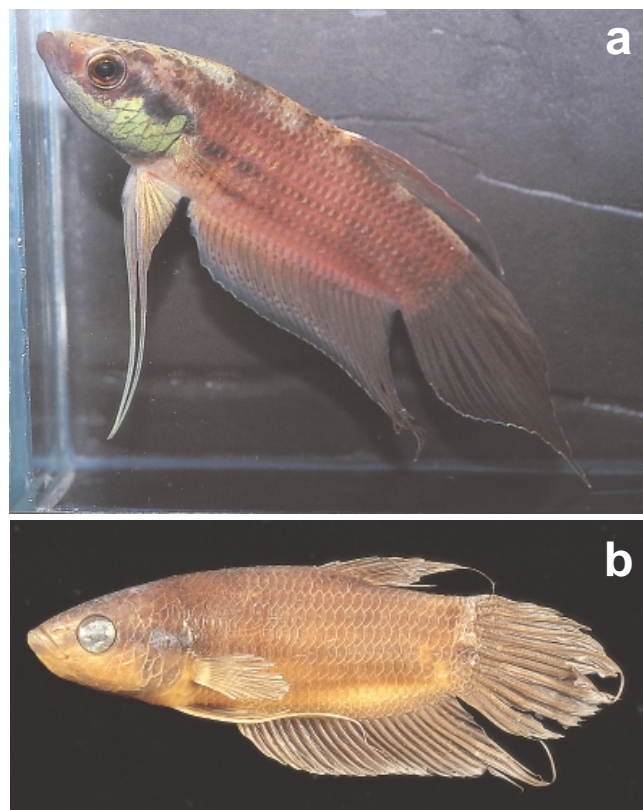


Fig. 4. *Betta raja* - a. not preserved, ca. 50 mm SL, Jambi (Pijoan); b. ZRC 38612, 64.2 mm SL, Jambi (Danau Rasau) (right side, reversed).

Kottelat & H. H. Tan, 1-2 Jun.1994. — ZRC 42504 (16), 54.3-65.6 mm SL; Rantau Panjang, from aquarium trade, coll. H. H. Tan & S. H. Tan, 21 Jul.1993. — ZRC 42505 (16), 50.2-62.8 mm SL; Rantau Panjang, from fish collectors, coll. H. H. Tan et al., Jun.1996. — ZRC 42506 (2), 48.9-50.2 mm SL; Darkie water reserve (1°17'54.8"S 104°08'30.4"E), coll. H. H. Tan et al., 6 Jun.1996. — ZRC 42507 (4), 28.0-48.1 mm SL; second stream on road towards Muara Bulian, after interjunction at crossroads towards Palembang, Muara Bulian and Jambi (1°47'44.4"S 103°25'16.1"E), coll. H. H. Tan et al., 7 Jun.1996. — ZRC 42508 (2), 44.6-46.7 mm SL; Sungai Pijoan (1°35'35.0"S 103°27'07.2"E), coll. H. H. Tan et al., 8 Jun.1996. — ZRC 42509 (17), 30.1-54.2 mm SL; Pijoan, Danau Souak Padang (1°36'34.4"S 103°26'55.1"E), coll. H. H. Tan et al., 8 Jun.1996. — ZRC 42510 (7), 21.3-57.7 mm SL; Leibong Sepbaju, stream in swampforest near Pijoan, coll. H. H. Tan & S. H. Tan, 21 Nov.1996. — ZMA 114.368 (2), 45.6-51.6 mm SL; Jambi; P. H. Moolenburgh, 19 Jul.1909. **Sumatra Selatan** - CMK 11447 (1), 24.6 mm SL; Sumatra Selatan: Sungai Simpang, small tributary entering Sungai Niru from east immediately upriver of Muara Niru; M. Kottelat, 2 Feb.1995 (MK 95-013).

Diagnosis. – *Betta raja* can be differentiated from the other members of the *B. pugnax* group by the following set of characters: mature males with very long pelvic fin (15-23 anal fin rays at pelvic fin end, even exceeding anal-fin base in some specimens); dark margins on anal fin and lower half of caudal fin; anal fin rays 25-28 (mode 26); lateral scales 30-32 (mode 31); head length 33.9-37.4% SL; predorsal length 20.0-24.6% SL; preanal length 46.1-52.4% SL; body length 62.8-70.7% SL.

Description. – The general appearance is illustrated in Figs. 4a, b; meristics and morphometrics of *B. raja* is listed in Table 2. Body relatively stocky (body depth 28.1-33.5% SL), head long and stocky (head length 33.9-37.4% SL; head width 18.5-22.3% SL and 51.8-62.0% HL). Dorsal, caudal and anal fins pointed; dorsal fin placed relatively far back (predorsal length 63.2-69.9% SL); caudal fin with distal part of rays extended slightly beyond interradiation membrane, median rays elongated; anal-fin base length about half of standard length (48.9-54.8% SL); pelvic fin rounded with long filamentous ray (37.4-69.8% SL); pectoral fin rounded.

Live coloration. – See Fig. 4b for general appearance. Dorsum of body brown, ventrum lighter brown to yellow. Dorsum of head brown, male with iridescent green opercle, female with gold opercle. Distinct pre- and postorbital black stripes on head, lower lip black. Male with some body scales on dorsal half with blue, other scales near belly gold, female without gold scales, rest of body scales with faint dark brown posterior edge. Body with faint irregularly spaced 3-5 vertical brown bars. Female and juvenile with more distinct central and second central stripes with caudal peduncle spot. Fins brownish, dorsal fin with dark brown dorsal transverse bars. Both male and female with diffuse blue colour on anal fin distal margin, small blackish irregularly spaced spots may be present on anal fin in some specimens. All fins with thin whitish distal edges, except hyaline pectoral fin. Pelvic fin with bright whitish distal tip.

Preserved coloration. – See Fig. 4a for general appearance. Dorsum of body dark brown, ventrum lighter brown to

whitish. Dorsum of head dark brown, male with distal part of opercle black. Distinct pre- and postorbital dark brown stripes on head, chin-bar absent. Body scales with black posterior edge, more prominent on belly scales. Body with irregularly spaced 3-5 vertical dark brown bars. Male, female and juvenile with distinct central and second central stripes with caudal peduncle spot distinct. Fins brownish to greyish, dorsal fin with dorsal transverse bars, anal fin sometimes with transverse bars, caudal transverse bars absent. Pectoral fin hyaline. Pelvic fin brownish, with whitish filamentous second ray.

Distribution. – *Betta raja* is found in the lowland swamp forests of the Batang Hari basin in Jambi, the northern part of Sumatra Selatan, in the Indragiri basin in Riau and eastern part of Sumatra Barat in Sijunjung.

Field notes. – In Danau Rasau, a blackwater lake draining to Batang Hari, fisherfolk catch them with hook-and-line and use them as bait for catching *Channa*. Syntopic species present: *Osteochilus spilurus*, *Parachela oxygastroides*, *Puntius johorensis*, *Rasbora cephalotaenia* (Cyprinidae), *Mystus bimaculatus*, *Pseudomystus leiocanthus* (Bagridae), *Kryptopterus macrocephalus*, *Silurichthys indragirensis* (Siluridae), *Pseudeutropius brachypterus*, *P. moolenburghae* (Schilbeidae), *Chaca bankanensis* (Chacidae), *Nandus nebulosus* (Nandidae), *Helostoma temminckii* (Helostomatidae), *Belontia hasseltii*, *Betta coccinea*, *Betta renata*, *Luciocephalus pulcher*, *Parosphromenus sumatranus*, *Sphaerichthys osphromenoides*, *Trichogaster leerii* (Osphronemidae), *Channa lucius*, *C. striata* (Channidae). *Betta raja* is a paternal oralbrooder (pers. observ.; Kubota et al., 1996: 40).

Etymology. – From the Malay vernacular Raja, meaning king or prince, also from the Indonesian vernacular for this species - Chupang Raja. A noun in apposition.

Remarks. – *Betta raja* can be differentiated from the other members of the species group by the following characters: mature males with very long pelvic fin (15-23 anal fin rays at pelvic fin end, even exceeding anal-fin base in some specimens); more anal fin rays than *B. fusca* (25-28, vs. 24-25); fewer anal fin rays than *B. schalleri* (mode 26, vs. 27); fewer dorsal fin rays than *B. pugnax*, *B. schalleri* and *B. prima* (mode 9, vs. 10-11); more subdorsal scales than *B. enisae* (6-7, vs. 5-5½); more lateral scales than *B. fusca*, *B. prima* and *B. enisae* (30-32, vs. 26-29); fewer lateral scales than *B. cracens* (mode 31, vs. 33); more predorsal scales than *B. schalleri* (20-22, vs. 17-19); fewer predorsal scales than *B. cracens* (20-22, vs. 23-24); smaller postdorsal length than *B. prima* (20.0-24.6% SL, vs. 24.1-26.3); greater head length than *B. fusca* and *B. cracens* (33.9-37.4% SL, vs. 30.8-33.8; 50.4-55.7% predorsal length, vs. 46.3-49.4); greater body depth at dorsal-fin origin than *B. schalleri*, *B. enisae* and *B. cracens* (28.1-33.5% SL, vs. 21.2-28.9); greater caudal peduncle depth than *B. cracens* (18.3-23.2% SL, vs. 15.1-16.7); greater preanal length than *B. cracens* (42.0-46.1% SL, vs. 46.1-52.4); greater pelvic fin length than *B. prima* (37.4-69.8% SL, vs. 30.1-37.2); greater dorsal-fin base length than

B. enisae (37.4-69.8% SL, vs. 8.7-12.1); slightly smaller head width than *B. fusca* (51.8-62.0% HL, vs. 59.7-69.8); greater snout length than *B. cracens* (26.3-29.8% HL, vs. 24.0-25.8); smaller orbital diameter than *B. pugnax* (24.0-28.7% HL, vs. 27.9-38.5) and *B. schalleri* (46-64% postorbital length, 61-76).

***Betta pugnax* (Cantor)**

Betta pugnax - Volz, 1905: 127 (part); 1907: 127 (part); SH Tan & HH Tan, 1994: 357.

Material examined. – Riau - ZRC 42516 (11). Riau Archipelago - ZMA 121.587 (2); ZRC 31452-57 (6); ZRC 14014-27 (10); ZRC 22294-95 (2); ZRC 38262 (11); ZRC 34831-54 (24); ZRC 38331 (28); ZRC 37536 (8). Jambi - ZRC 42517 (6).

Remarks. – *Betta pugnax* is found in Pulau Batam, Pulau Bintan, Pulau Lingga and Pulau Singkep of the Riau Archipelago and Sumatra. *Betta pugnax* has a wide distribution range and can be found throughout the Malay Peninsula (Tan & Tan, 1996).

Betta cf. pugnax

Material examined. – Nias - ZMA 121.592 (11).

Remarks. – The specimens from Nias (ZMA 121.592) are tentatively identified as *B. pugnax* and have the following characters: dark opercle, dorsal and caudal transverse bars present in male, absent in female; distinct chin-bar in juvenile, faint in adults; total anal fin rays 25-27; total dorsal fin rays 9-10; lateral scales 29-30; predorsal scales 21-22. To ascertain their true identity, fresh specimens would be required.

***Betta schalleri* Kottelat & Ng**

Betta schalleri Kottelat & Ng, 1994: 74, figs. 9-11.

Material examined. – Holotype - Banka - ZRC 35170 (holotype), 44.8 mm SL.

Paratypes - Banka - ZRC 35171-73 (3 paratypes); CMK 9639 (3 paratypes); ZRC 35174-78 (5 paratypes), CMK 9585 (4 paratypes).

Remarks. – *Betta schalleri* is closely allied to both *B. fusca* and *B. raja*. It is restricted to the island of Banka. *Betta schalleri* can be differentiated from the other members from Sumatra in the following characters: more anal fin rays than *B. fusca* (27, vs. 24-25); more dorsal fin rays than *B. cracens* and *B. fusca* (10-11, vs. 8-9); more subdorsal scales than *B. cracens* and *B. fusca* (6¹/₂-7, vs. 5¹/₂-6); more lateral scales than *B. fusca* (31, vs. 29); fewer lateral scales than *B. cracens* (31, vs. 32-33); fewer predorsal scales than *B. cracens*, *B. fusca* and *B. raja* (17-19, vs. 20-24); greater head length than *B. pugnax*, *B. cracens* and *B. fusca* (35.5-36.5% SL, vs. 27.5-35.2); smaller predorsal length than *B. fusca* (62.7-66.3% SL, vs. 68.5-70.2); greater preanal length than *B. cracens* (47.8-50.9% SL, vs. 42.0-46.1); greater body depth than *B. cracens*

(26.7-27.6% SL, vs. 21.2-24.2); greater dorsal fin base length than *B. cracens* (12.4-13.9% SL, vs. 10.5-11.6); smaller anal fin base length than *B. cracens* (50.4-52.0% SL, vs. 53.4-55.7); greater orbital diameter than *B. cracens* and *B. fusca* (61-76% postorbital length, vs. 47-58).

BETTA SPELENDENS SPECIES GROUP

***Betta imbellis* Ladiges**

Betta imbellis - Schaller & Kottelat, 1990: 36; Kottelat et al., 1993: 162; Tan & Ng, 2005: 78 (present volume).

Material examined. – Sumatra Utara - ZRC 40966 (17); CMK 13126 (5).

***Betta splendens* Regan**

Material examined. – Jambi - ZRC 42281 (5); ZRC 42461 (22).

Remarks. – The population of *Betta splendens* found in the highlands of Kerinci is most probably introduced. This population has adapted to the colder waters and did not take well to the warmer temperatures of captivity in the lowlands.

BETTA WASERI SPECIES GROUP

***Betta chloropharynx* Kottelat & Ng**

Betta chloropharynx Kottelat & Ng, 1994: 72, figs. 6-8.

Material examined. – Holotype - Banka - ZRC 35166 (holotype), 58.6 mm SL.

Paratypes – Banka - ZRC 35167 (1 paratype); CMK 9761 (1 paratype).

Remarks. – *Betta chloropharynx* belongs to the *B. waseri* group, as had been discussed by Tan (1998) and Tan & Kottelat (1998a). It is restricted to the island of Banka. *Betta chloropharynx* can be separated from *B. hipposideros* in the following characters: μ-shaped black throat mark (vs. horse-shoe shape black mark); absence of both dorsal and caudal transverse bars (vs. presence); fewer subdorsal scales (mode 5-6, vs. 6¹/₂). *Betta chloropharynx* can be differentiated from *B. renata* in the following characters: μ-shaped black throat mark (vs. kidney-shaped); absence of both dorsal and caudal transverse bars (vs. presence); non-spotted opercle (vs. spotted opercle); opercle with yellow lower margin (vs. black margin); fewer subdorsal scales (mode 5-6, vs. 6¹/₂). *Betta chloropharynx* can be distinguished from *B. spilotogeta* in the following characters: μ-shaped black throat mark (vs. black median spot); non-spotted opercle (vs. spotted opercle); and an opercle with yellow lower margin (vs. black margin).

***Betta hipposideros* Ng & Kottelat**

Betta anabatoides (non Bleeker, 1851) - Weber & de Beaufort, 1922: 357 (part).

Betta hipposideros - Tan & Ng, 2005: 84 (present volume).
Betta waseri (non Krummenacher, 1986) - Kottelat et al., 1993: 163 (part).

Material examined. – **Riau** - ZRC 39630 (2); ZMA 121.683 (3).
Riau Archipelago - ZRC 44058 (14).

Remarks. – *Betta hipposideros* is a stenotopic blackwater species and its range extension had been noted by Tan & Ng (2005). *Betta hipposideros* can be separated from *B. chloropharynx* in the following characters: horseshoe-shaped black throat mark (vs. μ -shaped black throat mark); presence of both dorsal and caudal transverse bars (vs. absence); more subdorsal scales (mode $6\frac{1}{2}$, vs. 5-6). *Betta hipposideros* can be differentiated from *B. renata* in the following characters: horseshoe-shaped black throat mark (vs. kidney-shaped); non-spotted opercle (vs. spotted opercle); opercle with yellow or brown lower margin (vs. black margin); fewer postdorsal scales (mode 12, vs. $9\frac{1}{2}$); more anal fin rays (mode 30, vs. 29); more lateral scales (mode 32, vs. 31). *Betta hipposideros* can be distinguished from *B. spilotogeta* in the following characters: horseshoe-shaped black throat mark (vs. black median spot); non-spotted opercle (vs. spotted opercle); opercle with yellow or brown lower margin (vs. black margin); presence of both dorsal and caudal transverse bars (vs. absence); and more subdorsal scales (mode $6\frac{1}{2}$, vs. $5\frac{1}{2}$).

***Betta renata* Tan †**

Betta anabatooides (non Bleeker, 1851) - Weber & de Beaufort, 1922: 357 (part); Hardenberg, 1931: 125; 1933: 308.
Betta renata Tan, 1998: 282, figs. 1-2.

Material examined. – Holotype - **Jambi** - MZB 9310 (holotype), 70.8 mm SL.

Paratypes - **Jambi** - ZRC 39265 (1 paratype); ZRC 39117 (3 paratypes); ZRC 40285 (7 paratypes); CMK 13024 (3 paratypes); ZRC 40286 (5 paratypes).

Others - **Jambi** - ZRC 40287 (1); ZRC 40288 (1); ZRC 42519 (1); ZMA 121.684 (4). **Sumatra Selatan** - NMBA 2298-2300 (3); NMBA 2303-04 (2); ZMA 121.682 (9).

Remarks. – *Betta renata* is a stenotopic blackwater species and can be differentiated from *B. chloropharynx* in the following characters: kidney-shaped black throat mark (vs. μ -shaped black throat mark); presence of both dorsal and caudal transverse bars (vs. absence); spotted opercle (vs. non-spotted); opercle with black lower margin (vs. yellow margin); more subdorsal scales (mode $6\frac{1}{2}$, vs. 5-6). *Betta renata* can be separated from *B. hipposideros* in the following characters: kidney-shaped black throat mark (vs. horse-shoe shape); spotted opercle (vs. non-spotted); opercle with black lower margin (vs. yellow or brown); more postdorsal scales (mode 12, vs. $9\frac{1}{2}$); fewer anal fin rays (mode 29, vs. 30); fewer lateral scales (mode 31, vs. 32). *Betta renata* can be distinguished from *B. spilotogeta* in the following characters: kidney-shaped black throat mark (vs. black median spot); more subdorsal scales (mode $6\frac{1}{2}$, vs. $5\frac{1}{2}$); more postdorsal scales (mode 12, vs. 10); fewer anal fin rays (mode 29, vs. 30); and fewer lateral scales (mode 31, vs. 32).

Betta cf. renata

Betta anabatooides - Bleeker, 1852a: 89; de Beaufort, 1939: 193.
Betta picta - Bleeker, 1879: 26.

Material examined. – **Biliton** - ZMA 121.695 (46, but only 10 largest specimens were examined), 56.9-76.8 mm SL.

Remarks. – The present series of specimens from Biliton are in poor condition. They are stained dark brown, had been previously dried out, the bodies are twisted and had clamped and rigid fins. They are tentatively identified as *B. renata* based on the following characters: a faint black rounded mark on throat below lower jaw, not joined to black lower jaw; faint spots on opercle; dorsal and caudal transverse bars; 2 rows of 8-12 black spots in the belly region above the anal fin; total anal fin rays 29-31; lateral scales 30-32; and subdorsal scales 6- $6\frac{1}{2}$. Fresh material would be necessary to ascertain their true identity.

***Betta spilotogeta* Ng & Kottelat**

Betta spilotogeta Ng & Kottelat, 1994: 606, fig. 8; SH Tan & HH Tan, 1994: 357.

Betta anabatooides - Weber & de Beaufort, 1922: 357 (part).

Material examined. – Holotype - **Riau Archipelago** - ZRC 35417 (holotype), 69.7 mm SL.

Paratypes - **Riau Archipelago** - ZRC 35418-20 (3 paratypes); CMK 10021 (2 paratypes); ZRC 35421-31 (11 paratypes); MZB (3 paratypes); ZRC 34783 (1 paratype); ZRC 34748 (1 paratype).

Others - **Riau Archipelago** - ZMA 121.586 (1).

Remarks. – *Betta spilotogeta* is restricted to the Pulau Bintan and Pulau Singkep of the Riau Archipelago. It is closely related to *B. renata* (see Tan, 1998). *Betta spilotogeta* can be differentiated from *B. chloropharynx* in the following characters: median black throat spot (vs. two rounded black marks); spotted opercle (vs. non-spotted); opercle with black lower margin (vs. yellow margin). *Betta spilotogeta* can be separated from *B. hipposideros* in the following characters: median black throat spot (vs. horse-shoe shape mark); spotted opercle (vs. non-spotted); opercle with black lower margin (vs. yellow or brown); more postdorsal scales (mode 10, vs. $9\frac{1}{2}$). *Betta spilotogeta* can be distinguished from *B. renata* in the following characters: black median spot (vs. kidney-shaped mark); absence of dorsal and caudal transverse bars (vs. presence); fewer subdorsal scales (mode $5\frac{1}{2}$, vs. $6\frac{1}{2}$); fewer postdorsal scales (mode 10, vs. 12); more anal fin rays (mode 30, vs. 29); and more lateral scales (mode 32, vs. 31).

***Luciocephalus pulcher* (Gray) †** (Fig. 5)

Diplopterus pulcher Gray, 1830: Pl. 87; 1831: 8.
Luciocephalus pulcher - Bleeker, 1851: 273; 1852a: 99; 1879: 29; Günther, 1861: 390; Károli, 1881: 172; Steindachner, 1901: 434; Vaillant, 1902: 19; Duncker, 1904: 165; Volz, 1904: 459; 1905:

127; 1907: 127; Weber & de Beaufort, 1912: 541; 1922: 369, fig. 94; Vinciguerra, 1926: 566; Hardenberg, 1935-36: 244; Herre & Myers, 1937: 70; Fowler, 1938: 124; de Beaufort, 1939: 194; Tweedie, 1952: 65; 1953: 48, pl. 9, fig. 1; Klausewitz, 1955: 322; Alfred, 1966: 54; Imaki et al., 1981: 43, fig. 106; Mizuno & Furtado, 1982: 324; Mohsin & Ambak, 1983: 176, fig. 133; Brown & Brown, 1987: 163; Kottelat, 1989: 20; Roberts, 1989: 178; Lim & Ng, 1990: 102; Lim et al., 1990: 50; Kottelat et al., 1992: 11; Ng et al., 1992: 29, fig. 103; Kottelat et al., 1993: 159, pl. 74; Ng et al., 1994: 210; SH Tan & HH Tan, 1994: 357; Kottelat & Lim, 1995: 247; Vidthayanon et al., 1997: 55; Sim, 2002: 71; Vidthayanon, 2002: 115; Tan & Lim, 2004: 111.

Material examined. – Neotype - **PENINSULAR MALAYSIA:** ZRC 42520, neotype, 106.2 mm SL; Johor: Mersing area, stream ca. km 66 to Kluang, km 166 to Batu Pahat, coll. H. H. Tan et al., 9 May.1995 .

Others - **Terengganu** - ZRC 23980-84 (5), 47.2-102.3 mm SL; ZRC 40204 (3), 50.4-56.2 mm SL. **Perak** - ZRC 39919 (4), 35.8-81.3 mm SL. **Selangor** - ZRC 28530-31 (2), 84.8-106.4 mm SL; ZRC 15054 (1), 128.3 mm SL. **Pahang** - ZRC 25117-19 (3), 59.0-67.8 mm SL; ZRC 420 (2), 84.6-94.0 mm SL. **Johor** - ZRC 39996 (1), 80.9 mm SL; ZRC 42521 (1), 84.3 mm SL; ZRC 42522 (1), 73.7 mm SL; ZRC 42523 (1), 85.8 mm SL; ZRC 42524 (6), 23.9-82.1 mm SL. **Singapore:** ZRC 19140 (1), 82.4 mm SL; ZRC 9600-04 (5), 58.7-97.6 mm SL; ZRC 1210 (1), 74.8 mm SL; ZRC 1209 (1), 105.0 mm SL; ZRC 1254 (1), 100.1 mm SL; ZRC 1253 (1), 106.1 mm SL. **SUMATRA: Sumatra Utara** - ZMA 121.701 (2), 43.4-54.4 mm SL. **Riau** - ZRC 39077 (5), 54.8-99.2 mm SL; ZRC 42531 (1), 31.4 mm SL; ZRC 39048 (1), 66.6 mm SL. **Riau Archipelago** - ZRC 37534 (1), 122.9 mm SL; ZRC 37552 (7), 12.0-118.4 mm SL; ZRC 42532 (5), 47.5-80.0 mm SL; ZRC 42533 (1), 80.5 mm SL; ZRC 42534 (6), 39.3-95.4 mm SL; ZRC 42535 (1), 103.8 mm SL; ZRC 42536 (4), 77.8-93.9 mm SL; ZRC 42537 (1), 99.2 mm SL; ZRC 38272 (2), 12.1-44.3 mm SL. **Jambi** - SMF 3364 (12), 42-114 mm TL; SMF 3605 (33), 61-124 mm TL; ZMA 121.700 (5), 47.0-106.0 mm SL; ZRC 37534 (4), 39.2-130.7 mm SL; ZRC 38541 (3), 21.6-69.4 mm SL; ZRC 42525 (10), 40.3-67.3 mm SL;

ZRC 42526 (8), 9.2-86.9 mm SL; ZRC 42527 (1), 85.6 mm SL; ZRC 42528 (2), 109.4-138.1 mm SL; ZRC 42529 (8), 49.2-90.0 mm SL. **Sumatra Selatan** - ZRC 42530 (1), 44.0 mm SL. **Banka** - ZRC 31006-08 (3), 40.6-58.5 mm SL. **Biliton** - ZRC 46302 (1), 33.6 mm SL. **BORNEO: Sarawak:** ZRC 37968 (1), 134.2 mm SL; ZRC 37924 (2), 88.3-103.9 mm SL; ZRC 37956 (3), 58.4-110.5 mm SL; ZRC 39505 (3), 17.5-96.7 mm SL; ZRC 39501 (1), 69.7 mm SL; ZRC 42538 (6), 68.3-126.3 mm SL; ZRC 422 (1), 141.9 mm SL. **Brunei:** ZRC 31818-19 (2), 35.5-44.6 mm SL; ZRC 42539 (5), 19.6-76.9 mm SL; ZRC 42540 (2), 15.4-123.7 mm SL.

Diagnosis. – *Luciocephalus pulcher* differs from *L. aura* in lacking numerous iridescent green spots on central stripe when live (vs. presence); presence of black irregular pattern on area below preorbital to central stripe (vs. absence); area just above anal-fin base with 3-4 dark brown blotches, which appear circular when body is viewed ventrally (vs. absence of such markings); yellowish caudal fin with 3-5 broad vertical black bars (vs. brownish caudal fin with 3-7 narrow iridescent vertical gold bars); presence of markings on anal and pelvic (vs. absence); smaller caudal-fin length (total length 120.0-125.6% SL, vs. 123.7-127.1); smaller postdorsal length (10.4-12.4% SL, vs. 12.0-13.2); greater head length (44.1-48.6% SL, vs. 43.3-45.9); smaller caudal peduncle depth (8.9-10.6% SL, vs. 10.7-11.2); and relatively shorter anal-fin base length (19.3-23.4% SL, vs. 23.6-24.5).

Description. – General body form as in Figs. 5a, b; meristics and morphometrics listed in Table 3. Head long and slender, almost half of standard length (head length 44.1-48.6% SL, head width 9.5-13.4% SL); elongated snout with long protrusible jaws (snout length 18.8-21.9% SL and 41.6-45.1% HL, upper jaw length 35.8-39.5% HL, lower jaw length 45.7-52.2% HL); body slender (body depth 13.6-17.6% SL); dorsal fin oval-shaped, situated posteriorly, near caudal fin (predorsal length 77.5-81.4% SL), dorsal-fin base about half of anal-fin base (40-50% anal-fin base length); caudal-fin asymmetrically pointed; a deep notch on anal fin at proximal 6-8th anal ray, notch at about one third of anal-fin base (29.1-43.8% anal-fin base length); pelvic fin with filamentous first ray, with extension about twice or more as long as other pelvic rays; pectoral fin rounded.

Live coloration. – Body pattern consists of a dark brown dorsum, whitish ventrum; preorbital and postorbital broad dark brown stripe joining with broad central dark brown stripe, having 6-17 black spots on either dorsal or ventral borders of central stripe, area just above central stripe golden; opercle area below preorbital and postorbital stripes with interrupted black stripe; pectoral fin hyaline, area just below pectoral fin with black stripe which may be interrupted; pelvic fin with 2-4 proximal black marks, rest hyaline; anal fin with very faint to distinct black marks near base, rest hyaline, area just above anal-fin base with 3-4 dark brown semi-circular blotches, which appear circular when body is viewed ventrally; dorsal fin with anterior 3-4 rays proximally pigmented dark brown, rest hyaline; caudal fin yellowish with 3-5 broad vertical black bars, either in a regular or irregular pattern.

Preserved coloration. – Preserved coloration illustrated in

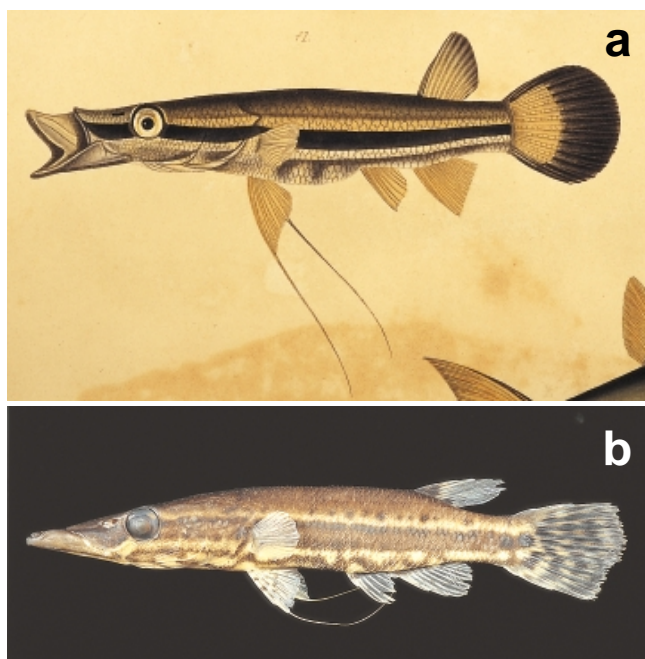


Fig. 5. a. *Diplopterus pulcher* – reproduction of Gray, 1830: pl. 87; b. *Luciocephalus pulcher* - ZRC 42520 (neotype), 106.2 mm SL, Malaysia: Johor.

Table 3. Meristics and morphometrics of *Luciocephalus pulcher* and *L. aura*.

	<i>Luciocephalus pulcher</i>	<i>Luciocephalus aura</i>
sample size, n	23	6
MERISTICS		
vertebrae	18-19 + 20-22 (total 38-40, 39) (n = 28)	17-19 + 20-22 (total 38-40, 39) (n = 13)
dorsal-fin ray	10-12 (11)	11-12 (11)
anal-fin ray	0-I, 19-21 (total 19-21, 19)	0, 18-21 (total 18-21, 20)
pelvic-fin ray	I, 5	I, 5
pectoral-fin ray	16-18 (17)	16-17 (17)
subdorsal scales	7 ¹ / ₂ -8 (8 ¹ / ₂)	8 ¹ / ₂
transverse scales	14 ¹ / ₂ -16 ¹ / ₂ (15 ¹ / ₂)	15 ¹ / ₂
lateral scales	42-45 (43)	43
predorsal scales	60-65 (61)	60-63 (60)
postdorsal scales	11-14 (13)	11-12 (12)
caudal peduncle scales	9 ¹ / ₂ -12 (11)	10-11 (11)
lateral scales below dorsal-fin origin	25-27 (26)	25-28 (26)
lateral scales above anal-fin origin	15-17 (15)	15-16 (15)
MORPHOMETRICS - % SL		
total length	120.0-125.6	123.7-127.1
body length	50.8-56.8	54.9-56.9
predorsal length	77.5-81.4	77.1-79.1
postdorsal length	10.4-12.4	12.0-13.2
preanal length	62.9-68.2	62.5-63.8
caudal peduncle length	11.1-15.2	11.4-14.0
head length	44.1-48.6	43.3-45.9
body depth	13.6-17.6	15.4-17.7
caudal peduncle depth	8.9-10.6	10.5-11.2
anal-fin base length	19.3-23.4	23.3-24.9
dorsal-fin base length	8.3-10.4	10.1-11.0
distance between pelvic- and anal-fin origins	18.1-22.0	18.1-20.3
pelvic-fin length	38.7-48.2	39.9-46.9
head width	9.5-13.4	9.8-10.7
snout length	18.8-21.9	18.7-20.2
% HL		
orbit diameter	13.7-17.0	13.3-14.1
postorbital length	38.2-43.2	40.0-42.9
head width	21.5-28.9	22.3-24.7
interorbital width	16.4-19.6	15.8-18.6
snout length	41.6-45.1	42.6-45.3
upper jaw length	35.8-39.5	34.9-38.2

Fig. 5b. Body with dark brown dorsum; whitish ventrum covered faintly or strongly with dark brown irregular pattern, often with 3-4 distinct dark brown semi-circular blotches just above anal-fin base, which appear as circular markings when body is viewed ventrally; broad dark brown preorbital and postorbital stripe joining with central stripe, ending at caudal peduncle with a black largish spot; middle of central stripe strongly pigmented or faint with dorsal and ventral borders covered with 6-17 black spots; area just above central stripe cream with 0-10 black spots on dorsal edge; area beneath preorbital to central stripe covered with faint or strong dark brown to black irregular markings; lower jaw whitish with black edge; pectoral fin hyaline; pelvic fin with 2-4 proximal black marks, rest hyaline; anal fin with very faint to distinct black marks near base, rest hyaline; dorsal fin with anterior 3-4 rays proximally pigmented black, rest hyaline; caudal fin whitish with 3-5 vertical black bars, either in a regular or irregular pattern.

Distribution. – *Luciocephalus pulcher* is known from Narathiwat province (Peninsular Thailand); Terengganu, Perak, Selangor, Pahang, Johor (Peninsular Malaysia); Pulau Bintan, Pulau Batam, Pulau Lingga, Riau, Jambi, Palembang, Banka, Biliton (Sumatra); Brunei Darussalam; north, central and south Sarawak; Kalimantan Barat; Kalimantan Tengah; and the island of Natuna Besar.

Field notes on biology. – *Luciocephalus pulcher* is found only in freshwater swamp forest and peat swamp habitats. It is usually found among submerged vegetation along the banks. It is an ambush predator, suddenly extending its funnel-like mouth and engulfing its prey. The use of suction to ingest prey is negligible (Lauder & Liem, 1981). It is a paternal oralbrooder, up to 90 eggs (3-4 mm diameter) have been found in the gular pouch (Kottelat et al., 1993: 159). Details on its spawning as documented by Britz (1994b).

Remarks. – Further to the characters mentioned in the diagnosis, *L. pulcher* can be differentiated from *L. aura* in having slightly greater preanal length (62.9-68.2% SL, vs. 62.5-63.8); slightly smaller postdorsal length (18.6-23.4% body length, vs. 21.0-24.1); slightly greater caudal peduncle length (21.9-28.6% body length, vs. 20.0-24.7); smaller anal-fin base length (35.4-42.3% body length, vs. 41.2-44.4); and greater orbital diameter (13.7-17.0% HL, vs. 13.3-14.1). As the populations of *L. pulcher* are many and widespread, there is a fair amount of variation in morphometrics to be expected from *L. pulcher*.

The name *Diplopterus pulcher* was first used by Gray in the caption of a plate (1830: pl. 87; Fig. 5a) and was later described briefly by Gray (1831: 8) based on specimen(s) collected by Hardwicke from the British territory of India (which included Peninsular Malaysia, which is near the northernmost known limit of the distribution of *L. pulcher*). No types were designated, but a colour plate was published (Gray, 1830: Pl. 87). Bleeker (1851) replaced the name *Diplopterus* with *Luciocephalus*, as *Diplopterus* was preoccupied by Boie (Aves). Eschmeyer (1998) wrote that no types were designated, although there is one specimen (NMV 46359) from Bleeker's collection in the National Museum of Victoria. Attempts at finding the types or locality of Gray's specimen(s) have all failed (W. N. Eschmeyer, D. Catania, M. Kottelat, A. Wheeler, and R. Pethiyagoda, pers. comm.). The specimen or specimens on which Gray (1830) based his figure is thus almost certainly no longer extant. As Gray's material came from many areas, it is not possible to ascertain the precise locality from which the specimen in the drawing is based (see Dawson (1946) for a history behind Gray and Hardwicke's illustrations). This uncertainty has not been a problem as it has long been accepted that *Luciocephalus* is a monospecific genus. There has also never been any doubt as to the identity of the fish depicted by Gray, although the plate actually does not depict the taxon accurately as it shows an individual with two separate anal fins, instead of an anal fin with a deep notch. This can easily be explained as an error on the part of the artist or perhaps the original specimen was damaged. The specimen depicted on Gray's figure (1830: Pl. 87) has a very uniform body coloration and patterning, and while this does not really match what is now known as *L. pulcher*, it has been assumed that this was merely variation or artistic inaccuracy. The present discovery of a second species of *Luciocephalus*, however, opens up a whole new set of problems. It is quite possible that Gray's figure was actually based on a specimen from Sumatra, and that it may even have been based on what is here named *L. aura*. This is especially confusing considering the uniform body patterning which is superficially closer to *L. aura* than *L. pulcher*. However, in view of the fact that *L. pulcher* is the type species of *Luciocephalus* Bleeker, 1851, and that the current understanding of the name refers to the more widespread species that occurs in Borneo, Malaysia and Sumatra, there is a clear need to designate a neotype for *L. pulcher* (Gray, 1830) that maintains this usage. This will ensure there is nomenclatural stability, especially with the present discovery of a second species which occurs sympatrically with *L. pulcher* in Sumatra, and the fact that

future studies may even reveal the existence of additional taxa. To this effect, we hereby designate a neotype for *L. pulcher* (Gray, 1830). The specimen is a recently collected specimen from Peninsular Malaysia and carries the catalogue number ZRC 42520.

From recent collections in Sumatra, a separate and distinct syntopic species was obtained. This taxon is described here as a new species below.

Luciocephalus aura, new species

(Fig. 6)

Material examined. – Holotype - **Jambi** - MZB 9311 (holotype), 82.6 mm SL; Jambi: Pijoan area, coll. H. H. Tan & S. H. Tan, 23 Nov.1996.

Paratypes - **Jambi** - CMK 11054 (2 paratypes), 76.8-80.8 mm SL, ZRC 41714 (1 paratype), 80.5 mm SL; Jambi: Sungai Pijoan, downriver of confluence with stream draining Danau Pinang (ca. half-hour upriver of Pijoan); M. Kottelat & H. H. Tan, 28 May.1994. — CMK 11257 (3 paratypes), 86.8-105.1 mm SL, MZB 9312 (1 paratype), 86.8 mm SL, ZRC 41715 (3 paratypes), 74.2-98.4 mm SL; Jambi: Danau Semangkat, a lake connected to Batang Hari by

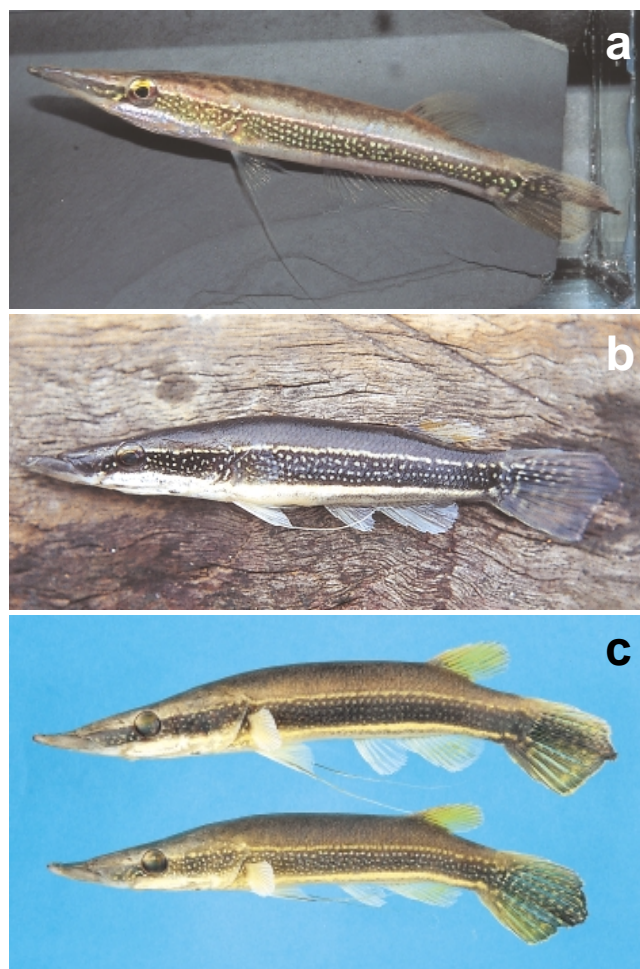


Fig. 6. *Luciocephalus aura* - a. ZRC 46203 (paratype), 81.2 mm SL, Jambi (Pijoan); b. freshly preserved specimen, CMK 11054 (paratype), 80.8 mm SL, Jambi (Pijoan); c. ZRC 47259, 111.4 and 102.2 mm SL, Jambi (Sungai Sentang).

Sungai Bangko opposite Kampung Senaning; M. Kottelat, 6 Jun.1994. — ZRC 41716 (3 paratypes), 78.5-89.4 mm SL; Jambi: Pijoan area, coll. H. H. Tan et al., 7 Jun.1996. — ZRC 46203 (8 paratypes), 72.0-83.2 mm SL; Jambi: Pijoan area; don. Patrick Yap, 16 Mar.2001.

Others - **Jambi** - ZRC 47259, 2 ex., 102.2-111.4 mm SL; Jambi: Sungai Sentang; don. Patrick Yap, Jun.2002.

Diagnosis. – *Luciocephalus aura* differs from *L. pulcher* in having numerous iridescent green spots on central stripe when live (vs. absence); absence of black irregular pattern on area below preorbital to central stripe (vs. presence); area just above anal-fin base without 3-4 dark brown semi-circles, which appear circular when body is viewed ventrally (vs. presence of dark markings); brownish caudal fin with 3-7 narrow iridescent vertical gold bars (vs. yellowish caudal fin with 3-5 broad vertical black bars); absence of markings on anal and pelvic fins (vs. presence); greater caudal-fin length (total length 123.7-127.1% SL, vs. 120.0-125.6); greater postdorsal length (12.0-13.2% SL, vs. 10.4-12.4); smaller head length (43.3-45.9% SL, vs. 44.1-48.6); greater caudal peduncle depth (10.5-11.2% SL, vs. 8.9-10.6); greater dorsal-fin base length (10.1-11.0% SL, vs. 8.3-10.4); and greater anal-fin base length (23.3-24.9% SL, vs. 19.3-23.4).

Description. – General body form as in Figs. 6a-c; meristics and morphometrics listed in Table 3. Head long and slender, almost half of standard length (head length 43.3-45.9% SL, head width 9.8-10.7% SL); elongated snout with long protrusible jaws (snout length 18.7-20.2% SL and 42.6-45.3% HL, upper jaw length 34.9-38.2% HL, lower jaw length 46.1-51.2% HL); body slender (body depth 15.4-17.7% SL); dorsal fin elongate rounded, situated posteriorly, near caudal fin (predorsal length 77.1-79.1% SL), dorsal-fin base less than half of anal-fin base (43-44% anal-fin base length); caudal-fin rounded; a deep notch on anal fin at proximal 6-8th anal ray, about one third of anal-fin base (36.0-45.0% anal-fin base length); pelvic fin with filamentous first ray, with extension about twice or more as long as other pelvic rays; pectoral fin rounded.

Live coloration. – Live and freshly captured coloration illustrated in Figs. 6a, b. Body pattern consists of a dark brown dorsum, whitish ventrum; distinct yellow narrow stripe on dorsal of body when viewed dorsally; preorbital and postorbital dark brown broad stripe joining with central dark brown broad stripe, having numerous iridescent green spots, area just above central stripe iridescent gold; opercle area below preorbital and postorbital stripes without markings; pectoral fin hyaline, area just below pectoral fin without markings; pelvic fin with filamentous ray brownish, rest hyaline; anal fin hyaline; dorsal fin with anterior 3-4 rays proximally pigmented brown, rest hyaline; caudal fin brownish with 3-7 narrow iridescent vertical gold bars, in a regular pattern.

Preserved coloration. – Preserved coloration illustrated in Fig. 6c. Body with brown dorsum, yellow narrow stripe on dorsal of body when viewed dorsally lost due to preservation; whitish ventrum with or without very faint brown stripe; broad

dark brown preorbital and postorbital stripe joining with central stripe, ending at caudal peduncle with black spot; middle of central stripe uniformly pigmented, green iridescent spots lost due to preservation; area just above central stripe cream with no pattern; area beneath preorbital to central stripe cream with no pattern; lower jaw brown without black edge; pectoral fin hyaline; pelvic fin with filamentous ray brownish, rest hyaline; anal fin with very faint brown marks near base, rest hyaline; dorsal fin with anterior 3-4 rays proximally pigmented black, rest hyaline; caudal fin blackish with 3-7 narrow vertical cream bars, in a regular pattern.

Distribution. – *Luciocephalus aura* is currently only known from the freshwater swamp forest habitats from the middle reaches of the Batang Hari basin in Jambi, central Sumatra.

Field notes. – *Luciocephalus aura* is found only in freshwater swamp forest habitats. Syntopic species include: *Chela maassi*, *Crossocheilus cobitis*, *Epalzeorhynchus kalopteris*, *Osteochilus microcephalus*, *O. spilurus*, *Pectenocypris* aff. *korthausae*, *Puntius gemellus*, *P. tetrazona*, *P. lineatus*, *Rasbora brittani*, *R. dorsiocellata*, *R. dusonensis*, *R. gracilis*, *R. pauciperforata*, *R. subtilis*, *Thynnichthys thynnoides* (Cyprinidae), *Nemacheilus selangoricus* (Balitoridae), *Pangio semicinctus* (Cobitidae), *Chaca bankanensis* (Chacidae), *Doryichthys deokhatoides* (Syngnathidae), *Gymnochanda* sp. (Ambassidae), *Pristolepis grooti* (Pristolepididae), *Betta falx*, *B. raja*, *Parosphromenus sumatranus*, *Luciocephalus pulcher*, *Sphaerichthys osphromenoides*, *Trichogaster trichopterus*, *Trichopsis vittata* (Osphronemidae), *Channa micropeltes* (Channidae). Recently, *L. aura* has become available in limited numbers in the aquarium fish trade (pers. observ.).

Etymology. – From the Latin *aura*, meaning glow, alluding to the glowing iridescence of the green spots on its body. A noun in apposition.

Remarks. – *Luciocephalus aura* can be differentiated from *L. pulcher* in having slightly smaller preanal length (62.5-63.8% SL, vs. 62.9-68.2); slightly greater postdorsal length (21.0-24.1% body length, vs. 18.6-23.4); slightly smaller caudal peduncle length (20.0-24.7% body length, vs. 21.9-28.6); greater anal-fin base length (41.2-44.4% body length, vs. 35.4-42.3); and smaller orbital diameter (13.3-14.1% HL, vs. 13.7-17.0).

Luciocephalus aura is found syntopically with *L. pulcher* in Jambi. There may be habitat differentiation for the two species in Jambi, with *L. pulcher* seeming to prefer more stagnant parts, whereas *L. aura* inhabits the more fast flowing sections (M. Kottelat, pers. comm.). Riehl & Kokoscha (1993) discussed the egg surface of a similar taxon from Kalimantan Tengah, but without examining their specimens, we cannot be sure if they are conspecific with the taxon from Sumatra.

Osphronemus goramy La Cepède *†

Osphronemus olfax - Günther, 1861: 382; Bleeker, 1879: 17; Vinciguerra, 1879: 385; Volz, 1905: 126; 1907: 126; Weber & de Beaufort, 1912: 540.

Osphronemus gourami - Regan, 1910: 774.
Osphronemus goramy - Weber & de Beaufort, 1922: 344; Roberts, 1992: 352.

Material examined. – Sumatra Utara - ZRC 42462 (2). Jambi - ZMA 120.496 (5); ZRC 42364 (1); ZRC 43174 (1).

Remarks. – Roberts (1992) revised *Osphronemus* and described two other species, with Sumatra having only one recognised species - *O. goramy*. This is a commonly cultivated food fish, with good tasting flesh.

***Parosphromenus bintan* Kottelat & Ng**

Parosphromenus sp. – SH Tan & HH Tan, 1994: 357.
Parosphromenus bintan Kottelat & Ng, 1998: 269, figs. 4-6.

Material examined. – Holotype - Riau Archipelago - Pulau Bintan - MZB (holotype), 23.6 mm SL.

Paratypes - Riau Archipelago - Pulau Bintan - ZRC 41403 (15 paratypes); CMK 11925 (6 paratypes); ZRC 30815-33 (19 paratypes).

Others - Riau Archipelago - Pulau Bintan - ZRC 31377-83 (7); ZRC 30815-33 (19); ZRC 31327-31 (5); ZRC 31162-64 (3); Pulau Lingga - ZRC (1).

Remarks. – *Parosphromenus bintan* was recently described by Kottelat & Ng (1998), and can be found in Pulau Bintan, Pulau Lingga and the island of Banka (pers. observ.). It can be distinguished principally from *P. deissneri* in having a rounded caudal fin and the median caudal rays branched (vs. lanceolate caudal fin in male, and median caudal ray simple in both sexes and filamentous in male); white pelvic fin filament (vs. dark grey to black). *Parosphromenus bintan* can be differentiated from *P. sumatranus* in missing the conspicuous black spot at the posterior extremity of the dorsal-fin base; and a white pelvic fin filament (vs. black) (Kottelat & Ng, 1998).

***Parosphromenus deissneri* (Bleeker)**

Osphronemus deissneri Bleeker, 1859: 376 (type locality: Baturussak, Banka).
Polyacanthus deissneri - Günther, 1861: 381.
Parosphromenus deissneri - Bleeker, 1879: 20; Weber & de Beaufort, 1922: 348; Kottelat et al., 1993: 164 (part); Kottelat & Ng, 1998: 265, figs. 1-3.

Material examined. – Neotype - Banka - ZRC 31377, neotype, 20.2 mm SL.

Others - RMNH 6363 (1); ZRC 31017-28 (12); CMK 9613 (12); ZRC 31378-83 (6); CMK 9651 (6). Biliton - ZRC 46184 (2).

Remarks. – *Parosphromenus deissneri* is found in the island of Banka, but recently also found in Biliton. Males have filamentous extension to the median caudal ray. All previous records of this taxon from Malay Peninsula and Borneo refer to other taxa. The holotype (RMNH 6363) is in very poor condition, with missing caudal fin, translucent body and loss

of body pattern. Ng & Kottelat (1998) had applied to the Commission to designate a neotype and had been successful (ICZN, 2000). The neotype (ZRC 31377) is a freshly collected male specimen from the island of Banka.

Parosphromenus deissneri can be differentiated from *P. bintan* in having a lanceolate caudal fin in male and the median caudal rays simple in both sexes, filamentous in male (vs. rounded caudal fin in male, and median caudal ray branched); and a dark grey to black pelvic fin filament (vs. white). *Parosphromenus deissneri* is distinguished from *P. sumatranus* in missing the conspicuous black spot at the posterior extremity of the dorsal-fin base.

***Parosphromenus sumatranus* Klausewitz †**
 (Fig. 7)

Parosphromenus deissneri - Regan, 1910: 775 (part); Kottelat et al., 1993: 164 (part).
Parosphromenus deissneri sumatranus - Klausewitz, 1955: 320.

Material examined. – Holotype - Jambi - SMF 3566 (holotype), 21.5 mm SL.

Paratypes – Jambi - SMF 3711 (4 paratypes).

Others - Jambi - ZRC 46208 (7); ZRC 42406 (50). Sumatra Selatan - ZRC 43250 (6).

Remarks. – *Parosphromenus sumatranus* has been exported for the aquarium trade identified as *P. deissneri* (T. Sim, pers. comm.). It can be differentiated from *P. bintan* and *P. deissneri* in having the conspicuous black spot at the posterior extremity of the dorsal-fin base (vs. absence). *Parosphromenus sumatranus* has black pelvic fin filament (vs. white of *P. bintan*) (Kottelat & Ng, 1998).

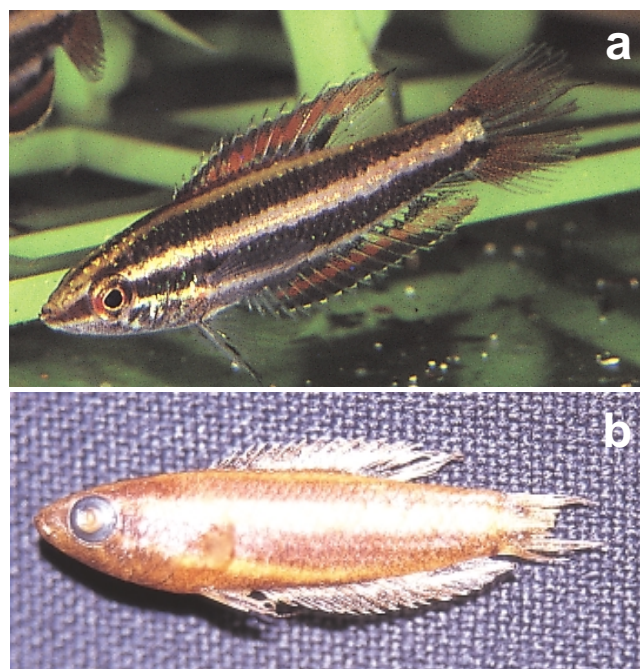


Fig. 7. *Parosphromenus sumatranus* - a. not preserved male, ca. 20 mm SL, Jambi (Pijoan); b. SMF 3711 (paratype), 22.8 mm SL, Jambi.

***Sphaerichthys osphromenoides* Canestrini †**

Osphromenus malayanus - Weber & de Beaufort, 1912: 540.
Sphaerichthys osphromenoides - Weber & de Beaufort, 1922: 349;
 Hardenberg, 1931: 125; 1933: 308; de Beaufort, 1939: 193;
 Klausewitz, 1955: 322; Roberts, 1989: 176; Kottelat et al., 1993:
 164.

Material examined. – Riau - ZRC 43114 (6); ZRC 39106 (4). **Riau Archipelago** - ZRC 44051 (5). **Jambi** - SMF 3371 (46); SMF 3568 (15); ZRC 43126 (12); ZRC 43048 (3); ZRC 46207 (8); ZRC 46206 (38). **Sumatra Selatan** - ZRC 43249 (13). **Banka** - ZRC 31010 (2); ZRC 31160 (2).

***Sphaerichthys selatanensis* Vierke**

(Fig. 8)

Material examined. – Biliton - ZRC 46183 (3).

Remarks. – The present series represents the first record of a non-*S. osphromenoides* species out of Borneo. It resembles *S. selatanensis* in having 4-5 cream or gold bars on body, however, it differs in having a different body colour (reddish, vs. brown). More material is required before its true identity can be ascertained.

***Trichogaster leerii* (Bleeker) †**

Osphromenus trichopterus - Volz, 1905: 126 (part); 1907: 126 (part).
Osphromenus trichopterus var. *leerii* - Günther, 1861: 384; Weber & de Beaufort, 1912: 540.
Trichopodus leeri - Regan, 1910: 783, pl. 79, Fig. 2; Weber & de Beaufort, 1922: 367.
Trichogaster leerii - Kottelat et al., 1993: 164.

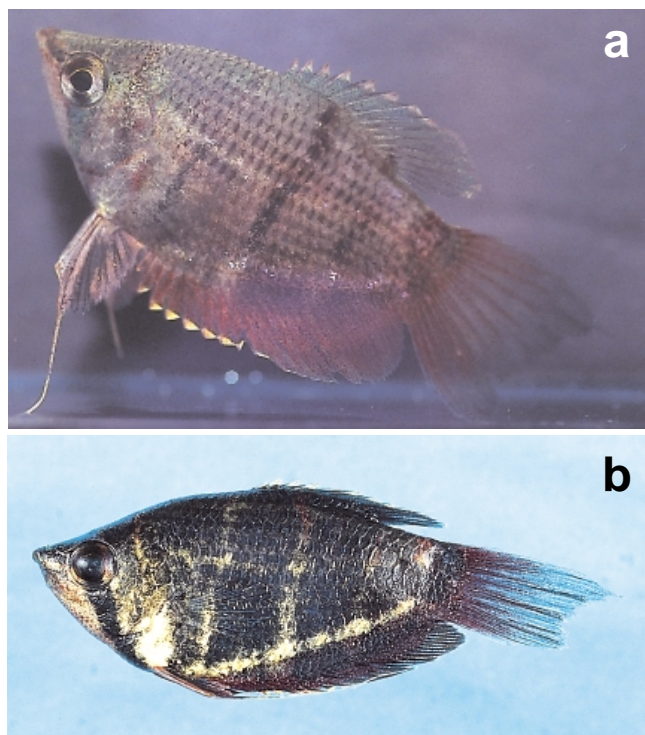


Fig. 8. *Sphaerichthys selatanensis* – a. not preserved; b. ZRC 46183, 32.4 mm SL, Biliton.

Material examined. – Sumatra Utara - ZRC 42488 (3). Riau - ZRC 39050 (6). **Jambi** - ZRC 39163 (2); ZRC 46209 (19). **Sumatra Selatan** - ZRC 43248 (1).

***Trichogaster pectoralis* (Regan) ***

Trichogaster pectoralis - Kottelat et al., 1993: 164.

Material examined. – Sumatra Utara - ZRC 42478 (1). Riau - ZRC 39049 (2). **Jambi** - ZRC 46210 (1); ZRC 42323 (3).

Remarks. – *Trichogaster pectoralis* is most probably introduced for aquaculture purposes.

***Trichogaster trichopterus* Pallas ***

(Fig. 9)

Osphromenus trichopterus - Günther, 1861: 384; Volz, 1905: 126 (part); 1907: 126 (part); Weber & de Beaufort, 1912: 540.
Osphromenus trichopterus - Perugia, 1893: 242.
Trichopodus trichopterus - Bleeker, 1879: 21; Vinciguerra, 1879: 385; Regan, 1910: 783; Weber & de Beaufort, 1922: 366; Fowler & Bean, 1927: 4; de Beaufort, 1939: 194.
Trichogaster trichopterus - Kottelat et al., 1993: 165; SH Tan & HH Tan, 1994: 358.

Material examined. – Sumatra Utara - ZRC 42471 (1). **Riau Archipelago** - ZRC 32600 (15). **Jambi** - ZRC 41739 (1); ZRC 46211 (4); ZRC 43258 (2).

Remarks. – Several captive strains of *T. trichopterus* have been developed. Blue coloured strains are usually reported in the aquarium literature as originating from Sumatra. In the various samples we have obtained across the whole range of the species, we have never seen blue-coloured individuals. The natural coloration of wild populations is as follows (see Fig. 9): greyish body colour, darker at the dorsal, almost white at ventral; head with dark grey dorsal and silverish opercle scales with 2-3 blackish bars, eyes bright red or orange when life; body with up to 20 blackish thin bars, anterior bars complete, posterior 4-5 bars interrupted; a large round black spot just after posterior edge of pectoral fin on median of body, another black spot on middle of caudal fin base; dorsal and caudal fins dark grey with rounded whitish spots; dorsal fin distal margin yellowish; anal fin with anterior part whitish and rest dark grey, broad orange distal margin,



Fig. 9. *Trichogaster trichopterus* - ZRC 43258, 57.8 mm SL, Jambi (Bertam).

posterior of anal fin with a few rounded yellowish spots; pectoral fin hyaline; pelvic fin elongated and exceeds anal fin base length, whitish silver.

***Trichopsis vittata* (Cuvier & Valenciennes) †**

Ctenops vittatus - Bleeker, 1879: 24; Regan, 1910: 776; Weber & de Beaufort, 1922: 351.

Ospromenus vittatus - Weber & de Beaufort, 1912: 540.

Trichopsis vittata - Kottelat et al., 1993: 165.

Material examined. – Sumatra Utara - ZRC 42469 (60). Jambi - ZRC 42584 (27).

Remarks. – This is a common and abundant species, most often found in disturbed habitats (e.g. padi fields, ditches). Specimens from Jambi have an iridescent green body colour.

SUB-ORDER CHANNOIDEI

FAMILY CHANNIDAE

The juvenile coloration pattern of all *Channa* species differ markedly from its adult coloration (see Ng & Lim, 1990). Typically, the juvenile coloration pattern consists of two longitudinal black stripes on body, with alternating yellow to bright red in between for *C. bankanensis*, *C. lucius*, *C. micropeltes* and *C. striata*. For *C. gachua*, the young have brownish transverse bars. For *C. melasoma* and *C. marulioides*, the young is plain with orangish dorsal, with ocellus on posterior part of dorsal fin and upper proximal part of caudal fin respectively. For *C. pleurophthalma*, the young have a reticulated pattern of four to six longitudinal interrupted black stripes on body, with faint black patches on lateral which would later develop into ocelli (Fig. 11b). The juvenile pattern for *C. cyanospilos* is not known, but probably similar to the young of *C. melasoma* due to their close affinity. Ng & Lim (1990) and Courtenay & Williams (2004) provide overviews of Channidae.

***Channa bankanensis* (Bleeker) *†**

Ophiocephalus bankanensis Bleeker, 1852b: 726 (type locality: Tobaali, Banka); 1879: 51; Günther, 1861: 475; Weber & de Beaufort, 1922: 323; de Beaufort, 1939: 192.

Channa bankanensis - Kottelat et al., 1993: 165; SH Tan & HH Tan, 1994: 358.

Material examined. – Riau Archipelago - ZRC 32724 (2). Jambi - ZRC 43125 (4); ZRC 41522 (4). Sumatra Selatan - ZRC 30530-32 (3). Banka - ZRC 30848 (1); ZRC 30934-38 (5).

Remarks. – This is a stenotopic blackwater species. *Channa bankanensis* can be differentiated from *C. lucius*, even at juvenile stage, in having a rounder head vs. pointed; numerous spots on unpaired fins vs. bars and stripes; reddish-brown life coloration vs. brownish-black. For more details on taxonomy and morphological changes during growth, see Ng & Lim (1991) and Lee & Ng (1994) respectively.

***Channa cyanospilos* (Bleeker) ***

Ophiocephalus cyanospilos Bleeker, 1853: 256 (type locality: Telokbetong); Günther, 1861: 474.

Ophiocephalus cyanospilus - Bleeker, 1879: 45; Volz, 1905: 132; 1907: 132.

Ophiocephalus striatus - Weber & de Beaufort, 1922: 317 (part).

Channa cyanospilos - Ng & Lim, 1991: 120; Kottelat et al., 1993: 165.

Material examined. – Aceh - MZB 5611B (1); ZRC 14252 (1). Riau — ZRC 39095 (2). Jambi - ZRC 41693 (5); MZB 9316 (1); CMK 14416 (1).

Remarks. – This species is apparently quite rare, as it is not encountered frequently. A detailed description of this species, comparison with *C. melasoma* and *C. striata* is provided by Ng & Lim (1991). The present series collected from the market shows more variation. The spots on the throat can be elongated and more blotchy. The spots on the lateral side of body is present in some, but absent in others.

***Channa gachua* (Hamilton)**

Ophiocephalus gachua - Volz, 1905: 131; 1907: 131.

Ophiocephalus gachua - Bleeker, 1879: 38; Perugia, 1893: 242; Weber & de Beaufort, 1912: 539; 1915: 270; 1922: 321; de Beaufort, 1939: 192.

Channa gachua - Kottelat et al., 1993: 165; SH Tan & HH Tan, 1994: 358.

Material examined. – Sumatra Utara - CMK 10804 (5); CMK 4514 (2); ZMA 121.681 (1). Riau Archipelago - ZRC 38314 (4). Jambi - CMK 10792 (1); ZRC 42541 (3); ZRC 42542 (7). Sumatra Selatan - NMBE 1020933 (1 - identified as *C. mystax*).

Remarks. – The specimens from Jambi possess numerous tiny black spots on head and body, in contrary to Ng et al. (1999: 60) who had stated that only specimens coming from Indochina had black spots on the body. It appears that there is a species complex and has a wide distribution range from India to Bali (Kottelat et al., 1993; Ng et al., 1999; Kottelat, 2001).

***Channa lucius* (Cuvier & Valenciennes) ***

Ophiocephalus bistratus - Weber & de Beaufort, 1922: 322.

Ophiocephalus lucius - Günther, 1861: 475; Bleeker, 1879: 53; Volz, 1905: 133; 1907: 133; Weber & de Beaufort, 1912: 538; 1922: 326; de Beaufort, 1939: 193.

Ophiocephalus polylepis - Günther, 1861: 475; Bleeker, 1879: 50.

Ophiocephalus spiritalis Fowler, 1904: 530, Pl. 9.

Channa lucius - Kottelat et al., 1993: 165; SH Tan & HH Tan, 1994: 358.

Material examined. – Riau - ZRC 43111 (1). Riau Archipelago - ZRC 37527 (1). Jambi - ZRC 43256 (1). Sumatra Selatan - ZRC 43252 (3). Banka - ZRC 30725 (1).

Remarks. – *Channa lucius* is sometimes confused with *C. bankanensis*, but can be differentiated by its more flattened and pointed head (vs. rounded), bars on fins (vs. spots) and brownish black life colour (vs. reddish brown).

***Channa marulioides* (Bleeker) ***

(Fig. 10)

Channa marulioides - Roberts, 1989: 170; Ng & Lim, 1990: 135.

Channa melanoptera - Roberts, 1989: 170.

Channa melanopterus - Ng & Lim, 1990: 135; Kottelat et al., 1993: 166.

Ophiocephalus marulius - Volz, 1905: 133; 1907: 133.

Ophiocephalus marulioides - Weber & de Beaufort, 1922: 315.

Ophiocephalus melanopterus - Bleeker, 1879: 41; Volz, 1905: 132; 1907: 132; Weber & de Beaufort, 1912: 539; 1922: 315.

Material examined. – Riau - ZRC 39029 (1). Jambi - ZRC 41508 (3).

Remarks. – *Channa marulioides* was described by Bleeker (1851) from Sambas in Kalimantan Barat, based on a 270 mm TL specimen. This species was depicted (Bleeker, 1877-78, Pl. 399, fig. 2) with an ocellus on the upper proximal part of caudal fin. Bleeker (1855) described *Channa melanoptera* based on a 601 mm TL specimen, from River Kapuas, Pontianak in Kalimantan Barat. The specimen was depicted (Bleeker, 1877, Pl. 399, fig. 2) as a yellowish brown fish with striped pattern on dorsal, caudal and anal fins, with a uniformly coloured body. Weber & de Beaufort (1922: 315, fig. 84) depicted *B. melanoptera* as having irregular patches of black on its lateral. We have come across and examined specimens which have regularly spaced black patches of lateral scales with white posterior edges (ZRC 41508). The identity of *C. marulioides* is characterised by the presence of the ocellus on the caudal fin, which is only distinct in young individuals (ca. 50 mm SL). This ocellus later fades off and the lateral black patches of scales becomes prominent. It seems that *C. melanoptera* is either a junior synonym of *C. marulioides* (viz., Lee & Ng, 1994) or it is a species restricted to the Sambas area in Kalimantan Barat. However, from recent collections there, there is no species of *Channa* resembling that of *C. melanoptera* as described by Bleeker (unpublished data). Lee & Ng (1994) had earlier reported *C. melanoptera* from Peninsular Malaysia and had arrived at the earlier conclusion.

The present series obtained from central Sumatra had four or five patches of white edged black scales on posterior three-quarters of body (Fig. 10). The ocellus on the caudal fin is obscured by dark pigmentation. It is not commonly encountered in the market.

***Channa melasoma* (Bleeker, 1851) ***

Ophiocephalus melanosoma - Günther, 1861: 473; Bleeker, 1879:



Fig. 10. *Channa marulioides* - ZRC 41508, ca. 420 mm SL, Jambi.

46; Weber & de Beaufort, 1912: 538; 1922: 319; de Beaufort, 1939: 192.

Channa melasoma - Kottelat et al., 1993: 166; SH Tan & HH Tan, 1994: 358.

Material examined. – Riau - ZRC 39094 (4). Riau Archipelago - ZRC 37489-94 (6); ZRC 14012 (1). Sumatra Selatan - ZRC 43251 (1); NMBE 1020932 (1 – originally identified as *C. mystax*).

Remarks. – This species resembles *C. cyanospilos* but differs in having a more pointed snout in lateral view (vs. blunt) (see Ng & Lim, 1991, for more details).

***Channa micropeltes* (Cuvier & Valenciennes) ***

Ophiocephalus micropeltes - Günther, 1861: 482; Bleeker, 1879: 55; Volz, 1905: 133; 1907: 133; Weber & de Beaufort, 1912: 538; 1922: 328; de Beaufort, 1939: 193.

Channa micropeltes - Roberts, 1989: 170; Kottelat et al., 1993: 166.

Material examined. – Riau - ZRC 39028 (2). Jambi - ZRC 38683 (1).—Sumatra Selatan - ZRC 30528-29 (2); NMBE 1020938 (1 - holotype of *C. studeri*).

***Channa pleurophthalma* (Bleeker) *†**

(Fig. 11)

Channa pleurophthalmus - Roberts, 1989: 170; Kottelat et al., 1993: 166.

Ophiocephalus pleurophthalmus - Günther, 1861: 479; Bleeker, 1879: 48; Volz, 1905: 133; 1907: 133; Weber & de Beaufort, 1922: 324.

Material examined. – Jambi - ZRC 41672 (20). Sumatra Selatan - ZRC 43203 (7); ZRC 43253 (2).

Remarks. – The adult fish has a spectacular colour pattern consisting of a metallic iridescent green base colour, with 3-4 lateral yellow to orange ocelli with black centre on the body



Fig. 11. *Channa pleurophthalma* - a. ZRC 41672, 46.9 mm SL, Jambi (Ayer Hitam); b. aquarium stock, ca. 250 mm SL, Jambi (Ayer Hitam).

and an additional ocellus on both the opercle and caudal fin base, and orange patches on the base of the anal and caudal fins (Fig. 11b). The young fish has a reticulated pattern of 4-6 longitudinal interrupted black stripes on body, with faint black patches on lateral which would later develop into ocelli (Fig. 11a).

Channa striata (Bloch) *

Ophiocephalus striatus - Bleeker, 1879: 42; Volz, 1905: 132; 1907: 132; Weber & de Beaufort, 1912: 538; 1922: 317 (part); Ahl, 1934: 238; Hardenberg, 1933: 308; de Beaufort, 1939: 192.

Ophiocephalus striatus - Fowler & Bean, 1927: 4.

Channa striata - Kottelat et al., 1993: 166; SH Tan & HH Tan, 1994: 358.

Material examined. – Sumatra Utara - ZRC 42470 (25). Riau - ZRC 43112 (2). Riau Archipelago - ZRC 32615-16 (2). Jambi - ZRC 41694 (1). Sumatra Selatan - ZRC 43255 (1). Banka - ZRC 30866 (1).

Remarks. – See Ng & Lim (1991) for a comparison of *C. striata* with *C. cyanospilos* and *C. melasoma*.

GENERAL DISCUSSION

The anabantoids and channoids of central Sumatra (consisting of the Riau, Jambi and West Sumatra Provinces) includes nearly all of the species previously recorded from the whole of Sumatra (30 of 43 species = 70%) or from mainland Sumatra (30 of 34 species = 88%); 21% (9 of 43 species) are found exclusively in the smaller islands surrounding Sumatra.

Anabantoids and channids are a staple source of protein for the local human population. They are found abundantly in lakes, rivers and streams. The presence of the labyrinth and accessory organs enables them to survive out of the water in moist conditions for extended periods of time. This feature facilitates their transport to far-off markets for live sale. Channids have firm and odourless flesh which is much favoured by locals (Ng & Lim, 1990). *Trichogaster trichopterus* and *T. pectoralis* are often salted and dried, commonly sold in the markets as salted fish. *Osphronemus goramy* has a light creamy-textured flesh that is well appreciated and is reflected by its high price in the market. Large species of *Betta* are often collected and used as baits for angling in Sumatra, and for *Chitala lopis* in the middle Kapuas basin (M. Kottelat, pers. comm.).

Certain species of anabantoids and channids possess brightly coloured and unusual head and body patterns, e.g. *Betta coccina*, *Parosphromenus* spp., *Sphaerichthys osphromenoides*, *Trichogaster leerii*, *Channa gachua*, *C. maruloides* and *C. pleurophthalmia*. This has made them popular in the aquarium trade, and some species are even bred commercially (e.g. *Sphaerichthys osphromenoides* and *Trichogaster trichopterus*; see Ng & Tan, 1997).

All species of Osphronemidae exhibit paternal care for the

eggs and to a certain extent, to the fry. The genus *Betta* is well noted for paternal care in oralbrooding and bubble nest building species. There is also sibling brood care, as exhibited by *B. brownorum* (from Sarawak) (Witte & Schmidt, 1992). The genus *Channa* exhibit biparental care for eggs and fry, sometimes causing grievous injury to unsuspecting humans who wade into a school of fry, especially the largest species - *C. micropeltes* (see Ng & Lim, 1990). Some taxa of Channidae even exhibit oral-brooding, e.g. *Channa gachua*. Species of Anabantidae and Helostomatidae are not known to show any brood care.

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