

## Redescription of *Betta picta* (Teleostei: Osphronemidae) and description of *B. falx* sp. n. from central Sumatra

TAN Heok Hui<sup>1</sup> & Maurice KOTTELAT<sup>1, 2</sup>

<sup>1</sup> School of Biological Sciences, National University of Singapore, Kent Ridge, Singapore 119260, Republic of Singapore.

<sup>2</sup> Route de la Baroche 12, Case postale 57, CH-2952 Cornol, Switzerland.

**Redescription of *Betta picta* (Teleostei: Osphronemidae) and description of *B. falx* sp. n. from central Sumatra.** - *Betta picta* is redescribed on the basis of material from Java. *Betta falx* sp. n. is described from Jambi, central Sumatra. The new species differs from *B. picta* by having fewer lateral scales (27 vs. 27-30), a narrower head profile and by lacking median caudal-fin extensions in mature males.

**Key-words:** *Betta* - Osphronemidae - Sumatra - taxonomy - biodiversity.

### INTRODUCTION

*Betta trifasciata* Bleeker, 1850, the type species of the genus *Betta* by monotypy, was described from Ambarawa, Java (BLEEKER 1850). However, Valenciennes (in CUVIER & VALENCIENNES 1846) had earlier described the same fish from Buitenzorg (now Bogor), Java, as *Panchax pictum* and, therefore *B. trifasciata* is a junior subjective synonym of *B. picta*. The type material of *B. picta* is lost and the type(s) of *B. trifasciata* is(are) apparently mixed up with other *Betta* species from several localities (RMNH 6370, 30 ex., 31.8-77.5 mm SL; Indonesia Archipelago; P. Bleeker, bought 1879) and are in a bad condition (pers. obs.). ROBERTS (1993: 72, fig. 39) published a watercolour copy of the original drawing by Kuhl & van Hasselt (labeled as *Panchax pictum*) on which Valenciennes had based his description. A similar looking species, previously identified as *B. picta*, from Jambi, central Sumatra, is here described as a new species. A redescription of *B. picta* is also presented.

The *B. picta* group was first established by WITTE & SCHMIDT (1992) and later emended by TAN & NG (in press). All members of the *B. picta* group share the common features of darkly pigmented anal and caudal distal fin margins, iridescent opercle, and a relatively small adult size (up to 60 mm TL). The *B. picta* group has the unique combination of characters: total anal-fin rays 21-26, dorsal-fin rays 8-10,

subdorsal scales 5-6, lateral scales 27-30, and vertebrae 27-29. The species group currently contains four species: *B. picta*, *B. taeniata* Regan, 1910, *B. simplex* Kottelat, 1994, and *B. falx* sp. n.

## MATERIAL AND METHODS

The species concept used here is the phylogenetic species concept (CRACRAFT 1989; WARREN 1992; see discussion in KOTTELAT 1997). For practical purposes, and especially as used in the present context, the phylogenetic species concept does not differ significantly from the evolutionary species concept; see MAYDEN & WOOD (1995) for a discussion of the hierarchy of species concepts. Species recognition in the genus *Betta* is further discussed in KOTTELAT & NG (1994: 65-67) who also comment on the use of colour marks as diagnostic characters and the limited or lack of use of morphometric characters. Systematic research may take different forms, and different types of publications may fulfill different purposes; our priorities in documenting biodiversity has been discussed in KOTTELAT (1995b, 1997). We call species group (abbreviated group) an assemblage of species sharing a set of diagnostic characters, which may or may not be a monophyletic lineage. In some cases, available data may support the monophyly of a given group, while for other groups such data are (still) missing or have not yet been re-evaluated. Our inability to demonstrate monophyly today does not automatically imply that a given group is not monophyletic, just that we do not know. Meanwhile, the recognition of groups, be they for convenience only, is justified by the necessity of handling subsets of the genus *Betta*, for example for comparing a species with those it seems related with and avoiding trivial and lengthy comparisons with completely and obviously unrelated species.

Methods for counts and measurements and the terminology for elements of the colour pattern follow TAN & NG (in press), modified from WITTE & SCHMIDT (1992). Chin-bar is used to refer to the dark thin stripe running under the preorbital stripe, from the lower margin of the eye forwards and downwards to the throat. The 'second central stripe' is a faint or distinct stripe, continuous or interrupted, usually starting behind pectoral-fin base, situated 1-2 scales ventral to central stripe anteriorly and joining it posteriorly. The dark, narrow, often slightly curved, concentric bars perpendicular to the rays on the interradial membranes of the dorsal and caudal fins are called dorsal (respectively caudal) transverse bars. These descriptive terms follow that of TAN & KOTTELAT (1998). Measurements are point to point on the left side of fish and were obtained with a pair of dial calipers (0.05 mm accuracy).

Specimens examined are deposited in the Muséum d'histoire naturelle, Genève (MHNG); Muzium Zoologicum Bogoriense, Bogor (MZB); Nationaal Natuurhistorisch Museum, Leiden (RMNH); Instituut voor Systematiek en Populatiebiologie, Universiteit van Amsterdam (ZMA); Zoological Reference Collection, National University of Singapore (ZRC); and the collection of the second author in Cornol (CMK).



FIG. 1. *Betta picta*, male, 30.9 mm SL, ZMA 121.675, Java: Cipanas; right side, reversed.  
 FIG. 2. *Betta falx*, holotype, MZB 9308, male, 32.7 mm SL; Sumatra: Jambi: Sungai Alai.  
 FIG. 3. *Betta falx*, male, ca. 25 mm SL; Sumatra: Jambi: Pijoan, not preserved.

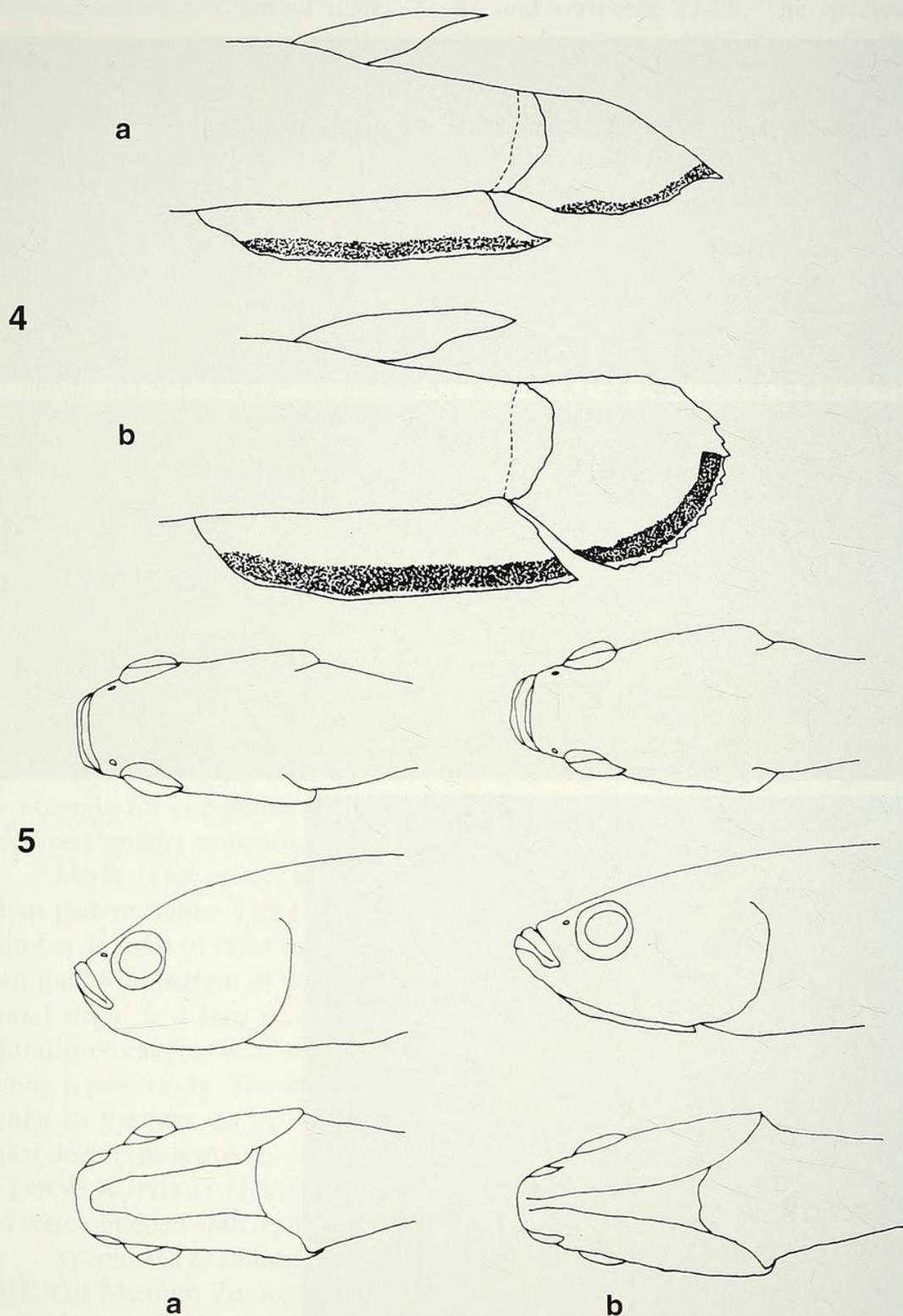


FIG. 4. Schematic drawing of caudal fin and posterior part of anal fin of: a, *Betta picta*, MZB 1325, 32.5 mm SL, male; b, *B. falx*, ZRC 40974, 32.5 mm SL, male.

FIG. 5. Dorsal, lateral and ventral views of head of: a, *Betta picta*, ZMA 121.589, 31.6 mm SL, male; b, *B. falx*, ZRC 40974, 33.3 mm SL, male.

## DESCRIPTIONS

**Betta picta** (Valenciennes, in Cuvier & Valenciennes, 1846)

Figs 1, 4a, 5a

*Panchax pictum* Valenciennes, in Cuvier & Valenciennes, 1846: 385.

*Betta trifasciata* Bleeker, 1850: 12; GÜNTHER 1861: 388; REGAN 1910: 781.

*Betta picta*: BLEEKER 1879: 26 (part); WEBER & de BEAUFORT 1922: 360 (part); WITTE & SCHMIDT 1992: 324 (key); KOTTELAT *et al.* 1993: 163 (part), plate 76; ROBERTS 1993: 38, fig. 39.

MATERIAL EXAMINED. ZMA 102.149, 10 ex., 22.3-31.6 mm SL, ZRC 40973, 2 ex., 29.9-32.0 mm SL; Indonesia: Java, ponds near Trogon (ca. 6°21'S 106°34'E, ca. 30 km northwest of Bogor); M. Weber, 1888. - ZMA 121.691, 52 ex., 13.3-32.8 mm SL; Indonesia: Java, Buitenzorg (Bogor); M. Weber, 1888. - MZB 1325, 37 ex., 13.8-32.2 mm SL, ZRC 42495, 5 ex., 28.0-32.1 mm SL; Indonesia: Java, Bogor, Tjidjeruk, Sawahbera; Sukardi, 24 Aug. 1970. - RMNH 10447, 3 ex., 29.3-32.4 mm SL; Indonesia: Java, Buitenzorg (Bogor); M. Weber. - RMNH 15794, 1 ex., 36.4 mm SL; Indonesia: Java, Buitenzorg (Bogor), Tjiblogoeng; A. Bushkiel, 1935. - ZMA 121.675, 30.9 mm SL, male; ZMA 121.589, 13 ex., 19.5-34.3 mm SL, ZRC 40972, 2 ex., 29.9-31.6 mm SL; Indonesia: Java, Tjipanas (Cipanas: ca. 6°43'S 107°2'E, ca. 30 km southeast of Bogor) near Sindanglaja; M. Weber, 1888. - ZMA 121.694, 38 ex., 14.9-31.2 mm SL; Indonesia: Java, Tjinjioean, after Poentjak Gedeh, ca. 1600m (Gunung Gede: ca. 25 km southeast of Bogor); Kerkhoven, 1921. - MHNG 2090-92, 3 ex., 23.6-30.0 mm SL; Indonesia: Java, Sukabumi (ca. 40 km southeast of Bogor); Walsh, July 1930. - ZMA 121.693, 2 ex., 28.8 mm SL; Indonesia: Java, Bandoeng (Bandung); Huysmans. - ZMA 121.689, 1 ex., 24.5 mm SL; Indonesia: Java, Bandoeng (Bandung), ca. 700m; I. Jacobson, 1934. - RMNH 26940, 4 ex., 31.8-35.3 mm SL; Indonesia: Java, Bezoeki (Besoki) (ca. 7°16'S 109°E, ca. 1050 km southeast of Bogor); J. Semmelink, 1864-65. - RMNH 13698-13699, 2 ex., 32.6-35.2 mm SL; Indonesia: Java, Ambarawa (ca. 7°8'S 110°20'E); J. Sybrandi, 1933. - RMNH 10740, 4 ex., 24.9-34.2 mm SL; Indonesian Archipelago; from P. Bleeker's collections.

DIAGNOSIS. *Betta picta* is distinguished from the other members of the species group in having iridescent yellow-gold opercle scales in male (vs. bluish or greenish), and anal and caudal fins with a narrow bluish distal band in live male (vs. broad band; bluish in *B. taeniata* and *B. simplex*, reddish in *B. falx*). Other characters distinguish *B. picta* are listed under Affinities.

DESCRIPTION. General appearance is shown in Fig. 1; meristics and morphometrics of the *B. picta* group are listed in Table 1. Body relatively slender (body depth 21.5-25.5 % SL), head long (head length 31.1-36.0 % SL). Dorsal and anal fins may be slightly pointed in male, more rounded in female and juvenile; dorsal fin placed relatively far back (predorsal length 63.0-67.6 % SL), anal-fin base length almost half of SL (42.6-48.4 % SL). Caudal fin of male with median rays slightly elongated, caudal fin of female and juvenile rounded. Pelvic fin falcate with second filamentous ray short (23.8-33.0 % SL).

*Coloration*. Life coloration illustrated in LINKE (1990) and KOTTELAT (1994). Body light brown, head and dorsal part of body darker brown. Head with distinct pre- and postorbital stripes, chin-bar and second postorbital stripe present. Body with central and second central stripes present, with faint spot on middle of caudal fin base. Male with iridescent yellow-gold opercle scales. Unpaired fins reddish. Anal fin and lower half of caudal fin with a pale blue subdistal band and broad dark blue distal band; dorsal fin with faint transverse bars. Pectoral fin hyaline, pelvic fin reddish with white filament. Female with whitish opercle scales. Unpaired fins yellowish brown

with very narrow white distal margin on dorsal and anal fins. Anal fin with a narrow subdistal blue band; dorsal and anal fins with faint transverse bars; caudal fin with transverse bars very faint or absent in some specimens only (based on photographs in LINKE 1990).

Preserved specimens light brownish or yellowish. Opercle pattern distinct in both sexes, both preorbital and postorbital stripes distinct, chin-bar and second postorbital stripe also distinct. Body with distinct central and second central stripes, with spot on middle of caudal fin base. Male with dark reddish distal band on anal and caudal fins, female and juvenile without dark margin. Dorsal and anal fins of only female and juvenile with transverse bars.

**DISTRIBUTION.** *Betta picta* is known only from the western two-thirds of Java. The easternmost record in Central Java is Ambarawa (Tuntang basin, draining to the north). All known localities are in basins draining to the north, except Sukabumi, Western Java, which is in the Mandiri basin draining to the south. *Betta picta* apparently inhabits hilly areas where it has been observed in slow-flowing side-waters of hill creeks (see LINKE 1990, for habitat description). It is not clear whether this really is its preferred habitat. It might originally have had a larger distribution range in Java and anthropogenic pressure and habitat modification induced from intensive agriculture might be responsible for its restricted distribution.

**AFFINITIES.** *Betta picta* is distinguished from *B. taeniata* in having iridescent yellow-gold opercle scales in male (vs. bluish-green opercle scales); anal and caudal fins with narrow bluish distal band in live male (vs. broad distal band); reddish caudal fin (vs. brownish); golden iris of eye (vs. dark brown); fewer modal vertebrae (27, vs. 28); fewer anal rays (21-23, mode 22, vs. 23-26, mode 26); fewer modal subdorsal scales (5½, vs. 6); fewer modal lateral scales (28, vs. 29); dorsal-fin origin modally above 13th scale of lateral series (vs. 14-15); more modal predorsal scales (20, vs. 19); smaller body depth (21.5-25.5 % SL, vs. 25.3-30.1); smaller anal-fin base length (42.6-48.4 % SL, vs. 47.9-52.7); slightly greater postorbital length (47.3-53.4 % HL, vs. 45.2-49.2); and slightly smaller interorbital width (26.0-31.1 % HL, vs. 29.2-36.2).

*Betta picta* is distinguished from *B. simplex* in having iridescent yellow-gold opercle scales in male (vs. greenish-blue opercle scales); anal and caudal fins with narrow bluish distal band in live male (vs. broad distal band); fewer transverse scales (9-9½, mode 9, vs. 9½-11½, mode 11½); dorsal fin origin modally above 13th scale of lateral series (vs. 14-15); greater total length (135.4-143.9 % SL, vs. 132.1-137.2); smaller predorsal length (63.0-67.6 % SL, vs. 66.7-69.8); smaller caudal peduncle depth (14.4-17.3 % SL, vs. 17.8-19.3); smaller body depth (21.5-25.5 % SL, vs. 29.3-32.2); and smaller anal-fin base length (42.6-48.4 % SL, vs. 48.3-50.0).

*Betta picta* is distinguished from *B. falx* in having the anal and caudal fins with a narrow bluish distal band in live male (vs. reddish and broad band; Fig. 4); iridescent yellow-gold opercle scales in live male (vs. greenish blue opercle scales); faint dorsal transverse bars in preserved male (vs. distinct); faint or absent caudal transverse bars in female (vs. distinct); head broad, width more or less constant (vs. narrower anteriorly, resulting in a more pointed appearance in dorsal view; compare

Fig. 5a and 5b); narrow preorbital black stripe (vs. thick); more modal dorsal rays (9, vs. 8); fewer modal subdorsal scales ( $5\frac{1}{2}$ , vs. 6); more modal lateral scales (28, vs. 27); dorsal fin origin modally above 13th scale of lateral series (vs. 12); anal fin origin modally below 7th scale of lateral series (vs. 6); more modal predorsal scales (20, vs. 19); slightly greater predorsal length (63.0-67.6 % SL, vs. 60.0-65.7); and slightly greater anal-fin base length (42.6-48.4 % SL, vs. 46.5-50.3).

	<i>B. picta</i>	<i>B. falx</i>	<i>B. taeniata</i>	<i>B. simplex</i>
sample size	12	12	16	4
<b>MERISTICS</b>				
[range (mode)]				
vertebrae	2 + 8 + 17-18 total: 27-28 (27)	2 + 8 + 17-18 total: 27-28	2 + 8 + 17-19 total: 27-29 (28)	2 + 8 + 18 total: 28
anal-fin rays	II, 19-21 total: 21-23 (22)	II, 19-21 total: 21-23 (22)	I-II, 22-24 total: 23-26 (26)	II, 21-22 total: 23-24 (24)
dorsal-fin rays	0-I, 7-9 total: 8-9 (9)	I-II, 7-8 total: 8-10 (8)	0-II, 8-9 total: 8-10 (9)	0-I, 8-9 total: 9
caudal-fin rays	ii, 5 + 6, ii	ii, 5 + 6, i-ii (ii, 5 + 6, ii)	ii, 5 + 6-7, i-ii (ii, 5 + 7, i)	i, 6 + 7, I
pelvic-fin rays	I, 1, 4	I, 1, 4	I, 1, 4	I, 1, 4
pectoral-fin rays	12	12	11-12 (12)	11-12 (12)
subdorsal scales	$5\frac{1}{2}$ - $6\frac{1}{2}$ ( $5\frac{1}{2}$ )	$5\frac{1}{2}$ - $6\frac{1}{2}$ ( $5\frac{1}{2}$ or 6)	5-6 (6)	5
transverse scales	9- $9\frac{1}{2}$ (9)	9- $9\frac{1}{2}$ ( $9\frac{1}{2}$ )	9- $9\frac{1}{2}$ ( $9\frac{1}{2}$ )	$9\frac{1}{2}$ - $11\frac{1}{2}$ ( $11\frac{1}{2}$ )
lateral scales	27-30 (28)	27	$27\frac{1}{2}$ -30 (29)	27-28 (28)
lateral scale below dorsal-fin origin	12-14 (13)	11-12 (12)	12-15 (14)	15
lateral scale above anal-fin origin	6-8 (7)	6-8 (6)	5-7 (7)	-
predorsal scales	19-21 (20)	19-20 (19)	19-21 (19)	20 (20)
postdorsal scales	9-11 (10)	9-11 (10)	9-11 (10)	9-10 (10)
<b>MORPHOMETRICS</b>				
<b>percentage of SL [range]</b>				
total length	135.4-143.9	135.8-142.2	132.9-141.6	132.1-137.2
predorsal length	63.0-67.6	60.0-65.7	62.4-67.7	66.7-69.8
postdorsal length	19.5-25.5	22.7-25.7	19.5-24.8	23.2-25.1
caudal peduncle depth	14.4-17.3	15.8-18.3	14.8-19.7	17.8-19.3
preanal length	48.7-53.6	48.7-52.3	47.2-54.1	51.1-52.7
head length	31.1-36.0	33.1-37.9	30.3-34.5	34.6-37.2
body depth	21.5-25.5	22.6-28.0	25.3-30.1	29.3-32.2
pelvic-fin length	23.8-33.0	24.2-34.3	23.5-37.3	28.1-28.7
anal-fin base length	42.6-48.4	46.5-50.3	47.9-52.7	48.3-50.0
dorsal-fin base length	10.2-13.0	10.5-13.3	10.8-15.1	11.2-11.8
<b>percentage of HL [range]</b>				
orbit diameter	23.4-27.1	24.2-28.1	23.8-30.7	-
postorbital length	47.3-53.4	46.1-53.4	45.2-49.2	-
interorbital width	26.0-31.1	24.7-30.5	29.2-36.2	-

TABLE 1. Meristic and morphometric data of the *Betta picta* species group

REMARKS. *Betta picta* is the only species of the genus naturally occurring on Java. All the preserved specimens we have examined seem to belong to a single species. We cannot exclude, however, that once live specimens from throughout the species' range become available, the status of these populations might have to be revised.

Previous workers have included in *B. picta* numerous populations from Sumatra (BLEEKER 1879; WEBER & DE BEAUFORT 1912, 1922; KOTTELAT *et al.* 1993). These Sumatran populations are described below as *B. falx*.

***Betta falx* sp. n.**

Figs 2, 3, 4b, 5b

*Betta pictum*: WEBER & DE BEAUFORT 1912: 541.

*Betta picta*: BLEEKER 1879: 26 (part); WEBER & DE BEAUFORT 1922: 360 (part); KOTTELAT *et al.* 1993: 163 (part).

HOLOTYPE. MZB 9308, 32.7 mm SL, male; Indonesia: Sumatra: Jambi Prov.: Sungai Alai, km 19.5 on Muara Bungo - Muara Tebo road (bridge at Sungai Alai: 1°28'42.6"S 102°18'31.7"E); H. H. Ng & S. H. Tan, 22 June 1995.

PARATYPES. All from Indonesia: Sumatra: Jambi Prov.: ZRC 40974, 20 ex., 17.2-33.0 mm SL, ZMA 121.673, 6 ex., 21.8-31.0 mm SL, MZB 9307, 4 ex., 17.5-26.3 mm SL, RMNH 33087, 5 ex., 19.7-26.7 mm SL; same data as holotype. --- ZRC 42496, 10 ex., 17.0-34.9 mm SL, MHNG 2593.95, 5 ex., 29.7-30.1 mm SL; same locality as holotype; H. H. Tan & H. H. Ng, 22 Jul 1997. --- ZRC 38571, 44 ex., 13.8-32.4 mm SL, CMK 11119, 44 ex., 10.5-30.8 mm SL; Sungai Alai at km 28 on Muara Bungo - Muara Tebo road, between half hour downriver of bridge to ca. 1 hour upriver, including small tributaries and Danau Gresik; M. Kottelat & H. H. Tan, 30-31 May 1994. --- ZRC 38254, 3 ex., 31.7-36.1 mm SL; Sungai Alai; M. Kottelat & H. H. Tan, May 1994.

OTHER MATERIAL (non type). All from Indonesia: Sumatra: ZMA 121.590, 29 ex., 17.1-27.4 mm SL, ZRC 40975, 2 ex., 25.2-25.6 mm SL; East Sumatra, Deli [Medan]; L. P. de Bussy - Le Cosquino, 1905-1920. --- ZMA 121.692, 5 ex., 23.7-32.0 mm SL; Aceh: Sungai Gloeogoer, beekje by Bohorot, Boven Langkat; L. P. de Bussy, Aug. 1917. --- ZMA 121.688, 2 ex., 32.9-33.8 mm SL; Sumatra Utara: Serdang [Sungai Serdang: 3°42'N 98°52'E]; V. Dedem, 26 July 1909. --- ZRC 38497, 5 ex., 13.1-18.8 mm SL, CMK 11034, 5 ex.; Jambi: Danau Pinang, lake connected to Sungai Pijoan, 1 boat hour upstream of Pijoan (19 km W of Jambi on road to Muara Bungo); M. Kottelat & H. H. Tan, 28 May 1994. --- ZRC 38506, 2 ex., 15.1-22.6 mm SL, CMK 11055, 2 ex.; Jambi: Sungai Pijoan just downriver of confluence with stream draining Danau Pinang; M. Kottelat & H. H. Tan, 28 May 1994. --- ZRC 38590, 11 ex., 15.8-26.5 mm SL, CMK 11136, 10 ex.; Jambi: Danau Kamining near Kampung Transos, ca. km 5 southwards on road branching off road Muara Bungo - Muara Tebo at km 36; M. Kottelat & H. H. Tan, 31 May 1994. --- CMK 11071, 1 ex.; Jambi, Sungai Keruh, ca. 2 km south of mainroad at km 23 on road Jambi - Muara Tembesi, tributary of Sungai Pijoan; M. Kottelat & H. H. Tan, 28 May 1994. --- ZRC 40976, 9 ex., 11.3-31.6 mm SL; Sungai Pijoan, 1°35'35.0"S 103°27'07.2"E; H. H. Tan *et al.*, 8 Jun. 1996. --- ZRC 40977, 2 ex., 24.0-24.1 mm SL; Jambi, Pijoan, Danau Souak Padang, 1°36'34.4"S 103°26'55.1"E; H. H. Tan *et al.*, 8 Jun. 1996.

DIAGNOSIS. *Betta falx* is distinguished from the other members of the *B. picta* group in having anal and caudal fins with reddish distal band in live male (vs. blue), distinct dorsal transverse bars in male (vs. absent in *B. taeniata* and *B. simplex*, faint in *B. picta*) and distinct caudal transverse bars in female (vs. absent in *B. taeniata* and *B. simplex*, faint or absent in *B. picta*). Other characters distinguishing *B. falx* are listed under Affinities.

DESCRIPTION. General appearance as shown in Figs. 2-3; meristics and morphometrics of the *B. picta* group are listed in Table 1. Body relatively slender (body depth 22.6-28.0 % SL), head long (head length 33.1-37.9 % SL). Dorsal and anal fins may be slightly pointed in male, more rounded in female and juvenile; dorsal fin placed relatively far back (predorsal length 60.0-65.7 % SL), anal-fin base length almost half of SL (46.5-50.3 % SL). Caudal fin of male, female and juvenile rounded. Pelvic fin falcate with second filamentous ray short (24.2-34.3 % SL).

*Coloration.* Life coloration illustrated in Fig. 3. Body light brown, head and dorsal part of body darker brown. Opercle pattern distinct in both male and female, both preorbital and postorbital stripes distinct, chin-bar and second postorbital stripe also distinct. Body with distinct central and second central stripes, with spot on middle of caudal fin base. Male with greenish-blue iridescent opercle scales. Unpaired fins yellowish. Anal fin and lower half of caudal fin with pale reddish subdistal band and broad reddish-brown distal band with very thin white margin; dorsal fin with distinct transverse bars. Pectoral fin hyaline, pelvic fin hyaline with white filament. Female with yellowish opercle scales. Unpaired fins yellowish without narrow dark distal band on dorsal and anal fins. Dorsal, anal and caudal fins with distinct transverse bars. Juveniles (less than 20 mm SL) with distinct transverse bars on unpaired fins, distal dark margin on anal fin absent, usually with a rather marmorated pattern on body. Young males (less than 25 mm SL) with caudal transverse bars which disappear in adult males.

Preserved specimens are brownish. Opercle pattern distinct in both male and female, both preorbital and postorbital stripes distinct, chin-bar and second postorbital stripe also distinct. Body with distinct central and second central stripes, black spot on middle of caudal fin base. Male with dark reddish-brown distal margin on anal and caudal fins, female and juvenile without dark distal margin. Male with distinct dorsal transverse bars only; female and juvenile with distinct transverse bars on dorsal, anal and caudal fins.

DISTRIBUTION. *Betta falx* is known from the Langkat area and Medan in Sumatra Utara, and Jambi province in central Sumatra. WEBER & DE BEAUFORT (1912: 541; 1922: 360, 362) recorded *B. picta* from Palembang, Upper Langkat, Muara Kompeh (Jambi province) and Deli (now Medan). From these localities, they had access only to material from Upper Langkat (ZMA 121.692) and Deli (ZMA 121.590), which we have re-identified as *B. falx*. The other records were based on BLEEKER (1879), but the material on which Bleeker based his records has now been mixed with *Betta* material of various species and localities and cannot be sorted (RMNH 6370, 30 ex.).

NOTES ON BIOLOGY. We have observed *B. falx* only in swamp forests in the Batang Hari basin, Jambi province. Specimens are typically found among submerged bank vegetation, in near stagnant waters, with pH 4.7-6.8. Syntopic osphronemids are *Belontia hasseltii*, *Betta* aff. *fusca*, *Luciocephalus pulcher*, *Parosphromenus sumatranus*, *Sphaerichthys osphromenoides*, *Trichogaster leerii*, *T. trichopterus* and *Trichopsis vittata*. *Betta falx* adapts well to captivity, where it readily spawns with fortnightly intervals. It is a paternal oralbrooder (THH, pers. obs.).

ETYMOLOGY. From the Latin *falx*, meaning scythe, alluding to the continuous curved shape of the broad anal and caudal distal margins of a male in display. A noun in apposition.

AFFINITIES. *Betta falx* is distinguished from *B. taeniata* in having iridescent greenish-blue opercle scales in male (vs. strongly coloured bluish-green opercle scales); anal and caudal fins with reddish distal band in live male (vs. blue); reddish fins (vs. brownish); distinct dorsal transverse bars in male and caudal transverse bars in female (vs. absence); fewer anal-fin rays (21-23, vs. 23-26); fewer modal dorsal-fin rays (8, vs. 9); fewer modal lateral scales (27, vs. 29); dorsal fin origin above 11-12th scale of lateral series (vs. 12-15); anal-fin origin modally below 16th scale of lateral series (vs. 7); and smaller interorbital width (24.7-30.5 % HL, vs. 29.2-36.2).

*Betta falx* is distinguished from *B. simplex* in having anal and caudal fins with reddish distal band in live male (vs. blue); distinct dorsal transverse bars in male and caudal transverse bars in female (vs. absence); fewer anal-fin rays (21-23, vs. 23-24); fewer modal dorsal-fin rays (8, vs. 9); more modal subdorsal scales (5 $\frac{1}{2}$ -6, vs. 5); fewer transverse scales (9-9 $\frac{1}{2}$ , mode 9 $\frac{1}{2}$ , vs. 9 $\frac{1}{2}$ -11 $\frac{1}{2}$ , mode 11 $\frac{1}{2}$ ); fewer modal lateral scales (27, vs. 28); dorsal-fin origin above 11-12th scale of lateral series (vs. 15); slightly greater total length (135.8-142.2 % SL, vs. 132.1-137.2); smaller predorsal length (60.0-65.7 % SL, vs. 66.7-69.8); greater postdorsal length (22.7-25.7 % SL, vs. 23.2-25.1); and smaller body depth (22.6-28.0 % SL, vs. 29.3-32.2).

*Betta falx* is distinguished from *B. picta* in anal and caudal fins with broad reddish distal band in live male (vs. narrow and bluish; Fig. 4); iridescent greenish-blue opercle scales (vs. yellow-gold); preserved male with distinct dorsal transverse bars (vs. faint); female with distinct caudal transverse bars (vs. very faint or absent); head narrower anteriorly, resulting in a more pointed appearance in dorsal view (vs. head broad, width more or less constant; compare Figs. 5a and 5b); thick preorbital black stripe (vs. narrow); fewer modal dorsal-fin rays (8 vs. 9); fewer modal lateral scales (27 vs. 28); dorsal fin origin above 11-12th scale of lateral series (vs. 12-14); anal fin origin modally below 6th scale of lateral series (vs. 7); fewer modal predorsal scales (19, vs. 20); and slightly greater anal-fin base length (46.5-50.3 % SL, vs. 42.6-48.4).

REMARKS. The Sumatra species identified by earlier workers (Bleeker, Weber & de Beaufort) as *B. picta* is *B. falx*. WITTE & SCHMIDT (1992: 324) recorded a "*B. (edithae)* sp. B" from Jambi. Our recent collections at numerous localities around Jambi did not yield any species resembling *B. edithae*; *B. falx* is the only species from this area which one might possibly consider as having some similarities with *B. edithae*.

No species of the *B. picta* group is presently known from Lampung, the southernmost province of Sumatra. *Betta falx* might occur there, but *B. picta* could also be present. Some Javanese species also extend over a limited range in southern Sumatra (e.g., *Nemacheilus fasciatus*, see KOTTELAT 1984).

Due to their close morphological similarity, *B. picta* and *B. falx* are apparently closely related, their niche preference, however, is quite marked. *Betta picta* is known

(so far) only from hill stream habitats, whereas *B. falx* is known (so far) only from lowland swamp forest habitats. As mentioned above, the possibility cannot be discounted that *B. picta* occupies a secondary niche (a sort of refuge habitat) in the hill stream as a result from anthropogenic pressures. The quasi totality of the lowland and foothills of Java has lost its natural forest cover and has been converted into rice fields. In Sumatra and Borneo, lowland and foothill streams are the habitats with the most diverse fish communities; KOTTELAT (1995a: 422) noted that about half of the fish species recorded from Java at the beginning of the century have not been collected again in the last 40 years. Beside the possible effect of bias as crude as the lack of sampling effort, these extinction may simply reflect the disparition of forest and foot-hill streams.

#### ACKNOWLEDGEMENTS

We are very grateful to Gunawan 'Thomas' and Verawaty Kasim, for the gift of material and being such good hosts; Peter K. L. Ng, for his advice and constructive discussions; Sonia Muller, Claude Weber (MHNG), Daisy Wowor, Renny Hardiaty (MZB), Martin van Oijen (RMNH), Isaäc Isbrücker (ZMA), Mrs. C. M. Yang and Kelvin K. P. Lim (ZRC), for access to and loan of specimens; Tommy H. T. Tan, S. H. Tan, Darren C. J. Yeo and H. H. Ng, for their help and companionship in the field; S. H. Tan for helping with the radiography of specimens; David M. Armitage for donating phototanks for THH's use. This paper is part of the higher degree for THH whose work has been partially supported by research grants RP 950326 and RP960314 to Peter K. L. Ng from the National University of Singapore. This is contribution 6/97 of the Systematics and Ecology Laboratory, School of Biological Sciences, National University of Singapore.

#### LITERATURE CITED

- BLEEKER, P. 1850. Bijdrage tot de kennis der visschen met doolhofvormige kieuwen van den Soenda-Molukschen Archipel. *Verhandelingen van het Bataviaasch Genootschap van Kunsten en Wetenschappen* 23: 1-15.
- BLEEKER, P. 1879. Mémoire sur les poissons à pharyngiens labyrinthiformes de l'Inde archipélagique. *Natuurkundige Verhandelingen van de Koninklijke Nederlandsche Akademie van Wetenschappen* 9: 1-56.
- CRACRAFT, J. 1989. Speciation and its ontology: the empirical consequences of alternative species concepts for understanding patterns and processes of differentiation, pp. 28-59. In: OTTE, D. & ENDLER, J. A. (eds). *Speciation and its consequences. Sinauer Associates, Sunderland, MA.*
- CUVIER, G. & VALENCIENNES, A. 1846. Histoire naturelle des poissons, tome dix-huitième. *Levrault, Paris*, xix + 505 pp., pls. 520-553.
- GÜNTHER, A. 1861. Catalogue of the Acanthopterygian fishes in the collection of the British Museum, vol. 3. *British Museum, London*, xxv + 586 pp.
- KOTTELAT, M. 1984. Revision of the Indonesian and Malaysian loaches of the subfamily Noemacheilinae. *Japanese Journal of Ichthyology* 31: 225-260.

- KOTTELAT, M. 1994. Diagnoses of the two new species of fighting fishes from Thailand and Cambodia (Teleostei: Belontiidae). *Ichthyological Exploration of Freshwaters* 5: 297-304.
- KOTTELAT, M. 1995a. The fishes of the Mahakam River, East Borneo: an example of the limitations of biogeographic analyses and the need for extensive fish surveys in Indonesia. *Tropical Biodiversity* 2 (3 [1994 (1995)]): 401-426.
- KOTTELAT, M. 1995b. Systematic studies and biodiversity: the need for a pragmatic approach. *Journal of Natural History* 29: 565-569.
- KOTTELAT, M. 1997. European freshwater fishes. An heuristic checklist of the freshwater fishes of Europe (exclusive of former USSR), with an introduction for non-systematists and comments on nomenclature and conservation. *Biologia, Bratislava, Section Zoology* 52 (Suppl. 5): 1-271.
- KOTTELAT, M. & NG, P. K. L. 1994. Diagnoses of five new species of fighting fishes from Banka and Borneo (Teleostei: Belontiidae). *Ichthyological Exploration of Freshwaters* 5: 65-78.
- KOTTELAT, M., WHITTEN, A. J., KARTIKASARI, S. N. & WIRJOATMODJO, S. 1993. Freshwater fishes of Western Indonesia and Sulawesi. *Periplus, Hong Kong*, 259 pp., 84 pls.
- LINKE, H. 1990. Labyrinthfische - Farbe im Aquarium. Ein Handbuch für Bestimmung, Pflege und Zucht. *Tetra, Melle, Germany*, 174 pp.
- MAYDEN, R. L. & WOOD, R. M. 1995. Systematics, species concepts, and the evolutionarily significant unit in biodiversity and conservation biology. *American Fisheries Society Symposium* 17: 58-113.
- REGAN, C. T. 1910. The Asiatic fishes of the family Anabantidae. *Proceedings of the Zoological Society, London*, 1909 [1910]: 767-787, pls. 77-79.
- ROBERTS, T. R. 1993. The freshwater fishes of Java, as observed by Kuhl & van Hasselt in 1820-23. *Zoologische Verhandelingen* 285: 1-94.
- TAN, H. H. & KOTTELAT, M. 1998. Two new species of *Betta* (Teleostei: Osphronemidae) from the Kapuas basin, Kalimantan Barat, Borneo. *Raffles Bulletin of Zoology* 46: 41-51.
- TAN, H. H. & NG, P. K. L. (in press). Revision of the fighting fish of the genus *Betta* (Teleostei: Osphronemidae) from Malaysia, Singapore and Brunei. *Raffles Bulletin of Zoology, Supplement*.
- WARREN, M. L. 1992. Variation of the spotted sunfish, *Lepomis punctatus* complex (Centrarchidae): meristics, morphometrics, pigmentation and species limits. *Bulletin of the Alabama Museum of Natural History* 12: 1-47.
- WEBER, M. & DE BEAUFORT, L. F. 1912. Die Fische, pp. 522-541, pls. 11-12. In: MAASS, A. (ed.). *Durch Zentral-Sumatra, Vol. 2. Behr, Berlin & Leipzig*.
- WEBER, M. & DE BEAUFORT, L. F. 1922. The fishes of the Indo-Australian archipelago, vol. 4. *Brill, Leiden*, xiii + 410 pp.
- WITTE, K.-E. & SCHMIDT, J. 1992. *Betta brownorum*, a new species of anabantoids (Teleostei: Belontiidae) from northwestern Borneo, with a key to the genus. *Ichthyological Exploration of Freshwaters* 2: 305-330.



Tan, Heok Hui and Kottelat, Maurice. 1998. "Redescription of *Betta picta* (Teleostei: Osphronemidae) and description of *B. falx* sp. n. from central Sumatra." *Revue suisse de zoologie* 105, 557–568.

<https://doi.org/10.5962/bhl.part.80050>.

**View This Item Online:** <https://www.biodiversitylibrary.org/item/128635>

**DOI:** <https://doi.org/10.5962/bhl.part.80050>

**Permalink:** <https://www.biodiversitylibrary.org/partpdf/80050>

#### **Holding Institution**

Smithsonian Libraries and Archives

#### **Sponsored by**

Biodiversity Heritage Library

#### **Copyright & Reuse**

Copyright Status: In Copyright. Digitized with the permission of the rights holder

Rights Holder: Muséum d'histoire naturelle - Ville de Genève

License: <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Rights: <https://www.biodiversitylibrary.org/permissions/>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.