THE RAFFLES BULLETIN OF ZOOLOGY 1995 **43**(1): 51-64

FOUR NEW SPECIES OF FISHES FROM THE MIDDLE KAPUAS BASIN, INDONESIAN BORNEO (OSTEICHTHYES: CYPRINIDAE AND BELONTIIDAE)

Maurice Kottelat

ABSTRACT. - Four new species were obtained in the middle Kapuas basin, Borneo, in or near Danau Sentarum Wildlife Reserve. *Osteochilus partilineatus*, new species, reaches a maximum known size of 54 mm SL and is distinguished from its congeners by having 10-11 branched dorsal-fin rays, 27-29 scales along lateral line, 12 circumpeduncular scales and a unique colour pattern of 4 dark longitudinal stripes on a yellowish body. *Parachela cyanea*, new species, reaches a maximum known size of 50 mm SL and is characterized by having 36-38 lateral line scales, 23-26 branched anal-fin rays, a bluish body in life and a dark vertical blotch at caudal-fin base. *Rasbora tuberculata*, new species, is distinguished by the presence of well developed tubercles on the back, the caudal peduncle, the dorsal fin and the upper caudal-fin lobe and by having a black spot at the tip of the dorsal and anal fins. *Betta enisae*, new species, is distinguished by the presence of conspicuous broad subdistal black and blue margins in anal and lower caudal fins and alternating black and blue vertical bars on the caudal fin.

INTRODUCTION

The aim of the present paper is to describe four new species of fishes which have been discovered in September 1993 during an ichthyological survey of Danau Sentarum Wildlife Reserve (DSWR) in the province of Kalimantan Barat, Indonesia. DSWR is located in the basin of the Kapuas, the largest river in Borneo. From the point of view of the fish fauna, the Kapuas is the best known basin in Indonesia; it has attracted the attention of scientists since the end of the 19th century. Kottelat (1991: 274) recorded that 303 species where known from the basin, and the 1993 survey resulted in the discovery of several new species and new records, so that the actual number is about 315 (Kottelat & Widjanarti, in preparation).

DSWR, also known as the Kapuas lakes, is a complex system of shallow lakes connected with the middle Kapuas upriver of Sintang. The lakes are shallow and their area varies dramatically depending of the season. They are filled by the high waters of the Kapuas; at

M. Kottelat - Honorary Research Associate, Department of Zoology, National University of Singapore, Kent Ridge, Singapore 0511. Address for correspondence: Case Postale 57, CH-2952 Cornol, Switzerland.

that time most of the area (mainly forest) is flooded, probably offering shelter, food and spawning ground to a variety of fish species. The water level amplitude is about 12 m. A variety of habitat types are available, including large rivers, forest streams, blackwaters, etc.

MATERIAL AND METHODS

Methods for counts and measurements follow Kottelat (1984) for cyprinids and Witte & Schmidt (1992) for belontids, except that snout length is not calculated but measured point to point from tip of snout to anterior margin of orbit (Kottelat & Ng, 1994). Specimens examined are in Muséum d'Histoire Naturelle, Genève (MHNG), Museum Zoologicum Bogoriense, Bogor (MZB), Nationaal Natuurhistorisch Museum, Leiden (RMNH), Zoologisch Museum, Amsterdam (ZMA) and Zoological Reference Collection, National University of Singapore (ZRC). CMK refers to the author's collection.

The species concept adopted here is the phylogenetic species concept (Cracraft, 1989; Kottelat, in prep.). See Kottelat & Ng (1994: 65-67) for a discussion of problems associated with species differentiation within *Betta* and Kottelat (in press) for a discussion of the need of systematic data for biodiversity research and conservation.

Osteochilus partilineatus, new species
(Fig. 1)

Material examined. - Holotype - MZB 5900, 48.8 mm SL; Indonesia: Borneo: Kalimantan Barat: Kapuas basin: Sungai Tangit near Lubuk Buaya; 0°59'14"N 112°04'31"E; coll. M. Kottelat et al., 8 Sep.1993.

Paratypes - 4 ex. (CMK 10243), 41.9-54.1 mm SL; same data as holotype. - 2 ex. (CMK 10223), 3 ex. (MZB 5901), 2 ex. (ZRC 38690), 38.5-48.7 mm SL; Indonesia: Borneo: Kalimantan Barat: Nanga Semunak (dry season location); 0°56'37"N 112°05'31"E; coll. M. Kottelat et al., 8 Sep.1993.

Diagnosis. - *Osteochilus partilineatus* shares with *O. pentalineatus* Kottelat (1982) the following combination of characters which distinguish them from all other species of the genus: a small size (maximum known size 54.1 mm SL in *O. partilineatus* and 56.4 in *O. pentalineatus*), fewer branched dorsal rays (10-11$^1/_2$), fewer scales along lateral line (27-29 + 1-2 and 29+2), fewer circumpeduncular scales (12), several small tubercles at the tip of the snout and a colour pattern consisting of 4-5 conspicuous black stripes on a reddish brown background. The two species are easily distinguished by details of the colour pattern. While in *O. pentalineatus*, there are five regular, straight stripes, the median one along lateral line and two above and below, the second and fourth stripe ending at caudal fin base, there are only four stripes in *O. partilineatus*, organised into a more irregular pattern: the upper stripe is arched, from the upper extremity of the gill opening to the upper extremity of the caudal base, the second is straight, starting immediately below beginning of upper stripe and ending at middle of caudal base; the third stripe begins at gill opening and ends about below middle of dorsal-fin base; the fourth stripe, quite faint anteriorly, begins above pectoral fin base and ends at lower end of caudal base.

Description. - General appearance is shown in Figure 1 and morphometric data of holotype and four paratypes are given in Table 1. Dorsal fin with 4 simple and 10(3) or 11(9) branched rays, last one being split to the base; dorsal origin above lateral line scale 8 or 9. Pectoral

fin rounded, with 12(1), 13(9) or 14(2) rays. Pelvic fin rounded, with 8(3) or 9(9) rays; axillary scale present. Anal with 3 simple and 5 branched rays, last one being split to the base. Caudal fin with 10+9 principal rays, 9+8 being branched. Caudal peduncle 1.28-1.60 times longer than deep. 27+2(1), 28+2(7), 29+1(1) or 29+2(3) scales along lateral line, 7 predorsal scales, 4 or $^1/_2$4/1/5$^1/_2$scales in transverse line, $^1/_2$2/1/2$^1/_2$ scales in transverse line on caudal peduncle, 3$^1/_2$ scales between lateral line and pelvic origin. Vertebral formula: 18+12=30 (2) and 19+11=30 (3).

Several small tubercles at tip of snout; in largest specimens, tubercles present on all body (except belly) and on all fin rays. Main plicae on lateral portion long unbroken ridges (ectomorph type of Roberts, 1989: 46). Two pair of maxillary barbels, long, anterior one reaching about vertical of anterior margin of eye, posterior one reaching beyond eye. About 20-27 gill rakers on lower arm of first gill arch.

Etymology. - From the Latin *partialis*, incomplete, and *lineatus*, striped (from *linea*, a flax thread). An allusion to the irregular and partly incomplete striped pattern. An adjective.

Coloration. - Preserved specimens: body and head brown, darker on the back, pale yellowish on belly. Body with four black stripes from gill opening to caudal-fin base. Upper stripe arched, from the upper extremity of gill opening to upper extremity of caudal-fin base; second stripe straight, along course of lateral line, starting immediately below beginning of upper stripe and ending at middle of caudal-fin base; third stripe beginning behind gill opening and ending about below middle of dorsal-fin base; fourth stripe beginning at upper pectoral fin base and ending at lower end of caudal-fin base. The second and third stripes are darker and wider than the other two, the second one being the widest. Lower stripe is often very faint anteriorly, sometime even missing, and posteriorly it can be split into a longitudinal row of small spots. All fins hyaline; dorsal fin with a row of black spots on membranes, at about proximal third of ray length; the spots in front of branched rays 2-3 are fainter or absent.

In life, the body is reddish brown, the belly whitish and the stripes deep black.

Fig. 1. *Osteochilus partilineatus*, paratype, CMK 10243, 46.9 mm SL.

Table 1. *Osteochilus partilineatus*, morphometric data of holotype (*, MZB 5900) and four paratypes (CMK 10243).

Standard length [mm]	54.1	50.2	48.8*	46.9	41.9
Percentage of standard length					
Total length	132.9	129.9	132.2	134.3	132.9
Head length	26.8	29.7	28.5	29.2	27.9
Predorsal length	49.7	51.0	50.0	49.3	49.9
Prepelvic length	50.6	51.8	53.1	53.1	52.3
Preanal length	76.2	76.5	74.0	76.3	75.7
Body depth at dorsal origin	27.8	26.9	27.9	29.4	25.5
Depth of caudal peduncle	12.6	12.2	12.3	13.0	11.9
Length of caudal peduncle	17.7	18.1	18.2	16.6	19.1
Body width	17.4	15.5	17.6	17.1	17.6
Length of dorsal fin base	26.2	25.3	24.6	25.6	24.6
Length of anal fin	17.9	19.9	17.8	20.3	17.8
Length of pelvic fin	18.9	18.3	19.5	19.0	19.5
Length of pectoral fin	19.4	18.9	19.3	20.3	19.3
Length of upper caudal lobe	31.2	31.5	30.7	32.0	30.7
Length of median caudal rays	17.2	16.3	17.6	18.8	17.6
Length of lower caudal lobe	30.9	29.9	30.5	30.8	30.5
Percentage of head length					
Head depth	73	66	69	73	72
Snout length	43	38	37	40	37
Eye diameter	23	22	27	23	27
Interorbital width	46	43	42	40	42

Habitat. - *Osteochilus partilineatus* has been obtained by cast-netting in a large and deep black water forest stream with fast water (possibly due to heavy rain the preceding night). It has not been obtained in forest creeks with shallower and quieter water entering the stream immediately upriver. Specimens have also been obtained by sorting catches obtained by fishermen's traps in more open areas but the species is apparently much rarer there or does not enter traps (out of an estimated 10,000-20,000 trapped specimens less than 70 mm SL, we obtained only 7 specimens of *O. partilineatus*). The water was of the blackwater type, generally clear but very dark coloured.

Discussion. - *Osteochilus partilineatus* and *O. pentalineatus* are apparently closely related with *O. spilurus* with which they share the small size, numerous small tubercles on tip of snout, large scales (i.e. low number of lateral line and circumpeduncular scales), short dorsal fin, and preferred habitat (acidic waters of forest streams). *Osteochilus spilurus* is easily distinguished by the absence of stripes and the presence of a conspicuous black spot on the caudal peduncle.

Comparative material. - *Osteochilus pentalineatus*: MHNG 2059.02, 56.4 mm SL; Kalimantan Tengah.

Parachela cyanea, new species
(Fig. 2)

Material examined. - Holotype - MZB 5911, 49.5 mm SL; Indonesia: Borneo: Kalimantan Barat: Kapuas basin: Sungai Tangit at Radai Tangit; 0°57'26"N 112°04'39"E; coll. M. Kottelat et al., 13 Sep.1993.

Paratypes - All from Kalimantan Barat, Indonesia. 40 ex. (MZB 5912), 22 ex. (CMK 10480), 10 ex. (ZRC 38457), 10 ex. (MHNG 2566.62), 10 ex. (ZMA 121.500), 24.1-42.6 mm SL; same data as holotype. - 4 ex. (CMK 10192), 24.7-30.9 mm SL; Danau Pemerak; 0°03'17"N 112°03'06"E; M. Kottelat, 7 Sep.1994. - 20 ex. (MZB 5913), 41 ex. (CMK 10207), juveniles, 13.1-28.7 mm SL; small tributaries of Sungai Tawang immediately upriver of its confluence with Sungai Kenelang; 0°46'33"N 111°59'27"E; coll. M. Kottelat et al., 7 Sep. 1993. - 2 ex. (CMK 10227), 42.1-44.0 mm SL; Nanga Semunak (dry season location); 0°56'37"N 112°05'31"E; coll. M. Kottelat et al., 8 Sep.1993. - 1 ex. (CMK 10238), 38.4 mm SL; Sungai Tangit near Lubuk Buaya; 0°59'14"N 112°04'31"E; coll. M. Kottelat et al., 8 Sep.1994. - 1 ex. (CMK 10317), 28.7 mm SL; Sungai Belitung near Danau Sekawi; coll. M. Kottelat et al., 10 Sep.1993. - 1 ex. (CMK 10475), 34.7 mm SL; Nanga Semunak (dry season location); 0°56'37"N 112°05'31"E; coll. M. Kottelat et al., 13 Sep.1993.

Diagnosis. - The new species is distinguished from the other named species of *Parachela* by the presence of a black blotch at the base of the caudal fin. Further, the combination of the following characters is also unique: 36-38 scales along lateral line (vs. 59-63 in *P. hypophthalmus* (Bleeker, 1860), 38-44 in *P. oxygastroides* (Bleeker, 1852), *P. siamensis* (Günther, 1868) and *P. ingerkongi* (Banarescu, 1969), 40-44 in *P. maculicauda* (Smith, 1934)), 23-26 branched anal rays (vs. 30-34 in *P. ingerkongi*), caudal fin hyaline (vs. with black spot at tip of each lobes in *P. maculicauda).*

Description. - General appearance is shown in Figure 2 and morphometric data of holotype and five paratypes are given in Table 2. Dorsal fin with 2 simple and 7 branched rays, last one being split to the base; dorsal-fin origin above origin of anal fin. Pectoral fin falcate, reaching anal-fin origin, 1 simple and 12-13 branched rays; no axillary scale or axillary lobe. Pelvic fin with 1 simple and 6 branched rays; no axillary scale. Anal with 3 simple and 23-26 branched rays (Table 3), last one being split to the base. Caudal fin with 10+9 principal rays, 9+8 being branched. Caudal peduncle 1.02-1.21 times longer than deep. Scales deciduous, difficult to count with accuracy; dorsal midline in front of dorsal fin naked; 36-38 scales along lateral line, 10-12/1/3$^{1}/_{2}$-4 scales in transverse line between dorsal and pelvic-fin origins. Vertebral formula: 16+19=35 (4), 16+20=36 (7), and 17+19=36 (1).

Etymology. - From the Greek kuanos, meaning dark blue, for the bluish coloration of the live specimens. An adjective.

Coloration. - Preserved specimens: Body and head pale brown, darker on head, nape and dorsal mid-line; scattered pigments on dorsal half of body, especially distinct along lateral line canals where they form a series of paired elongated dots. A faint mid-axial streak. A vertically elongated black blotch at caudal fin base. A black stripe along anal-fin base and ventral margin of caudal peduncle and a second one immediately above and parallel, joining the first one at posterior base of anal fin. Fins hyaline, but pectoral and caudal fins can be blackish in some specimens.

In life, the body is translucent, silvery, with a bluish shine.

Habitat. - *Parachela cyanea* was obtained in streams or lake arms under forest cover, often with blackwaters. It was not caught in the large rivers and lakes with murky water.

Fig. 2. *Parachela cyanea*, paratype, CMK 10227, 44.0 mm SL.

Table 2. *Parachela cyanea*, morphometric data of holotype (*, MZB 5911) and 5 paratypes (MZB 5912, CMK 10480, 10227, 10238).

Standard length	49.5*	44.0	42.6	42.1	41.5	38.4
Percentage of standard length						
Total length	130.5	125.7	-	124.2	131.6	127.6
Head length	27.5	25.0	25.4	25.2	26.0	25.5
Predorsal length	63.2	65.7	62.7	63.4	62.7	63.8
Prepelvic length	53.3	53.4	54.0	54.2	53.5	52.9
Preanal length	65.9	65.9	66.4	64.4	64.6	65.9
Head depth at nape	19.8	21.1	17.6	18.5	20.2	17.7
Body depth at pelvic origin	28.7	29.6	27.7	29.0	25.6	26.8
Depth of caudal peduncle	10.1	10.9	10.3	11.2	10.6	9.9
Length of caudal peduncle	9.7	9.1	9.9	9.3	9.4	9.6
Body width	10.5	9.3	9.4	10.5	9.6	9.4
Length of dorsal-fin base	4.9	5.2	4.7	5.2	5.6	5.0
Length of anal-fin base	29.9	26.8	29.6	29.2	31.1	29.2
Length of pelvic fin	13.1	13.6	12.4	11.4	11.8	12.5
Length of pectoral fin	34.3	34.6	33.8	33.3	34.5	34.1
Length of upper caudal lobe	26.7	25.7	23.9	25.4	24.3	25.3
Length of median caudal rays	13.7	13.2	12.0	11.4	12.5	10.7
Length of lower caudal lobe	30.3	29.3	-	28.0	30.1	28.9
Percentage of head length						
Snout length	26	27	26	28	28	28
Eye diameter	34	40	39	39	35	40
Interorbital width	22	26	25	28	27	28

Table 3. Branched anal ray counts in sympatric *Parachela oxygastroides* and *P. cyanea* from Danau Sentarum Wildlife Reserve.

	23	24	25	26	27	28
P. cyanea	3	4	9	7		
P. oxygastroides		1	1	1	7	2

Discussion. - Using Weber & de Beaufort's (1916) key or data in Kottelat et al. (1993), *P. cyanea* could key out as *P. oxygastroides*. The two species occur sympatrically and can be distinguished immediately by body shape (*P. oxygastroides* has a more elongated appearance), size differences (up to at least 170 mm SL, vs. maximum known size 50 mm in *P. cyanea*), different appearance and colour pattern (usually a conspicuous longitudinal stripe in preserved specimens of *P. oxygastroides*). A dissected *P. cyanea* (CMK 10480, 37.9 mm SL) is a female with ripe ovaries.

The species I am calling here *P. oxygastroides* is the one diagnosed and illustrated in Kottelat et al. (1993) and figured in Roberts (1989); it is unlikely to be conspecific with the material from Thailand and Malay Peninsula illustrated under this name by Banarescu (1969: figs. 2-3) which possibly represents *P. siamensis* (see also Kottelat, 1985: 265). However, there are some reservations with this identification.

Bleeker (1852: 431) described *Leuciscus oxygastroides* on the basis of 9 specimens 50-148 mm TL from 3 localities in Borneo (Prabukarta, Kusan R.), Sumatra (Palembang, Musi River) and Java (Batavia). He described it as having pectoral fins much longer than head, reaching beyond pelvic, about 40 scales along lateral line, and fins with a dark posterior margin.

Bleeker (1860: 471) used two specimens previously identified as *C. oxygastroides* for the original description of *Chela hypophthalmus*. In 1863 (p. 134), he stated that these two specimens (155-165 mm TL) are possibly from Palembang, but that there is some doubt as different localities were mixed in the same jar. In the key he is stating that *C. hypophthalmus* has blackish stripes in the caudal lobes, while these are not very explicitly mentioned in the description; the stripes are illustrated in plate 143 fig. 3. In the key, *C. oxygastroides* is described as having no stripe in the caudal fin, while in the Latin description (p. 136) the stripes are apparently mentioned; in Remarks he explicitly stated that they are missing; they are not shown on his plate 143 fig. 4. Bleeker's (1863) re-description of *C. oxygastroides* is based on 6 specimens 90-148 mm TL from two localities in Java, one in Sumatra and two in Borneo.

Weber & de Beaufort (1916: 51) describe *Chela oxygastroides* as having a more or less distinct longitudinal band on each caudal lobe (but they do not appear in their figure) and *C. hypophthalmus* as having a caudal with a black margin and dark lobes. Banarescu (1969: 192) does not describe coloration but illustrates two specimens with plain caudal fins.

Kottelat et al. (1993) report only two species of *Parachela* from Indonesian waters. Beside *P. cyanea*, 3 species have to be added to this list. *Parachela maculicauda* previously known from the Malay Peninsula has been collected since in Riau, Sumatra. A possibly unnamed species with plain body, 42-48 lateral line scales and a black margin on caudal fin is known from Jambi, Sumatra; its relationships with *P. siamensis* still have to be clarified. Finally,

P. ingerkongi, originally described as a subspecies of *P. oxygastroides*, had been overlooked by Kottelat et al. (1993); recently collected material shows it is a valid species.

Comparison material. - *Parachela oxygastroides*: CMK 10371, 14 ex., 65.7-94.4 mm SL; Kapuas basin. - RMNH 4984, 5 ex., RMNH 9062, 1 ex., paralectotypes.

Rasbora tuberculata, new species
(Fig. 3)

Material examined. - Holotype - MZB 5902, 26.8 mm SL; Indonesia: Borneo: Kalimantan Barat: Kapuas basin: Sungai Pala at Pala Hulu (Kec. Siberuang, Kp. Renyai Hulu), km 99 on road from Sintang to Putussibau; 0°21'42"N 111°55'47"E; coll. M. Kottelat et al., 16 Sep.1993.

Paratypes - 16 ex. (CMK 10540), 6 ex. (MZB 5903), 5 ex. (ZRC 38691), 8.8-25.3 mm SL; same data as holotype.

Others (non types) - 10 ex. (ZRC 37769), 3 ex. (CMK 11021), 18.2-23.0 mm SL; Malaysia: Borneo: Sarawak: Sungai Serait, Bako National Park; N. Sivasothi et al., 30 Jun.1994.

Diagnosis. - *Rasbora tuberculata*, is distinguished from any known species of *Rasbora* by the presence of well developed tubercles on the back in front of dorsal fin, on the caudal peduncle, on dorsal fin and on the upper lobe of caudal fin. Additional characters useful to distinguish the species (but not unique) are: presence of a black spot at the tip of dorsal and anal fins, a black longitudinal stripe on flanks, lateral line incomplete, perforating 9-13 scales, 27-28+1-2 scales along normal course of lateral line.

Description. - General appearance is shown in Figure 3 and morphometric data of holotype and four paratypes are given in Table 4. Dorsal fin with 2 simple and 7 branched rays, last one being split to the base; dorsal origin above lateral line scale 10 or 11. Pectoral fin slightly falcate, with 12-13 rays; a very small axillary lobe present. Pelvic fin slightly pointed, with 8 rays; axillary scale present. Anal with 3 simple and 5 branched rays, last one being split to the base. Caudal fin with 10+9 principal rays, 9+8 being branched. Caudal peduncle 1.92-2.13 times longer than deep. 27+2(4), 28+1(1), 28+2(3) or 29+2(1) scales in longitudinal series (counted along normal course of lateral line in *Rasbora*). Lateral line incomplete, perforating anterior 9-13 scales, reaching pelvic-fin origin or slightly beyond. 10-11 predorsal scales, $^1/_2$4/1/3$^1/_2$ scales in transverse line, $^1/_2$5$^1/_2$ scales in transverse line on caudal peduncle, 1$^1/_2$ scales between lateral line and pelvic origin. Vertebral formula: 15+17=32 (1), 16+15=31 (1), and 16+16=32 (2).

There are patches of very well developed antrorse tubercles on the back, along middorsal profile, in front of dorsal fin base and on caudal peduncle. In a few specimens a few tubercles are also present on ventral midline on the caudal peduncle, at caudal fin origin. Smaller tubercles are also present on the dorsal fin and the upper lobe of caudal fin; they are best developed on the simple rays (particularly the first simple dorsal ray) but are also present on the anterior most branched rays and sometimes also on the inter-radial membranes. Smaller tubercles are also present on the head, where they are especially well developed on the dentary. The smallest specimen in which tubercles have been observed is 14.0 mm SL.

Etymology. - From the Latin *tuberculum*, a small swelling; an adjective.

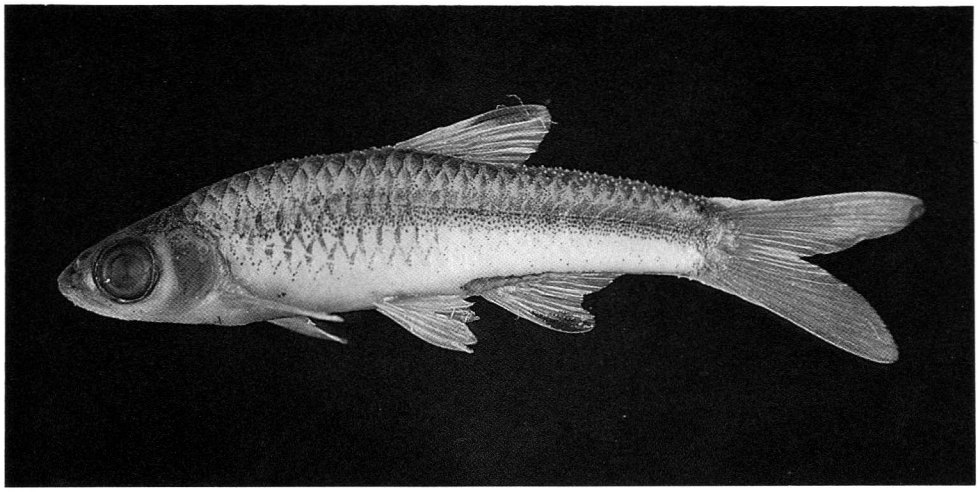

Fig. 3. *Rasbora tuberculata*, holotype, MZB 5902, 26.8 mm SL.

Table 4. *Rasbora tuberculata*, morphometric data of holotype (*, MZB 5902) and four paratypes (MZB 5903, CMK 10540).

Standard length	26.8*	25.3	25.0	24.5	24.3
Percentage of standard length					
Total length	134.7	137.2	132.4	131.81	32.1
Head length	26.5	27.3	27.6	26.5	24.7
Predorsal length	54.5	54.5	54.8	52.2	53.9
Prepelvic length	48.5	49.4	50.8	47.3	48.1
Preanal length	63.1	62.8	66.0	64.9	62.1
Body depth at pelvic origin	24.6	24.1	24.0	24.5	23.9
Depth of caudal peduncle	13.4	13.4	12.4	12.2	12.3
Length of caudal peduncle	25.7	26.9	25.6	25.7	26.3
Body width	12.7	14.2	12.8	13.9	11.9
Length of dorsal fin	26.5	26.9	23.9	23.7	22.6
Length of anal fin	20.9	20.6	18.8	17.1	18.9
Length of pelvic fin	17.9	19.4	14.8	16.3	15.6
Length of pectoral fin	18.3	20.2	17.2	19.6	20.2
Length of upper caudal lobe	34.7	33.6	30.8	28.2	30.5
Length of median caudal rays	14.6	15.4	15.2	14.7	14.8
Length of lower caudal lobe	32.1	31.6	30.4	28.2	28.8
Percentage of head length					
Head depth	65	65	67	71	80
Snout length	31	29	28	31	35
Eye diameter	41	38	41	43	43
Interorbital width	37	36	33	32	38

Coloration. - Body pale olivaceous brown, whitish on belly. A blackish middorsal stripe from head to caudal base. A faint longitudinal stripe from gill opening to caudal fin base, usually very faint in front of dorsal origin; mid-axial streak complete, situated in the middle of the midlateral stripe between caudal base to level of dorsal fin origin, and about one scale row above centre of the midlateral stripe between dorsal fin origin and gill opening. Anterior scales of median rows (those immediately above and below midlateral stripe) with dark crescent mark situated along posterior margin of scale pocket (reticulate pattern of Brittan, 1954). Supra-anal streak present and continuous with a mid-ventral peduncular streak. Melanophores along cleithrum form a humeral mark along posterior margin of gill-cover. Fins hyaline, except dorsal and anal fins which both have a small black spot at the tip of last simple and first branched rays. The smallest specimen in which the black anal and dorsal spots have been observed is 14.0 mm SL.

Habitat. - The specimens have been collected in a small creek in a hilly area, flowing through a succession of riffles over large boulders and deeper pools. The water was clear, from slow to swift.

Discussion. - *Rasbora tuberculata* apparently is related to *R. bankanensis* (Bleeker, 1853) with which it shares the general appearance, the pale coloured body with a faint midlateral stripe and the unique black blotch at the tip of the anal fin. It is however easily distinguished by the presence of tubercles and of a spot at the tip of the dorsal fin, by an incomplete lateral line perforating 9-13 scales (vs. complete or perforating 23-27 scales), a more slender body (depth 4.0-4.2 times in SL, vs. 3.1-3.8) and a more slender caudal peduncle (1.9-2.1 times longer than deep, vs. 1.4-1.7) (*R. bankanensis* data from Brittan, 1954).

Rasbora ennealepis Roberts, 1989 is another species similar to *R. bankanensis* and also known from the Kapuas basin. It is distinguished by a complete lateral line (vs. incomplete in *R. tuberculata*), 24-25 scales in lateral series (vs. 27-29) and 10 circumpeduncular scales (vs. 12) (*R. ennealepis* data from Roberts, 1989).

The specimens from Sarawak differ slightly from the typical specimens in having more pored scales along lateral line (12-17, extending to level of anal origin), the tubercles slightly less developed (this might be influence by season, developmental state or other factors) and the black pigmentation more intense. The black blotch on the dorsal fin extends over the distal half to three quarters of all rays, and the blotch on the anal fin covers about the distal half of the rays. The snout appears somewhat more blunt.

Betta enisae, new species

(Figs. 4)

Material examined. - Holotype - MZB 5907, male, 36.6 mm SL; Indonesia: Borneo: Kalimantan Barat: Sungai Santik, a tributary of Sungai Tawang immediately west of Danau Sentarum Field Centre; 0°50'21"N 112°03'50"E; coll. M. Kottelat et al., 4 Sep.1993.

Paratypes - All from Indonesia: Kalimantan Barat. 5 ex. (MZB 5908), 7 ex. (CMK 10128), 2 ex. (ZRC 38453), 21.0-58.7 mm SL; same data as holotype. - 4 ex. (CMK 10100), 28.9-30.2 mm SL; Sungai Genali (tributary of Sungai Belitung) and a small forest creek entering it near Nanga Sekulat; 0°40'53"N 112°09'05"E; coll. M. Kottelat et al., 4 Sep.1993. - 4 ex. (MZB 5909), 5 ex. (CMK 10183), 21.2-47.8 mm SL; Sungai Empaik, a tributary of Sungai Telian; blackwaters; 0°53'28"N 111°57'29"E; coll. M. Kottelat et al., 6 Sep.1993. - 2 ex. (CMK 10217), 29.5-30.2 mm SL; small tributaries of Sungai Tawang immediately upriver of its confluence with Sungai Kenelang; 0°46'33"N 111°59'27"E; coll.

M. Kottelat et al., 7 Sep.1993. - 3 ex. (MZB 5910), 2 ex. (CMK 10270), 30.6-50.5mm SL; small forest tributaries of Sungai Tangit, around 0°59'31"N 112°04'21"E; coll. M. Kottelat et al., 8 Sep.1993. 4 ex. (CMK 10294), 28.9-30.2 mm SL; several small tributaries of Sungai Embaluh Leboyan and Sungai Semalah; coll. M. Kottelat et al., 9 Sep.1993. - 1 ex. (CMK 10509), 3 ex. (ZRC 38061), 52.8-57.9 mm SL; Pemukul, a hole with water (dried river bed ?) in the forest near Nanga Kenelang; from fisherman; coll. M. Kottelat et al., 13 Sep.1993.

Diagnosis. - *Betta enisae*, apparently belongs to a group of unnamed species recognised by Witte & Schmidt (1992) as *Betta* sp. E group. The group is characterized by the absence of a black stripe on the head below the one going from tip of chin through eye to caudal base, by a bright iridescent opercle and throat (black when preserved), very long pelvic (reaching mid-length of anal-fin base in the present species), pointed dorsal and anal, caudal from rounded to rhomboid, large head (its length 34.6-37.7 % SL in *B. enisae*), and relatively deep body (26.2-28.9 % SL). There is presently a single named species in this group, *B. schalleri* Kottelat & Ng, 1994 from Banka; *B. enisae* is easily distinguished by the colour pattern of the anal and caudal fins (presence of broad subdistal black and blue margins in anal and lower caudal fin and alternating black and blue bars on caudal fin, vs. absence). This pattern also distinguishes it from any other named species of the genus. *Betta enisae* further differs from *B. schalleri* by having fewer dorsal rays (0-1,7-8, total 8-9, vs. II,8-9, total 10-11), fewer scales in lateral row (26-28, vs. 31) and fewer subdorsal scales (5-5$^{1}/_{2}$, vs. 6$^{1}/_{2}$-7) (*B. schalleri*: data from Kottelat & Ng, 1994).

Description. - General appearance is shown in Figures 4 and morphometric and meristic data of holotype and five paratypes are given in Table 5. Vertebral formula:2,8,17(4)=27(1), 2,8,18(4)=28(2), and 2,8,19(4)=29(2). Pelvic fin with a spine, a simple and 4 branched rays; when depressed, pelvic fin filament reaching about middle of anal-fin base in specimens

Fig. 4. *Betta enisae*, holotype, MZB 5907, 36.6 mm SL.

Table 5. Morphometric and meristic data of holotype (*, MZB 5907) and 5 paratypes (MZB 5908, CMK 10128) of *Betta enisae*.

Standard length [mm]	36.6 *	39.5	38.0	37.0	36.7	34.0
Sex	m	m	m	f	f	f
In percents of standard length						
Total length	155.2	143.0	154.2	143.0	146.0	150.6
Head length	36.3	37.7	37.6	34.6	35.4	35.6
Postorbital length	17.8	18.7	17.4	16.2	15.8	17.1
Predorsal length	69.9	68.9	70.3	69.7	67.3	69.7
Preanal length	51.6	52.2	54.2	51.9	50.6	50.1
Postdorsal length	25.4	26.1	25.0	24.9	26.7	26.5
Body depth	26.2	28.9	27.6	27.6	27.2	27.4
Depth of caudal peduncle	18.3	19.5	18.2	18.6	18.3	17.6
Body width	17.8	18.7	17.1	18.9	19.6	19.7
Length of dorsal-fin base	8.7	10.4	12.1	10.8	10.9	10.6
Length of anal-fin base	53.3	50.1	50.0	50.8	52.9	50.6
Length of pelvic fin	46.7	42.3	42.9	34.6	33.8	42.4
Length of pectoral fin	24.3	23.5	24.5	21.1	22.6	23.8
Length of caudal fin	52.5	44.3	50.0	42.7	44.7	48.7
In percents of postorbital head						
Head length	205	201	217	213	224	209
Snout length	60	57	68	57	62	59
Eye diameter	68	57	62	67	67	67
Interorbital width	72	70	76	73	76	72
Meristics						
D	I,7	0,8	I,7	I,7	I,8	I,7
A	II,24	II,21	II,23	II,23	II,22	III,21
P	12	11	12	11	12	11
V	I,1,5	I,1,4	I,1,4	I,1,4	I,1,4	I,1,4
C	i,5+6,ii	i,5+6,ii	i,5+6,ii	i,5+6,ii	i,5+6,ii	i,5+6,ii
Lateral scale rows	28	27	28	27	27	26
Transversal scale rows	$^1/_2$9	$^1/_2$9	$^1/_2$10	$^1/_2$10	$^1/_2$9	$^1/_2$9
Subdorsal scale rows	5	5	5	5	5	5
Predorsal scale rows	11+11	11+11	10+11	10+11	10+10	10+10
Postdorsal scale rows	11	11	10	10	11	11
Dorsal origin over anal ray	10	9	10	10	10	10
Dorsal origin over scale row	15	15	14	16	14	14

about 35-40 mm SL. Pectoral fin with 11-12 rays. Caudal fin lanceolate, i,5+6,ii. Dorsal fin pointed, reaching caudal base in males, shorter in females; 0,8 (1), I,7 (9) or II,8 (3). Anal fin pointed, not reaching beyond middle of caudal fin; II,21 (2), II,22 (4), II,23 (4), II,24 (1), III,21 (1), III, 23 (1).

Etymology. - Named for Enis Widjanarti, in appreciation for her efficient and enthusiastic help during field work in the Kapuas lakes.

Coloration. - Preserved material. Body and head yellowish brown, darker on the back. Three dark lateral stripes. Midlateral stripe most conspicuous of all, darker anteriorly, from tip of chin through eye to lower caudal base. Upper stripe from upper margin of eye to upper

caudal base. Lower stripe from lower pectoral base to lower caudal base, meeting the midlateral stripe above last third of anal base; this stripe is usually missing on the throat, but in a few specimens it is present (but very faint) between pectoral base and eye and between eye and throat. Head of male dark brown to blackish, darker in the lower half.

Pectoral fin hyaline. Anterior edge and filament of pelvic white, rest of fin blackish in male, greyish in female. Dorsal fin with a few faint dark marks set transversally on the membranes (very faint in females). Anal fin with 6-9 rows of conspicuous blackish vertical marks on the membranes, lower margin with a broad black margin and a hyaline subdistal band. Anal fin with a broad black distal margin and a hyaline subdistal margin; tip of rays white; membranes basally dark grey to blackish. Patterning of the caudal and anal fin present in both sexes, but only faintly developed in females.

Life colouration of male, based on slides of the holotype (Fig. 4). Body and head brown, stripes inconspicuous, except on head. Opercle greenish brown. A small yellowish-green iridescent patch behind eye. Pelvic white. Dorsal hyaline, transverse marks on the membranes blackish. Anal and lower caudal fin with broad black margin, bordered proximally by a broad blue band and distally by a very narrow white, distal margin. Basal area of anal fin reddish brown. Rest of caudal fin blue; vertical marks are black in the upper half, tending towards blackish brown in the lower half.

Habitat. - *Betta enisae* has been collected or observed in all forest streams in DSWR. It was usually found among leave litter along the shores in shallow water. In the dry season, it was one of the very few species surviving in isolated deep and narrow holes in the dry stream beds. It was always associated with but much less abundant than *B. dimidiata* Roberts, 1989.

Distribution. This species is presently only known from the middle Kapuas basin.

Discussion. - *Betta akarensis* Regan, 1910 (including *B. climacura* Vierke, 1988), *B. chini* Ng, 1993 and some 'populations' of *B. pugnax* (Cantor, 1849) and *B. balunga* Herre, 1940 also have vertical marks in the caudal fin, but in these species, the black bars are narrower, more numerous, fainter (often absent) and there is no broad black and blue marginal bands in the anal and lower caudal fin. *Betta enisae* further differs from *B. chini* from Sabah by having a longer head (35-38% SL, vs. 29-31), fewer anal rays (II-III,21-24, total 23-26, vs. II,25-27, total 27-29) and fewer scales in lateral row (26-28, vs. $30^1/_2$-$31^1/_2$) (*B. chini*: data from Ng, 1993). *Betta enisae* further differs from *B. akarensis* from Sarawak and *B. balunga* from Sabah and Kalimantan Tengah by fewer anal rays (II-III, 21-24, vs. I-III,25-29 in *B. akarensis* [Kottelat et al., 1993] and I-II,26-27 in *B. balunga* [pers.obs., CMK 9451]).

ACKNOWLEDGEMENTS

It is a pleasure to thank Pak Sa'id, Andi Erman and especially Enis Widjanarti for assistance in the field, and Sonia Muller (MHNG) for the radiographs. The material described here has been obtained during a survey of Danau Sentarum Wildlife Reserve for Asian Wetland Bureau Indonesia and I am grateful to Wim Giesen for supporting my visit. PHPA (Perlindungan Hutan dan Pelestarian Alam) granted permission to work in the reserve area.

LITERATURE CITED

Banarescu, P., 1969. Contributions to the systematics of the genus *Oxygaster* (Pisces, Cyprinidae) with description of a new subspecies. *Rev. Roum. Biol., Zool.*, **14**: 191-198.

Bleeker, P., 1852. Zesde Bijdrage tot de kennis der ichthyologische fauna van Borneo. Visschen van Pamangkat, Bandjermassing, Praboekarta en Sampit. *Natuurk. Tijdschr. Nederl. Indië*, **3**: 407-442.

Bleeker, P., 1860. Ordo Cyprini, Karpers. *Acta Soc. Sci. Indo-Neerl.*, **7**(5, 2): 1-492.

Bleeker, P., 1863. *Atlas ichthyologique des Indes Orientales Néêrlandaises*. Tome III. Cyprins. Muller, Amsterdam, 150 pp., pls. 102-144.

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: D. Otte & J.A. Endler (eds.). *Speciation and its consequences*. Sinauer Assoc., Sunderland, MA.

Günther, A., 1868. *Catalogue of the fishes in the British Museum*. 7. British Museum, London.

Kottelat, M., 1982. A small collection of fresh-water fishes from Kalimantan, Borneo, with descriptions of one new genus and three new species of Cyprinidae. *Rev. Suisse Zool.*, **89**: 419-437.

Kottelat, M., 1984. A new *Rasbora* s.l. (Pisces: Cyprinidae) from northern Thailand. *Rev. Suisse Zool.*, **91**: 717-723.

Kottelat, M., 1985. Fresh-water fishes of Kampuchea. A provisory annotated check-list. *Hydrobiologia*, **121**: 249-279.

Kottelat, M., 1991. Notes on the taxonomy and distribution of some Western Indonesian freshwater fishes, with diagnoses of a new genus and six new species (Pisces: Cyprinidae, Belontiidae, and Chaudhuriidae). *Ichthyol. Explor. Freshwaters*, **2**: 273-287.

Kottelat, M., in press. Systematic studies and biodiversity: the need for a pragmatic approach. J. Nat. Hist.

Kottelat, M. & P. K. L. Ng, 1994. Diagnoses of five new species of fighting fishes from Banka and Borneo (Teleostei: Belontiidae). *Ichthyol. Explor. Freshwaters*, **5**: 65-78.

Kottelat, M. & E. Widjanarti, manuscript. Fishes of Danau Sentarum Wildlife Reserve.

Kottelat, M., A. J. Whitten, S. N. Kartikasari & S. Wirjoatmodjo, 1993. *Freshwater fishes of Western Indonesia and Sulawesi*. Periplus Editions, Hong Kong, 259 pp., 84 pls.

Ng, P. K. L., 1993. On a new species of *Betta* (Teleostei: Belontiidae) from peat swamps in Sabah, East Malaysia, Borneo. *Ichthyol. Explor. Freshwaters*, **4**: 289-294.

Roberts, T. R., 1989. The freshwater fishes of western Borneo (Kalimantan Barat, Indonesia). *Mem. Calif. Acad. Sci.*, **14**: 1-210.

Weber, M. & L. F. de Beaufort, 1916. *The fishes of the Indo-Australian archipelago. III. Ostariophysi: II Cyprinoidea, Apodes, Synbranchi*. Brill, Leiden, xv+455 pp.

Witte, K.-E. & J. Schmidt, 1992. *Betta brownorum*, a new species of anabantoids (Teleostei: Belontiidae) from northwestern Borneo, with a key to the genus. *Ichthyol. Explor. Freshwaters*, **2**: 305-330.

Received 27 Dec 1994
Accepted 11 Jan 1995