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Betta hendra – a new species of fighting fish (Teleostei: Osphronemidae) from Kalimantan Tengah (Borneo, Indonesia)

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Abstract

Betta hendra spec. nov. is described from Kalimantan Tengah, Borneo, Indonesia. It is a bubble-nesting fighting fish of the *B. coccina* species group. The new species differs from the other members of the group by a bright greenish iridescent colour on the flanks and unpaired fins. It is distinguished from its geographical neighbour species *B. uberis* by a lower number of dorsal-fin rays (10–12 versus 14–17).

Key words

Betta hendra, *Betta coccina* species group, Indonesia, Borneo, taxonomy, speciation.

Introduction

The fighting fish genus *Betta* comprises more than 65 species distributed in South-East Asia. It is the most speciose genus of the family Osphronemidae (BRITZ, 2001; TAN & NG, 2005). There are both mouth-brooding and bubble-nesting fighting fish species (SCHMIDT, 1996; RÜBER *et al.*, 2004). They are divided into several species groups (e. g. SCHMIDT, 1996; TAN & NG, 2005).

The new species described here from the south-west of Borneo (Kalimantan Tengah) is a member of the *Betta coccina* group. The species of this group occupy a particular kind of habitat. They are restricted to peat swamp forests with black water and a pH value of (or even below) 5.0 (WITTE & SCHMIDT, 1992). Due to their small size (usually < 30 mm SL), their cryptic appearance (most members possess a blackish or dark crimson red body colour), and their semi-aquatic ecotopes in the rainforest, they have been discovered only recently or not recognized as distinct species in the past. WITTE & SCHMIDT (1992) give a review of the discoveries and taxonomic exploration of the *coccina* group.

The first species of this group to be described was *B. coccina*, by VIERKE (1979), followed by a ‚vorläufige Beschreibung‘ (= ‚preliminary description‘) of *B. tussyae* by SCHALLER (1985). SCHALLER (1986) also published the brief description of *B. persephone*. WITTE & KOTTELAT (in KOTTELAT, 1991) added *B. rutilans* from Borneo. The first comprehensive treatment of the species group (including ethological studies, discussion of the taxonomy, and a phylogenetic analysis) was performed by WITTE & SCHMIDT (1992), who described *B. brownorum*. A few months later in the same year NG & KOTTELAT (1992) described *B. livida*. The next taxon, *B. miniopinna*, was created by TAN & TAN (1994) for a species similar to *B. persephone*. KOTTELAT & NG (1994) described *B. burdigala* from Bangka, in 1994. And finally, *B. uberis* is the species most recently described, from Borneo by TAN & NG (2006).

The purpose of the present paper is to describe *Betta hendra* spec. nov., a recently discovered species from Borneo (Kalimantan Tengah, Indonesia), and to discuss

its biogeography and phylogenetic position within the species group.

Material and methods

Measurements were taken as straight lines (to the nearest 0.1 mm) between two points (see SCHINDLER & SCHMIDT 2006) with an electronic digital calliper. Proportions are expressed as percentages of standard length (SL). Terminology for measurements and colour pattern is based on WITTE & SCHMIDT (1992) with modifications as specified in SCHINDLER & SCHMIDT (2006). Counts were made as described by WITTE & SCHMIDT (1992) except for the number of predorsal scales, which were counted continuously. Numbers in brackets indicate the number of specimens examined for the datum in question.

To ensure the optimally objective comparison of colours, all photographs of live specimens were taken under the same conditions. The photographs were taken using a camera flash with a colour temperature of about 5600 Kelvin, without any influence from any other light source.

Water parameters were measured in the field with the following instruments: wtw-Weilheim, type pH 320 with pH electrode SenTix 21 for the hydrogen-ion concentration and water temperature, and Sera Handmessgerät (tolerance of 0.2%) for the electrical conductivity.

The material examined is listed under the species description below. Types are deposited in the Senckenberg Naturhistorische Sammlungen Dresden, Museum für Tierkunde, Dresden (MTD). Specimens not indicated as the holotype or paratypes are non-type material. The description follows the general format used by TAN & NG (2005). In addition to the data obtained from material examined, data from TAN & NG (2005; 2006), WITTE & SCHMIDT (1992), and previously published descriptions of species (see introduction) were also used.

In accordance with previous taxonomic publications on the genus *Betta* (see TAN & NG, 2005; 2006), the new species is diagnosed and described on eidonomical features. The definition of species groups and the classification of species follows TAN & NG (2005). The species concept used is the diagnostic variant of the 'phylogenetic species concept' (NIXON & WHEELER, 1990).

Betta hendra spec. nov.

Figs. 1–3, Table 1

Holotype: MTD 32875, male, 29.4 mm SL; Indonesia, Borneo, Kalimantan Tengah, about 3 km south-east of Palangkaraya in direction of Berengbengkeli; 02° 16.5 S, 113° 56.6 E; leg. H. Linke *et al.*, May 2011. **Paratypes:** MTD 32876–77, 2, 25.9–27.4 mm SL;

Table 1. Morphometric data (as percentages of standard length; SL in mm) of *Betta hendra* spec. nov. (n = 7). Mean = arithmetic mean; min = lowest value; max = highest value; sd = standard deviation.

	min	max	mean	sd
Standard length (mm)	25.9	41.9	33.6	6.30
Total length	122.2	131.6	126.9	3.44
Predorsal length	56.3	61.0	58.1	1.55
Postdorsal length	19.6	24.3	22.1	1.64
Preanal length	36.8	41.3	39.5	1.63
Body depth at dorsal fin	20.6	24.8	22.5	1.38
Caudal peduncle depth	14.8	19.4	17.1	1.47
Head length	23.2	27.2	25.6	1.31
Orbit diameter	6.7	8.3	7.6	0.54
Postorbital length	11.7	14.5	13.3	0.83
Interorbital width	7.9	9.6	8.9	0.59
Dorsal-fin base length	17.0	24.0	20.5	2.15
Anal-fin base length	54.3	62.7	58.3	2.61
Pelvic-fin length	20.0	40.5	28.6	6.90
Pelvic-fin spine length	5.1	6.8	5.8	0.89

same data as for holotype. MTD 32878–81, 4, males, 33.5–41.9 mm SL; aquarium offspring of wild-caught specimens (collecting site as for holotype).

Diagnosis. *Betta hendra* is a member of the *B. coccina* species group. It differs from the remaining species of this clade by having bright, greenish-coloured flanks and unpaired fins (versus body blackish without iridescent scales, or greenish iridescent scales restricted to the lateral blotch or the central parts of the flanks). It is distinguished from its geographic neighbour species *B. uberis* by a lower number of dorsal-fin rays (total 10–12 in *B. hendra* versus 14–17 in *B. uberis*).

Description. For general appearance see figs. 1–3. Measurements are summarised in table 1. Body slender, almost circular in anterior part. Dorsal-fin base not scaled; anal-fin base with one row of scales on posterior third. Dorsal fin with I,9 (1), I,10 (1), I,11 (4) or II,10 (1) rays, total 10 (1), 11 (1), or 12 (5). Anal fin with II,24 (2), II,25 (1), II,27 (2), III,27 (1) or III,28 (1) rays, total 26 (2), 27 (1), 29 (2), 30 (1) or 31 (1). Caudal fin round in males and females. Pectoral fin round. Pelvic fin pointed, with 1 spine, 1 simple and 4 branched rays; pelvic-fin length up to 41% of SL in adult males. Scales in longitudinal series 29 (2), 30 (3), or 31 (2); scales in transverse series at dorsal-fin origin 8 (1), 9 (5) or 10 (1); predorsal scales 18–21 (mode 19); postdorsal scales 8–10 (mode 9).

Preserved coloration. See figure 1. Body and head dark reddish brown. Preorbital and postorbital stripes present, faint and indistinct. No distinct stripes on body sides. Dorsal fin reddish brown with dark dots on distal parts.



Fig. 1. Holotype of *Betta hendra* spec. nov. (MTD 32875, 29.4 mm SL).



Fig. 2. Adult male of *Betta hendra* spec. nov. in the aquarium.

Caudal fin reddish brown without bars, darker at base darker, distal with few dark dots distally. Anal fin brown, darker at base and distally. Pelvic fins dark brown, tips whitish. Pectoral fins colourless.

Live colouration. Body sides of males (Fig. 2) with iridescent greenish blue metallic scales; dorsally dark brown. Light brown stripe on dorsum from head to anterior dorsal-fin base. Head reddish brown. Two distinct parallel vertical bright red to golden bars on opercle. Iris greenish blue. No distinct dark stripes on head or body sides. Unpaired fins reddish brown, speckled with greenish blue dots and streaks. Pelvic fins reddish brown with greenish blue tips. Pectoral fins hyaline. Females (Fig. 3) as for males but fewer iridescent greenish blue metallic scales on body sides. Parallel vertical bars on opercle lighter and less bright.

Distribution. *Betta hendra* occurs in peat swamps in the Sungai Sebangau drainage south and west of Palangkaraya, Kalimantan Tengah, Borneo (Fig. 4).

Habitat. The type locality is a blackwater peat swamp south of Palangkaraya. In May 2011 LINKE measured the following water parameters: pH about 4, conductivity 6 $\mu\text{S}/\text{cm}$, and water temperature 28.5 °C. The water had no current and was shaded by trees and bushes. The water depth was only about 5 to 50 cm. The fighting fishes were collected among the aquatic and marsh plants. At some sites *B. hendra* was syntopic with *B. foerschi*.

Reproductive behaviour. Observations under aquarium conditions have revealed *B. hendra* to be a bubble-nester.



Fig. 3. Adult female of *Betta hendra* spec. nov. in the aquarium.

Etymology. The specific name is in honour of Hendra Tommy, (Kurnia Aquarium, Palangkaraya, Kalimantan Tengah, Borneo), who discovered and exported the species. For the purposes of nomenclature the name should be treated as a Latinised noun in apposition.

Comparative notes. *Betta hendra* spec. nov. can be distinguished from the remaining species of the group by the bright greenish coloured flanks in live specimens. Preserved specimens differ as follows: fewer dorsal-fin rays than *B. burdigala* and *B. uberis* (total 10–12 in *B. hendra* versus >12); in males and females no dark mid-lateral blotch (versus mid-lateral blotch present in *B. livida*, *B. brownorum*, *B. coccina* and some *B. uberis*); body brownish red (versus body blackish in *B. persephone* and *B. miniopinna*); lack of prominent stripes on body sides (versus present in *B. tussyaie*); parallel vertical bars on opercle present (versus absent in *B. rutilans*). It can be distinguished from the sympatric *B. foerschi* by smaller size (<35 mm SL versus >40 mm SL), anal-fin base scaled only on posterior third (versus anal-fin base completely scaled), and head length less than 29% of SL (versus >30% of SL in *B. foerschi*).

Discussion

Betta hendra is considered a member of the *B. coccina* species group (as discussed in WITTE & SCHMIDT, 1992) by virtue of its brownish base colour in preserved speci-

mens, its slender and anteriorly almost circular body shape, and its adaptation to peat swamp habitats. It differs from other species of this group by the characters or character states given in the diagnosis and comparative notes. The *coccina* species group has been confirmed as a monophyletic assemblage based on the analysis of morphological, ecological, and molecular data sets (WITTE & SCHMIDT, 1992; SCHMIDT, 1996; RÜBER *et al.*, 2004).

The occurrence of species of the *coccina* group is correlated with the distribution of blackwater peatlands on the Malay Peninsula and the islands of Sumatra and Borneo (WITTE & SCHMIDT, 1992; TAN & NG, 2005; TAN & NG, 2006; this study). Tropical peatlands in South-East Asia are mostly low-altitude (usually at elevations of less than 50 m above sea level), coastal or sub-coastal environments, which, however, may extend for a distance of more than 200 km along river valleys (WÜST *et al.*, 2007). WITTE & SCHMIDT (1992) treat the adaptation and restriction of the members of the *B. coccina* group to blackwater peat swamps as an apomorphy of the clade. This type of apomorphic adaptation to a particular kind of habitat may lead to the evolution of distinct lineages (WIENS, 2004) and the development of species groups (COSTA, 2006). The distribution of the peatlands is fragmentary and exhibits an insular pattern (PAGE *et al.*, 2006; WÜST *et al.*, 2007). The maintenance of an ancestral ecological niche by the members of a monophyletic clade (in this case the *coccina* species group) is termed ‘niche conservatism’ (WIENS *et al.*, 2010). Where stenotopic fishes are restricted to a particular habitat, as is the case with the species of the *Betta coccina* group and isolated peat swamps, their distribution can be seen as an ‘archipelago’ that physically divides species by limiting gene flow. Speciation events where niche conservatism



Fig. 4. Borneo island showing the collection site of *Betta hendra* spec. nov. (dot).

plays the primary role in promoting allopatric speciation have recently been described and discussed (WIENS, 2004; KOZAK & WIENS, 2006). Hence it is reasonable to assume that a similar process has led to specific diversification within the *Betta coccina* group. The peatlands around Sebangau and Palangkaraya were formed during the Holocene after the Last Glacial Maximum (PAGE *et al.*, 2006). It is therefore assumed here that *Betta hendra* separated during this, the most recent, geological epoch.

Over the last two decades the extent of the forest covering the peatlands of South-East Asia has decreased from 77% to 36% (MIETTINEN *et al.*, 2012). If peatland deforestation continues at the same annual rate then this particular type of forest will disappear by around 2030 (MIETTINEN *et al.*, 2012). That will undoubtedly have a serious impact on fish communities adapted to this kind of environment. Hence it is no wonder that, unfortunately, the probable extinction rate for stenotopic fish species adapted to this habitat is estimated to be more than 50% over the next three to four decades (GIAM *et al.*, 2012).

The *Betta coccina* clade is so far the only species group within the genus *Betta* that has been the subject of phylogenetic analysis (WITTE & SCHMIDT, 1992). However, a few new species have subsequently been added, making it difficult to apply the character states used for the cladogram in WITTE & SCHMIDT (1992) for the known diversity of the group. Nevertheless their work remains an informative basis for discussion of the phylogenetic relationships of *B. hendra* within the clade. Since *B. hendra* possesses iridescent greenish-coloured flanks in live specimens, a character state known from the related outgroup taxa *B. foerschi* and *B. bellica*, and lacks the apomorphic character of a dark lateral blotch, it may be a basal member of the *Betta coccina* group.

Specimens of *B. hendra* raised in captivity are substantially larger (up to 45 mm SL) than the wild-caught type specimens (< 30 mm SL). This endorses the statement by SCHALLER & KOTTELAT (1989) that descriptions of new species should not be based exclusively on aquarium specimens. Nevertheless, observations on aquarium specimens are important. Characteristics of live colour pattern and behaviour can usually be obtained only from specimens kept in tanks. These characters (colour pattern and ethological features) are necessary for the differentiation and diagnosis of the species. Furthermore, aquarium maintenance makes it possible to see whether presumed diagnostic characters (or character states) are retained unchanged over the generations. This may in turn support the hypothesis that we are dealing with a cluster of individuals that are to be treated as a distinct entity taxonomically. The fact that both wild-caught and tank-bred specimens of *Betta hendra* possess the diagnostic characters of the species is proof that these features are stable and that the sample examined represents the species accurately. Thus *B. hendra* is a distinct species under the principle of the phylogenetic species concept and an independently evolving lineage.

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