

**REDESCRIPTION OF THE MALAYAN FIGHTING FISH
BETTA PUGNAX (TELEOSTEI: BELONTIIDAE),
AND DESCRIPTION OF *BETTA PULCHRA*, NEW SPECIES
FROM PENINSULAR MALAYSIA.**

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ABSTRACT.- *Betta pugnax* (Cantor, 1850) is redescribed from type and topotypic material. The closely allied *Betta pulchra*, new species, is described from blackwater habitats of Pontian, Johor. It is distinguished from *B. pugnax* s. str. by having a stouter body, a narrowly instead of broadly lanceolate caudal fin, and more iridescent scales on the body in life.

INTRODUCTION

One of the earliest anabantoid fighting fishes described was *Betta pugnax* (Cantor, 1850), from the Malaysian island of Penang. The species has since been recorded from Indo-China, Malay Peninsula, Riau Archipelago, Sumatra and Borneo (see Kottelat et al., 1993; Tan & Tan, 1994).

Although *B. pugnax* had been widely reported and illustrated, no one had ever described the species in detail on the basis of the types and fresh topotypic material. This species has been reported to be polymorphic and its complicated taxonomy has been discussed on numerous occasions (e.g. Weber & de Beaufort, 1922; Herre, 1940; Witte & Schmidt, 1992). We here redescribe *B. pugnax* based on the type material and a large series of fresh specimens from Peninsular Malaysia and Singapore. We also discuss the status of *B. macrophthalmia* Regan, 1910, and *B. brederi* Myers, 1935, which have previously been synonymised under *B. pugnax*. A new blackwater species of *Betta* allied to *B. pugnax* is also described from southwestern Peninsular Malaysia.

MATERIAL AND METHODS

Meristics and morphometric measurements follow Witte & Schmidt (1992) except that the predorsal scale counts are the total of head and trunk counts. Specimens examined are deposited in the Zoological Reference Collection (ZRC), School of Biological Sciences, National University of Singapore; the United States Natural History Museum (USNM), Smithsonian Institution, Washington D. C.; the California Academy of Sciences (CAS), San Francisco; the British Museum of Natural History (BMNH), London; and Balitbang Zoologi, Muzium Zoologicum Bogoriense (MZB), Bogor. The abbreviation for standard length is SL, total length is TL, head length is HL, Gunung (hill or mountain) is Gg. and Sungei (stream or river) is Sg.

TAXONOMY

Betta pugnax (Cantor, 1850)

(Figs. 1a-c, 3a-c, 4a-b)

Macropodus pugnax Cantor, 1850: 84, figs. 1-3.

Betta anabatooides (non Bleeker, 1851): Bleeker, 1860a: 334; Weber & de Beaufort, 1922: 357; Herre & Myers, 1937: 72; Fowler, 1938: 121; Herre, 1940: 46.

Betta pugnax: Günther, 1861: 389; Károli, 1881: 172; Hanitsch, 1901: 4; Duncker, 1904: 164; Hanitsch, 1912: 27; Tweedie, 1952: 73; Alfred, 1961a: 183, 1961b: 18, 1964: 147, fig. 2, 1966: 49, pl. 8, fig. 1; Moshin & Ambak, 1983: 173, fig. 130; Kottelat, 1985: 275; Zakaria-Ismail, 1987: 409; Kottelat, 1989: 19; Lim and Ng, 1990: 94, fig.; Lim et al., 1990a: 317; Lim et al., 1990b: 49; Witte & Schmidt, 1992: 327; Kottelat, 1994: 297; Tan & Tan, 1994: 357; Lim, 1995: 161.

Betta picta (non Valenciennes, 1846): Bleeker, 1879: 26; Weber & de Beaufort, 1922: 360; Fowler, 1938: 121; Herre, 1940: 44.

Betta trifasciata (non Bleeker, 1850): Károli, 1881: 172 (part).

Betta macrophthalmia Regan, 1910: 781.

Betta brederi Myers, 1935: 25-26.

Betta fusca (non Regan, 1910): Tweedie, 1936: 22; Fowler, 1938: 259; Herre, 1940: 46.

Betta taeniata (non Regan, 1910): Tweedie, 1936: 22; Herre & Myers, 1937: 72; Herre, 1940: 45.

Betta rubra (non Perugia, 1893): Herre, 1940: 45.

Material examined. - **Malaysia, Penang:** Lectotype - BMNH 1860.3.19:930, 60.6 mm SL, Pinang, coll. Cantor. Paralectotypes - BMNH 1860.3.19:317-318, 2 ex., 51.8-66.2 mm SL, Pinang, coll. Cantor. Other material - ZRC 1610, 8 ex., 40.3-59.4 mm SL, Batu Ferringi Catchment Area, coll. Alfred et al., 1961. - ZRC 1611, 2 ex., 36.4-37.1 mm SL; Sg. Bayan Lepas; Alfred et al., 1961. - ZRC 1612, 6 ex., 42.4-58.2 mm SL, Sg. Telok Bahang, 14½ miles Telok Bahang Road, coll. Alfred et al., 1961. - ZRC 1613, 1 ex., 27.4 mm SL, Pulau Betong, Kampong Trang, coll. Alfred et al., 1961. - ZRC 1614, 1 ex., 36.3 mm SL, Sg. Balik Pulau, 1 mile north-east of Balik Pulau, coll. Alfred et al., 1961. - ZRC 14753, 2 ex., 48.4-48.9 mm SL, Kolam Ayer, coll. Alfred et al., 1964. - ZRC 31990, 4 ex., 44.3-57.0 mm SL, Kampong Tengah, coll. H. H. Tan & S. H. Tan, 8 Jun.1993. - ZRC 32047, 2 ex., 44.4-59.5 mm SL, Pantai Acheh, coll. H. H. Tan & S. H. Tan, 8 Jun. 1993. - ZRC 32065, 7 ex., 40.3-50.9 mm SL, Sg. Relau (upper reaches), Kampong Darat, coll. H. H. Tan & S. H. Tan, 9 Jun.1993. - ZRC 32302, 1 ex., 48.1 mm SL, Balik Pulau, Kampong Titi Serong (upstream), coll. H. H. Tan & S. H. Tan, 10 Jun.1993. - ZRC 39264, 1 male, 60.1 mm SL, Penang, coll. K. K. P. Lim, 1995. **Kedah:** ZRC 11631, 1 ex., 47.3 mm SL, Pulau Langkawi, Dayang Bunting, coll. not known, Mar.1960. - ZRC 29633, 3 ex., 35.9-51.5 mm SL, Pulau Langkawi, Telaga Tujuh waterfalls, coll. K. K. P. Lim, 30 Jan.1990. **Terengganu:** ZRC 21720, 1 ex., 41.2 mm SL, Sekayu waterfalls, coll. P. K. L. Ng et al., 18 Mar.1992. **Pahang:** ZRC 9003, 3 ex., 46.9-52.4 mm SL, Lake Chini, coll. 205 SQN RAF, Changi, 19-25 Aug.1967. — ZRC 8306, 3 ex., 46.7-67.3 mm SL, Rompin, eastern tributaries of Sg. Kinchin (north of base camp), coll. Rompin-Endau Expedition ZRC team, 13 Jun.1989. — ZRC 3476, 5 ex., 45.4-56.0 mm SL, Tasek Bera, coll. C. C. Lindsey, 29-31 Mar.1965. **Perak:** ZRC uncat., 4 ex., 41.3-52.9 mm SL, Taiping, Bukit Larut base, coll. K. K. P. Lim et al., 21 Dec.1994. - ZRC

39572, 2 ex., Taiping, Bukit Larut base, coll. H. H. Tan et al., 18 Nov.1995. **Selangor:** ZRC 435 (identified as *B. picta*), 2 ex. (out of 6 ex.), 48.7-49.1 mm SL, West of Ginting Sempak (14³/₄ miles from Kuala Lumpur), coll. A. W. Herre & Tweedie, 1937. - ZRC 19138, 1 ex., 54.5 mm SL, University of Malaya campus, in peaty stream, coll. P. K. L. Ng, 20 Nov.1989. - ZRC uncat., 3 ex., 41.7-48.6 mm SL, University of Malaya campus, in remnant swamp forest, coll. H. H. Tan et al., 22 Dec.1994. - ZRC 39579, 1 ex., disturbed area near north Selangor peatswamp forest, coll. P. K. L. Ng, Sep.1994. **Johor:** ZRC 23096, 2 ex., 47.5-48.6 mm SL, Ulu Endau, Sg. Anak Jasin, coll. T. H. T. Tan & J. B. Tay, 4 Apr.1992. - ZRC 28404, 3 ex., 38.9-39.8 mm SL, Kota Tinggi, Sg. Tementang, coll. P. K. L. Ng et al., 15 Oct.1992. - ZRC 38220, 2 ex., 55.2-55.8 mm SL, Kota Tinggi, Sg. Tementang, coll. H. H. Tan et al., 21 Aug.1994. - ZRC 11912, 2 ex., 49.0-54.3 mm SL, Kota Tinggi, coll. C. F. Lim. - ZRC 25765, 1 ex., 47.6 mm SL, Sg. Mupor along Kota Tinggi-Mersing road, coll. P. K. L. Ng et al., 24 Jul.1992. - ZRC 18130, 2 ex., 42.4-45.2 mm SL, 100 m north of road marker 175 km on Johor Bahru-Kuantan road (north of Mersing), coll. P. K. L. Ng et al., 19 Oct.1991. - ZRC 19490, 1 ex., 43.1 mm SL, swamp near Mersing, coll. P. K. L. Ng, Sep.1991. - ZRC 8442, 2 ex., 53.1-55.0 mm SL, Muar, 14th mile on Yong Peng Road, coll. not known, 7 May.1962. - ZRC 19072, 1 ex., 47.3 mm SL, Mawai district, coll. M. W. F. Tweedie, 1935. - ZRC 8501, 1 ex., 48.3 mm SL, 14th mile on Muar-Yong Peng road, coll. E. R. Alfred, 28 Sep.1967. - ZRC 28720, 1 ex., 42.2 mm SL, near Pontian, coll. P. K. L. Ng et al., 4 Mar.1992. - ZRC 28995, 1 ex., 53.1 mm SL, Gg. Pulai Reservoir, coll. P. K. L. Ng et al., 4 Mar.1992. - ZRC 19135, 1 ex., 50.6 mm SL, stream near Gg. Pulai Reservoir (south), coll. P. K. L. Ng, 14 Mar.1990. - ZRC 1576.1-1576.11, 11 ex., 58.4-67.2 mm SL, Gg. Pulai, coll. L. K. Charles, Apr.1934. - ZRC uncat., 2 ex., 41.7-42.1 mm SL, Gg. Pulai, along stream via access road to Pekan Nanas, coll. H. H. Tan et al., 20 May 1993. - ZRC 38240, 5 ex., 38.3-46.8 mm SL, Pontian, stream draining from Gg. Pulai Reservoir, coll. P. K. L. Ng et al., 29 Sep.1994. - ZRC 13887, 3 ex., 42.9-52.5 mm SL, Gg. Panti foothills, coll. P. K. L. Ng, 31 Aug.1990. - ZRC 19492, 2 ex., 59.0-59.6 mm SL, Gg. Panti, forest, coll. P. K. L. Ng, Oct.1991. - ZRC 32485, 1 ex., 49.9 mm SL, Air Hitam, Parit Botak, blackwater stream, km 8, coll. Yong, 23 Jan.1993. - Holotype - *Betta brederi*, USNM 094400, 64.2 mm SL female, Johor, coll. Ramsperger, Arnold, 22 Oct.1934. **Singapore:** ZRC 38297, 9 ex., 44.7-52.6 mm SL, Nee Soon Swamp forest, coll. P. K. L. Ng et al., 23 Aug.1993. - ZRC 38298, 9 ex., 41.6-56.3 mm SL, Nee Soon Swamp forest, coll. P. K. L. Ng et al., 29 Jul.1993. - ZRC 12196, 2 ex., 42.4-49.2 mm SL, forest stream draining into northern arm of Lower Pierce Reservoir, coll. P. K. L. Ng, 13 Jul.1990. - ZRC 34621, 1 ex., 54.3 mm SL, Rifle Range road, coll. C. Y. Chang et al., 27 May.1993. - ZRC 30376, 2 ex., 40.6-44.2 mm SL, Nee Soon Swamp forest, edge of abandoned kampong near upper Thomson road, coll. P. K. L. Ng, 15 Jan.1993. - Holotype - *Betta macrophthalma*, BMNH 1868.7.10:28, 36.3 mm SL juvenile, Singapore, coll. Peters.

Diagnosis.- The oral brooding *B. pugnax* can be distinguished from all other species of *Betta* by its relatively large head, 2.5-3.6 times in SL; iris without broad iridescent patches; live specimens usually brown with greenish to bluish iridescent spots on the scales, males usually with iridescent operculum scales, occasionally even covering the anterior portion of the belly; juveniles and females usually with a light brown background displaying two dark bands running transversely across the body converging at the base of the caudal peduncle with a dark spot; body stout, body depth 2.7-3.6 times in SL; juveniles generally more slender with proportionately larger eyes; head rhombic when viewed from above, with central stripe and sometimes with an oblique lower preorbital stripe from eye to throat, dark lower preorbital stripe extending; maxillary approaching vertical of front margin of eye in just several specimens; fins of mature specimens pointed, often elongated, caudal broadly lanceolate (Fig. 5a); preorbital part of lower stripe usually present but sometimes not visible.

Description.- General body shape and appearance as in Figs. 1a-c, 3a-c, 4a-b. Body slender, vertebral formula 2,8,18-21; dorsal-fin origin above 13th scale of lateral row; posterior extremity pointed, reaching about anterior 3rd of caudal fin. Caudal fin broadly lanceolate. Anal fin origin under the 7th scale of lateral row; posterior extremity pointed and reaching beyond anterior half of caudal fin. Pectoral fin rounded. Scale counts: lateral 28-31 scales (mode 29), transverse 9-9¹/₂ (mode 9¹/₂), subdorsal 5-8 (mode 6), predorsal 19-21 (mode 20), postdorsal 11-12 (mode 11). Fin ray counts: dorsal 0-II, 7-10 (total 8-10, mode 10), caudal ii, 4+5, ii, anal I-II, 22-26 (total 25-28, mode 26), pelvic I, 1, 4, pectoral 13.

Morphometrics, in % SL: TL 130.6-148.1; pre-dorsal fin length 60.9-73.4; pre-anal fin length 40.6-51.2; pelvic fin length 26.6-43.8; head length 27.5-35.2; body depth at dorsal origin 24.8-32.1; anal fin base 44.2-54.0; dorsal fin base 9.9-15.7; in % HL: orbital diameter 27.9-38.5; post-orbital length 45.0-55.7; inter-orbital distance 32.4-53.0; snout length 8.8-24.2; in % PDL: head length 41.6-54.3.

Colouration.- Live colour as in Figs. 1a-c. Topotypes from Penang have a blue iridescent operculum with a light brown background. Each scale on the body and the operculum has an area with concentrated chromatophores. The chromatophores are typically blue to greenish-blue. Specimens from Taiping, Perak exhibit the same features (Fig. 1b). Both localities are similar, i.e. hill streams with clear waters of about pH 7.4. Specimens from more acidic waters, like those from Singapore, tend to have less blue and more green colouration in their iridescence (Fig. 1c).

Specimens of *B. pugnax* from various parts of Peninsular Malaysia and Singapore have been kept in captivity and their colour patterns observed. Acclimatised male specimens invariably exhibit concentric barring on the caudal fin membrane, although populations from Gunung Pantí (ZRC 13887, 19492) area in Johor only have faint markings. Twenty-one adult specimens from Singapore were dissected and their gonads examined (ZRC 38297, ZRC 38298). Specimens with barred caudal pattern were invariably males whilst specimens without the pattern were females. Mature male and female *B. pugnax* can thus be differentiated with this character, although it may vary somewhat with locality.

Distribution.- This species is widely distributed in Peninsular Malaysia and Singapore (Fig. 6).

Ecology.- Specimens were mainly collected in Penang from streams on hills and around the foothills. The waters were clear and ranged from fast flowing to sluggish. These habitats were usually with sandy bottoms covered with rocks. There was little or no submerged vegetation. Overhanging bank vegetation, submerged leaf litter and exposed roots of bank vegetation constituted the main habitats for *B. pugnax* and they were found in and at the peripheries of stagnant areas. The pH averaged 7.4 (7.1-7.6). Water depth ranged from 10 to 80 cm. There were no sympatric belontiids in these habitats. This fish has survived well in the habitat as evident by the numerous juveniles encountered in the streams. Certain sites visited were badly disturbed, however, and introduced guppies (*Poecilia reticulata*) were thriving. Some of the sites mentioned by Alfred (1964) had been converted into industrial estates and the natural waterways have been canalised. The only other *Betta* found on the island, but not sympatric with *B. pugnax*, is *B. imbellis* Ladiges, 1975.

Specimens from Penang usually breed at sizes >40 mm SL, whereas certain populations from Johor and Singapore <40 mm SL were in full adult colour and mouthbrooding (pers. obs.). Some juveniles were reared to adulthood from a wild-caught mouthbrooding male from Singapore. These juveniles were grown out under crowded conditions in a small tank. These specimens reached maturity at much smaller sizes, and fully coloured specimens of <40 mm SL were observed to be already mouthbrooding (pers. obs.). This demonstrates the adaptability of this species to mature at a relatively small size.

Remarks. - Cantor (1850) described *B. pugnax* based on an unspecified number of specimens and did not designate a type. Alfred (1964) selected as lectotype, a complete specimen preserved in alcohol whereas the two paralectotypes were formerly dried specimens

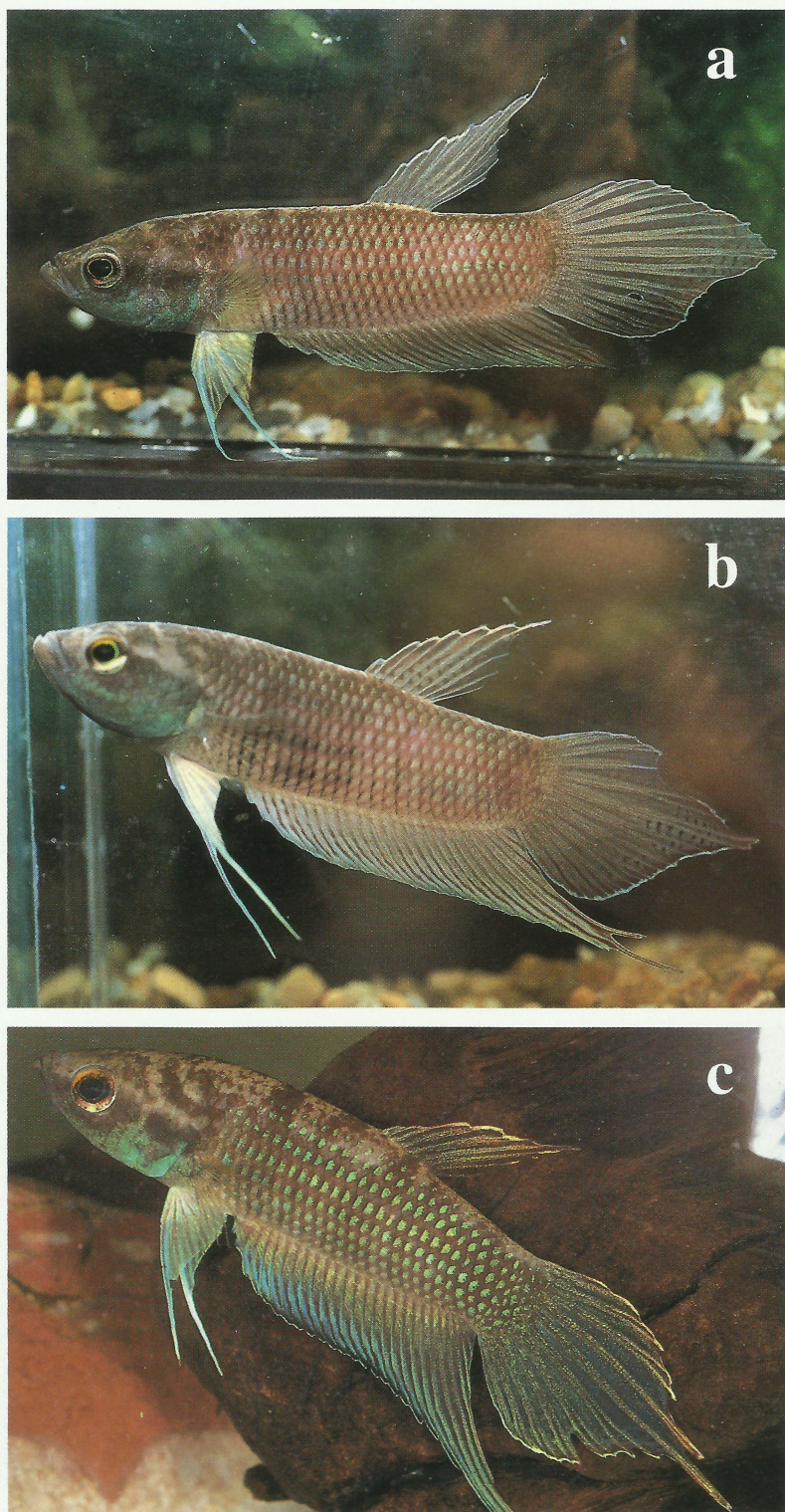


Fig. 1. *Betta pugnax*: a - ZRC 39264, 60.1 mm SL male example from Penang (right side, reversed); b - ZRC 39664, 56.7 mm SL male example from Taiping, Perak (right side, reversed); c - male example (not preserved) from Nee Soon swamp forest, Singapore (photographed by Peter K. L. Ng).

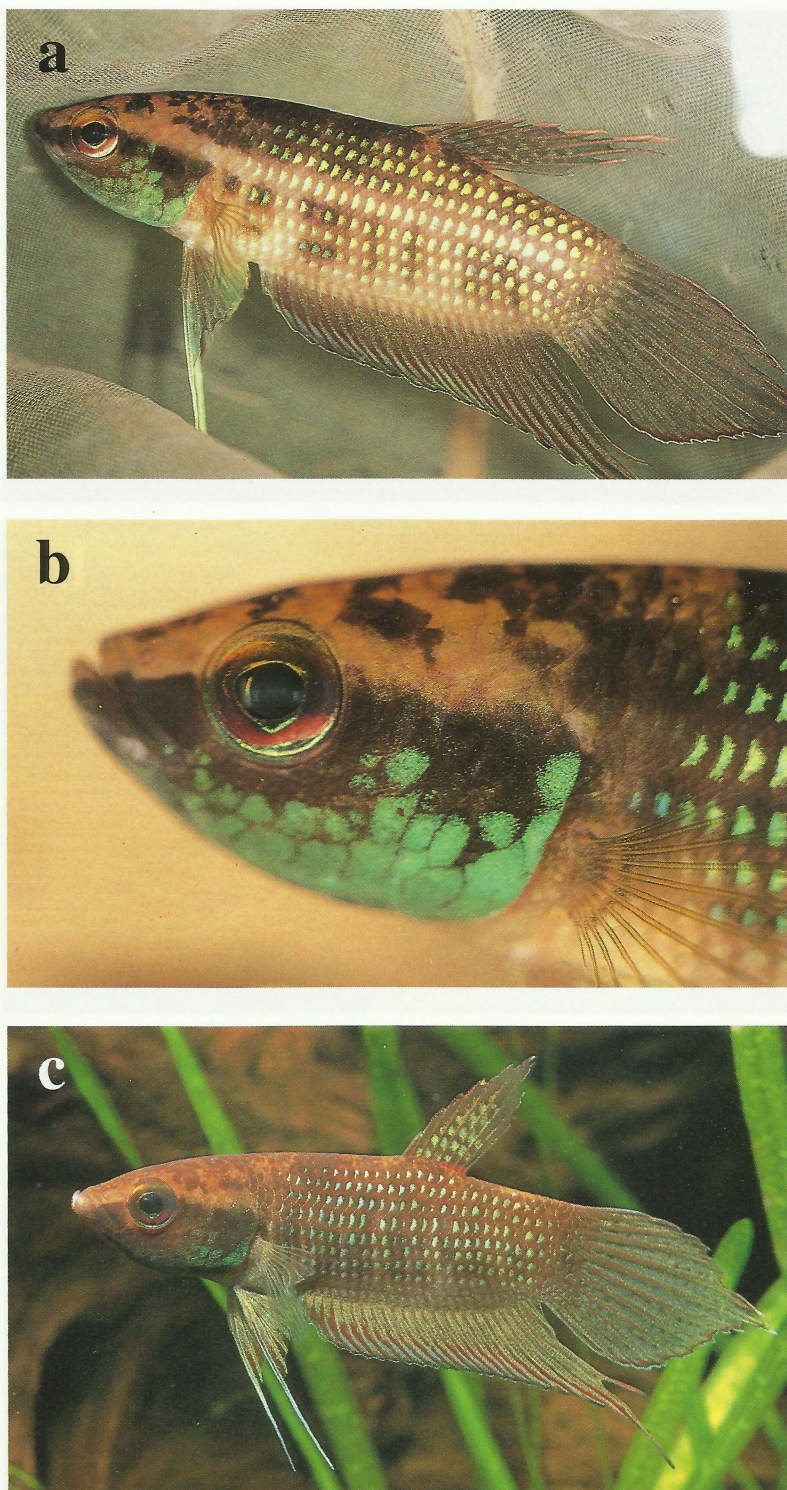


Fig. 2. *Betta pulchra*, new species: a - ZRC 17368, 55.9 mm SL male example from Pontian, Johor (photographed by Peter K. L. Ng); b - ZRC 17368, profile of head (photographed by Peter K. L. Ng; right side, reversed); c - male example (not preserved) from Pontian, Johor (photographed by Koji Yamazaki).

that are now stored in alcohol. Only the skins on the left side of the two paralectotypes remains whereas the vertebrae and the right side of the bodies had been removed. The whereabouts of the removed body parts is not known. The fins of all the specimens are also damaged (Fig. 3a). Citation for this species is also somewhat confusing as Cantor's catalogue bears the printed date 1849 but was not published until 1850 (see Tweedie, 1952).

Bleeker (1860a, 1860b) and Weber & de Beaufort (1922) reported *B. anabatoides* Bleeker, 1851, from Singapore without stating whether they had examined any specimens. This is also the case for Herre & Myers (1937), Fowler (1938) and Herre (1940). We have examined many *Betta* specimens from Singapore; none of them of which are *B. anabatoides* s. str. *Betta pugnax* and *B. tomi* are the only large species of *Betta* recorded from Singapore. *Betta anabatoides* can be easily distinguished from *B. pugnax* by its higher lateral scale count (33 vs. 29-30), higher anal fin ray count (31 vs. 25-28), and absence of iridescent operculum scales (pers. obs.). Herre & Myers (1937) identified a juvenile (35 mm long) specimen from Singapore as *B. anabatoides* without indicating the specimen catalogue number. The identification is probably incorrect. We are confident that all large *Betta* species (above 50 mm SL) from Singapore are either *B. pugnax* or *B. tomi*, of which *B. tomi* is extinct and grows to a larger size (see Ng & Kottelat, 1994). *Betta tomi* also differs from *B. pugnax* in having a higher lateral scale count (31 vs. 29-30), higher vertebral count (33 vs. 28-31) and a different throat pattern (two black oval spots vs. chin-strap) (cf. Ng & Kottelat, 1994). *Betta anabatoides* can be differentiated from *B. tomi* by having a higher lateral scale count (33 vs. 31) and absence of throat markings (vs. presence of two oval spots) (cf. Witte & Schmidt, 1992; Ng & Kottelat, 1994). There are seven specimens deposited in CAS (CAS 133176) which were collected by Herre in 1937 from Singapore. They have been tentatively identified as *B. tomi* (see Ng & Kottelat, 1994). This is of significance especially since the specimen determined by Herre & Myers (1937) as *B. anabatoides* was also from Singapore. The size of that specimen also falls in the range of the specimens deposited in CAS. All the available evidence thus indicates that *B. anabatoides* is in fact, not present in Singapore, with the record of Herre & Myers (1937) almost certainly referring to *B. tomi* instead.

Regan (1910) described *Betta macrophthalma* from a specimen (36.3 mm SL) obtained from Singapore. Schmidt (1988) regarded *B. macrophthalma* as valid and senior synonym of *B. waseri* Krummenacher, 1986 (see Schmidt, 1988; Linke, 1990). Witte & Schmidt (1992) noted that *B. macrophthalma* was a junior synonym of *B. pugnax*, and considered *B. waseri* as a valid species. Ng & Kottelat (1994) redescribed *B. waseri* and described three new allied species. We have examined the holotype of *B. macrophthalma* (BMNH 1868.7.10:28 - Fig. 3c) and most of the known material of *B. pugnax* from Singapore and they are clearly conspecific. We conclude that *B. macrophthalma* is a juvenile of *B. pugnax*. Only two *Betta* species have been recorded from Singapore other than *B. pugnax*, viz. *B. imbellis* Ladiges, 1975, which is most likely introduced (see Ng et al., 1993) and *Betta tomi* Ng & Kottelat, 1994, which is now probably extinct.

Myers (1935) described *B. brederi* from two specimens from an unspecified locality in Johor, Peninsular Malaysia. The fish was not illustrated and Myers distinguished his species as new on comparisons with *B. splendens*, *B. anabatoides*, *B. patoti*, *B. picta*, *B. taeniata* and *B. bellica*. He did not compare his species with *B. pugnax*. Breder (1934) had reported that it might be *B. pugnax*, but Myers was convinced that it represented a hitherto undescribed species. This has caused some instability in the taxonomy of this species group with some workers considering it valid (Vierke, 1988) and others synonymising it with *B. pugnax* (see

Witte & Schmidt, 1992). The two type specimens were two of four that had been caught in the spring of 1933 by A. Ramsperger and purchased by C. W. Coates for the New York Aquarium (Myers, 1935). These four fishes were used by Breder for studying the breeding behaviour of *Betta* which practices oral brooding (Breder, 1934). The description of *B. brederi* was published on February 6, 1935, which indicates that the specimens had been kept in captivity for at least a year or more. Examination of the holotype of *B. brederi* (USNM 094400 - Fig. 4a) indicates that it is an obese *B. pugnax*. We made a direct comparison of the holotype of *B. brederi* with a live specimen of *B. pugnax* from Singapore which had been kept in captivity for about two years (Fig. 4b). The specimen in Fig. 4 is showing signs of obesity due to a generous feeding regime. Comparing Fig. 4b with the holotype of *B. brederi* (Fig. 4a), we conclude that *B. brederi* is merely an overfed specimen of *B. pugnax*. From our experience, aquarium fishes (including several *Betta* species) which have generous feeding regimes usually have their natural physiognomy altered (pers. obs.).

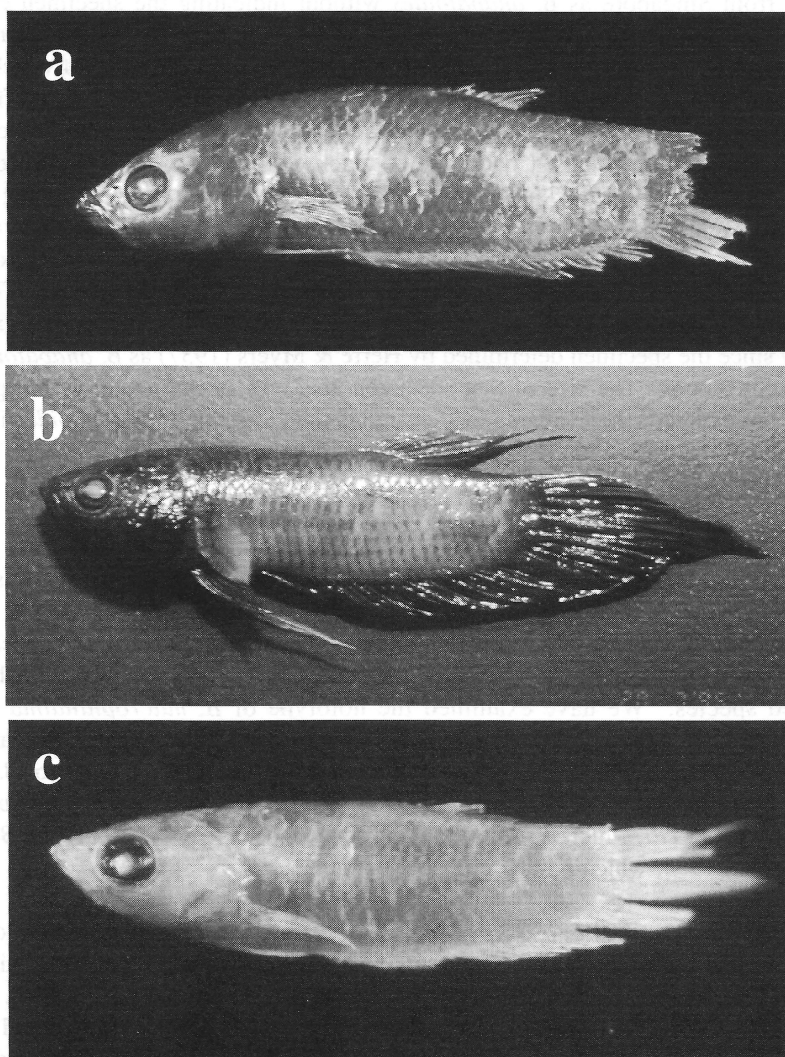


Fig. 3. *Betta pugnax*: a - lectotype, BMNH 1860.3.19:930, 60.6 mm SL example from Penang; b - ZRC 39264, 60.1 mm SL male example from Penang; c - *Betta macrophthalmia* holotype, BMNH 1868.7.10:28, 36.3 mm SL example from Singapore.

Tweedie (1936) reported *B. fusca* from Singapore and Langkawi Island; whilst Herre (1940) reported it from Singapore and Johore. Tweedie's paper provided a list of fishes curated in the Raffles Museum (now ZRC) and also listed other *Betta* species such as *B. ocellata* from Borneo and *B. taeniata*. The fishes were identified mostly by Herre. We had examined the specimens which were identified as *B. fusca* by Herre in the Raffles Museum (present day ZRC) and found them to be *B. pugnax*.

Herre & Myers (1937) reported *B. taeniata* from Singapore, Johore and Perak. Examination of the specimens identified as *B. taeniata* by Herre & Myers (1937) and Herre (1940) in the Raffles Museum (now ZRC) confirm that they are *B. pugnax* and not *B. taeniata*. Herre & Myers (1937) had in fact stated that the specimens that they had examined did not agree entirely with *B. taeniata* and were very variable, having one or two dorsal spines. They also commented that the specimens could represent *B. brederi*, which is here regarded as a junior subjective synonym of *B. pugnax*. Herre (1940) based his identification of *B. taeniata* mainly on the presence of two longitudinal bands, one over the eye and the other below the pectoral, versus the absence of these two bands in *B. pugnax*. The other characters that he used: lateral scale counts, predorsal scale counts and anal fin ray counts, were within the normal meristic variation of *B. pugnax*. The characters used by Herre & Myers (1937) are not reliable with *Betta* species (see Witte & Schmidt, 1992). In general, species of this genus exhibit the striped pattern depending on their physiological state, e.g. sex, maturity, reproductive condition. To this effect, we have examined the syntypes of *B. taeniata* (BMNH 1893.3.6: 147-150, 4 ex., 33.8-42.1 mmSL) and fresh material collected from Sarawak.

Roberts (1989: 173) listed *B. pugnax* as from Kapuas basin. His figure depicts a specimen of 45.4 mm SL (Kapuas 1976-51, MZB 3866), which shows very long pelvic fins and a rather short and stocky body. Witte & Schmidt (1992: 327) doubted the identity of Roberts' specimens and tentatively placed the Kapuas specimens under *Betta* (sp. E) sp. E. We had examined specimens from MZB lots number 3859, 3863-66 and the characters do not agree with *B. pugnax* s. str. in their very long pelvic fins (filamentous tip reaching up to 19th anal ray); chin bar being absent; and the caudal striation present or faint in both sexes. These specimens probably belong to an undescribed species.

We had examined specimens of *B. cf. pugnax* from Sarawak, which Witte & Schmidt (1992: 327) had identified as *Betta* (sp. E) sp. F. These specimens belong to be a new species and will be described elsewhere. It differs from *B. pugnax* s. str. as follows: longer pelvic fins, caudal striation absent and opercular markings below postorbital strip present.

Comparative material examined. - *Betta cf. pugnax*: MZB 3859, 1 female, 30.8 mm SL; Kapuas 1976-6. - MZB 3863, 1 female, 39.8 mm SL; Kapuas 1976-37. - MZB 3864, 2 males, 38.0 - 45.7 mm SL, 1 female, 41.3 mm SL; Kapuas 1976-39. - MZB 3865, 1 female, 40.0 mm SL; Kapuas 1976-42. - MZB 3866, 1 male, 45.4 mm SL; Kapuas 1976-51 (see Roberts, 1989: 13-17).

Betta anabatooides: MZB 3846, 1 ex., 58.0 mm SL; Kapuas 1976-1. - ZRC 22842-43, 2 ex., 46.7-55.9 mm SL; Borneo: Kalimantan Tengah, Mentaya Basin, Sg. Ramban, 22 km west of Sampit on road to Pembuanghulu; T. R. Roberts, 11 Jun.1992. - ZRC uncat., 2 ex., 47.2-55.3 mm SL; Borneo: Kalimantan Selatan, Banjarmasin, stream at 55 km to Martapura on Rantau-Martapura road; H. H. Ng & O. K. S. Chia, 6 Jun.1996.

***Betta pulchra* , new species**

(Figs. 2a-c, 4c)

Material examined. - Holotype - ZRC 28860, 49.9 mm SL; Malaysia: Johor, Pontian, Kampong Jasa Sepakat; P. K. L. Ng et al., 8 May.1992.

Paratypes - ZRC 17368-17370, 3 ex., 55.9-34.4 mm SL; Malaysia: Johor, Pontian; P. K. L. Ng et al., 1989. - ZRC 29123-29125, 3 ex., 50.2-44.8 mm SL; Malaysia: Johor, Pontian, Sri Bunian, Kampong Pt. Tekong; P. K. L. Ng et al., 8 May.1992. - ZRC. 39252, 5 ex., 39.0-45.3 mm SL; Malaysia: Johor, Pontian, ~4 km towards Pontian Kechil from Sri Bunian (1°27'13.1"N 103°24'52.1"E); P. K. L. Ng et al., 15 Aug.1995. - ZRC 28861-28899, 39 ex., 46.5-19.8 mm SL; Malaysia: Johor, Pontian, Kampong Jasa Sepakat; P. K. L. Ng et al., 8 May.1992.

Other material - ZRC. 39251, 15 ex., 21.5-36.5 mm SL; Malaysia: Johor, Pontian, Sri Bunian, Kampong Pt. Tekong (1°27'59.2"N 103°26'07.7"E); P. K. L. Ng et al., 15 Aug. 1995. - ZRC. 39250, 13 ex., 21.7-43.1 mm SL; Malaysia: Johor, Pontian, Sri Bunian, Kampong Jasa Sapakat (1°31'30.5"N 103°27'47.7"E), 5 km into side road leading into oil-palm estate; P. K. L. Ng et al., 15 Aug.1995.

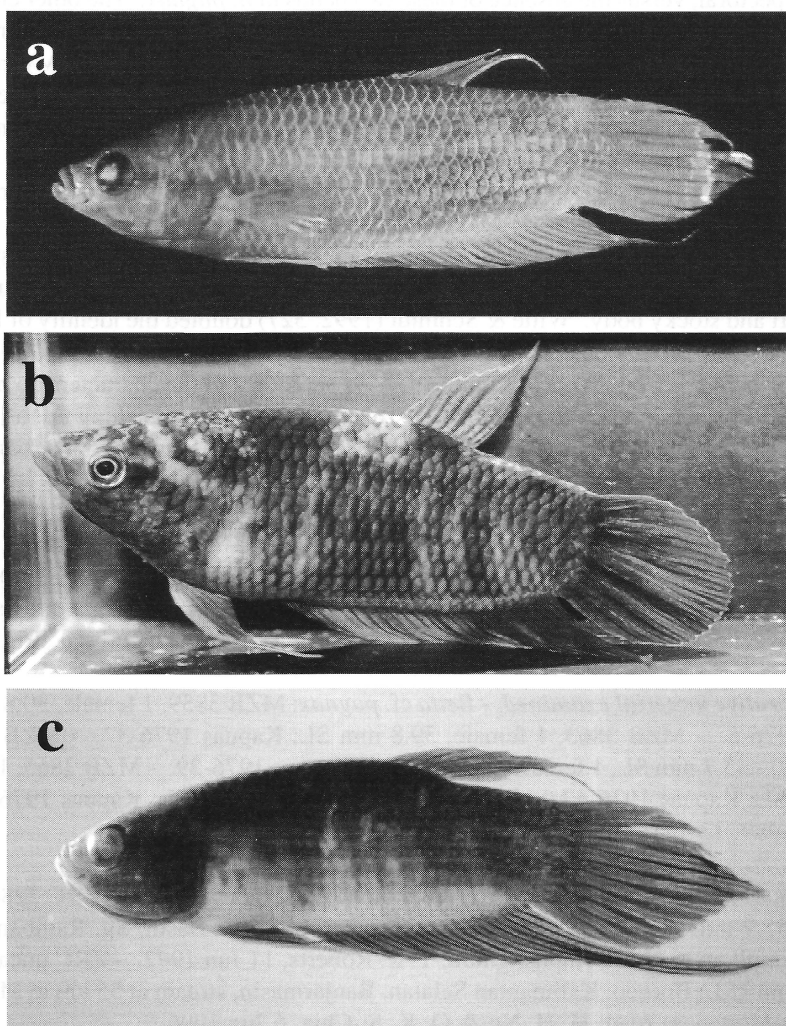


Fig. 4. a - *Betta brederi* holotype, USNM 094400, 64.2 mm SL female example from Johor; b - *Betta pugnax*, obese specimen from Singapore, not preserved (right side, reversed); c - *Betta pulchra*, new species, holotype, ZRC 17368, 55.9 mm SL male example from Pontian, Johor.

Diagnosis.- *Betta pulchra* is a distinctly stouter fish than *B. pugnax* s. str. (dorsal depth 25.9-36.9 vs. 24.8-32.1 % SL). It possess more iridescent scales on the body in life than that of *B. pugnax*. The caudal fin of *B. pulchra* is narrowly lanceolate compared to the broadly lanceolate caudal fin of *B. pugnax* (Fig. 5a-b). The dorsal, caudal, anal and pelvic fins of *B. pulchra* are proportionately longer than those of *B. pugnax*.

Description.- General body shape and appearance as in Figs. 2a-c, 4c. Body short and stocky, vertebral formula 2,8,19; head sharp and stout with black stripe running from lower jaws across eye and to edge of operculum; operculum iridescent; dorsal fin origin above 13th scale of lateral row, posterior extremity pointed, reaching about anterior third of caudal fin. Caudal fin narrowly lanceolate. Anal fin origin under 8th scale of lateral row; posterior extremity pointed, reaching to half or more of caudal fin, often reaching the end or beyond in mature male specimens. Pectoral fin rounded. Scale counts: lateral 28-30 (mode 29), transverse $9\frac{1}{2}$, subdorsal $6-7\frac{1}{2}$ (mode 7), predorsal 18-21 (mode 20), postdorsal 10-11 (mode 10). Fin ray counts: dorsal I-II, 8-9 (total 9-10, mode 9), caudal ii, 4+5, ii, anal I-II, 22-26 (total 24-28, mode 26), pelvic I, 1, 4, pectoral 12-13 (mode 13). Morphometrics, in % SL: TL 136.6-156.6; pre-dorsal fin length 60.8-66.0; pre-anal fin length 44.7-50.0; pelvic fin length 29.1-53.2; head length 32.7-37.6; body depth at dorsal origin 25.9-36.9; anal fin base 49.8-52.9; dorsal fin base 13.9-15.9; in % HL: orbital diameter 26.0-31.3; post-orbital length 44.3-49.7; inter-orbital distance 34.3-41.8; in % PDL: head length 49.8-58.5.

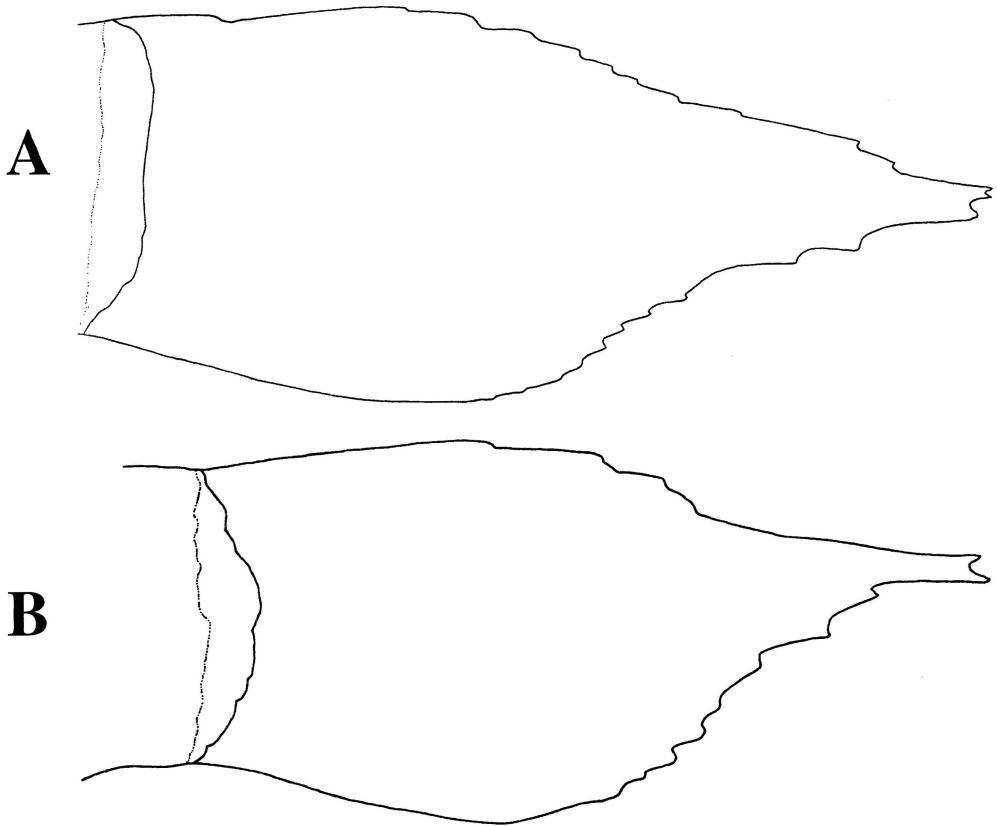


Fig. 5. Caudal fin outline of: a - *Betta pugnax*, ZRC 39264, 60.1 mm SL male example from Penang; b - *Betta pulchra*, new species, ZRC 39252, 39.8 mm SL male example from Pontian, Johor.

Colouration.- Live colour as in Figs. 2a-c. The colour pattern is similar to that of *Betta pugnax* s. str., except that the colour of the iridescent scales are greenish (cf. blue to greenish-blue of *B. pugnax*). The chromatophores on the body of this species are more intense than those of *B. pugnax* in life. Operculum with iridescent greenish scales; body brown with iridescent green scales. Distal part of pelvic rays iridescent green; dorsal fin with faint ladder-like vertical bars on membrane; caudal fin clear, with barred or striated pattern on mature males; anal fin with red outer border and black edge.

Ecology.- This species is found in blackwater habitats, other sympatric belontiids are *Belontia hasseltii*, *Betta bellica*, *B. imbellis*, *Sphaerichthys osphromenoides*, *Parosphromenus* sp. and *Trichopsis vittata*. This species is common only in the overgrown bank vegetation of the irrigation canals. The whole of Pontian was a peat swamp forest, but had been converted to oil-palm, pineapple and rubber plantations. The pH of the waters range from 3.9 to 4.2. This species is a paternal oralbrooder, the fry are not molested unless adults are starved. Juveniles at about 15 mm long already exhibit some iridescence on the body (pers. obs.).

Distribution.- This new species appears to be restricted to the blackwaters in Pontian, Johor, West Malaysia (Fig. 6).

Etymology.- The name is derived from the Latin *pulcher* meaning handsome, alluding to the beauty of this fish.

Remarks.- Witte & Schmidt (1992) had suggested that *B. pugnax* belongs to its own species group, but recognised only one species. The only other species referred to this species-group so far is *B. prima* Kottelat, 1994. *Betta pulchra*, new species, is the third species in this group. From the live colour photographs of *B. prima* depicted (Kottelat, 1994: 299), this species has very light green iridescent operculum scales (cf. blue to greenish-blue of *B. pugnax* and *B. pulchra* respectively). The lower head stripe is complete (vs. incomplete in *B. pugnax* and *B. pulchra*). The fins are also shorter and not as elongated as in *B. pulchra*. *Betta prima* is also a smaller species (40 mm SL vs. 60 mm SL and above for *B. pugnax*). Male *B. prima* do not possess the barred or striated pattern on the caudal fin, whereas both *B. pugnax* and *B. pulchra* have this feature. Another newly described species, *B. schalleri* Kottelat & Ng, 1994, looks similar to species in the *B. pugnax* species group, although it is currently in the *Betta* sp. E group as defined by Witte & Schmidt (1992) (see Kottelat & Ng 1994: 75). *Betta pulchra* differs from *B. schalleri* by the following characters: TL - 145.5 (mean) vs. 140.8 (mean) % SL; HL - 34.4 (mean) vs. 36.0 (mean) % SL, 212 (mean) vs. 230 (mean) % post-orbital head length; Dorsal depth - 30.6 (mean) vs. 27.4 (mean) % SL; length of pelvic fin - 39.5 (mean) vs. 33.2 (mean) % SL; eye diameter - 59 (mean) vs. 71 (mean) % post-orbital head length; inter-orbital width - 83 (mean) vs. 73 (mean) % post-orbital head length; presence of barred or striated pattern on the caudal membrane vs. absence of the caudal pattern. We had also examined the syntypes of *B. fusca* (BMNH 1908.17.13:18-19, 53.2-59.7 mm SL) and it can be differentiated from *B. pulchra* by having more predorsal scales (23-24 vs. 18-21) and absence of a chin-bar (vs. present).

Betta pulchra has so far, not been found together with *B. pugnax* (pers. obs.). In fact, *B. pugnax* has not been collected from true blackwater habitats so far. This suggests that the two species have different habitat preferences. The morphological differences between the two are quite distinct and are valid for females and subadults. We have kept juveniles and grown them up in the aquarium with neutral water and fed them with commercial feed. The physiognomy of these captive adult specimens are still similar to wild caught adult specimens,

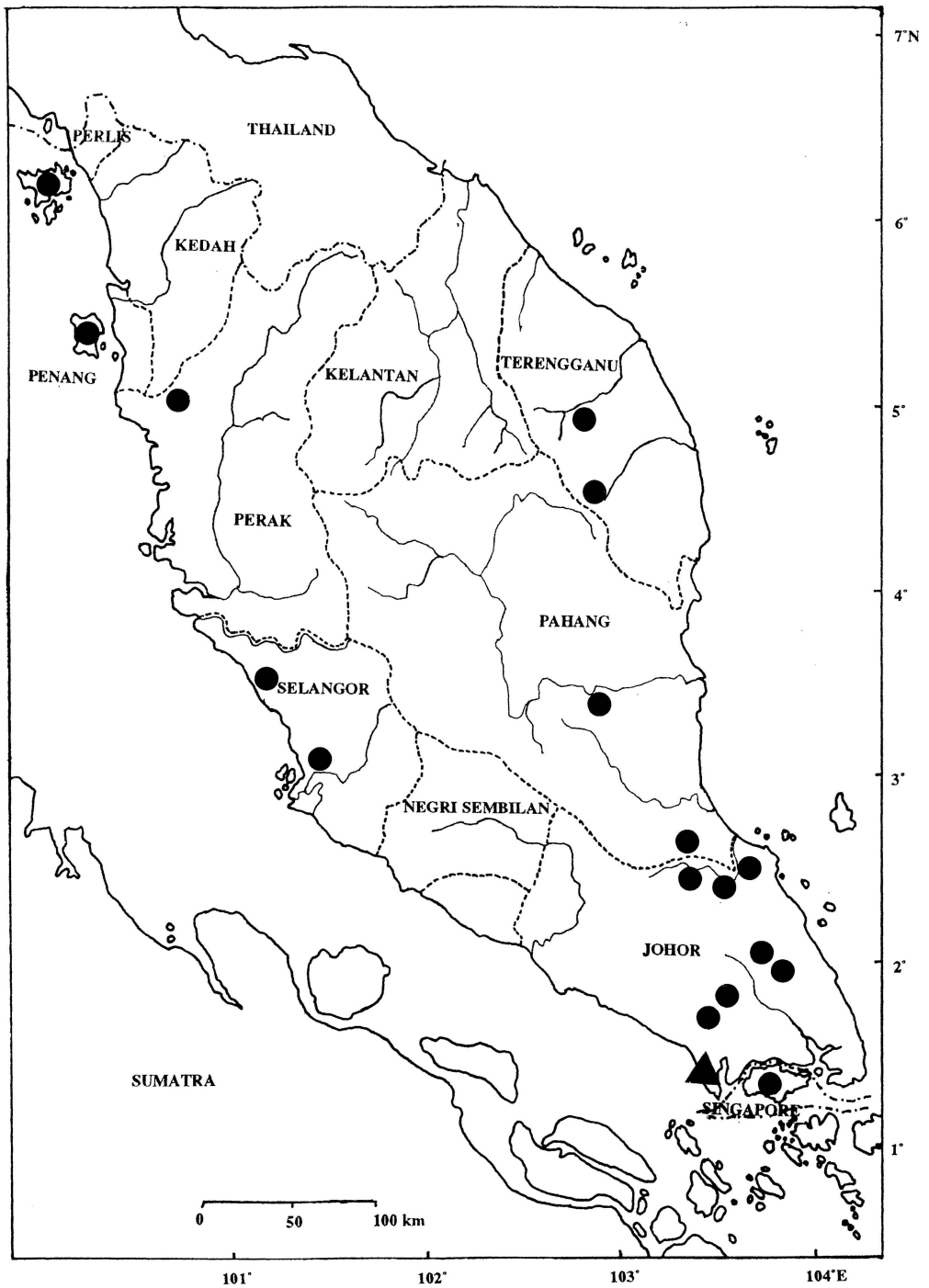


Fig. 6. Map of the distribution of *Betta pugnax* ● and *Betta pulchra* ▲, new species, in Malaysia Peninsula.

suggesting that these morphological features are genotypically controlled. Moreover, polymorphism due to different habitat types has yet to be demonstrated in belontiids.

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