RAFFLES BULLETIN OF ZOOLOGY **69**: 522–540
Date of publication: 10 December 2021
DOI: 10.26107/RBZ-2021-0069
http://zoobank.org/urn:lsid:zoobank.org:pub:4D1086F5-6FC4-4FB7-9A83-A13769F4BF2B

Two new species of *Barbodes* from the Malay Peninsula and comments on 'cryptic species' in the *B. binotatus* group (Teleostei: Cyprinidae)

Maurice Kottelat[1,2*] & Kelvin K. P. Lim[2]

Abstract. *Barbodes sellifer*, new species, is described from Singapore, the southern Malay Peninsula and Riau (Sumatra). It is distinguished by having, among others, a large triangular to rectangular blotch between the dorsal fin and the midlateral row of scales (+1). *Barbodes zakariaismaili*, new species, is described from the Jelai watershed of the Pahang drainage. It is distinguished, among others, by having an elongated blotch on the anterior third of scale rows 0 and +1, and a narrow, faint bar between dorsal-fin origin and scale row +1. The existence of the supposed *B. binotatus* cryptic species is discussed; it does not satisfy any of the criteria under different concepts and this terminology should not be used. Among others, it is made of diagnosable units, and the morphological disparity among the supposed 'cryptic' taxa is not substantially lower than among non-'cryptic' relatives. It is simply a taxonomically difficult group.

Key words. *Barbodes*, Singapore, Malaysia, cryptic species

INTRODUCTION

A number of small cyprinid fishes of the genus *Barbodes* from Southeast Asia distinguished by having, at least at some stage of their ontogeny, a midlateral row of four or five black spots on the flank, one black spot at and below the origin of the dorsal fin, and one black spot above the base of the anal fin have been called *Barbodes binotatus*. They are known from throughout Southeast Asia, where they usually occur in streams with clear, slow to fast moving water. They exhibit different colour patterns but reportedly few differences in morphology (with morphology being understood almost exclusively as meristics [scale and fin-ray counts] and some morphometry, which may be biased). This diversity has long been considered to characterise a single very variable species (e.g., Weber & de Beaufort, 1916: 186; Smith, 1945: 183; Kottelat et al., 1993: 42). Roberts (1989: 61) included 15 nominal species in the synonymy of his *B. binotatus*, but other authors have recognised some of these species as valid. For example, Herre (1940: 31) described *Puntius binotatus banksi* from Singapore, the Malay Peninsula (Johor), and Borneo (Kuching); Inger & Chin (1962: 73) considered *B. sealei* as a distinct species which, in northern Borneo, is sympatric with a species they identified as *B. binotatus*. These fishes became known collectively as the '*B. binotatus* group' (e.g., Kottelat & Lim, 1995: 233), a vague term that did not imply close phylogenetic relationships but merely that they share a colour pattern with a midlateral row of three to five black spots. In a catalogue of fishes from the inland waters of Southeast Asia, Kottelat (2013: 77) listed both *B. banksi* and *B. sealei* as valid species.

In a checklist of the fishes of Sarawak and Brunei, we earlier commented (Kottelat & Lim, 1995: 233) "examination of large series from numerous localities throughout the range of the so-called [*Barbodes*] *binotatus* reveals that this name has been applied to a variety of species, usually easily distinguishable and apparently with clear cut geographic boundaries (Kottelat & Lim, unpubl.). [*Barbodes*] *banksi* occurs in Sarawak and in Kalimantan Barat [...]. [*Barbodes*] *sealei* is the only other species of the [*B.*] *binotatus* group known from Sarawak".

Kottelat (2000) created the name *B. rhombeus* to accommodate the species from the Mekong and Chao Phraya drainages and commented 'This species is usually identified as [*Puntius*] *binotatus*, a species restricted to Java, Bali, Lombok and highlands of Sumatra. All specimens referred to *P. binotatus* from elsewhere in Southeast Asia belong to several species, many of them still unnamed. The real *P. binotatus* is distinguished by its colour pattern [...]. Several species of the "*P. binotatus* group" occur in the intermediate areas (Sumatra lowlands and Malay Peninsula), all with distinctive colour patterns. A PCA analysis of morphometric and meristic characters of *P. binotatus* and the other species [....] has shown that these characters exhibit limited variation and that colour pattern is the most reliable character to distinguish species (Bariche, 1998)'. This PCA analysis was based mainly on our material.

Accepted by: Kevin Conway

[1]Rue des Rauraques 6, CH - 2800 Delémont, Switzerland; Email: mkottelat@dplanet.ch (*corresponding author)

[2]Lee Kong Chian Natural History Museum, Faculty of Science, National University of Singapore, 2 Conservatory Drive, Singapore 117377; Email: kelvinlim@nus.edu.sg

ISSN 2345-7600 (electronic) | ISSN 0217-2445 (print)

Our examination of material from over 500 populations throughout the range of the *B. binotatus* group shows that it in fact comprises several species with discrete ranges, distinguishable by the colour pattern of juveniles and/or the adults, and morphology. The main difficulty is to have access to sufficiently large series that include both adults and juveniles so as to understand the ontogeny of the elements of the colour pattern. Earlier authors had access to mainly small samples, not optimally preserved, usually including few adults, and few or no juveniles. Little attention had been given to describing the colour pattern of the juveniles. The analysis implies the search for characters other than the ritual scale and fin-ray counts (of little diagnostic value in this group), a difficulty for many evidently being that characterising shape is more difficult than compiling numerals. Within the whole *B. binotatus* group, we have observed differences in head and snout shape, position of the mouth and eyes, development of rostral fold, lips, and postlabial grove, and development, shape and size of scales on the caudal-fin base (not all these characters have diagnostic value in the case of the two species described here).

We have assembled material of the *B. binotatus* 'group' and worked at a revision of the group since the 1990s. With the hope that the results would be more conveniently organised, we had originally decided to publish all the information under a single title. The work progressed more slowly than desired because of the difficulties, among others, associated with obtaining material from some critical geographic areas. Although this work is well-advanced, circumstances make it necessary to publish some of our results now. We and other colleagues require names for use in various publications, and it has become necessary to name several still undescribed species without further delay. We describe herein two species from Singapore, the southern Malay Peninsula, the Riau Archipelago, Central Sumatra, and islands of Anambas and Natuna.

MATERIAL AND METHODS

Methods for measurements and counts follow Kottelat (2001) and Kottelat & Freyhof (2007). Lateral line scale counts are given as scales on the body + scales on the base of the caudal fin. The last two branched rays in the dorsal and anal fins articulating with the same pterygiophore are counted as 1½. Counts of unbranched dorsal- and anal-fin rays include only those visible externally or that can be detected with a needle [the anteriormost unbranched dorsal-fin ray is minute in *Barbodes* and counts of 3 externally visible rays in the dorsal fin are suspicious; a fourth ray is likely present but not visible externally]. Frequency of meristic values is indicated in parentheses, if more than one value is observed; an asterisk (*) indicates the condition for the holotype. Scale rows are numbered as follows: lateral-line row is row 0; the row immediately above it is row +1, the next row is +2, etc. The row immediately below the lateral-line row is row -1, etc. The rows are counted below the dorsal-fin origin; in front, rows are not continuous; the row above the lateral line row (or the next row above) becomes divided into two rows anterior to the vertical through the dorsal-fin origin (becoming +1 and +2, or +2 and +3, respectively); the middorsal scales in front of dorsal-fin origin are counted as a row. Examined material is in: ZRC, Zoological Reference Collection, Lee Kong Chian Natural History Museum, Singapore; and CMK, collection of the first author. The chresonymy presented herein includes only selected publications that cite specimens examined by the authors.

Barbodes sellifer, new species

(Figs. 1–4)

Puntius binotatus banksi: Herre, 1940: 31 (in part: Singapore: Botanic Gardens).

Puntius binotatus (non Valenciennes, in Cuvier & Valenciennes, 1842): Menon, 1954: 15 (in part: Mawai District in Johor, Singapore). – Alfred, 1963: 145 (in part: Penang Island: Bayan Lepas, Kampong Sungei Pinang, Kampong Trang, Balik Pulau, Georgetown, Ayer Itam, Sungei Burong; excluding Sungei Telok Bahang); 1966: 23 (various localities on Singapore Island). – Zakaria-Ismail, 1993: 205, pl. 3f (Pahang: Krau Game Reserve). – Tan & Tan, 1994: 353 (Riau Archipelago: Pulau Bintan).

Puntius banksi (non Herre, 1940): Ng & Lim, 1996: 110 (Singapore: Nee Soon swamp forest, Lower Peirce forest, Sime Road forest). – Tan & Lim, 2004: 109 (Anambas Islands: Pulau Jemaja; Natuna Islands: Pulau Natuna Besar).

Systomus banksi (non Herre, 1940): Ng & Tan, 1999: 355 (Endau basin: Sungai Kahang, Sungai Kinchin, Sungai Lenggor).

Holotype. ZRC 12354 mm SL, 97.8 mm SL; Singapore: Nee Soon swamp forest; K. Yong & P. K. L. Ng, 30 April 1990.

Paratypes. All from Singapore: ZRC 12355, 1, 69.2 mm SL; same data as holotype. — ZRC 1036, 3, 45.8–50.3 mm SL; Sungei Seletar, Nee Soon rifle range; E. R. Alfred, 17 February 1958. — ZRC 9612–9614, 3, 22.0–33.0 mm SL; Nee Soon streams; P. K. L. Ng, May 1988. — CMK 6027, 4, 18.4–60.4 mm SL; small streams in Nee Soon Rifle Range; 1°24′00″N 103°49′50″E; M. Kottelat et al., 21 May 1988. — ZRC 1242, 22, 13.3–78.9 mm SL; Botanic Gardens lake; T. Oates, 20 January 1964. — ZRC 17754, 3, 35.2–77.7 mm SL; Lower Peirce forest; E. Koh, 31 October 1991. — ZRC 50405, 3, 74.9–80.4 mm SL; Upper Peirce reservoir west arm off end of Dairy Farm Road at junction of Bukit Timah Expressway; H. H. Tan et al., 24 January 2006. — ZRC 54462, 3, 47.9–51.9 mm SL; Western catchment area, Pasir Laba; K. K. P. Lim & M. A. H. Chua, 19 June 2012. — ZRC 54865, 5, 30.1–45.2 mm SL; Western catchment, forest stream near Nanyang Technological University; D. J. J. Ng et al., 26 May 2016.

Additional material (non-type). Singapore: ZRC 349, 20 paralectotypes of *Puntius binotatus banksi*, 30.2–58.8 mm SL; pond in Botanic Gardens; A. W. C. T. Herre, March 1937. — ZRC 1222, 10, 44.2–75.6 mm SL; Sungei Kallang, outlet from MacRitchie Reservoir; 2 January 1964.

Malay Peninsula: East Coast: JOHOR: ZRC 53354, 3, 79.6–99.8 mm SL; Tebrau River at Tebrau Waterworks; 20 February 2007. — ZRC 19349, 7, 24.0–70.9 mm SL; Layang Layang; 6 February 1991. — CMK 7370, 1, 48.9 mm SL;

Fig. 1. *Barbodes sellifer*, new species, Singapore; **a**, ZRC 12354, holotype, 97.8 mm SL; **b**, ZRC 54462, paratype, 47.9 mm SL. (Photographs by M. Kottelat).

Sungai Mupor, about 15 km from Kota Tinggi on road to Mersing; 1°52′N 103°56′E; 22 January 1991. — ZRC 552, 6, 27.8–39.7 mm SL; Kota Tinggi District, Sedili Besar basin, drainage canals in Mawai Estate; 15 December 1957. — ZRC 39853, 4, 34.4–57.0 mm SL; Kota Tinggi District, Sedili Besar basin, Sungai Tementang; September 1995. — ZRC 13635, 10, 13.4–69.7 mm SL; Kota Tinggi District, streams at foothills of Gunung Panti; 16 September 1990. — ZRC 14196, 21, 22.3–73.0 mm SL; Kota Tinggi District, streams at foothills of Gunung Panti; 20 Septemer 1990. — ZRC 55945, 6, 33.3–47.7 mm SL; Kota Tinggi District, Gunung Panti foothills, stream along Bunker Trail; 8 May 1995. — CMK 7398, 9, 33.6–65.5 mm SL; Northeastern foothills of Gunung Panti, about 20 km north of Kota Tinggi; swampy creek; 22 January 1991. — CMK 8488, 3, 19.2–41.9 mm SL; Sungai Ambat, 61 km north of Kota Tinggi on road to Mersing; 24 July 1992. — CMK 16300, 1, 50.4 mm SL; stream on road Mersing–Batu Pahat, 53 km from Mersing, 34.4 km after turnoff from road Mersing–Johor; 12 May 2000. — ZRC 47845, 2, 32.7–57.3 mm SL; base of Gunung Belumut; 23 April 2003. — ZRC 55287, 5, 68.3–95.0 mm SL; Endau basin, Sungai Melayu; 1–2 August 2016. — ZRC 55301, 12, 53.2–110.2 mm SL; Endau basin, tributary of Sungai Kahang flowing from Bukit Tinggi; 5–6 August 2016. PAHANG: ZRC 41223, 2, 19.0–42.7 mm SL; Pahang basin: Sungai Kla at Raub; 10 November 1992. — ZRC 60582, 8, 27.8–68.1 mm SL; Pahang basin, Sungai Lompat at Krau Game Reserve; 26 August 1991. — ZRC 60585, 16, 21.4–55.5 mm SL; Pahang basin, tributary of Sungai Tekam; 28 February 1993 — ZRC 531, 2, 75.5–75.6 mm SL; Pahang basin, Kuala Tahan; 1948. — ZRC 543, 2, 75.6–72.7 mm SL; Pahang basin, Kuala Tahan; June 1950. — ZRC 6773, 1, 28.0 mm SL; Pahang basin, Kuala Tahan; 7 March 1957. — CMK 8435, 1, 65.8 mm SL; ZRC 542, 1, 73.0 mm SL; Pahang basin, Tasik Bera; October 1949. — ZRC 8084, 1, 118.8 mm SL; Pahang basin, Tasik Bera; 11 December 1967. — ZRC 60580, 3, 30.6–37.6 mm SL; Pahang basin, tributary of Sungai Triang; 23–25 January 1993. TERENGGANU: ZRC 22016, 27, 22.8–59.7 mm SL; CMK 8127, 31, 18.2–60.5 mm SL; North of Ayer Puteh, about 121 km on road from Kuantan to Kuala Terengganu; 17 March 1992. — ZRC 21699, 7, 22.1–42.4 mm SL; CMK 8170, 8, 19.7–48.8 mm SL; Sekayu waterfall; 18 March 1992. — ZRC 23497, 1, 51.5 mm SL; CMK 8186, 2, 35.6–58.7 mm

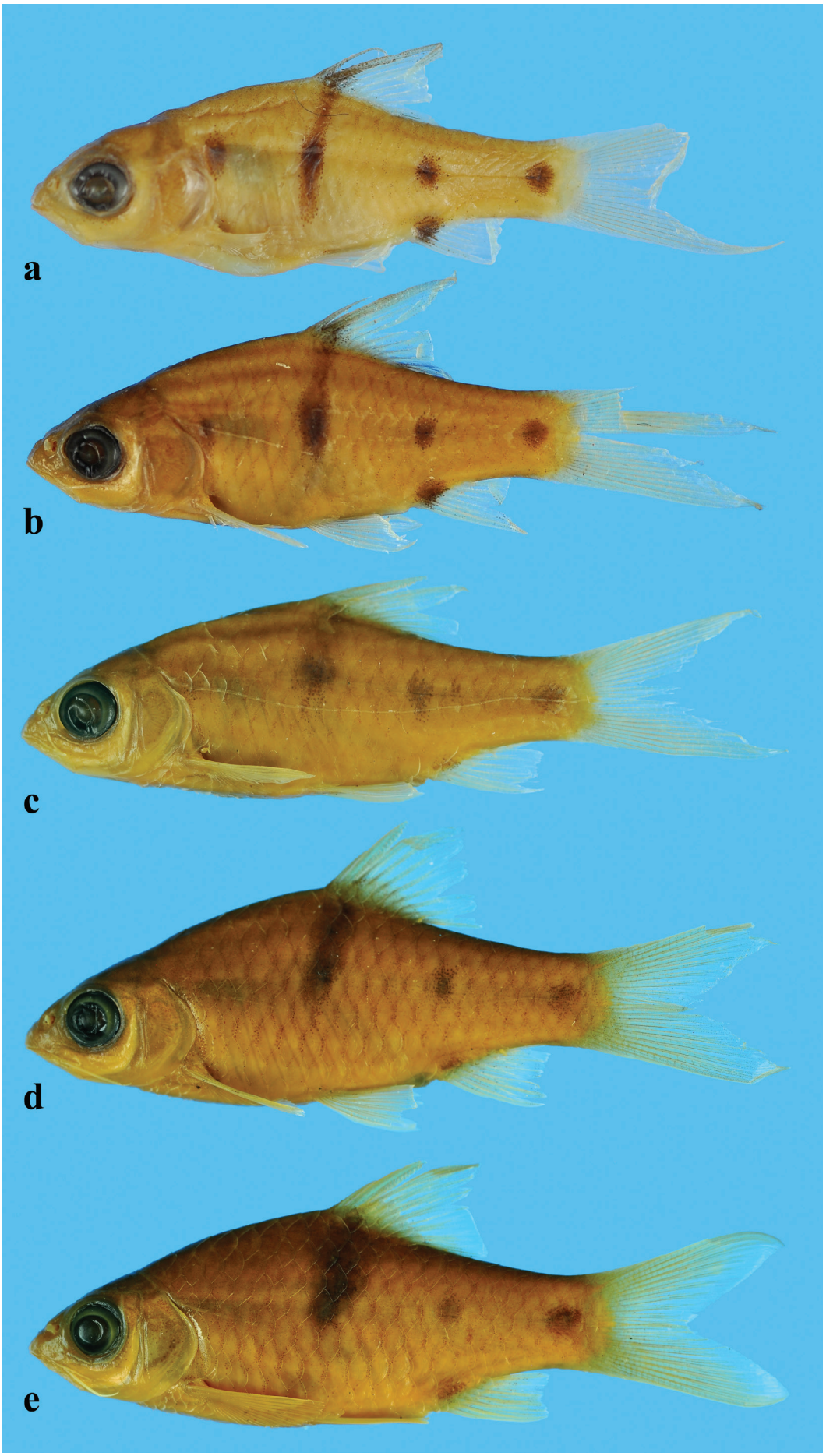

Fig. 2. *Barbodes sellifer*, new species, ZRC 1242, paratypes, Singapore; **a**, 13.3 mm SL; **b**, 21.1 mm SL; **c**, 30.8 mm SL; **d**, 33.6 mm SL; **e**, 42.7 mm SL. (Photographs by M. Kottelat).

Fig. 3. *Barbodes sellifer*, new species, ZRC 21699, 42.4 mm SL; Malaysia: Terengganu: Sekayu. (Photograph by M. Kottelat).

Fig. 4. *Barbodes sellifer*, new species, about 60 mm SL; Singapore: Nee Soon swamp forest (type locality). Live specimen, in situ, January 2005, not preserved. (Photograph by Nick Baker).

SL; tributary of Sungai Terengganu immediately downriver of Sekayu Waterfall Park; 18 March 1992. — ZRC 43780, 20, 17.3–72.0 mm SL; swampy area in Sekayu Waterfall Park; 21 October 1998. — ZRC 41866, 3, 70.1–85.5 mm SL; Sungai Brang outside Sekayu Waterfall Park; October 1997. — ZRC 59859, 3, 51.4–70.9 mm SL; Sungai Jemeris; 4 October 2017.

Malay Peninsula: West Coast: JOHOR: CMK 9261, 14, 20.0–37.4 mm SL; Gunung Pulai reservoir; 4 March 1992. — CMK 7912, 1, 45.0 mm SL; Sungai Machap, bridge on road between Ayer Hitam and Simpang Renggam; 18 August 1992. — ZRC 55697, 4, 32.7–51.9 mm SL; Pekan Nanas, Kampung Melayu Raya, Hutan Lipur Gunung Pulai; 28 December 2016. — ZRC 52352, 5, 54.8–107.8 mm SL; Muar basin, Sungai Labis near Bukit Kepong; 8 September 1993. — ZRC 523, 1, 83.2 mm SL; Relau, Mount Ophir; August 1905. MELAKA: ZRC 6798, 5, 62.2–67.8 mm SL; Melaka; November 1968. NEGERI SEMBILAN: ZRC 551, 13, 37.0–71.0 mm SL; Sungai Mertang at Kuala Pilah; 23 April 1931. KUALA LUMPUR: ZRC 19445, 1, 89.0 mm SL; forest stream in campus of Universiti Malaya; 20 November 1989. — ZRC 38424, 2, 47.9–51.5 mm SL; forest stream in campus of Universiti Malaya; 22 December 1994. SELANGOR: ZRC 5842, 1, 74.8 mm SL; Subang 25th mile; 1960s. — ZRC 541, 1, 84.0 mm SL; Sungai Buloh; March 1956. PERAK: ZRC 38423, 2, 55.2–70.6 mm SL; Taiping at base of Bukit Larut; 21 December 1994. — ZRC 41126, 2, 53.2–80.9 mm SL; Taiping at base of Maxwell Hill; 16 February 1997. PENANG: ZRC 618, 9, 64.1–92.2 mm SL; Pulau Pinang, Sungai Bayan Lepas; 19 October 1961. — ZRC 1585, 22, 33.1–91.0 mm SL; Pulau Pinang, Sungai Air Terjun at Georgetown Christian Cemetery; 5 November 1961. — ZRC 32101, 5, 19.0–81.6 mm SL; Pulau Pinang, Sungai Relau at Kampung Darat; 9 June 1993.

Indonesia: Sumatra: RIAU: ZRC 14035, 8, 11.2–53.8 mm SL; Pulau Batam: north-west part; 25 February 1991. — ZRC

Table 1. Morphometric data of *Barbodes sellifer*, new species, holotype, ZRC 12354, and eight paratypes (ZRC 12355, 17754, 50405, CMK 6027) and *B. zakariaismaili*, new species, holotype, ZRC 52347, and six paratypes, ZRC 62315. Values of holotype (H) included in ranges and means.

	B. sellifer			*B. zakariaismaili*		
	H	range	mean	H	range	mean
Standard length (mm)	69.2	59.5–97.8		66.1	58.7–67.4	
In percent of standard length						
Total length	137.0	131.9–141.3	136.3	131.5	124.1–133.4	131.0
Head length	30.2	27.6–32.2	29.7	27.8	26.6–28.1	27.4
Predorsal length	57.9	57.9–62.9	59.8	54.3	52.8–57.8	55.1
Prepelvic length	52.2	48.4–53.5	51.3	49.3	47.6–50.8	49.4
Preanal length	74.5	70.5–74.6	73.5	73.1	71.5–73.4	72.8
Head depth at nape	24.4	22.2–24.4	23.4	22.0	20.5–22.0	21.3
Body depth at dorsal-fin origin	39.2	37.3–42.4	39.7	34.6	32.2–34.6	33.1
Depth of caudal peduncle	16.4	15.9–17.1	16.5	15.8	14.8–15.9	15.3
Length of caudal peduncle	18.7	18.3–21.0	19.4	19.2	19.2–20.8	19.9
Length of dorsal fin	29.1	22.4–29.1	24.9	22.0	21.2–25.4	23.0
Length of upper caudal-fin lobe	35.5	31.5–38.0	33.9	29.1	28.9–32.3	30.7
Length of median caudal-fin rays	15.9	14.9–18.6	16.4	15.0	14.9–19.7	17.3
Length of lower caudal-fin lobe	38.9	32.5–39.0	35.1	29.1	29.1–32.7	30.7
Length of anal fin	19.0	14.8–19.0	16.6	16.5	15.9–18.6	17.1
Length of pelvic fin	20.9	17.5–20.9	19.3	17.6	17.3–20.9	19.1
Length of pectoral fin	24.8	21.4–26.3	23.1	21.2	21.2–23.6	22.2
Snout length	10.3	8.8–11.0	9.9	8.6	8.2–9.7	8.7
Eye diameter	8.9	7.8–8.9	8.4	6.1	5.8–6.7	6.2
Interorbital distance	11.6	10.6–11.6	11.0	11.5	9.7–11.5	10.5
Head width	17.6	16.9–18.9	17.6	17.1	15.2–17.5	16.6
In percent of head length						
Snout length	34	31–36	33	31	30–35	32
Eye diameter	29	26–30	28	22	21–25	22
Interorbital distance	38	34–41	37	41	35–41	38
Head width	58	56–63	59	62	56–64	60

22265, 6, 14.7–55.0 mm SL; Pulau Batam: east coast north of Kabil Pier; 29 January 1992. — ZRC 32631, 1, 111.3 mm SL; Pulau Bintan: reservoir near Gunung Bintan Besar; 14 May 1993. — ZRC 32897, 2, 50.2–67.5 mm SL; Pulau Bintan: northern part, stream along road to Pasir Panjang; 11 May 1993. — ZRC 33957, 2, 42.7–48.5 mm SL; Pulau Bintan: northern part; 10 May 1993. — ZRC 37565, 1, 86.8 mm SL; Pulau Bintan: Ekang Laut at 62 km on highway from Tanjung Uban to Tanjung Pinang; 27 April 1994. — CMK 11929, 4, 26.8–67.3 mm SL; Pulau Bintan, km 63 on road to Tandjung Pinang; 26 June 1995. — ZRC 31410, 3, 23.0–73.9 mm SL; Pulau Lingga: Daik; 28 March 1993. — ZRC 31486, 2, 32.3–45.7 mm SL; Pulau Lingga: Daik, Sungai Tanda; 28 March 1993. — CMK 9705, 18, 25.0–47.0 mm SL; Indragiri Hulu: Kec. Seberida; Sungai Sekuyam, north of Kelasa, Pangkalan Kasai; 18 August 1991. — CMK 9707, 3, 17.4–65.9 mm SL; Kab. Indragiri Hulu: Desa Seberida; 20 September 1991. ANAMBAS: ZRC 60528, 15, 47.0–97.6 mm SL; Anambas Islands: Pulau Jimaja, Teluk Tiru, Air Neraja waterfalls; 12 March 2002. NATUNA: ZRC 55184, 1, 32.5 mm SL; Pulau Natuna Besar: outskirts of Ranai; 2 November 2002. — ZRC 55250, 1, 48.8 mm SL; Pulau Natuna Besar: Sungai Air Tayan at Ranai; 30 October 2002. — ZRC 60507, 3, 60.1–80.6 mm SL; Pulau Natuna Besar: Bunguran Timur, peat swamp between Desa Harapan Jaya and Desa Binjai; 2 November 2002.

Diagnosis. *Barbodes sellifer*, new species, is distinguished from all other species that have been placed in the *B. binotatus* group by the presence in adults of a large triangular to rectangular blotch extending downwards from in front of and below the base of the dorsal fin in adults (sometimes incomplete or narrower); juveniles have a midlateral row of 3–5 black spots, with the second spot vertically elongated, contacting a small spot below branched dorsal-fin rays 1–2.

Description. General appearance is shown in Figs. 1–3. Morphometric data of holotype and 8 paratypes are given in Table 1. A relatively deep-bodied species of *Barbodes*, with body depth at dorsal-fin origin about 2.4–2.7 times in standard length, and depth of caudal peduncle 2.3–2.6 times in body depth. Dorsal profile of head and body arched, with a shallow concavity at nape. Snout rounded to pointed. Ventral profile less arched than dorsal profile. Interorbital area flattened; eye almost flush with dorsal profile of head, diameter 1.2–1.4 times in interorbital distance (Fig. 5a). Mouth subterminal,

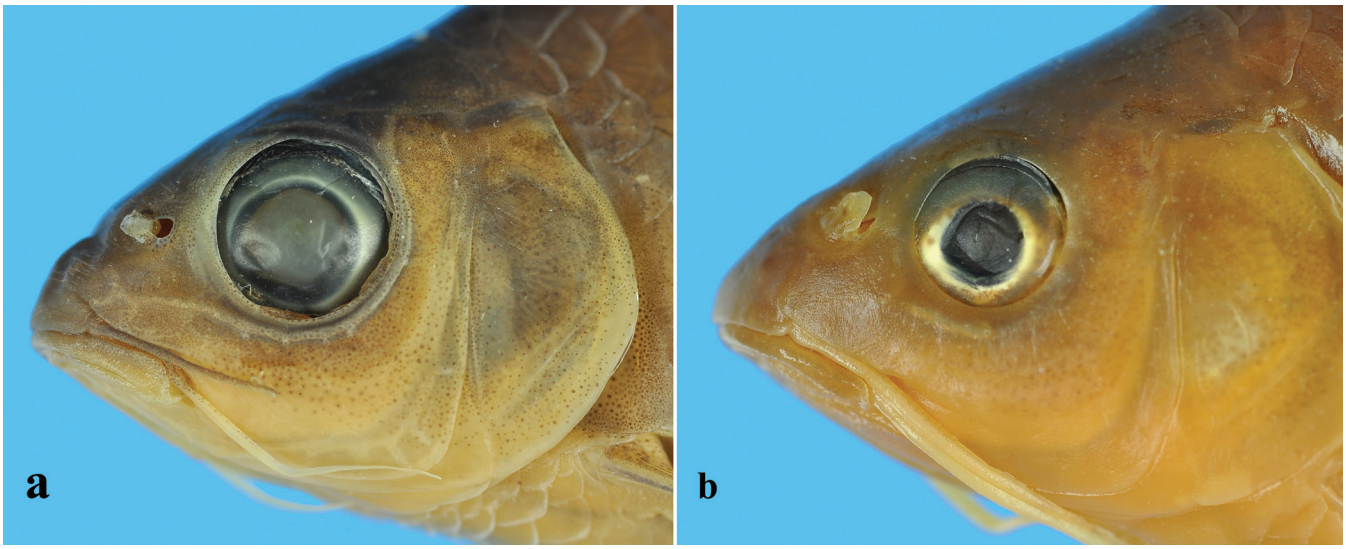

Fig. 5. **a**, *Barbodes sellifer*, new species, CMK 6027, paratype, 59.5 mm SL; **b**, *B. zakariaismaili*, new species, ZRC 52347, holotype, 66.3 mm SL. Note differences in snout shape, and in size and position of eye. (Photographs by M. Kottelat).

postlabial groove deep, narrowly interrupted in middle; snout slightly projecting, rostral fold covering upper part of upper lip; lower jaw partly enclosed in upper lip.

Dorsal fin with 3 (1) or 4 (8*) visible unbranched (anterior one very small, often hidden under scales) and 8½ (8*) or 9½ (1) branched rays; origin above lateral line scale 8 (8*) or 9 (1); distal edge straight to slightly concave; last unbranched ray massive, with 15–20 serrae along most of posterior edge of stiff portion; in specimens about 50–60 mm SL, space between serrae about half of length of serrae near base of ray, about equal to length of serrae near tip; in larger specimens, spaces becoming narrower; in holotype, base of serrae broader and becoming adjacent. Pectoral fin slightly rounded, with 15 (3*), 16 (5), or 17 (1) rays (including anterior unbranched ray); reaching to or almost to pelvic-fin base. Pelvic fin with straight to slightly convex posterior edge, with 9 rays (including anterior unbranched ray); reaching to about 2 scales in front of anus; pelvic axillary scale present, about ¼–⅓ of fin length. Anal fin with 3 unbranched and 5½ branched rays; posterior edge slightly concave. Caudal fin with 10+9 principal rays (of which 9+8 branched), forked, lobes rounded to pointed at tip. Caudal peduncle 1.1–1.3 times longer than deep.

21+2 (6*), 21+3 (1), or 22+2 (2) scales along lateral line, 9 (4) or 10 (5*) predorsal scales, ½4/1/4½ rows of scales from dorsal-fin origin to about 2 scales in front of pelvic-fin base, ½2/1/2½ scales rows in transverse line on caudal peduncle, 3 scale rows between lateral line and pelvic-fin origin. Posteriormost scale on each lobe of caudal fin larger than preceding ones (Fig. 6a).

Two pairs of maxillary barbels; anterior one reaching about posterior margin of eye; posterior one reaching beyond middle of postorbital part of head, almost to posterior edge of opercle.

Colouration. Preserved specimens: Adults (over about 40 mm SL): body and head dark yellowish brown, darker on back, pale yellowish on belly. Faint (usually) blackish reticulate pattern on body, made of a crescentic mark on scale pocket and a band of pigments (on 2–5 rows) along posterior scale margin; crescentic marks more conspicuous anteriorly. A conspicuous black blotch on body below base of dorsal fin rays, from triangular to rectangular, extending downwards from row +5 to row +1 or +2; 4–6 scales wide on row 4; 2.5–4.5 on row +2, 0–2 on row +1; extending forward one or two scales in front of dorsal-fin origin and reaching backwards between base of 4th branched ray and end of fin base. A faint rounded spot at mid-height of body, above base of last unbranched and first two branched anal-fin rays (usually missing in specimens above about 35–40 mm SL). A roundish to slightly longitudinally elongated spot at mid-height on caudal peduncle, immediately in front of caudal-fin base. Fins dusky. Posterior edge of anal fin lined with a narrow band of black pigments.

Juveniles and ontogenetic changes, 13–30 mm SL (Fig. 2). Body pale brown. In smallest specimens (about 13–20 mm SL), a small spot at base of dorsal, on sheath scales at base of first two branched dorsal-fin rays, extending on simple rays, branched rays 1–2 and membranes in between (Fig. 2a, b); extension on rays and membranes disappear at around 25 mm SL. A black spot above base of branched anal-fin rays 1–3, becoming faint or disappearing in adults.

Typically, a midlateral row of four black spots on flank. Spot 1 faintest, slightly vertically elongated, disappearing at around 20 mm SL. Spot 2 vertically elongated, reaching ventrally about halfway between lateral line and pelvic-fin base; connected to black spot at dorsal-fin base (around 13–16 mm SL; Fig. 2a, b); downwards extension disappearing around 20 mm SL; upwards extension widening after reaching about 30 mm SL (Fig. 2c). Spot 2 disappearing in adults.

Spot 3 (and sometimes an additional spot close behind) above anal-fin origin, disappearing around 35–40 mm SL. Last black spot roundish, at mid-height of caudal peduncle, immediately in front of caudal-fin base.

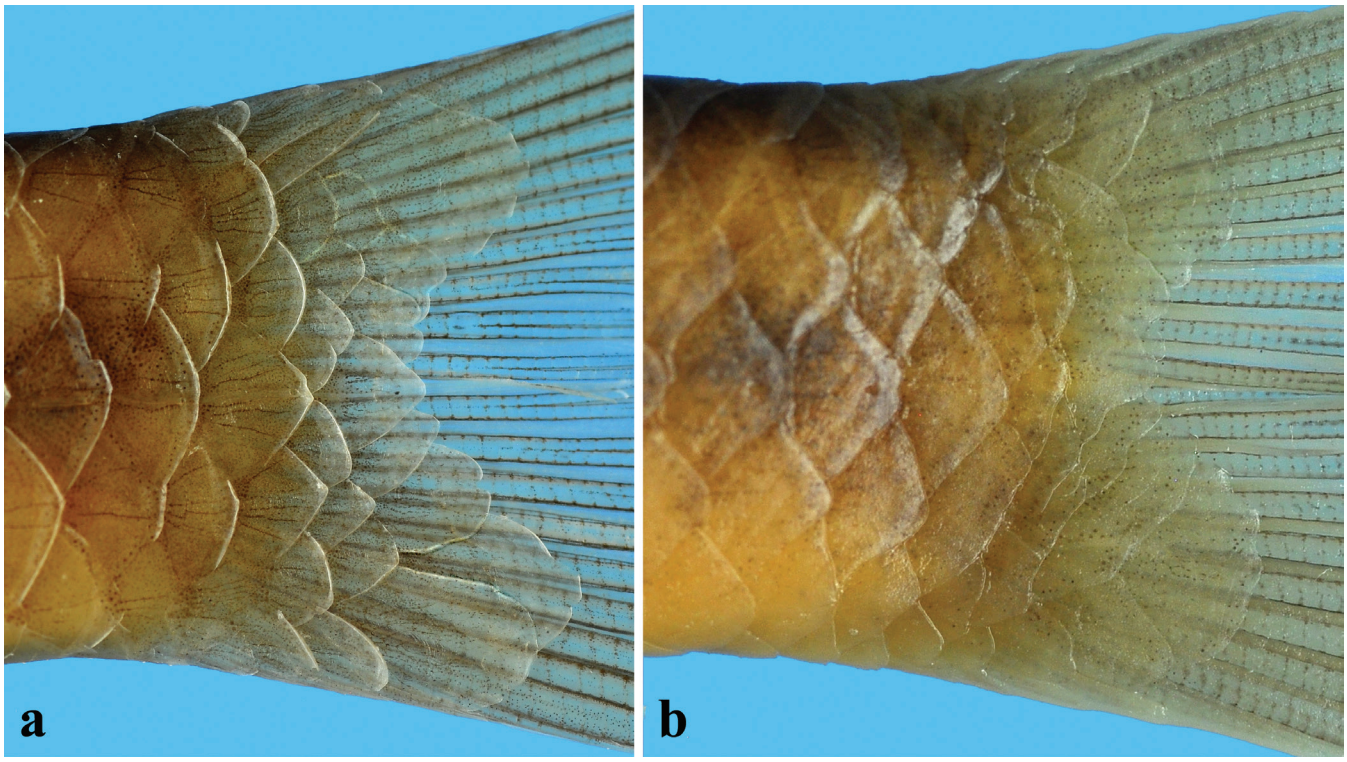

Fig. 6. Scales at caudal-fin base in: **a**, *Barbodes sellifer*, new species, ZRC 12355, 69.2 mm SL; and **b**, *B. zakariaismaili*, new species, ZRC 62315, 67.4 mm SL. Edge of posteriormost scales enhanced. (Photographs by M. Kottelat).

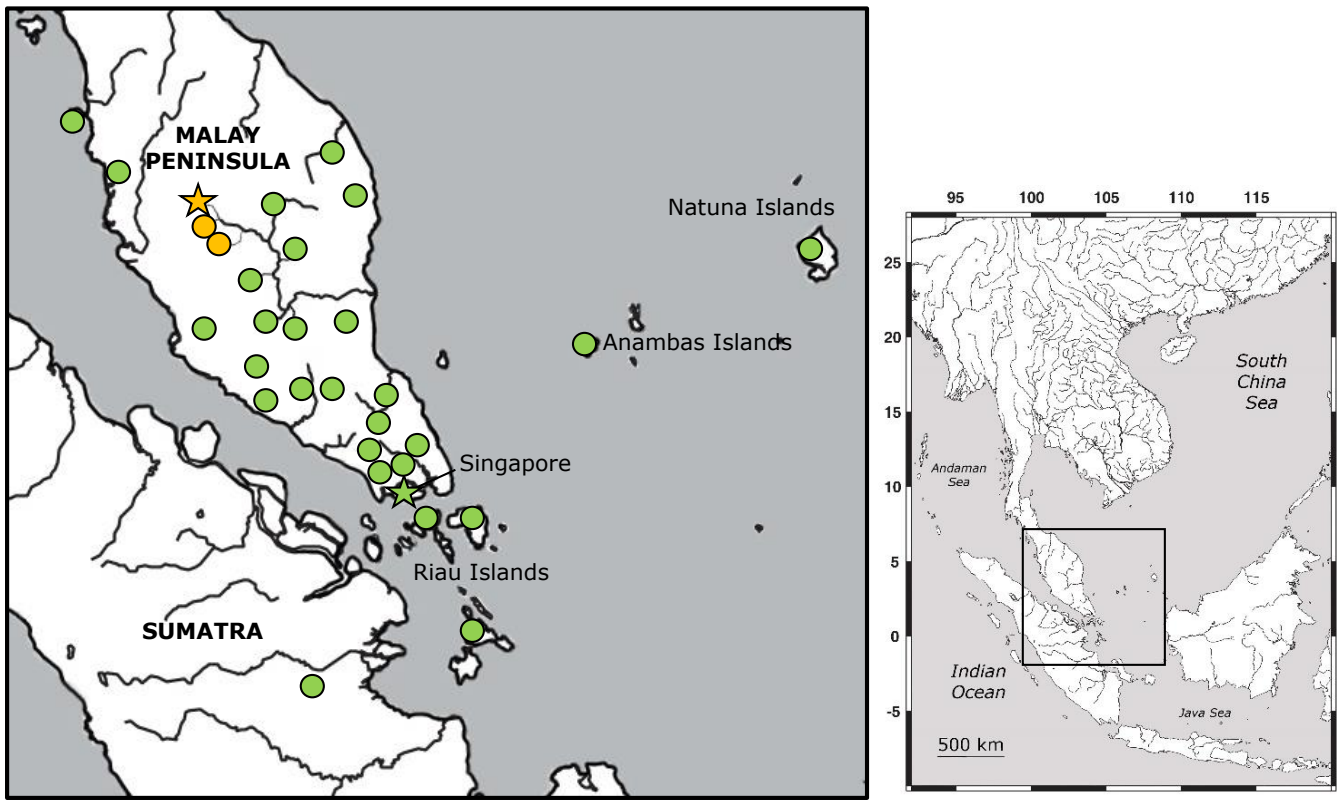

Fig. 7. Distribution of *Barbodes sellifer*, new species (green marks) and *B. zakariaismaili*, new species (orange marks) on Malay Peninsula and Sumatra, based on examined material. Stars are type localities. Each mark may consist of more than one locality. (K. K. P. Lim).

Fig. 8. The forest stream (**a**) inhabited by *Barbodes sellifer*, new species, in the type locality, Nee Soon swamp-forest in Singapore; and a view from the surface (**b**) showing a congregation of many individuals of *B. sellifer* (with the distinct black subdorsal blotch) with a few *Rasbora elegans* (with the two black spots on the side). (Photographs by K. K. P. Lim, March 2005).

In life (Figs. 4, 8b), body silvery to pale brownish, with markings (as described above) black with bluish hue. Fins usually pale yellow to dusky; dorsal, caudal, and anal fins may have a reddish tinge. Dark triangular blotch not always obvious when viewed from the sides, often obscured by light reflecting off the scales.

Distribution and habitat. Singapore; Malay Peninsula: Johor, Pahang in the Endau and Pahang (except the Sungai Jelai watershed) basins; Indonesia: Sumatra in Riau, and islands of Riau (Lingga, Batam, Bintan), Anambas and Natuna (Fig. 7).

We have also seen material from many localities elsewhere in the Malay Peninsula. Most of these samples included only a few specimens, only incomplete ontogenetic series, or specimens that had not been optimally preserved; at this stage we prefer to consider these identifications as tentative only. This includes localities in Melaka, Negeri Sembilan, Selangor, southern Perak, Penang (east slope), and Terengganu.

Recent research in Peninsular Malaysia recognised the presence of '*Barbodes banksi*' in Johor (including Segamat), Pahang (including Tasek Bera), Perak (Pangkor, Pondok Tanjung and Sungai Bongkok), Penang (including Balik Pulau and Teluk Bukit) and Kelantan (Gua Musang and Lata Janggut) (see Fahmi-Ahmad et al., 2015: 32; Ng et al., 2019: 521; Fahmi-Ahmad et al., 2020: 537; Ahmad Sobri et al., 2021: 657; Ng & Tan, 2021: 13 as *Barbodes* cf. *banksi*). Although we have not examined their material, it seems that most are *B. sellifer*, or tentatively that species.

Most *B. sellifer* habitats are situated in low-lying areas, in forest and freshwater swamps with clear or turbid water. The species is not known to inhabit environments with highly acidic black-water, such as peat swamps. It is gregarious and usually occurs in large, loose congregations at all levels of the water column (Fig. 8).

Etymology. Sellifer is a Latin adjective meaning 'bearing a saddle' (feminine: sellifera, neuter: selliferum).

Remarks. *Barbodes sellifer*, new species, has long been identified as *B. banksi* (Fig. 9), a species endemic to western Borneo. *Barbodes banksi* was originally described on the basis of material from four localities: Singapore (Botanic Gardens), Johor (5 miles north of Kota Tinggi; 16 miles north-east of Kota Tinggi), and Sarawak (18 miles east of Kuching) (Herre, 1940: 31). All these specimens are syntypes; Böhlke (1953) designated a lectotype (specimen CAS-SU 33900, from Sarawak: 18 miles east of Kuching) and this fixes the name *B. banksi* for the species from Borneo. We have seen material of *B. banksi* from Sarawak (northwards to Sungai Larut drainage) and Kalimantan Barat (Sambas and northern part of Kapuas drainage).

Barbodes sellifer, new species, is distinguished from *B. banksi* in having the blotch below the dorsal fin much more conspicuous, broadly triangular to rectangular, occupying 4–6 scales along the back and on row 4, and 2.5–4.5 on row 2 (vs. blotch linear, slightly slanted forwards, uniformly about 1–2 scales wide, upper anterior extremity located entirely under dorsal-fin base), the dorsal profile of head and snout rounded, more convex than ventral profile (vs. dorsal profile only slightly more convex than ventral one). We have not seen juveniles of *B. banksi* in the size range of the examined juveniles of *B. sellifer*. The smallest available *B. banksi* specimens (CMK 8419, 27.0 mm SL; CMK 6636, 27.9 mm SL, Fig. 9a) have the same narrow mark below the dorsal

Fig. 9. *Barbodes banksi*, **a**, CMK 6636, 27.9 mm SL; Borneo: Kalimantan Barat: Singkawang; **b**, CMK 11512, 65.9 mm SL; Borneo: Sarawak: Batang Ai. (Photographs by M. Kottelat).

fin as do the adults, ending in a black spot on scale row 0; and one or two faint black spots on the same row above the anal-fin origin.

There is some variability within the material that we identify as *B. sellifer*. Occasional specimens or populations have a paler colouration and the blotch below the dorsal fin may appear narrower and fainter. While some are possibly individual variation, most of these specimens have been obtained from disturbed areas with murky water and without canopy. The material from Johore, Pahang, Riau, and Anambas largely agree with the Singapore populations. In our material from drainages in Melaka, Negeri Sembilan, Selangor, Perak, Penang, and Terengganu, the dark subdorsal blotch is often more rectangular than triangular; the spot located on scale row 0 at the vertical of the anal-fin origin in juveniles may be retained in adults. In some of the specimens from Kelantan and Terengganu there is a faint and irregular stripe on row +1, behind the subdorsal mark; this stripe is faint in preserved specimens (Fig. 3). Specimens in ZRC 60582 and 60585 from the middle section of the Pahang River drainage have scales with dark edges. In the Malay Peninsula, on the east coast, we identify material from localities northwards to the Terengganu drainage. On the west coast, we have seen material northwards to about Taiping (Sungai Larut watershed; Perak). In Penang we have seen material of *B. sellifer* only from the east slope (another species of the *B. binotatus* group is present on the west slope, at least in material collected in 1961).

Barbodes rhombeus (Fig. 10) is a second species of the *B. binotatus* group present in Singapore (Tan et al., 2020: 157). The earliest collection we are aware of was made in 1967 (ZRC 7775). This was after the publication of Alfred (1966) in which material of *Barbodes* consists only of *B. sellifer*. The existence of two forms of *B. binotatus* on Singapore was first published by Ng & Lim (1996: 110, 115, as *Puntius banksi* and *P. binotatus*). No explanation is available regarding their introduction, but it seems likely that they were imported as contaminants with species of high aquaculture value, possibly from Peninsular Malaysia or Thailand. In Singapore, *B. sellifer* seems confined to the streams under forest canopy while *B. rhombeus* is found in streams in disturbed, open areas. It is assumed that *B.*

Fig. 10. *Barbodes rhombeus*, ZRC 40316, 83.9 mm SL; Singapore. (Photograph by K. K. P. Lim).

Fig. 11. *Barbodes binotatus*, CMK 8976, 43.0 mm SL; Java: Ciliwung at Cilebut. (Photograph by M. Kottelat).

rhombeus may have replaced *B. sellifer* in exposed habitats in which they once occurred. We are not aware of any hybridisation that might have taken place.

Several species are apparently confused under the name *B. rhombeus*. They are known from the Indochinese area and the Malay Peninsula (pers. obs., manuscript). Adult *B. sellifer* is distinguished from adult *B. rhombeus* in having, among others, a large triangular to rectangular blotch under the dorsal fin (vs. a small spot below base of branched rays 1–2 and a faint and irregular midlateral stripe), and the interorbital area flattened (vs. convex).

Barbodes sellifer, new species, is distinguished from *B. binotatus* (from Java; Fig. 11) by having, among others, the large blotch on the upper half of the body below the dorsal fin (vs. only a small black spot on part of row +4 and sheath scales, at base of branched dorsal-fin rays 1–2 [total area about equal to size of one scale]); the absence of a blackish midlateral stripe at all stages (vs. a midlateral stripe from upper extremity of gill opening to spot at end of caudal peduncle in juveniles; in adults, stripe straight, narrow, usually wider and more distinct anteriorly, sometimes faint, interrupted or missing in posterior half of body).

Barbodes bunau (Fig. 12) is another species with a large triangular blotch below the dorsal fin (Rachmatika, 2005). The species does not belong to the *B. binotatus* group but is related to *B. lateristriga* and is known only from two drainages in northern Kalimantan Timur (Borneo). *Barbodes bunau* is easily distinguished from *B. sellifer* in having a larger and conspicuously wider subdorsal blotch that spans the entire dorsal fin base; in lacking a dark spot on the caudal peduncle; in having three to five rows of black spots on the flank, particularly on the anterior part; and in having a dusky dorsal fin.

***Barbodes zakariaismaili*, new species**

(Figs. 13, 14)

Holotype. ZRC 52347, 66.1 mm SL; Malaysia: Pahang: Pahang drainage: Cameron Highlands: Sungai Boh, 200 m upstream from Sungai Menson; 4°26′10″N 101°29′40″E [about 700 masl]; M. Zakaria-Ismail, 26 October 1992.

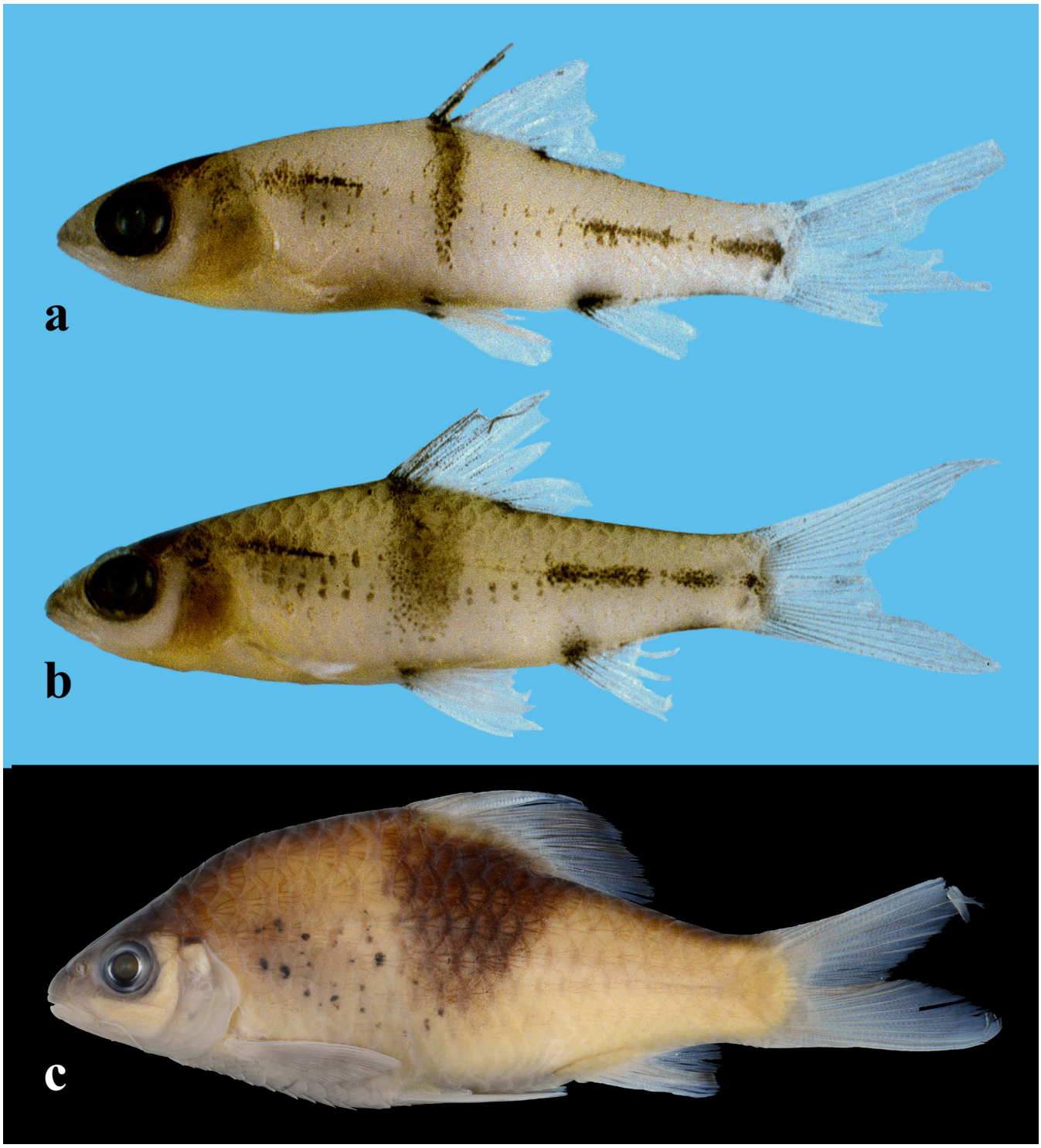

Fig. 12. *Barbodes bunau*, Borneo: Indonesia: Kalimantan Timur: **a**, **b**, CMK 9535, 20.2 (a) and 28.3 mm SL (b), Sungai Sebuku; **c**, ZRC 49867, paratype, 67.5 mm, Sungai Sesayap. (Photographs by M. Kottelat (a, b) and Tan H. H. (c)).

Paratypes. ZRC 62315, 18, 30.0–67.4 mm SL; CMK 27384, 9, 24.1–67.9 mm SL; same data as holotype.

Additional material (non types). All from Pahang, Pahang drainage. ZRC 60583, 4, 23.9–81.3 mm SL; Sungai Menson, tributary of Sungai Bertam (4.4245°N 101.5083°E); 19 August 1990. — ZRC 60590, 1, 60.5 mm SL; Sungai Menson, tributary of Sungai Bertam (4.4500°N 101.5057°E); 26 October 1992. — ZRC 60584, 6, 26.5–66.5 mm SL; Sungai So'ok near Kuala Kernip; 28 September 1992. — ZRC 60576, 4, 43.5–69.0 mm SL; ZRC 60577, 11, 22.9–68.9 mm SL; ZRC 60578, 3, 37.1–62.8 mm SL; Sungai Tersang between Bukit Talom and Sungai Koyan (4.0610°N 101.7610°E); 16 February 1993. — ZRC 60581, 22, 13.5–26.0 mm SL; small stream draining to Sungai Tanom (4.6307°N 102.0640°E); 4 November 1992. — ZRC 52348, 9, 51.6–78.3 mm SL; ZRC 60587, 6, 34.1–66.1 mm SL; ZRC 60588, 1, 57.1 mm SL; Sungai Kenor, tributary of Sungai Lipis (3.9833°N 101.6258°E); 15 February 1993.

Fig. 13. *Barbodes zakariaismaili*, new species, Malaysia: Pahang: Cameron Highlands; **a**, ZRC 52347, holotype, 66.3 mm SL; **b**, ZRC 62315, paratype, 58.3 mm SL. (Photographs by M. Kottelat).

Diagnosis. *Barbodes zakariaismaili*, new species, is distinguished from all other species of the *B. binotatus* group by its unique colour pattern in adults, including a faint longitudinally elongate blackish midlateral mark from the upper extremity of the gill opening to below the dorsal-fin origin; a black spot below the anterior part of the dorsal-fin base, extending downwards to the midlateral row as a narrow triangular mark; and a blackish spot at the end of the caudal peduncle. Other characters useful for identification, but not unique to the species, are: slender body (depth 2.9–3.1 times in SL); interobital area convex; eye not flush with dorsal profile, relatively small (4–5 times in head length, 1.5–1.9 times in interorbital distance); juveniles with a conspicuous reticulate pattern made of black pigments on scale pockets.

Description. General appearance is shown in Figs. 13 and 14. Morphometric data of holotype and six paratypes are given in Table 1. A relatively slender species of *Barbodes*, with body depth at dorsal-fin origin about 2.9–3.1 times in standard length, and depth of caudal peduncle 2.0–2.3 times in body depth. Dorsal profile of head and body arched, with a shallow concavity at nape, and a low post-occipital hump in specimens above about 50 mm SL. Snout pointed, directed forwards. Ventral profile slightly less arched than dorsal profile. Interorbital area convex; eye not flush with dorsal profile of head, diameter 1.5–1.9 times in interorbital distance (Fig. 5b). Mouth subterminal, postlabial groove deep, narrowly interrupted in middle; snout slightly projecting, rostral fold covering upper part of upper lip; lower jaw not enclosed in upper lip.

Dorsal fin with 3 (3) or 4 (4*) visible unbranched and 8½ branched rays; origin above lateral line scale 7 (1), 8 (5*), or 9 (1); distal edge straight to slightly convex; last unbranched ray moderately thick, with 17–25 serrae along most of posterior edge of stiff portion, space between serrae narrower than width of serrae. Pectoral fin rounded, with 15 (4*) or 16 (3) rays (including anterior unbranched ray); reaching almost to pelvic-fin base. Pelvic fin with slightly rounded posterior edge, with 9 (6*) or 10 (1) rays (including anterior unbranched ray); reaching to about 2 scales in front of anus; pelvic axillary scale present, about ¼ of fin length. Anal fin with 3 unbranched and 5½ branched rays; posterior edge straight. Caudal fin with 10–11 + 9 principal rays (of which 8+8 (1) or 9+8 (6*) branched), forked, lobes rounded, tip slightly pointed. Depth of caudal peduncle 1.2–1.4 times in its length.

21+3 (1), 22+2 (5*), or 23+2 (1) scales along lateral line, 8 (1), 9 (5*), or 10 (1) predorsal scales, ½3/1/4½ (1) or ½4/1/4½ (6*) rows of scales from dorsal-fin origin to about 2 scales in front of pelvic-fin base, ½2/1/2½ scales rows in transverse line on caudal peduncle, 3 scale rows between lateral line and pelvic-fin origin. Posteriormost scale on each lobe of caudal fin larger than preceding ones (Fig. 6b).

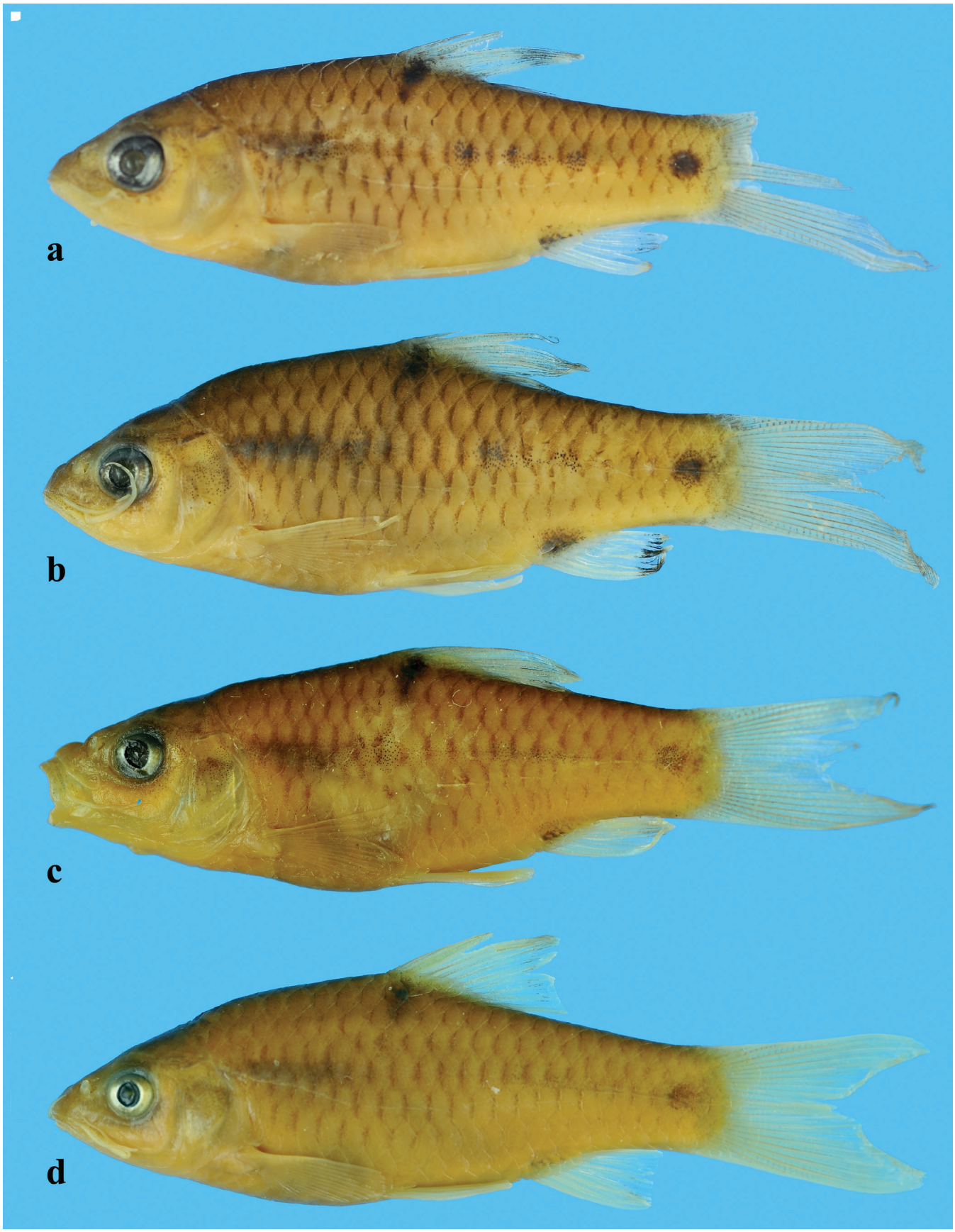

Fig. 14. *Barbodes zakariaismaili*, new species, Malaysia: Pahang: Cameron Highlands; **a**, **b**, CMK 27384, paratypes: 27.8 mm SL (a) and 33.7 mm SL (b); **c**, **d**, ZRC 62315, paratypes: 30.1 mm SL (c) and 35.5 mm SL (d). (Photographs by M. Kottelat).

Two pairs of maxillary barbels; anterior one reaching about middle of postorbital area of head; posterior one reaching posterior edge of opercle.

Colouration. Preserved specimens: specimens above 35 mm SL: body and head yellowish brown, darker on back, yellowish on belly. No reticulate pattern on body. On scale row +1 and on anterior 3–5 scales of row 0, scale pockets covered by dark pigments, centre of scales dark brown, posterior fourth of scales paler brown and with sparse black pigments; sometimes appearing as a midlateral row of dark spots. In anterior third, these scales superimposed on a faint longitudinally elongate blackish midlateral mark (made of deeper pigments) from upper extremity of gill opening to below dorsal-fin origin. On row +2, centre of scales less dark and mark on scale pocket narrower. On lateral line row and rows –1 and –2, only dark scale pocket pigmentation. A faint dark grey spot at end of caudal peduncle. A black spot on sheath scales of dorsal fin or on upper part of row +4, at base of branched dorsal-fin rays 1–2; area of spot equal to about one scale; a faint triangular extension, about 1–1.5 scale wide, reaching to row +3 or +2 (then in contact with midlateral row of dark scales). All fins hyaline; in a few specimens, distal edge of anal fin blackish.

Juveniles. Only three small specimens available, 27.8–33.7 mm SL (Fig. 14a–c). Body with conspicuous reticulate pattern made of black pigments on scale pocket, on rows +4 to –2. Elongated blotch on anterior third of body present, made of pigments in deeper layer. An elongated patch of pigments under scales on row +1, extending from below end of dorsal-fin base to end of anal-fin base, vaguely forming two or three spots. Roundish black spot at posterior extremity of caudal peduncle. Black spot at dorsal-fin base as in adults. Black spot on body, at base of anal fin. Distal margin of anal fin black. Dorsal fin: black pigments along edges of branched rays near branching point.

Distribution. *Barbodes zakariaismaili* is presently recorded only from Peninsular Malaysia, in tributaries of the Sungai Jelai of the Pahang drainage in north-western Pahang State (Fig. 7). The type locality, Sungai Boh, is a small and shallow hill stream about 4–6 metres wide, under forest canopy. It has clear and cool water flowing over rock and sand substrate (Khaironizam M. Z., pers. comm.).

Etymology. The species is named for Mohd. Zakaria-Ismail in appreciation for his work on the fish fauna of Malaysia. A noun in the genitive, indeclinable.

Remarks. *Barbodes zakariaismaili*, new species, has a relatively slender body, with the ventral profile only slightly less curved than the dorsal one, and the tip of the snout about level with the axis of the body. This body shape is unusual in the *B. binotatus* group; among the named species presently recognised as valid, we have seen it only in *B. binotatus*.

Barbodes binotatus (Fig. 11) is distinguished from the other species of the group by the presence of a midlateral stripe from the upper extremity of the gill opening to the spot at the end of the caudal peduncle, in both juveniles and adults; *B. sellifer*, new species, by the large triangular to rectangular blotch below the dorsal-fin base, *B. banksi* by the narrow slanted bar under the dorsal-fin origin, and *B. rhombeus* has only a small black spot at the origin of the dorsal fin, at the end of the caudal peduncle, and a midlateral row of 3–5 spots sometimes connected by a thin stripe.

Barbodes zakariaismaili, new species, is distinguished from *B. sellifer*, new species, in having, in adults, a faint longitudinally elongate blackish midlateral mark from the upper extremity of the gill opening to below the dorsal-fin origin (vs. absence), a black spot below the anterior part of the dorsal-fin base, extending downwards to the midlateral row as a narrow triangular mark (vs., in adults, a large triangular to rectangular blotch extending downwards from in front of and beneath the base of the dorsal fin, sometimes incomplete or narrower), a more pointed snout (Fig. 5), and a smaller eye (diameter 21–25% HL vs. 26–30). Our morphometric data, based on a few specimens of both species in the size range 66–98 mm SL, suggest that *B. zakariaismaili* differs from *B. sellifer* in having a shorter (27–28% SL vs. 28–32) and shallower head (depth 20–22% SL vs. 22–24), a smaller predorsal length (53–58% SL vs. 58–63) and a more slender body (depth at dorsal-fin origin 32–35% SL vs. 37–42; depth of caudal peduncle 15–16% SL vs. 16–17). However, we have not measured a sufficient number of specimens from enough localities to be certain that all these differences would hold for all populations.

Presently, we include in *B. zakariaismaili* material from the Sungai Jelai watershed only. Its presence in the headwaters of adjacent drainages is not impossible. We are aware of *B. sellifer*-like fish from the Kelantan drainages, but have not seen fresh or well-preserved specimens to be able to determine their identity; they may be *B. zakariaismaili*. It is noteworthy that *B. zakariaismaili* is recorded in hilly areas, while *B. sellifer* occurs in the lowlands, in areas then covered by forest.

DISCUSSION

After this article was completed we received the papers by Ahmad Sobri et al. (2021), dealing with "molecular taxonomy" of *B. binotatus* in Peninsular Malaysia, and Ng & Tan (2021), dealing with "cryptic species and grey zone speciation in the *B. binotatus* complex in Sundaland". We will not comment on semantic shortcomings, inappropriate usage of words, and misunderstanding of some taxonomic and nomenclatural concepts. The *B. banksi* and *B.* cf. *banksi* recorded by these authors from the Malay Peninsula are apparently mostly *B. sellifer*, new species. Their *B. binotatus* and *B.* aff. *binotatus* are not *B. binotatus*; the gross distribution hiatus between Java and the Malay Peninsula alone hints at misidentification; comparison with the published (and cited) data and illustrations immediately lead in that direction. Their *B. rhombeus* is possibly *B. rhombeus*, or maybe not. We intend to address the identity of these species in forthcoming papers.

Both papers exaggerate the situation of the taxonomy of the *B. binotatus* group. They misrepresent (or confuse) the fact that nobody has published on the group in detail (and the *already known* variability within the group) as indicative of a group whose taxonomy is difficult to solve, while in fact it is a standard taxonomic situation. We discuss below the 'cryptic species' issue.

We must, however, correct a few points in Ng et al. (2021). The authors wrote (p. 1257) "The holotype [of *B. binotatus*] does not exist since the species from Java was described from an ink drawing by van Hasselt (Kottelat, 2013)"; neither a holotype or ink drawing are mentioned by Cuvier & Valenciennes (1842: 168) in the original description of *B. binotatus*, nor by Kottelat (2013). The species was based on three syntypes, still preserved, and most likely from Bogor, Java (this is mentioned in Kottelat, 2013: 77 and will be further discussed in a forthcoming paper). Another nominal species, *Barbus maculatus*, was also described from Bogor in the same volume (Cuvier & Valenciennes, 1842: 195), apparently based on a drawing, itself possibly based on one of the syntypes of *B. binotatus*; *B. maculatus* is a simultaneous synonym of *B. binotatus* and the first reviser (Bleeker, 1855: 408) gave precedence to *B. binotatus* (see Kottelat, 2013: 78).

Herre (1940) did not designate a holotype for *B. banksi*; the species was described on a series of syntypes (see above). The '*B. binotatus*' from Philippines and north Borneo that we have examined are *B. sealei* or related species; the Philippines material we have examined is clearly different from any member of the *B. binotatus* group. The Lake Lanao *Barbodes* species flock is unlikely to be derived from an ancestor in the *B. binotatus* group, but more likely from a lineage related to *B. sealei*. The counts of unbranched rays in the dorsal and anal fins (Ng et al., 2021: table 4) are unlikely, but the method of obtaining them is nowhere stated.

Ahmad Sobri et al. (2021) err when they mention only the absence of serration to distinguish *Oliotius oligolepis* from species placed in *Barbodes* by Kottelat (2013). Much more significant characters were mentioned to diagnose *Oliotius*, for example the very large scales (hence, very low counts), the rows of papillae on the head, and the unique colour pattern. This raises questions about the identification of the material whose sequences were fished on Genbank (Yang et al., 2010; Ren et al., 2020), possibly without due attention to voucher-identification or provenance, a recurrent issue and cause of errors (Norén & Kullander, 2018).

Species of the *B. binotatus* group are not 'cryptic' taxa. The *B. binotatus* group has often been considered to be comprised of 'cryptic species' (in discussions, at meetings, etc., but apparently not formally published), and some comments seem timely on 'cryptic species' and why *B. binotatus* is not a group of cryptic species. The term 'cryptic species' is often used without a clear definition. In many papers, 'cryptic species' is used as a fashionable way to name any taxonomically complicated group, especially in the title of a paper or for marketing research projects. 'Very variable and probably made of more than one species' would be more objective but less sensational than 'cryptic species'.

Experience shows that 'cryptic species' most commonly translates as: species that have not been studied with attention before (or that have not been the subject of a taxonomic revision). Most 'cryptic species' vanish when experienced researchers are allowed to examine well-preserved specimens.

Although there is a variety of definitions of 'cryptic species', authors rarely explicitly explain what they refer to by that wording. A commonly implied definition is that of Bickford et al. (2006): cryptic species are "two or more distinct species that are erroneously classified (and hidden) under one species name". This is often translated into 'cryptic species' are morphologically indistinguishable; this is contingent on who tried to distinguish them and how. One should add that semantics and the concept of 'cryptic species' imply that there are minimally two cryptic species; there cannot be one cryptic species, even if they collectively already have a name.

Struck et al. (2018) reviewed the different definitions proposed in the literature. Their approach focused mainly on developing a framework to quantitatively identify whether species are cryptic or not through combining phenotypic disparity and genetic divergence. Their objective was more in a context of evolutionary processes. They considered that to be 'cryptic', species must be "distinguishable, for example, [...] diverged genotypic clusters of individuals [...] that do not form diagnostic morphological clusters" and that the degree of morphological disparity among the cryptic taxa should be substantially lower than among non-cryptic relatives. "Diverged genotypic cluster" is only an example and could be replaced by other criteria or species concepts (Struck et al., 2018). From what we know of the *B. binotatus* group, these criteria are not satisfied; the constituent species are not less morphologically divergent than observed among other congeners (e.g., between *B. lateristriga*, *B. bunau*, and *B. kuchingensis*); in fact they are more divergent. Struck et al. (2018: 156) commented that in many fields "cryptic species are usually taken at face value based on the original reports"; we can only concur. This is a serious issue, potentially misleading, for example, future research and conservation.

In another approach (not process-related), authors have considered the ambiguities in the usage of a 'cryptic species' 'concept', in which they see largely "a temporary formalization of the problems with delineation of the species" (Korshunova et al., 2017), hiding inadequate taxonomy rather than a biological phenomenon.

Korshunova et al. (2019: 18) challenged the theory that 'cryptic' species can only be defined morphologically *a posteriori* to the obtainment of molecular data. In fact, many of the component taxa of 'cryptic species' were or could have been distinguished already before the analysis, and hence were not 'cryptic'. They noted that (in the context of their study) additional terms might have been " 'true cryptic species' (morphological differences have not yet been found), 'semi-cryptic species' (morphological differences are very

difficult to present), 'quasi-cryptic species' (morphological differences are relatively easy to present) and 'false cryptic species' (morphological differences are obvious, but for some reason missed or not highlighted in previous studies)". [We stress that this was in a discussion, not a formal proposal of a classification]. In other words, most 'cryptic' species in fact are taxonomically ordinary species.

Korshunova et al. (2019: 20) commented that, in their study, 'the problem was not in the absence of "physically distinguishable morphological characters", but in the absence of enough finely differentiated units in the taxonomic framework that would have allowed species distinction at a much finer level'. In other words, had earlier authors recognised more species instead of attributing all the variability to a single, very variable species, they would not have been called cryptic species.

Clearly, the *B. binotatus* group of 'cryptic species' is largely made of 'quasi-cryptic' and 'false cryptic species'. This reflects the current trend to first investigate molecular aspects and only then invest the time to investigate morphology and discover what the naked eye would have seen if a critical examination had been made; a corollary is also often the production of technically-poor descriptions of new taxa. The excuse that this approach expedites the discovery of species before they disappear and help manage their conservation, etc., besides being invalid, is mostly pro domo marketing, rarely followed by, and obviously unlikely to result in, concrete targeted conservation actions. Intuition and educated guesswork might be just as valuable in executing the same actions more quickly and cheaply; but the disguise of the latest technology misdirects attention from the actual goals. On-the-ground-experience is that conservation will not target molecules or obscure taxa, but focus on habitats, with the trivial reality that 'we conserve what we can, when we can, where we can and however we can'.

This is not to deny the possibility that some of the species we recognise here may themselves include several 'cryptic species', until they are examined with more scrutiny or until additional characters are investigated. "Presumption of the 'existence of morphological differences' should be applied [because of] the biological impossibility of the existence of two genetically different but morphologically completely identical species. [If] we are unable to present definite morphological differences this means that we are just currently unable to detect them [...]" (Korshunova et al., 2019: 21). Morphologically could be advantageously replaced by phenotypically.

The opposite situation may also exist, of 'molecularly-cryptic species' (called anti-cryptic speciation by Bickford et al., 2006: 151) in which species display morphological differences but little genetic differentiation (at least until additional genetic characters are examined). As examples, Korshunova et al. (2017: 2) cited bats (Mayer & von Helversen, 2001), lycaenid butterflies (Wiemers & Fiedler, 2007), and cichlid fishes (without providing references). We have not examined these cases in detail, but additional works presenting morphologically different species of fish with very small genetic differentiation (at least as presently reported) include, for example, Central American cichlids (Barluenga et al., 2006), Lake Victoria cichlids (Samonte et al., 2007; Wagner et al., 2013; Meier et al., 2018), and East African cyprinids (Nagelkerke et al., 2015: 1206; Levin et al., 2021). The final pattern may be composite, that the *B. binotatus* group includes species with low morphological disparity and low molecular differences, and others with greater morphological differences, and others with high molecular differences.

Another issue is whether there is a value at *naming* supposed cryptic species (populations that are genetically different but morphologically 'indistinguishable'). Is there a need to apply formal names for entities that we do not discern? More pragmatically, are cryptic species not simply flags to indicate that resources (time, funding, access to material) have not been available and that we do not (any longer?) train people to look at the organism?

COMPARISON MATERIAL

Barbodes banksi: Borneo: Malaysia: Sarawak: CMK 8419, 1, 27.0 mm SL; Malaysia: Sarawak: blackwater ditch on road from Batu Kawa to Kuching, about 1 km after turnoff on road from Bau to Batu Kawa; 3 July 1992. — ZRC 39377, 3, 56.5–60.1 mm SL; Sungai Stom Muda, along road from Kuching to Bau; 7 September 1995. — ZRC 61467, 6, 50.4–70.2 mm SL; Pueh area, Sungai Sebanko, tributary of Sungai Perinder; 5 November 2013. — ZRC 39387, 5, 58.7–72.7 mm SL; Matang, 1.3 km before junction to Sungai Cina Matang; 4 September 1995. — ZRC 659, 19, 15.4–67.5 mm SL; Kampung Pangkalan Kuap, Bukit Stigang, 7 miles south of Kuching; 20 January 1969. — CMK 11512, 2, 67.9–71.7 mm SL; Sungai Perut Gelo, a tributary of Sungai Batang Ai; 5 January 1995. — ZRC 60395, 2, 87.7–91.1 mm SL; Sri Aman, Lupar basin, Sungai Kaup, tributary of Sungari Engkari; 26 September 2018.

Borneo: Indonesia: Kalimantan Barat: CMK 6636, 10, 27.9–59.6 mm SL; Nyarungkup, about 10 km north of Singkawang; 20 April 1990. — CMK 6641, 5, 39.9–51.9 mm SL; Petinjan, 8 km SE of Singkawang on road to Pontianak; 20 April 1990. — CMK 6679, 2, 41.8–53.5 mm SL; Brado, 3 km SE of Anjungan on road to Sintang; 21 April 1990. — CMK 11747, 1, 40.7 mm SL; Kapuas basin: Sungai Pala at Pala Hulu (Kec. Siberuang, Kp. Renyai Hulu), km101 on road from Sintang to Putussibau; 16 June 1995.

Barbodes binotatus: Indonesia: West Java: ZRC 40127, 13, 31.9–72.6 mm SL; Bogor, tributary of Cipinang Gading; 10 July 1996. — ZRC 40141, 8, 34.8–63.3 mm SL; Bogor: Desa Cinangneng, Kecamatan Ciampea; 10 July 1996. — ZRC 40142, 4, 7.0–19.9 mm SL; Bogor: Sawah Bera; 10 July 1996. — CMK 7357, 8, 12.4–28.4 mm SL; Ronca Danau (crater lake); 17 February 1991. — CMK 8976, 3, 43.0–53.3 mm SL; Sungai Ciliwung at Cilebut; 31 March 1992.

Barbodes bunau: Indonesia: Kalimantan Timur: ZRC 49867, 4 paratypes, 67.3–77.8 mm SL; Paya Seturan County: Sesayap basin, Sungai Belakau, tributary of Rian River; November 1999. — CMK 9535, 5; Sebuku drainage: Sungai Sanul, tributary of Sungai Tikung; 14 February 1993.

Barbodes rhombeus: Singapore (introduced): ZRC 52077, 32, 13.4–103.7 mm SL; stream off Venus Drive, 1 November 2010. — ZRC 54686, 20, 27.0–90.8 mm SL; stream at Mandai Track 15; 28 July 2015. — ZRC 40318, 1, 83.9 mm SL; Andrew Road; August 1996. Thailand: ZRC 45312, holotype, 50.1 mm SL; CMK 10678, 2 paratypes, 33.8–40.2 mm SL; Trat Prov.: stream near Ban Tha Kum, 9 km north of Ban Noen Sung on road 3271 from Trat to Bo Rai; 3 December 1993. — CMK 20211, 2; Trat Prov.: Khlong Ma Nao Lek, km 51 on road from Trat to Khlong Yai; 19 November 2007. Laos: CMK 13342, 2 paratypes, 46.2–55.7 mm SL; Vientiane Prov.: Houay Sala Yai, a tributary of Nam San; 28 February 1997. — CMK 24417, 14, 21.1–48.9 mm SL; Saysomboune Prov.: Khon: Nam Mang near Ban Pa La Veak [Nam Mang drainage]; 13 February 2014.

ACKNOWLEDGEMENTS

We are pleased to thank Mohd. Zakaria-Ismail for making the specimens of *B. zakariaismaili* available and Khaironizam Md. Zain for some information on the habitat at its type locality, Nick Baker and Tan Heok Hui for Figures 4 and 12c, respectively, and Rohan Pethiyagoda and Tan Heok Hui for comments on the manuscript. Work on *Barbodes* started in the last century (!); the manuscript was initiated in 2008 when MK was a Visiting Senior Research Fellow at the National University of Singapore, and later partly supported by research fellowships from the Lee Kong Chian Natural History Museum between 2004 and 2017.

LITERATURE CITED

Ahmad Sobri NZ, Lavoué S, Aziz F, Mohd Nor SA, Mohammed Akib NA & Khaironizam MZ (2021) To lump, to split or to maintain? Molecular taxonomy of the spotted barb *Barbodes binotatus* (Cyprinidae) and closely related species in Peninsular Malaysia. Journal of Fish Biology, 99(2): 656–668.

Alfred ER (1963) Notes on a collection of fresh-water fishes from Penang. Bulletin of the Singapore National Museum, 32: 143–154, pls. 3–4.

Alfred ER (1966) The fresh-water fishes of Singapore. Zoologische Verhandelingen, 78: 1–68, pls. 1–8.

Bariche M (1998) Le complexe *Puntius binotatus* (Pisces, Cyprinidae) de Java et Sumatra est-il formé d'une ou de plusieurs espèces? Statut d'une population cavernicole de Java. Unpublished Mémoire de DEA, Muséum National d'Histoire Naturelle, Paris, 29 pp.

Barluenga M, Stölting KN, Salzburger W, Muschick M & Meyer A (2006) Sympatric speciation in Nicaraguan crater lake cichlid fish. Nature, 439(7077): 719–723.

Bickford D, Lohman DJ, Sodhi NS, Ng PKL, Meier R, Winker K, Ingram KK & Das I (2006) Cryptic species as a window on diversity and conservation. Trends in Ecology and Evolution, 22(3): 148–155 [2007].

Bleeker P (1855) Verslag van eenige verzamelingen van visschen van Oost-Java. Natuurkundig Tijdschrift voor Nederlandsch Indië, 9: 391–414.

Böhlke JE (1953) A catalogue of the type specimens of recent fishes in the Natural History Museum of Stanford University. Stanford Ichthyological Bulletin, 5: 1–168.

Cuvier G & Valenciennes A (1842) Histoire naturelle des poissons. Tome seizième. Bertrand, Paris, xx + 472 pp., pls. 456–487.

Fahmi-Ahmad M, Syed AR & Amirrudin BA (2015) Ichthyofaunal diversity of Tasek Bera RAMSAR site, Pahang, Peninsular Malaysia. Journal of Wildlife and Parks, 30: 27–44.

Fahmi-Ahmad M, Theng ECM, Nor SAM & Ahmad A (2020) Deciphering species-group taxonomic complexity of common, *Barbodes binotatus* and saddle barbs, *B. banksi* in Peninsular Malaysia. Malaysian Journal of Fundamental and Applied Sciences, 16(5): 536–543.

Herre AWCT (1940) Additions to the fish fauna of Malaya and notes on rare or little known Malayan and Bornean fishes. Bulletin of the Raffles Museum, Singapore, 16: 27–61.

Inger RF & Chin PK (1962) The fresh-water fishes of North Borneo. Fieldiana, Zoology, 45: 1–268.

Korshunova T, Martynov A, Bakken T & Picton B (2017) External diversity is restrained by internal conservatism: new nudibranch mollusc contributes to the cryptic species problem. Zoologica Scripta, 46(6): 683–692.

Korshunova T, Picton B, Furfaro G, Mariottini P, Pontes M, Prkic J, Fletcher K, Malmberg K, Lundin K & Martynov A (2019) Multilevel fine-scale diversity challenges the 'cryptic species' concept. Scientific Reports, 9(6732): 1–23.

Kottelat M (2000) Diagnoses of a new genus and 64 new species of fishes from Laos (Teleostei: Cyprinidae, Balitoridae, Bagridae, Syngnathidae, Chaudhuriidae and Tetraodontidae). Journal of South Asian Natural History, 5(1): 37–82.

Kottelat M (2001) Fishes of Laos. Wildlife Heritage Trust, Colombo, 198 pp.

Kottelat M (2013) The fishes of inland waters of Southeast Asia: a catalogue and core bibliography of the fishes known to occur in freshwaters, mangroves and estuaries. Raffles Bulletin of Zoology, Supplement 27: 1–663.

Kottelat M & Freyhof J (2007) Handbook of European freshwater fishes. Kottelat, Cornol & Freyhof, Berlin, xiv + 646 pp.

Kottelat M & Lim KKP (1995) Freshwater fishes of Sarawak and Brunei Darussalam: a preliminary annotated check-list. Sarawak Museum Journal, 48(69): 227–256.

Kottelat M, Whitten AJ, Kartikasari SN & Wirjoatmodjo S (1993) Freshwater fishes of Western Indonesia and Sulawesi. Periplus, Hong Kong, 259 pp., 84 pls.

Levin B, Simonov E, Franchini P, Mugue N, Golubtsov A & Meyer A (2021) Rapid adaptive radiation in a hillstream cyprinid fish in the East African White Nile River basin. *Molecular Ecology, 30(21): 5530–5550.*

Mayer F & von Helversen O (2001) Cryptic diversity in European bats. Proceedings of the Royal Society, Biological Sciences, 268: 1825–1832.

Meier JI, Marques DA, Wagner CE, Excoffier L & Seehausen O (2018) Genomics of parallel ecological speciation in Lake Victoria cichlids. Molecular Biology and Evolution, 35(6): 1489–1506.

Menon AGK (1954) Notes on Malayan fishes in the collection of the Raffles Museum, Singapore. Part 4. Bulletin of the Raffles Museum, Singapore, 25: 5–26.

Nagelkerke LAJ, Leon-Kloosterziel KM, Megens HJ, De Graaf M, Diekmann O & Sibbing FA (2015) Shallow genetic divergence and species delineations in the endemic *Labeobarbus* species flock of Lake Tana, Ethiopia. Journal of Fish Biology, 87(5): 1191–1208.

Ng CKC, Lim TY, Amirrudin A & Khaironizam MZ (2019) Provisional checklist of freshwater fish diversity and distribution in Perak, Malaysia, and some latest taxonomic concerns. Zootaxa, 4567(3): 515–545.

Ng CKC & Tan J (2021) Cryptic species and grey zone speciation of the *Barbodes binotatus* complex (Teleostei, Cyprinidae) in Sundaland. Journal of Fish Biology, 99(4): 1256–1273.

Ng HH & Tan HH (1999) The fishes of the Endau drainage, Peninsular Malaysia with descriptions of two new species of catfishes (Teleostei: Akysidae, Bagridae). Zoological Studies, 38(3): 350–366.

Ng PKL & Lim KKP (1996) The freshwater fishes of Singapore. Journal of the Singapore National Academy of Science, 22–24: 109–124.

Norén M & Kullander SO (2018) The enigmatic *Betadevario ramachandrani* (Teleostei: Cyprinidae: Danioninae): phylogenetic position resolved by mitogenome analysis, with remarks on the prevalence of chimeric mitogenomes in GenBank. Cogent Biology, 4(1525857): 1–8.

Rachmatika I (2005) A new species of cyprinid fish: *Puntius bunau* from the Seturan basin of Indonesian Borneo. Treubia, 33(2): 181–190 [2004].

Ren Q, Yang L, Chang CH & Mayden RL (2020) Molecular phylogeny and divergence of major clades in the *Puntius* complex (Teleostei: Cypriniformes). Zoologica Scripta, 49(6): 697–709.

Roberts TR (1989) The freshwater fishes of western Borneo (Kalimantan Barat, Indonesia). Memoirs of the California Academy of Sciences, 14: 1–210.

Samonte IE, Satta Y, Sato A, Tichy H, Takahata N & Klein J (2007) Gene flow between species of Lake Victoria haplochromine fishes. Molecular Biology and Evolution, 24: 2069–2080.

Smith HM (1945) The fresh-water fishes of Siam, or Thailand. Bulletin of the United States National Museum, 188: i–xi + 1–622, 9 pls.

Struck TH, Feder JL, Bendiksby M, Birkeland S, Cerca J, Gusarov VI, Kistenich S, Larsson KH, Liow LH, Nowak MD, Stedje B, Bachmann L & Dimitrov D (2018) Finding evolutionary processes hidden in cryptic species. Trends in Ecology and Evolution, 33(3): 153–163.

Tan HH & Lim KKP (2004) Inland fishes from the Anambas and Natuna Islands, South China Sea, with description of a new species of *Betta* (Teleostei: Osphronemidae). Raffles Bulletin of Zoology, Supplement 11: 107–115.

Tan HH, Lim KKP, Liew JH, Low BW, Lim RBH, Kwik JTB & Yeo DCJ (2020) The non-native freshwater fishes of Singapore: an annotated compilation. Raffles Bulletin of Zoology, 68: 150–195.

Tan SH & Tan HH (1994) The freshwater fishes of Pulau Bintan, Riau Archipelago, Sumatera, Indonesia. Tropical Biodiversity, 2(3): 351–368.

Wagner CE, Keller I, Wittwer S, Selz OM, Mwaiko S, Greuter L, Sivasundar A & Seehausen O (2013) Genome-wide RAD sequence data provide unprecedented resolution of species boundaries and relationships in the lake Victoria cichlid adaptive radiation. Molecular Ecology, 22: 787–798.

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

Wiemers M & Fiedler K (2007) Does the DNA barcoding gap exist? – a case study in blue butterflies (Lepidoptera: Lycaenidae). Frontiers in Zoology, 4(8): 1–16.

Yang L, Mayden RL, Sado T, He SP, Saitoh K & Miya M (2010) Molecular phylogeny of the fishes traditionally referred to Cyprinini *sensu stricto* (Teleostei: Cypriniformes). Zoologica Scripta, 39(6): 527–550.

Zakaria-Ismail M (1993) The fish fauna of the Sungai Teris and Sungai Rengit, Krau Game Reserve, Pahang, Malaysia. Malayan Nature Journal, 46(3–4): 201–228.