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Rasbora marinae, a new species of cyprinid fish from northwestern Borneo (Teleostei: Danionidae)

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Abstract. *Rasbora marinae*, new species, is described from Brunei Darussalam and northern Sarawak, Borneo. It shares with *R. cephalotaenia* the colour pattern of a mid-lateral stripe from tip of snout to end of median caudal-fin rays and rows of black spots on the flank, including two rows along edges of the mid-lateral stripe; it differs from *R. cephalotaenia* in retaining the mid-lateral stripe in adults, and in the absence of a conspicuous black blotch at the middle of the caudal-fin base.

Key words. Southeast Asia, biodiversity, taxonomy, Cypriniformes, peat swamps

INTRODUCTION

The cyprinid genus *Rasbora* includes small cyprinid fishes found throughout South and Southeast Asia and is one of the most species-rich genera of freshwater fishes. Since the most recent monograph by Brittan (1954) more than half a century ago, several groups have been recognised during the last 25 years (Kottelat & Vidthayanon, 1993; Kottelat & Witte, 1999; Liao et al., 2010). Even though Brittan's (1954) *Rasbora* was recently divided into nine different genera by Liao et al. (2010) based on both morphology and molecular data, their *Rasbora* sensu stricto (*Rasbora* s.s.) with currently 78 recognised species (see Kottelat, 2013; Lumbantobing, 2014; Britz & Tan, 2018; Wilkinson & Tan, 2018) still includes the majority of taxa. *Rasbora* s.s. is distributed in the west from the Ganges drainage across the Indian subcontinent, to water bodies in Indochina and Sundaland in the southeast, to southern China and even reaching the Philippine islands of Palawan and Mindanao (Brittan & Brattstrom, 1952; Brittan, 1954). *Rasbora* s.l. was subdivided by Brittan (1954) into a group of species with unclear systematic affinities and eight species complexes, the species composition of which was modified by subsequent authors (see Kottelat & Vidthayanon, 1993). New genera were proposed for some of the species with unclear affinities. Brittan's (1954) Pauciperforata complex was also described as a new genus *Trigonopoma* (Liao et al., 2010), still leaving seven of Brittan's (1954) original species complexes in *Rasbora* s.s. = sensu Liao et al. (2010). The greatest diversity within *Rasbora* s.s. is found on the island of Borneo with around 40 recognised species from six of the seven species groups.

The waterways of Borneo even today can hardly be considered well explored and many new freshwater fish species are still being discovered there regularly (e.g., Tan, 2012; Tan & Lim, 2013, 2014; Liao & Tan, 2014; Low et al., 2014; Ciccotto & Tan, 2018), including eight new species of the genus *Rasbora* only in the last two decades: *R. dies* Kottelat, 2008; *R. patrickyapi* Tan, 2009; *R. lacrimula* Hadiaty & Kottelat, 2009; *R. atranus* Kottelat & Tan, 2011a; *R. rheophila* Kottelat, 2012; *R. cryptica* Kottelat & Tan, 2012; *R. simonbirchi* Britz & Tan, 2018; and *R. pycnopeza* Wilkinson & Tan, 2018.

The species described in this paper closely resembles *R. cephalotaenia*, which is the type species of the genus *Rasbora* (Bleeker, 1859; Kottelat, 2013). *Rasbora cephalotaenia* is also senior synonym of *R. beauforti* as designated by Kottelat & Tan (2011b). *Rasbora cephalotaenia* is unmistakable (Brittan, 1954) with its distinguishing body pattern of two regularly interrupted black stripes. In the juvenile stage, it is easy to confuse with similar black-striped *Rasbora*, especially with syntopic species like *R. einthovenii* and *Trigonopoma* species (pers. obs.).

From collections in 1996 to 2005, several series of specimens with body colour pattern similar to *R. cephalotaenia* were encountered. Closer examination confirms it to be a new species of *Rasbora*, and it is herein described.

MATERIAL AND METHODS

Material examined is deposited in the Natural History Museum (BMNH), London, UK; Nationaal Natuurhistorisch Museum (RMNH), Leiden, The Netherlands; National

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Fig. 1. *Rasbora marinae*, ca. 60 mm SL; Sarawak: Tatau; freshly caught specimen; not preserved.

Museum of Natural History, Washington (USNM), USA; Instituut voor Systematiek & Populatiebiologie (ZMA, now integrated in RMNH), Universiteit van Amsterdam, The Netherlands; Zoological Reference Collection (ZRC), Lee Kong Chian Natural History Museum, National University of Singapore, Singapore; and the collection of the second author (CMK) in Delémont, Switzerland.

Specimens were measured from point to point on the left side using dial callipers (up to 0.5 mm accuracy). Methods for measurements and counts follow Kottelat (2001) and Kottelat & Freyhof (2007). Lateral line scale count is given as scales on body + scales on caudal-fin base. Vertebral count is provided as a total number of abdominal and caudal vertebrae.

TAXONOMY

Rasbora marinae, new species
(Figs. 1, 2)

Rasbora sp. – Zakaria-Ismail, 1984: 73; Tan & Lim, 2007: 73, Appendix 4.

Rasbora cephalotaenia (non Bleeker) – Eden, 1984: 185; Kottelat et al., 1993: 45 (in part); Kottelat & Lim, 1995: 233 (in part); Parenti & Meisner, 1995: 35; Sulaiman & Shahdan, 2003: 63; 2007: 24; Sulaiman et al., 2018: 29.

Holotype. ZRC 51189, 97.1 mm SL; Brunei Darussalam: Belait district: Sungai Ingei, tributary of Sungai Belait (4°09′42.6″N, 114°42′59.5″E); H. H. Tan et al., 9–11 May 1996.

Paratypes. CMK 20122, 5 ex., 39.2–93.0 mm SL; ZRC 51190, 12 ex., 33.5–106.3 mm SL; same data as holotype. – ZRC 51191, 9 ex., 38.7–78.5 mm SL; Brunei Darussalam: Belait district: Sungai Pelok and Sungei Sepan, feeding into Sungai Ingei; H. H. Tan et al., 11 May 1996. – USNM 328057, 60 ex., 17.0–63.9 mm SL; Brunei Darussalam: Belait district: tributary stream of Ulu Belait that enters Ulu Belait downstream from Lubok Tapah; L. R. Parenti, 13 July 1993. – ZRC 52488, 23 ex., 18.1–70.4 mm SL; Sarawak: Bintulu, Sungei Penyilan; Grand Perfect Sdn. Bhd., 15 August 2005.

Diagnosis. *Rasbora marinae* is differentiated from congeners by the following combination of characters: a mid-lateral black or dark brown stripe from the tip of the snout to the end of the median caudal-fin rays; rows of black spots on the flank, including two rows along the edges of the mid-lateral stripe; lateral line complete, with 30–31 + 1–2 scales; 12 circumpeduncular scale rows. *Rasbora marinae* is very similar to *R. cephalotaenia* from which it differs in retaining the mid-lateral stripe in adults (vs. stripe disappearing with increasing size, leaving only the 2 rows of black spots along its edges), and the absence of a conspicuous black blotch at the middle of the caudal-fin base (vs. presence).

Description. See Figs. 1, 2 for overall appearance, and Table 1 for morphometric data of holotype and 12 paratypes. Head blunt, relatively short (26.0–29.2% SL), mouth terminal with distinct symphysal knob on tip of lower jaw. Body compressed, deepest at dorsal-fin origin (24.3–26.3% SL), tapering to its shallowest at caudal peduncle (12.4–13.6% SL). Dorsal fin triangular and short-based (10.6–13.0 % SL), with 2 simple and 7½ branched rays; origin above lateral line scale 12–13. Pectoral fin slightly falcate, with 15–16 rays; a small axillary lobe present. Pelvic fin pointed, with 9 rays; axillary scale present. Anal fin triangular, short-based (10.7–12.4% SL), with 3 simple and 5½ branched rays. Caudal fin forked and symmetrical (upper caudal-fin lobe length 28.3–32.7% SL, lower caudal-fin lobe length 29.3–34.0% SL), with 10+9 principal rays, 9+8 branched. Caudal peduncle 1.5 times longer than deep. Lateral line straight and complete; 30–31 + 1–2 pored scales. 13 predorsal scales, ½4/1/3½ scales in transverse line (counted about 3 scales in front of pelvic-fin base), ½3/1/1½ scales in transverse line on caudal peduncle, 1 scale between lateral line and pelvic-fin origin. Total vertebral count 31–32 (mode 32).

Fig. 2. *Rasbora marinae*, Brunei. A, ZRC 51189, holotype, 97.1 mm SL; B, ZRC 51190, paratype, 36.5 mm SL.

Fig. 3. *Rasbora cephalotaenia*, colouration of freshly caught specimens. A, Kahayan basin, clear water stream, ca. 50 mm SL; B, Sebangau basin, black water stream, ca. 60 mm SL.

Fig. 4. *Rasbora cephalotaenia*, Indonesia: Belitung (type locality). A, BMNH1866.5.2.151, 63.8 mm SL, lectotype (copyright BMNH); B, ZMA 121.702, 71.6 mm SL; C, ZRC 56732, 54.1 mm SL.

Colouration. A dark brown mid-lateral stripe from tip of snout through eye and to end of caudal peduncle, continued by black pigments on membranes between three median rays of caudal fin. Mid-lateral stripe below and separated from axial streak until above anal-fin base, then contiguous. Stripe margined by a row of black spots along upper margin, from under dorsal-fin origin to base of caudal fin; a second row of spots from upper edge of mid-lateral stripe behind gill-opening, crossing mid-lateral stripe and, from above pelvic-fin origin, running along lower edge of mid-lateral stripe. A short row of black spots on 4–6 anterior lateral line scales. A pale stripe above mid-lateral stripe. Row of spots above pale stripe on about 10 anterior scales, more or less continuous with row along upper edge of mid-lateral stripe; above it, a row of spots from head to about mid-length of caudal peduncle. Rest of dorsum dark brown, with rows of fainter spots. Spots comprise a patch of melanophores on both scale pocket and posterior extremity of exposed part of the preceding scale. A faint black stripe from base of pectoral fin to posterior extremity of anal-fin base. Fins hyaline, except for pigments on interradial membrane of three median caudal-fin rays.

In specimens less than about 30 mm SL, mid-lateral stripe well contrasted, with defined edges. Spots missing. No stripe between pectoral- and anal-fin bases, but dark grey stripe along anal-fin base.

In life (Fig. 1): A uniform dark grey to black mid-lateral stripe from tip of snout to tip of median caudal-fin rays; coloured stripe above black stripe as follows: golden stripe from tip of snout to opercle edge, pinkish-gold stripe from post-opercle edge to base of caudal fin. Back yellowish-brown with gold iridescence. Belly greyish to cream. A diffused grey stripe from above pectoral fin to base of anal fin. Dorsal fin yellowish. Anterior portion of caudal fin yellow, posterior half orangish-red but can be faint, with thin black margin and black stripe on membranes between three median rays. Anal, pelvic, and pectoral fins hyaline.

Fig. 5. *Rasbora cephalotaenia*, South Sumatra. A, ZRC 52474, 71.2 mm SL; B, ZRC 52474, 37.8 mm SL.

Distribution. *Rasbora marinae* is currently found in Belait and Tutong Districts, Brunei Darussalam; and in Sarawak, north of Tatau basin including Lambir Hills, to Baram basin (see map in Fig. 6; Zakaria-Ismail, 1984; Parenti & Meisner, 1995; Sulaiman & Shahdan, 2003; Tan & Lim, 2007; unpublished data).

Field notes. *Rasbora marinae* seems to occupy the same niche as *R. cephalotaenia*, in blackwater and brown water habitats; but *R. cephalotaenia* may occasionally also occur in clear water. In Brunei, species syntopic with *R. marinae* include: *Barbodes xouthos*, *Desmopuntius johorensis*, *D. pentazona* (Cyprinidae), *Rasbora einthovenii*, *R. kottelati*, *Trigonopoma pauciperforatum* (Danionidae), *Pangio agma* (Cobitidae), *Ompok borneensis*, *Silurichthys marmoratus* (Siluridae), *Clarias leiacanthus* (Clariidae), *Hemirhamphodon kuekenthali* (Zenarchopteridae), *Nandus nebulosus* (Nandidae), *Betta akarensis*, *Luciocephalus pulcher* (Osphronemidae), *Channa baramensis*, *C. lucius* (Channidae), *Macrognathus maculatus*, and *M. circumcinctus* (Mastacembelidae).

Kottelat & Lim (1993: 230) commented that *R. tubbi* is apparently related and vicariant with *R. cephalotaenia*, replacing it in northern Sarawak, from where it had not been recorded at the time the checklist was compiled. This hypothesis is that *R. marinae* is the sister species of *R. cephalotaenia*, and both species are found in acid water and peat swamp habitats. Both *R. tubbi* and *R. marinae* occur in North Sarawak and Brunei, where *R. tubbi* is found only in clear water hill streams.

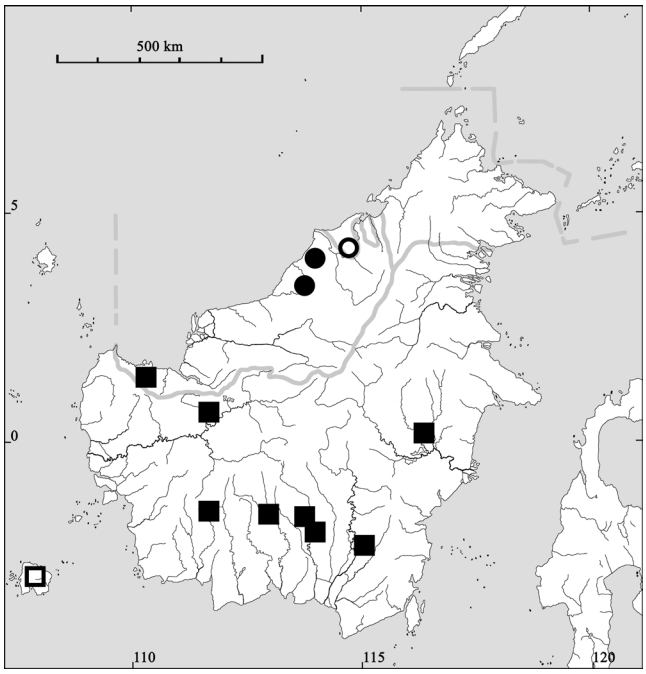

Fig. 6. Distribution of *Rasbora cephalotaenia* (squares) and *R. marinae* (circles) in Borneo and Belitung Island. Hollow symbols represent type localities.

Table 1. Morphometric and meristic data of *Rasbora cephalotaenia* from Belitung [type locality] and Sumatra (ZMA 121.702 [5], ZRC 52474 [3]) and holotype and paratypes of *R. marinae* (ZRC 51189, ZRC 51190, CMK 20122). Values of holotype included in ranges. Numbers in parentheses are modal counts.

	Rasbora marinae		***Rasbora cephalotaenia***
	Holotype	**Paratypes (n = 13)**	**(n = 8)**
Standard length (mm)	97.1	57.1–106.5	43.4–75.4
Percentage of standard length			
Total length	131.4	127.0–134.6	127.1–134.2
Body length	74.9	73.7–76.9	70.2–79.5
Pre-dorsal length	55.4	54.6–57.8	53.6–57.7
Pre-anal length	72.9	71.3–73.8	70.7–76.3
Pre-pelvic length	51.7	51.2–52.7	51.8–55.8
Head length	27.8	26.0–29.2	26.5–29.7
Body depth at dorsal-fin origin	25.7	24.3–26.3	22.0–24.7
Body depth	22.1	19.8–22.1	18.2–21.1
Depth of caudal peduncle	13.6	12.4–13.6	10.6–12.5
Length of caudal peduncle	19.8	18.5–21.0	16.0–21.5
Length of dorsal-fin base	11.5	10.6–13.0	10.6–12.5
Length of anal-fin base	11.9	10.7–12.4	9.5–11.8
Length of pelvic fin	21.8	18.4–21.8	14.3–19.6
Length of pectoral fin	23.7	22.4–24.9	19.1–23.8
Length of upper caudal-fin lobe	31.5	28.3–32.7	28.5–31.7
Length of median caudal-fin rays	14.9	13.2–17.0	13.9–17.3
Length of lower caudal-fin lobe	31.3	29.3–34.0	28.7–32.2
Percentage of head length			
Head depth	59	55–59	52–57
Head width	48	46–53	43–47
Snout length	33	29–35	30–35
Orbit diameter	23	22–27	24–29
Interorbital width	40	33–40	31–37
Meristics		(n = 21)	(n = 8)
Vertebrae (total)	32	31–32 (32)	31–33 (32)
Lateral line scales	30 + 2	30–31 + 1–2 (31)	29–32 + 1–2 (30)
Pre-dorsal scales	13	13	12–13 (13)
Transverse scale rows	½4/1/3½	½4/1/3½	½4/1/3½
Transverse scale rows on caudal peduncle	½3/1/1½	½3/1/1½	½3/1/1½

Etymology. This species is named for Marina Wong (Brunei Museum, retired) in appreciation of her contributions to the knowledge of the natural history of Southeast Asia and her generous help in organising fieldwork in Brunei for the first author and team.

Remarks. *Rasbora marinae* (Figs. 1, 2) and *R. cephalotaenia* (Figs. 3–5) are closely related and share the basic colour pattern of a mid-lateral stripe and rows of spots. They are distinguished by the colour pattern of the adults. The meristic and morphometric data sets (Table 1) show broad overlaps.

The shared colour pattern (unique within *Rasbora*) allows them to be considered as allopatric species. Juveniles are distinguished only by the presence of the black blotch at the base of the caudal fin in *R. cephalotaenia*, which is missing in *R. marinae*. In juveniles less than 30 mm SL, the stripe is uniformly dark brown, with discrete edges. With increasing size, the rows of spots develop and the edges of the mid-lateral stripe become irregular. With increasing size, the mid-lateral stripe becomes paler in *R. cephalotaenia* and finally disappears (Fig. 3). In *R. marinae*, the stripe remains present at all sizes.

Rasbora marinae and *R. cephalotaenia* occur in adjacent non-overlapping areas. *Rasbora marinae* is restricted to the northern half of Sarawak and Brunei (see Fig. 6), while *R. cephalotaenia* is known from the southern half of Borneo and also reported from Sumatra, islands of Bangka and Belitung (type locality), and the Malay Peninsula. This distribution pattern in Borneo is shared with those of the allopatric species pairs *R. kottelati–R. kalochroma* (Lim, 1995), *Desmopuntius pentazona–D. hexazona* (Alfred, 1963; Kottelat et al., 1993), *Hemirhamphodon kuekenthali–H.*

Fig. 7. A, *Rasbora einthovenii*, ZRC 50123, 32.1 mm SL, Sambas (topotypic material); B, *Trigonopoma pauciperforatum*, ZRC uncat, 34.4 mm SL, Sarawak.

byssus (Tan & Lim, 2013), *Pangio agma–P. semicincta* (Burridge, 1992; Kottelat & Lim, 1993), *Betta akarensis–B. ibanorum* (Tan & Ng, 2004), and *Parosphromenus allani–P. barbarae* (Tan & Grinang, 2020), all distinguishable from each other most easily by colour pattern.

Rasbora marinae is superficially similar to two other *Rasbora*, *R. dusonensis* and *R. tornieri* (see Ng & Kottelat, 2013b: figs. 1A, B). *Rasbora marinae* can be differentiated from these two by the following features: absence of black margin on caudal fin (vs. presence of thick black margin in *R. dusonensis* and thin black margin in *R. tornieri*); yellowish caudal fin in life (vs. reddish-orange in *R. tornieri*); greater pre-anal length than *R. tornieri* (71.3–73.8% SL, vs. 66.9–71.7); smaller body depth than *R. tornieri* (19.8–22.1% SL, vs. 23.9–27.1); deeper caudal peduncle than *R. dusonensis* and *R. tornieri* (12.4–13.6% SL, vs. 10.4–11.7 and 11.4–12.7 respectively) (data for *R. dusonensis* and *R. tornieri* from Ng & Kottelat, 2013b).

Juvenile *R. marinae* may be confused with two syntopic species, *R. einthovenii* and *Trigonopoma pauciperforatum* (see Fig. 7). *Rasbora marinae* can be easily differentiated from *Trigonopoma pauciperforatum* in having the following features: stouter body and caudal peduncle (vs. more slender); and dorsal fin length less than head length (vs. more than head length). *Rasbora marinae* can be differentiated from *R. einthovenii* in having the following characters: position of central black stripe along median of body (vs. lower half of body); distinct cream stripe above central black stripe (vs. absence); more pointed caudal-fin tips (vs. blunt and rounded caudal-fin tips); adult morphometric characters: greater pre-anal length (71.3–73.8% SL, vs. 67.0–69.1); smaller pectoral-fin length (22.4–24.9% SL, vs. 24.3–26.4); smaller caudal-peduncle length (18.5–21.0% SL, vs. 21.4–23.9); smaller interorbital width (33–40% HL, vs. 41–46); and smaller eye diameter (22–27% HL, vs. 28–33) (data for *R. einthovenii* from Tan, 2009c).

Comparative material. *Rasbora cephalotaenia* [many lots not listed]: Malay Peninsula: ZRC 15681–15723, 43, 32.7–57.3 mm SL; Selangor: north Selangor peat swamp forest, stream at km 50 to Tanjung Malim (United Plantation Berhad); NUS 1991–92 Zoology Honours class, 18 June 1991. – ZRC 52472, 2, 82.9–89.0 mm SL; Johor: Sungei Endau, ca. 100 m before Sungei Mawar; H. H. Tan et al., 8 May 1995. – ZRC 52473, 2, 82.3–88.0 mm SL; Johor: Mawai, Sungai Tementang; H. H. Tan et al., 24 February 1995. Sumatra: BMNH 1866.5.2:151, 1, lectotype, 63.8 mm SL; Bleeker's collection. – ZRC 38598, 3, 61.4–80.3 mm SL; Jambi: Danau Rasau, blackwater lake draining into Batang Hari, opposite Kampung Rantau Panjang; M. Kottelat & H. H. Tan, 1–2 June 1994. – ZRC 52474, 7, 34.4–81.1 mm SL; Sumatra Selatan: Sungai Sentang; H. H. Tan, 27 July 1997. – ZRC 33224–33228, 5, 41.4–78.0 mm SL; Pulau Bintan north (1°08′08.7″N, 104°22′47.2″E); T. H. T. Tan et al., 11 May 1993. – ZRC 31336, 1, 49.0 mm SL; Banka: 3 km north of Payung; M. Kottelat et al., 5

March 1993. – ZRC 30948, 1, 48.0 mm SL; Bangka: 99.4 km south of Pangkalpinang, 2.6 km north of Serdang; M. Kottelat et al., 3 March 1993. – ZMA 121.702, 11, 43.4–78.3 mm SL; Biliton [Belitung]; F. J. Kuiper, 1936–37. – ZRC 56732, 1 ex., 54.1 mm SL; Belitung Barat: Badau, stream along road to Batu Mentas, swampy area perpendicular to unpaved road (02°47.667′S, 107°50.103′E, 57 m asl, pH 5.8); P. Yap et al., 11 April 2013. – ZRC 56733, 6 ex., 49.8–62.2 mm SL; Belitung Barat: Tanjung Pandan, Kelapa Kra, brown water stream (02°42.338′S, 107°41.140′E, 28 m asl, pH 5.7); P. Yap et al., 11 April 2013. Borneo: ZRC 668, 6, 63.0–94.4 mm SL; Sarawak: Kampung Pangkalan Kuap, Batang Stigang, 7 miles south of Kuching; B. L. Lim, 20 January 1969. – CMK 10246, 1, 69.2 mm SL; Kalimantan Barat: Kapuas drainage: Sungai Tangit near Lubuk Buaya, in open forest areas (0°59′14″N, 112°4′31″E); M. Kottelat et al., 8 September 1993. – CMK 7801, 2, 53.0–55.7 mm SL; Kalimantan Timur: Mahakam drainage: swift blackwater stream entering Mahakam River downriver of Muara Pahu (0°14′S, 116°07′E); M. Kottelat, 5 August 1991. – ZRC 52443, 1, 33.7 mm SL; neotype of *R. beauforti*; Kalimantan Tengah: Kotawaringin drainage; Sungei Karang Enyir, near Karang Panjang village; 2°44′14″S, 111°36′05″E; M. Kottelat & Tan H. H., 12 March 2008.

Rasbora einthovenii – ZRC 50123, 5 ex., 26.4–34.7 mm SL; West Kalimantan: Sambas (type locality) basin, Sungai Sinabar, tributary of Sambas River.

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