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## *Trichopodus poptae*, a new anabantoid fish from Borneo (Teleostei: Osphronemidae)

Bi Wei Low\*, Heok Hui Tan\*\* and Ralf Britz\*\*\*

*Trichopodus poptae*, new species, is distinguished from all other species in the genus by an almost non-discernible colour pattern, except for a single black blotch at the base of the caudal fin; fewer lateral scales (34–38, vs. 40–65); fewer total dorsal-fin rays than *T. pectoralis* (14–16, vs. 17–18); more total dorsal-fin spines than *T. microlepis* (6–7, vs. 3–4); fewer total anal-fin rays than *T. microlepis* and *T. pectoralis* (38–41, vs. 44–50). An artificial key to the genus is provided.

### Introduction

The gouramies of the Southeast Asian genus *Trichopodus* La Cepède are laterally compressed, deep-bodied fishes with a long-based anal fin (Regan, 1910). They share with their closest relatives, the species of the genus *Trichogaster*, the reduction of the pelvic-fin spine and an extreme elongation of the posterior branch of the first pelvic-fin soft ray into a long thread-like filament (Britz, 1995). The pelvic girdle and associated muscles of *Trichopodus* and *Trichogaster* are also modified to allow the elongated fin filament to be moved in different directions including forward (Steinbach, 1950; Liem, 1963). This filament carries a series of taste buds innervated by the facial nerve and is used as an organ of touch and taste (Scharer et al., 1947; Steinbach, 1950; Weber, 1963).

*Trichopodus* gouramies are bubble-nest builders and obligate air-breathers that possess an auxiliary breathing apparatus associated with the gills, the labyrinth organ, which allows for the intake of atmospheric air and allows their persistence in oxygen-deprived environments (Tweedie 1953; Burggren, 1979). Consequently, they inhabit a wide range of habitats, but are typically found in heavily vegetated areas of shallow, sluggish or standing waters, or seasonally-flooded habitats (Smith, 1945; Mohsin & Ambak, 1983). *Trichopodus* species have also been exploited as ornamental fish and food fish (Ng & Tan, 1997; Tan & Ng, 2005b).

*Trichopodus* gouramies were previously known as *Trichogaster* Bloch & Schneider, following the erroneous interpretation of the type species by Myers (1923a, 1923b). This was until Derijst (1997)

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pointed out that the type species of *Trichogaster* should have been what was known as *Colisa fasciata*, and that the type species of the genus *Trichopodus* La Cèpède is what was known as *Trichogaster trichopterus* (Britz, 2004; Tan & Kottelat, 2009). As it turns out, *Trichopodus*, previously mistaken as a synonym for *Osphronemus* and *Trichogaster*, is valid. Following this revised classification, there are currently four recognized *Trichopodus* species, viz., *T. pectoralis* Regan, 1910, *T. trichopterus* (Pallas, 1770), *T. leerii* (Bleeker, 1852) and *T. microlepis* (Günther, 1861). Herein, we describe a new species of *Trichopodus* from the Barito River drainage in southern Borneo.

### Material and methods

Material examined is deposited in: BMNH, Natural History Museum, London; MZB, Research and Development Centre for Biology, The Indonesian Institute of Sciences (LIPI, formerly the Museum Zoologicum Bogoriense), Cibinong; and ZRC, Lee Kong Chian Natural History Museum, National University of Singapore.

Method for meristic and measurements follow that of Ng & Kottelat (1994) and Tan & Ng (2005a). Lateral scales were counted as the number of scales in a longitudinal series above the lateral line, from behind the opercular margin to the posterior end of the hypural complex. Measurements were taken with digital calipers. SL is standard length, TL is total length and HL is head length.

Selected specimens were cleared and double stained following the method of Taylor & Van Dyke (1985).

### *Trichopodus poptae*, new species (Figs. 1–2)

**Holotype.** MZB 21466, 64.3 mm SL; Indonesia: Kalimantan Tengah: Barito River drainage: Desa Kerendan, catch by locals; D. Siebert et al., 23 Sep 1995.

**Paratypes.** BMNH 2001.1.15.7668–7692, 14; MZB 21467, 4, ZRC 54264, 5, 31.8–66.1 mm SL; same data as holotype. – BMNH 2001.1.15.7649–7667, 18, 30.2–58.1 mm SL; same data as holotype. – BMNH 2001.1.15.1998, 1, 60.1 mm SL; Indonesia: Barito River drainage: Kalimantan Tengah: Sun-

gai Tengkon; D. Siebert et al., 24 Sep 1995. – BMNH 2001.1.15.1999, 1, 45.4 mm SL; Indonesia: Barito River drainage: Kalimantan Tengah: Sungai Pakumerah, a tributary of Sungai Kerendan; D. Siebert et al., 28 Sep 1995.

**Diagnosis.** *Trichopodus poptae* is distinguished from all congeners in having a black blotch on the caudal peduncle with no other distinct markings on the body (vs. two black blotches, one in the middle of the body and the other on the caudal peduncle in *T. trichopterus*; a black stripe extending from the mouth to the caudal peduncle in *T. pectoralis* and *T. leerii*; no distinct body markings in *T. microlepis*), and fewer lateral scales (34–38, vs. 49–63 in *T. pectoralis*, 40–52 in *T. trichopterus*, 43–50 in *T. leerii*, 57–65 in *T. microlepis*).

*Trichopodus poptae* can be further distinguished from its congeners by the following suite of characters: more dorsal-fin spines than *T. microlepis* (6–7, vs. 3–4); fewer total dorsal-fin rays than *T. pectoralis* (14–16, vs. 17–18); fewer total anal-fin rays (38–41, vs. 44–50 in *T. pectoralis*, 44–49 in *T. microlepis* and 41–46 in *T. trichopterus*); fewer predorsal scales (30–34, vs. 37–44 in *T. pectoralis*, 36–41 in *T. leerii* and 45–52 in *T. microlepis*); fewer transverse scales at dorsal fin origin (8–9, 1, 8–10, vs. 11–13, 1, 15–17 in *T. pectoralis* and 14–17, 1, 19–22 in *T. microlepis*); fewer longitudinal scale rows on caudal peduncle (5–6, 1, 4–5, vs. 7–9, 1, 6–9 in *T. pectoralis* and 8–9, 1, 6–8 in *T. microlepis*); greater caudal peduncle depth (16.0–17.2, vs. 13.3–15.8 % SL in *T. pectoralis*, 14.2–15.7 % SL in *T. leerii* and 12.2–14.8 % SL in *T. microlepis*); greater body depth at anus (43.4–47.4, vs. 36.3–42.1 % SL in *T. pectoralis* and 39.5–42.8 % SL in *T. leerii*); smaller postdorsal length (21.9–24.5, vs. 25.1–27.9 % SL in *T. leerii* and 25.8–32.9 % SL in *T. microlepis*); greater orbital diameter (28.8–33.8, vs. 18.7–27.1 % HL in *T. pectoralis* and 23.2–27.0 % HL in *T. microlepis*); fewer pterygiophores between first and second haemal spine (4, vs. 5 in *T. trichopterus*, *T. pectoralis* and *T. microlepis*).

**Description.** General body form as in Figures 1–2; meristics and morphometrics listed in Table 1. Body oval, laterally compressed and deep. Head laterally compressed with pointed snout and slight convexity at supra-orbital area. Mouth superior, very small and protractile. Lateral line complete or interrupted, with 34–38 scales in a longitudinal series above lateral line. Dorsal fin inserted slightly behind middle of body with



**Fig. 1.** *Trichopodus poptae*, MZB 21466, holotype, 64.3 mm SL; Indonesia: Kalimantan Tengah: Barito River drainage (copyright BMNH).



**Fig. 2.** *Trichopodus poptae*, BMNH 2001.1.15.7669, paratype, 30.8 mm SL; Indonesia: Kalimantan Tengah: Barito River drainage.

VI-VII, 8-9 rays; dorsal-fin base short, with 14-16 subdorsal scales. Caudal fin emarginate to forked with 7-8+8 principal soft rays. Anal fin inserted before dorsal-fin origin with XIII-XV, 25-27 rays;

anal-fin base about  $\frac{3}{4}$  of SL. Pelvic fins with i, 2-4 rays, with first ray filamentous and elongated. Pectoral fin rounded.

Vertebral count: 9-10+21-22 = 30-31 (mode



= 30 or 31, n = 10). First dorsal-fin pterygiophore inserted between neural spines 10 and 11 (7) or 11 and 12 (3). Anal-fin pterygiophore complex in front of first haemal spine with 6 (8) or 7 (2) fin spines; 4 (9) rarely 5 (1) anal-fin pterygiophores between first and second haemal spine.

**Colouration.** See Figures 1–2 for overall appearance. Dorsal surface of head and body dark brown, fading to cream on lateral and ventral surfaces, with 15–18 (mode 16 or 17, n = 22) faint light brown stripes that follow longitudinal rows of scales on body. Stripes on upper half of body are more or less regular and horizontal, whereas on lower half they are curved downwards posteriorly and

continued onto anal fin. All fins relatively hyaline, more opaque at base. Caudal and posterior part of anal fin with faint pattern of cream spots (more visible on fish with white background). A distinct black blotch at lower half of caudal peduncle, roughly covering 2½ scale rows deep and 3 scale rows wide. Juvenile (around 30 mm SL; Fig. 2) with similar colouration pattern as adult.

Live colouration not documented.

**Distribution.** *Trichopodus poptae* is currently known only from the middle Barito River drainage in Southern Kalimantan, Borneo, in the tributaries of Sungai Tengkon and Sungai Keren-dan.

**Table 1.** Meristic and morphometric data of *Trichopodus poptae* (n = 10).

|   | holotype | type series                      |
|---|----------|----------------------------------|
| Standard length (in mm)                 | 64.3     | 44.1–66.1                        |
| <b>Meristics (mode)</b>                 |          |                                  |
| Anal-fin rays                           | XIII, 27 | XIII–XV, 25–27 (XIII, 27)        |
| Dorsal-fin rays                         | VI, 8    | VI–VII, 8–9 (VII or VII, 8)      |
| Caudal-fin rays                         | 8, 8     | 7–8, 8 (8, 8)                    |
| Pelvic-fin rays                         | i, 3     | i, 2–4 (i, 3)                    |
| Pectoral-fin rays                       | 10       | 9–10 (9)                         |
| Subdorsal scales                        | 16       | 14–16 (14)                       |
| Transverse scales at dorsal-fin origin  | 8, 1, 10 | 8–9, 1, 8–10 (8 or 9, 1, 8 or 9) |
| Lateral scales                          | 38       | 34–38 (38; n = 9)                |
| Lateral scale at dorsal-fin origin      | 15       | 14–15 (14; n = 9)                |
| Lateral scale at anal-fin origin        | 3        | 3–4 (3; n = 9)                   |
| Predorsal scales                        | 33       | 30–34 (33)                       |
| Postdorsal scales                       | 24       | 21–25 (24)                       |
| Peduncular scales                       | 6, 1, 5  | 5–6, 1, 4–5 (6, 1, 5; n = 9)     |
| <b>Morphometrics (mean)</b>             |          |                                  |
| <b>In percentage of standard length</b> |          |                                  |
| Total length                            | 142.8    | 137.9–149.4 (143.7)              |
| Body length                             | 70.0     | 68.5–71.0 (70.0)                 |
| Predorsal length                        | 59.7     | 56.4–62.1 (59.4)                 |
| Postdorsal length                       | 22.7     | 21.9–24.5 (23.5)                 |
| Caudal peduncle depth                   | 16.1     | 16.0–17.2 (16.6)                 |
| Preanal length                          | 43.4     | 41.8–46.1 (44.6)                 |
| Head length                             | 31.9     | 31.1–33.6 (32.4)                 |
| Body depth as anus                      | 44.3     | 43.4–47.4 (45.6)                 |
| Pelvic-fin length                       | 129.1    | 123.3–150.7 (137.8)              |
| Anal-fin base length                    | 75.9     | 73.2–79.4 (75.6)                 |
| Dorsal-fin base length                  | 24.6     | 22.3–25.9 (24.2)                 |
| Prepelvic length                        | 35.8     | 34.1–37.2 (35.5)                 |
| Head width                              | 16.5     | 15.9–17.7 (16.6)                 |
| <b>In percentage of head length</b>     |          |                                  |
| Orbit diameter                          | 29       | 29–34 (30.9)                     |
| Postorbital length                      | 44       | 44–46 (44.6)                     |
| Interorbital width                      | 44       | 39–45 (41.3)                     |
| Snout length                            | 31       | 28–32 (29.9)                     |



**Field notes.** All the specimens were obtained from local fishers and villagers. Collection pots with preservative were left behind by the main expedition team in Desa Kerendan when the team progressed further upstream. Upon returning from survey work upstream several days later, these collection pots were retrieved from the local fishers and were filled with *T. poptae* (D. Siebert, pers. comm.).

*Trichopodus poptae* had been collected only in the area of Desa Kerendan, a small village in the upper Sungai Lahei watershed within the Barito River drainage. A few specimens were collected from small streams, with gravel bottoms, which villagers said flowed from relatively undisturbed watersheds. Most specimens were collected from streams and ponds in the near vicinity of Desa Kerendan by village children.

Fishes caught with *T. poptae* in streams were: Cyprinidae – *Barbodes binotatus*, *B. everetti*, *Cyclocheilichthys apogon*, *Labiobarbus fasciatus*, *Malayochela maassi*, *Osteochilus* sp., *Rasbora dusonensis*, *R. elegans*; Cobitidae – *Acanthopsooides* sp., *Pangio shelfordii*; Botiidae – *Chromobotia macracantha*, *Syncrossus hymenophysa*; Balitoridae – *Homalopteroides* sp.; Nemacheilidae – *Nemacheilus lactogenus*, *N. spiniferus*; Vaillantellidae – *Vaillantella euepiptera*; Bagridae – *Mystus castaneus*, *M. nigriceps*, *M. singaringan*; Siluridae – *Ompok leiacanthus*, *Silurichthys gibbiceps*; Clariidae – *Clarias leiacanthus*; Zenarchopteridae – *Hemirhamphodon* sp.; Pristolepididae – *Pristolepis fasciata*; Osphronemidae – *Betta obscura*, *B. pallifina*; Channidae – *Channa lucius*, *C. marulioides*, *C. striata* (D. Siebert, pers. comm.; taxonomy updated).

**Etymology.** Named for Canna Maria Louise Popta (1860–1929), curator of fishes for the Rijksmuseum van Natuurlijke Historie from 1891 to 1928 (Brown, 1994); in honour for her pioneer taxonomic work on the freshwater fish fauna of Borneo, based on the trans-Borneo expeditions conducted between 1893 to 1900.

#### Artificial key to the genus *Trichopodus*

1. – Body with single longitudinal black stripe extending from mouth to caudal peduncle. .... 2
- Body with one or two black blotches along mid-body, or no distinct markings. .... 3

2. – Body with grey to black oblique bars; 33–39 branched anal-fin rays; 27–31 transverse scales; dorsal-fin base length 25.9–31.5 % SL. Distribution: Indochina. .... *T. pectoralis*
- Body with a mosaic of small, light silvery spots with dark outlines; 25–30 branched anal-fin rays; 19–25 transverse scales; dorsal-fin base length 19.4–23.8 % SL. Distribution: Peninsular Malaysia, Sumatra, southern Borneo. .... *T. leerii*
3. – Body silvery or grey with no distinct markings; 3–4 dorsal-fin spines; 57–65 lateral scales; 34–40 transverse scales; dorsal-fin base length 14.5–17.3 % SL. Distribution: Indochina. .... *T. microlepis*
- Body with one or two black blotches on mid-body; 5–9 dorsal-fin spines; 34–52 lateral scales; 17–25 transverse scales; dorsal-fin base length 21.9–28.7 % SL. .... 4
4. – Body with two black blotches, one in middle of body and other on caudal peduncle, and faintly distinct grey oblique bars; 9–12/31–38 anal-fin rays; 40–52 lateral scales; head length 27.3–30.6 % SL. Distribution: Indochina, Peninsular Malaysia, Sumatra, Java, Borneo. .... *T. trichopterus*
- Body with a single black blotch on caudal peduncle; 13–15/25–27 anal-fin rays; 34–38 lateral scales; head length 31.3–33.6 % SL. Distribution: southern Borneo. .... *T. poptae*

#### Discussion

The genus *Trichopodus* belongs to the family Osphronemidae, in which it forms the sister group to *Trichogaster* based on the results of morphological and molecular analyses (Britz, 1995; Rüber et al., 2006). The two genera were classified by Britz (2001) in the subfamily Luciocephalinae along with the genera *Parasphaerichthys*, *Ctenops*, *Sphaerichthys*, and *Luciocephalus*, the monophyly of which is supported by the shared presence of a posterior process of the basioccipital on which Baudelot's ligament inserts and the loss of the



first branchiostegal ray. The molecular analysis of Rüber et al. (2006), however, did not recover *Trichopodus* and *Trichogaster* as members of the Luciocephalinae, but as the sister group to the Macropodinae.

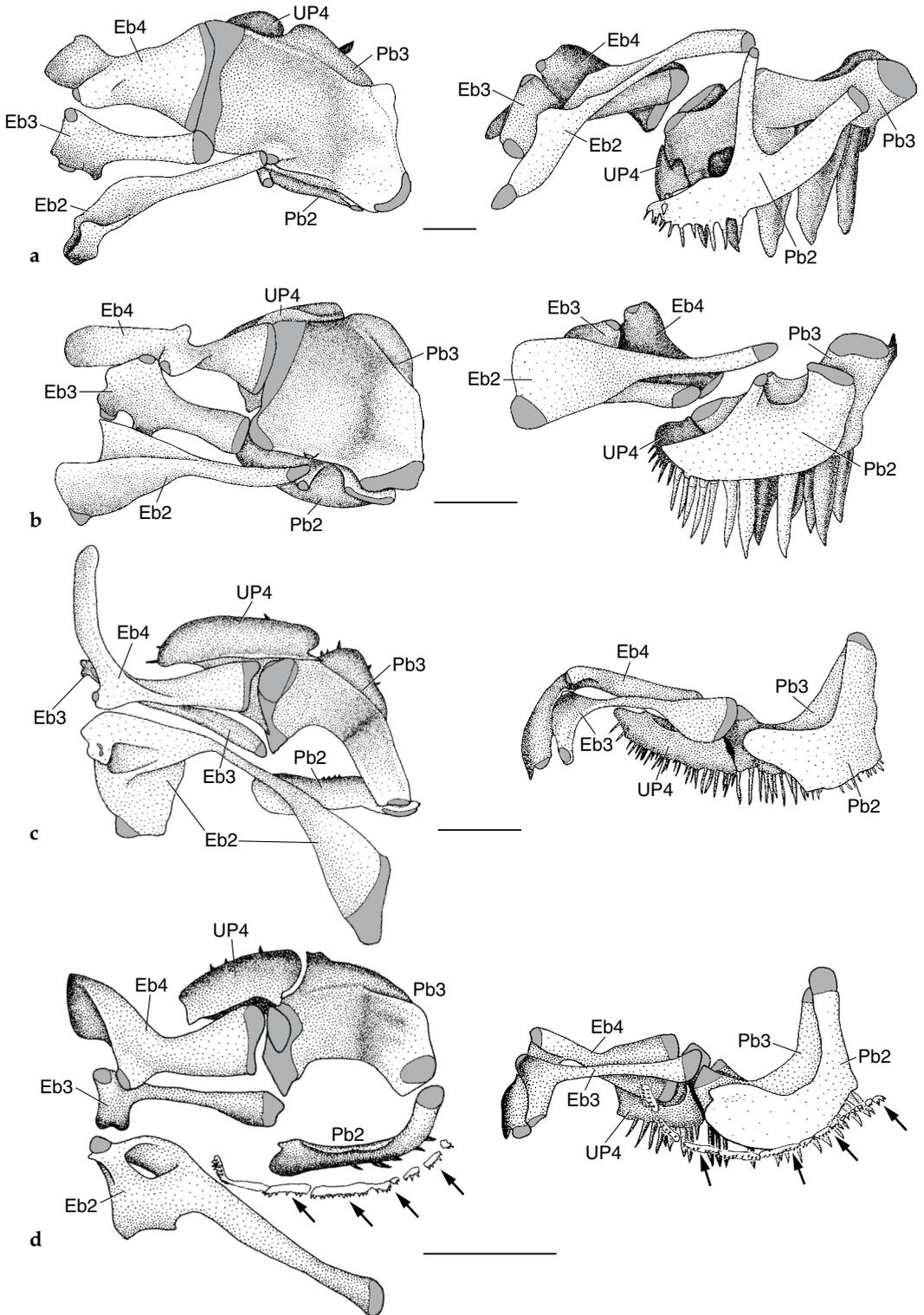
Notwithstanding the different hypotheses about their phylogenetic position, *Trichopodus* and *Trichogaster* are sister taxa and share a number of skeletal and muscular modifications of the pelvic girdle and fin that enable them to move the highly elongated first pelvic soft ray in any direction including at least 180 degrees backwards to their tail and forwards to beyond the tip of their head (Steinbach, 1950). These filaments are used as exploratory organs of touch and taste (Scharrer et al., 1947; Steinbach, 1950; Weber, 1963). While elongated first pelvic-fin rays occur in a number of anabantoids (Britz, 1995: fig. 16), their movement is very restricted, especially anteriorly, and there are no modifications to the pelvic girdle.

*Trichopodus* and *Trichogaster* also share additional uniquely derived dorsal gill arch characters that identify them as sister taxa among anabantoids that we take the opportunity to discuss here (see Fig. 3). Primitively among anabantoids, epibranchial 2 runs parallel to epibranchials 3 and 4 and its tip articulates with a cartilage capped dorsally directed process in the middle of pharyngobranchial 2. This condition can be found in representatives of all anabantoid genera with the exception of *Trichopodus* and *Trichogaster*. In these two genera, pharyngobranchial 2 is elongated, reaches the midline and has shifted anteriorly in its distal portion, so that its tip no longer articulates with pharyngobranchial 2 but ends freely. This anterior shift is associated with the loss of the cartilage capped process on pharyngobranchial 2, which only connects to the remaining upper gill arch elements via its cartilage capped process that articulates with a similar process on pharyngobranchial 3. This highly unusual arrangement of epibranchial 2 was illustrated by Rosen & Patterson (1990) for *Trichogaster lalia*, but not described or discussed. The only other anabantoid, in which we also found the dorsally directed process on pharyngobranchial 2 missing is *Luciocephalus*, but here epibranchial 2 is still aligned in parallel with the other epibranchials and not shifted anteriorly. We interpret the lack of the pharyngobranchial process as independently derived in *Luciocephalus* and probably related to its highly predatory behaviour and its greatly flattened dorsal gill arches.

The dorsal gill arch skeleton also shows interesting differences between *Trichopodus* and *Trichogaster*. In *Trichopodus* the distal end of epibranchial 2 is flattened and greatly expanded, while that of *Trichogaster* is round in diameter. *Trichogaster* on the other hand has a band of tiny serially arranged toothplates in front of pharyngobranchial 2, not illustrated and probably overlooked by Rosen & Patterson (1990: fig. 29). *Trichopodus* and *Trichogaster* can also be easily distinguished from each other, by the short dorsal fin with a reduced number of fin spines and rays in the former and the long dorsal fin with numerous spines and rays in the latter. A series of ray-less pterygiophores in front of the dorsal fin in *Trichopodus* are remnants of the formerly longer dorsal fin. Further differences between the two genera are the complete lack of pelvic-fin rays other than the filamentous first ray on *Trichogaster*, while *Trichopodus* still has an additional 3–4 small to tiny rays depending on the species.

The number of pterygiophores between haemal spines 1 and 2 differs among *Trichopodus* species and separates them into two groups: *T. pectoralis*, *T. trichopterus*, and *T. microlepis* usually have 5 pterygiophores, while *T. leeri* and *T. poptae* usually show 4. This lower number in *T. leeri* and *T. poptae* correlates with fewer total anal-fin rays in these two species (37–44, vs. 41–50 in the other three species). *Trichopodus poptae* is most easily distinguished from its congeners by its colour pattern, consisting of a black blotch on the caudal peduncle and no other markings on the body except some pale longitudinal lines. The cream spots on its fins are somewhat reminiscent of those of *T. leeri*, the so-called pearl gourami. In the molecular phylogeny of Rüber et

**Fig. 3.** Dorsal gill arches 2 to 4 in dorsal (left side) and frontal view (right side) of: **a**, *Sandelia bainsii* (Anabantidae), BMNH 2014.4.2.1, 98 mm SL; **b**, *Belontia hasselti* (Osphronemidae, Belontiinae), BMNH 2014.4.2.2, 74 mm SL; **c**, *Trichopodus microlepis* (Osphronemidae, Luciocephalinae), BMNH 2014.4.2.3, 65 mm SL, epibranchial 2 removed in frontal view; **d**, *Trichogaster lalia* (Osphronemidae, Luciocephalinae), BMNH 2014.4.2.4, 38 mm SL, epibranchial 2 removed in frontal view, band of tiny ossicles in front of pharyngobranchial 2 marked with arrowheads. Note lack of articular process in middle of pharyngobranchial 2 and anterior shift of tip of epibranchial 2 in **c** and **d**. **Eb2,3,4**, epibranchial 2,3,4; **Pb2,3**, pharyngobranchial 2,3; **UP4**, upper pharyngeal toothplate 4. Scale bars 1 mm.





al. (2006) *T. leeri* was recovered as the sister group to the other three *Trichopodus* species known at that time. It will be interesting to see where *T. poptae* fits phylogenetically among the different *Trichopodus* species, but its similarities to *T. leeri*, which are most likely plesiomorphies, point to a position at the base of *Trichopodus*, either as the sister group of all other species or as the sister group to *T. leeri*.

**Comparison material.** *Trichopodus leerii*: ZRC 38614, 8, 47.0–61.9 mm SL; Indonesia: Sumatra: Jambi: Danau Rasau. – ZRC 43248, 1, 66.8 mm SL; Indonesia: South Sumatra: Sungei Sentang.

*Trichopodus microlepis*: ZRC 53428, 6, 74.4–98.7 mm SL; Cambodia: Phnom Penh: Pochengtong Market. – BMNH uncat, E3 223, 1, 71.1 mm SL; E3 224, 1, 69.0 mm SL; E3 225, 1, 65.8 mm SL; not labelled, 1, 66.3 mm SL; Cambodia: local markets.

*Trichopodus pectoralis*: ZRC 1621, 6, 93.6–168.0 mm SL; Malaysia: Penang: Bayan Lepas Fishponds. – BMNH uncat, E3 233, 1, 106.9 mm SL; E3 234, 1, 105.2 mm SL; E3 235, 1, 100.4 mm SL; E3 236, 1, 101.4 mm SL; Cambodia: local markets.

*Trichopodus trichopterus*: ZRC 43871, 3, 72.8–75.2 mm SL; Indonesia: Java: Banjar market, about 500 m from train station. – ZRC 53311, 7, 42.2–73.5 mm SL; Singapore: Sungei Buloh Wetland Reserve, Outdoor Classroom pond.

The following references were used to supplement comparison materials in the diagnosis of *T. poptae* (relevant species in parentheses): Regan, 1910 (*T. pectoralis*, *T. trichopterus*, *T. leerii* and *T. microlepis*); Smith, 1945 (*T. pectoralis*, *T. trichopterus*, *T. leerii* and *T. microlepis*); Mohsin & Ambak, 1983 (*T. pectoralis* and *T. trichopterus*); Rainboth, 1996 (*T. pectoralis*, *T. trichopterus*, *T. leerii* and *T. microlepis*); Kottelat, 2001 (*T. microlepis*).

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*Parananochromis orsorum*, female (photograph by A. Lamboj)

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