



***Devario xyrops*, a new species of danionine fish from south-western Myanmar (Teleostei: Cyprinidae)**

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Abstract

Devario xyrops is described from small rivers on the western slope of the Rakhine Yoma in south-western Myanmar. It is distinguished from all other species in the genus except *D. anomalus* by its colour pattern including a dark blotch or condensed series of vertical bars anteriorly on the side, separate from a posterior dark horizontal band; and distinguished from *D. anomalus* in particular by deeper body (29.9–35.8% SL, vs. 25.0–26.8 % SL) and fewer lateral line scales (31–33, modally 32 vs. 33–35, modally 34).

Key words Rakhine Yoma, Thandwe, Bangladesh, colour pattern, endemism

Introduction

The cyprinid fish genus *Devario* Heckel includes 37 species distributed in South and Southeast Asia (Fang Kullander, 2001; Fang *et al.*, 2009; Conway *et al.*, 2009). Nine species, viz., *D. affinis* (Blyth), *D. spinosus* (Day), *D. browni* (Regan), *D. annandalei* (Chaudhuri), *D. strigillifer* (Myers), *D. shanensis* (Hora), *D. sondhii* (Hora & Mukerji), *D. auropurpureus* (Annandale), and *D. jayarami* (Barman) have been described from Myanmar. In addition, *D. yuensis* (Kumar & Tombi Singh) from the Yu River drainage in Manipur is likely to occur in Myanmar in addition to *D. kakhienensis* (Anderson) from the border region of Myanmar and Yunnan, China. Those species are all characterized by a colour pattern consisting either of several alternating dark and light stripes along the side, or a series of more or less distinct dark vertical bars.

Collections made in 1998 near Thandwe on the western versant of the Rakhine Yoma in south-western Myanmar include many specimens of a conspicuously large species of *Devario*, characterized by a distinctive colour pattern in which the dark lateral markings are expressed as an anterior blotch and a posterior short horizontal band. In the meantime, this species was also imported to Europe as an aquarium fish with the code names “TW02”, and “Broken Line”. This paper is dedicated to the formal description of this species.

Material and methods

Specimens were fixed in formalin in the field, eventually transferred to 70 % ethanol for storage, and are kept in the fish collection of the Swedish Museum of Natural History, Stockholm (NRM). Additional material is deposited in the collection of the Natural History Museum, London (BMNH), and California Academy of Sciences, San Francisco (CAS). Measurements were taken with digital callipers to a precision of 0.1 mm. Counts and measurements were made according to Fang (1997a), and colour pattern terminology follows Fang (1998). Fin-ray counts from median fins and vertebral counts were obtained from X-radiographs made with a Philips MG-105 low voltage X-ray unit and Kodak X-Omat V plates. The last ray in the dorsal and anal

fins is tightly joined to the preceding ray and shares a pterygiophore with it; it is here distinguished as a half-ray, following the annotation used by Kottelat (2007). Abdominal vertebrae counts include the Weberian apparatus (assumed to contain four centra). Statistics was calculated using SPSS v. 17 (SPSS, 2008).

Comparative material. *Devario* sp., CAS 94595, 2, 33.5–58.5 mm SL; Bangladesh: Sangu River basin: Chittagong Hill Tracts, small sandy hill stream near Ramail (east of Bandarban town); 30 May 1996, T. R. Roberts.



FIGURE 1. *Devario xyrops*, holotype, NRM 45658, adult female, 60.6 mm SL; Myanmar: Rakhine State: Yan Khaw Chaung, ca 4 km on logging road from Gwetauk village, 23 km on road Taunggok–Pyay.

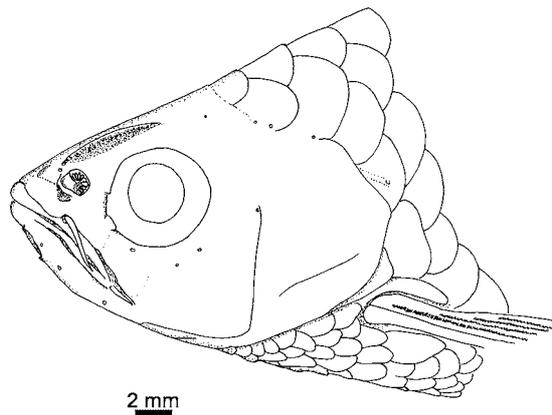


FIGURE 2. *Devario xyrops*. Lateral aspect of head of male, NRM 40842, 71.1 mm SL.



FIGURE 3. *Devario xyrops*, paratype, NRM 45596, juvenile, 21.9 mm SL. Myanmar: Rakhine State: Yan Khaw Chaung, ca 4 km on logging road from Gwetauk village, 23 km on road Taunggok–Pyay.

Devario xyrops, new species

(Fig. 1)

Holotype. NRM 45658, adult female, 60.6 mm SL; Myanmar: Rakhine State: Thandwe: Thade River drainage: Taungkok, Yan Khaw Chaung, ca 4 km on logging road from Gwetauk village, 23 km on road Taungkok–Pyay; 21 Mar 1998, S. O. Kullander & R. Britz (SOK-98-010).

Paratypes. All from Myanmar, Rakhine State. NRM 40843, 21, 44.8–76.9 mm SL; NRM 41674, 1, 55.2 mm SL; NRM 45596, 10, 9.5–21.9 mm SL. Same data as holotype. — NRM 40835, 6: 33.3–49.7 mm SL; NRM 41673, 1, 41.8 mm SL; Kananmae Chaung, near Leldee village, by foot 45 min from Gwechaung village at km 18 on road Thandwe–Taungkok. 20 Mar 1998. S. O. Kullander & R. Britz (SOK-98-007). — BMNH 2009.5.5.20–24, 5, 36.8–74.0 mm SL; Kyeintali Chaung; 15 Oct 2008, Thein Naing.

Diagnosis. Distinguished from all other species of *Devario* except *D. anomalus* Conway *et al.* (2009) by the colour pattern, with a dark blotch anteriorly on the side composed of 4–5 short partly confluent vertical bars which may also be confluent to form a homogeneous blotch, and a wide dark horizontal band (P stripe) posteriorly on the side. Distinguished from *D. anomalus* by proportional measurements and meristics, most important by deeper body (29.9–35.8% SL, vs. 25.0–26.8 % SL) and fewer lateral line scales (31–33, modally 32 vs. 33–35, modally 34). Distinguished from all barred species of *Devario* also by presence of an infraorbital process.

Description. Measurements and counts were taken from 10 specimens, 59.5–76.9 mm SL (Table 1), representing the largest adults available, supplemented by counts from 13 additional X-radiographed specimens. All measured specimens were examined for gonads, and all have ripe ovaries and testes. The two largest specimens, 74.6 and 76.9 mm SL, are female, and male, respectively.

Body laterally compressed, elongate, females slightly more deep-bodied than males (31.4–35.8 % SL vs. 29.9–31.0 %), and with deeper (16.5–18.7 % SL vs. 15.8–16.9 %) and wider (13.5–14.6 % SL vs. 12.9–13.5 %) head. Predorsal contour straight, ascending, sloping posteriorly from dorsal-fin insertion. Prepelvic contour strongly curved, more so in females; chest conspicuously more compressed below pectoral fin, but not keeled. Snout short, rounded in dorsal aspect, subtriangular in lateral aspect, about as long as eye diameter. Infraorbital process broader than high, with truncate distal margin which usually slightly irregular. Danionine notch caudally margined by well developed anteromedial projecting laminar dentary process. Skin cover absent from distal part of infraorbital process, dentary process, and anterior margin of supraorbital. Mouth terminal, obliquely directed upwards. Small bony knob at dentary symphysis. Maxilla reaching to below anterior margin of orbit. Jaws equal anteriorly; lower jaw ending anteriorly at horizontal through middle of eye. Lower jaw with 2–3 rows of minute conical tubercles concentrated on lateral surface, and additional scattered tubercles anteriorly, occasionally absent (Fig. 2) or only a few tubercles close to lower lip; tuberculation variably developed from hardly visible to well developed without correlation with sex. In all males two rows of strong, densely arranged sharp-tipped conical tubercles on the unbranched, and following 6–7 rays of pectoral fin; pectoral-fin tubercles absent in females. Rostral barbels short, length of infraorbital 1 or to base of maxillary barbels; maxillary barbels much shorter, at most half length of rostral barbels.

Lateral line complete, along 31 (1), 32 (7), 33 (1) scales, and 2 scales on caudal-fin base; comprising one tubed scale followed by a canal running steeply caudoventrad under unperforated scales to slightly posterior to pectoral-fin base, where curved caudad and represented by scales with indistinct or absent perforation anteriorly, becoming distinctly perforated posterior to adpressed pectoral fin; running in a curve parallel to the ventral body outline and ending low on caudal peduncle and caudal-fin base; vertical section represented by about six scales, horizontal section by 25 or 26 scales, continued by two scales on caudal-fin base. Median predorsal scales 13 (2), 14 (7), 15 (1). Lateral scale rows passing between dorsal and pelvic fins $\frac{1}{2}7+1+2$ (10). Circumpeduncular scale rows 12 (5), 13 (1), 14 (4). A row of scales along anal-fin base. About $\frac{1}{4}$ of caudal-fin length scaled basally.

Dorsal-fin rays iii.10 $\frac{1}{2}$ (10), iii.11 $\frac{1}{2}$ (11), iii.12 $\frac{1}{2}$ (2). Anal-fin rays iii.13 $\frac{1}{2}$ (8), iii.14 $\frac{1}{2}$ (14), iii.15 $\frac{1}{2}$ (1). Pectoral-fin rays i.11 (4), i.12 (4), i.13 (2). Pelvic-fin rays i.6 (2), i.7 (18). Dorsal fin inserted at highest point

of dorsum, little posterior to middle of body. Anal fin inserted below anterior rays of dorsal fin. Pectoral-fin insertion at about vertical through posterior margin of osseous opercle; extending to pelvic-fin origin, slightly longer in females than in males (22.8–24.9 % SL vs. 20.9–22.4 %). Pectoral-fin axial lobe well developed. Pelvic fin inserted slightly anterior to midbody, not reaching to anal-fin origin. Pelvic axillary scale present. Caudal fin forked, lobes of about equal length.

Vertebrae 16+18=34 (7), 17+17=34 (12), 17+18=35 (4). Pharyngeal teeth 5,4,2/2,4,5 (one specimen dissected).

TABLE 1. Morphometry of *Devario xyrops*. Measurements are in per cent of SL, except for SL and TL (in mm). SD = standard deviation.

	N	Min	Max	Mean	SD
SL (mm)	10	59.5	76.9	67.7	6.05
TL (mm)	10	80.1	103.8	90.5	8.53
Body depth	10	29.9	35.8	32.5	2.05
Head length	10	24.2	26.2	25.4	0.62
Snout length	10	7.0	8.2	7.6	0.39
Head depth	10	15.8	18.7	17.1	0.92
Head width	10	12.9	14.6	13.6	0.51
Upper jaw length	10	9.6	11.6	10.3	0.59
Lower jaw length	10	11.8	13.3	12.4	0.44
Orbital diameter	10	7.0	8.6	7.8	0.55
Interorbital width	10	10.6	11.8	11.1	0.43
Caudal peduncle length	10	16.8	19.6	18.0	0.83
Caudal peduncle depth	10	12.3	13.4	12.9	0.38
Dorsal-fin base length	10	19.3	22.7	21.0	0.06
Anal-fin base length	10	20.3	23.4	22.0	1.16
Predorsal length	10	57.0	61.3	59.0	1.28
Preanal length	10	62.2	66.7	64.3	1.35
Prepelvic length	10	46.0	48.4	47.3	0.89
Pectoral-fin length	10	20.9	24.9	23.0	1.28
Pelvic-fin length	10	14.3	16.5	15.7	0.75
Rostral barbel length	10	2.8	5.2	4.6	0.73
Maxillary barbel length	10	1.1	2.5	1.9	0.44

Colouration in preservative. Dorsum pale brownish, sides whitish. Opercle brownish dorsally, silvery ventrally. Narrow dark brown predorsal midline. Dark brown vertically oriented cleithral spot covering part of first lateral-line scale and scale above. On middle of side anterior to vertical from dorsal-fin origin a series of 4–5 brown short vertical bars, partly confluent, in many specimens dark brown and confluent to form elongate dark blotch. Dark brown horizontal band, margined by narrower light bands above and below, starting slightly posterior to vertical from anal-fin origin, terminating at end of caudal peduncle. Area between anterior and posterior lateral markings either without markings or with indistinct short vertical bars; dorsally, between posterior part of anterior lateral marking and anterior part of posterior lateral band, usually a short light brown horizontal stripe or row of small spots. Dorsal and anal fins pigmented basally and with a greyish stripe from anterior margin of fin to tips of posterior rays; hyaline distal to dark stripe. Caudal fin lightly pigmented, horizontal dark band on caudal peduncle continuing faintly on middle rays. Pectoral and pelvic fins hyaline. Juvenile 21.9 mm SL (Fig. 3), with dark brown band posteriorly as in adults, but vertical bars only indicated in anterior pigmentation. Smaller juveniles with lateral band indistinct and anterior pigmentation diffuse.

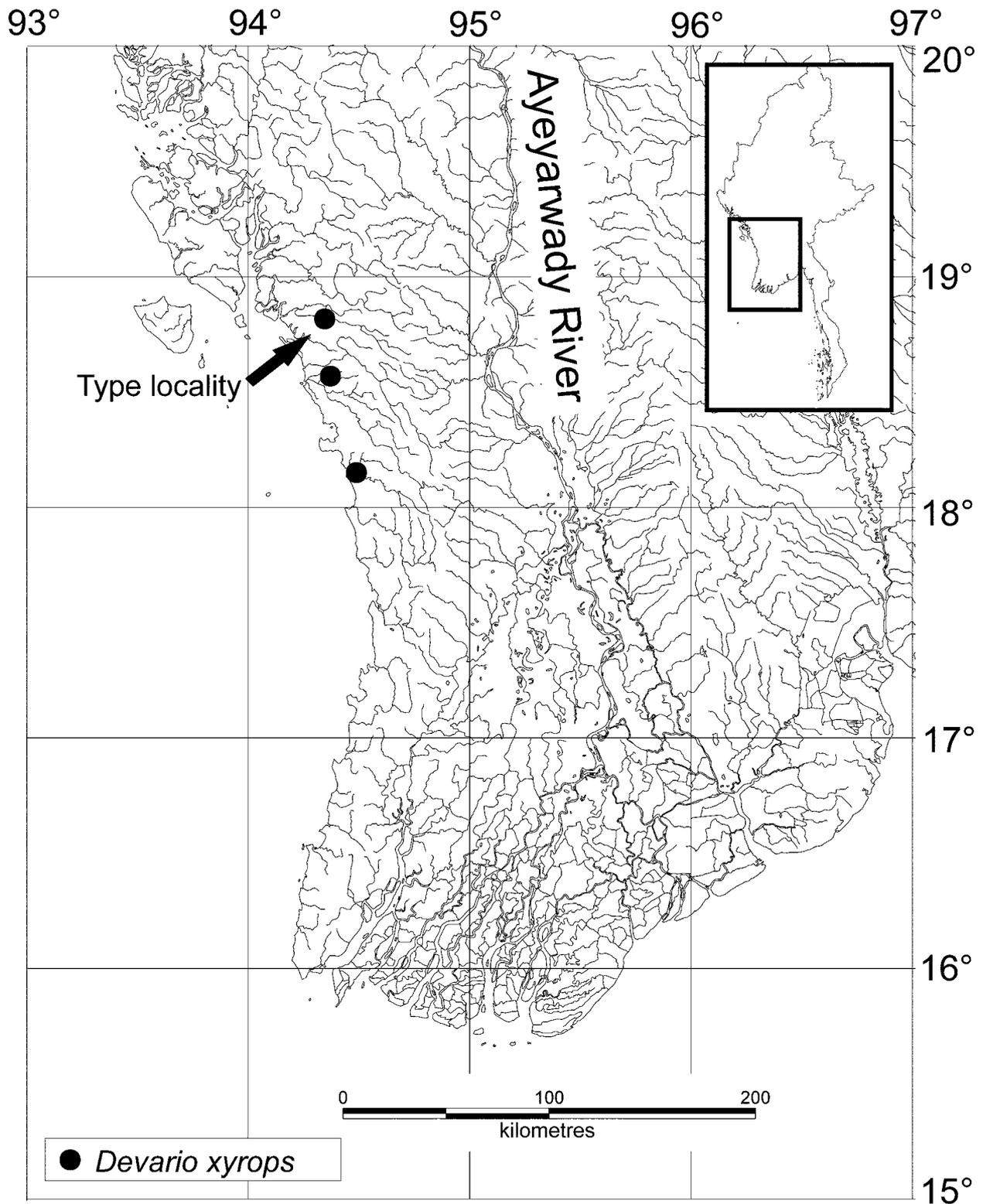


FIGURE 4. *Devario xyrops*. Collecting sites in Myanmar.

Molecular data. Nucleotide sequences of the mitochondrial cytochrome *b* gene and a fragment of the nuclear rhodopsin gene were obtained from a single specimen from the type locality (NRM 41674) and reported by Fang *et al.* (2009), with GenBank accession numbers EU241374 and EU241439 (as *Danio* sp “TwoSpot”).

Etymology. The specific epithet refers to the sharp, exposed bony margin of the supraorbital and the wide infraorbital process, and is combined from the Greek *xyron* (ξύρον), razor, and *ops* (ὄψι) eye. It stands as a noun in apposition.



FIGURE 5. *Devario xyrops*. Type locality: Yan Khaw Chaung, ca 4 km on logging road from Gwetauk village, 23 km on road Taunggok–Pyay; 21 Mar 1998.

Geographical distribution and habitat. Known only from small streams on the western slope of the Rakhine Yoma, north and south of Thandwe (Fig. 4). The type locality (Fig. 5) is the same as for *Garra vittatula* (Kullander & Fang, 2004: 265). It was a small forest river, at the time of sampling in the low water season reduced to a series of connected pools, up to 2 m wide, and nowhere more than 1 m deep. The water was clear, colourless, and slow-flowing or stagnant. The stream bottom consisted of stones, gravel and rock.

Devario xyrops was the dominant species. Other species included the cyprinids *Garra rakhinica* Kullander & Fang, *G. vittatula* Kullander & Fang, *Danio feegradei* Hora, also endemic to the western Rakhine State, and *Xenentodon cancila* (Hamilton) (Belontiidae), *Channa* sp. (Channidae), *Lepidocephalichthys* sp. (Cobitiidae), and *Sicyopterus fasciatus* (Day) (Gobiidae). *Puntius binduchitra* (Hora) (Cyprinidae); another endemic cyprinid easily identified by its colour pattern, was observed but could not be collected, and also one larger cyprinid specimen could not be sampled. The second locality, the Kananmae Chaung, is the type locality of *Danio aesculapii* Kullander & Fang, and is described by Kullander & Fang (2004:265; 2009: fig. 3). It is also a small forest stream with stony bottom. Habitat information is not available for the BMNH specimens.

Discussion

The western slope of the Rakhine Yoma has a distinctive fish fauna, with ten endemic species described, listed by Kullander & Fang (2009), including two danionins, *Danio feegradei* (Hora, 1937) and *D. aesculapii* (Kullander & Fang, 2009). *Devario xyrops* was the only species of *Devario* collected during a four-day survey from near Gwa to near Taungkok, and is also the only species of the genus otherwise collected on the western slope of the Rakhine Yoma.

The colour pattern of *D. xyrops*, shared with *D. anomalus* (Conway *et al.*, 2009) from Bangladesh, and characterized by a series of vertical bars anteriorly on the side, separated from a dark stripe posteriorly, is distinctive within the genus. Colour pattern is highly variable among species of *Devario*, including species that are almost uniformly light coloured, with a series of distinct vertical bars along the side, with large blotches, or, most common, with several alternating dark and light horizontal stripes along the side. *Devario xyrops* and *D. anomalus* resemble *D. browni* (Regan) in having a dark stripe starting far posterior to the head, but in *D. browni* the stripe starts, with a rounded expansion, at midbody or slightly more anteriorly (Fang, 2000a). The posterior horizontal band is positionally homologous with the P stripe in other species of *Devario*. The colour pattern also resembles that of the barred species of *Devario*, e.g., *D. interruptus* (Day) and *D. maetaengensis* (Fang), which possess a series of vertical bars anteriorly on the side, followed by a horizontal stripe along the middle of the side (Fang, 1997b, 2000b). In those species, there is a series of spaced bars starting immediately posterior to the cleithral spot and grading into the horizontal stripe, instead of being clustered well posterior to the head region and well separated from the horizontal stripe.

Devario xyrops is most similar in colour pattern to *D. anomalus*, described from six specimens collected in a small coastal stream near Cox's Bazaar (Conway *et al.* 2009). The description of *D. anomalus* was published while the present manuscript was in review, and we have not examined type specimens. Based on information and images in the original description of *D. anomalus*, it is a much more elongate species (body depth 25.0–26.8 % SL vs. 29.9–35.8 % in *D. xyrops*), with shorter head (head length 22.8–24.5 % SL, vs. 24.2–26.2 % SL), shorter pectoral fin (18.1–20.7 % SL vs. 20.9–24.9 %), and shorter pelvic fin (12.2–14.7 % vs. 14.3–16.5 % SL), more scales in the lateral line (33–35, mode 34, vs. 31–33, mode 32), more predorsal scales (15–16 vs. 13–15, modal 15), and fewer branched anal-fin rays (12½–13½, bimodal, vs. 13½–15½, modally 14½).

Two small specimens (CAS 94595, 33.5–58.5 mm SL) from the Sangu River basin in Bangladesh, emptying into the Bay of Bengal northeast of the type locality of *D. anomalus*, are similar to both *D. anomalus* and *D. xyrops*, but not clearly identifiable as belonging to either of these species. Both specimens are faded and soft and the colour pattern is not optimally preserved. In the larger specimen there is an area with irregular vertical bars anteriorly on the side, and a narrow dark band starting slightly posterior to a vertical through the anal-fin origin. The Sangu specimens are more deep-bodied (body depth 29.7 % SL in the larger specimen), and have fewer lateral line scales (30–31) than *D. anomalus*. They differ from *D. xyrops* in having a pointed rather than broad and truncate infraorbital process, 12½ branched anal-fin rays (vs. 13½, 14½, or 15½ in *D. xyrops*), and a better developed lateral line which starts with 2–3 tubed and perforated scales, followed by 2–3 unperforated scales and 25–26 perforated scales. The lower jaw bears numerous

tubercles unlike in *D. anomalus* and *D. xyrops*. It seems likely that this is a distinct species, but the specimens available are not so well preserved as to inspire to a formal description.

The naked, wide infraorbital process in *D. xyrops* is conspicuous, as is also the naked rim of the supraorbital, although the naked bone condition also occurs in other species of *Devario*. The shape of the infraorbital process varies considerably among species of *Devario*, but the common condition appears to be a relatively narrow process. Conway *et al.* (2009) did not comment on the shape of the infraorbital process in *D. anomalus*, and in their drawing of the infraorbital bones (Conway *et al.*, 2009: fig. 4), the shape is ambiguous but may be similar to that of *D. xyrops*.

In the molecular analysis of danionins by Fang *et al.* (2009), *D. xyrops* is well nested inside a clade of species of *Devario* in both the cytochrome *b* and rhodopsin trees. In the cytochrome *b* tree it groups with Indian species *D. devario* (Hamilton), *D. cf. malabaricus* (Jerdon), and the Sri Lankan *D. pathirana* (Kottelat & Pethiyagoda), and not with remaining species which are from the Ayeyarwaddy, Thanlwin, and Mekong drainages. This association is not recovered in the rhodopsin tree, in which the *Devario* clade is not well resolved.

Acknowledgements

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