

## Two New Species of *Puntius* from Northern Myanmar (Teleostei: Cyprinidae)

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*Puntius tiantian* is described from Putao in northernmost Myanmar, diagnosed by having a dark vertical bar anteriorly on the side, a dark blotch on the caudal peduncle, slender and weakly serrated last unbranched dorsal fin ray, and complete lateral line. *Puntius didi* is described based on material from Myitkyina and Indawgyi Lake. It is similar to *P. tiantian* in color pattern, but possesses a thicker and more strongly serrated last unbranched dorsal fin ray, and a shorter lateral line perforating only 6–10 scales. The single record of *P. phutunio* from Myanmar most likely represents misidentified *P. didi*.

SOUTH and South East Asia is rich in small-sized, often colorful species currently referred to the catchall Asian cyprinid genus *Puntius*. Comparative analyses by Taki et al. (1978), using morphology, and Kortmulder (1972) and Kortmulder and van der Poll (1981), using combined morphology and behavior characters, suggest that several phylogenetic lineages are involved but there is no phylogenetic analysis available. The *Puntius conchoni* species group recognized by Taki et al. (1978) is widely distributed in Pakistan, India, Nepal, Sri Lanka, and Myanmar, and also present in the Mekong drainage of Laos and Thailand. The group includes 16 small species, less than 80 mm SL, and usually less than 50 mm SL, characterized above all by a conspicuously wide infraorbital 3 + 4 covering most of the cheek. The color pattern characteristically includes prominent dark blotches or vertical bars on the sides. Many of the species of the *P. conchoni* group that were described recently were reported to have a limited geographic distribution, but several species are reported to have a vast distribution in India and Myanmar.

Four species of the *P. conchoni* group have been reported from Myanmar, viz. *P. conchoni*, *P. phutunio*, *P. puntio*, and *P. stoliczkanus* (Jayaram, 1991; treating *P. stoliczkanus* as a synonym of *P. ticto*). Our recent collecting in Myanmar suggests that several more species are present, and that previous identifications of species of the *P. conchoni* group in Myanmar are often incorrect.

*Puntius phutunio* is a distinctive minute species of *Puntius* with a characteristic vertically elongate blotch anteriorly on the side and a round blotch posteriorly above the anal fin base. Originally described from “northeastern Bengal,” and reported from several rivers in northern India (Jayaram, 1991), there is also a

record of *P. phutunio* from northern Myanmar (Prashad and Mukerji, 1929).

We collected small specimens of *Puntius* with a color pattern similar to *P. phutunio* in several localities in northern Myanmar. Closer comparison with *P. phutunio* from India and similar species of the *P. conchoni* group shows that the material from Myanmar represents two distinct species of the *P. conchoni* group, both of which are new.

### MATERIALS AND METHODS

Measurements were taken point to point with digital calipers measuring to 0.01 mm, rounded to nearest 0.1 mm. Standard length, head length, and snout length are taken from the tip of the snout to the caudal fin base, posterior opercular margin, and anterior orbital margin, respectively. Predorsal, prepelvic, and preanal lengths are taken from the tip of the snout to the anterior base of each fin. Head depth is taken immediately behind the orbit. Body depth is taken at the origin of the dorsal fin. Dorsal, pectoral, pelvic, and anal fin lengths are taken from the base of the first ray to the distal tip of the longest ray. Caudal peduncle length is taken from the base of the last anal fin ray to the middle of the base of the caudal fin. Lateral line scale counts include only scales on the body. Scales in a lateral row equates the lateral line scale count, or, when the lateral line is abbreviated, includes the lateral line scales and posterior scales in the same horizontal row. Dorsal, anal, and caudal fin counts, and vertebral counts were obtained from radiographs. Vertebral counts include the Weberian apparatus (individual centra not distinguishable in radiographs, but considered to be four, as known from other cyprinids), and the last half-centrum. Vertebrae anterior to the first interneural dorsal fin pterygiophore are distinguished as



Fig. 1. *Puntius tiantian*, holotype, NRM 43006, 37.7 mm SL; Myanmar: Putao.

predorsal vertebrae, and are included in the count of precaudal vertebrae. Homology interpretation of infraorbitals follows Taki et al. (1978). The term lateral fold is recognized following Taki (1974) for the skin fold that covers the upper lip laterally and is separated from the rostral fold by a distinct groove. Morphometry was analyzed with SPSS 11.5. X-radiographs were made with a Philips MG-105 low voltage X-ray unit, and photographs obtained with a Nikon D100 camera.

Institutional abbreviations are as listed in Leviton et al. (1985) and Leviton and Gibbs (1988). Local toponomy is used in descriptions of collecting sites, but it should be noted that local transliteration of Burmese geographical names

is not consistent; the Ayeyarwaddy River is better known outside Myanmar as the Irrawaddy River.

***Puntius tiantian*, new species**

Figure 1, Table 1

*Holotype*.—NRM 43006 (37.7 mm SL) Myanmar, Kachin State, Ayeyarwaddy River drainage, Nan Hto Chaung, in Putao, ca 1.6 km from 46th regiment, 27°19'44"N, 97°22'36"E, S. O. Kullander and R. Britz, 28 March 1998.

*Paratypes*.—All from Myanmar, Kachin State, Ayeyarwaddy River drainage. NRM 40924, 12, 27.8–37.5 mm SL, Nan Hto Chaung, in Putao,

TABLE 1. STANDARD LENGTH (IN MILLIMETERS) AND PROPORTIONAL MEASUREMENTS IN PERCENTS OF STANDARD LENGTH OF *Puntius tiantian*. SD = standard deviation. Regression line parameters, a (intercept), b (slope), and r (Pearson's correlation coefficient) are calculated from measurements expressed in millimeters. The holotype is included in calculated values.

	Holotype	n	min	max	mean	SD	a	b	r
Standard length (mm)	37.7	10	28.5	45.3	35.7	4.33			
Head length	27.3	10	24.3	28.2	27.1	1.04	2.861	0.190	0.945
Snout length	6.9	10	6.9	7.8	7.3	0.30	-0.309	0.082	0.960
Orbit diameter	9.3	10	8.6	10.5	9.5	0.53	1.370	0.056	0.948
Interorbital width	10.6	10	9.7	11.0	10.4	0.43	0.626	0.086	0.939
Head width	15.4	10	14.3	16.0	15.1	0.48	0.961	0.124	0.969
Head depth	21.0	10	18.8	22.1	21.0	0.95	2.743	0.132	0.950
Body depth	39.9	10	36.4	39.8	38.7	0.94	2.083	0.328	0.978
Predorsal length	53.9	10	52.7	55.5	54.4	0.94	0.109	0.541	0.990
Prepelvic length	51.5	10	50.8	53.4	51.9	0.86	0.585	0.503	0.991
Preanal length	73.7	10	73.6	76.4	74.7	0.88	-1.426	0.787	0.996
Caudal peduncle depth	17.0	10	15.5	18.1	17.1	0.75	1.474	0.130	0.914
Caudal peduncle length	18.3	10	18.1	20.1	19.1	0.65	1.283	0.155	0.961
Dorsal fin length	24.4	10	23.2	26.0	24.9	0.80	2.130	0.189	0.975
Anal fin length	18.0	10	17.7	18.6	18.2	0.29	-0.043	0.183	0.992
Pectoral fin length	21.8	10	20.6	23.6	21.7	0.92	1.588	0.172	0.948
Pelvic fin length	19.4	10	19.2	20.7	19.9	0.55	0.491	0.185	0.973

ca 1.6 km from 46th regiment, close to rice mill, 27°19'44"N, 97°22'36"E, S. O. Kullander and R. Britz, 27 March 1998. NRM 40936, 2, 21.5–26.6 mm SL, same data as holotype. NRM 40948, 1, 45.3 mm SL, Putao, Mali Hka River at Machanbaw, 27°15'15"N, 97°25'34"E, S. O. Kullander and R. Britz, 28 March 1998.

**Diagnosis.**—*Puntius tiantian* belongs to the *Puntius conchoni* group and is uniquely distinguished in that group by the shape of the last unbranched dorsal fin ray which is slender, flexible, and with short serrations posteriorly instead of thick and strongly serrated. Similar to *P. cumingii*, *P. didi*, and *P. meingangbii* in the shared possession of a dark vertical bar anteriorly on side and a dark round blotch on caudal peduncle, distinguished from these species by lateral line continued to caudal fin base vs. present on only 5 to 10 scales. Distinguished from the geographically close *P. didi* by body depth 35.4–39.8% SL vs. 40.4–48.2% in *P. didi* and dorsal fin length 23.2–26.0% SL vs. 26.6–31.8% in *P. didi*, and males with a single dark band across dorsal and anal fin vs. two series of black elongate marks in dorsal fin and one series of black marks in anal fin in male *P. didi*.

**Description.**—Elongate, compressed laterally. Predorsal contour ascending, almost straight, without indentation at beginning of musculature, nape not or only slightly elevated, leveled out in advance of dorsal fin base. Almost straight slanting from dorsal fin base to caudal fin base. Preventral contour straight to chest, which is slightly curved, abdomen straight, anal fin base and caudal peduncle contour slightly concave.

Head short, laterally compressed. More than 50% of orbit in anterior half of head. Snout rounded. Mouth subterminal, not reaching to vertical from anterior margin of orbit. Lateral fold on snout present. Barbels absent in holotype; rudimentary maxillary barbel present in other specimens, but may be absent from one side. Lips moderately thick, U-shaped in ventral aspect. Infraorbital 3 + 4 broad, anterior end at middle of orbit, anteriorly extending to middle of depth of cheek, posteriorly extending to preopercle. Breeding tubercles minute, present along rays of anterior side of pectoral and pelvic fins, and along pectoral girdle, in some specimens also along margins of ventral scales anterior to pelvic fins and along margins of preopercular, opercular, and interopercular bones; no evident sexual dimorphism in development of tubercles. Gill rakers 2 on epibranchial, one

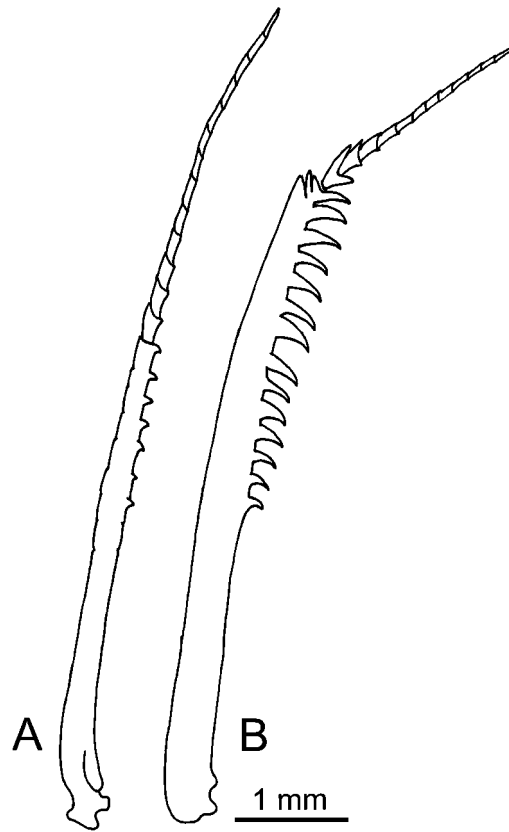


Fig. 2. Left lateral aspect of last unbranched dorsal fin ray in (A) *Puntius tiantian*, NRM 40924, 35.0 mm SL; (B) *Puntius didi*, NRM 36179, 32.3 mm SL.

in angle, and 3 (1), 4 (6), 5 (3) on ceratobranchial.

Dorsal fin origin slightly in advance of pelvic fin origin; distal margin straight or slightly convex; last ray reaching to or slightly beyond vertical from middle of anal fin base. Last unbranched dorsal fin ray (Fig. 2A) osseous proximally, not much thicker than first branched ray, rigid and unsegmented proximally, beyond proximal 1/3 segmented and gradually more flexible distally, middle portion with about 6–11 short paired serrae along posterior margin (Fig. 2A). D. iii.8 (7), iv.8 (7). Pectoral fin rounded, not reaching to vertical from insertion of pelvic fin. P. i.12 (2), i.13 (4), i.14 (4). Pelvic fin rounded, not attaining vent. V. i.7 (2), i.8 (8). Anal fin with straight or slightly concave distal margin, last ray reaching to middle of caudal peduncle. A. iii.5 (14). Caudal fin deeply emarginate, lobes making up slightly less than half of fin length. Principal caudal fin rays 9 + 9 (2), 10 + 9 (12); procurent rays dorsally 4 (1), 5 (1), 6 (11), ventrally 5 (13).

Scales in lateral row/lateral line 19 (2), 20 (6), 21 (1); lateral line complete, usually with one pored scale on caudal fin. Predorsal scales 8 (7), 9 (3), prepelvic scales 11 (1), 12 (9), circumpeduncular scales 12 (10). Scales in transverse row  $4\frac{1}{2}/1/3\frac{1}{2}$  (10). Pelvic axillary scale present, length slightly less than  $1/3$  of length of pelvic fin.

Predorsal vertebrae 8 (11), 9 (2), precaudal + caudal  $16 + 13 = 29$  (1),  $17 + 13 = 30$  (11),  $18 + 13 + 31$  (1). One specimen dissected, 32.1 mm SL (NRM 40924) with short wide pharyngeal bone with slender dorsal tip, narrow ventrally with expansion near tip, without dorsal angle; teeth 5, 3, 2.

*Coloration in preservative.*—Dorsal midline and top of head brownish; sides ventrad gradually less densely pigmented, without dark pigment below level of insertion of pectoral fin. Scales at and below midaxis with pigmentation restricted to overlap with preceding scale, and also scales dorsally on side with paler centra. Snout and lips lightly pigmented, grayish; cheek with sparse brownish pigment; opercle pigmented, brownish; scattered pigmentation on subopercle. Infraorbitals, opercle, and subopercle reflecting silvery.

Two prominent dark blotches on side. Anterior blotch black, covering lateral line scales 3–4 in two specimens (including holotype) or 4–5, and scales immediately dorsally, but also adjacent parts of scales next dorsally, ventrally, and caudally. Blotch expanded by dark brown pigmentation dorsad to dorsal midline, but not onto predorsal midline scales, and ventrad on parts of scales to level of pectoral fin insertion. Posterior blotch black, on middle of caudal peduncle, immediately posterior to vertical from posterior end of anal fin base, covering two lateral line scales ( $16^{\text{th}}$ – $17^{\text{th}}$  in holotype) and adjacent halves of scales dorsally and ventrally, and a smaller portion of adjacent anterior and posterior scales. The extent of brownish pigmentation extending the anterior black blotch dorsally and ventrally varies between specimens, but the marking is invariably vertical. In smallest specimen, 22.6 mm SL, caudal peduncle blotch included in a brown bar reaching around the caudal peduncle; other small specimens, <30 mm SL, with dark pigmentation dorsal and ventral to a distinct lateral blotch, but not encircling the caudal peduncle. Uniform light blotch between head and ventral extension of dark blotch, below lateral line scales.

In holotype, dorsal fin hyaline, anterior margin grayish, base pigmented, a wide dark band across middle of rays, composed of dark elon-

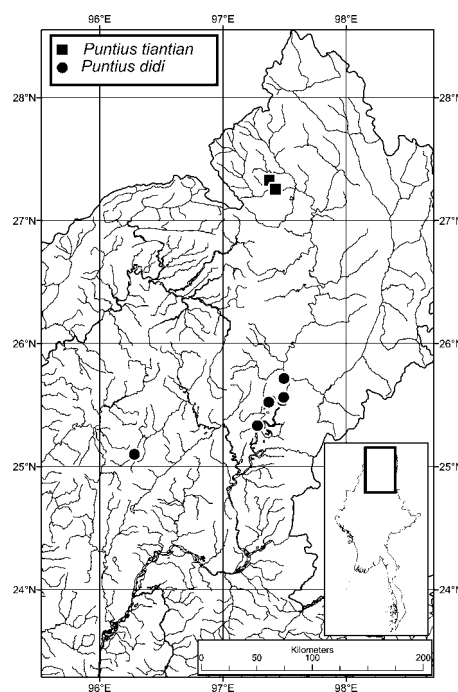


Fig. 3. Collecting sites of *Puntius tiantian* and *P. didi* on a map of northern Myanmar.

gate marks on interradial and interdivisional membranes, followed by a hyaline band and narrowly dark distal margin; anal fin hyaline except for narrow band of black pigmentation across middle of rays and some pigment basally on anterior rays. In specimens <30 mm and four large specimens 33.7–45.3 mm, anal and dorsal fin markings faint to hardly visible, whereas in remainder anal pigmentation forms distinct band, and dorsal fin cross band and margins distinctly dark gray to black. Pectoral fin slightly dusky, with hyaline distal margin. Pelvic fin hyaline except in 33.5 mm specimen with a series of black elongate marks across middle of fin. Caudal fin hyaline.

*Coloration in life.*—A small specimen, 26.6 mm SL, photographed alive immediately after capture was similar to preserved material, but with silvery reflections on head sides and abdominal scales, and a slight pinkish tinge to fins.

*Distribution and habitat.*—Known only from the vicinity of Putao in northern Myanmar (Fig. 3). Despite extensive collecting efforts in small streams bordering Putao, only 13 specimens of *P. tiantian* were collected. The small seine used was inadequate for sampling at the Mali Hka site, margin of a large fast flowing river, and the

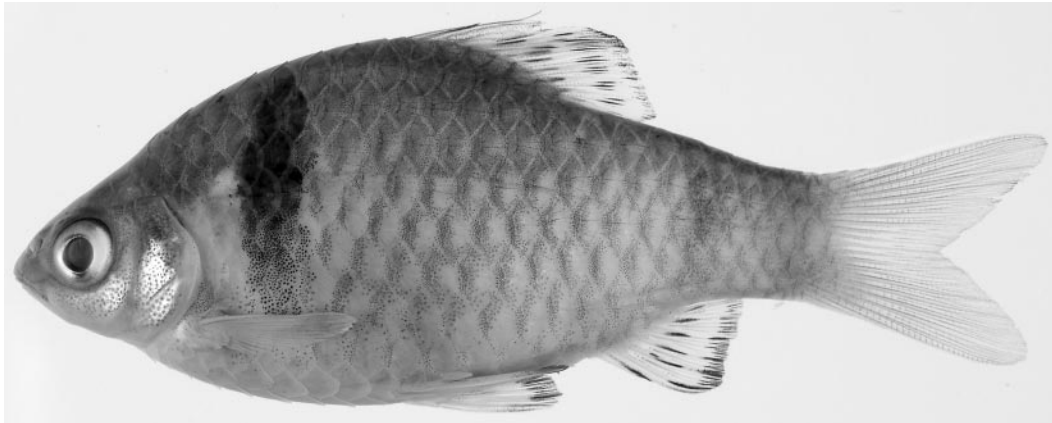


Fig. 4. *Puntius didi*, holotype, male, NRM 50267, 39.9 mm SL; Myanmar: Myitkyina.

single specimen is not indicative of the abundance of the species at this site.

The type locality (Nan Hto Chaung; Kullander and Britz, 2002: Fig. 29) was a small hill stream, about 3 m wide on average, flowing through low forest, with grass and shrub along banks, and over a varied bottom with rock, gravel, and sand. The current was fast, with some riffle stretches. The water level was low, the depth mostly less than 50 cm. There was no aquatic vegetation. The water was clear and colorless. Associated fauna in Nan Hto Chaung included small species of *Acanthocobitis* (Balitoridae), *Barilius*, *Devario*, and *Psilorhynchus* (Cyprinidae) that were most abundant, but also species of *Schistura* (Balitoridae), *Lepidocephalichthys* (Cobitidae), *Microrasbora* (Cyprinidae), and *Mastacembelus* (Mastacembelidae), *Badis pyema* (Badidae), *Heteropneustes fossilis* (Clariidae), and *Batasio tengana* (Bagridae) present. We also fished the larger Ma Kyaw Wa Chaung, into which the Nan Hto flows. Samples were mixed with some from Nan Hto, but notes show that samples from Ma Kyaw Wa consist of larger species, predominantly *Garra* sp. and *Amblyceps murraystuarti*.

A single specimen was obtained from the Mali Hka River, a major river more than 100 m wide, but relatively shallow. Seining along 20 m stonebed shoreline yielded one *P. tiantian*, one specimen of *Acanthocobitis* (Balitoridae), and juveniles of several cyprinid species (*Bangana* sp., *Neolissochilus* sp., *Schizothorax* sp., *Semiplotus cirrhosus*, *Tor* sp.).

**Etymology.**—We dedicate this and the following species to our two sons, Didi (Mandarin Chinese for earth, little brother) and Tiantian (Mandarin Chinese, meaning heaven), who had to repeatedly suffer their parents' absence

searching for these and other fish in faraway lands. *Puntius tiantian* inhabits streams at the foot of the Himalayas, that is, somewhat close to heaven. The name is a noun in apposition.

#### *Puntius didi*, new species

Figure 4, Table 2

**Holotype.**—NRM 50267 (39.9 mm SL) Myanmar, Kachin State, Ayeyarwaddy River drainage, Hpa Lap Chaung just S of Yuzana Myaing village (8 km left from Myitkyina-Myitzon road km 11), 25°31'25"N, 97°22'19"E, F. Fang and A. Roos, 1 April 1997.

**Paratypes.**—All from Myanmar, Kachin State, Ayeyarwaddy River drainage. NRM 36167, 4, 28.8–31.5 mm SL, Hpa Lap Chaung about 5.6 km N Yuzana Myaing (8 km to left from Myitkyina-Myitzon road km 11), 25°32'8"N, 97°23'20"E, F. Fang and A. Roos, 1 April 1997. NRM 36179, 1, 32.3 mm SL; NRM 37278, 1, 36.5 mm SL, Hpa Lap stream about 3 km N of Yuzana Myaing (8 km to left from Myitkyina-Myitzon road km 11), 25°32'3"N, 97°23'22"E, F. Fang and A. Roos, 1 April 1997. NRM 36349, 19, 29.8–40.2 mm SL, Hpa Lap Chaung just S of Yuzana Myaing village (8 km left from Myitkyina-Myitzon road km 11), 25°31'25"N, 97°22'19"E, F. Fang and A. Roos, 1 April 1997. NRM 37277, 1, 29.9 mm SL, stream about 24 km on road Myitkyina—Myitzon, 25°33'46"N, 97°29'30"E, F. Fang and A. Roos, 3 April 1997. NRM 37279, 1, 29.9 mm SL, Nan Kwe Chaung, 17 km on road Myitkyina-Mogaung, 200 m S of road, 800 m E of Sha Dau village, 25°19'57"N, 97°16'47"E, F. Fang and A. Roos, 2 April 1997. NRM 39909, 42, 20.0–38.6 mm SL, stream about 1.5 km on road Myitzon—Myitkyina, 25°42'57"N, 97°29'45"E, F. Fang and A. Roos, 3 April 1997. NRM 40893, 1, 25.3 mm

TABLE 2. STANDARD LENGTH (IN MILLIMETERS) AND PROPORTIONAL MEASUREMENTS IN PERCENTS OF STANDARD LENGTH OF *Puntius didi*. SD = standard deviation. Regression line parameters, a (intercept), b (slope), and r (Pearson's correlation coefficient) are calculated from measurements expressed in millimeters. The holotype is included in calculated values.

	Holotype	n	min	max	mean	SD	a	b	r
Standard length (mm)	39.9	17	25.3	40.2	35.0	3.84			
Head length	27.3	17	26.5	29.6	27.6	0.93	1.783	0.225	0.963
Snout length	7.3	17	6.6	7.4	7.0	0.24	0.124	0.067	0.950
Orbit diameter	10.0	17	10.0	12.3	10.8	0.55	1.320	0.070	0.926
Interorbital width	10.5	17	10.5	12.3	11.3	0.48	0.142	0.109	0.928
Head width	14.5	17	14.4	16.7	15.3	0.72	1.354	0.114	0.912
Head depth	22.3	17	21.2	23.7	22.5	0.67	0.881	0.200	0.965
Body depth	46.1	17	40.4	48.2	44.9	2.48	-4.011	0.565	0.952
Predorsal length	55.9	17	54.1	58.8	55.9	1.24	-0.994	0.588	0.984
Prepelvic length	49.9	17	43.8	52.2	50.0	2.09	1.092	0.468	0.928
Preanal length	73.7	17	72.6	77.0	74.5	1.25	-1.527	0.789	0.992
Caudal peduncle depth	16.8	17	16.2	19.4	17.5	0.87	-0.222	0.181	0.921
Caudal peduncle length	21.3	17	18.5	21.3	19.5	0.82	-0.789	0.218	0.943
Dorsal fin length	26.6	17	26.6	31.8	29.1	1.57	1.006	0.262	0.874
Anal fin length	18.8	17	18.8	22.3	20.1	0.96	1.081	0.170	0.894
Pectoral fin length	22.3	17	21.3	24.6	22.9	0.96	-0.391	0.240	0.936
Pelvic fin length	21.6	17	20.9	24.2	22.7	1.05	-0.840	0.252	0.938

SL; NRM 43007, 1, 29.7 mm SL, Tang Shang Chaung, about 300 m upstream from bridge at 34 km on road Myitkyina-Myitzon, 25°33'47"N, 97°29'32"E, S. O. Kullander and R. Britz, 26 March 1998. NRM 40998, 1, 31.9 mm SL, lower 300 m of Nant Yen Khan Chaung, affluent of Lake Indawgyi, little S of Lonton village, 25°6'0"N, 96°16'59"E, S. O. Kullander and R. Britz, 31 March 1998.

*Diagnosis.*—*Puntius didi* belongs to the *Puntius conchoni* group and is most similar to *P. cumingii*, *P. meingambii*, and *P. tiantian* in shared possession of a dark vertical bar anteriorly on side and a dark round blotch on caudal peduncle. Distinguished from *P. cumingii* by 12 vs. 10 circumpeduncular scales and 3½ vs. 4½ scales above midline. *Puntius meingambii* is more slender, with body depth of adults 33.3–39.6% SL vs. 40.4–48.2% SL in *P. didi*. Distinguished from the geographically close *P. tiantian* by having last unbranched dorsal fin ray thick and strongly serrated instead of slender, flexible and with short serrations posteriorly, body depth 40.4–48.2% SL vs. 35.4–39.8% SL, dorsal fin length 26.6–31.8% SL vs. 23.2–26.0% SL, lateral line limited to six to seven, rarely up to ten anterior scales, vs. continued to caudal fin base, and males with two series of black marks in dorsal fin and one series of black marks in anal fin, vs. a single dark band in each fin in male *P. tiantian*. Distinguished from *P. phutunio* by wider infraorbital 3 + 4, extending posteriorly to the

margin of the preopercle instead of only half-way to the preopercle, 12 vs. 10 circumpeduncular scales, absence of a dark blotch anteriorly at the base of the dorsal fin, and absence of a dark band extending obliquely rostrad and ventrad from immediately posterior to the dorsal fin base.

*Description.*—Deep, elevated, compressed laterally. Body depth 40.4–48.2% SL. Predorsal contour ascending, almost straight, nape slightly elevated. Almost straight dorsal contour, slanting from dorsal fin base to caudal fin base. Pre-ventral contour straight to middle of abdomen where curved, straight horizontal to pelvic fin bases, from pelvic fin bases slanting to anal fin base, which forms a gently concave outline continuous with caudal peduncle outline.

Head short, laterally compressed. More than 50% of orbit in anterior half of head. Snout rounded. Mouth subterminal, not reaching to vertical from anterior margin of orbit. Lateral fold on snout present. Rostral barbel absent; maxillary barbel present, rudimentary. Lips moderately thick, strongly curved and U-shaped in ventral aspect. Infraorbital 3 + 4 broad, anterior end at middle of orbit, anteriorly extending to middle of depth of cheek, posteriorly extending to preopercle. Breeding tubercles minute, present along rays of anterior side of pectoral and pelvic fins, and along pectoral girdle, in some specimens also along margins of ventral scales anterior to pelvic fins and along margins

of preopercular, opercular, and interopercular bones; no evident sexual dimorphism in development of tubercles. Gill rakers 2–3 on epibranchial, one in angle, and 4 (5), 5 (8), 6 (3), 7 (1) on ceratobranchial.

Dorsal fin origin opposite pelvic fin origin; distal margin straight or slightly concave; last ray reaching to vertical from middle or end of anal fin base. Last unbranched dorsal fin ray almost as long as first branched ray; proximal 2/3 osseous, much thicker than first branched ray, rigid, strongly serrated, with 15–17 pairs of serrae posteriorly; apical 1/3 flexible, segmented, without serrations (Fig. 2B). D. iii.8 (3), iv.8 (28). Pectoral fin rounded, not or barely reaching to vertical from base of pelvic fin. P. i.12 (1), i.13 (11), i.14 (5). Pelvic fin rounded, attaining vent. V. i.7 (2), i.8 (15). Anal fin with straight distal margin, last ray reaching to middle of caudal peduncle or almost to caudal fin base. A. iii.5 (31). Caudal fin deeply emarginate, lobes making up slightly less than half of fin length. Principal caudal fin rays 10 + 9 (29); procurrent rays dorsally 5 (2), 6 (27), ventrally 5 (27), 6 (2).

Scales in lateral row 19 (2), 20 (10), 21 (5); lateral line scales 6 (3), 7 (11), 8 (1), 10 (1). Predorsal scales 8 (17), prepelvic scales 10 (1), 11 (4), 12 (10), 13 (2), circumpeduncular scales 12 (17). Scales in transverse row 4½/1/3½ (17). Pelvic axillary scale present, length corresponding to 1/3 of pelvic fin length.

Predorsal vertebrae 8 (31), precaudal + caudal 16 + 14 = 30 (1), 17 + 12 = 29 (3), 17 + 13 = 30 (24), 17 + 14 = 31 (1), 18 + 13 = 31 (2). One specimen dissected, 28.9 mm SL (NRM 36167) with short wide pharyngeal bone with slender dorsal tip, narrow ventrally with expansion near tip, without dorsal angle; teeth 4, 3, 2.

*Coloration in preservative.*—Dorsal midline brown; scales on side ventrad gradually lighter on middle, at level of pectoral fin base and below, pigmented only along posterior margin. Top of head grayish brown, snout and lips grayish, paler toward orbit; cheek with sparse brownish pigment; opercle and subopercle pigmented, brownish; usually scattered pigmentation on interopercle. Infraorbitals, opercle, and subopercle silvery reflecting.

Two prominent dark blotches on side. Anterior blotch black, two scales wide, typically covering lateral line scale 4 and half of scales anterior and posterior, with variation including slight shift anteriorly or posteriorly, and also the two scales next dorsally. Below blotch gradually less densely pigmented and becoming narrower

close to level of pectoral fin, pigmentation ending at or below level of pectoral fin base. Blotch extended dorsad by dark brown pigment to, but not onto, dorsal midline scales. Silvery immediately anterior to blotch, on lateral line scale, with or without variable amount of masking black pigment. An unpigmented or lightly pigmented blotch between the cleithrum and the ventral extension of the dark anterior blotch. Posterior blotch brown to dark brown, usually indistinct, rarely almost obsolete, on middle of caudal peduncle, immediately posterior to vertical from posterior end of anal fin base, covering one scale at middle of caudal peduncle and adjacent parts of neighboring scales, usually also with an indistinct ventral extension. In NRM 39909, ventral expansion of anterior blotch more indistinct than in other samples, and may be obsolete, and caudal peduncle blotch distinctly expressed in contrast with other samples.

Fin coloration variable. Selected specimens dissected confirm males as having more intensely colored fins than females. Based on grades of color intensity, 38 specimens are females, with distinct but faint dorsal fin pigmentation and no anal or pelvic fin pigmentation; 18 specimens are males with intense dorsal, anal, and occasionally pelvic fin pigmentation; specimens <30 mm with only diffuse or no pigmentation on dorsal fin, other fins hyaline. In males dorsal fin hyaline with black distal margin and two rows of black marks crossing fin, outer row marks located between ray branches, inner row marks on interradial membrane; anal fin with black distal margin and six black oval marks across middle; pelvic fin in six specimens with black distal margin and a row of black marks from anterior base across middle of fin. In females dorsal fin markings indistinct, anal fin only diffusely pigmented or hyaline, pelvic fin hyaline or only slightly dusky. Pectoral fin in all specimens slightly dusky, distal margin hyaline; caudal fin without pigmentation.

*Coloration in life.*—Female, 32.1 mm SL, photographed alive, similar to preserved specimens, but sides with silvery reflections on scale centers, lower sides of head, chest, and abdomen silvery; dorsal and anal fins, and margins of caudal fin lobes tinged with yellow, pelvic fins orange, eye orange dorsally on both sides of dark bar passing through eye.

*Distribution and habitat.*—Known only from near Myitkyina and Lake Indawgyi in northern Myanmar (Fig. 3). *Puntius didi* was collected in small numbers (1–4) in most localities; only two sam-

pling sites, both from 1997, yielded significant numbers (20 and 42). This suggests that *P. didi* is either relatively rare or stenotopic.

The type locality was a stream with fast flowing, clear, brownish water, pH 6.5, temperature 23.2 C. Land vegetation consisted of bamboo forest providing 60% shadow. No aquatic vegetation. The bottom consisted of mud mixed with stones. Other species encountered were *Acanthocobitis botia* (Balitoridae), *Xenentodon* sp. (Belontiidae), *Parambassis* sp. (Ambassidae), *Danio strigillifer*, *Oreochthys* sp., *Puntius puntio* auct., *P. sophore*, *Rasbora daniconius*, *R. rasbora* (Cyprinidae), *Mastacembelus* sp. (Mastacembelidae), and *Notopterus notopterus* (Notopteridae), with *P. puntio* auct. by far the most abundant (112 out of 164 specimens preserved). Other localities were also small streams with a similar associated fish fauna of small fishes, predominantly cyprinids, and include localities reported for *Badis kyar* (Kullander and Britz, 2002: Fig. 31), *Badis corycaeus*, *Dario hysginon* (Kullander and Britz, 2002: 346, 363), *Danio kyathit* (Fang, 1998), and *Pillaia kachinica* (Kullander et al., 2000).

*Etyymology*.—We dedicate this species to our son, Didi (Mandarin Chinese, meaning earth, little brother). In contrast to the similar *P. tiantian*, *P. didi* is a species of the lowlands, steady on earth. The name is a noun in apposition. See also etymology of *P. tiantian*.

#### DISCUSSION

*Puntius tiantian* and *P. didi* belong to a group of Asian cyprinids referable to as the *P. conchoni* group (Taki et al., 1978), characterized by small adult size, fused and broad infraorbital 3 + 4, well-developed lateral folds on snout, absence of rostral barbels, minute or absent maxillary barbels, osseous and serrated last unbranched dorsal fin ray, often abbreviated lateral line, a color pattern including a blotch anteriorly on the side (absent in *P. conchoni*) and a blotch on the caudal peduncle, and a broad pharyngeal bone characterized by pointed dorsal tip, spaced moderate-sized teeth, and absence of dorsal angle. Taki et al. (1978), studying a sample of 23 species of *Puntius*, included *P. conchoni*, *P. cumingii*, *P. ticto*, and *P. nigrofasciatus* in the *P. conchoni* group. Kortmulder (1972) and Kortmulder and van der Poll (1981) identified the same species and also *P. gelius*, *P. narayani*, *P. phutunio*, *P. stoliczkanus*, and tentatively *P. tetrazona* as members of the *P. conchoni* group. We assign *P. gelius*, *P. punctatus*, *P. stoliczkanus*, and *P. phutunio* to the *P. conchoni* group based on personal examinations of morpholog-

ical characters listed above. Based on literature information we also include *P. bandula*, *P. manipurensis*, *P. meingangbii*, *P. narayani*, *P. setnai*, *P. shalynius*, and *P. yuensis*, but some of these taxa are only superficially described. The distinctive broad infraorbital 3 + 4 characteristic of all species of the *P. conchoni* group was also found in *P. amphibius*, *P. bimaculatus*, *P. fasciatus*, *P. guganio*, *P. melanampyx*, *P. semifasciolatus*, and *P. vittatus*, but these species differ in combinations of other characters involving barbel development, dorsal fin ossification and serrations, and color pattern. We exclude *P. tetrazona* and other small barred South East Asian species of *Puntius* with narrow infraorbital 3 + 4 (*P. tetrazona* and *P. pentazona* groups of Taki et al., 1978).

Jayaram (1991) distributed species included in the *P. conchoni* group in his *P. sophore* (*P. conchoni*, *P. shalynius*, *P. ticto*), *P. fasciatus* (*P. cumingii*, *P. narayani*, *P. nigrofasciatus*), and *P. puntio* (*P. gelius*, *P. phutunio*) groups, diagnosed by various combinations of variable counts, proportions, and color pattern but not justified by a phylogenetic analysis or explicit mention of putative apomorphic character states. Many authors recognize *Puntius* as a catch-all genus (Rainboth, 1996; Kottelat, 1998; Kullander et al., 1999), but in the absence of a phylogenetic analysis we maintain the generic name *Puntius* for the *P. conchoni* group.

*Puntius tiantian* and *P. didi* are almost identical in meristics, but differ in lateral line development, the pored scales restricted to 6–10 anterior scales in *P. didi*, but continued to the caudal fin base in *P. tiantian*. The two species also differ in body and fin shape, development of the last unbranched dorsal fin ray and in details of the color pattern. Orbit size, body depth, and dorsal fin length are the most trenchant distances in biplots (Fig. 5A–C), PCA (Fig. 5D), and ratios (Tables 1 and 2: orbit diameter 8.6–10.5% SL in *P. tiantian*, vs. 10.0–12.3% in *P. didi*; body depth 35.4–39.8% SL in *P. tiantian* vs. 40.4–48.2% in *P. didi*; dorsal fin length 23.2–26.0% SL in *P. tiantian*, vs. 26.6–31.8 in *P. didi*). Principal Component analysis of pooled measurements of specimens of adult size range recovers most variation in PC2 (7.5% of total variation) in snout length, orbit diameter, body depth, prepelvic length, and dorsal fin length (Table 3; Fig. 5D). Snout length is the smallest dimension measured, and the variability seems to be mainly individual; prepelvic length variation is contained entirely within *P. didi*. The other measurements are also recovered in biplots as mildly or strongly species diagnostic.

*Puntius tiantian* and *P. didi* are similar in color pattern, but notably the center of the anterior

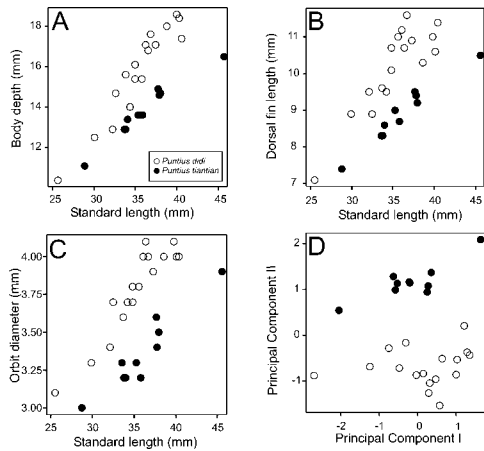


Fig. 5. Comparative morphometry of *Puntius didi* and *P. tiantian*. (A) body depth plotted against SL; (B) dorsal fin length plotted against SL; (C) orbit diameter plotted against SL; (D) scores of principal component II plotted against component I.

dark blotch on the side is more dorsal relative to the lateral line in *P. didi* than in *P. tiantian*. Male specimens of *P. didi* have contrasting black marks on the dorsal and anal fins, whereas in *P. tiantian* there is a dark stripe in the position of the outer row of marks in *P. didi*, and also a dark stripe instead of series of marks on the anal fin. The difference in fin coloration may relate to the difference in dorsal fin length, as there is more space for markings in *P. tiantian*. The dor-

sal fin pigmentation appears as a band in *P. didi* because the dark pigment follows successively on interradial membranes and between the major branch of rays, whereas in *P. didi* the inner row marks are located to interradial membranes and the outer row marks to the membrane between the major branch of the rays. In the anal fin, the pigment marks are in comparable position, but more intensely pigmented in *P. didi*, and whereas in *P. tiantian* the pigmentation making up the medial band appears immediately anterior and posterior to fin rays and between the major branches of a ray, in *P. didi* the pigmentation may occupy the whole space between two rays and does not appear between the branches. In *P. tiantian* the dark blotch on the caudal peduncle is always well expressed, whereas in *P. didi* it is mostly indistinct; in one sample of *P. didi*, however, it is well expressed, comparable to *P. tiantian*.

In *P. tiantian*, the last unbranched dorsal fin ray is unusually slender and weakly serrated (Fig. 2A) compared to other species in the *P. conchoni* group and other species of *Puntius* with osseous and serrated last unbranched dorsal fin ray. In museum specimens of species of *Puntius* the flexible distal tip of the basally osseous and serrated last unbranched dorsal fin ray is very often displaced relative to the ossified part, or the ray is simply broken at the point of transition; in such specimens the resulting tip is barbed, with an anterior spine formed by the

TABLE 3. VARIABLE LOADINGS ON THE FIRST THREE PRINCIPAL COMPONENTS OF POOLED MEASUREMENTS FROM *Puntius tiantian* (N = 10) AND *P. didi* (N = 17). Highest loadings for PCII and PCIII in boldface.

	Component		
	I	II	III
Head length	0.090	0.017	0.003
Snout length	0.107	<b>0.057</b>	0.006
Orbit diameter	0.081	<b>-0.044</b>	-0.005
Interorbital width	0.116	-0.010	<b>0.024</b>
Head width	0.089	0.018	0.018
Head depth	0.096	-0.009	-0.009
Body depth	0.143	<b>-0.041</b>	-0.016
Predorsal length	0.118	0.019	0.004
Prepelvic length	0.100	<b>0.052</b>	-0.001
Preanal length	0.118	0.033	0.003
Caudal peduncle depth	0.114	0.014	<b>-0.028</b>
Caudal peduncle length	0.112	0.022	-0.021
Dorsal fin length	0.114	<b>-0.051</b>	0.014
Anal fin length	0.111	-0.024	0.004
Pectoral fin length	0.112	0.002	0.014
Pelvic fin length	0.132	-0.037	-0.002
Eigenvalue	0.196	0.017	0.03
Variance explained %	86.3	7.5	1.3

anterodorsal tip of the terminal segment and posterior spines formed by the two posterior serrae of the same segment. In *P. tiantian*, the last unbranched ray is intact in all except three specimens, in which the ray is simply broken without forming a barbed tip. We postulate that the ability to dislocate the flexible tip is an antipredatory device in species of *Puntius*, whereby the spine gains a stronger hold in the flesh of the mouth of the predator than would be the case with the posterior serrations alone. In *P. tiantian*, the osseous portion is much more slender, the serrations fewer and shorter, and the distal tip does not separate easily, suggesting that the dorsal fin in this species has no significant function as antipredatory device.

In addition to *P. tiantian* and *P. didi*, the *P. conchoni* group is represented in Myanmar by *P. conchoni* auct., *P. stoliczkanus*, and *P. ticto* auct. In *P. ticto* the humeral marking is represented by a minute black spot. *Puntius didi* occurs together with *P. ticto* in Myitkyina. The two species can be distinguished by the color pattern and the lateral line (complete in *P. ticto*). In *P. stoliczkanus*, from southeastern Myanmar, the dark spot anteriorly on the side is somewhat larger than in *P. ticto*, but still small compared to *P. tiantian* and *P. didi*. In *P. conchoni*, which occurs all over Myanmar, the humeral marking is absent. Another small species of *Puntius* reported from Myanmar, *P. puntio* auct., lacks humeral marking, has an even more rudimentary maxillary barbel than *P. tiantian* or *P. didi*, smooth last unbranched dorsal fin ray, and much narrower infraorbital 3 + 4, not extending to the preopercle.

Besides *P. tiantian* and *P. didi*, there are four species in the *P. conchoni* group with a prominent anterior vertical bar and a prominent spot at the caudal peduncle, viz. *P. bandula*, *P. cumingii*, *P. meingangbii*, and *P. phutunio*. *Puntius bandula* is restricted to one small stream in Sri Lanka. Barbels absent, last unbranched dorsal fin ray osseous, serrated; lateral line short (8–12 scales long), 3–6 gill rakers (Kottelat and Pethiyagoda, 1991). In *P. bandula* the caudal peduncle blotch is expressed as a band encircling the caudal peduncle, and the dorsal, pelvic, and anal fins are blackish; meristic and morphometric characters are similar to *P. didi*.

*Puntius cumingii* is restricted in distribution to Sri Lanka (Pethiyagoda, 1991). Barbels absent, dorsal ray osseous and serrated proximally, flexible distally; lateral line short (5–6 scales); 13 gill rakers fide Jayaram (1991: 150), but the specimen that we examined has only five. Lower scale counts (lateral row 18 vs. 19 or more; circumpeduncular scales 10 vs. 12, and scales

above midline 3½ vs. 4½) distinguishes the species from similar Myanmar species, but we had only one specimen available for comparison.

*Puntius meingangbii* was described on material from Moreh, near Imphal, in the Yu River drainage in Manipur, India. It was described as having a short lateral line comprising six scales, a deep humeral blotch and a caudal peduncle blotch (Arunkumar and Tombi Singh, 2003), thus similar to *P. didi*. We have not been able to examine Manipur material of *P. meingangbii*, but the most obvious diagnostic character, judging from measurements and photographs, is the more elongate body in comparison to *P. didi*.

According to data from the original description, *P. meingangbii* differs in some important respects from *P. didi*, and other species of *Puntius*. Some of these characters may be errors, e.g., two serrated unbranched dorsal fin rays (should be 3–4 unbranched rays, the last serrated?), 2 (should be 3?) unbranched anal fin rays, 18 caudal fin rays (all cyprinids typically have 19 principal caudal fin rays), barbels absent (rudimentary maxillary barbel overlooked?). The figure accompanying the original description appears crude, scales are definitely incorrectly drawn, and fin shapes are definitely incorrect. The posterior dark spot is drawn as situated above the anal fin, as in *P. phutunio*, and the diagnosis describes it as a black band “across that portion of the anterior caudal peduncle which is above the anal fin.” In this respect *P. meingangbii* is more comparable with *P. phutunio* than with *P. didi* from Myanmar. On the other hand, in the color description the posterior dark spot is said to be present on the 16th to 18th scales along the lateral line, which if mapped onto *P. didi* could place it posterior to the anal fin base, and this position is confirmed by a photograph of a specimen probably from the type series of *P. meingangbii* deposited in the Manipur University fish collection. Some other characters were not observed in *P. didi*, such as “tip of snout black with minute black dots”, “pectoral fin blackish” and “ventral and anal fin blackish-red to red.” Photographs of *P. meingangbii* deposited in the Manipur University fish collection show the posterior dark marking on the side as a blotch rather than as a vertical bar.

*Puntius bizonatus*, described by Vishwanath and Laisram (2004) from the Lokchao River at Moreh, in the Yu River drainage, is apparently the same species as *P. meingangbii*, having a vertical dark stripe anteriorly on the side and a dark stripe on the caudal peduncle, as well as a short lateral line perforating 5–7 scales. Vishwanath and Laisram (2004) describe the posterior dark marking as a vertical band, but a pho-

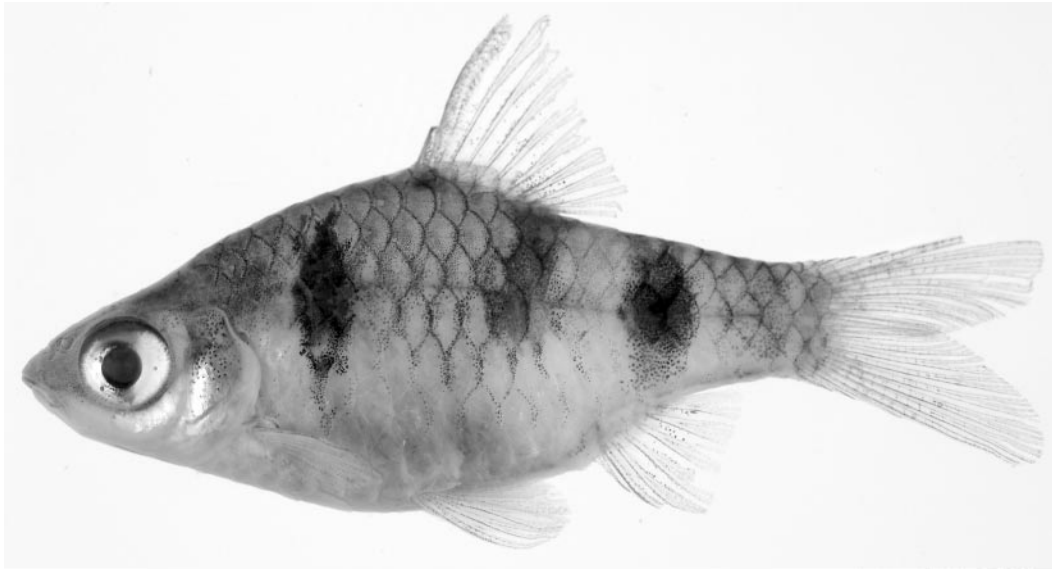


Fig. 6. *Puntius phutunio*, NRM 40431, 22.8 mm SL; India, Ganga River drainage, Tumapao River about 65 km NNE of Calcutta.

tograph in Vishwanath (2002: Fig. 42) shows a dark spot in its place. *Puntius bizonatus* appeared as a nomen nudum in Vishwanath (2002: 16, Fig. 42; no holotype mentioned and thus unavailable under the International Code of Zoological Nomenclature, Article 16.4),

On the basis of published information, *P. didi* can be definitely distinguished from *P. meingangbii* by deeper body, 40.4–48.2% of SL, vs. 33.3–39.6% SL. The figure of *P. meingangbii* (Arunkumar and Tombi Singh, 2003: Fig. 2) indicates an elongate species, and the body depth is given as 33.3–35.3% of SL (SL range 30–35 mm), which is much less than in specimens of *P. didi* of comparable size (40.4–48.2% at 25–40 mm SL), and less also than in *P. tiantian* (36–40% SL). The type series of *P. bizonatus* has a body depth of 35.8–39.6% SL, based on measurements of six specimens, 26.9–39.4 mm SL (Vishwanath and Laisram, 2004), which is less than in *P. didi*, although notably greater than given for the type series of *P. meingangbii* by Arunkumar and Tombi Singh (2003). Photographs of *P. meingangbii* deposited in the Manipur University fish collection show relatively elongate specimens, with a body depth calculated from the photographs of 34.5%, 37.6% and 38.4%, respectively.

Prashad and Mukerji (1929: 201) reported that *P. phutunio* occurs in “great abundance in the [Indawgyi] lake and in various small muddy and rocky streams in the Myitkyina District.” At the time *P. phutunio* and *P. cumingii* were the only known species of the genus with a promi-

nent vertical bar anteriorly on the side and it is likely, given that the occurrence of *P. didi* in the area is confirmed by our collections, that the species reported by Prashad and Mukerji is actually *P. didi*. All other records of *P. phutunio* are from India (Jayaram, 1991). A photograph, reproduced by Vishwanath (2002: 75, Fig. 48), of one of the specimens examined by Prashad and Mukerji (ZSI F10929/1), from Kamaing, shows a color pattern compatible with that of *P. didi*, including a prominent dark blotch anteriorly on the side, and a distinct but less intense dark band on the caudal peduncle, but no additional dark vertical bars.

*Puntius phutunio*, in addition to the anterior bar and caudal peduncle blotch, possesses a distinct blotch anteriorly at the base of the dorsal fin, and a dark band extending obliquely rostrad and ventrad from immediately posterior to the dorsal fin base to about the middle of the side (Fig. 6). This middle bar is lighter than the anterior bar and caudal peduncle blotch, often reduced in length and occasionally obsolete. Infraorbital 3 + 4 is moderately wide, only extending to the middle of the cheek. The maxillary barbel is minute. The last unbranched dorsal fin ray is osseous and serrated proximally, flexible distally. The lateral line is short, restricted to about five scales; gill rakers number about four, and circumpeduncular scales ten.

It is possible that the specimen of *Barbus stoliczkanus* reported from a hill stream near Tanja (Putao) by Chaudhuri (1919) belongs to *P. tiantian*, although no description was provided. Ac-

cording to Hora et al. (1939: 268) it has a complete lateral line, but the body depth reported is slightly deeper (43% SL) than in the type series of *P. tiantian*. In the comparison table (Hora et al., 1939: 274), the information on position of the two blotches on the side is marked with two periods, probably indicating missing information (elsewhere in the table, absence is indicated as such).

#### MATERIAL EXAMINED

Detailed information about each NRM sample can be obtained by searching the catalog number from the NRM fish collection online database at <http://www.nrm.se/> or the GBIF online database at <http://www.gbif.org/>. *Puntius amphibioides*: NRM 12058 (India, Kottayam); *P. bimaculatus*: NRM 8063 (Sri Lanka, Kandy); *P. burmanicus*: NRM 33151 (Myanmar, Yangon); *P. cholae*: NRM 40526 (India, Dibru River); *P. conchonioides*: NRM 40470 (India, Bihar), 40665 (Myanmar, Myitkyina), 33176 (Myanmar, Putao); *P. cumingii*: ZMUL 962–5406 (Sri Lanka); *P. fasciatus*: NRM 12121 (India, Kerala); *P. filamentosus*: NRM 12136 (India, Kerala); *P. gelius*: NRM 40328 (India, Dibrugarh); *P. guganio*: NRM 40520 (India, Dibru River); *P. melanampyx*: NRM 12106 (India, Kerala); *P. pentazona*: NRM 18819 (Singapore); *P. phutunio*: NRM 40431 (India, near Calcutta); *P. punctatus*: NRM 12074 (India, Kerala); *P. puntio* auct.: NRM 36354 (Myanmar, Myitkyina); *P. sarana*: NRM 13688 (Sri Lanka); *P. semifasciolatus*: NRM 45722 (Hong Kong); *P. sophore*: NRM 40609 (India, Calcutta); *P. stoliczkanus*: NRM 39962 (Myanmar, near Martaban); *P. terio*: NRM 40394 (India, near Calcutta); *P. ticto*: NRM 40327 (India, Dibrugarh), 36320 (Myanmar, Lashio), 40393 (India, near Calcutta); *P. vittatus*: NRM 12254 (Sri Lanka, Ratnapura).

#### ACKNOWLEDGMENTS

Specimens were collected during field surveys supported by grants to F. Fang from the Hierta-Retzius Foundation (Royal Swedish Academy of Sciences), the Ax:son Johnson Foundation, and the Riksmusei Vänner, and to S. Kullander from the Swedish Natural Science Research Council (R-RA 04568-316). We are indebted to U Win Aung, U Tun Shwe, and U Mya Thein Roy for the collecting permit (unnumbered) from the Department of Fisheries, Myanmar, R. Britz, A. Roos, and Thein Win for field assistance, W. Vishwanath for photographs and unpublished information on *P. meingangbii*, and M. Kottelat for helpful comments on the manuscript.

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