

The World's Smallest Vertebrate, *Schindleria brevipinguis*, A New Paedomorphic Species in the Family Schindleriidae (Perciformes: Gobioidei)

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ABSTRACT. *Schindleria brevipinguis* n.sp., from the Lizard Island-Carter Reef vicinity of the Great Barrier Reef, Australia and from Osprey Reef nearby in the Coral Sea, is a small, unpigmented gobioid species distinctive in having fewer dorsal- and anal-fin rays and a deeper body with larger eyes than the other described species, *S. pietschmanni* and *S. praematura*. The urogenital papilla of male *S. brevipinguis* has a markedly different shape from those of the other two species. *Schindleria brevipinguis* apparently provides an even more extreme example of paedomorphosis than its congeners, and with males maturing by 7 mm and the largest specimen only 8.4 mm, it almost certainly is the world's smallest fish and smallest vertebrate.

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Schindleriidae, a family of small, paedomorphic, marine gobioid fishes (Johnson & Brothers, 1993), is widely distributed in warm-water reef habitats of the Indian and Pacific Oceans (e.g., Bruun, 1940; Jones & Kumaran, 1964; Sardou, 1974; Ozawa & Matsui, 1979; Belyanina, 1989; Harris & Cyrus, 1996; Landaeta *et al.*, 2002). *Schindleria praematura* (Schindler, 1930) and *S. pietschmanni* (Schindler, 1931) originally were described as *Hemiramphus* species; Giltay (1934) subsequently placed them in their own genus and family. To date, these two species remain the only described members of the family, although Yoshino *et al.* (2000) and Kon & Yoshino

(2002) have suggested that Schindleriidae probably contains many species.

In 1979, while conducting ichthyoplankton research in the Lizard Island-Carter Reef vicinity of the Great Barrier Reef, Queensland, J.M. Leis and party collected a small *Schindleria* specimen that clearly differed from *S. praematura* and *S. pietschmanni*. Four additional specimens were collected from the Lizard Island-Carter Reef vicinity from 1981–1983, and in 1988 another was collected at Osprey Reef, nearby in the Coral Sea. These six specimens are described here as a new *Schindleria* species.

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Materials and methods

Counts, measurements, and descriptions of general body shape follow Leis & Carson-Ewart (2000). All counts and measurements were made at 25× or 50× magnification using a binocular microscope equipped with an ocular micrometer. All measurements are in mm and standard length (SL) is used throughout. Length of the urogenital papilla is measured from the body margin, along the axis of the papilla. Specimens were neither cleared and stained nor dissected; thus counts of vertebrae, gill-rakers, cerato-branchial teeth, and branchiostegal rays were made only when those structures were easily discernible. Illustrations were made with the aid of a camera lucida. Institutional abbreviations follow Leviton *et al.* (1985). Comparative material examined: *Schindleria pietschmanni*, SIO 91–140 (13: 4.4–13.6 mm); *S. praematura*, AMS I.20970-009 (10: 4.0–10.2 mm); SIO 91–140 (2: 13.9–15.4 mm).

Schindleria brevipinguis n.sp.

Fig. 1

Type material. HOLOTYPE: AMS I.23552-006, 8.4 mm, a mature female, collected in a plankton tow by J. Leis and party on 18 January 1982, from the vicinity of Carter Reef, Queensland, Australia (14°33.5'S 145°35'E). PARATYPES (all from Queensland, Australia): AMS I.23729-003 (1: 5.1 mm, immature, probably male, lee of Carter Reef, 14°33'S 145°35'E); AMS I.26323-003 (1: 6.6 mm, male, Carter Reef, 14°33.5'S 145°35'E); AMS I.30632-003 (1: 6.5 mm, male, Osprey Reef lagoon, 13°47–55'S 146°35–40'E); QM I.33614 (1: 7.7 mm, male, Carter Reef, 14°35'S 145°35'E); SIO 03–35 (1: 6.9 mm, male, Carter Reef, 14°34'S 145°35'E).

Diagnosis. A small, stout, unpigmented *Schindleria* species, largest specimen 8.4 mm; body depth at pectoral-fin origin 9–12% of standard length and at anal-fin origin 9–14% SL. Dorsal-fin rays 13, anal-fin rays 10–11; first dorsal-fin ray at myomere 18–20 and first anal-fin ray below dorsal-fin ray 4. Vertebrae 20 + 15–16 = 35–36, myomeres 19–20 + 14–16 = 34–36. Premaxillae and dentaries lack teeth. Males have a rod-like, flexible urogenital papilla lacking lobes, projections, or accessory papillae, with distal half tapering to a blunt point and usually anteriorly directed.

Description. Dorsal-fin rays 13 (Table 1), anal-fin rays 10–11, dorsal- and anal-fin rays spaced at intervals of approximately one ray per myomere; first dorsal-fin ray at myomere 18–20 (mode = 19), last ray at myomere 28–33 (31); first anal-fin ray at myomere 22, just before to just behind dorsal-fin ray 4 (usually below D 4), last ray below last dorsal-fin ray; pectoral-fin rays 14–16 (14); pelvic fins absent; principal caudal-fin rays 7 + 6, procurrent rays 5–6 + 5–6; all fin-rays unbranched; vertebrae 20 + 15–16 (20 + 16); myomeres 19–20 + 14–16 (20 + 16); branchiostegal rays 5; gill-rakers and teeth absent; gas bladder at myomeres 9–13 (10–12).

Head small, length averages 18% SL (Table 2); snout short, length averages 23% of head length (HL); eye moderately large, slightly oval to round, length averages 30% HL and height averages 32% HL; gut moderately long

Table 1. Selected meristic characters for *Schindleria brevipinguis*. Parenthetical values are approximate.

	holotype		paratypes			
	AMS I.23552-006	AMS I.23729-003	AMS I.26323-003	AMS I.30632-003	QM I.33614	SIO 03–35
dorsal-fin rays	13	13	13	13	13	13
anal-fin rays	10	11	11	11	10	10
pectoral-fin rays	14	>12*	(14)	14	14	16
caudal fin: principal rays	7+6	7+6	7+6	7+6	7+6	7+6
caudal fin: procurrent rays	5+5	5+5	6+6	6+5	6+5	5+5
branchiostegal rays	—	—	5	—	5	5
gill-rakers	—	(0)	(0)	0	0	—
vertebrae	20+15	—	(20)+16	—	20+16	—
myomeres	20+14	19+16	20+16	20+16	20+16	19+16
1st D ray at myomere	18	20	20	19	19	19
last D ray at myomere	28	30	33	31	31	31
1st A ray below D ray	4	4	4	4	4	4

* incomplete

and straight, preanal length averages 64% SL; dorsal-fin origin slightly anterior to level of anus, predorsal fin length averages 61% SL; caudal peduncle length averages 11% SL; elongate, but moderately deep-bodied compared with *S. pietschmanni* and *S. praematura*, body depth at pectoral-fin origin averages 10% SL and at anal-fin origin 12% SL; unornamented, rod-like urogenital papilla of male tapers to a blunt point, usually with distal half anteriorly directed, resulting in a somewhat scythe-shaped appearance in lateral view, length in mature specimens averages 6% SL.

Table 2. Measurements (in millimetres) of *Schindleria brevipinguis*. Parenthetical values are approximate.

measurement	holotype		paratypes			
	AMS I.23552-006	AMS I.23729-003	AMS I.26323-003	AMS I.30632-003	QM I.33614	SIO 03–35
TL	9.1	5.8	7.3	7.2	8.6	7.6
SL	8.4	5.1	6.6	6.5	7.7	6.9
predorsal fin L	5.5	3.1	4.1	3.8	4.7	4.0
PAL	6.0	3.2	4.0	4.1	4.8	4.4
HL	1.2	1.1	1.2	1.2	1.4	1.3
postocular HL	0.5	0.5	0.6	0.6	0.7	0.6
snout L	0.3	0.2	0.3	0.3	0.3	0.3
ED (width × height)	0.4×0.4	0.3×0.4	0.4×0.4	0.4×0.4	0.4×0.5	0.4×0.4
BD (at pectoral-fin origin)	0.7	0.6	0.7	0.7	0.9	0.8
BD (at anal-fin origin)	0.8	0.6	0.9	0.8	1.0	0.9
pectoral-fin base L	0.5	0.3	0.4	(0.3)	0.5	0.5
pectoral-fin base width	0.4	0.3	0.4	0.3	0.5	0.4
caudal peduncle L	0.8	0.6	0.8	0.7	0.9	0.8
min. caudal peduncle depth	0.2	0.2	0.2	0.2	0.2	0.2
length of urogenital papilla		0.2	0.5	0.3	0.5	0.4
HW	0.7	0.6	0.7	0.7	0.8	0.7

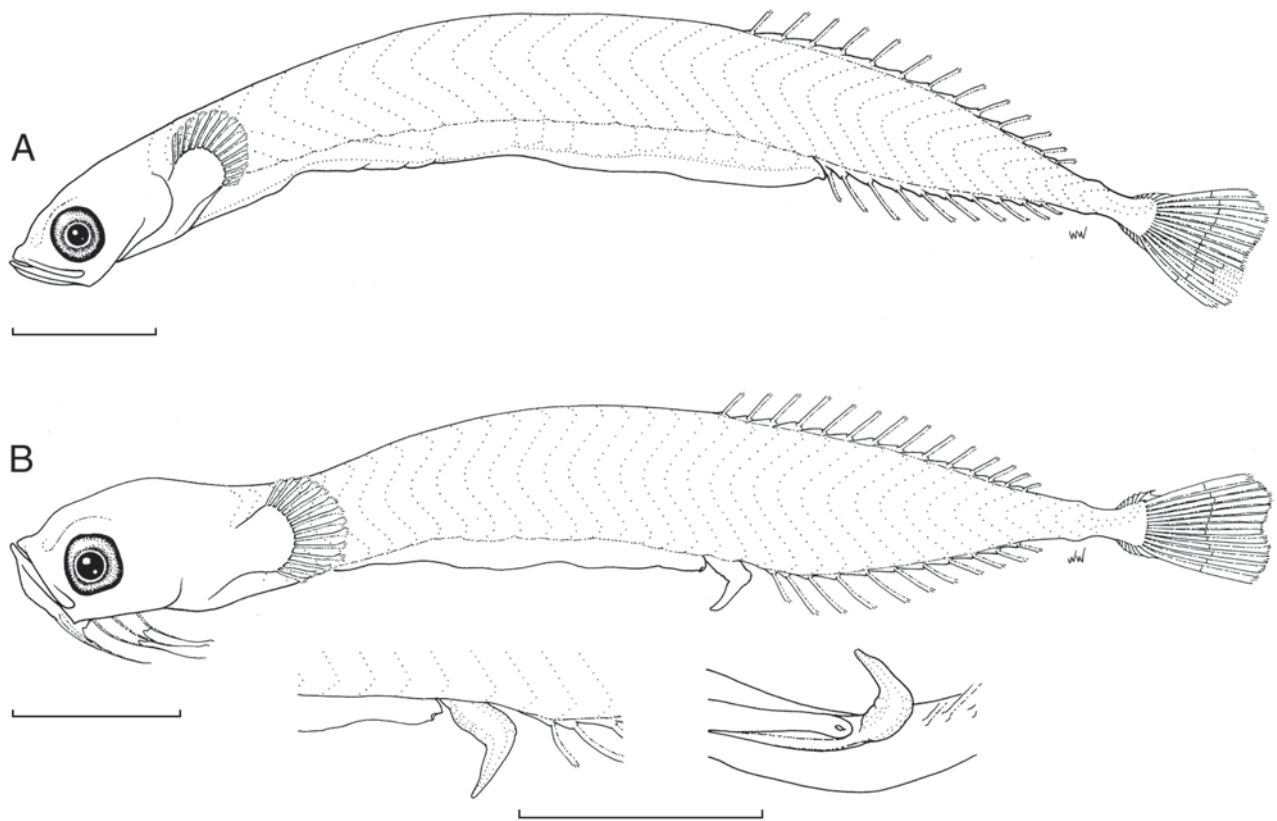


Fig. 1. *Schindleria brevipinguis* n.sp. (A) Holotype, AMS I.23552-006 (8.4 mm, female), from vicinity of Carter Reef, Great Barrier Reef, Queensland, Australia; (B) paratype, AMS I.26323-003 (6.6 mm, male; note that branchiostegal area is somewhat damaged) from Carter Reef vicinity, Great Barrier Reef. Enlarged lateral (left) and ventral (right) views of urogenital papilla are shown below paratype. Scale bar = 1 mm.

All specimens unpigmented apart from the eyes. A small species: the largest specimen, a mature female bearing approximately 12 large, somewhat irregularly shaped ova (mean diameter 0.4 mm, range about 0.3–0.5 mm), is 8.4 mm.

Etymology. From the Latin *brevis*, short, referring to the small size of this species, and *pinguis*, stout, referring to the deeper, broader body compared with the other *Schindleria* species. A common name suggested for the family is infantfishes, and for the species, stout infantfish.

Distribution. Currently known only from the Lizard Island-Carter reef area (c. 14°33–35'S 145°35'E) of the Great Barrier Reef, Queensland, Australia, and from Osprey Reef (13°47–55'S 146°35–40'E), nearby in the Coral Sea. Specimens were collected in oblique plankton net tows from the Great Barrier Reef and Osprey Reef lagoons in waters ranging from 15–30 m deep.

Remarks. Yoshino *et al.* (2000) suggested that at least eight *Schindleria* species, all different from Schindler's original descriptions of *S. pietschmanni* and *S. praematura*, occur in the Ryukyu Islands, Japan. These were distinguished primarily by the morphology of the urogenital papilla of male specimens. Because females have less well-developed urogenital papillae, fewer types were identifiable; thus morphology of the male urogenital papilla was considered a key character for recognition of *Schindleria* species. In the case of *Schindleria brevipinguis* the male urogenital papilla is not critical to identification; both males and

females are readily distinguishable from *S. pietschmanni* and *S. praematura* on the basis of several other morphological and meristic characters. Most useful among these are the number of dorsal- and anal-fin rays and relative positions of the dorsal and anal fins, as noted in the key above. *Schindleria brevipinguis* has a deeper body, averaging 10% and 12% SL at pectoral- and anal-fin origins, vs. 5% and 6%, respectively, in *S. praematura* and 6% at both locations in *S. pietschmanni*. Schindler (1930, 1931) gave slightly higher values for relative body depth of *S. praematura* and *S. pietschmanni*: 5.9–6.8% SL and 6.1–7.5% SL, respectively, both still smaller than the relative body depth of *S. brevipinguis*. *Schindleria brevipinguis* has slightly larger eyes than *S. pietschmanni*, averaging about 30% HL vs. about 25% HL, and fewer preanal vertebrae than *S. praematura*: 20 vs. 23–25 (Schindler, 1930), respectively. *Schindleria brevipinguis* apparently lacks teeth in the jaws while the other two have small, but readily discernible teeth in both jaws. Both *S. pietschmanni* and *S. praematura* typically have pigment dorsally on the gas bladder, but *S. brevipinguis* does not. The urogenital papilla of male *S. brevipinguis* is distinctly different from the papillae of male *S. praematura* and *S. pietschmanni* (cf. Fig. 1; Jones & Kumaran, 1964, fig. 2; Sardou, 1974, fig. 8) and thus is a useful ancillary character for identification of male specimens. Note that the urogenital papilla of male *S. praematura* from Hawaii we examined differs from that shown by Sardou (1974, fig. 4), and by Bruun (1940, fig. 2) for specimens from Madagascar and Samoa, respectively.

Key to the described species of *Schindleria*

- 1 Anal-fin rays 10–14, usually 10–12; first anal-fin ray behind position of dorsal-fin ray 3, usually under dorsal-fin ray 4–11 2
 — Anal-fin rays 15–18, usually 15–16; first anal-fin ray under dorsal-fin ray 1–3 (Indo-West Pacific) *S. pietschmanni*
- 2 Dorsal-fin rays 13; first anal-fin ray just before to just behind (usually under) dorsal-fin ray 4 (Queensland, Australia) *S. brevipinguis* n.sp.
 — Dorsal-fin rays 16–22, usually 19–21; first anal-fin ray under dorsal-fin ray 7–11 (Indo-Pacific) *S. praematura*

Schindleria brevipinguis may represent an even more extreme example of paedomorphosis than *S. pietschmanni* and *S. praematura*. The apparent lack of premaxillary and dentary teeth, of teeth on the ceratobranchials, and of branched caudal-fin rays in *S. brevipinguis* compared with the presence of all these in the other two species suggests that somatic development is more truncated in *S. brevipinguis*. In contrast to *S. brevipinguis*, *S. pietschmanni* has premaxillary teeth late in the larval stage by about 4.5 mm, dentary teeth by c. 5 mm, and the central 11 principal caudal-fin rays are branching in the juvenile stage by c. 7 mm. *Schindleria praematura* has teeth in both jaws by 4.0 mm and the central caudal-fin rays begin to branch at about 6.0 mm. The gas bladder shifts posteriorly with development in both *S. pietschmanni* and *S. praematura*, from a mid-gut location in larvae to above the posterior third of the gut in adults (Watson, 2000); the more anterior, mid-gut gas bladder location in adult *S. brevipinguis* may provide additional evidence for more truncated development.

Schindleria brevipinguis, which matures at 7–8 mm, almost certainly is the world's smallest fish and smallest vertebrate. Previously, the record for shortest fish was held by the gobiid, *Trimmatom nanus*, with females maturing at about 8 mm and males and females averaging 8.6 and 8.9 mm, respectively (Winterbottom & Emery, 1981). *Schindleria brevipinguis* males mature at 6.5–7 mm, and the largest known specimen of either gender is only 8.4 mm. Based on Bruun's (1940) information on length and weight of *S. pietschmanni* and *S. praematura*, a mature *S. brevipinguis* would be expected to weigh 2 mg or less, and in fact a lightly blotted, formalin-preserved, 6.5 mm male (AMS I.30632-003) weighed 0.7 mg. Thus *S. brevipinguis* is undoubtedly the lightest vertebrate.

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