



Schindleria nigropunctata, a new species of paedomorphic gobioid fish from the Red Sea (Teleostei: Schindleriidae)

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Abstract

A new species of paedomorphic gobioid fish, *Schindleria nigropunctata* from the Red Sea, is described on the basis of two specimens. The new species is characterised by its relatively high body bearing pigment spots, largest specimen 15.6 mm standard length (SL), the body depth at pectoral-fin origin 5–6% of SL and at anal-fin origin 9% of SL, the predorsal length 53–67% of SL, preanal length 54–67% of SL, dorsal-fin rays 13, anal-fin rays 11 or 12, first dorsal-fin ray at myomere 24; first anal-fin ray below second dorsal-fin ray, myomeres 20 + 21 or 22 = 41 or 42 total; premaxillae and dentaries with small teeth; gas bladder located posteriorly at 47–49% of SL; males with a rod-like, flexible urogenital papilla lacking lobes, projections or accessory papillae, with narrow, pointed and usually posteriorly directed. A key to the species of Schindleriidae is presented.

Keywords Egypt · Red Sea · Fishes · Paedomorphic gobioid fish · New species · Identification key

Introduction

The paedomorphic gobioid fishes of the family Schindleriidae are an unusual group of small, planktonic fishes living in shallow waters of the Indo-West Pacific, usually close to coral reefs (Johnson and Brothers 1993; Watson and Walker 2004). The first species was described from the Hawaiian Islands as *Hemiramphus praematurus* by Schindler (1930), who assumed that the species was a larval hemiramphid. Another species was described, also from the Hawaiian Islands, as *Hemiramphus pietschmanni* by Schindler (1931). Giltay (1934), who had found a single specimen of *H. praematurus* from off New Guinea, concluded that there was no evidence of a close relationship to hemiramphids, and described a new genus *Schindleria* for the two species, with *H. praematurus* Schindler, 1930 as the type by original designation, within the

family Schindleriidae (see van der Laan et al. 2014: 124). Johnson and Brothers (1993) demonstrated that the family is a member of the suborder Gobioidi, and that schindleriids are paedomorphic gobies. Gill and Mooi (2010) found a close relationship of schindleriids to microdesmids. Watson and Walker (2004) described a third species, *Schindleria brevipinguis*, from northeastern Australia. Kon et al. (2011) reported schindleriids from the Ryukyu Islands and Palau, and, in a molecular analysis, proposed that there are at least 21 cryptic species of *Schindleria* in the western Pacific.

Abu El-Regal and Kon (2008) reported a specimen of *Schindleria* sp. from off Hurghada, Egypt, which they found to be close to *S. pietschmanni*. They thus documented the presence of the genus in the Red Sea. Another species from the Red Sea, *Schindleria elongata*, was described by Fricke and Abu El-Regal (2017). During recent studies, the second author collected two specimens from the same area, which turned out to belong to an unknown species and which is described in the present paper.

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Materials and methods

The type material of the new species is deposited in the Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt (Main), Germany (SMF); abbreviations of museum collections follow Fricke and Eschmeyer (2017a).

Methods follow Watson and Walker (2004); fin-ray counts follow Fricke (1983). The standard length is abbreviated as SL, the head length as HL. Nomenclature follows Eschmeyer et al. (2017). The family classification follows van der Laan et al. (2014); the higher classification is treated according to Nelson (2006). References and journals follow Fricke (2017) and Fricke and Eschmeyer (2017b). The distribution map includes records based on materials and literature records, including Schindler (1932), Bruun (1940), Ozawa and Matsui (1979), Harris and Cyrus (1996) and Leu et al. (2008).

Results

Taxonomic list

Class Actinopterygii
Subclass Neopterygii
Division Teleostei
Order Perciformes
Suborder Gobioidae
Family Schindleriidae Giltay, 1934
Genus *Schindleria* Giltay, 1934

Schindleria nigropunctata new species

Common name: Blackspotted paedomorph goby.

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Holotype: (Figs. 1a and 2) SMF 35956, 15.6 mm SL, female, Red Sea, Egypt, Magawish Island, reef lagoon, 27°10'02"N 33°52'27"E, Mohamed A. Abu El-Regal, 23 Apr. 2016, 22:00–23:00 h, light trap.

Paratype: (Figs. 1b, c and 3): SMF 35957, one specimen (male), 13.8 mm SL, Red Sea, Egypt, Magawish Island, reef lagoon, 27°10'02"N 33°52'27"E, Mohamed A. Abu El-Regal, 23 Apr. 2016, 22:00–23:00 h, light trap.

Diagnosis: A relatively high-bodied, pigmented species of *Schindleria*, largest specimen 15.6 mm; body depth at pectoral-fin origin 5–6% of SL and at anal-fin origin 9% SL; predorsal length 53–67% of SL, preanal length 54–67% of SL. Dorsal-fin rays 13, anal-fin rays 11 or 12; first dorsal-fin

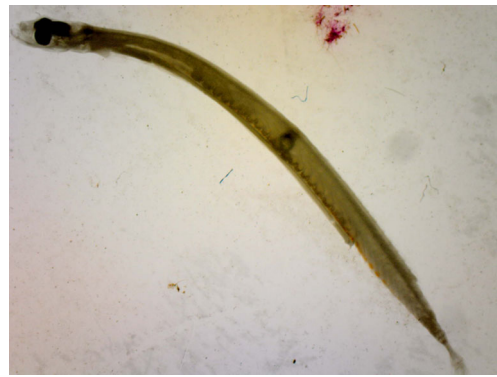


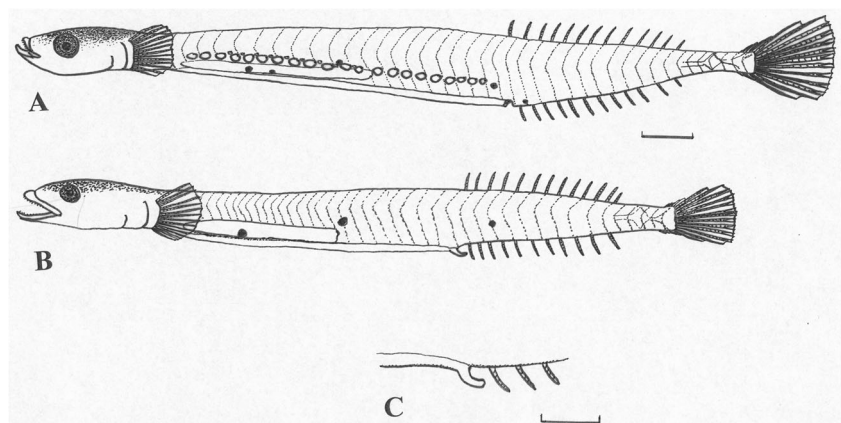
Fig. 2 *Schindleria nigropunctata* n. sp., SMF 35956, holotype, 15.6 mm SL, female, Red Sea, Egypt. Lateral view of fresh specimen, immediately after collection (photograph: M. Abu El-Regal)

ray at myomere 24 and first anal-fin ray below second dorsal-fin ray. Myomeres 20 + 21 or 22 = 41 or 42 total. Premaxillae and dentaries with small teeth. Gas bladder located posteriorly at 47–49% of SL. Males have a rod-like, flexible urogenital papilla lacking lobes, projections or accessory papillae, with the distal half narrow, pointed and usually posteriorly directed.

Description: Dorsal-fin rays 13 (13) (Table 1), anal-fin rays 12 (11), dorsal-fin rays spaced at intervals of approximately 0.8–1 rays per myomere, anal-fin rays at approximately 0.7–0.8 rays per myomere; first dorsal-fin ray at myomere 24 (24), last ray at myomere 36 (35); first anal-fin ray at myomere 25 (25), just before to just behind second dorsal-fin ray (second), last ray opposite last dorsal-fin ray; pectoral-fin rays 13 (13); pelvic fins absent; all fin-rays unbranched; vertebrae 20 + 22 (20 + 21); caudal fin rays (v), ii, 9, ii, (v); myomeres 20 (20) + 22 (21); branchiostegal rays five; gill-rakers absent; gas bladder located posteriorly at myomeres 13 (13); premaxillae and dentaries with small teeth.

Head small, length 14.1% (15.2%) of SL (Table 1); snout length 22% (21%) of HL; eye small, nearly round, maximum orbit diameter 18% (14%) of HL; gut long and straight, preanal length 67% (68%) of SL; dorsal-fin origin above level of anus, predorsal fin length 67% (67%) of SL; caudal

Fig. 1 *Schindleria nigropunctata* n. sp., SMF 35956, holotype, 15.6 mm standard length (SL), female, Red Sea, Egypt. **a** Lateral view of preserved specimen (scale indicates 10 mm). SMF 35957, paratype, 13.8 mm SL, male, Red Sea, Egypt. **b** Lateral view of preserved specimen (scale as in **a**). **c** Urogenital papilla (scale indicates 4 mm)



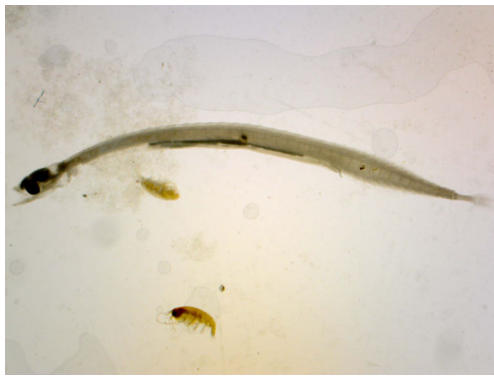


Fig. 3 *Schindleria nigropunctata* n. sp., SMF 35956, paratype, 13.8 mm SL, male, Red Sea, Egypt. Lateral view of fresh specimen, immediately after collection (photograph: M. Abu El-Regal)

peduncle length 11% (10%) of SL; body depth at pectoral-fin origin 5% (6%) of SL and at anal-fin origin 9% (9%) of SL; unornamented, rod-like urogenital papilla of male with a narrow point, with distal half posteriorly directed, length in mature specimen 3% of SL.

Color in preservative (Fig. 1): Specimens pale; eyes blackish, top of head with dark pigment, sides of body with a few scattered dark pigment spots. Eyes in female holotype dark brown, visible through skin.

Color when fresh (Figs. 2 and 3): Head and body yellowish brown, eyes and top of head blackish, sides of body with 2–3

Table 1 *Schindleria nigropunctata* n. sp., Red Sea, Egypt, Magawish Island: counts and measurements

	Holotype SMF 35956	Paratype SMF 35957
Standard length (SL) (mm)	15.6	13.8
Caudal-fin length (mm)	1.5	1.2
Sex	Female	Male
Dorsal-fin rays	13	13
Anal-fin rays	12	11
Pectoral-fin rays	13	13
Position of first anal ray relative to dorsal rays	2nd	2nd
Teeth	Small	Small
Predorsal length (mm)	10.4	9.3
Preanal length (mm)	10.5	8.4
Head length (HL) (mm)	2.2	2.1
Eye diameter (mm)	0.4	0.3
Body depth at pectoral-fin base (mm)	0.8	0.8
Body depth at anal-fin origin (mm)	1.4	1.2
Position of swim bladder along body (reaching to)	Middle (49% of SL)	Middle (47% of SL)
Number of eggs	21	–
Body pigment	Yes	Yes

dark pigmented areas. Anal-fin base in female holotype with orange spots.

Distribution: (Fig. 4) The species is only known from the type locality, near Hurghada, Egypt, Red Sea. It was collected in a shallow fringing reef lagoon at night. The species is expected to have a broader distribution range in the Red Sea.

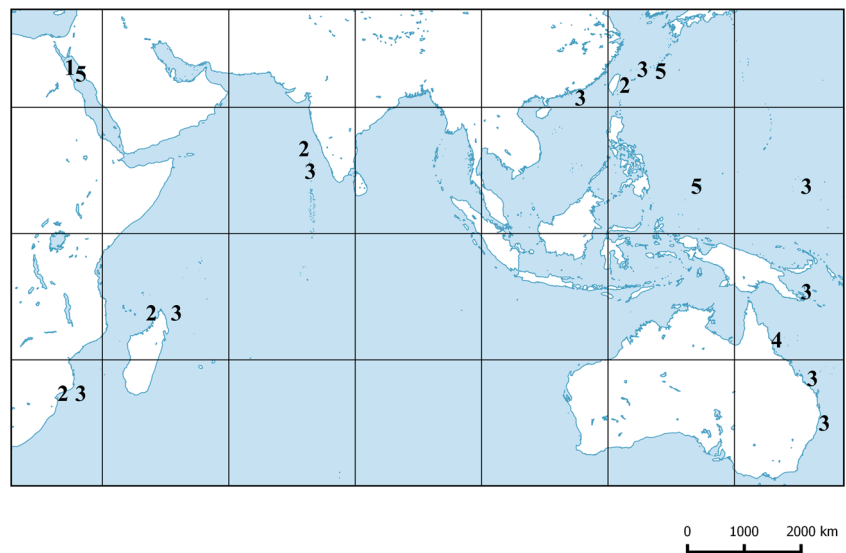
Etymology: After *niger* (Latin), meaning black, and *punctatus* (Latin), meaning spotted. The name refers to the black melanophores on the body of the new species. Hence, the suggested common name is “blackspotted pedomorphic goby”.

Comparisons: The species of *Schindleria* are compared in Table 2. In the presence of dark pigment on the body, *Schindleria nigropunctata* n. sp. is similar to *S. praematura* and *S. pietschmanni* from the Indo-West Pacific. From these species, it is distinguished by its low number of dorsal-fin rays (13 in *S. nigropunctata* n. sp. versus 15–18 in *S. pietschmanni* and 16–22 in *S. praematura*), its 11–12 anal-fin rays (versus 13–18 in *S. pietschmanni*), the small eye diameter (14–18% of HL in *S. nigropunctata* n. sp. versus 24–25% in *S. pietschmanni* and *S. praematura*) and the shorter gas bladder, which reaches backwards to 47–49% of SL in *S. nigropunctata* n. sp. (versus 66% in *S. pietschmanni* and *S. praematura*). From the co-occurring species *S. elongata*, the new species differs in the presence of pigment spots on the body (versus unpigmented in *S. elongata*), the shorter head (14–15% of SL in *S. nigropunctata* n. sp. versus 17–18% in *S. elongata*), the smaller eye (orbit diameter 14–18% of HL in *S. nigropunctata* n. sp. versus 28–32% in *S. elongata*), the larger body depth at anal-fin origin (9% of SL in *S. nigropunctata* n. sp. versus 5–7% in *S. elongata*) and the shorter gas bladder, which reaches backwards to 47–49% of SL in *S. nigropunctata* n. sp. (versus 56–60% in *S. elongata*).

Key to the species of Schindleriidae

- 1a Pigment on body absent 2
- 1b Body with pigment spots 3
- 2a Predorsal length 66–70% of SL; preanal length 66–71% of SL (average 69%); body depth at pectoral-fin base 4–5% of SL; body depth at anal-fin origin 5–7% of SL; gas bladder located posteriorly at 56–60% of SL; jaws with small teeth (Red Sea) *S. elongata*
- 2b Predorsal length 58–65% of SL; preanal length averages 61–71% of SL (average 64%); body depth at pectoral-fin base 8–12% of SL; body depth at anal-fin origin 10–14% of SL; gas bladder located posteriorly at 46–48% of SL; teeth in jaws absent (eastern Australia) *S. brevipinguis*
- 3a Dorsal-fin rays 13; orbit diameter 14–18% of HL; gas bladder reaching back to 47–49% of SL *S. nigropunctata* n. sp.
- 3b Dorsal-fin rays 15–22; orbit diameter 24–25% of HL; gas bladder reaching back to about 66% of SL 4

Fig. 4 Distribution of species in the genus *Schindleria* in the Indo-West Pacific. 1. *Schindleria elongata* and *S. nigropunctata*. 2. *Schindleria pietschmanni*. 3. *Schindleria praematura*. 4. *Schindleria brevipinguis*. 5. *Schindleria* spp. (not assigned to any nominal species; see Kon and Yoshino 2002; Abu El-Regal and Kon 2008; Kon et al. 2011)



- 4a First anal-fin ray below first to third dorsal-fin ray; anal-fin rays 13–18; preanal length 64–72% of SL *S. pietschmanni*
- 4b First anal-fin ray below 7th–11th dorsal-fin ray; anal-fin rays 10–14; preanal length 53% of SL *S. praematura*

Discussion

The Schindleriidae was recently treated as a junior synonym of the family Gobiidae by Thacker (2009), based on a phylogenetic analysis. This was followed by some authors, but

others like La Mesa (2011) and van der Laan et al. (2014) continued to use the family name Schindleriidae. The latter approach is adopted here, classifying the Schindleriidae as a family separate from the Gobiidae.

The description of this new species of paedomorphic gobioid fish from the Red Sea brings the nominal species known in the family to five. However, as Kon et al. (2011) pointed out, there may be many additional, cryptic species in the western Pacific, based on molecular analysis. The present study uses only traditional, morphological species discrimination.

Together with *S. elongata* and an unidentified species reported by Abu El-Regal and Kon (2008), and discussed by Fricke and Abu El-Regal (2017), there are now three species

Table 2 Comparison of the species of *Schindleria* (family Schindleriidae)

	<i>S. nigropunctata</i> n. sp.	<i>S. elongata</i>	<i>S. brevipinguis</i>	<i>S. pietschmanni</i>	<i>S. praematura</i>
Dorsal-fin rays	13	13–14	13	15–18	16–22
Anal-fin rays	11–12	10–11	10–11	13–18	10–14
Position of first anal-fin ray relative to dorsal-fin ray	2nd	2nd–4th	4th	1st–3rd	7th–11th
Teeth	Small	Small	Absent	Small	Small
Predorsal length	66–67	66–70	58–65	53	54
Preanal length	67–68	66–71	64	64–73	53
Head length	14–15	17–18	18–22	12–15	13–16
Eye diameter	14–18	28–32	30	24	25
Body depth at pectoral-fin base	5–6	4–5	8–12	5	6
Body depth at anal-fin origin	9	5–7	10–14	6	6
Position of gas bladder along body (reaching to)	47–49% of SL	56–60% of SL	46–48% of SL	66% of SL	66% of SL
Pigment on body	Yes	No	No	Yes	Yes
Distribution	Red Sea	Red Sea	Queensland, Australia	Indo-West Pacific	Indo-West Pacific

Proportions are given as percent of standard length (SL), except the eye diameter, which is given as percent of head length (HL). Values differing from those of *S. nigropunctata* n. sp. are in **bold**

of schindleriids found co-occurring in the Red Sea near Hurghada, Egypt. The schindlerid fauna of the Red Sea remains insufficiently known, and additional studies on ichthyoplankton are necessary to provide insight in the diversity and distribution of these cryptic fish species.

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References

- Abu El-Regal M, Kon T (2008) First record of the paedomorphic fish *Schindleria* (Gobioidei, Schindleriidae) from the Red Sea. *J Fish Biol* 72:1539–1543
- Bruun AF (1940) A study of a collection of the fish *Schindleria* from South Pacific waters. Dana report no. 21, 12 pp
- Eschmeyer WN, Fricke R, van der Laan R (2017) Catalog of fishes (version: 31 Aug 2017). Available online at: <http://researcharchive.calacademy.org/research/Ichthyology/Catalog/fishcatmain.asp>. Accessed 11 Sep 2017
- Fricke R (1983) A method of counting caudal fin rays of actinopterygian fishes. *Braunsch Naturk Schr* 1:729–733
- Fricke R (2017) References in the catalog of fishes (version: 31 Aug 2017). Available online at: <http://researcharchive.calacademy.org/research/Ichthyology/Catalog/fishcatmain.asp>. Accessed 11 Sep 2017
- Fricke R, Abu El-Regal M (2017) *Schindleria elongata*, a new species of paedomorphic gobioid from the Red Sea (Teleostei: Schindleriidae). *J Fish Biol* 90:1883–1890
- Fricke R, Eschmeyer WN (2017a) A guide to fish collections in the catalog of fishes (version: 31 Aug 2017). Available online at: <http://researcharchive.calacademy.org/research/Ichthyology/Catalog/collections.asp>. Accessed 11 Sep 2017
- Fricke R, Eschmeyer WN (2017b) Journals in the catalog of fishes (version: 31 Aug 2017). Available online at: <http://researcharchive.calacademy.org/research/Ichthyology/Catalog/journals.asp>. Accessed 11 Sep 2017
- Gill AC, Mooi RD (2010) Character evidence for the monophyly of the Microdesminae, with comments on relationships to *Schindleria* (Teleostei: Gobioidei: Gobiidae). *Zootaxa* 2442:51–59
- Giltay L (1934) Notes ichthyologiques. VIII.—Les larves de Schindler sont-elles des Hemiramphidae? *Bull Mus Roy Hist Nat Belg* 10:1–10
- Harris SA, Cyrus DP (1996) Occurrence of Schindler’s fishes, genus *Schindleria* (Teleostei: Gobioidei), at a small reef in the mouth of the Kosi estuary, Kwazulu-Natal: a first record for southern Africa. *Bull Mar Sci* 59:228–234
- Johnson GD, Brothers EB (1993) *Schindleria*: a paedomorphic goby (Teleostei: Gobioidei). *Bull Mar Sci* 52:441–471
- Kon T, Yoshino T (2002) Extremely early maturity found in Okinawan gobioid fishes. *Ichth Res* 49:224–228
- Kon T, Yoshino T, Nishida M (2011) Cryptic species of the gobioid paedomorphic genus *Schindleria* from Palau, western Pacific Ocean. *Ichth Res* 58:62–66
- La Mesa M (2011) Planktonic and paedomorphic gobioids. In: Patzner RA, van Tassell JL, Kovačić M, Kapoor BG (eds) *The biology of gobies*. CRC Press and Science Publishers, Jersey and Enfield, pp 465–491, 1 pl
- Leu M-Y, Fang L-S, Mok H-K (2008) First record of *Schindleria pietschmanni* (Schindler, 1931) (Actinopterygii: Schindleriidae) from Taiwan. *Platax* 2008:15–21
- Nelson JS (2006) *Fishes of the world*, 4th edn. Wiley, Hoboken, xix + 601 pp
- Ozawa T, Matsui S (1979) First record of the schindlerid fish, *Schindleria praematura*, from southern Japan and the South China Sea. *Jpn J Ichthyol* 25:283–285
- Schindler O (1930) Ein neuer *Hemiramphus* aus dem Pazifischen Ozean. *Anz Akad Wiss Wien* 67:79–80
- Schindler O (1931) Ein neuer *Hemiramphus* aus dem Pazifischen Ozean. *Anz Akad Wiss Wien* 68:2–3
- Schindler O (1932) Sexually mature larval Hemiramphidae from the Hawaiian islands. *Bull Bernice P Bishop Mus* 97:1–28, pls 1–10
- Thacker CE (2009) Phylogeny of Gobioidei and placement within Acanthomorpha, with a new classification and investigation of diversification and character evolution. *Copeia* 2009(1):93–104
- van der Laan R, Eschmeyer WN, Fricke R (2014) Family-group names of recent fishes. *Zootaxa* 3882(2):1–230
- Watson W, Walker HJ Jr (2004) The world’s smallest vertebrate, *Schindleria brevipinguis*, a new paedomorphic species in the family Schindleriidae (Perciformes: Gobioidei). *Rec Aust Mus* 56:139–142