

A new species of *Schindleria* (Teleostei: Gobiidae) from Tahiti (French Polynesia) with a unique lower jaw dentition

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Abstract

A new paedomorphic gobiid species, *Schindleria multidentata*, is described from the Pacific island of Tahiti (French Polynesia). The new species belongs to the group with a long dorsal fin (LDF). *Schindleria multidentata* is characterized by an elongate, slender body (body depth at pectoral-radial plate origin 4.1 % of SL and at anal-fin origin 5.6 % of SL); a long dorsal fin originating distinctly anterior to the origin of the anal fin (predorsal-fin length 57.5, preanal-fin length 74.4 % of SL); a short tail (29.8 % of SL); a short (length 3.3 % of SL) and wide (83.5 % in length of pectoral-radial plate) pectoral-radial plate; a simple last procurent ray with a length about 25 % of that of the first and last principle caudal-fin rays respectively; 19–21 dorsal fin rays; 13–15 anal-fin rays; the first-anal fin ray below dorsal-fin ray 9–10; numerous tiny and densely set teeth in the upper and lower jaws (about 40 on the premaxilla and about 30 on the dentary); teeth on the dentary separated by a distinct gap (diastema) into an anterior and a posterior group; the maxilla slightly curved, thin, rod-like, distally flattened, and with a plate-like expansion; and the lower jaw forming a narrow, slightly pointed arch.

Key words

Dentition, French Polynesia, paedomorphosis, progenesis, *Schindleria multidentata* **sp. nov.**, Tahiti.

Introduction

Schindleria (Schindler's fishes or infant fishes) are extremely progenetic (JOHNSON & BROTHERS, 1993). Their body is larva-like, elongate and translucent and lacks pelvic fins, the first dorsal fin and scales (SCHINDLER, 1932). The caudal skeleton is unique among teleosts with hypurals fused to a hypural plate and a very elongate urostyle. Additionally, a muscle/tendon system bridges the distance from the posterior-most regular myomeres to the hypural plate (AHNELT & SAUBERER, 2018). *Schindleria* are distributed in the Indo-Pacific from the Nazca and Sala y Gomez submarine ridges off South America to East and South Africa and the Red Sea (summarized in AHNELT & SAUBERER, 2020). They have a planktonic life style and often occur in shallow waters of coral reef lagoons (JONES & KUMARAN, 1964; LEIS, 1994; WATSON,

2000). Nevertheless, offshore and deep-water records have also been documented (BELYANINA, 1989; PARIN, 1991; AHNELT & SAUBERER, 2018).

Six nominal species have been formally described so far: *S. praematura* (SCHINDLER, 1930), *S. pietschmanni* (SCHINDLER 1931), *S. brevipinguis* WATSON & WALKER, 2004, *S. elongata* FRICKE & EL-REGAL, 2017, *S. nigropunctata* FRICKE & EL-REGAL, 2017 and *S. macrodentata* AHNELT & SAUBERER, 2018. Nevertheless, based on a hypothesized 25 cryptic species just in the Western Pacific Ocean, KON *et al.* (2007, 2011) proposed high endemism with likely a large number of undescribed species. As representatives of *Schindleria* lack many morphological traits important for proper species-level diagnosis in gobioid fishes such as scales or pelvic and first dorsal



Fig. 1. Sampling site (black star) of *Schindleria multidentata* in the Southwest Pacific, French Polynesia, Tahiti. Source of map: CartoGIS Services, College of Asia and the Pacific, Australian National University. Map reproduced with the permission of CartoGIS Services, ANU College of Asia and the Pacific, The Australian National University.

fins, the description based on morphological diagnostic characters is challenging. KON *et al.* (2007) stated that Schindler's fishes "... are so similar morphologically that they are difficult or impossible to be distinguished based on morphological characters alone".

Generally, formal descriptions of *Schindleria* were based on the relative position of the dorsal and anal fins, number of rays of these two fins, the number of vertebrae and the absence or presence of teeth in the upper and lower jaws (SCHINDLER 1930, 1931; WATSON & WALKER, 2004, FRICKE & EL-REGAL, 2017a, b). Recently three additional morphological features have been suggested as diagnostic for the different species of *Schindleria*: the shape of the pectoral-radial plate, the shape of the last procurent caudal-fin ray and the shape of the lower jaw arch (AHNELT & SAUBERER, 2018). Together with the characters mentioned above and the size, number and spacing of the teeth, there is a series of morphological characters available that can be utilized to diagnose species of *Schindleria*, although it is likely that additional genetic information will be needed to describe especially the cryptic species.

The teeth in the oral jaws are an important diagnostic character for *Schindleria*. If developed, teeth are present

on the premaxilla (tooth bearing element of the upper jaw) and the dentary (tooth bearing element of the lower jaw) in all nominal species (AHNELT & SAUBERER, 2018). According to characters of dentition, Schindler's fishes can be assigned to three groups: (i) one toothless species (*S. brevipinguis*), (ii) one species with few, widely spaced and large teeth (*S. macrodentata*) and (iii) four species with numerous, tiny and densely set teeth (*S. elongata*, *S. nigropunctata*, *S. pietschmanni* and *S. praematura*). In the latter four species, the teeth extend along the entire margin of the premaxilla but just along the anterior quarter of the dentary (JOHNSON & BROTHERS, 1993; AHNELT, unpublished).

During the "Dana Expedition 1928–1930" a series of larval fishes was collected in the harbor of Papeete (Tahiti), capital of French Polynesia (Fig. 1). BRUUN (1940) reported on these specimens under the name *Schindleria praematurus* [sic]. But distinct differences concerning the body shape, the number and size of eggs, the shape of the urogenital papilla of both sexes and the dentition suggest that these samples comprise more than one species. The specimens, which show a unique dentition and a uniquely shaped maxillary, are described here as a new species.

Material and methods

The type specimens of *Schindleria multidentata* are deposited in the København Universitet, Zoologisk Museum, Copenhagen Denmark and are registered ZMUC P771779 (holotype) and ZMUC P771800 and ZMUC P 771801 (paratypes).

I follow THACKER (2009) in the considering Schindleriidae as a junior synonym of Gobiidae, a view adopted by e.g., GILL & MOOI (2010) and BENTACUR-R *et al.* (2017). However, other authors have classified Schindleriidae as a distinct family within the Gobioidae (e.g., FRICKE & EL-REGAL, 2017A, B, EL-REGAL & KON, 2019).

Because the specimens were initially preserved in formalin the description of the new species is based on morphological characters, because molecular characters are not currently available. Measurements were made with the aid of a stereo microscope and a micrometer eyepiece to the nearest 0.1 mm.

The six nominal species of *Schindleria* (Fig. 2) have been assigned to two groups based on the positions of their dorsal and anal fin origins (AHNELT, 2019). Long dorsal fin (LDF) species (“*S. praematura*” of KON *et al.* 2007) are *S. macrodentata*, *S. nigropunctata*, *S. praematura* and possibly also *S. elongata*. In these LDF species the origin of the long dorsal fin is distinctly anterior to the origin of the anal fin (by at least 6 fin rays). Short dorsal fin (SDF) species (“*S. pietschmanni*” KON *et al.*, 2007) are *S. brevipinguis* and *S. pietschmanni*. In SDF species the origin of the short dorsal fin is above or only slightly anterior (about three fin rays) to the origin of the anal fin.

Abbreviations of collections

AMS Australian Museum in Sydney, Australia
CAS California Academy of Sciences, USA
NMW Naturhistorisches Museum in Wien, Austria
SMF Senckenberg Museum in Frankfurt, Germany
ZMUC Statens Naturhistoriske Museum, Zoologisk Museum in København, Denmark.

Comparative material

Schindleria brevipinguis. One specimen. AMS I 2632-003, paratype, 6.6 mm SL. Australia, Queensland, Carter Reef, 18 January 1982. Photographs of the holotype (AMS I 23552-006) and one paratype (AMS I 30632-003).

Schindleria elongata. Photographs of the holotype (SMF 35780) and of the paratypes (SMF 35781).

Schindleria macrodentata. Two specimens. ZMUC 77624, holotype, 16.5 mm SL. Molucca Sea, Indonesia, between the islands of Sulawesi and Halmahera, March 1929. ZMUC 77617, paratype, 18.7 mm SL. Sulu Sea, Philippines, northwest of the north tip of the Island Panaya, 27 June 1929.

Schindleria nigropunctata. Two specimens. Holotype, SMF 35956, 15.9 mm standard length (SL), female, Red Sea, Egypt, Magawish Island, 23 April 2016. Paratype, SMF 35957, male, 13.9 mm SL, otherwise same data as holotype.

Schindleria pietschmanni. 42 specimens. NMW 99182. Syntypes. 15.1–17.0 mm standard length (SL). North West Hawaiian Islands, French Frigate Shoal. May 1928.

Schindleria praematura. 49 specimens. NMW 99183. 18.3–20.5 mm SL. North West Hawaiian Islands, French Frigate Shoal. May 1928.

Schindleria multidentata, spec. nov.

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Figs. 3–4; Tables 1–2

Holotype: ZMUC P771779. Female, 20.0 mm SL. South Pacific Ocean, French Polynesia, Tahiti, harbor of Papeete, 17°32'S, 149°34'W, at surface; station 3571. 10–15 October 1928. Dana Expedition 1928–1930.

Paratypes: ZMUC P771800. One male, 17.1 mm SL; ZMUC P771801, one female, 17.9 mm SL. Otherwise same data as holotype.

Diagnosis. Body slender, elongated and not pigmented in preserved specimen; tail distinctly shorter than abdomen; largest specimen 20.0 mm SL, body depth at pectoral-radial plate origin 4.1 % of SL and at anal-fin origin 5.6 % of SL; origin of dorsal fin distinctly anterior to origin of anal fin (LDF type), predorsal length 57.6 % of SL and preanal length 74.3 % of SL; tail length (excluding caudal fin) 29.8 % of SL. Dorsal-fin rays 19–21, anal-fin rays 13–15; first anal-fin ray positioned below 9th–10th dorsal fin ray; premaxilla with about 40 closely spaced tiny teeth along entire ventral margin; about 30 teeth on dentary separated by a distinct gap (diastema) into two groups (Figs. 5–6); 34–36 myomeres; male urogenital papilla elongate, tube like, tapering towards tip; female urogenital papilla tiny, inconspicuous.

Description. Morphometric (table 1) and meristic characters (table 2) are given separately for the holotype and the two paratypes, respectively. First dorsal fin and pelvic fins absent; dorsal-fin rays 19–21; anal-fin rays 13–15; pectoral-fin rays 16–17; principal caudal-fin rays 13 (7+6); 6 ventral and 6 dorsal procurent rays; most posterior dorsal and ventral procurent rays simple, elongated, about 25 % of length of first principle caudal-fin ray; first dorsal-fin ray at myomere 15–16, last at myomere 32–34; first anal-fin ray at myomere 23–24, last at myomere 31–32; total number of myomeres 34–36, 22 precaudal and 12–14 caudal myomeres; 33–35 total vertebrae with 22 precaudal, 11–13 caudal vertebrae; branchiostegal rays 5. Tooth bearing elements of upper (premaxilla) and lower (dentary) jaws with many, closely spaced and tiny teeth (Figs. 5–6); premaxilla with about 40 teeth along entire ventral edge; dentary with about 27–31 teeth in total, divided by distinct gap into two groups; first group of teeth in three rows on bony ridge, extending from symphysis postero-laterally (about 21–22 teeth); second group as a single row on dorsal edge of dentary (7–9 teeth) (Figs. 5–6); *ligamentum*



Fig. 2. Types of the six nominal species of *Schindleria*, lateral view. A, *Schindleria brevipinguis*, paratype, AMS-I-26323-003 (right side reversed). B, *Schindleria elongata*, holotype, SMF 35780. C, *Schindleria macrodentata*, holotype, ZMUC P77624 (from AHNELT & SAUBERER 2018). D, *Schindleria nigropunctata*, holotype, SMF 35956. E, *Schindleria pietschmanni*, syntype, NMW 86871. F, *Schindleria praematura*, syntype, NMW 86241. Differences in coloration are due to different preservation. Arrows indicate origin of dorsal and anal fins respectively. Scale bars = 1 mm, but = 2 mm in C (*S. macrodentata*).



Fig. 3. Holotype of *Schindleria multidentata* (ZMUC P771779), female, 20 mm SL, French Polynesia, Tahiti. Arrows indicate origin of dorsal and anal fins respectively. Scale bar = 2 mm.

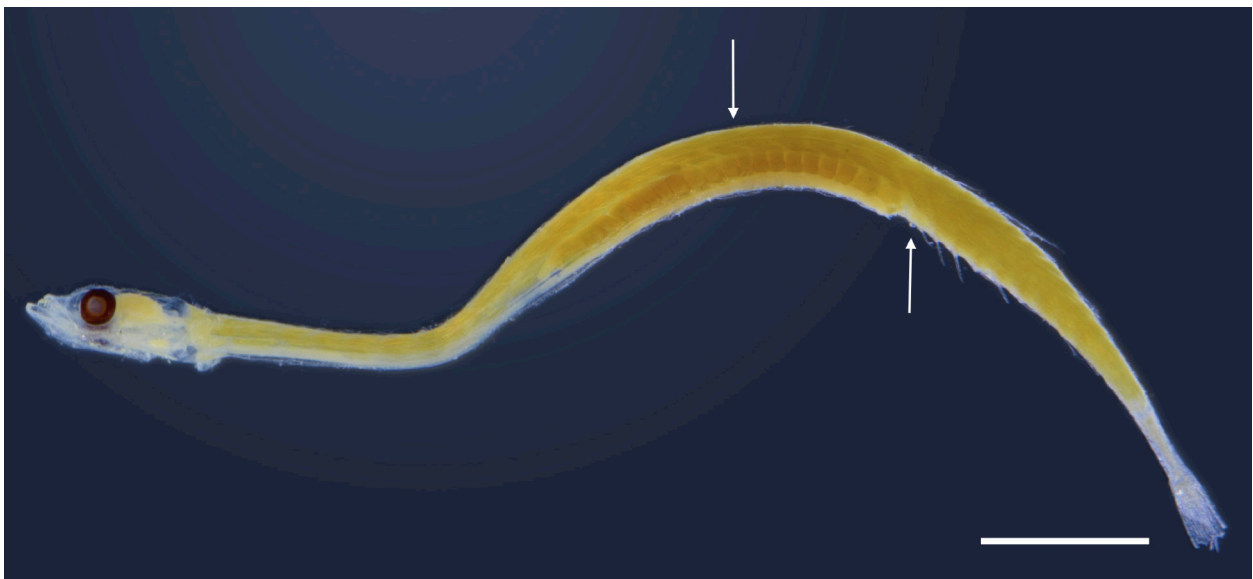


Fig. 4. Paratype of *Schindleria multidentata* (ZMUC P771800), female, 17.9 mm SL, French Polynesia, Tahiti. Arrows indicate origin of dorsal and anal fins respectively. Scale bar = 2 mm.

maxillo-mandibulare antierius, attaching between both groups of teeth and extending to medial side of plate-like distal end of maxilla (Figs. 6–7). Body slender, abdomen and tail of about similar height; tail distinctly shorter than abdomen; head elongate with large, nearly round, uniformly blackish eyes (Fig. 6); postorbital region of head relatively short, distinctly less than half of head length; snout relatively long, about $1/3^{\text{rd}}$ of head length; distal end of thin, slightly convex maxilla abruptly expanded to flat, roughly triangular plate (Fig. 6); pectoral-radial plate

longer than wide, of paddle-like shape, narrow at base and distinctly expanded distally (Fig. 7); gut straight; urogenital papilla of female inconspicuous, that of male elongate, tubular, tapering towards tip without distinct lobes at opening (Fig. 8); ovary filled with 21 (paratype) and 33 (holotype) well-developed eggs, but number likely higher as anterior part of the ovaries already empty (Fig. 4). Because of preservation body of specimens are not translucent except head, therefore exact position of gas bladder at myomeres 15–16 only discernable in holotype.

Table 1. Body proportions in % of standard length of *Schindleria multidentata* sp. nov.

Specimen	Holotype ZMUC P771779	Paratype ZMUC P771800	Paratype ZMUC P771801
Standard length (SL) in mm	20.0	17.1	17.9
Sex	female	male	female
Predorsal-fin length	57.1	57.8	57.9
Preal-fin length	74.2	74.6	72.1
Gut length	71.3	71.6	69.3
Tail length (excluding caudal fin)	26.8	32.7	28.5
Head length	13.8	13.6	12.9
Head width	3.8	3.9	3.6
Caudal-fin length	damaged	6.8	damaged
Body depth at pectoral-fin base	4.0	4.1	4.0
Body depth at anus	5.8	7.3	6.1
Body depth at origin of anal-fin	5.4	5.8	5.5
Body depth at base of 4 th anal-fin ray	5.6	6.8	5.6
Caudal peduncle length	7.8	10.8	7.5
Caudal peduncle depth	1.2	1.4	1.3
Pectoral-radial plate length	3.2	3.3	3.2
Pectoral-radial plate width (at origin)	1.6	1.6	1.7
Pectoral-radial plate width (max.)	2.6	2.8	2.6
Snout length	4.2	4.9	4.3
Eye diameter horizontal	2.8	3.0	2.7
Eye diameter vertical	2.6	2.8	2.8
Postorbital length	5.8	6.1	5.1
Interorbital width	2.1	2.3	2.1
% of caudal peduncle length			
Caudal peduncle depth	15.4	13.0	15.6
% of head length			
Snout length	30.5	36.1	32.8
Eye diameter horizontal	20.4	22.3	20.9
Eye diameter vertical	18.9	20.6	19.4
Postorbital length	42.2	42.9	42.0
Interorbital width	20.4	22.3	21.1
Head width	27.3	28.3	27.0
% of eye diameter horizontal/vertical			
Interorbital width	75.0/80.7	71.4/83.3	75.3/80.2
% of pectoral-radial plate length			
Pectoral-radial plate width (at origin)	50.0	50.0	49.4
Pectoral-radial plate width (max.)	81.3	85.7	81.2

Coloration in life. Not known.

Coloration in ethanol. Yellowish brown because muscles colored by preservative visible through transparent skin; urostylar part of caudal peduncle appearing more transparent; head translucent; eyes uniformly black.

Etymology. The name *multidentata*, derived from the Latin *multus* = many, and *dentatus* = toothed, refers to the high number of teeth on the tooth bearing elements of the oral jaws.

Distribution. Known only from Papeete, Tahiti, French Polynesia, (17°32'S, 149°34'W) (Fig. 1).

Comparisons. *Schindleria multidentata* sp. nov. is a member of the LDF group of species in the genus and

differs noticeably from *S. brevipinguis*, *S. elongata* and *S. pietschmanni* by having a short tail and the dorsal fin originating considerably in front of the level of the anal-fin origin.

Additional species of the LDF group are *S. macrodentata*, *S. nigropunctata* and *S. praematura*, from which *S. multidentata* sp. nov. differs in a number of characters.

Schindleria multidentata differs from *S. macrodentata* (character states in parentheses) in having (i) many, closely spaced and tiny teeth (vs. few, widely spaced and large teeth); (ii) teeth on dentary separated by a distinct gap in an anterior and a posterior group (vs. teeth in a continuous row); (iii) pectoral-radial plate paddle shaped, nearly as wide as long (vs. elongate, distinctly longer than wider); (iv) more dorsal- and anal-fin rays, 21–22 and 13–15 respectively (vs. 19–20 and 10 rays, resp.); (v) last procurent ray in the caudal fin skeleton

Table 2. Meristic information of *Schindleria multidentata* sp. nov.

Specimen	Holotype ZMUC P771779	Paratype ZMUC P771800	Paratype ZMUC P771801
Standard length (SL) in mm	20.0	17.1	17.9
Sex	female	male	female
Dorsal-fin rays	19	21	18
Anal-fin rays	13	15	13
Pectoral-fin rays (left/right)	16/16	17/17	16/16
Caudal-fin rays	13 (7+6)	13 (7+6)	13 (7+6)
Procurent rays	6/6	6/6	6/6
1 st anal-fin ray ventral to dorsal-fin ray x	10	10	9
Gut ends ventral to dorsal-fin ray x	9	8	8
Total number of myomeres	34	36	34
Number of precaudal myomeres	22	22	22
Number of caudal myomeres	12	14	12
Number of vertebrae	33	35	33
Position of swim-bladder	?	myomere 14–15	?
Position of first dorsal-fin ray	myomere 16	myomere 15	myomere 15
Position of last dorsal-fin ray	myomere 32	myomere 34	myomere 32
Position of first anal-fin ray	myomere 23	myomere 24	myomere 23
Position of last anal-fin ray	myomere 32	myomere 31	myomere 31
Teeth on premaxilla (pmx)	~ 40	pmx broken	~ 39
Teeth on dentary	~ 31 (~ 22+9)	~ 27 (~ 21+7)	~ 30 (~ 21+8)
Number of eggs	30*	—	21*
Pigmentation of body (except eyes)	no pigments	no pigments	no pigments

* Number of eggs present but about anterior quarter or third of ovary already empty.

simple (vs with an additional spiny process at its base); (vi) lower jaw shape in ventral view a rounded arch (vs. pointed arch); and (vii) maxilla abruptly and distinctly expanded at its distal end (vs. only slightly expanded at its distal end).

Schindleria multidentata differs from *S. nigropunctata* (character states in parentheses) in having (i) about 40 tiny teeth along entire length of premaxilla (vs. about 20 teeth); (ii) teeth along about three quarters of the dentary (vs. restricted to anterior third of dentary) (iii) teeth on dentary separated into two groups, three rows close to the symphysis with about 20–23 teeth followed by a single row of about 7–9 teeth (vs. a single irregular row of few tiny teeth close to the symphysis); and (iv) more dorsal- and anal-fin rays, 21–22 dorsal- and 14 anal-fin rays, respectively (vs. 17 dorsal and 12 anal rays); eyes and cornea black (vs. eyes dark grey, cornea silvery with black spots dorsally).

Schindleria multidentata differs from *S. praematura* (character states in parentheses) in having (i) about 40 tiny teeth along entire length of premaxilla (vs. about 30 teeth); (ii) about 30 teeth along about three quarters of the dentary (vs. about 12 teeth on anterior third of dentary); (iv) teeth on dentary separated into two groups, three rows close to the symphysis with about 20–23 teeth followed by a single row of about 7–9 teeth (vs. a single group of few tiny teeth close to the symphysis); (v) narrower head, about 28 % of head length (vs. about 43 %); (vi) eyes smaller, about 21 % of head length (vs. 24 %); (vii) narrower interorbital width, 75 % of eye diameter (vs. about 89 %).

Discussion. Including the new *Schindleria multidentata* there are currently seven nominal species of *Schindleria*. Based on the position of the dorsal and anal fins relative to each other and on the length of the tail these species can be assigned to two groups: the LDF group with the origin of the dorsal fin distinctly anterior to the origin of the anal fin and with a short tail (about a quarter of standard length) and a SDF group with species having the origins of the dorsal and the anal fins more or less above each other and with a long tail (nearly half of standard length). LDF species are *S. macrodentata*, *S. multidentata*, *S. nigropunctata*, *S. praematura* and possibly also *S. elongata*. SDF species are *S. brevipinguis* and *S. pietschmanni*. Schindler's fishes of the LDF group are seemingly much more abundant than species of the SDF group. A total of 49 publications from 1930–2019, comprising the known distribution area of *Schindleria* off South America to South Africa, have documented more than twice as many records of LDF species than SDF species (46 vs. 20 records) (AHNELT & SAUBERER, 2020).

Some morphological traits like the pectoral-radial plate, the posterior-most procurent ray, the shape of the lower jaw arch and the dentition are helpful to discern species of *Schindleria* (AHNELT & SAUBERER, 2018). Other important diagnostic characters come from the dentition. According to the dentition *Schindleria* can be assigned to three groups: (i) one with the toothless species *S. brevipinguis*, (ii) one containing the single species *S. macrodentata* with few, widely spaced and large teeth and (iii) one with five species with numerous, tiny and densely set teeth (*S. elongata*, *S. multidentata*, *S. ni-*

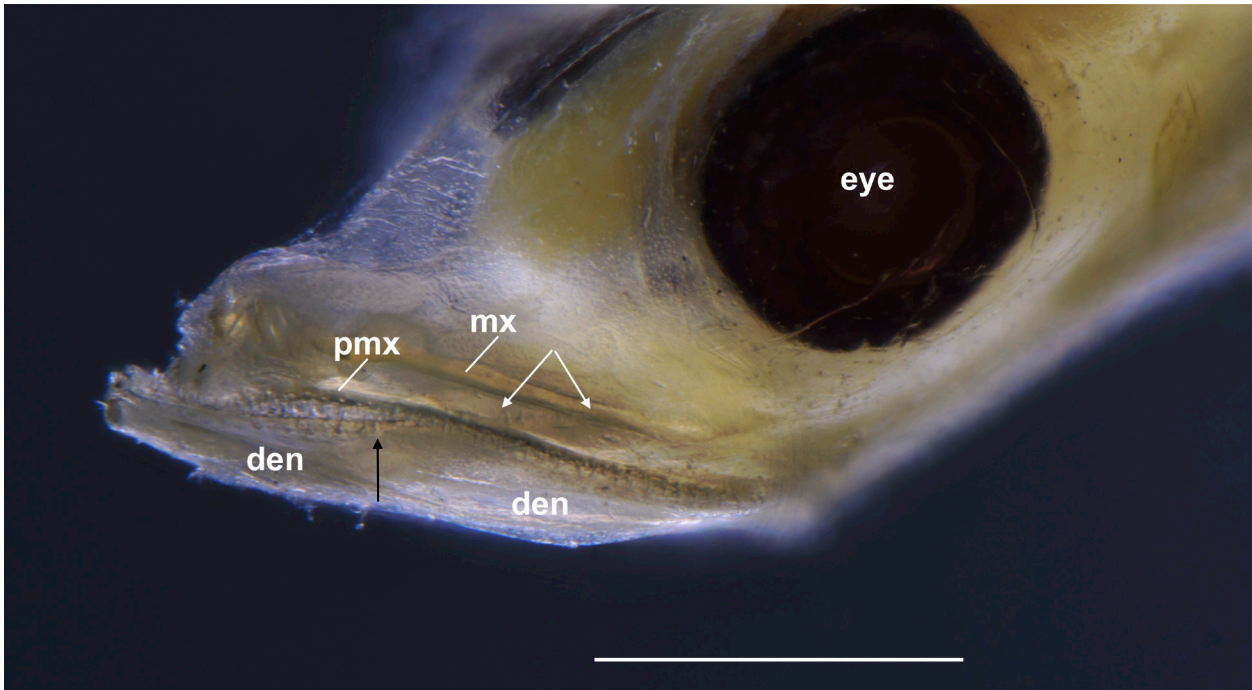


Fig. 5. Head of *Schindleria multidentata*, holotype (ZMUC P771779), female, lateral view. Black arrow indicates end of anterior tooth group. White arrows indicate origin and end of posterior tooth group on dentary. Premaxilla overlies gap between anterior and posterior tooth groups. Maxilla covers last teeth of posterior-most tooth group, is slightly shifted postero-ventrally and its distal part is missing. den, dentary; mx, maxilla; pmx, premaxilla. Scale = 0.5 mm.

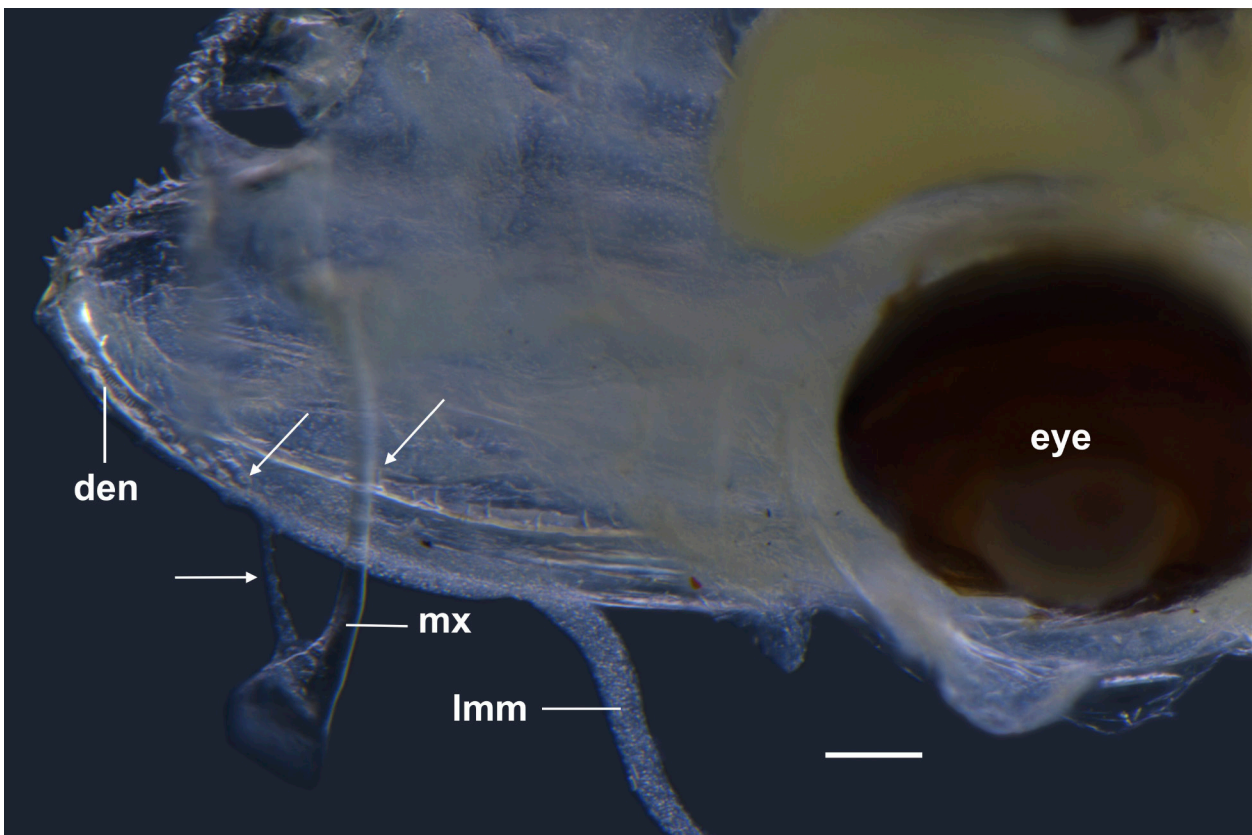


Fig. 6. Jaws of *Schindleria multidentata*, paratype (ZMUC P771800), male, dorso-lateral view. Dentition of the dentary and attachment of the ligamentum maxillo-mandibulare on the lower jaw. The ligamentum maxillo-mandibulare is ripped off and only a portion of it (horizontal arrow) is still attached to the distal plate of the maxilla. Oblique arrows indicate the gap between the two groups of teeth on the dentary pointing to the last tooth of the anterior group and the first of the posterior group respectively. Note the plate-like expanded distal end of the maxilla. den = dentary; lmm = ligamentum maxillo-mandibulare anterius; mx = maxilla. Scale = 0.1 mm.

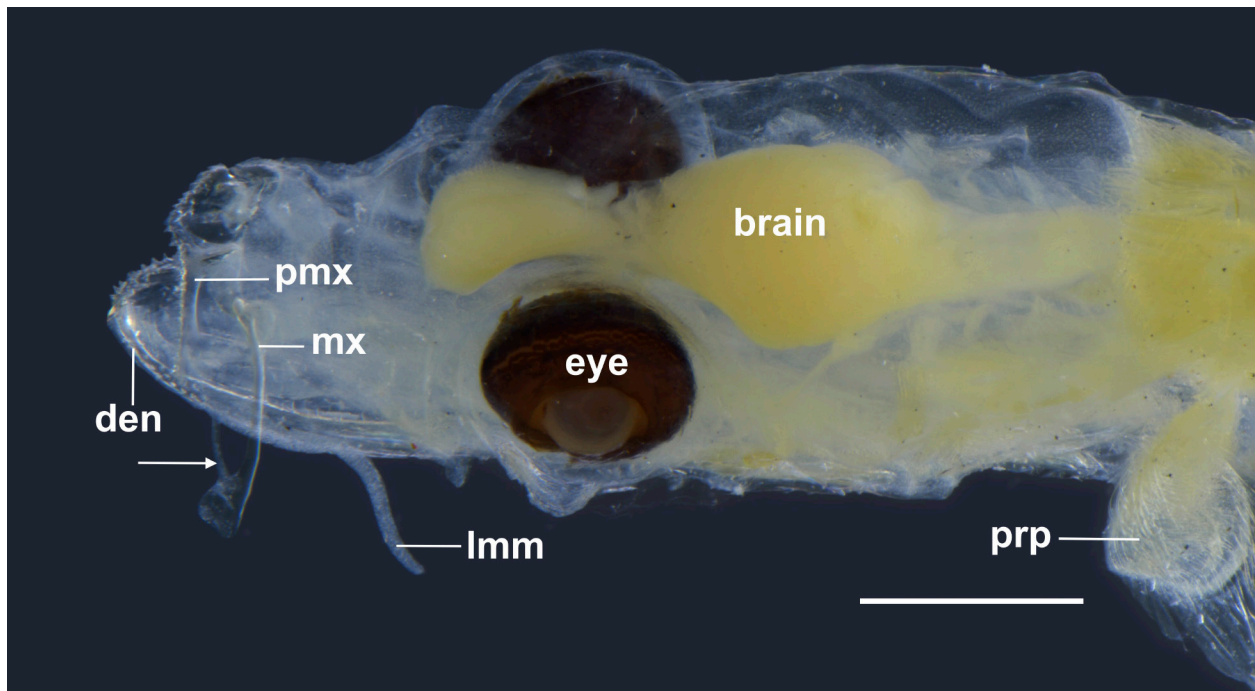


Fig. 7. Head of *Schindleria multidentata*, paratype (ZMUC P771800), male, dorso-lateral view. Maxilla with distal plate like part. Note that the largest part of the ligament (lmm) is ripped off its attachment at the distal plate of the maxilla. A small part of the ligament (arrow) is still attached to the maxilla. The premaxilla is broken with the distal part missing. den = dentary; lmm = *ligamentum maxillo-mandibulare anterius*; mx = maxilla; pmx = premaxilla; prp = pectoral-radial plate. Scale = 0.5 mm.

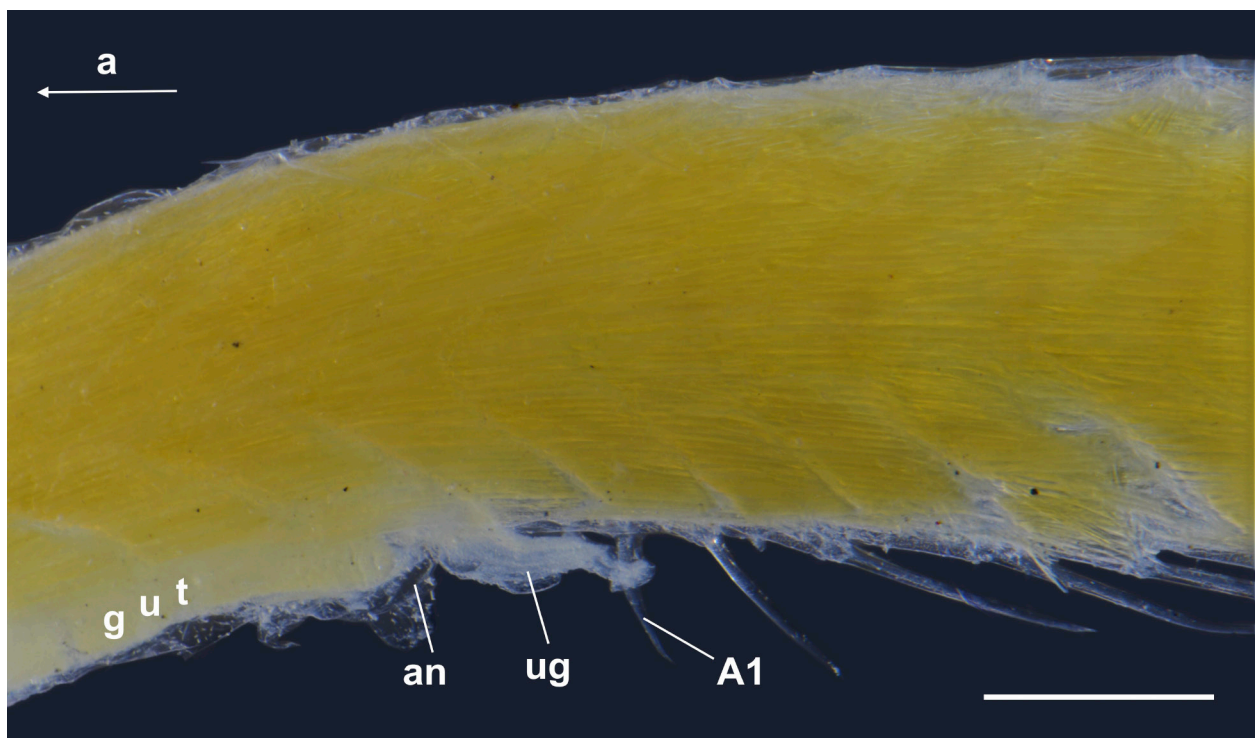


Fig. 8. *Schindleria multidentata*, paratype (ZMUC P771800), male, transition from precaudal to caudal region, lateral view. Note that fin rays are not segmented. A1 = first ray of anal fin; an = anus; ug = urogenital papilla. a = anterior. Scale = 0.5 mm.

gropunctata, *S. pietschmanni* and *S. praematura*). In the latter, tiny teeth extend along the entire ventral margin of the premaxilla and (except for *S. multidentata*), along the anterior-most part of the dentary (JOHNSON & BROTHERS,

1993; AHNELT, unpublished) (Fig. 9). *Schindleria multidentata* is the only species with tiny teeth on the dentary not restricted to its anterior-most part. Characteristically the lower jaw teeth of this species are arranged in two

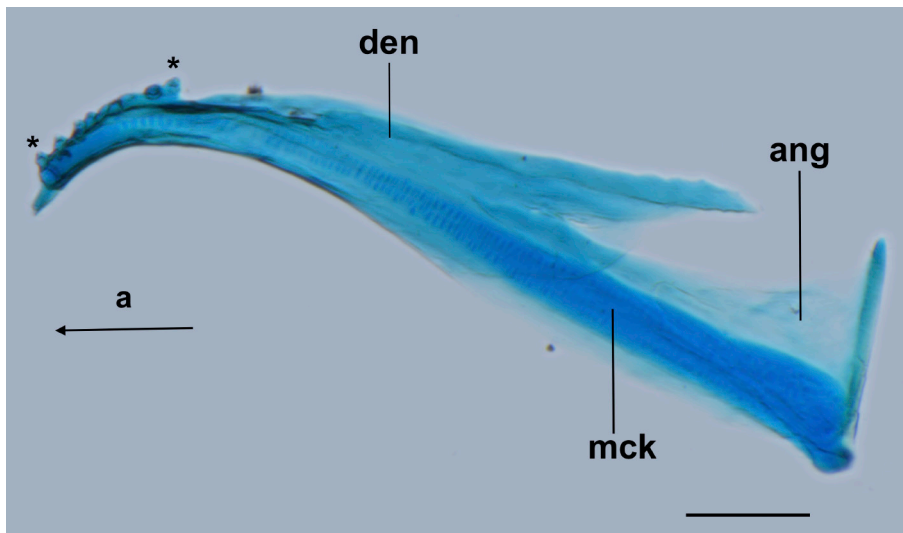


Fig. 9. *Schindleria* sp., Hawaii (CAS uncatalogued); right lower jaw, dorso-medial view. Asterisks indicate the bases of the anterior and posterior-most teeth of a group restricted to the symphysis of the lower jaw. This group corresponds to the anterior tooth group (for further explanation see text). ang = angulo-articular; den = dentary; mck = Meckel's cartilage (dark blue). a = anterior; scale = 1 mm.

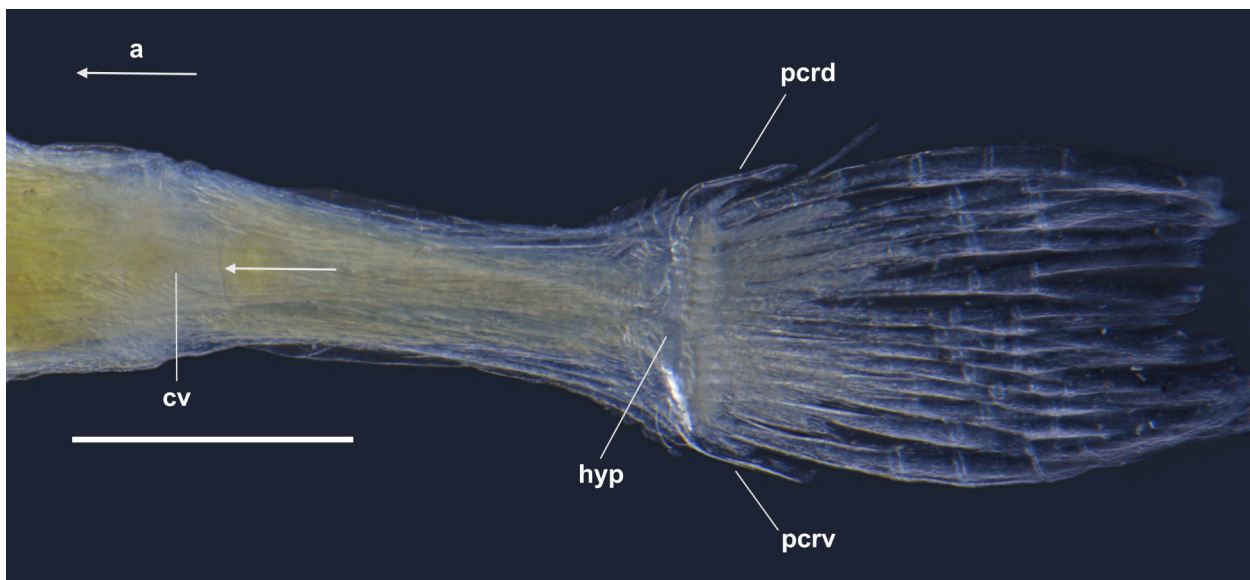


Fig. 10. *Schindleria multidentata*, paratype (ZMUC P771800), male, urostylar area and caudal fin, lateral view. Note that the fin rays of the caudal fin are segmented or segmented and branched. Urostyle about 85% of caudal fin length. Arrow indicates border between first preural vertebra (cv) and urostyle. pcrd, pcrv = last (6th) dorsal and ventral procurent rays respectively. a = anterior. Scale = 0.5 mm.

groups separated by a distinct diastema (gap) (Fig. 6). The anterior group is formed by three tooth rows with especially the lateral row directed outwards and the posterior group by a single tooth row with the teeth vertically oriented. This pattern has so far only been found in *S. multidentata*.

The functional significance of the diverse dentition patterns in *Schindleria* is unknown. Obviously adult specimens are actively feeding as all investigated specimens had guts full with an unidentifiable content. No parts of prey or plants were discernable in the digestive duct. It is not only unclear how and on what these fishes are feeding, but the entire lifestyle of *Schindleria* including its reproductive behavior is virtually unknown. Important aspects of its basic biology and ecology of this enigmatic group of Gobiidae are still awaiting detailed exploration.

Key to species of *Schindleria*

- 1 Teeth on jaws absent or small, numerous, narrowly spaced; pectoral-radial plate short, paddle shaped; predorsal length 58–70 % SL; head length 12–22 % SL 2
- 2 Teeth on jaws large, few, widely spaced; pectoral-radial plate elongate; predorsal length 72–76 % SL; head length 11 % SL; Indonesia, Philippines *S. macrodentata*
- 2 Teeth on dentary restricted to anterior third or less (< 15 teeth) 3
- 3 Teeth on dentary along about two thirds to three quarters of its length (> 25 teeth); teeth separated in two groups by distinct gap; Tahiti *S. multidentata*
- 3 Dorsal-fin rays 13–14; anal-fin rays 10–12; predorsal length 58–70 % SL 4

- Dorsal-fin rays 15–22; anal-fin rays 13–18; predorsal length 53–54 % SL 5
- 4 Teeth on jaws absent; predorsal length 58–65 % SL; body depth at pectoral-fin base 8–..... 12 % SL; Queensland, Australia *S. brevipinguis*
Teeth small, numerous; predorsal length 66–70 % SL; body depth at pectoral-fin base 4–6 % SL 6
- 5 Head length 14–15 % SL; eyes small with diameter 14–18 % of head length; body depth at anal-fin origin 9 % SL; northern Red Sea *S. nigropunctata*
Head length 17–18 % SL; eyes large with diameter 28–32 % of head length; body depth at anal-fin origin 5–7 % SL; northern Red Sea *S. elongata*
- 6 Dorsal-fin rays 16–22; anal fin originates below dorsal-fin rays 7–11; preanal length short, < 55 % SL; Hawaiian Islands *S. praematura*
Dorsal-fin rays 15–18; anal fin originates below dorsal-fin rays 1–3; preanal length long, > 60 % SL; Hawaiian Islands *S. pietschmanni*

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