

Description of a New Species of Rariphotic *Parapercis* (Perciformes: Pinguipedidae) from the Solomon Islands

JOHN S. SPARKS,¹ NICHOLAS CHALOUX,² ROBERT C. SCHELLY,³ DAVID F.
GRUBER,⁴ TATE S. SPARKS,⁵ AND BRENNAN T. PHILLIPS^{2, 6}

ABSTRACT

A new species belonging to the pinguipedid genus *Parapercis* is described herein from a single specimen collected via a remotely operated vehicle (ROV) from rariphotic depths in the Western Province of the Solomon Islands. *Parapercis rota*, new species, is readily distinguished from all other congeners by a unique pigmentation pattern comprising four large, rounded, orangish-olive saddles dorsally on the flank, each with a distinct, large, dorsomedial white spot completely enclosed within the saddles, plus a fifth saddle on the caudal peduncle with only a small white dorsomedial dot; 10 discrete broad, dark orangish-olive oval vertical bars below the lateral midline; a single row of dark spots on the soft dorsal fin; caudal fin lined dorsally and ventrally with stripes of yellowish-olive pigmentation extending the length of the fin; and two prominent dark brown to black spots at the caudal-fin base. ROV-based collecting systems are a promising and relatively affordable technology for studying ichthyological diversity on deeper reef habitats, particularly those beyond the reach of technical SCUBA. The discovery and description of *P. rota* adds to the growing number of *Parapercis* species that are known to occur in mesophotic and deeper waters.

¹ American Museum of Natural History, Department of Ichthyology, Division of Vertebrate Zoology, New York.

² University of Rhode Island, Department of Ocean Engineering, Narragansett, RI.

³ Division of Science and Resource Management, Grand Canyon National Park, National Park Service, Flagstaff, AZ.

⁴ Department of Natural Sciences, Baruch College, City University of New York, New York.

⁵ Millburn High School, Millburn, NJ.

⁶ University of Rhode Island, Graduate School of Oceanography, Narragansett, RI.

INTRODUCTION

Parapercis Bleeker, 1863 is a species-rich pinguipedid genus that currently comprises approximately 90 valid species (Johnson and Motomura, 2017; Johnson and Wilmer, 2018; Ho, 2015; Fricke et al., 2021) and exhibits a wide distribution extending from the eastern Atlantic to the central Pacific oceans. In the past decade alone, 23 novel species have been formally described (see references in Johnson and Motomura, 2017; Yosuva et al., 2020; Fricke et al., 2021), not including the new species described herein, and several additional novel species are awaiting formal description. *Parapercis* are commonly known as sandperches and are generally colorful, ornately pigmented elongate fishes that frequently occur over sandflats or rubble on or near coral reefs. Members of the genus are conservative in terms of general body shape and meristic features, tending to overlap considerably, such that the most useful diagnostic features for distinguishing species are frequently pigmentation pattern and coloration.

As Johnson and Wilmer (2018) note, with the increase in deeper reef exploration beyond 40 m using closed circuit rebreathers, and demersal trawling in depths up to 400 m, several novel members of *Parapercis* from mesophotic/rariphotic reef habitats, and even deeper, have been discovered and described in recent years. Herein we describe a new species of *Parapercis* collected at rariphotic depths in the Western Province of the Solomon Islands. The new species was observed and collected at a depth of 187 m using a novel ROV-based rotenone fish sampler that our research team designed and successfully deployed for the first time in the Solomon Islands in 2019 (Chaloux et al., 2021; fig. 1A). ROV-based ichthyological sampling of mesophotic and rariphotic reefs adds yet another means of accessing and exploring these vastly understudied habitats.

MATERIALS AND METHODS

The holotype of the new species, along with several other mesophotic/rariphotic species, was collected via a novel ROV-based rotenone fish sampler at 187 m depth just outside of Peava Island lagoon in the Western Province of the Solomon Islands on July 28, 2019. We use the recently defined term, rariphotic, to refer to a faunal zone below the mesophotic and above the aphotic, and ranging from ~130 to 309 m (Baldwin et al., 2018). Figure 1B shows the new species being imaged via a camera mounted on the ROV just prior to collection. Videos and still images of the new species in its natural habitat were taken via an Insite Pacific HD camera affixed with a 5.1–51 mm 10× mechanical zoom that was mounted to the front of the ROV and that recorded 1080 p (progressive scan) video at 60 frames per second (fps). Still images in aquaria were acquired with a Nikon D800 or D4 DSLR fitted with a Nikon AF-S Micro NIKKOR 105 mm f/2.8 macro lens.

The holotype of the new species was fixed in 10% formalin and preserved in 75% ethanol. Osteological features of the new species and related taxa were examined using radiographs, dry skeletal preparations, and specimens cleared-and-stained (C&S) for bone and cartilage (following the protocol of Taylor and Van Dyke, 1985). Morphometric measurements were recorded to the nearest 0.1 mm using dial calipers. Standard length (SL) is used throughout. Vertebral

counts exclude the ural centrum (= last half-centrum). Terminology follows Cantwell (1964), Randall (2008), and Sparks and Baldwin (2012), unless noted otherwise. Following Hubbs and Lagler (1949), the first caudal vertebra is defined here as the first vertebra bearing a definitive hemal spine. Vertebral and fin spine/ray counts were obtained from radiographs. Pored scales in the lateral line are counted in series from the dorsal margin of the gill opening to the caudal flexure; scales posterior of flexure are not included in the count. Institutional abbreviations are as listed in Leviton et al. (1985) and Sabaj Pérez (2019).

RESULTS

SYSTEMATIC ACCOUNT

Parapercis rota, new species

Figures 1B, 2, 3; table 1

HOLOTYPE: AMNH 277100, 44.3 mm SL; Western Province, Solomon Islands, Peava Island; ROV-based rotenone collection from anchor just offshore and outside of Peava Island lagoon; 187 m depth; 8°47'03.3"S 158°14'08.7"E; JSS-SI19-010; J.S. Sparks, N. Chaloux, and B.T. Phillips, July 28, 2019.

DIAGNOSIS: The new species is readily distinguished from all congeners by a unique pigmentation pattern, comprising four large, rounded, orangish-olive saddles dorsally on the flank, each with a large distinct dorsomedial white spot completely enclosed within the saddles, such that they resemble wheels, plus a much smaller fifth saddle on the caudal peduncle with only a small white dorsomedial spot, 10 discrete broad, dark orangish-olive oval vertical bars below the lateral midline, a single row of dark spots on the soft dorsal fin, the caudal fin is lined dorsally and ventrally with stripes of yellowish-olive pigmentation extending the length of the fin, and two prominent dark brown to black spots at the caudal-fin base.

DESCRIPTION: Selected proportional measurements and meristic data presented in table 1. Body elongate and moderately dorsoventrally depressed anteriorly. Body becoming rounded and tubular in cross section medially, and increasingly laterally compressed posteriorly. Head dorsoventrally depressed, particularly anteriorly, and not elongate. Snout short, weakly pointed in lateral profile. Snout more or less rounded in dorsal view. Predorsal profile mostly straight. Orbits very large. Eyes dorsolaterally oriented and fully visible (= included) in dorsal view. Interorbital width roughly half of orbit diameter. Suborbital distance slightly less than orbit height. Nape broad and flattened. Mouth relatively wide and moderate in size, slightly oblique, and jaws not elongate. Posterior margin of maxilla extending to a vertical approximately at anterior margin of orbit. Upper lip generally broad throughout. Lower lip broader anteromedially, becoming progressively narrow posteriorly. Lower jaw weakly prognathous. Rostral margin of lower jaw protruding slightly anterior to upper jaw. Symphysis of lower jaw rounded in shape in ventral view. Fleshy flap present below lower jaw.

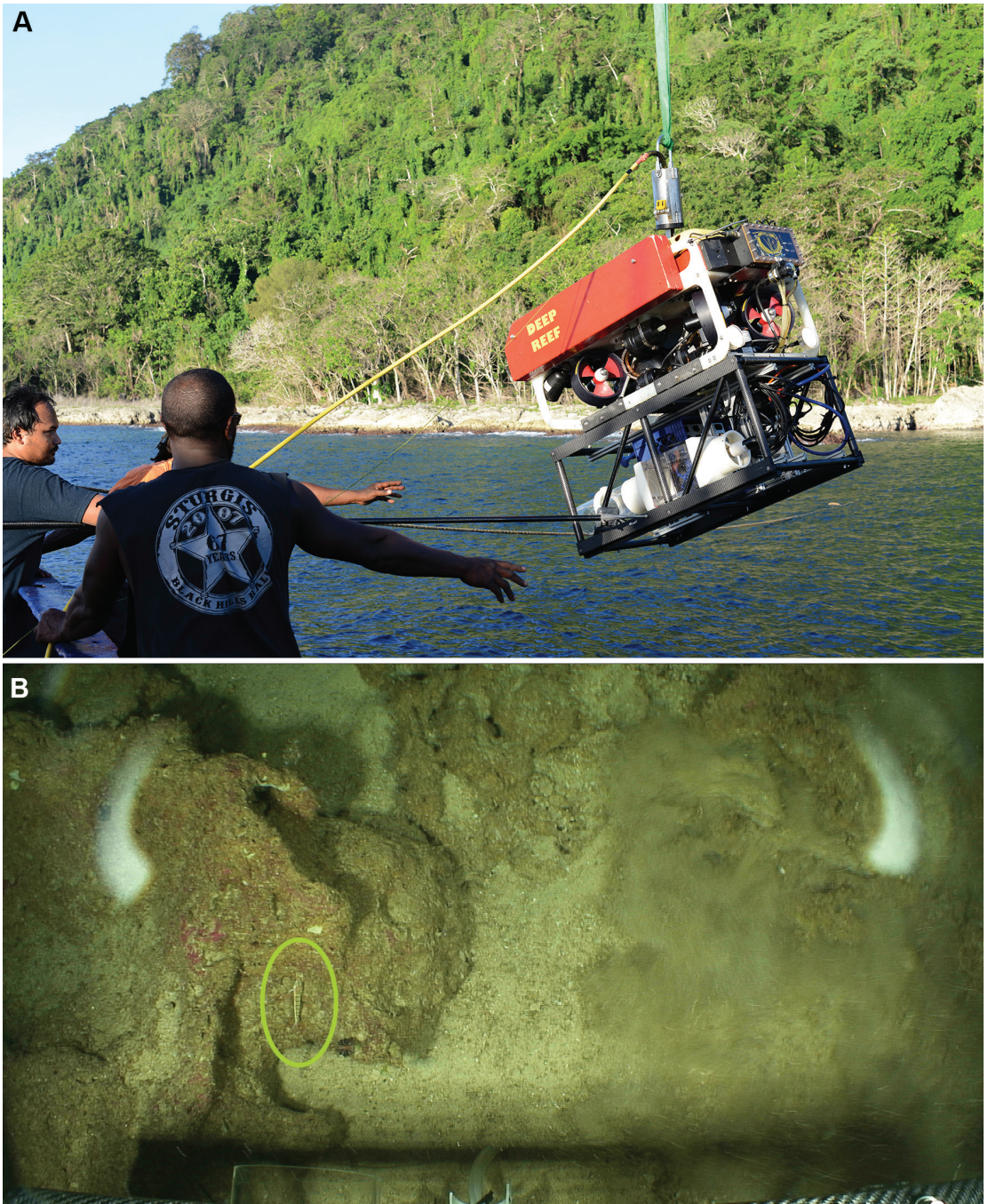


FIG. 1. **A**, ROV-based fish sampling system utilized to collect new *Parapercis* species being deployed in the Solomon Islands. The fish sampler can be seen mounted to the bottom of the ROV. **B**, *Parapercis rota*, new species, shown in its rariphotic habitat just prior to collection (enclosed by yellow oval) by ROV at 187 m depth in the Western Province, Solomon Islands. The suction intake of the fish sampler can be seen just below the specimen.

Interorbital series comprised of seven elements, including lacrimal, with posterior, uppermost element firmly attached to neurocranium. Posterior margin of preopercle appears smooth, but with very fine serrations that are barely visible even under magnification. Opercle bearing a single well-developed spine. Midcaudal margin of subopercle bears three prominent serrations that resemble teeth. Operculum extending just anterior of a vertical at origin of spinous dorsal fin. Gill membranes free of isthmus, but with broad and substantial, medial flap of tissue.

Upper jaw with outer row of large, slightly recurved caniniform teeth, and an anteromedial band comprising several rows (four rows anteromedially) of much smaller villiform to small conical teeth. Villiform and small conical teeth in upper jaw restricted medially. Greatly enlarged outer canine teeth in upper jaw number three to four on each side, with the second or third tooth from symphysis of upper jaw largest. Posterolateral to greatly enlarged teeth surrounding symphysis, caniniform outer row teeth becoming progressively smaller posteriorly. Outermost row on lower jaw comprised of three large, recurved canine teeth on each side, with posteriormost, third tooth in series largest. A broad anteromedial band of small villiform to conical teeth present in lower jaw with multiple rows medially (three rows anteromedially), tapering to a single row posteriorly. Posterior teeth becoming caniniform and somewhat larger than those anterior in lower jaw. Vomer with two to three (medially) rows of very stout, slightly recurved conical teeth. Palatine teeth absent.

Lower limb of first gill arch with 10 elongate and triangular rakers, comprising nine denticulate outer ceratobranchial rakers, and one smaller hypobranchial raker of same morphology. Other rakers on arches two to four considerably shorter and more robust. These rakers highly denticulate apically with denticles directed medially. Six branchiostegals present.

Scales on flank and opercle comparatively large and strongly ctenoid. Smaller ctenoid scales present on caudal fin, and extending approximately $1/2$ to $2/3$ length of fin. Scales on nape reduced in size. Scales on nape cycloid anteriorly and becoming weakly ctenoid posteriorly. Scales on cheek numerous and cycloid, much smaller than those on flank. Ventrums fully scaled. Interpelvic chest scales and scales below pectoral insertion markedly reduced in size, cycloid anteriorly and becoming increasingly ctenoid posteriorly. Lacrimal, snout, and occiput asquamate. Nine or 10 scales in diagonal from dorsal margin of opercle to origin of spinous dorsal fin. Seven scales in diagonal from lateral line to first ray of soft dorsal fin. Nine predorsal scales along dorsal midline. Pored scales in lateral line 58.

Fin spine and soft-ray counts as follows: dorsal V, 21; anal I, 17; pectoral 17; pelvic I, 5; principal caudal rays 9 upper + 7 lower, all branched. Vertebral count 10 precaudal + 19 caudal = 29. Anteriormost three to four vertebral centra noticeably reduced in size when viewed laterally. Dorsal insertion of pectoral fin at about level of vertical through origin of spinous dorsal fin; pectoral fin extending posteriorly to vertical through eighth soft dorsal-fin ray when adducted. Pelvic-fin origin at about level of vertical through posterior margin of opercle and extending to just past third anal-fin ray when adducted. Membrane of fifth dorsal spine attached to first ray of soft dorsal at about $1/2$ of length of fifth spine measured from fin base. Anal-fin

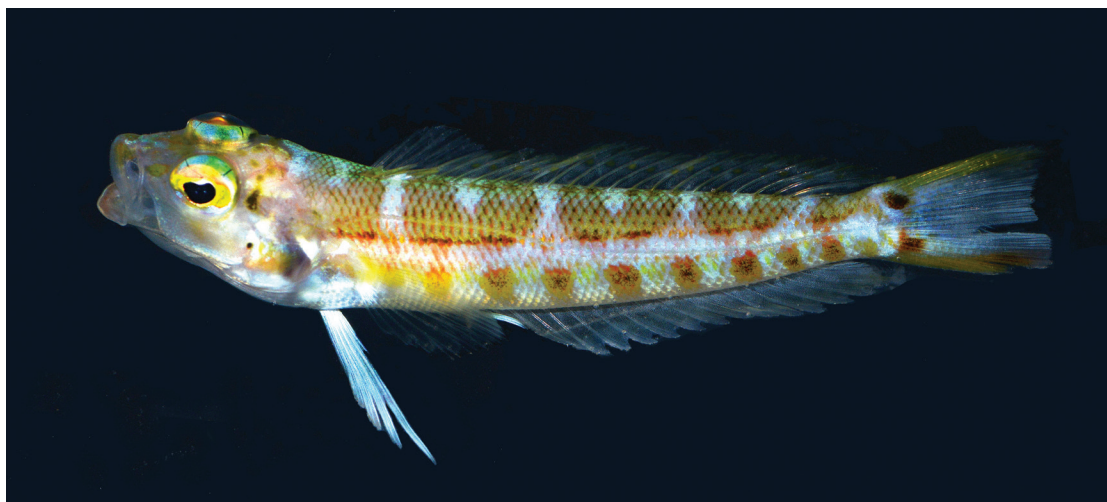


FIG. 2. *Parapercis rota*, new species, holotype, AMNH 277100, Western Province, Solomon Islands, off Peava Island, 187 m depth. Imaged immediately following collection to illustrate pigmentation pattern in life.

origin at vertical through fifth ray of soft dorsal fin. Soft dorsal terminating slightly anterior to anal-fin termination. Caudal fin relatively short and weakly emarginate.

PIGMENTATION IN LIFE: Coloration of the freshly collected holotype is shown in figure 2. Pigmentation pattern on the upper flank comprises four large orangish-olive saddles, each with a distinct dorsomedial white spot comprising multiple scales that is completely surrounded by a wide margin of darker pigmentation, plus a fifth saddle on the caudal peduncle with only a very small dorsomedial white dot. Each saddle is broadly outlined in white. Scales within the flank saddles are outlined in dark olive. Saddles with burgundy pigmentation dorsally, neon green medially, and with dark red stripes along their ventral margin. There are 10 discrete, dark orangish-olive oval vertical bars below the lateral midline, and two prominent dark brown to black spots at the caudal fin base, with the lower spot somewhat smaller and more diffuse than the upper. The chest and belly are white and somewhat iridescent. The dorsal fin is hyaline with a single row of well-defined dark olive spots at about 2/3 length of the dorsal spines and rays spanning the length of the soft dorsal fin, and also with some dark olive pigmentation distally. The caudal fin is hyaline centrally and distally along the posterior margin, somewhat white centrally, and with stripes of yellowish-olive pigmentation dorsally and ventrally extending the length of the fin. There are two black patches distally on the caudal fin central to the bands of yellowish-olive pigmentation. The pectoral fin is mostly hyaline with some yellowish pigmentation dorsally, and the pelvic fin is bright white.

PIGMENTATION IN PRESERVATIVE: Coloration in alcohol is shown in figure 3. Overall body coloration is tan to light brown with only faint remnants of the dorsal saddles, series of vertical bars below the lateral midline, and spots at the caudal base remaining in preservative. Additionally, a large black blotch is present posterior to the orbit and another smaller black blotch is present dorsally on the preopercle. All remaining faint markings are black or dark brown in coloration. All other former pigmentation has faded in preservation.



FIG. 3. *Parapercis rota*, new species, holotype, AMNH 277100, 44.3 mm SL. Preserved in ethanol.

DISTRIBUTION: Known only from a single specimen collected by an ROV-based rotenone fish sampler (fig. 1A) at a depth of 187 m in the Western Province of the Solomon Islands near Peava Island, just outside of Peava Lagoon ($8^{\circ}47'03.3''\text{S}$ $158^{\circ}14'08.7''\text{E}$). The specimen was collected on a mostly barren rocky outcropping surrounded by sandy substrate and rubble, where other mesophotic/rariphotic species, were also observed and collected (fig. 1B). Additional individuals of the new species were observed at this locality, but could not be collected.

ETYMOLOGY: Named in reference to the characteristic pigmentation pattern on the upper flank comprising well-defined dark saddles that are continuous (i.e., connected) ventrally along the lateral midline, and that have a central (= dorsomedial) white spot, such that they resemble wheels (Latin = *rota*).

DISCUSSION AND COMPARISONS

Based on examination of the original descriptions, museum collections, and available images of live, fresh, and preserved *Parapercis* specimens, the pigmentation pattern of *P. rota* is unique within the genus. As Allen and Erdmann (2012: 1156) noted, two other species that occur in the general region, *P. biordinis* Allen, 1976 (endemic to Western Australia), and *P. diplospilus* Gomon, 1981 (Philippines, Indonesia; Exmouth, Western Australia to Moreton Bay, Queensland; Bray, 2021), in addition to their newly described *P. sagma* Allen and Erdmann, 2012 (Indonesia, Vanuatu), also have a characteristic pair of dark spots at the base of the caudal fin. To these three species can be added, *P. hoi* Johnson and Motomura, 2017 (Philippines; Broome, Western Australia), and the new species (Solomon Islands), both of which also have a prominent pair of dark spots at the caudal base.

Of all *Parapercis* species occurring in the region, those most similar in terms of overall pigmentation pattern to *P. rota* are *P. sagma*, *P. diplospilus*, and *P. snyderi* (Indo-West Pacific, extending from southern Japan to Queensland and Western Australia; Bray, 2021). However, *P. rota* is easily distinguished from both *P. sagma* and *P. diplospilus* by the presence of only five large saddles in the new species, due to the fact that the darkly pigmented portions of the saddles are conjoined ventrally (above the lateral midline; fig. 2), in contrast to the pattern in *P. sagma* and *P. diplospilus*

where the saddles are not continuous ventrally, but are interrupted by regions of lighter pigmentation. As a result, in the latter two species there are eight to nine smaller saddles spanning the length of the flank, lending these taxa a more mottled overall appearance.

Parapercis rota can be further distinguished from *P. sagma* by fewer vertebrae (29 vs. 31 in *P. sagma*), shorter jaws (maxilla reaching only to about anterior margin of orbit vs. extending through anterior 1/3 of orbit), fewer canine teeth on each side at the front of the lower jaw (3 vs. 4), fewer inner rows of teeth in both the upper (4 vs. 10) and lower (3–4 vs. 5–6) jaws, an increased number of dark vertical bars along the flank below the lateral midline (10 vs. 8–9), a single row of dark spots on the soft dorsal fin (vs. two rows), more caudal fin rays (16 vs. 15), an emarginate caudal fin (vs. weakly rounded), and a higher lateral-line scale count (58 vs. 53).

Although the new species was collected at a depth of 187 m, considerably deeper than the reported range of the type series of *P. sagma*, which is reported as 60–80 m (Allen and Erdmann, 2012), it is noteworthy that Ho (2015: 269) lists a number of MNHN nontype specimens of *P. sagma* from Vanuatu that he examined, most of which were collected at significantly deeper depths (up to 439 m) than were the specimens comprising the type series of Allen and Erdmann (2012: 60–80 m), which significantly extends the depth range of that species.

Parapercis rota is further distinguished from *P. diplospilus* by a nonmottled overall pigmentation pattern, particularly dorsal to the lateral midline (vs. highly mottled in *P. diplospilus*), more dark vertical bars below the lateral midline (10 vs. 9), a longer snout (9.5 vs. 6.5–7.1% SL), more pectoral-fin rays (17 vs. 14–16), fewer dorsal-fin soft rays (21 vs. 22), fewer anal-fin soft rays (17 vs. 18), a single row of dark spots on the soft dorsal fin (vs. 2–3 rows), and by the presence of a somewhat diffuse lower dark spot at the caudal base (vs. both spots equally vivid).

Although *P. snyderi* Jordan and Starks, 1905, also has a similar number of large, rounded saddles on the upper flank as in *P. rota*, in *P. snyderi* these saddles have at most a small light dorsomedial dot, or the dot is lacking entirely, in contrast to a conspicuous dorsomedial region of white pigmentation comprising multiple scales in the new species (fig. 2). *Parapercis rota* can further be distinguished from *P. snyderi* by the presence of two prominent dark brown to black spots at the caudal-fin base (vs. absence in *P. snyderi*), absence of a heavily spotted operculum with solid, black pigmentation ventrally (vs. presence), absence of a darkly pigmented spinous dorsal fin (vs. presence), absence of multiple rows of large dark spots on the soft dorsal fin (single vs. 2–4 rows), more pectoral-fin rays (17 vs. 13–15), absence of a series of vertical rows of large dark spots on the caudal fin, lending the fin a striped appearance (vs. presence), and a significantly higher lateral-line scale count (58 vs. 38–43: *P. snyderi* lateral-line scale count range from Randall, 2003).

The other two species that possess a characteristic pair of dark spots at the base of the caudal fin, *P. biordinis* and *P. hoi*, both lack dark saddles on the upper flank. Instead, flank pigmentation in *P. biordinis* is characterized by two rows of small dark blotches, with each row comprised of four dark spots (Allen, 1976: fig. 3), whereas flank pigmentation in *P. hoi* is characterized by two rows of irregular dusky colored blotches, with each row comprised of seven blotches (Johnson and Motomura, 2017: fig. 6A, B).

TABLE 1. Morphometric and meristic data for holotype of *Parapercis rota*.

Character	Holotype
Standard length (mm)	44.3
Percentage of SL	
Head length	24.2
Snout length	9.5
Caudal-peduncle length	8.8
Caudal-peduncle depth	8.6
Predorsal length	31.8
Dorsal-fin base length	61.4
Preanal length	53.5
Anal-fin base length	42.0
Pectoral-fin length	21.5
Prepelvic length	29.1
Pelvic-fin length	28.9
Caudal-fin length	26.0
Percentage of HL	
Snout length	39.3
Orbit diameter	40.2
Interorbital width	18.7
Upper-jaw length	43.9
Lower-jaw length	60.8
Suborbital depth	21.5
First dorsal-spine length	9.4
Longest dorsal-spine length	35.5
Anal-spine length	22.4
Meristics	
Gill rakers (lower limb 1st arch)	10
Vertebrae (precaudal + caudal)	10 + 19 = 29
Dorsal fin	V, 21
Anal fin	I, 17
Pectoral fin	17
Pelvic fin	I, 5
Lateral-line scales	58

Parapercis rota is further distinguished from *P. biordinis* by the absence of a pair of dark blotches on the medial portion of the caudal fin (vs. presence in *P. biordinis*), the presence of a series of 10 dark vertical blotches below the lateral midline (vs. four spots), fewer anal-fin rays (17 vs. 18), fewer pectoral-fin rays (17 vs. 18), and a higher lateral-line scale count (58 vs. 49–54; *P. biordinis* lateral-line scale count range from Allen, 1976, and Johnson and Motomura, 2017). *Parapercis rota* is further distinguished from *P. hoi* by a higher lateral-line

scale count (58 vs. 49–50 in *P. hoi*), fewer vertebrae (29 vs. 30), a longer snout (9.5 vs. 6.8%–7.0% SL), the absence of a broad red bar ventral to the orbit and extending across the suborbital region (vs. presence), and the absence of a series of alternating dark and light wavy lines on the caudal fin (vs. presence).

Despite repeated attempts, only a single specimen of the new species could be collected via ROV during our 2019 expedition to the Solomon Islands. However, based on its unique and striking pigmentation pattern, which is quite unlike any described species of *Parapercis*, as well as the extreme depth (nearly 200 m) that the specimen was collected relative to most other members of the genus in the region except *P. sagma*, we believe that it is both justified and prudent to formally describe the new species at this time, particularly given the likelihood of obtaining additional specimens in the near future is quite low. However, we anticipate that with intensified collecting efforts focusing on deeper mesophotic/rariphotic reefs in the region via ROV-based ichthyological sampling devices like the one described herein, which are relatively affordable and can be operated by both a small crew and vessel, additional specimens attributable to the new species will be collected.

ACKNOWLEDGMENTS

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APPENDIX 1

MATERIAL EXAMINED

- Parapercis biordinis*: WAM P.25206-001, holotype (image: preserved), Western Australia.
- Parapercis diplospilus*: USNM 220470, holotype (image: preserved), Philippines.
- Parapercis hexophtalma*: ZMB 517, holotype, 1 ex., Eritrea; UMMZ 185817, 5 ex., Madagascar; UMMZ 185962, 4 ex., Madagascar; USNM 200698, 3 ex., Madagascar; UMMZ 242950, 1 ex., Sumatra, Indonesia; USNM 202356, 2 ex., Egypt.
- Parapercis hoi*: NMV A.29690-001, holotype (images: fresh and preserved), Western Australia.
- Parapercis maculata*: BPBM 20453, neotype, 1 ex., India; BPBM 27177, 1 ex., Oman; BPBM 34459, 1 ex., Madagascar; BPBM 40663, 4 ex., Sri Lanka.
- Parapercis maramara*: AMNH 243241, holotype, Madagascar; AMNH 243242, 4 ex., 1 ex. C&S, Madagascar; AMNH 243243, 1 ex., Madagascar.
- Parapercis millepunctata*: AMNH 72696, 1 ex., Society Islands.
- Parapercis punctulata*: ANSP 126939, described as paratype of *Parapercis trispilota*, 1 ex., Seychelles; ANSP 126950, described as paratype of *Parapercis bivittata*, 1 ex., Seychelles; ANSP 126956, described as paratype of *Parapercis trispilota*, 1 ex., Seychelles; ANSP 126959, described as paratype of *Parapercis bivittata*, 1 ex., Seychelles; ANSP 126961, described as paratype of *Parapercis bivittata*, 1 ex., Seychelles; ANSP 126962, described as paratypes of *Parapercis trispilota*, 3 ex., Seychelles; USNM 329392, 1 ex., South Africa; USNM 349524, 1 ex., Mascarene Islands; USNM 349525, 1 ex., Mascarene Islands.
- Parapercis queenslandica*: AMNH 212365, 2 ex., Queensland, Australia; AMNH 212738, 1 ex., Queensland, Australia; AMNH 213848, 10 ex., Queensland, Australia.
- Parapercis robinsoni*: ANSP 53451, neotype, 1 ex., South Africa; USNM 196492, 2 ex., Saudi Arabia; USNM 200718, 1 ex., Somalia; USNM 200720, 1 ex., South Africa; USNM 266972, 6 ex., Bahrain.
- Parapercis saga*: MZB 20597, holotype (images: fresh and preserved), West Papua, Indonesia; BPBM 40709, paratype (image: fresh), Vanuatu.
- Parapercis schauinslandii*: AMNH uncat., 1 ex., Indo-West Pacific.
- Parapercis snyderi*: AMNH 212174, 2 ex., Queensland, Australia; BPBM 18986, 1 ex. (image: preserved), Japan; BPBM 21959, 1 ex. (image: preserved), Malaysia.
- Parapercis xanthozona*: RMNH 5946, holotype, Java, Indonesia; ANSP 27780, described as holotype of *Parapercis atromaculata*, 1 ex., Sumatra, Indonesia.