

TWO NEW SANDPERCHES (PERCIFORMES: PINGUIPEDIDAE: *PARAPERCSIS*) FROM SOUTH CHINA SEA, BASED ON MORPHOLOGY AND DNA BARCODING

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ABSTRACT. — Two new cryptic sandperch species of the pinguipedid genus *Parapercis* are described from off southern Taiwan, northern South China Sea. *Parapercis kentingensis* n. sp., described from 25 specimens, is morphologically similar to *P. shaoi* Randall, 2008. *Parapercis rubromaculata* n. sp., described from four specimens, is morphologically similar to *P. randalli* Ho & Shao, 2010. The four species have sympatric distributions in southern Taiwan. Both new species differ from their congeners in colouration and a combination of other characters. Morphological evidence for establishing new species status is also supported by DNA barcoding.

KEY WORDS. — Teleostei, taxonomy, cryptic species, DNA barcoding, South China Sea

INTRODUCTION

Prior to 2008, *Parapercis shaoi* Randall, 2008 was recorded by many authors as *Parapercis somaliensis* Schultz, 1968 (e.g., Masuda et al., 1975; Masuda et al., 1984; Shao & Ho, 1991; Shao et al., 1993; Shen et al., 1993). Randall (2008) distinguished *P. shaoi* from *P. somaliensis* by the lack of a strongly serrated preopercle and by having a posterior prolongation of upper part of the caudal fin, a different colouration, a smaller eye, and a broader interorbital space.

Recently, Ho & Shao (2010) described *Parapercis randalli* from southern Taiwan. This species is similar to *P. shaoi* in having reddish body and brownish blotches on the dorsal surface. When collecting the type series of *P. randalli*, the first author also noticed some specimens with a similar appearance, but lacking the characteristic black spots of *P. randalli* on the caudal fin. As a precaution, these specimens were not included in the description of that species. Additional collections in southern Taiwan yielded two colour forms among specimens that were initially identified as *P. shaoi*.

These observations led us to investigate the taxonomic status of these four colour forms by DNA barcoding (i.e., by comparing the cytochrome c oxidase subunit I sequence, COI). The results support recognition of these forms as species level.

The purposes of this study are to: describe and name the two new species of *Parapercis*; and to provide morphological and molecular evidences to distinguish these four congeners.

MATERIAL AND METHODS

Taxonomy. — Type specimens for this study are deposited at the National Museum of Marine Biology & Aquarium, Pingtung, Taiwan (NMMBP) and the Queensland Museum, Brisbane, Australia (QM). Other specimens used for comparisons are deposited in the Biodiversity Research Center, Academia Sinica, Taiwan (ASIZP). Methods for taking measurements and counts followed Randall et al. (2008). Data for comparison is provided in Randall (2008), Ho & Shao (2010), and those taken by the first author.

Genetics. — A piece of muscle from the caudal peduncle was taken from each specimen and preserved in 95% ethanol at 4°C for the molecular experiments. Crude DNA extraction was undertaken using the Genomic DNA Mini Kit (Geneaid GT300, Taiwan) extraction protocol and stored at –20°C. A barcode fragment of approximately 650 base pairs (bp) of the mitochondrial cytochrome *c* oxidase subunit I gene (*COI*) gene was amplified using the primer pair FishF2 (5' TCG ACT AAT CAT AAA GAT ATC GGC AC 3') and FishR2 (5' ACT TCA GGG TGA CCG AAG AAT CAG AA 3') by polymerase chain reaction (PCR) as described by Ward et al. (2005). Each 25 µl PCR reaction contains about 10–50 ng template DNA, 2.5 µl 10× reaction buffer, 1.6 µl dNTP mix (2.5 mM dNTP each), 1 µM of each primer, 0.5 U of *Taq* polymerase (Genomics, Taipei, Taiwan), and distilled water. Thermal cycling started with one cycle of 94°C for 4 min, and subsequent 35 cycles of 94°C for 30 s, annealing at 45–50°C for 30 s, and extension at 72°C for 30 s. Finally, a single extension step at 72°C for 10 min. Reaction products were sequenced bi-directionally and analysed on an ABI3730XL model automated sequencer (Applied Biosystems, USA). The *COI* gene sequences were then submitted to Genbank under the accession numbers of JN628991–3 (*P. shaoi*), JN573361–3 (*P. kentingensis* n. sp.), JN58598–7 (*P. rubromaculata* n. sp.), and JN585988–9 (*P. randalli*).

Sequences (594 bp) were aligned using CLUSTAL X version 1.81 (Thompson et al., 1997). A neighbour-joining (NJ) phylogenetic tree of the Kimura two-parameter distance (K2P) with 10,000 bootstrapping replications (Felsenstein, 1985) was constructed using MEGA 3.1 (Kumar et al., 2004).

Comparative material. — *Parapercis shaoi*: ASIZP 65966 (holotype, 126.0 mm), NE Taiwan, 8 Mar.2005. ASIZP 66064 (1 ex., 147.0 mm), paratype, E. Taiwan, 9 Mar.2005. The following NMMB specimens were collected from Hengchun, Pingtung, southern Taiwan: NMMB-P11445 (1 ex., 131.8 mm), 10 Oct.2010; NMMB-P11449 (1 ex., 130.0 mm), 10 Oct.2010; NMMB-P11451 (1 ex., 123.0 mm), 10 Oct.2010; NMMB-P11452 (1 ex., 132.9 mm), 4 Oct.2010; NMMB-P11455 (6 ex., 100.6–134.8 mm), 29 Sep.2010; NMMB-P11460 (1 ex., 124.6 mm), 11 Oct.2010; NMMB-P11461 (1 ex., 110.0 mm), 11 Oct.2010; NMMB-P11465 (1 ex., 125.9 mm), 27 Sep.2010. *Parapercis randalli*: NMMBP 10462 (holotype, 106.6 mm) and NMMBP 10463 (2 ex., 101.2–102.2 mm), Kenting, Pingtung, southern end of Taiwan, 5–70 m, 4 Sep.2010; QM I.38817 (1 ex., 96.9 mm), Kenting, Pingtung, southern end of Taiwan, 50–150 m, 11 Oct.2010.

TAXONOMY

Family Pinguipedidae

Parapercis kentingensis, new species

(Figs. 1A–C, 2, 3A, C, E)

New English name: Kenting sandperch

Parapercis somaliensis (non Schultz): Masuda et al., 1975: 259, Fig. 81-K (southwest Kii peninsula and Ryukyu Is., Japan).

Masuda et al., 1984: 192, pl.261-B (southern Japan). Shao et al., 1993: 309, Fig. I (southern Taiwan, in part). *Parapercis shaoi* (non Randall): Randall, 2008:171 (one paratype, BPBM40667, is re-identified as present new species).

Material examined. — Holotype: NMMB-P11453 (130.6 mm), Hengchun, Pingtung, southern Taiwan, northern part of South China Sea, hook and line, 50–150 m, purchased from Hengchun market by H.-C. Ho, 10 Oct.2010.

Paratypes: All collected from near the holotype locality: NMMB-P11437 (1 ex., 107.9 mm), 5 Sep.2010; NMMB-P11446 (1 ex., 117.5 mm), 10 Oct.2010; NMMB-P11447 (1 ex., 116.2 mm), 10 Oct.2010; NMMB-P11450 (1 ex., 125.7 mm), 10 Oct.2010; NMMB-P11454 (4 ex., 118.1–137.2 mm), 29 Sep.2010; NMMB-P11456 (1 ex., 121.8 mm), 11 Oct.2010; NMMB-P11459 (1 ex., 101.4 mm), 27 Sep.2010; NMMB-P11458 (1 ex., 131.3 mm), 11 Oct.2010; NMMB-P11462 (1 ex., 110.8 mm), 11 Oct.2010; NMMB-P11463 (1 ex., 111.4 mm), 11 Oct.2010; NMMB-P11464 (1 ex., 134.0 mm), 11 Oct.2010; QM I.33860 (1 ex., 127.4 mm), out of NMMB-P11454, 29 Sep.2010.

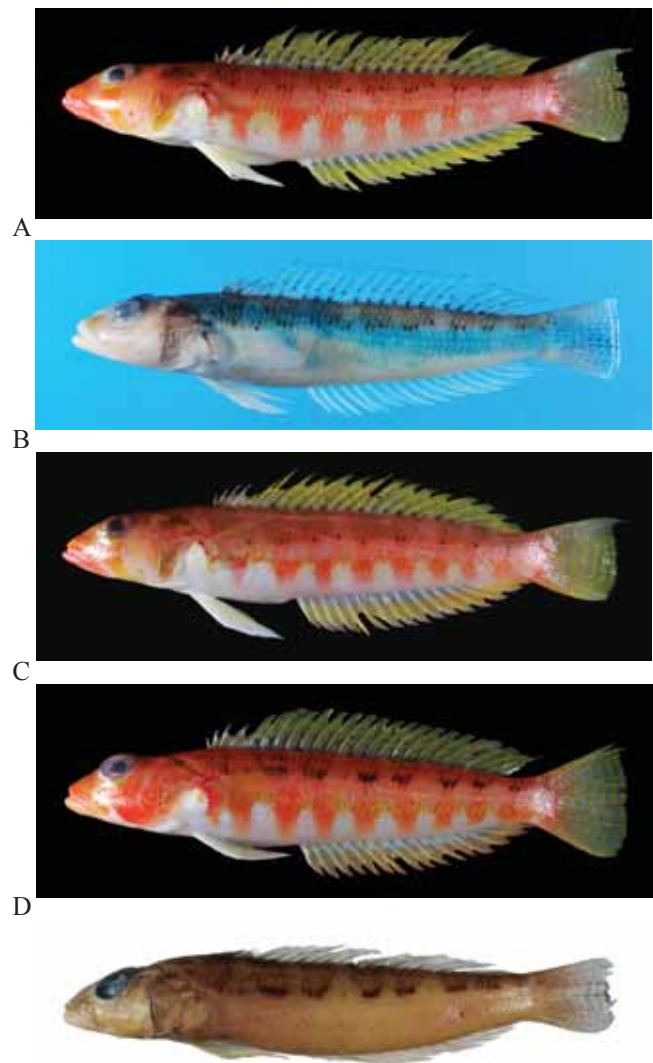


Fig. 1. A–C: *Parapercis kentingensis* n. sp. A, NMMB-P 11453, holotype, 130.6 mm SL, fresh; B, preserved holotype, partially stained with blue; C, QM I.38860, 127.4 mm SL, fresh. D, E: *Parapercis shaoi* Randall, 2008. D, NMMB-P 11452, non-type, 132.9 mm SL, fresh; E, ASIZP 65966, preserved holotype, 126.0 mm SL.

Non-types: All specimens collected from off Pingtung, southern Taiwan. NMMB-P1214 (1 ex., 128.6 mm) and NMMB-P1218 (2 ex., 123.1–130.0 mm), Wanlito, 6 Oct.2005; NMMB-P1637 (2 ex., 147.1–147.2 mm), Oluanbi, 17 Apr.2004; NMMB-P4049 (1 ex., 119.0 mm), Houbihu, 31 Aug.2002; NMMB-P9609 (1 ex., 137.0 mm), Houbihu, 16 Mar.2008; NMMB-P9671 (1 ex., 110.1 mm), 21 Jun.2008; NMMB-P11437 (1 ex., 109.4 mm), Tongkang, 5 Sep.2010; BPBM40667 (1 ex., 138.0 mm), Hengchun, 26 May 1975 (paratype of *Parapercis shaoi*).

Diagnosis. — Eight brown blotches on dorsal surface; a large brownish patch above opercle; an oblique reddish-yellow bar crossing cheek; a series of eight reddish bars below midline of lateral body; one to three small spots on posterior portion of cheek; three rows of small brownish spots on dorsal fin; pectoral fin base whitish with few small spots; a series of small spots, each restricted to the size of one scale, above midline of lateral body; four to five vertical rows of small spots on caudal fin; and a combination of the following characters: dorsal-fin rays V, 21; anal-fin rays I, 17; pectoral-fin rays 16–18 (mainly 17); pored lateral-line scales 52–54 (53–54); gill rakers on 1st gill arch 14–19 (16–18); pseudobranchs 17–24; three pairs of canine teeth anteriorly in lower jaw; no palatine teeth; vomerine teeth stout, in a single curved row; scales on body ctenoid, becoming cycloid on nuchal, prepectoral and prepelvic areas; margin of preopercle smoothly indented; V dorsal-fin spines, the fourth longest; caudal fin rounded, with a slight prolongation on upper lobe; and appressed pelvic fin not reaching origin of anal fin.

Description. — Morphometric and meristic data of type series are provided in Table 1. The following data are provided for the holotype, followed by the range of all types in parentheses (if different from that of holotype).

Dorsal-fin rays V, 21; anal-fin rays I, 17; all dorsal and anal soft rays branched, last soft ray branched to base; pectoral-fin rays 17 (16–18, 16/17 in one paratype and 17/18 in another), branched except uppermost; pelvic-fin rays I, 5; principal caudal-fin rays 17, the uppermost and lowermost unbranched; upper procurrent caudal-fin rays seven (seven to nine); lower procurrent caudal-fin rays seven (six to seven); lateral-line scales 53 (52–54, not including two to four smaller pored scales on base of caudal fin); scales above first lateral-line scale to origin of dorsal fin six; scales above highest part of lateral line to base of dorsal fin 4.5; scales below lateral line postero-ventrally to origin of anal fin about 14 (13–15); median predorsal scales nine (eight to nine); circumpeduncular scales 24 (24–28); gill rakers 6+12 (4–8 + 10–12 = 14–19); pseudobranchial filaments 23 (17–24); branchiostegal rays 6; vertebrae 10+20 (seven specimens examined, including the holotype).

Body depth 5.2 times (4.8–5.7) in SL, 1.6 (1.5–1.8) in HL; body nearly cylindrical anteriorly, the width 5.0 (4.7–6.4) in SL, 1.6 (1.4–2.0) in HL, strongly compressed posteriorly; head length 3.2 (3.1–3.6) in SL; ventral part of head, chest, and abdomen slightly convex; snout length 3.1 (2.5–3.3) in HL; orbit diameter 3.7 (3.2–4.0) in HL; interorbital space flat, the least fleshy width 7.5 (6.0–10.1) in HL; caudal-

peduncle depth 3.4 (2.9–3.5) in HL; caudal-peduncle length 3.3 (2.6–3.9) in HL.

Mouth large, the maxilla nearly reaching a vertical through center of eye, upper-jaw length 2.2 (2.2–2.5) in HL; mouth oblique, forming an angle of about 20° to horizontal axis of body, lower jaw projecting; front of upper jaw with three pairs of recurved canine teeth, the middle one on each side twice as large as the rest; side of upper jaw with row of about 20 slender conical teeth that curve medially and posteriorly, anterior eight increasingly larger and more strongly recurved; remaining teeth in outer row on side of jaw decreasing in length; broad band of villiform teeth medial to canines in about seven rows at front of upper jaw, gradually narrowing posteriorly to a narrow band in about three irregular rows; front of lower jaw with three pairs of incurved canine teeth, increasing in length laterally, third twice as large as second and strongly curving laterally as well as posteriorly; band of about five rows of villiform teeth medial to canines at front of lower jaw, medial row continuing laterally in jaw posterior to last canine as row of seven increasingly larger and more strongly recurved teeth, followed by a single row of small teeth to end of jaw; vomer with a chevron-shaped row of four (four to six) stout conical teeth, those of middle row largest, the lateral teeth progressively smaller; no palatine teeth; lips smooth, their inner surface with large fleshy papillae that interdigitate with anterior teeth; tongue broadly rounded, reaching forward to posterior vomerine teeth.

Gill membranes free from isthmus, with a broad cross-wise free fold. Gill rakers short and spinous, longest about one-third length of longest gill filaments. Nostrils small, anterior nostril in front of center of eye (viewed from side), a little more than half way to groove at edge of upper lip, with slight anterior rim and pointed posterior flap that reaches three-fourths internarial distance when laid back; posterior nostril dorso-posterior to anterior nostril, its aperture ovate, with slight rim.

Pores of cephalic sensory system as shown in Fig. 2. Row of three large pores above maxilla; two pores near nostrils, one above and one below; two pores on either side anteriorly in interorbital space; irregular series of small pores medially on posterior half of interorbital space, followed by two irregular transverse series of pores posteriorly on occiput, connected by a canal under the skin, divided into three double series, one series continuing to ventroposterior margin of eye, a second series continuing to above the free margin of preopercle, and a third series continuing to anterior end of lateral line on body; series of two small pores at dorsal-posterior corner of eye connected to anterior series of occiput series; row of four pores below anterior half of eye; series of six large pores along the margin of preopercle, central two close together, continuing to series of four large pores on mandible; a large medial pore at front of chin.

Opercle with single sharp spine level with ventral edge of pupil (when viewed from side); margin of interopercle smooth except for four (three to five) tiny, close-set serrae on a small bony prominence on upper edge; preopercle broadly

rounded, its free edge smooth except for slight indentations at each pore site, extending from level of ventral edge of orbit downward and forward to slightly in front of vertical at posterior edge of orbit.

Scales finely ctenoid on body, becoming cycloid anterior to a line from base of third dorsal spine to anterior end of lateral line, and on prepectoral and prepelvic areas; scales on opercle cycloid except above spine where a few are very weakly ctenoid; those on subopercle large and ctenoid; those on cheek cycloid, small, mostly nonimbricate, in about 16 (14–16) irregular horizontal rows, from below center of eye to posterior edge of preopercle, with 8 additional short rows extending dorsally to behind ventral half of orbit; no scales on dorsal, anal, or pelvic fins; progressively smaller scales extending out on basal portion of caudal fin for at least two-thirds length of fin; base of pectoral fin with up to 4 rows of small cycloid scales; lateral line broadly arched over pectoral fin, then gradually slanting to straight midlateral portion on about posterior fourth of lateral body.

Origin of dorsal fin over second to third lateral-line scale, predorsal length 3.1 (3.1–3.3) in SL, equal to head length; 1st dorsal-fin spine 11.7 (7.3–11.8) in HL; second dorsal-fin spine 7.2 (5.2–8.0) in HL; third dorsal-fin spine 5.1 (3.7–5.1) in HL; fourth dorsal-fin spine longest, 4.5 (3.0–5.0) in HL; fifth dorsal-fin spine 6.1 (4.0–6.1) in HL, full length of spine attached to first soft ray by membrane; last dorsal soft ray longest, 2.3 (1.8–2.4) in HL; origin of anal fin below base of fourth dorsal soft ray, preanal length 2.0 (1.9–2.2) in SL; anal-fin spine 6.0 (4.6–9.3) in HL; last anal soft ray longest, 2.5 (2.2–2.9) in HL; caudal fin rounded, with prolonged upper lobe centered on third branched ray, extending about two-thirds orbit diameter posterior to central margin of fin, total fin length 5.2 (4.8–6.1) in SL, 1.6 (1.3–1.7) in HL; pectoral fins broadly rounded when spread, tenth ray longest, 5.3 (4.6–5.3) in SL, 1.7 (1.4–1.7) in HL; origin of pelvic fins anterior to pectoral-fin origin, below base of exposed part of opercular spine, prepelvic length 3.6 (3.4–3.7) in SL, 1.1 (1.0–1.1) in HL; pelvic-fin spine slender, 4.3 (4.2–4.3) in

HL; pelvic fins extending to anus, but not reach origin of anal fin; fourth soft pelvic ray longest, 4.5 (4.3–5.0) in SL, 1.4 (1.3–1.5) in HL.

Colour when fresh. — See Figs. 1A, C, 3A, C, E. Pale reddish-brown dorsally, grading to white ventrally, bright white between pectoral and pelvic fins; both jaws and anterior portion of snout reddish; eight brownish blotches evenly distributed on dorsal surface of body; a row of eight reddish bars on body below mid-lateral line; a large brownish patch above opercle; an irregular series of small brown spots, each restricted to one scale, above the lateral body axis; a yellowish ventroposteriorly directed bar with reddish margin on cheek, three horizontal series of brownish spots on soft portion of dorsal fin; spinous portion of dorsal fin reddish yellow anteriorly and dorsally; one to three small spots on posterior portion of cheek; pectoral-fin base whitish with few small spots; a short row of brownish spots behind pectoral fin base; caudal fin with alternating yellow and pale blue stripes and four to five vertical rows of small reddish spots; anal fin yellow, with a pale blue base.

Colour in alcohol. — See Fig. 1B. Creamy white with eight blackish blotches on dorsal surface of body, blotches progressively smaller from anterior to posterior, first between posterior margin of neurocranium and origin of dorsal fin, middle six immediately below soft dorsal fin base, and last on caudal peduncle; a large brownish patch above opercle; three series of small spots on soft dorsal fin; a horizontal series of small black spots, each restricted to one scale, above midline of lateral body; spinous portion of dorsal fin brownish gray; dorsoposterior portion of eye brownish; opercle and subopercle pale brownish; peritoneum pale brown; and gill cavity pale to grayish.

Distribution. — Known from the type series collected at Hengchun, Pingtung, southern tip of Taiwan, northern part of South China Sea, at depths between 50–150 m. Present in Japan, as confirmed by examination of colour figure in Masuda et al. (1975: 259, pl. 81-K).

Etymology. — Named after the Kenting National Park in southern Taiwan, the type locality for the species.

Remarks. — *Parapercis kentingensis* is most similar to *P. shaoi* (Fig. 1D, E), sharing meristic values for fin elements and vertebrae and having similar proportional measurements. The species are sympatric in Taiwan and southern Japan based on our observations and from literature records. *Parapercis kentingensis* can be distinguished from *P. shaoi* by its relatively depressed head and somewhat pointed snout (vs. head relatively deep and snout less pointed); a yellow bar below the eye (vs. a broad reddish patch); yellow patch on snout tip not extending posteriorly to middle of upper jaw (vs. extending to about four-fifths of upper jaw length); one to three reddish spots on cheek (vs. spots absent); anterior pectoral fin base pale or with a very narrow reddish bar (vs. with a broad reddish band); usually presence of a few brownish spots on pectoral fin base (vs. spots absent); three horizontal series of brownish spots on dorsal fin (vs. three

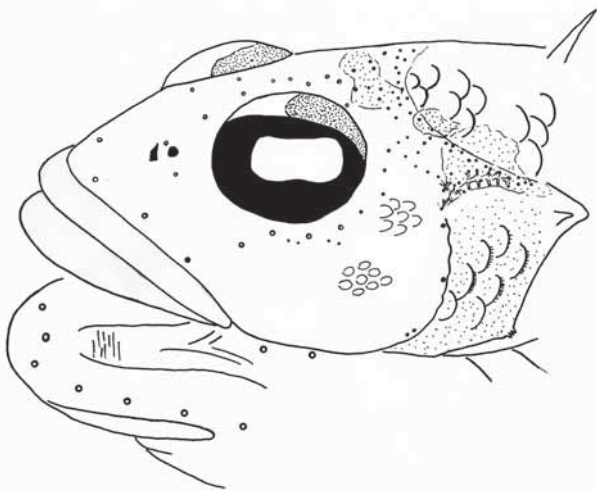


Fig. 2. Dorsal-lateral view (above) and ventral view (below) of head showing the cephalic pore system of *Parapercis kentingensis* n. sp., from the holotype.

to four broken bluish strips); small spots above the lateral body axis (vs. spots much larger); lateral body below the axis yellowish, but not forming a clear band (vs. forming a clear band); four to five vertical rows of small brownish spots on caudal fin (vs. spots absent) (Fig. 3A, C, E vs. Fig. 3B, D, F); and different COI DNA structure.

Parapercis kentingensis also resembles *P. somaliensis* and *P. albipinna* Randall, 2008 in having similar formulae for fin elements, vertebrae, and similar proportional measurements. It differs from *P. somaliensis* mainly in colouration of fins and head and in having a smoothly indented preopercle

(vs. distinctly serrate) and other characters used to separate *P. shaoi* from *P. somaliensis* (see Randall, 2008: 174). It differs from *P. albipinna* in the colouration of the fins and body, and in having the prolongation of the upper lobe of the caudal fin (vs. prolongation absent), and other characters used to separate *P. shaoi* from *P. albipinna* (see Randall, 2008: 174).

Genetics. — The 594 bp of COI gene sequences were obtained from three specimens each of *P. kentingensis* and *P. shaoi*. Genetic distances between specimens of *P. kentingensis* and *P. shaoi* are 10–11% K2P genetic distance,

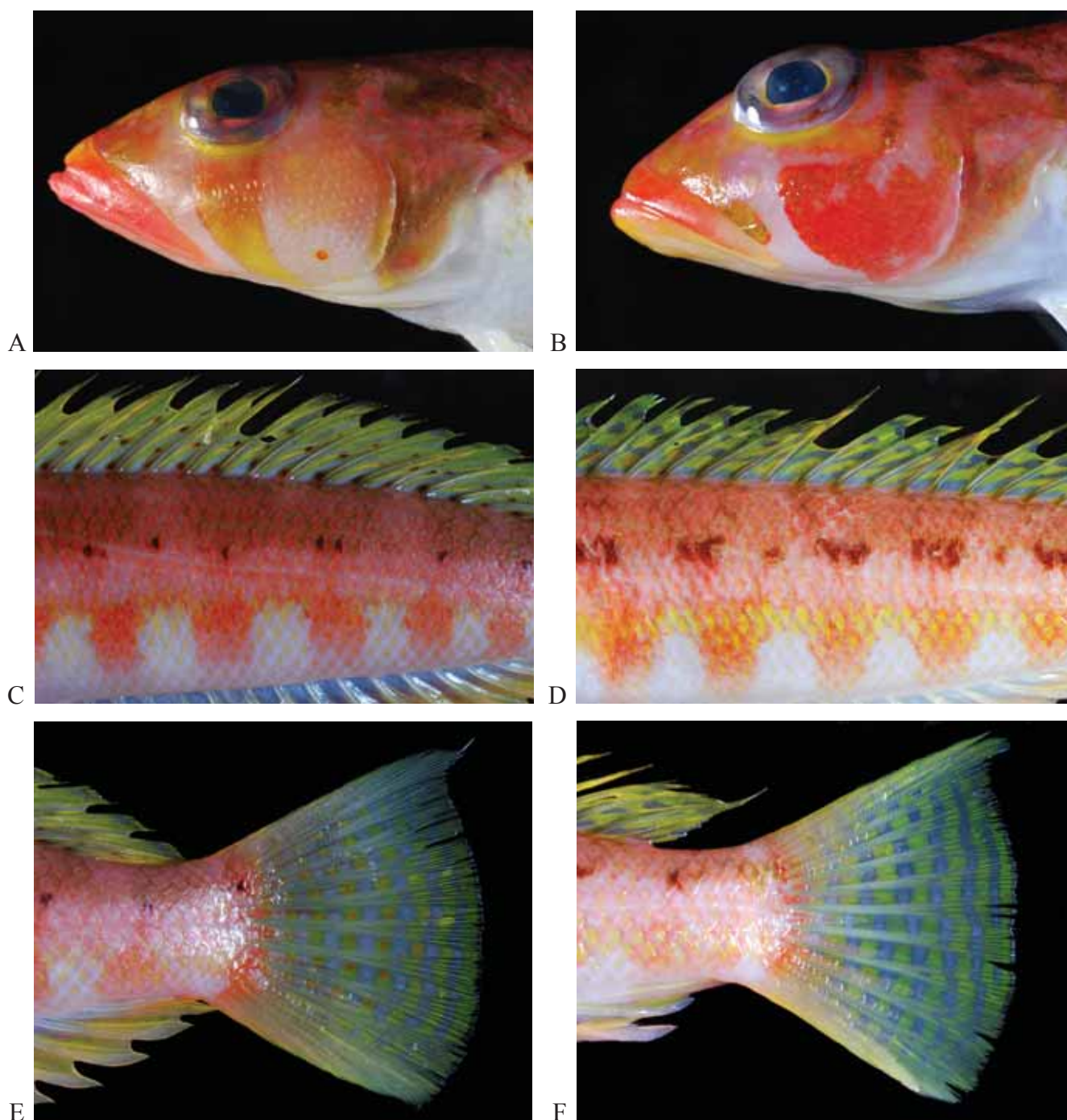


Fig. 3. Selected comparative views of *P. kentingensis* n. sp. (A, C, E) [QM I.38860, paratype, 127.4 mm SL] and *P. shaoi* Randall, 2008 (B, D, F) [NMMB-P11455, non-type, 127.5 mm SL]. A, B: lateral view of left head. C, D: middle left side of body. E, F: left of caudal fin. All photographed from freshly caught specimens.

whereas those of individuals of each species were not more than 1% (Fig. 4).

***Parapercis rubromaculata*, new species**

(Fig. 5A–D, 6A–C)

New English name: redspot sandperch

Material examined. — Holotype: NMMB-P12635 (97.2 mm), Hengchun, Pingtung, southern Taiwan, northern South China Sea, hook and line, ca. 50–80 m, 10 Oct.2010, purchased from Hengchun market by H.-C. Ho.

Paratype: QM I. 38836 (1 ex., 89.5 mm), near type locality, 29 Sep.2010; NMMB-P12637 (1 ex., 78.1 mm), near type locality, 11 Oct.2010, otolith taken before preservation; both purchased from Hengchun market by H.-C. Ho. NMMB-P12636 (1 ex., 114.0 mm), Hengchun, Pingtung, southern Taiwan, 24 May 2008, purchased from Houbihu fish market by C.-W. Chang.

Diagnosis. — Many irregular red spots on caudal fin; five reddish-brown blotches on dorsal body surface; five reddish patches on midline of lateral body, each connected to an overlying dorsal blotches; a diagonal reddish-yellow bar below eye crossing cheek; a series of irregular yellowish patches below midline of lateral body; dorsal fin with medial row of yellowish spots and a row of reddish spots on base of soft rays; anal fin yellowish with a whitish base and some irregular pinkish lines; eye yellowish with two horizontal bar, one above and other below iris; and a combination of the following characters: dorsal-fin rays V, 21; anal-fin rays I, 17; pectoral-fin rays 17; pored lateral-line scales 52–53; gill rakers on 1st gill arch 13–14; pseudobranches 15–17; three pairs of canine teeth anteriorly in lower jaw; no palatine teeth; vomerine teeth stout, in a single curved row; cycloid scales on cheek and in predorsal, prepectoral and prepelvic areas; margin of preopercle smoothly indented; 4th dorsal spine longest; ventral half of caudal fin slightly rounded, dorsal half truncate with a prolongation on upper corner; appressed pelvic fin extends well beyond anus.

Description. — Morphometric and meristic data of type series are provided in Table 1. The following data are provided for the holotype, followed by the range for all types in parentheses, if different from the holotype.

Dorsal-fin rays V, 21; anal-fin rays I, 17; all dorsal and anal soft rays branched, last soft ray branched to base; pectoral-fin rays 17, all branched except uppermost; pelvic-fin rays I, 5; principal caudal-fin rays 17, uppermost and lowermost unbranched; upper procurrent caudal-fin rays nine, lower procurrent caudal-fin rays seven (seven to eight); lateral-line scales 53 (52–53, not including three smaller pored scales on base of caudal fin); scale rows above first lateral-line scale to origin of dorsal fin six; scale rows above highest part of lateral line to base of dorsal fin 4.5; scale rows below lateral line postero-ventrally to origin of anal fin about 11 (11–12); median predorsal scales eight; circumpeduncular scales 24; gill rakers 4+9 (4 + 9–10); pseudobranchial filaments 16 (15–17); branchiostegal rays six; vertebrae 10+19.

Body depth 5.8 (5.8–6.0) times in SL, 1.9(1.7–1.9) in HL; body nearly cylindrical anteriorly, width 5.2 (5.2–5.5) in SL, 1.6 (1.6–1.8) in HL, strongly compressed posteriorly; head length 3.1 (3.1–3.4) in SL; ventral part of head, chest, and abdomen slightly convex; snout length 2.8 (2.8–3.4) in HL; orbit diameter 3.8 (3.1–3.8) in HL; interorbital space

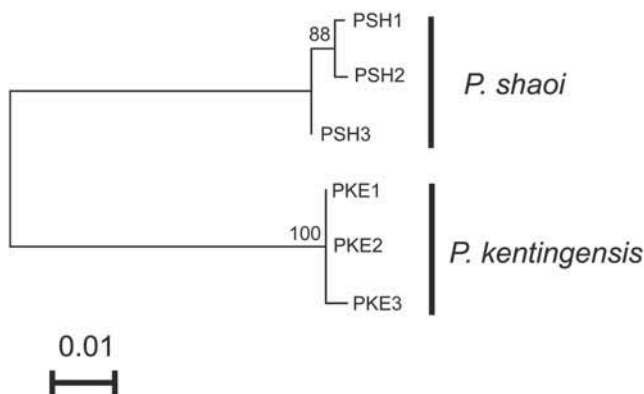


Fig. 4. Neighbour-joining tree of *P. kentingensis* and *P. shaoi* inferred from COI gene sequences with 10000 bootstrap replicates. Bootstrap values > 50% are indicated.

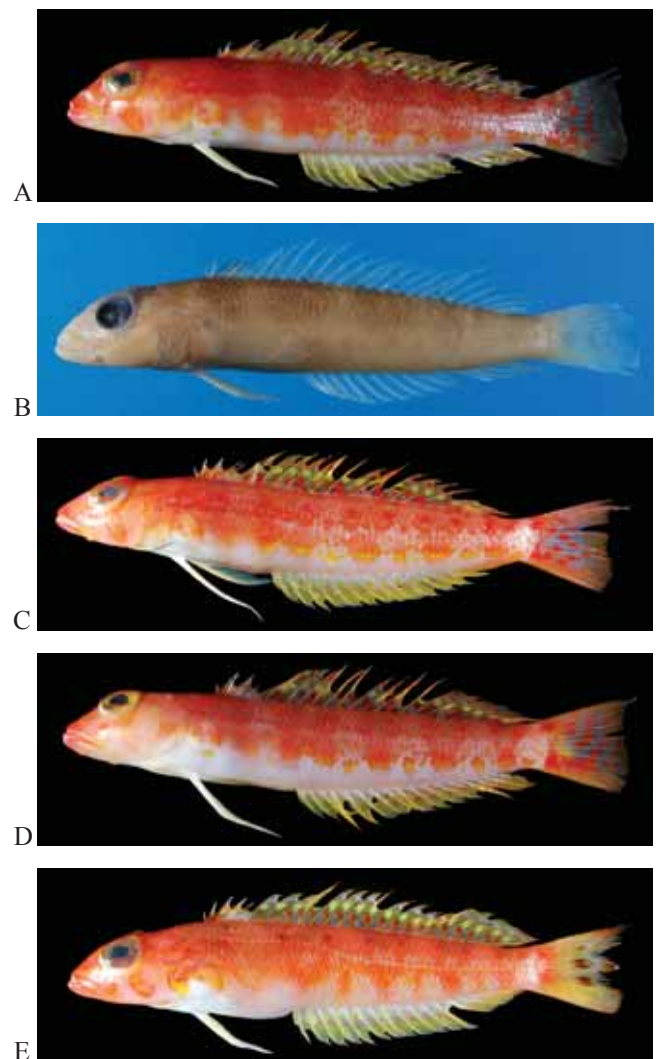


Fig. 5. A–D: *Parapercis rubromaculata* n. sp. A, NMMB-P12635, holotype, 97.2 mm SL, fresh; B, preserved holotype; C, QM I.38860, paratype, 89.5 mm SL, fresh; D, NMMB-P12637, paratype, 78.1 mm SL, fresh; E, *Parapercis randalli* Ho & Shao, 2010, QM I.38817, paratype, 96.9 mm SL, fresh.

Table 1. Morphometric and metistic data of four *Paraperis* species in Taiwan.

Species Name	<i>P. kentingensis</i> n. sp.			<i>P. shaohi</i>			<i>P. rubromaculata</i> n. sp.			<i>P. randalli</i>		
	Holotype	Type series	Non-type	Holotype	Type series	Mean (Range)	SD	Mean (Range)	SD	Mean (Range)	SD	Mean (Range)
SL (mm)	130.6	101.4–137.2 (n=16)	100.6–134.8 (n=13)	97.2	78.1–114.0 (n=4)			96.9–106.6 (n=4)				
Morphometrics (% SL)												
Body depth	19.1	18.8 (17.5–20.8)	19.3 (18.1–20.8)	17.2	17.0 (13.2–19.8)		0.9	18.9 (18.4–20.0)	0.3			
Body width	19.9	19.3 (15.6–21.3)	19.9 (18.2–23.0)	19.3	18.6 (14.2–20.7)		1.1	18.2 (17.4–18.9)	0.6			
Head length	31.4	29.8 (27.4–31.8)	29.5 (27.4–30.8)	31.8	30.8 (24.9–33.2)		1.1	30.2 (29.2–31.1)	1.3			
Snout length	10.1	10.1 (9.4–11.6)	10.0 (9.3–10.9)	11.5	10.0 (7.7–11.2)		0.5	9.8 (9.3–10.6)	1.1			
Orbital diameter	8.4	8.3 (7.7–8.9)	8.3 (7.1–9.0)	8.3	9.0 (7.1–10.7)		0.5	8.5 (8.0–8.9)	0.5			
Interorbital width	4.2	4.0 (2.7–4.7)	3.6 (3.1–4.6)	4.4	3.9 (3.1–4.3)		0.4	4.9 (3.8–5.6)	0.4			
Upper-jaw length	14.5	12.8 (11.4–14.5)	1.9 (9.1–13.7)	12.7	12.3 (9.8–14.5)		1.3	12.8 (12.6–13.0)	0.6			
Caudal-peduncle depth	9.2	9.4 (8.6–9.8)	9.3 (8.6–10.5)	8.7	8.7 (6.8–10.0)		0.6	9.0 (8.6–9.3)	0.2			
Caudal-peduncle length	9.5	9.3 (7.6–10.7)	9.0 (7.6–9.8)	9.0	9.7 (7.2–12)		0.8	9.3 (8.6–9.7)	0.7			
Predorsal length	32.2	31.5 (30.1–32.4)	31.6 (30.4–32.9)	31.8	30.8 (24.4–34.4)		0.8	30.3 (29.2–31.1)	0.8			
Preal length	50.2	48.9 (46.5–51.6)	48.8 (47.0–50.8)	42.1	46.0 (40.0–51.9)		1.0	46.8 (45.4–47.8)	3.8			
Prepelvic length	27.4	27.9 (26.5–32.7)	28.1 (24.6–31.7)	27.0	26.5 (22.2–29.3)		1.7	26.9 (26.1–27.7)	1.5			
Dorsal-fin base	59.0	60.8 (57.0–62.7)	61.1 (57.7–63.1)	62.0	61.8 (46.8–73.1)		1.6	61.6 (60.3–62.9)	1.8			
1st dorsal-fin spine length	2.7	3.1 (2.5–3.9)	3.2 (2.8–4.0)	2.6	2.6 (2.0–2.5)		0.3	2.7 (1.9–4.2)	0.5			
2nd dorsal-fin spine length	4.4	4.8 (4.0–5.6)	5.0 (4.4–5.9)	4.4	4.6 (3.6–5.5)		0.5	5.2 (4.4–6.5)	0.5			
3rd dorsal-fin spine length	6.1	6.8 (5.7–8.4)	6.6 (5.7–7.9)	6.2	6.3 (5.2–7.4)		0.6	6.4 (5.4–7.3)	0.4			
4th dorsal-fin spine length	7.0	7.7 (6.4–9.7)	7.5 (6.5–8.6)	6.6	7.1 (6.2–7.7)		0.6	7.4 (6.7–8.9)	0.7			
5th dorsal-fin spine length	5.1	5.9 (5.1–7.3)	6.3 (5.0–7.0)	5.5	5.9 (4.8–6.5)		0.6	6.7 (6.0–7.1)	0.4			
Longest soft dorsal ray	13.6	14.1 (12.2–15.5)	13.2 (9.6–15.4)	14.1	13.5 (10.2–17.3)		1.5	14.1 (12.4–15.9)	1.6			
Anal-fin base	42.5	43.0 (40.5–45.1)	42.5 (40.0–44.5)	42.6	43.8 (33.5–51.3)		1.1	42.2 (41.8–42.8)	1.2			
Anal-fin spine length	5.2	4.6 (3.0–6.2)	4.5 (3.3–5.8)	5.9	5.2 (7.0–4.6)		0.9	4.1 (3.3–5.1)	0.9			
Longest soft anal ray	12.3	12.0 (10.9–13.4)	11.9 (10.6–12.9)	13.3	12.9 (10.1–14.2)		0.6	12.5 (12.0–13.1)	0.3			
Caudal-fin length	19.1	19.4 (16.4–20.8)	19.4 (17.0–21.2)	20.5	21.2 (16.3–23.0)		1.3	21.2 (20.2–22.1)	1.3			
Pectoral-fin length	18.9	20.1 (18.1–21.9)	20.2 (19.3–21.9)	20.9	20.4 (22.0–20.6)		0.8	20.1 (19.6–20.9)	0.7			
Pelvic-fin spine length	4.7	6.8 (4.7–7.5)	6.5 (5.5–7.3)	5.9	6.2 (5.0–6.8)		0.7	6.7 (6.3–6.8)	0.9			
Pelvic-fin length	22.1	21.7 (20.0–23.4)	22.6 (16.8–24.1)	23.1	23.2 (23.5–25.0)		1.9	20.0 (18.0–20.5)	1.9			
Meristics												
Dorsal-fin rays	V, 21	Value (Frequency) V, 21 (16)	Value (Frequency) V, 21 (13)	V, 21	Value (Frequency) V, 21 (4)			Value (Frequency) V, 21 (4)				
Anal-fin rays	I, 17	I, 17 (16)	I, 17 (10), I, 18 (3)	I, 17	I, 17 (4)			I, 17 (4)				
Pectoral-fin rays	17/17	16/17 (1), 17/17 (14), 17/18 (1)	16/16 (1), 17/16 (2), 17/17 (10)	17/17	17/17 (4)			17/18 (1), 18/18 (3)				
Pored lateral-line scales	53	52 (2), 53 (8), 54 (6)	52 (3), 53 (10)	53	52 (1), 53 (3)			53 (4)				
Gill rakers on 1st gill arch	18	14 (1), 15 (1), 16 (5), 17 (2), 18 (6), 19 (1)	15 (2), 16 (7), 17 (3), 18 (1)	13	13 (1), 14 (3)			14 (2), 15 (1), 16 (1)				
Pseudobranches	23	17 (1), 18 (2), 19 (4), 20 (1), 21 (2), 23 (5), 24 (1)	18 (1), 19 (2), 20 (4), 21 (4), 22 (2)	16	15 (1), 16 (2), 17 (1)			16 (2), 18 (2)				

flat, least fleshy width 7.2 (7.2–8.5) in HL; caudal-peduncle depth 3.6 (3.3–3.7) in HL; caudal-peduncle length 3.6 (2.8–3.6) in HL.

Mouth large, maxilla nearly reaching vertical through center of eye, the upper-jaw length 2.5 (2.3–2.7) in HL; mouth oblique, forming an angle of about 20° to horizontal axis of body, the lower jaw projecting; front of upper jaw with two or three pairs of recurved canines, last on each side twice as large as anteriormost; side of upper jaw with one row of about four to six slender conical teeth that curve medially and posteriorly, gradually increasing in size posteriorly; remaining teeth in outer row on side of jaw decreasing in length; broad band of villiform teeth in about 10 rows medial to canines at front of upper jaw, gradually narrowing posteriorly in jaw to narrow band in about three irregular rows; front of lower jaw with three pairs of incurved canines, increasing in length laterally, the third twice as large as second and strongly curving laterally as well as posteriorly; a band of about seven rows of villiform teeth medial to canines at front

of lower jaw, medial row continuing laterally in jaw posterior to last canine as a row of five to seven increasingly larger and more strongly recurved teeth, followed by a single row of small teeth to end of jaw; vomer with a chevron-shaped row of five to six stout conical teeth, middle largest, lateral teeth progressively smaller; no palatine teeth; lips smooth, their inner surface with large fleshy papillae that interdigitate with anterior teeth; tongue broadly rounded, reaching forward to posterior vomerine teeth.

Gill membranes free from isthmus, with a broad free fold across. Gill rakers short and spinous, longest about one-third length of longest gill filaments. Nostrils small; anterior nostril in front of center of eye (as viewed from side), slightly more than half way to groove at edge of upper lip with a slight anterior rim and a pointed posterior flap that reaches three-fourths internarial distance when laid back; posterior nostril dorso-posterior to anterior nostril, aperture ovate with a slight rim.

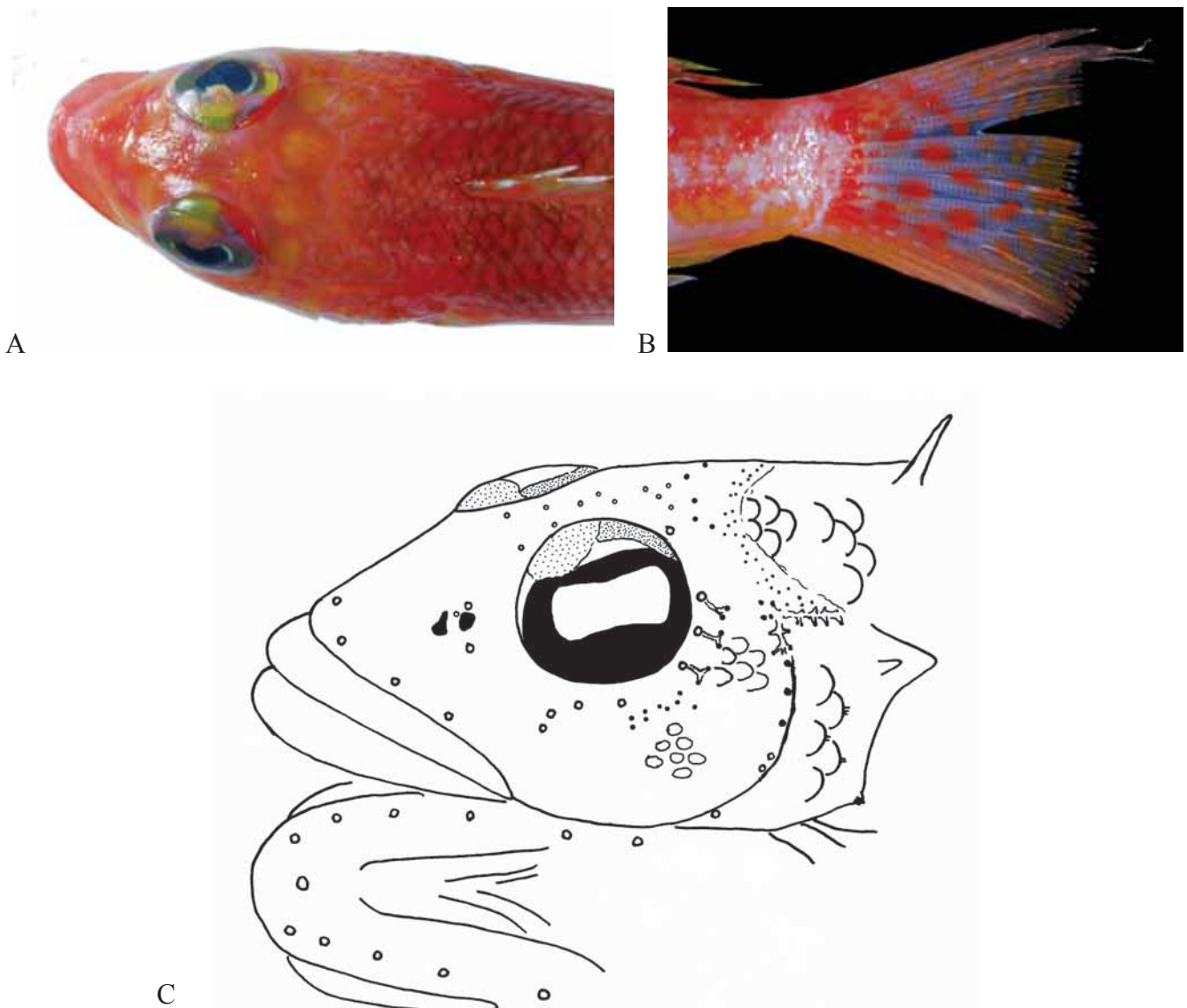


Fig. 6. *Parapercis rubromaculata* n. sp. A, dorsal view of head of holotype, fresh; B, left side of caudal fin, QM I.33860, paratype, fresh; C, dorsolateral (above) and ventral (below) views of the head showing the cephalic pore system, from the holotype.

Pores of cephalic sensory system as shown in Fig. 6C. A row of three large pores on each side of maxilla; two or three median pores near nostrils, one above and one below, one small pore, when present, between both nostrils; two median pores anteriorly in interorbital space; a irregular series of small pores posteriorly in interorbital space, followed by two irregular transverse series of pores posteriorly on occiput, connected by a canal under the skin, divided into three double series, one continuing to ventroposterior margin of eye, one continuing to above free margin of preopercle and one continuing to anterior end of lateral line on body; one pore at dorso-posterior corner of eye; a row of four median pores below anterior half of eye; a series of three pores at posterior margin of eye, each connected by a canal beneath the skin and two terminal pores; a series of eight large pores along the inner margin of preopercle, the central two close together, continuing to a series of four large pores on mandible; a large pore at front of chin.

Opercle with a single sharp spine at level of ventral margin of pupil (when viewed from side); margin of interopercle smooth except for three or four (two to five in paratypes) tiny, close-set serrae on a small bony prominence at upper end; preopercle broadly rounded, its free edge smooth except for slight indentation at pore sites, extending downward and forward from level of ventral edge of orbit to slightly in front of a vertical at posterior edge of orbit.

Scales finely ctenoid on body, becoming cycloid anterior to a line from base of third dorsal spine to anterior end of lateral line, and on pre-pectoral and pre-pelvic areas; scales on opercle cycloid except above spine where a few are very weakly ctenoid; those on subopercle large and weakly ctenoid; those on cheek cycloid, small, mostly non-imbricate, in about 12 irregular horizontal rows, from below center of eye to posterior edge of preopercle, with 8 additional short rows of scales extending dorsally to behind ventral half of orbit; no scales on dorsal, anal, or pelvic fins; progressively smaller scales extending out on basal portion of caudal fin for at least two-thirds length of fin; base of pectoral fin with up to four rows of small cycloid scales; lateral line broadly arched over pectoral fin, then gradually slanting to straight midlateral portion on about posterior fourth of body.

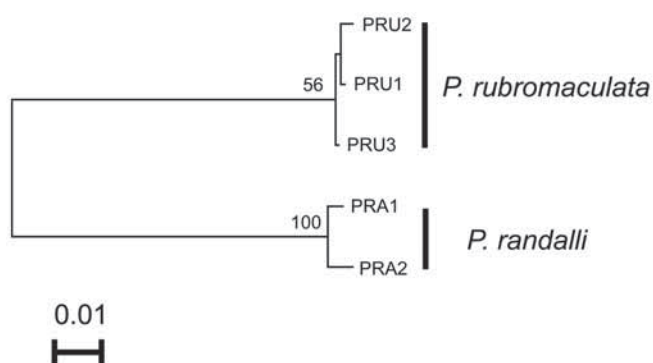


Fig. 7. Neighbour-joining tree of *P. rubromaculata* and *P. randalli* inferred from COI gene sequences with 10000 bootstrap replicates. Bootstrap values > 50% are indicated.

Origin of dorsal fin over second to third lateral-line scale, predorsal length 3.1 (3.1–3.3) in SL, about equal to head length; 1st dorsal-fin spine 12.4 (10.0–13.6) in HL; second dorsal-fin spine 7.2 (6.0–7.2) in HL; third dorsal-fin spine 5.2 (4.5–5.2) in HL; fourth dorsal-fin spine longest, 4.8 (3.9–4.8) in HL; fifth dorsal-fin spine 5.8 (4.9–5.8) in HL, entirely attached to first soft ray by membrane; last dorsal soft ray longest, 2.3 (1.9–2.7) in HL; origin of anal fin below base of fourth dorsal soft ray, preanal length 2.4 (2.0–2.4) in SL; anal-fin spine 5.4 (4.7–7.0) in HL; last anal soft ray longest, 2.4 (2.3–2.5) in HL; ventral half of caudal fin slightly rounded, a small excisur at middle, dorsal half truncate with a prolonged upper lobe which centered on third branched ray, extending about two-thirds orbit diameter posterior to central margin of fin, total fin length 4.9 (4.3–5.0) in SL, 1.6 (1.3–1.6) in HL; pectoral fins broadly rounded when spread, tenth ray longest, 4.8 (4.8–5.2) in SL, 1.5 in HL; origin of pelvic fins anterior to that of pectoral fin, below base of exposed part of opercular spine, prepelvic length 3.7 (3.5–4.0) in SL, 1.2 (1.1–1.2) in HL; pelvic-fin spine slender, 5.4 (4.2–5.4) in HL; pelvic fins extending beyond anus, fourth soft pelvic ray longest, 4.3 (4.1–4.9) in SL, 1.4 (1.3–1.4) in HL.

Colour when fresh. — See Figs. 5 A, C, D, 6A, B. Dorsal surface reddish, grading to white on ventral portion of lateral body, bright white between pectoral and pelvic fins; anterior portions of both jaws and snout reddish orange; five very broad pale brownish blotches evenly distributed on dorsal surface of body; a row of five reddish patches along midline of lateral body; anterior portion of eye yellowish, followed by a bright red band; eye yellowish, iris black with a horizontal reddish bar both above and below; a reddish-yellow ventro-posteriorly directed bar crossing cheek, soft dorsal fin with a horizontal series of yellowish spots centrally and a series of red spots at base; a pale blue line on two-thirds height of soft portion of dorsal fin; spinous portion of dorsal fin reddish yellow anteriorly and dorsally; anal fin yellowish, with a whitish base, a whitish margin and some pinkish lines; about 20–30 irregular bright red spots on caudal fin; prolonged caudal-fin rays reddish; pelvic and anal fins yellowish.

Colour in alcohol. — See Fig. 5B. Creamy white with five broad blackish blotches on dorsal surface of body, becoming progressively smaller from anterior to posterior, first one between posterior margin of neurocranium and origin of soft dorsal fin, middle three below soft dorsal fin, slightly forked ventrally, and the last at caudal peduncle.

Distribution. — Known from the type series collected at Hengchun, southern tip of Taiwan, northern part of South China Sea, at depth ca. 50–80 m.

Etymology. — *ruber* – red, and *maculate* – spot, referring to the characteristic red spots on the caudal fin of this species when fresh.

Remarks. — *Parapercis rubromaculata* is most similar to a recently described species *P. randalli* (Fig. 5E) which coexists in the area. The holotype and one paratype of the former

were collected together with the type series of *P. randalli*. However, as these specimens lacked the characteristic black spots on the caudal fin, they were not included in the description of *P. randalli*. *Parapercis rubromaculata* differs from *P. randalli* in having many red spots on caudal fin (vs. two vertical rows of black spots) and a red area on the dorso-posterior corner of the eye (vs. red area absent); in lacking black spots posterior to the eye, above the opercle and the area between the spinous portion of dorsal fin and the pectoral fin (vs. spots present); having a relatively long pelvic fin (23.5–25.0% SL vs. 18.0–20.5% SL), which extends well beyond the origin of anal fin (vs. just reaches); and a different COI DNA structure.

Genetics. — The 594 bp of COI gene sequences were obtained from three specimens of *P. rubromaculata* and two specimens of *P. randalli*. Genetic distances between specimens of *P. rubromaculata* and *P. randalli* are 14% K2P genetic distance, whereas those of individuals of each species were not more than 1% (Fig. 7).

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LITERATURE CITED

Felsenstein, J., 1985. Confidence limits on phylogenies: An approach using bootstrap. *Evolution*, **39**, 783–791.

Ho, H.-C. & K.-T. Shao, 2010. *Parapercis randalli*, a new sandperch (Pisces: Pinguipedidae) from Southern Taiwan. *Zootaxa*, **2690**: 59–67.

Kumar, S., K. Tamura & M. Nei, 2004. MEGA3: Integrated software for molecular evolutionary genetics analysis and sequence alignment. *Briefings in Bioinformatics*, **5**: 150–163.

Masuda, H., K. Amaoka, C. Araga, T. Uyeno & T. Yoshino, 1984. *The Fishes of the Japanese Archipelago*. Tokai University Press, Tokyo. 450 pp.

Masuda, H., C. Araga & T. Yoshino, 1975. *Coastal Fishes of Southern Japan*. Tokai University Press, Tokyo. 382 pp.

Randall, J. E., 2008. Six new sandperches of the genus *Parapercis* from the Western Pacific, with description of a neotype for *P. maculata* (Bloch and Schneider). *The Raffles Bulletin of Zoology*, Supplement **19**: 159–178.

Randall, J. E., H. Senou & T. Yoshino, 2008. Three new pinguipedid fishes of the genus *Parapercis* from Japan. *Bulletin of the National Museum of Nature and Science (Ser. A)*, Supplement **2**: 69–84.

Schultz, L. P., 1968. Four new fishes of the genus *Parapercis* with notes on other species from the Indo-Pacific area (Family Mugiloididae). *Proceedings of the United States National Museum*, **124**(3636): 1–16.

Shao, K.-T., J.-P. Chen & S.-C. Shen, 1993. *Marine fishes of the Ken-Ting National Park*. Ken-Ting National Park Headquarters, Pingtung. 427 pp. (Text in Chinese).

Shao K.-T. & L.-T. Ho, 1991. *Fishes of Boat Fishing (II)*. Vacation Press, Taipei. 240 pp. (Text in Chinese).

Shen, S.-C., S.-C. Lee, K.-T. Shao, H.-C. Mok, C.-H. Chen, C.-C. Chen & C.-S. Tzeng, 1993. *Fishes of Taiwan*. Department of Zoology, National Taiwan University, Taipei. 960 pp. (Text in Chinese).

Thompson, J. D., T. J. Gibson, F. Plewniak, F. Jeanmougin & D. G. Higgins, 1997. The CLUSTAL X windows interface: Flexible strategies for multiple sequence alignment aided by quality analysis tools. *Nucleic Acids Research*, **25**: 4876–4882.

Ward, R. D., T. S. Zemlak, B. H. Innes, P. R. Last, & P. D. N. Hebert, 2005. Barcoding Australia's fish species. *Philosophical Transactions of the Royal Society B*, **360**: 1847–1857.