Review of *Schismatogobius* (Gobiidae) from Papua New Guinea to Samoa, with description of seven new species

by

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Abstract. – The species of *Schismatogobius* from Papua New Guinea to Samoa are reviewed and compared to the three known species described from the area. Eleven species are recognized including seven new species. These are described using genetic and morphomeristic approaches. The species differ by a high percentage of divergence in partial COI gene (636 bp) and by several characters including the number of pectoral fin rays, the pattern of the ventral surface of the head in males and/or females, the pectoral fin colour pattern, the jaw length/head length ratio or the jaw length of male and/or female, and the fin lengths.

Résumé. – Revue de *Schismatogobius* (Gobiidae) de la Papouasie-Nouvelle-Guinée à Samoa, avec description de sept nouvelles espèces.

De nombreux spécimens de *Schismatogobius,* collectés de la Papouasie-Nouvelle-Guinée aux îles Samoa, ont été étudiés et comparés aux trois espèces décrites de la région. Onze espèces ont été répertoriées dont sept nouvelles. Celles-ci sont décrites en utilisant des approches génétique et morphométristique. Elles diffèrent par un fort pourcentage de divergence de la séquence partielle du gène COI (636 pb) et par plusieurs caractères incluant, principalement, le nombre de rayons aux nageoires pectorales, la coloration de la surface ventrale de la tête du mâle et/ou de la femelle, le ratio longueur de la mâchoire/longueur de la tête ou longueur de la mâchoire du mâle et/ou de la femelle, et la longueur des nageoires.

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The species of *Schismatogobius* de Beaufort, 1912 are distinctive and charismatic freshwater gobies, found in suitable habitats in the tropical Indo-West Pacific. Ten nominal species have been described since 1912, but the genus has never been reviewed or revised. The genus is widely distributed in the tropical Indo-West Pacific and has been collected in many freshwater streams, almost always above tidal influence. It is generally found in areas of coarse sand (Akihito *et al*., 1988), pebbles (Kottelat and Pethiyagoda, 1989; Chen *et al*., 1995a, b, 2001; Keith *et al*., 2004) and small boulders and gravels (Herre, 1927; Allen, 1989; Pusey *et al*., 2004; Jenkins and Boseto, 2005).

Birdsong *et al*. (1988), in their review of axial skeletal characters, placed 10 genera within their *Gobionellus* group and first suggested that *Schismatogobius* may also belong to this group (Doug Hoese, pers. comm.). Larson (2001) later placed *Schismatogobius* in a clade within the subfamily Gobionellinae, stating that it "appears to be a derived gobionelline". Tornabene *et al*. (2013) carried out the first molecular study that included a species of *Schismatogobius* and found that it may be a gobiine related to *Bathygobius* and *Glossogobius* (based on RAG1 nuclear gene) or cousin to kraemeriids (based on rhodopsin nuclear gene). Its exact relationships still remain to be studied, as Kottelat and Pethiyagoda (1989) pointed out.

Nine species are presently assigned to *Schismatogobius*: *S. marmoratus* (Peters, 1868), described from Samar Island, Philippines; *S. bruynisi* de Beaufort, 1912, from Ceram, Indonesia; *S. insignus* (Herre, 1927), from Negros Island, Philippines; *S. roxasi* Herre, 1936, from Panay, Philippines; *S. deraniyagalai* Kottelat & Pethiyagoda, 1989, from Sri Lanka; *S. ampluvinculus* Chen, Shao & Fang, 1995, from Taiwan; *S. fuligimentus* Chen, Séret, Pöllabauer & Shao, 2001, from New Caledonia; *S. vanuatuensis* Keith, Marquet & Watson, 2004, from Vanuatu, and *S. vitiensis* Jenkins & Boseto, 2005, from Fiji. Another species, *Gobiosoma pallida* Herre, 1934, has been placed in *Schismatogobius* by Chen *et al*. (1995b) and Chen *et al*. (2001), but direct examination of the holotype and paratypes (held at CAS and not in good condition) showed that it is not *Schismatogobius* (scales on caudal peduncle, male without prolonged jaws, no preopercular pores) nor a gobionelline and its identity remains uncertain, other than that it belongs to the Gobiinae.

The most striking features of *Schismatogobius* are its total absence of scales, the remarkable stability in the distinctive colour patterns in all species (a red-brown to grey-black

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banded and mottled disruptive colour pattern), the greatly expanded jaws in males in contrast to those of females, having 10-13 (generally 11 or 12) branched caudal fin rays (most gobioids have commonly 13 or more), and lacking pronounced sexual dimorphism in fin lengths or shape. *Schismatogobius* are possibly amphidromous, and there is limited information on the breeding biology of these fishes.

When viewed dorsally and laterally, *Schismatogobius* display little or no pattern differentiation between species although markings can be of significance (Keith *et al*., 2004). Species can show three or four black body bands, when observed in dorsal view. The three dark band pattern seems to be present in post-larvae and juveniles of all species, while the majority of adults have four bands and only a few species have three bands as adults. As the fish are often found half buried in pebbles or gravels, their mottled and spotted brown to reddish and black colouration conceals them well in order to catch prey (generally small insect larvae). However, they need to see each other, to attract sexual partners or for a male to defend a reproductive territory or nest. The colours of the head, lips, mouth lining and the pectoral fin markings (on both front and back sides) are striking, especially the enlarged mouth in males and its bright red-orange inner coloration (Kottelat and Pethiyagoda, 1989). The mouth is gaped during courtship behaviour, the inner colour thus becoming more visible and attractive to females.

Schismatogobius have also distinctive markings on the ventral surface of head (mentum and isthmus), breast, frenum and pelvic fins; these are sexually dichromatic and generally, although slightly variable, unique to each species or a group of species. These markings probably play also a role during courtship. There are also two main patterns on the outer face of each pectoral fin: (i) dark stripes or rows of dark spots that may coalesce or (ii) with a dorsal black spot when the animal is viewed anteriorly. Three-banded adults usually have a dorsal black band or spot anteriorly on their pectoral fins.

One feature that has very often been used to separate species of *Schismatogobius* is the number of pectoral rays, which can vary from 13 to 17. There are also three rough size categories in *Schismatogobius*: small species (average adult size < 22 mm SL), medium species (average adult size 25-30 mm SL) and large species (average adult size 30-35 mm SL) (though it must be acknowledged that these are quite small fishes).

Most *Schismatogobius* have a cephalic sensory pore system of B, D, F, K, L, N and O, with pore D singular and all others paired, and with the oculoscapular canal absent between pores F and K. *Schismatogobius deraniyagalai* differs from all other species (Kottelat and Pethiyagoda, 1989) as it is the only member of the genus lacking the preopercular canal and associated pores N and O, while some individuals also lack the posterior section of the oculoscapular canal and its associated pores K and L. The sensory papillae are generally as described by Akihito *et al*. (1988) and Chen *et al*. (2001) with three horizontal papilla lines on the cheek: the upper row below posterior margin of eye to rear of the preoperculum (row *b*), the middle row from below anterior nostril toward upper rear part of preoperculum (row *c*) and the lowermost row above jaws from the midline of upper jaw toward lower part of preoperculum (row *d*). The lower cheek row *e*, that runs along the edge of the preoperculum from behind the corner of the jaw may be reduced (*e.g*. Chen *et al*., 2001). The operculum has a vertical papilla row, placed close behind the preoperculum (row *ot*) and two short oblique rows cross the central area (rows *os* and row *oi*). The sensory pore system and cheek papillae will not be illustrated for the following descriptions, except if different from this scheme.

Many surveys of tropical island rivers have carried out in the western Pacific during the last 20 years with numerous *Schismatogobius* specimens being collected. Examination of the *Schismatogobius* collections of many museums (AMS, ASIP, AUM, BLIP, CAS, MNHN, MZB, NTM, QM, RMNH, SMF, UF, USNM, WAM and ZMB) and recent trips organised by the MNHN, particularly in the Solomon Islands and Samoa, have discovered new species and also extended the distributions for the previously known species.

The purpose of this paper is to review those *Schismatogobius* species found from Papua New Guinea (PNG) to Samoa (as only three species were described in the past from this area), using genetic and morphometric approaches, and to give descriptions for seven new species. A key for the species of the area is also provided.

METHODS

DNA Barcode analysis

Sample collection

Fish were collected from freshwater streams in the Solomon Islands, Samoa, Australia, New Caledonia and Vanuatu. Individuals were sampled using a DEKA 3000 electrofishing system (Gerätebau, Marsberg, Germany). Fish were euthanised using an overdose of essential clove oil (10%), or a piece of fin was removed before the fish was released otherwise unharmed. Entire fish or fin clips were stored and preserved in 95% alcohol for molecular analysis.

Material examined

A total of 21 *Schismatogobius* specimens were used for this analysis.

Schismatogobius bruynisi: 4 specimens: MNHN 2016-0269 (tag 06948), Liva River, Kolombangara [= Kolobangara] Island, Solomon Islands, 11 Nov. 2015, Keith *et al*. coll.; MNHN 2016-0270 (tag 12065), Vage River, Kolombangara Island, Solomon Islands, 10 Nov. 2015, Keith *et al*.

coll.; MNHN 2016-0271 (tags 11939 and 11932), Lokapare, Choiseul Island, Solomon Islands, 20 Oct. 2014, Boseto *et al*. coll.

Schismatogobius vanuatuensis: 4 spms: MNHN 2016-0283 (tag 6916), Manga River, Kolombangara Island, Solomon Islands, 19 Nov. 2015, Keith *et al*. coll.; MNHN 2016-0282 (tag 6917), Vanga River, Kolombangara Island, Solomon Islands, 18 Nov. 2015, Keith *et al*. coll. Voucher Van1 and Van2, Vanuatu, Jul. 2005, Keith *et al*. coll.

Schismatogobius fuligimentus: 2 spms: voucher NC28207 and S1, New Caledonia, Feb. 2007, Keith *et al*. coll.

Schismatogobius nsp1: 3 spms: MNHN 2016-0267 (tag 06945), MNHN 2016-0268 (tags 06946 and 12070), Kolombangara Island, Solomon Islands, Nov. 2015, Keith *et al*. coll.

Schismatogobius nsp2: 3 spms: MNHN 2016-0265 (tag 6914), MNHN 2016-0266 (tag 5483) and QM I.40660 (tag 11927), Kolombangara Island, Solomon Islands, Nov. 2015, Keith *et al*. coll.

Schismatogobius nsp3: 2 spms: MNHN 2016-0298 (tag 10585) and MNHN 2016-0297 (tag 10598), Ranongga Island, Solomon Islands, Oct. 2015, Keith *et al*. coll.

Schismatogobius nsp Australia: 1 spm: voucher Aus1 (Queensland, Australia).

Schismatogobius nsp Samoa: 2 spms: MNHN 2016-0263 (tag 21) and MNHN 2016-0264 (tag 22), Samoa, Upolu, Feb. 2012, Keith *et al*. coll.

No PNG specimens were able to be sequenced.

DNA extraction and amplification

Pectoral fin tissue was used to extract total genomic DNA from the 21 individuals using the Macherey & Nagel NucleoSpin® Tissue kits following the manufacturer instructions on an Eppendorf EpMotion 5075.

The classic DNA barcode fragment of the cytochrome oxydase I (COI) mitochondrial gene was amplified using primers FishF1-5'TCAACCAACCACAAAGACATTGGCAC3'and FishR1-5'ACTTCAGGGTGACCGAAGAATCAGAA3' (Ward *et al*., 2005). All PCRs were performed on Biometra thermocyclers in a 25 µl volume of 5% of DMSO, 5 µg of bovine serum albumin, 300 µM of each dNTP, 0.3 µM of Taq DNA polymerase from Qiagen, 2.5 µl of the corresponding buffer, and 1.7 pM of each of the two primers. After a 2-minute denaturation at 94°C, the PCR ran 50 cycles of 25 seconds at 94°C, 25 seconds at 52°C and 1 minute at 72°C, with a 3-minute terminal elongation. Purification and Sanger sequencing of PCR products were performed by Eurofins (http://www.eurofins.fr) using the same forward and reverse PCR primers. Chromatograms were assembled and edited using Geneious 8.1.5. All the sequences were aligned with MAFFT Alignment (implemented in Geneious). The percentage of identity between sequences was calculated on Geneious 8.1.5. The translation into amino acids was checked for the partial fragment of COI gene, using the vertebrate mitochondrial genetic code. After translation, one or two bases were discarded at the beginning and the end of the sequences and as a result all the sequences in the alignment started and ended with a codon.

A phylogenetic tree was performed using Bayesian inference (MrBayes v.3.2; Ronquist *et al*., 2012). The best-fitting models of evolution were computed in PartitionFinder (Lanfear *et al*., 2012). According to PartitionFinder, the model that best represented the COI alignment was by codon position with a Kimura 2-parameter model (Kimura, 1980) with a proportion of invariable sites for the first codon position (SYM+4), a F81 (Felsenstein, 1981) model with a proportion of invariable sites (F81+I) for the second codon position and a Hasegawa-Kishino-Yano (HKY) model with discrete gamma distribution for the third codon position. The Bayesian analysis was undertaken using the three-codon positions and was run for 10 million generations, sampling every 250 generations with two independent runs to access convergence. Run convergence was checked using TRACER v.1.6.0 (Rambaut and Drummond, 2007). Trees were summarized using the 50% majority rule method after discarding the first 25% of the sample as burnin and visualised using FigTree v.1.4.2 (Rambaut, 2007). The DNA alignment was completed with additional COI sequences found in GenBank, representing appropriate outgroups (*Awaous, Rhinogobius, Redigobius*).

Morphomeristics

Methods follow Keith *et al*. (2004) with the exception of the body depth, which is measured at anal fin origin, and the pectoral fin length, which is measured from the upper insertion to the posterior extremity. Measurements were taken with a dial calliper to the nearest tenth of a millimetre. All counts were taken from the right side. The size is given in standard length (SL). Abbreviation are as follow: P, Pectoral rays; D, Dorsal rays; A, Anal rays; PDL, Predorsal length (% SL); PAL, Preanal length (% SL); HL, Head length (% SL); JL, Jaw length (% SL); CPL, Caudal peduncle length (% SL); CPD, Caudal peduncle depth (% SL); Pect-L, Pectoral fin length (% SL); BDa, Body depth at anus (% SL); SDFL, Second dorsal fin length (% SL); AFL, Anal fin length (% SL); CFL, Caudal fin length (% SL); SL, Standard length (SL) (mm).

Teeth were always counted to the right of the symphysis, from the tooth closest to the symphysis to the posteriormost dentary or premaxillary tooth; outer row of teeth were counted in the upper jaw and inner row counted in the lower jaw.

Abbreviations used to represent cephalic sensory pores follow Akihito (1986) and sensory papilla rows as in Sanzo (1911). Abbreviations for institutions and collections cited follow the American Society of Ichthyologists and Herpe-

tologists (http://www.asih.org/sites/default/files/documents/resources/symbolic_codes_for_collections_v5.0_sabajperez_2014.pdf).

Morphomeristic data are summarized in tables III and IV.

Schismatogobius de Beaufort, 1912

Diagnosis

Distinguished from other known gobionelline species by having one epural, a dorsal pterygiophore pattern of 3-12210 or 3-22110 (modally the latter), 10+15-16 (modally 16) vertebrae, the first five neural spines sometimes expanded at the tips, two pre-anal pterygiophores, palatine short, ectopterygoid slender and not expanded ventrally, a reduced longitudinal papilla row pattern on the head (one exception), no scales on slender body, head and body almost cylindrical, 16-17 segmented caudal fin rays of which 10-13 are branched, has posterior nasal pores but no anterior interorbital pores, has postorbital but no infraorbital pores, and only the opercular portion of the rear oculoscapular canal is present; males with very large mouths with a brightly coloured lining (red, orange or yellow) and a distinctive banded and mottled body coloration in all species. Species inhabit swift shallow freshwater tropical streams, hiding among gravel, pebbles and coarse sand.

RESULTS

DNA Barcode analysis

A total of 636 base pairs were amplified for the COI gene.

The Bayesian phylogenetic reconstruction (Fig. 1) allowed delimiting eight species, which are all strongly supported (Posterior Probability (PP) values = 1). Furthermore, these eight species are distributed into two clades: one composed of *Schismatogobius vanuatuensis* and a new species from Australia; the other clade is composed of the six other species, *S. bruynisi*, *S. fuligimentus* and four new species: one from Samoa and three from the Solomon Islands.

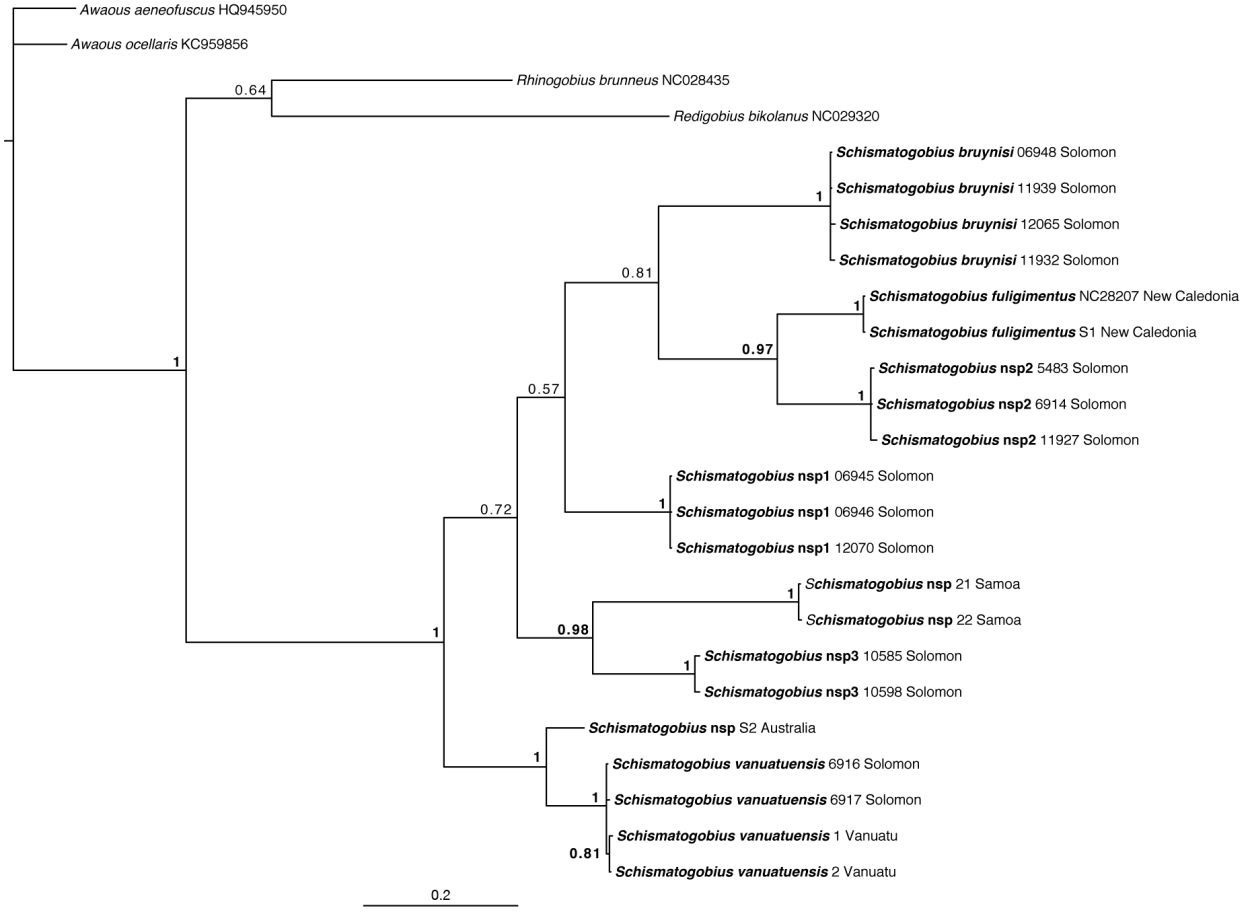

Figure 1. – Bayesian phylogenetic reconstruction, based on the partial COI barcode region (636 bp). The posterior probability values are given at each node. Following each species name is the country the specimen comes from; the numbers following the species are the numbers given on the field.

The mean percentage of divergence between the new species from the Solomon Islands is 16.15%. The two most divergent species, *Schismatogobius* n. sp. from Samoa and *S. bruynisi* from the Solomons, have a mean divergence of 19.18%. The most closely related species in the dataset, *S. vanuatuensis* and *S.* n. sp. from Australia, have a percentage of divergence of 6.76%. Within a species, the mean percentage of divergence between two individuals is 0.29% (Tab. II).

Morphomeristics

Specimen examination led to recognising 11 species, from PNG to Samoa. Four of them have been already described: *S. fuligimentus* Chen, Séret, Pöllabauer & Shao, 2001, endemic to New Caledonia; *S. vitiensis* Jenkins & Boseto, 2005, endemic to Fiji; *S. vanuatuensis* Keith, Marquet & Watson, known from Vanuatu and now also from Solomon Islands and PNG (Fig. 4) and *S. bruynisi* de Beaufort, 1912, described from Ceram, Indonesia, but now also known from PNG and Solomon Islands. Seven are new to science and their descriptions are given herein.

Schismatogobius tuimanua, new species
(Figs 1, 2A, 3, 4; Tabs I-III)

Material examined. – Three specimens from Samoa and American Samoa with a size range of 18.9-20.8 mm SL.

Holotype. – MNHN 2016-0263, female (20.8 mm SL); Luatuanuu River, Samoa, 21 Feb. 2013, coll. Keith, Marquet and Gerbeaux.

Paratypes. – MNHN 2016-0264, female (18.9 mm SL); Tavea River, Samoa, 22 Feb. 2013, coll. Keith, Marquet and Gerbeaux. BLIP 19800196, female (19.4 mm SL); Nuvuli, Papa Stream, Tutuila Island, American Samoa, Aug. 1980, coll. Carl and Ford.

Diagnosis

13-14 pectoral rays; pectoral fins banded with 4-5 rows of blackish bars. Membrane in first dorsal fin posterior to spine 6 is not connected at base of spine in second dorsal fin. Ventral surface of head and isthmus blackish, paler on chest and branchiostegals in female; pelvic disc banded with usually two or three rows of black spots. Males not yet known.

Description

Male unknown, data only from three females. A small *Schismatogobius* (size < 21 mm SL). Body naked, slender, almost cylindrical anteriorly, compressed posteriorly. Head rounded, snout rather pointed. Mouth oblique. Lower jaw tip anteriormost, reaching a vertical at the middle of the eye; jaw length 32-33% of HL. Eyes high on head, close together with interorbital width about third to half of eye diameter. Anterior nostril short and tube-like.

Dorsal fins VI-I,9, membrane in first dorsal fin posterior to spine 6 not connected at base of spine in second dorsal fin. D1 with all spines about equal in length. Anal fin I,9, origin slightly behind or approximately below second dorsal fin origin. Caudal fin with 11-12 branched rays, posterior margin rounded. Pectoral fins oblong with posterior margin pointed and 13(1)-14(2) rays (Tab. I), only ventralmost ray unbranched. Pelvic fins always I,5 with both fins joined together for their entire length between rays 5 to form a strong cup-like disc; between spines a well developed frenum, slightly lobed; fins not extending beyond anus. Morphomeristic data are given in table III.

Tongue (anterior tip) bilobed. Teeth in upper jaw (12-15) in two or three rows, teeth conical on sides and only slightly recurved across front. Teeth in lower jaw (10-14) usually in two rows of teeth anteriorly and single row laterally, all teeth very small, conical, with outer row teeth only slightly enlarged and somewhat recurved.

Cephalic sensory pore system always with pores B, D, F, K, L, N and O, pore D singular with all other pores paired; oculoscapular canal absent between pores F and K. Anterior interorbital extension of anterior oculoscapular canal with double terminal pores B slightly posterior to posterior nostril. D pore at rear of interorbital. Posterior extension of ante-

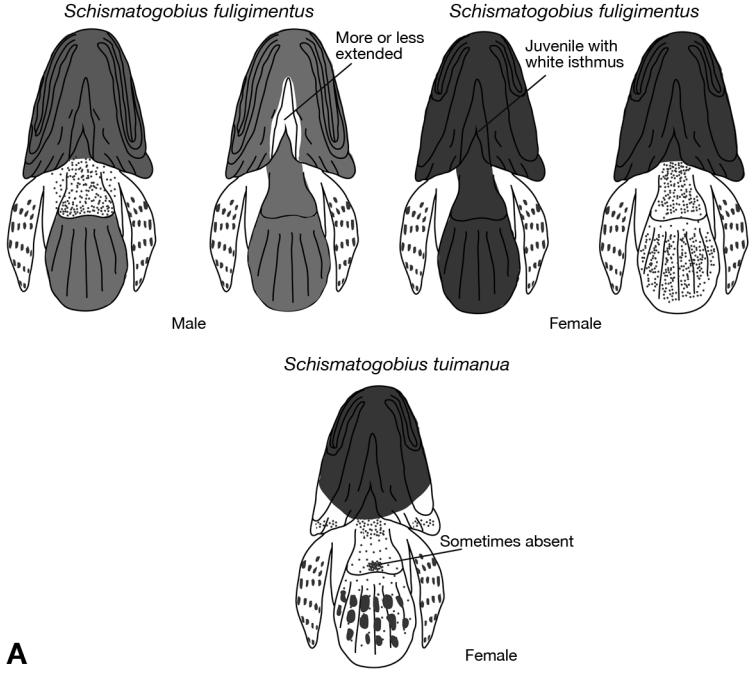

Figure 2. – **A-F**: Schematic drawings of the ventral surface of head of *Schismatogobius* species from Papua New Guinea to Samoa. **A**: 13-14 pectoral rays.

rior oculoscapular canal terminating laterally on each side of head at pore F, just behind posterior edge of eye. Posterior oculoscapular canal with 2 terminal pores, K and L; preopercular canal with 2 pores, N and O. Cutaneous sensory papillae not well developed and inconspicuous due to preservation.

Sexual dimorphism unknown. Urogenital papilla of female broadly oval in ventral view.

Colour in preservation (Fig. 3B)

Female: usually with three vertical black bands in dorsal view; first band below the first dorsal fin, second band below middle to posterior part of second dorsal fin and third band, the smaller one, at base of caudal fin. Ventral part of body mostly cream coloured, tan to grey and brownish dorsally; belly whitish; lateral body colour markings mottled. Head dusky; ventral surface of head and isthmus dusky (Fig. 2A). First dorsal fin with three longitudinal black bands or rows of black spots; basal band wider. Second dorsal fin mostly cream to tan with black spots in rows on membrane and rays. Caudal fin cream to tan with large black blotch on basal part of fin, blotch extending back toward two oval white patches on upper and lower mid-part of fin; blackish spots and mottling above and below black blotch; patterns on proximal half of fin usually with bolder markings than those on distal half. Anal fin mostly cream with dusky pigmentation at base. Pelvic disc banded with two to three rows of black spots, membrane between fifth rays clear, frenum mostly without markings, sometimes with a middle black blotch, distal margin of disc mostly clear. Pectoral fins tan, striped anteriorly with about 4-5 irregular blackish bars; dark spot visible on posterior upper part. The general aspect of the female in preservation is mottled (grey, white and cream), with a cream belly; rows of black spots clearly visible on pectoral fins and clear pattern of the caudal fin.

Colour in life (Fig. 3A)

Three vertical black bands in dorsal and lateral view. First black band under first dorsal fin, second black band under second half, and extending posteriorly, of second dorsal, third black band at base of caudal fin. Lateral and dorsal parts of body between the three vertical black bands on the body reddish: interspaces between black bands whitish to cream coloured, finely mottled with orange reticulation and spotting, becoming more dense and less reticulate on head and nape. Belly

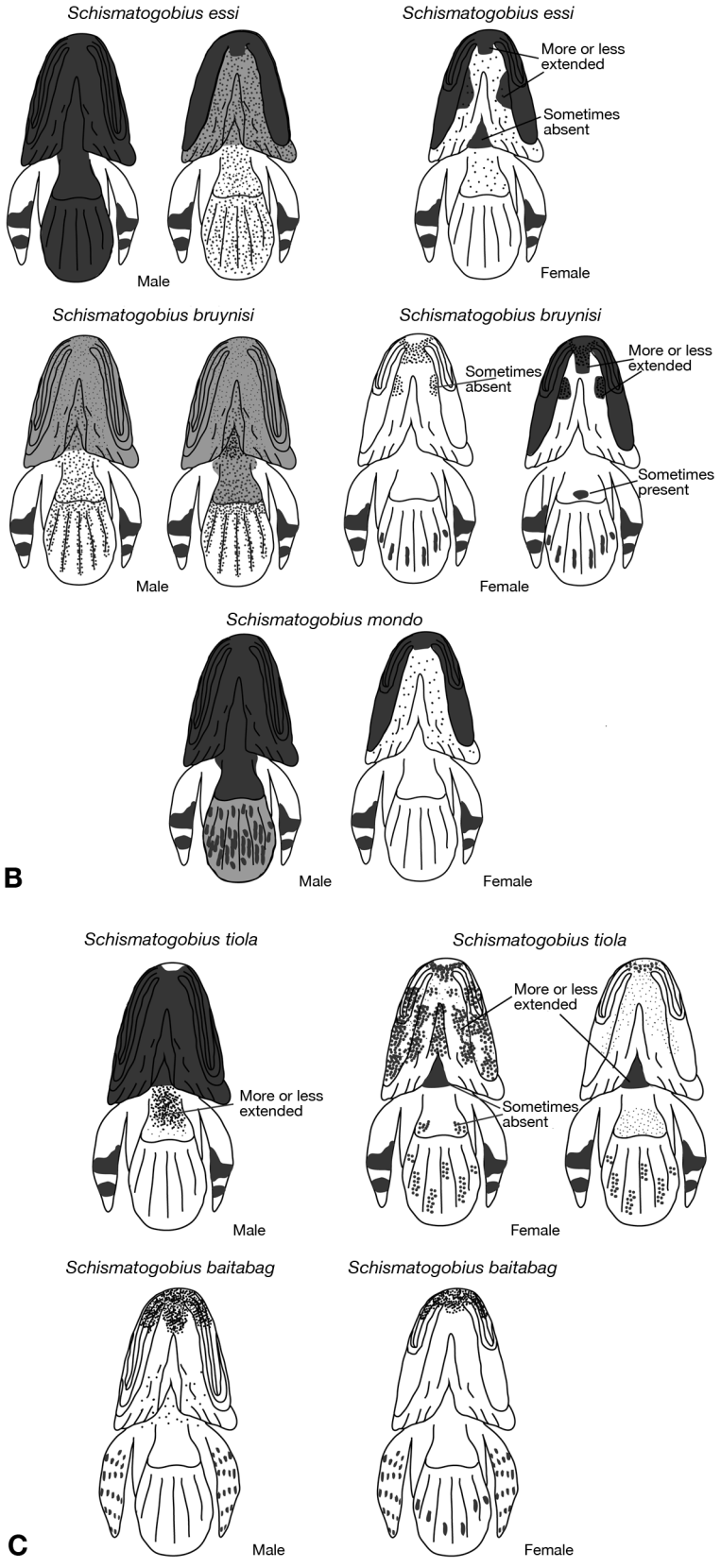

Figure 2. – **B**, **C**: 14-15 pectoral rays.

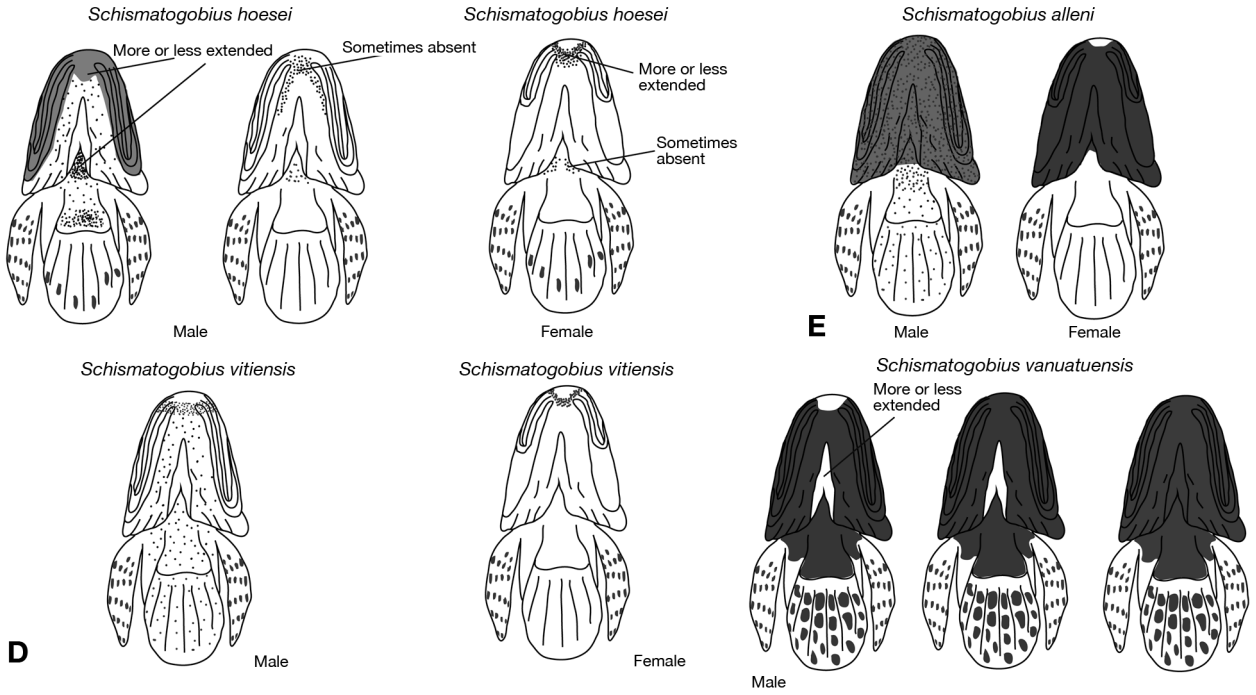

Figure 2. – **D**: 16 pectorals rays.

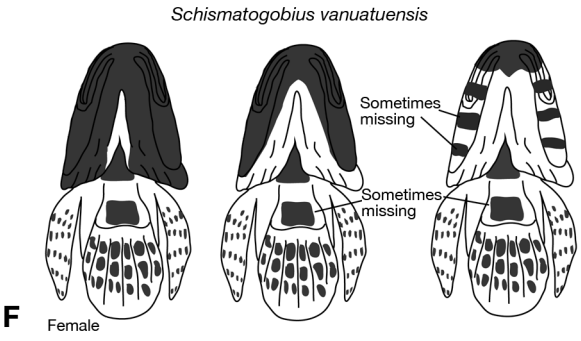

Figure 2. – **E**, **F**: 17 pectoral rays.

whitish. Ventral surface of head and isthmus dusky. First dorsal fin translucent with three longitudinal black bands. Second dorsal fin translucent with black markings appearing as spots on each ray. Caudal fin marbled black and white, with a black spot at hypural and two white spots posteriorly. Anal fin mostly translucent. Pelvic disc mostly banded with two rows of black spots over rays, membrane between fifth rays clear, frenum mostly without markings. Pectoral fins translucent with about 4-5 irregular blackish bars.

Habitat

Schismatogobius tuimanua has been collected in freshwater streams in a moderate flow in shallow areas of rocks and gravel (depth 0.4-0.6 m) just above tidal influence. It appears to be very rare, as three separate field trips failed to find more than three specimens.

Etymology

The name for the new species, as a noun in apposition, is derived from the name of *Tuimanu'a*, the king of all the kings in the Samoan myth of creation, to honour Samoan people.

Remarks

In the Samoan myth of creation, the god *Tagaloa* looked down from his place in the sky and considered creating a place on the Earth where he could stand. So he made a resting place by creating the rock called *Manu'atele* [Greater Manu'a]. Then, *Tagaloa* looked upon all he had created and decided that there should be a king greater than all the others and that he should reside in *Manu'atele*. He selected the son of *Po* [night] and *Ao* [day] to be the king of all the *Tui*

Table I. – Number of pectoral rays of *Schismatogobius* species from Papua New Guinea to Samoa

Pectoral rays	13	14	15	16	17
S. tuimanua	1	2			
S. fuligimentus	7	6			
S. bruynisi		2	10		
S. tiola		1	6		
S. essi		2	8	1	
S. mondo		1	1		
S. baitabag		1	2		
S. hoesei			6	30	1
S. vitiensis			3	3	
S. vanuatuensis				2	9
S. alleni					2

Figure 3. – **A**: *Schismatogobius tuimanua* n. sp., female, 18.9 mm SL (Photo P. Gerbeaux). **B**: *Schismatogobius tuimanua*, holotype, MNHN 2016-0263, female, 20.8 mm SL (Photo P. Keith).

[kings]; and he carried the title *Tuimanu'a Moaatoa* (http://www.sacred-texts.com/pac/jpolys/ssc.htm).

Affinities

S. tuimanua differs from the other species sequenced that occur in the area studied by having a high percentage of divergence in COI gene (16.7-19.5%) (Tab. II) and from all these species, except *S. fuligimentus*, in having 13-14 pectoral rays. It differs from *S. fuligimentus* in having a smaller jaw length/head length ratio in female (32.4-33.3% *vs* 35-41.9%), and a smaller anal fin length (25.2-27.7% *vs* 27.5-33.7% SL).

Distribution

Schismatogobius tuimanua is endemic to Samoa and Western Samoa (Fig. 4).

***Schismatogobius tiola*, new species**

(Figs 1-2C, 4-5; Tabs I-III)

Material examined. – Seven specimens from Solomon Islands with a size range of 23.1-33.5 mm SL.

Holotype. – MNHN 2016-0265, male (25.5 mm SL); Poitete River, Kolombangara [= Kolobangara] Island, Solomon, 14 Nov. 2015, coll. Keith, Lord, Boseto and Marquet; tag 6914.

Paratypes. – MNHN 2016-0266, 2 females (28.2-33.5 mm SL); Poitete River, Kolombangara Island, Solomon, 11 & 13 Nov. 2015, coll. Keith, Lord, Boseto and Marquet. QM I.40660, 1 female (25 mm SL); Vanga River, Kolombangara Island, Solomon, 18 Nov. 2015, coll. Keith, Lord, Boseto and Marquet; tag 11927. MNHN 2016-0292, 1 male (23.1 mm SL); Maravari River, Vella Lavella Island, Solomon, 31 Oct. 2016, coll. Keith, Lord, Boseto and Hevalao; tag 10635. MNHN 2016-0294, 1 female (26.9 mm SL); Mondo River, Ranongga Island, Solomon, 26 Oct. 2016, coll. Keith, Lord, Boseto and Hevalao; tag 10587. MNHN 2016-0295, 1 female (29.8 mm SL); Poro River, Ranongga Island, Solomon, 23 Oct. 2016, coll. Keith, Lord, Boseto and Hevalao; tag 13930.

Diagnosis

Usually 15 pectoral rays; pectoral fins with a large triangular dorsal (or transverse) black band and a smaller one posteriorly. First dorsal fin membrane posterior to spine 6 not connected to base of spine of second dorsal fin. Anal fin I,8-9. Ventral surface of head in male blackish with a white mentum. Ventral surface of head in female whitish or slightly pigmented with dusky blotches and with usually a blackish ring around mentum.

Description

A medium sized *Schismatogobius* (average size < 29 mm SL). Body naked, slender, almost circular in cross-section. Head rounded, snout rather pointed, cheeks bulbous in male. Mouth oblique, tip of lower lip anteriormost. Jaw lengths in males much greater than in females; jaw length 48-55% of HL in male and 28-35% of HL in females. Lower jaw reaching vertical of 1/3 to 1/2 of the eye in female and exceeding (for half eye diameter) a vertical of posterior margin of eye in male. Eyes high on head, close together with interorbital width about equal to half eye diameter. Anterior nostril short and tube-like.

Dorsal fins VI-I,9, membrane in first dorsal fin posterior to spine 6 not connected to base of spine of second dorsal fin. D1 with all spines about equal in length. Anal fin I,8(2)-I,9(5), slightly behind or approximately below second dorsal fin origin. Caudal fin with 11-12 branched rays, posterior margin rounded. Pectoral fins oblong with posterior margin pointed and 14(1)-15(6) rays (Tab. I), ventralmost ray unbranched. Pelvic fins always I,5, with both fins joined together for their entire length between fifth rays to form a strong cup-like disc and a well developed and lobed frenum between spines, fins not extending beyond anus. Morphomeristic data given in table III.

Tongue (anterior tip) bilobed. Teeth in upper jaw (15-20) usually in two rows, teeth conical and slightly recurved. Teeth in lower jaw (6-13) usually in one or two rows anteriorly and single row laterally, all teeth conical with outer row teeth only slightly enlarged and somewhat recurved.

Cephalic sensory pore system always with pores B, D, F, K, L, N and O, pore D singular with all other pores paired; oculoscapular canal absent between pores F and K. Anterior interorbital extension of anterior oculoscapular canal with double terminal pores B slightly posterior to posterior nostril. D pore at rear of interorbital. Posterior extension of anterior oculoscapular canal terminating laterally on each side of head at pore F, just behind posterior edge of eye. Posterior oculoscapular canal with 2 terminal pores, K and L; preoper-

Table II. – Pairwise distance matrix (percentage of divergence between *Schismatogobius* paired individuals).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	*S. bruynisi* 06948 Solomon																				
2	*S. bruynisi* 11939 Solomon	0.00																			
3	*S. bruynisi* 12065 Solomon	0.31	0.31																		
4	*S. bruynisi* 11932 Solomon	0.31	0.31	0.62																	
5	*S.* **nsp1** 06945 Solomon (*S. essi*)	**15.09**	**15.09**	**15.09**	**15.09**																
6	*S.* **nsp1** 06946 Solomon (*S. essi*)	**15.09**	**15.09**	**15.09**	**15.09**	0															
7	*S.* **nsp1** 12070 Solomon (*S. essi*)	**15.09**	**15.09**	**15.09**	**15.09**	0	0														
8	*S.* **nsp** S2 Australia (*S. hoesi*)	**16.35**	**16.35**	**16.67**	**16.19**	13.84	13.84	13.84													
9	*S. vanuatuensis* 6916 Solomon	18.71	18.71	19.03	18.4	14.78	14.78	14.78	6.76												
10	*S. vanuatuensis* 6917 Solomon	18.87	18.87	19.18	18.55	14.94	14.94	14.94	6.92	0.16											
11	*S. vanuatuensis* 1 Vanuatu	18.71	18.71	19.03	18.4	14.78	14.78	14.78	7.08	0.31	0.47										
12	*S. vanuatuensis* 2 Vanuatu	18.55	18.55	18.87	18.24	14.94	14.94	14.94	6.92	0.16	0.31	0.16									
13	*S.* **nsp** 21 Samoa (*S. tuimanua*)	**19.18**	**19.18**	**19.5**	**19.18**	**16.67**	**16.67**	**16.67**	**17.61**	**17.92**	**18.08**	**17.92**	**17.77**								
14	*S.* **nsp** 22 Samoa (*S. tuimanua*)	**19.18**	**19.18**	**19.5**	**19.18**	**16.67**	**16.67**	**16.67**	**17.61**	**17.92**	**18.08**	**17.92**	**17.77**	0.16							
15	*S.* **nsp3** 10585 Solomon (*S. mondo*)	**16.51**	**16.51**	**16.19**	**16.51**	**15.25**	**15.25**	**15.25**	**15.41**	**15.25**	**15.41**	**15.25**	**15.41**	**15.25**	**15.25**						
16	*S.* **nsp3** 10598 Solomon (*S. mondo*)	**16.82**	**16.82**	**16.51**	**16.82**	**15.33**	**15.33**	**15.33**	**15.17**	**15.49**	**15.64**	**15.49**	**15.64**	**15.09**	**15.09**	0.71					
17	*S. fuligimentus* NC28207 New Caledonia	16.51	16.51	16.82	16.35	16.19	16.19	16.19	18.08	18.71	18.55	18.71	18.87	18.08	18.08	16.04	16.12				
18	*S. fuligimentus* S1 New Caledonia	16.51	16.51	16.82	16.35	16.19	16.19	16.19	18.08	18.71	18.55	18.71	18.87	18.08	18.08	16.04	16.12	0			
19	*S.* **nsp2** 5483 Solomon (*S. tiola*)	**16.51**	**16.51**	**16.82**	**16.35**	**17.45**	**17.45**	**17.45**	**17.92**	**18.71**	**18.55**	**18.55**	**18.55**	**18.24**	**18.4**	**17.3**	**17.06**	**10.85**	**10.85**		
20	*S.* **nsp2** 6914 Solomon (*S. tiola*)	**16.35**	**16.35**	**16.67**	**16.19**	**17.3**	**17.3**	**17.3**	**17.77**	**18.55**	**18.4**	**18.4**	**18.4**	**18.08**	**18.24**	**17.14**	**16.9**	**10.69**	**10.69**	0.16	
21	*S.* **nsp2** 11927 Solomon (*S. tiola*)	**16.35**	**16.35**	**16.67**	**16.19**	**17.3**	**17.3**	**17.3**	**17.92**	**18.87**	**18.71**	**18.71**	**18.71**	**18.24**	**18.4**	**17.45**	**17.22**	**10.85**	**10.85**	0.63	0.47

cular canal with 2 pores, N and O. Cutaneous sensory papillae not well developed and inconspicuous due to preservation.

Sexual dimorphism fairly well developed with male having jaws longer than females and a different colour pattern on ventral surface of head. Urogenital papilla broadly rounded in females and slightly pointed in males.

Colour in preservation (Fig. 5C)

Usually four vertical black bands in dorsal view; first band below first dorsal fin, second and third bands below second dorsal fin and fourth band at hypural crease. Lateral body colour markings variable with individual patterns of marbled brown to grey to black. Head dusky, darker dorsally than ventrally in lateral view. In male, ventral surface of head and frenum mostly black, with white mentum (Fig. 2C). Ventral surface of head in female whitish or slightly pigmented usually with blackish ring around mentum (Fig. 2C), or mostly brown with a white mentum and a more or less white isthmus; belly whitish; breast whitish. First dorsal fin with large black median band and black margin. Second dorsal fin mostly cream with a black median band. Caudal fin black and white, with black blotch at centre of hypural crease and two white spots posteriorly. Anal fin mostly cream. Pelvic disc mostly whitish over rays, sometimes slightly pigmented. Base of pectoral fin white and distal part black.

Colour in life (Fig. 5A, B)

Four vertical black bands in dorsal view, each band with a bright blue border, both in male and female. In male, presence of bright blue spots on each black band. Between vertical black bands, orange to rose with many large blue spots. Male head orange to rose with many small blue spots. Female head darker and mottled, mostly black at nape and between eyes. Lower half of the body in lateral view mottled, with black, with and reddish blotches, clearly different from superior half of the body. First dorsal fin translucent with large black median band and black margin. Second dorsal fin translucent with rows of small dark spots on rays. Caudal fin marbled or barred with black and white, with black spot at hypural crease and two large white spots posteriorly. Anal fin translucent. Pelvic disc mostly whitish over rays. Frenum mostly without markings. Pectoral fins whitish at the base, with small orange and blue spots, and black on distal half.

Table III. – Morphometristics of the seven new *Schismatogobius* species. Morphometrics are given as percentages of standard length. P: Pectoral rays; D: Dorsal rays; A: Anal rays; PDL: Predorsal length (% SL); PAL: Preanal length (% SL); HL: Head length (% SL); JL: Jaw length (% SL); CPD: Caudal peduncle depth (% SL); Pect-L: Pectoral fin length (% SL); BDa: Body depth at anus (% SL); SDFL: Second dorsal fin length (% SL); AFL: Anal fin length (% SL); CFL: Caudal fin length (% SL); SL: Standard length (mm).

	S. tuimanua		*S. tiola*		*S. essi*		*S. mondo*		*S. baitabag*		*S. hoesei*		*S. alleni*	
	Holotype	Paratypes	Holotype	Paratypes	Holotype	Paratypes	Holotype	Paratypes	Holotype	Paratypes	Holotype	Paratypes	Holotype	Paratype
P	13	14	15	14-15	14	14-15	14	15	14-15	15	16	15-16	17	17
D	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9	VI,I9
A	I9	I9	I8	I8-9	I9	I8-9	I9	I9	I9	I9	I9	I9	I9	I9
PDL	35.2	38.6-39.3	34.1	34-40.9	38.8	36.6-41.8	38.9	37.8	38.1	34.3-41.3	39.2	33.8-42	40.2	36.2
PAL	58.7	60.9-67	54.5	55.6-63.4	52.7	54-56.5	59.4	54.6	56.5	56-58.6	57.6	54.3-64.6	66.1	55.6
HL male	–	–	25.5	29.4	25.7	26.1-28.8	29.2	–	28.8	–	34.5	30.2-34.5	–	29.7
JL male	–	–	14.1	14.3	13.6	13-15.8	13.7	–	15.7	–	21.1	17.5-21.7	–	14.2
JL/HL male	–	–	55.4	48.5	52.7	48-57.4	46.8	–	54.4	–	61.3	60.1-65.9	–	47.9
HL female	24	26.5-27	–	25.7-27.8	–	25.1-28.9	–	24.8	–	25.1-29.3	–	26-30	28.8	–
JL female	8	8.6-9	–	7.8-8.9	–	8.4-9	–	8.9	–	7.5-7.7	–	9.7-11.9	11.6	–
JL/HL female	33.2	32.4-33.3	–	28.1-34.6	–	30.9-34	–	36	–	25.8-30.8	–	35.8-44.4	40.1	–
CPD	7.2	7-8.5	7.1	6.9-9.2	8.3	6.4-9.2	7.8	8	6.8	5.4-8	7.2	6-8.4	8.3	6.2
Pect L	21.6	26.5	22	22-26	26.6	19.5-26.1	–	20.8	21	19.5-27	23.6	21.2-27.4	27.9	22.8
BDa	16	15-16.9	13.3	11.8-14.3	12.6	10.2-14.2	13.3	12.4	11.1	11.5-12.7	15.6	11.4-16.7	19.8	10.9
SDFL	32.4	34.9-35.3	28.4	29.1-34.6	35.2	30.2-36.1	31.7	33.3	32.4	29-32.4	40	33.1-41.3	36	33.7
AFL	25.2	26-27.7	25.9	23.3-26.8	27.7	26.8-33.3	25.6	28.3	30.2	27-31.8	34.3	26.4-36.3	27	27.2
CFL	21.6	23.2	23.1	21.2-26	17.9	16-19.8	24.8	26.1	18.3	18.5-21.3	18.3	18.5-26.2	27.6	18.1

Habitat

Schismatogobius tiola has been collected in freshwater streams with moderate to fast flow in shallow areas of rocks and gravel (depth 0.3-1 m) just above tidal influence with *S. bruynisi* and *S. vanuatuensis*, in the same habitat.

Etymology

The name for the new species, as a noun in apposition, is dedicated to Tiola, the protecting spirit of war canoes in the Solomon Islands legend of canoe building and their prow figurehead.

Remarks

In the story of Tiola, a stone dog protector of Nusa Roviana village, Tiola would turn its body to face the direction of where the village should raid or in the direction of incoming warriors. In these times, people did not know how to make the *tomako* [war canoe]. But Tiola told the people how to make the *tomako* using certain materials. People wondered where they could find the power to consecrate the *tomako*. Tiola told them to make a canoe icon (*nguzunguzu*) and place it on the bow of the canoe. The dog sat down and folded its legs and said 'Like this' (Aswani, 2000). The *nguzunguzu* conferred upon them the power of Tiola. In this legend, Tiola is thought to come from Kolombangara, the type locality of the new species.

Affinities

S. tiola differs from the other species sequenced and present in the area studied by having a high% of divergence in COI gene (10.9-18.9%) (Tab. II) and from these species, except *S. bruynisi, S. essi* n. sp., *S. mondo* n. sp. and *S. baitabag* n. sp., in having mostly 15 pectoral rays. It differs from *S. bruynisi* in having a smaller jaw length in male (14.1-14.3 *vs* 17.5-21.7% SL) and female (7.8-8.9% *vs* 11.1-12.6% SL), jaw length/head length ratio in male (48.5-55.4% *vs* 57.9-69.2%) and female (28.1-34.6% *vs* 42.5-47.5%), and a different colour pattern of ventral surface of head and frenum in male and female (Fig. 2B, C). It differs from *S. essi* in having a larger size (average adult size more than 26 mm SL *vs* less), a smaller anal fin length (23.3-26.8% *vs* 26.8-33.3% SL), a greater caudal fin length (21.2-26% *vs* 16-19.8% SL), and a different colour pattern of ventral surface of head, pelvic disk and frenum in male and female (Fig. 2B, C) and of pectoral fins. It differs from *S. mondo* n. sp. in having usually four transverse black bands

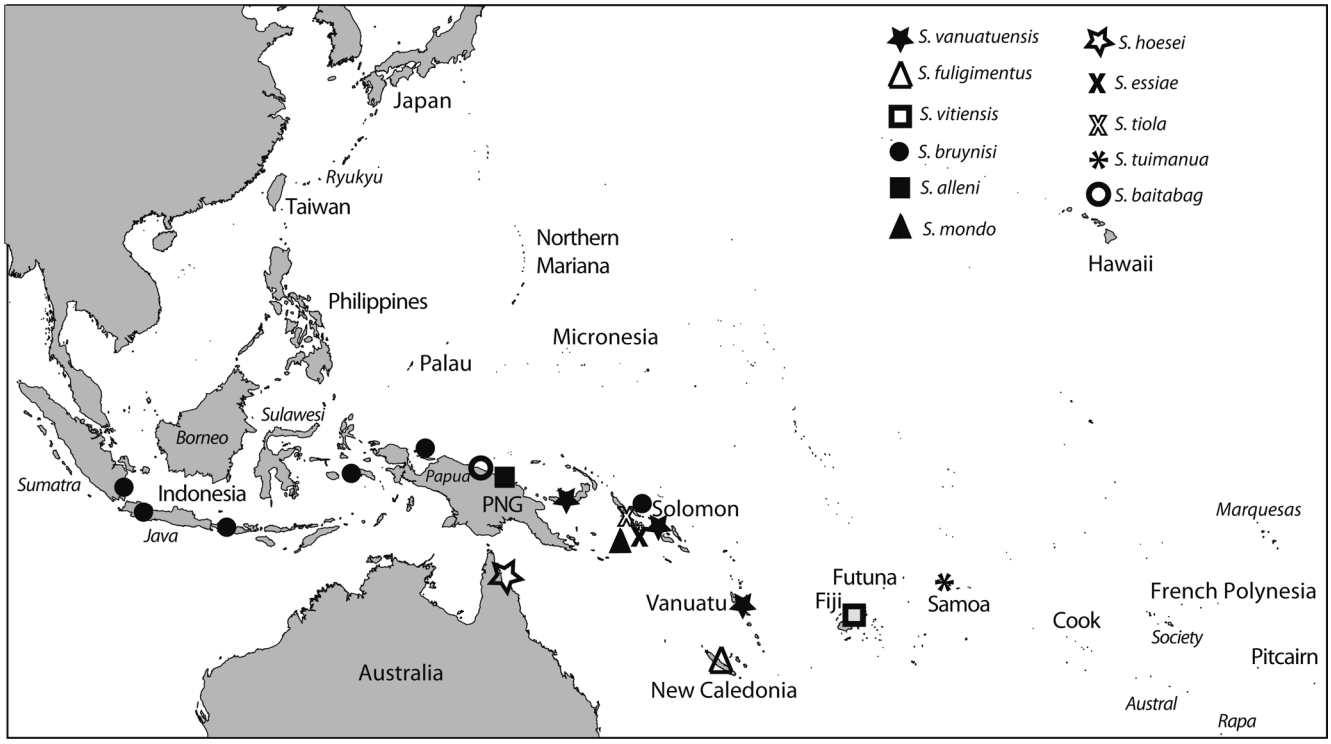

Figure 4. – Distribution area of *Schismatogobius* species from Papua New Guinea to Samoa.

on the body *vs* three, a greater jaw length in male (14.1-14.3% *vs* 13.7% SL), a greater jaw length/head length ratio in male (48.5-55.4% *vs* 46.8%), a smaller jaw length/head length ratio in female (28.1-34.6% *vs* 36%), and a different colour pattern of ventral surface of head, pelvic disk and frenum in male and female (Fig. 2B, C). It differs from *S. baitabag* n. sp. in having pectoral fins with a large black band anteriorly *vs* pectorals striped, a greater jaw length in female (7.8-8.9% *vs* 7.5-7.7% SL), and a different colour pattern of ventral surface of head, pelvic disk and frenum in male and female (Fig. 2C).

Distribution

S. tiola is known only from the Solomon Islands (Fig. 4).

Schismatogobius essi new species
(Figs 1-2B, 4, 6; Tabs I-III)

Material examined. – Eleven specimens from Solomon Islands with a size range of 18.2-26.3 mm SL.

Holotype. – MNHN 2016-0267, male (20.1 mm SL); Vage River, Kolombangara Island [= Kolobangara], Solomon, 11 Nov. 2015, coll. Keith, Lord, Boseto and Marquet; tag 6945.

Paratypes. – MNHN 2016-0268, 3 males and 2 females (16.5-26.3 mm SL); Vage River, Kolombangara Island, Solomon, 11 Nov. 2015, coll. Keith, Lord, Boseto and Marquet; tags 12071, 6946, 12062, 12070 & 12075. AMS I.47237.001, 1 female (15.3 mm SL), Vage River, Kolombangara Island,

Table IV. – Morphomeristics of the four known species of the studied area. Morphometrics are given as percentages of standard length. See legend in table III.

	S. fuligimentus	*S. bruynisi*	*S. vitiensis*	*S. vanuatuensis*
P	13-14	(14)-15	15-16	(16)-17
D	VI,I9	VI,I9	VI,I9	VI,I9
A	I9	I9	I9	I9-I10
PDL	34-41.8	35.6-42	38.2-42	39.6-43.9
PAL	54.1-65.2	55.8-64.6	56.6-65.3	58.2-63.5
HL male	26.5-32.8	26-32	31.1-31.5	30-31.6
JL male	15.1-21.4	17.5-21.7	18.6-21.5	18.8-22.9
JL/HL male	56.8-67.7	57.9-69.2	59.8-68.8	60.1-72.4
HL female	23.2-30.3	25-27.9	28.6-30.7	28.8-32.1
JL female	8.5-10.6	11.1-12.6	8.7-10.8	12.2-14.9
JL/HL female	35-41.9	42.5-47.5	30.4-35	38.1-48.5
CPD	6.1-9.2	6.8-8.8	6.5-8.1	5.8-7.9
Pect L	17.9-26.6	20.2-26.7	20.9-25.6	22.3-28.2
BDa	11.1-16.5	13.5-18.4	13-14.6	11.4-17.1
SDFL	28.8-36.2	30.6-37.9	26.9-32.8	28.1-35.3
AFL	27.5-33.7	29.7-32.6	23.3-30.1	24.5-30.1
CFL	18.4-27.5	19.5-28.3	17.2-19.9	17.3-21.6

Figure 5. – **A**: *Schismatogobius tiola* n. sp., male, 23.1 mm SL; **B**: Female, 30 mm SL (Photos C. Lord). **C**: *Schismatogobius tiola*, holotype, MNHN 2016-0265, male 25.5 mm SL (Photo P. Keith).

Solomon, 10 Nov. 2015, coll. Keith, Lord, Boseto and Marquet; tag 12064. NTM 16447-002, 1 female (18.2 mm SL); Erava River, Tetepare Island, Solomon, 12 Sep. 2006, coll. Jenkins and Boseto. QM I38030, 1 female (22.3 mm SL), Tinahula River, Guadalcanal, Solomon Islands, Jul. 2006, coll. Smith. MNHN 2016-0296, 2 females (22.2-23.5 mm SL); Valakadju River, Vella Lavella Island, Solomon, 28 Oct. 2016, coll. Keith, Lord, Boseto and Hevalao; tags 10640 & 10639.

Diagnosis

Usually 15 pectoral rays; pectoral fins with broad black triangular wedge dorsally usually with few rows of dark spots below it; dorsal fins VI-I,9, membrane in first dorsal fin posterior to spine 6 not connected to base of spine in second dorsal fin. Anal fin I,8-9. Ventral surface of head, frenum and pelvic disc in male entirely blackish or entirely brownish. In female, underside of head pale with chin and surrounding area blackish, with diffuse dark brown area on anterior part of branchiostegal membrane and isthmus.

Description

A small sized *Schismatogobius* (average size < 21 mm SL). Body naked, slender, almost circular in cross-section.

Figure 6. – *Schismatogobius essi* n. sp., holotype, MNHN 2016-0267, male, 20.1 mm SL (Photo P. Keith).

Head rounded, snout rather pointed, cheeks bulbous in males. Mouth oblique, tip of lower lip anteriormost. Jaw lengths in males much greater than in females; jaw length 48-57% of HL in males and 31-34% of HL in females. Lower jaw reaching a vertical of anterior third of eye in female and reaching or exceed (for third of eye diameter) a vertical of posterior part of eye in male. Eyes high on head, close together with narrow interorbital, 9.2% of HL. Anterior nostril with short tube.

Dorsal fins VI-I,9, membrane in first dorsal fin posterior to spine 6 not connected to base of spine of second dorsal fin. D1 with all spines about equal in length. Anal fin I,8(2)-I,9(7), slightly behind or approximately below second dorsal fin origin. Caudal fin with 11-12 branched rays, posterior margin rounded. Pectoral fins oblong with posterior margin pointed and 14(2)-15(8)-16(1) rays (Tab. I), ventralmost ray unbranched. Pelvic fins always I,5, with both fins joined together their entire length between rays 5 to form strong cup-like disc; a well developed frenum (small pointed lobe at each side) between spines, fins not extending beyond anus. Morphomeristic data given in table III.

Tongue (anterior tip) bilobed, not deeply. Teeth in upper jaw (12-23) usually in two rows, teeth conical and slightly recurved. Teeth in lower jaw (10-12) usually in one or two rows anteriorly and single row laterally, all teeth conical with outer row teeth only slightly enlarged and somewhat recurved.

Cephalic sensory pore system always with pores B, D, F, K, L, N and O, pore D singular with all other pores paired; oculoscapular canal absent between pores F and K. Anterior interorbital extension of anterior oculoscapular canal with double terminal pores B slightly posterior to posterior nostril. D pore at rear of interorbital. Posterior extension of anterior oculoscapular canal terminating laterally on each side of head at pore F, just behind posterior edge of eye. Posterior oculoscapular canal with 2 terminal pores, K and L; preopercular canal with 2 pores, N and O. Cutaneous sensory papillae not well developed and inconspicuous due to preservation.

Sexual dimorphism fairly well developed with males always having jaws longer than females and a different colour pattern on the ventral surface of head. Urogenital papilla broadly rounded in females and slightly triangular in males.

Figure 7. – **A**: *Schismatogobius mondo* n. sp., paratype, MNHN 2016-0298, female, 18.0 mm SL (Photo P. Keith). **B**: *Schismatogobius mondo* n. sp., holotype, MNHN 2016-0297, male, 20.1 mm SL (Photo P. Keith).

Colour in preservation (Fig. 6)

Usually four vertical black bands over pale yellowish body in dorsal view; first band below first dorsal fin, second and third bands below the second dorsal fin (may coalesce to form single broad band, slightly paler toward centre) and fourth band at base of caudal fin. Side of body, between dark bands, with fine brown mottling and speckles, may form vermiculate patterns. Head slightly darker than body, side of head with darker brown mottling; indistinct darker brown bar from eye to jaw and another on opercle just behind rear preopercular margin; few small dark brown spots on middle of nape and another above corner of opercle. In male, ventral surface of head, frenum and pelvic disk entirely blackish or brownish (Fig. 2B). In female, underside of head pale with chin and surrounding area blackish, with diffuse dark brown area on anterior part of branchiostegal membrane and isthmus, most of isthmus and breast unpigmented (Fig. 2B). Belly pale anteriorly; posterior half of belly with brown pigment where black body bar extends. First dorsal fin with black basal band and black margin. Second dorsal fin translucent with several vertical blackish streaks and spots along rays. Caudal fin black and white, with broad black blotch (continuation of last body bar) extending in irregular pattern onto fin and becoming dusky posteriorly, partly surrounding two whitish spots posteriorly. Anal fin translucent to cream. Pectoral fins with broad black triangular wedge, with narrow black bar (formed by row of spots) ventrally and second short row of black spots posteriorly; a dark spot is generally visible on the posterior upper part.

Colour in life

Similar to that in preservation, but lateral and dorsal parts of body between vertical black bands reddish. First dorsal fin translucent with small black basal band and black margin. Second dorsal fin translucent with black stripes. Caudal fin black and white, with black blotch at hypural and two white spots posteriorly. Anal fin translucent. Pectoral fins with broad black triangular band or wedge commencing from dorsal part.

Habitat

Schismatogobius essi has been collected in freshwater streams with moderate to fast flow in shallow areas of gravel (depth 0.3-0.7 m) just above tidal influence, in company with *S. bruynisi* and *S. vanuatuensis*.

Etymology

The name for the new species, as a noun in apposition, is dedicated to the NGO ESSI (Ecological Solution, Solomon Islands), which tries to improved taxonomic and ecological knowledge of species and ecosystems throughout the Solomon Islands, through close collaboration with local tribes or communities.

Affinities

S. essi differs from the other species sequenced and present in the area studied by a high% of divergence in COI gene (13.8-17.4%) (Tab. II) and from all these species except for *S. bruynisi, S. tiola* n. sp., *S. mondo* n. sp. and *S. baitabag* n. sp., in having mostly 15 pectoral rays. It differs from *S. bruynisi* in having a smaller jaw length in male (13-15.8 *vs* 17.5-21.7% SL) and female (8.4-9% *vs* 11.1-12.6% SL) and jaw length/head length ratio in male (48-57.4% *vs* 57.9-69.2%) and female (30.9-34% *vs* 42.5-47.5%), and a different colour pattern of ventral surface of head, pelvic disk and frenum in male (Fig. 2B). It differs from *S. tiola* in having a smaller size (average adult size less than 26 mm SL *vs* more), a greater anal fin length (26.8-33.3% *vs* 23.3-26.8% SL), a smaller caudal fin length (16-19.8% *vs* 21.2-26% SL), and a different colour pattern of ventral surface of head, pelvic disk and frenum in female (Fig. 2C) and of pectoral fins. It differs from *S. mondo* n. sp. in having usually four transverse black bands on the body *vs* three, a greater jaw length/head length ratio in male (48-57.4% *vs* 46.8%), a smaller jaw length/head length ratio in female (30.9-34% *vs* 36%), and a smaller caudal fin length (16-19.8% *vs* 24.8-26.1%) (Fig. 2B). It differs from *S. baitabag* n. sp. in having pectoral fins with a large black wedge *vs* pectorals banded with rows of dark spots, a greater jaw length in female (8.4-9% *vs* 7.5-7.7% SL), jaw length/head length ratio in female (30.9-34% *vs* 25.8-30.8%), and a different colour pattern of ventral surface of head, pelvic disk and frenum in male and female (Fig. 2C).

Distribution

S. essi is known only from the Solomon Islands (Fig. 4).

Schismatogobius mondo, new species

(Figs 1-2B, 4, 7; Tabs I-III)

Material examined. – Two specimens from Solomon Islands with a size range of 18-20.1 mm SL.

Holotype. – MNHN 2016-0297, male (20.1 mm SL); Mondo River, Ranongga Island, Solomon Islands, 26 Oct. 2015, coll. Keith, Lord, Boseto and Hevalao; tag 10598.

Paratype. – MNHN 2016-0298, female (18.0 mm SL); Dae River, Ranongga Island, Solomon Islands, 24 Oct. 2015, coll. Keith, Lord, Boseto and Hevalao; tag 10585.

Diagnosis

14-15 pectoral rays; pectoral fins partly crossed by broad black band and few rows of black spots. First dorsal fin membrane posterior to spine 6 not connected to base of spine of second dorsal fin. Anal fin I,9. Three transverse black bands on the body. Ventral surface of head and frenum in male blackish. Ventral surface of head in female whitish with a blackish border.

Description

A small sized *Schismatogobius* (average size < 22 mm SL). Body naked, slender, almost circular in cross-section. Head rounded, snout rather pointed. Mouth oblique, tip of lower lip anteriormost. Jaw lengths in male much greater than in female; jaw length 47% of HL in male holotype and 36% of HL in female paratype. Lower jaw reaching vertical of 1/3 of the eye in female and exceeding (for 1/3 of eye diameter) a vertical of posterior margin of eye in male. Eyes high on head, close together; interorbital width about equal to half eye diameter. Anterior nostril in short tube.

Dorsal fins VI-I,9, membrane in first dorsal fin posterior to spine 6 not connected to base of spine of second dorsal fin. D1 with all spines about equal in length. Anal fin I,9, slightly behind or approximately below second dorsal fin origin. Caudal fin with 12 branched rays, posterior margin rounded. Pectoral fins oblong with posterior margin pointed and 14(1)-15(1) rays (Tab. I), ventralmost ray unbranched. Pelvic fins always I,5, with both fins joined together for their entire length between fifth rays to form a strong cup-like disc and a well developed and lobed frenum between spines, fins not extending beyond anus. Morphomeristic data given in table III.

Tongue (anterior tip) bilobed. Teeth in upper jaw (16-20) in two or three rows, teeth conical and slightly recurved. Teeth in lower jaw (7-12) in two rows anteriorly and single row laterally, all teeth conical with outer row teeth only slightly enlarged and somewhat recurved.

Cephalic sensory pore system always with pores B, D, F, K, L, N and O, pore D singular with all other pores paired; oculoscapular canal absent between pores F and K. Anterior interorbital extension of anterior oculoscapular canal with double terminal pores B slightly posterior to posterior nostril. D pore at rear of interorbital. Posterior extension of anterior oculoscapular canal terminating laterally on each side of head at pore F, just behind posterior edge of eye. Posterior oculoscapular canal with 2 terminal pores, K and L; preopercular canal with 2 pores, N and O. Cutaneous sensory papillae not well developed but similar to pattern described by Akihito *et al*. (1988).

Sexual dimorphism fairly well developed with male having jaws longer than female and a different colour pattern on ventral surface of head. Urogenital papilla broadly rounded in female and slightly pointed in male.

Colour in preservation (Fig. 7B)

Three vertical black bands in dorsal and lateral views; first band below first dorsal fin, second below second dorsal fin and third one at hypural crease. Head black. These lateral body black markings alternate with 3 vertical white to grey stripes. In male, ventral surface of head and frenum black, with pelvic fins brownish to black (Fig. 2B). Ventral surface of head in female slightly pigmented with a blackish border (Fig. 2B); belly whitish; breast whitish. First dorsal fin with large black basal band. Second dorsal fin mostly cream with rows of black spots on rays. Caudal fin black and white, with black spot at centre of hypural crease and two white spots posteriorly. Anal fin mostly cream. Pectoral fins with a large triangular transverse black band.

Colour in life (Fig. 7A)

Female with three vertical black bands, lateral and dorsal parts of body between vertical black bands are cream with rose to orange mottling, pinkish towards the nape becoming darker on the posterior part of the body. Head pinkish dorsally with a few brown markings; cheeks with numerous tight brown spots. Ventral surface of head white. First dorsal fin translucent with wide black basal band. Second dorsal fin translucent with rows of small dark dots on rays. Caudal fin barred black and white, with large black blotch beginning at hypural crease and extending on first half fin toward two white oval spots. Anal fin translucent. Pectoral fins translucent with a couple of rows of black spots.

Habitat

Schismatogobius mondo has been collected in freshwater streams with moderate to fast flow in shallow areas of rocks and gravel (depth 0.3-0.6 m) just above tidal influence with *S. bruynisi, S. tiola* and *S. vanuatuensis*, in the same habitat.

Etymology

The name for the new species, a noun in apposition, is derived from Mondo village, the type locality. It honours the Mondo village people who helped us to collect the species but also welcomed us warmly.

Affinities

S. mondo differs from the other species sequenced and present in the area studied by having a high% of divergence in COI gene (15.1-17.4%) (Tab. II) and from these species, except *S. bruynisi, S. tiola* n. sp., *S. essi* n. sp. and *S. baitabag* n. sp., in having mostly 15 pectoral rays. It differs from *S. bruynisi* in having a smaller jaw length in male (13.7 *vs* 17.5-21.7% SL) and female (8.9% *vs* 11.1-12.6% SL), jaw length/head length ratio in male (46.8% *vs* 57.9-69.2%) and female (36% *vs* 42.5-47.5%), and a different colour pattern of ventral surface of head and frenum in male and female (Fig. 2B, C). It differs from *S. tiola* n. sp. in having three transverse black bands on the body *vs* four, a smaller jaw length in male (13.7% *vs* 14.1-14.3% SL), a smaller jaw length/head length ratio in male (46.8% *vs* 48.5-55.4%), a greater jaw length/head length ratio in female (36% *vs* 28.1-34.6%), and a different colour pattern of ventral surface of head, pelvic disk and frenum in male and female (Fig. 2B, C). It differs from *S. essi* n. sp. in having three transverse black bands on the body *vs* four, a smaller jaw length/head length ratio in male (46.8% *vs* 48-57.4%), a greater jaw length/head length ratio in female (36% *vs* 30.9-34%), and a greater caudal fin length (24.8-26.1% *vs* 16-19.8%). It differs from *S. baitabag* n. sp. in having pectoral fins with a large black band anteriorly *vs* pectorals striped, a greater jaw length in female (8.9% *vs* 7.5-7.7% SL), a greater jaw length/head length ratio in female (36% *vs* 25.8-30.8%),%), a greater caudal fin length (24.8-26.1% *vs* 18.5-21.3%) and a different colour pattern of ventral surface of head, pelvic disk and frenum in male and female (Fig. 2B, C).

Distribution

S. mondo is known only from the Solomon Islands (Fig. 4).

Schismatogobius baitabag, new species
(Figs 2C, 4, 8; Tabs I-III)

Material examined. – Three specimens from Papua New Guinea with a size range of 22.5-27.8 mm SL.

Holotype. – NTM S13675-011, male (27.8 mm SL); Baitabag Village, Nagada River, Madang, Papua New Guinea, 13 Oct. 1992, coll. Larson, Mizeu, Matthew and villagers.

Paratypes. – NTM S13675-001, 1 female (25.9 mm SL); same data as holotype. WAM P29613-015, 1 female (22.5 mm SL); Bogia, 4.5 N road to Awar, 19 Oct. 1987, coll. Allen and Parenti.

Diagnosis

Usually 15 pectoral rays; pectoral fins banded with rows of dark spots. Membrane in first dorsal fin posterior to spine 6 partly connected to base of spine of second dorsal fin. Ventral surface of head, frenum and pelvic disk in male yellowish, with black mentum and lower lips. Ventral surface of head, frenum and pelvic disk in female yellowish, with dark mentum.

Description

A medium sized *Schismatogobius* (average size 25 mm SL). Body naked, slender, almost circular in cross-section. Head rounded, snout rather rounded. Mouth oblique, tip of lower lip anteriormost. Jaw lengths in male much greater than in females; 54% in male holotype (in HL), 26-31% in females. Lower jaw reaching a vertical of anterior third of eye in female and reaching (for 1/4 of eye diameter) a vertical of posterior part of eye in male. Eyes high on head, close together with interorbital width about one third of the eye diameter. Anterior nostril in short tube.

Dorsal fins VI-I,9, membrane of first dorsal fin posterior to spine 6 partly connected to base of spine of second dorsal fin. D1 with all spines about equal in length. D2 depth low, base long. Anal fin I,9, slightly behind or approximately below second dorsal fin origin. Caudal fin with 11-13 branched rays, posterior margin rounded. Pectoral fins oblong with posterior margin pointed and 14(1)-15(2) rays (Tab. I), ventralmost ray unbranched. Pelvic fins always I,5, with both fins joined together their entire length between rays 5, forming strong cup-like disc; a well developed frenum between spines, fin not extending beyond anus. Morphomeristics data given in table III.

Tongue (anterior tip) bilobed. Teeth in upper jaw (14-18) usually in two or three rows, teeth conical and slightly recurved. Teeth in lower jaw (10-12) in one or two rows of teeth anteriorly and single row laterally, all teeth conical with outer row teeth only slightly enlarged and somewhat recurved.

Cephalic sensory pore system always with pores B, D, F, K, L, N and O, pore D singular with all other pores paired; oculoscapular canal absent between pores F and K. Anterior interorbital extension of anterior oculoscapular canal with double terminal pores B slightly posterior to posterior nostril. D pore at rear of interorbital. Posterior extension of anterior oculoscapular canal terminating laterally on each side of head at pore F, just behind posterior edge of eye. Posterior oculoscapular canal with 2 terminal pores, K and L; preopercular canal with 2 pores, N and O. Cutaneous sensory papillae not well developed and inconspicuous due to preservation.

Figure 8. – *Schismatogobius S. baitabag* n. sp., holotype, NTM S13675-011, male, 27.8 mm SL (Photo P. Keith).

Sexual dimorphism fairly well developed with male having jaws longer than female. Urogenital papilla broadly rounded in females and slightly triangular in male.

Colour in preservation (Fig. 8)

Usually four vertical brown bands in dorsal view; first band below first dorsal fin, second and third bands below second dorsal fin and fourth band at base of caudal fin. Body and nape otherwise pale fawn with vermiculate brown markings and spots. Head beige with fine brownish speckling. Ventral surface of head, frenum and pelvic disk in male yellowish, with dark mentum and dark brown lower lip. Ventral surface of head, frenum and pelvic disk in female yellowish with dark mentum (Fig. 2C). Belly whitish; breast whitish. First and second dorsal fin mostly cream with rows of black spots. Caudal fin striped and translucent, with small dark brown spot at hypural crease. Anal fin mostly cream. Pectoral fins banded with rows of small dark spots.

Colour in life

Field notes by HKL on live holotype: "Generally yellowish brown with faint orange mouth. Live colour – translucent colours; pale honey brown with four brown bands across body (last across base of tail). Row of irregular brown markings along midside of body. Dorsal half of body has tiny whitish spots scattered evenly over the pale honey-gold brown. A fifth brownish – very indistinct – band runs just behind pectoral fin to D1 origin – with two small brown spots in dorsal midline in centre of band. Brown mark from eye to middle of mouth. Dorsal fins with fine brown spots." On a very poor colour slide of the holotype (taken while alive, viewed from above), it can be seen that the head and body are yellowish brown with dark brown body bands and fine whitish spots cover the nape and dorsum. The iris is reddish-gold. The pectoral fin is transparent with rows of small dark spots interspersed with at least two rows of whitish spots.

Habitat

Schismatogobius baitabag has been collected in freshwater streams with moderate to fast flow in shallow areas of gravel. The holotype came from a bend in the Nagada River in a valley, with slow to moderate flow over sand, gravel, smooth rocks and boulders, with some leaf litter and logs, depth 0-2 m. Forest and gardens overhung the riverbanks.

Etymology

The name for the new species is derived from Baitabag village, by the Nagada River, the type locality and as thanks to the Baitabag village men and many small children who cheerfully helped HKL collect the holotype and many other interesting fishes (HKL regrets not recording their names). It is a noun in apposition.

Affinities

S. baitabag differs from the other species present in the area studied, except *S. bruynisi, S. tiola* n. sp., *S. mondo* n. sp. and *S. essi* n. sp. in having mostly 15 pectoral rays. It differs from these species in having pectoral fins with rows of small dark spots *vs* a broad black blotch. Moreover, it differs also from *S. bruynisi* in having a smaller jaw length in female (7.5-7.7% *vs* 11.1-12.6% SL) and jaw length/head length ratio in female (25.8-30.8% *vs* 42.5-47.5%), and a different colour pattern of ventral surface of head, pelvic disk and frenum in male and female (Fig. 2B, C). It differs from *S. tiola* in having a smaller jaw length in female (7.5-7.7% *vs* 7.8-8.9% SL) and a different colour pattern of the ventral surface of head, pelvic disk and frenum in male and female (Fig. 2C). It differs from *S. essi* in having a smaller jaw length in female (7.5-7.7% *vs* 8.4-9% SL), a different jaw length/head length ratio in female (25.8-30.8% *vs* 30.9-34%) and a different colour pattern of the ventral surface of head, pelvic disk and frenum in male and female (Fig. 2B). It differs from *S. mondo* n. sp. in having a smaller jaw length in female (7.5-7.7% *vs* 8.9% SL), a smaller jaw length/head length ratio in female (25.8-30.8% *vs* 36%), a smaller caudal fin length (18.5-21.3% *vs* 24.8-26.1%) and a different colour pattern of ventral surface of head, pelvic disk and frenum in male and female (Fig. 2B, C).

Distribution

S. baitabag is known from Northern Papua New Guinea (Fig. 4).

***Schismatogobius hoesei*, new species**

(Figs 1-2D, 4, 9; Tabs I-III)

Schismatogobius sp. – Allen, 1989: 209 (Plate 52).

Schismatogobius sp. – Allen *et al.,* 2002: 273.

Schismatogobius insignum – Hoese and Larson, 2006: 1682.

Material examined. – 64 specimens, all from Queensland, Australia, with a size range of 16-39.3 mm SL.

Figure 9. – *Schismatogobius hoesei* n. sp., male (Photo D. Hoese).

Holotype. – AMS I.21272-011, male (33.8 mm SL); South branch of Endeavour River, west of Cooktown, Queensland, Australia, 19 Sep. 1979, coll. Hoese.

Paratypes. – AMS I 21272-0012, 4 males, 4 females (28.1-36.2 mm SL); same data as holotype. MNHN 2016-0293, 1 male, 1 female (30.9-32.7 mm SL); same data as holotype. AMS I.22058-007, 1 male, 1 female, 2 juv. (16-29.8 mm SL), Daintree River, 18 Sep. 1980, coll. Hoese & Larson. QM I.40661, 1 male (29.8 mm SL); Daintree River, 1 Jul. 1995, coll. Hales. QM I.29399, 1 male and 1 female (37.3-39.3 mm SL); Mulgrave River, 13 Jul. 1994, coll. Graham. NTM S.14191-003, 1 male and 1 female (29-29.8 mm SL); Daintree River, 1 Sep. 1993, coll. Pusey. NTM S.14188-002, 1 male and 1 female (33-33.1 mm SL); Daintree River, 27 Aug. 1994, coll. Pusey. NTM S.16057-001, 1 male (34.3 mm SL); Daintree River, 8 Dec. 2004, coll. Kroon. WAM P.26968-001, 2 males and 1 female (26.5-29.5 mm SL); Daintree River, 18 Sep. 1980, coll. Hoese. WAM P.28545-009, 1 female (35.4 mm SL); Hilda Creek River, 24 Nov. 1985, coll. Allen and Stark. BLIP 19790085, 1 male, 2 females (30.9-31.7 mm SL); same data as holotype.

Non types. – QM I.36404, 1 specimen, Johnstone River, Aug. 2002, coll. Hagedorn. QM I.31250, 1 spm, Annan River, 17 Jun. 1998, coll. McDougall. QM I.33215, 1 spm, trib. Barron River, Cairns, Aug. 1997, coll. McDougall. QM I.30766, 2 spms, Behana Creek, Nov. 1996, coll. Schmida. QM I.30474, 1 spm, 1 male, Daintree River, 1 Jul. 1995, coll. Hales. AMS I.22067-001, 1 spm, Mulgrave R., 6 km SW of Gordonvale on Goldsborough Rd., 20 Sep. 1980, coll. Hoese. AMS I.21272-001, 23 spms, South branch of Endeavour River, west of Cooktown, 19 Sep. 1979, coll. Hoese. AMS I.22086-007, 2 spms, S of Innisfail on highway, Liverpool Creek, 4 Oct. 1980, coll. Hoese. AMS I.22711-001, 3 spms, Little Mulgrave River, near Gordonvale turnoff, 30 Sep. 1981, coll. Hoese.

Diagnosis

Usually 16 pectoral rays; pectoral fins banded with rows of dark spots. Membrane in first dorsal fin posterior to spine 6 connected to base of spine of second dorsal fin. Ventral surface of head in male entirely white to yellowish, with variably dark areas on chin and isthmus, or with a blackish lower border to preopercle, blackish lips and black mentum. Ventral surface of head in female white to yellowish with variably developed blackish area around mentum.

Figure 10. – *Schismatogobius alleni* n. sp., holotype, QM I.39304, female, 33.3 mm SL (Photo P. Keith).

Description

A large *Schismatogobius* (average adult size > 30 mm SL). Body naked, slender, almost circular in cross-section. Head rounded, snout obtuse, cheeks may be bulbous in large males. Mouth oblique, tip of lower lip anteriormost. Jaw lengths in males much greater than in females, with jaws reaching back to rear half of eye in large females (40-47% of HL) and nearly to rear edge of preopercle in large males (up to 70% in HL). Eyes high on head, close together with interorbital width of 6.4-10.6% of HL. Anterior nostril in short tube.

Dorsal fins VI-I,9, membrane in first dorsal fin posterior to spine 6 connected to base of spine of second dorsal fin. D1 with all spines about equal in length; fifth spine usually longest. Anal fin I,9, slightly behind or approximately below second dorsal fin origin. Caudal fin with 11-12 branched rays, posterior margin rounded. Pectoral fins rounded to slightly pointed, with 15(6)-16(30)-17(1) rays (Tab. I), ventralmost ray unbranched. Pelvic fins always I,5, with both fins joined together their entire length between rays 5, forming strong cup-like disc; well-developed frenum with two distinctly pointed lobes between spines; fins not extending beyond anus. Morphomeristic data given in table III.

Tongue variably bilobed. Teeth in upper jaw (13-18) usually in two rows, teeth conical and slightly recurved. Teeth in lower jaw (9-12) usually in one or two rows of teeth anteriorly and single row laterally, all teeth conical with outer row teeth only slightly enlarged and somewhat recurved.

Cephalic sensory pore system always with pores B, D, F, K, L, N and O; pore D singular with all other pores paired; oculoscapular canal absent between pores F and K. Anterior interorbital extension of anterior oculoscapular canal with double terminal pores B slightly posterior to posterior nostril. D pore at rear of interorbital. Posterior extension of anterior oculoscapular canal terminating laterally on each side of head at pore F, just behind posterior edge of eye. Posterior oculoscapular canal with 2 terminal pores, K and L; preopercular canal with 2 pores, N and O. Cutaneous sensory papil-

lae similar to pattern described by Akihito *et al*. (1988) for *Schismatogobius roxasi*.

Urogenital papilla broadly rounded in females and slightly triangular in males.

Colour in preservation (Fig. 9)

Head and body pale brown with brown to blackish markings; basic pattern as in living fish, but duller; orange, blue and yellow being replaced by fawn to whitish pigment.

Colour in life

Based on photos of living fish by Keith Martin and Gunther Schmida. Head and body whitish to pinkish brown with three vertical dark brown to black bands crossing dorsum and short saddle across nape just before first dorsal fin (latter may be indistinct); first band below first dorsal fin, second below second dorsal fin and third band below rear of second dorsal fin; bands may have narrow blue edges and may be diffuse or broken-up into blotches; dark bands reach to mid-side of body where they become variable blotches and oblique blotchy lines. Dorsal half of body between bars with indistinct whitish to pale bluish rounded spots and speckles and network of thin brown to red-brown lines, forming variable vermiculate pattern. Underside of body pinkish white to whitish. Head dusky brown dorsally, cheeks and snout may be darker than rest of head, with small dark brown spots on cheek close to eye; may be indistinct dusky bar from eye crossing both lips. Lips brownish to greyish, and mouth lining bright orange in males. Iris mottled grey-gold. First dorsal fin transparent with median dusky stripe or row of dusky spots and thin blackish margin. Second dorsal fin transparent to faintly yellowish with 2-3 rows of small dark spots and dusky margin. Anal fin transparent to faintly dusky. Pectoral fins translucent to yellowish with 3-4 rows of dusky to dark brown spots, plain dusky brownish basally. Pelvic fins translucent to whitish. Caudal fin translucent to pale yellowish, with large brown to blackish blotch extending from base onto fin; blotch roughly diamond-shaped and may have darker edges extending out from margins forming large X; on either side of posteriormost point of diamond shape, two white oblong blotches or oval spots; 1-3 rows of small dark spots on remainder of fin.

Allen (1989) and Allen *et al*. (2002) illustrated this species alive and freshly dead; Schmida (2008: 81) illustrated a live specimen. Pusey *et al*. (2004) noted that the isthmus of mature males becomes orange along with the mouth and their pelvic fins become almost black with orange margin.

Habitat

The habitat was recorded as being very similar in all rivers where *Schismatogobius* were collected. Generally they are found in freshwater, in creeks and rivers no further than 50 km from the sea (Pusey *et al*., 2004), with sand and fine gravel substrate. The collections were generally all from very shallow areas, less than 1 metre deep, with slow but steady flow and relatively clear water. *Glossogobius bicirrhosus*. *G. illimis* and *Redigobius bikolanus* have been found in the same habitat *i.e*. the type locality (D. Hoese, pers. comm.). Pusey *et al*. (2004) reported that this species is found in fast flowing streams with a rocky or gravel bottom. Most commonly, it occurs in the transitional areas between pools and rapids, where the substrate is composed of rocks and cobbles and the flow rapid.

Etymology

This new species is named *hoesei* in dedication to Doug Hoese, eminent gobyologist and good friend who first collected this fish in Australia and recognised its significance.

Affinities

S. hoesei differs from the other species sequenced and present in the area studied by a high % of divergence in COI gene (6.9-18.1%) (Tab. II) and from all these species but for *S. vitiensis* in having mostly 16 pectoral rays. It differs from *S. vitiensis* in having a greater jaw length/head length ratio in female (35.8-44.4% *vs* 30.4-35%), a greater second dorsal fin length (33.1-41.3% *vs* 26.9-32.8% SL), and a different colour pattern of ventral surface of head, pelvic disk and frenum in male (Fig. 2D).

Distribution

S. hoesei is known only from the Wet Tropics Region (Queensland, Australia) (Fig. 4) and has been recorded from the Annan, Endeavour, Daintree, Mossman, Mulgrave, Russell, Barron, Johnstone rivers and Liverpool Creek (Pusey *et al*., 2004; this paper).

***Schismatogobius alleni*, new species**

(Figs 2E, 4, 10-11; Tabs I-III)

Material examined. – Two specimens from Papua New Guinea with a size range of 27.6-33.3 mm SL.

Holotype. – QM I.39304, female (33.3 mm SL); Uruf Creek, tributary of Markham River, Papua New Guinea, 3 Jul. 2012, coll. Webb.

Paratype. – AUM 47579, male (27.6 mm SL); Ularimbin creek, East Sepik, Papua New Guinea, 7 Oct. 2007, coll. Armbruster *et al*.

Diagnosis

17 pectoral rays; pectoral fins banded. Membrane in first dorsal fin posterior to spine 6 not connected to base of spine of second dorsal fin. Transverse row of papillae on midcheek between row *b* and *d*. Ventral surface of head in male plain brownish with blackish pigment on frenum and pelvic

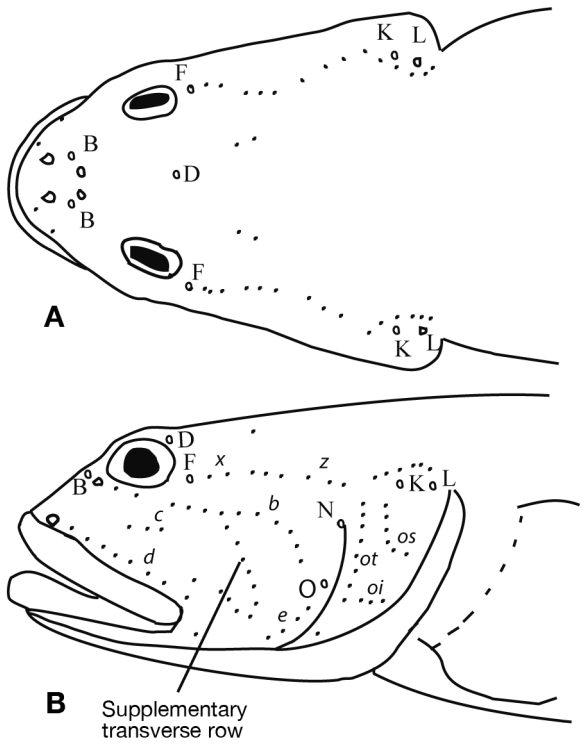

Figure 11. – Diagrammatic illustration of head in *Schismatogobius alleni* showing cephalic sensory pore system and cutaneous sensory papillae. **A**: Dorsal view; **B**: Lateral view.

disk. Ventral surface of head in female blackish, black pigment surrounding whitish mentum and middle of lower lip; frenum whitish.

Description

A medium sized *Schismatogobius* (average size < 30 mm SL). Body naked, slender, rounded anteriorly, compressed posteriorly. Head bluntly rounded, snout obtuse, cheeks bulbous. Mouth oblique, tip of lower lip anteriormost. Jaw lengths in males much greater than in females. Lower jaw reaching a vertical from posterior part of eye in female and exceeding (for 1/2 of eye diameter) a vertical of posterior part of eye in male. Eyes high on head, close together with interorbital width of 15% of HL in female. Anterior nostril in short tube.

Dorsal fins VI-I,9, membrane in first dorsal fin posterior to spine 6 not connected to base of spine of second dorsal fin. D1 with all rays about equal in length. Anal fin I,9, slightly behind or approximately below second dorsal fin. Caudal fin with 10-12 branched rays, posterior margin rounded. Pectoral fins oblong with posterior margin pointed and 17 rays (Tab. I), ventralmost ray unbranched. Pelvic fins always I,5, with both fins joined together for their entire length between rays 5 to form strong cup-like disc, a well developed lobed frenum between spines; fins not reaching anus. Morphomeristics data given in table III.

Tongue (anterior tip) bilobed in male; reduced and rounded in female. Teeth in upper jaw (20-22) usually in two rows, teeth conical and slightly recurved, usually. Teeth in lower jaw (11-12) in one or two rows of teeth anteriorly and single row laterally, all teeth conical with outer row teeth only slightly enlarged and somewhat recurved.

Cephalic sensory pore system always with pores B, D, F, K, L, N and O, pore D singular with all other pores paired; oculoscapular canal absent between pores F and K. Anterior interorbital extension of anterior oculoscapular canal with double terminal pores B slightly posterior to posterior nostril. D pore at rear of interorbital. Posterior extension of anterior oculoscapular canal terminating laterally on each side of head at pore F, just behind posterior edge of eye. Posterior oculoscapular canal with 2 terminal pores, K and L; preopercular canal with 2 pores, N and O. Cutaneous sensory papillae with a distinct supplementary transverse row of papillae on the cheek between row *b* and *d* (Fig. 11).

Sexual dimorphism fairly well developed with male having jaws longer than female and different colour pattern on ventral surface of head. Urogenital papilla broadly rounded in females and slightly triangular in males.

Colour in preservation (Fig. 10)

Head and body dark grey dorsally and whitish ventrally with three dark brown bands, first band below first dorsal fin, second below second dorsal fin and third band below rear of second dorsal fin; bands reaching to mid-side of body where they become staggered dark blotches and oblique dark lines. Dorsal half of body with indistinct whitish spots. Ventral surface of head in male entirely blackish with blackish pigments on frenum and pelvic disk (Fig. 2E). Ventral surface of head in female entirely blackish, black pigment surrounding whitish mentum and middle of lower lip. Pelvic frenum whitish (Fig. 2E); breast and belly whitish. First dorsal fin whitish with 2-3 rows of dusky spots and narrow dusky margin; in male, fin has broad black band. Second dorsal fin transparent to whitish with 3-4 oblique rows of small dark spots. Anal fin translucent whitish with dusky streaks posteriorly. Pectoral fins with plain dusky area basally, rest of fin translucent whitish with two broad rows of blackish spots (forming two blackish bands that are broad dorsally and narrow ventrally) and a third fainter row of spots toward tip of fin. Pelvic fins translucent whitish. Caudal fin whitish, with large blackish angular blotch extending from base onto fin, oblique blackish lines extending out from blotch forming large X; on either side of posteriormost part of blotch, two rows of small blackish spots on remainder of fin.

Colour in life

Unknown, but probably similar to that in preservation, with bright reddish or rose colour between black transverse bands.

Habitat

Schismatogobius alleni has been collected in freshwater streams with moderate flow in shallow areas of gravel.

Etymology

The name of the species honours our friend and colleague Gerry Allen for his extensive and enthusiastic work on the freshwater fish fauna of Papua New Guinea.

Affinities

S. alleni differs from the other species present in the area studied, except *S. vanuatuensis,* in having 17 pectoral rays. It differs from *S. vanuatuensis* in having a transverse row of papillae on mid-cheek between row *b* and *d*, a smaller jaw length/head length ratio in the male (47.9% *vs* 60.1-67.1%), a shorter jaw length in male (14.2% *vs* 18.9-23.2% SL), and a different colour pattern of the ventral surface of the head, pelvic disk and frenum in male and female (Fig. 2E, F).

Distribution

S. alleni is known only from Northern Papua New Guinea (Fig. 4) but the picture of a *Schismatogobius* from Timika in southern Papua in Allen *et al*. (2000) looks like this species.

Key to species from PNG to Samoa

1a: Pectoral rays 13-14, fins banded; membrane in first dorsal fin posterior to spine 6 not connected to base of spine in second dorsal fin **2**
1b: Pectoral rays 14-15, usually 15, fins with broad black blotch anteriorly; membrane in first dorsal fin posterior to spine 6 not connected at base of spine in second dorsal fin **3**
1c: Pectoral rays 14-15, usually 15, fins banded, membrane in first dorsal fin posterior to spine 6 partly connected to base of spine in second dorsal fin . . . . . ***S. baitabag***
1d: Pectoral rays 15-16, usually 16; fins banded **4**
1e: Pectoral rays 16-17, usually 17; fins banded **5**

2a: Jaw length in head length in female 32.4-33.3%; anal fin length 25.2-27.7% SL; Samoa. . . . . ***S. tuimanua***
2b: Jaw length in head length in female 35-41.9%; anal fin length 27.5-33.7% SL; New Caledonia. . . . .***S. fuligimentus***

3a: Jaw length in male 17.5-21.7% SL and female 11.1-12.6% SL; jaw length in head length in male 57.9-69.2% and female 42.5-47.5%; body depth at anus 13.5-18.4% SL . . . . . ***S. bruynisi***
3b: Jaw length in male 13-15.8% SL and female 7.8-9% SL; jaw length in head length in male 46.8-57.4% and female 28.1-36%; body depth at anus 10.2-14.3% SL **6**

4a: Jaw length in head length in female 35.8-44.4%; second dorsal fin length 33.1-41.3% SL; membrane in first dorsal fin posterior to spine 6 connected to base of spine in second dorsal fin . . . . . ***S. hoesei***
4b: Jaw length in head length in female 30.4-35%; second dorsal fin length 26.9-32.8% SL; membrane in first dorsal fin posterior to spine 6 not connected at base of spine in second dorsal fin . . . . . ***S. vitiensis***

5a: A transverse row of papillae on cheek between row *b* and *d;* jaw length in male 14.2% SL; jaw length in head length in male 47.9%; membrane in first dorsal fin posterior to spine 6 connected to base of spine of second dorsal fin. . . . ***S. alleni***
5b: No transverse row of papillae on cheek between row *b* and *d;* jaw length in male 18.9-23.2% SL; jaw length in head length in male 60.1-67.1%; membrane in first dorsal fin posterior to spine 6 not connected to base of spine in second dorsal fin . . . . . ***S. vanuatuensis***

6a: Adult with three transverse black bands. Jaw length in head length in male 46.8% and female 36% . . . . . ***S. mondo***
6b: Adult with four transverse black bands. Jaw length in head length in male 48-57.4% and female 28.1-34.6%. . . . **7**

7a: A small species, < 26 mm SL. Anal fin length 26.8-33.3% SL; caudal fin length 16-19.8% SL; in female, underside of head pale with chin and surrounding area blackish, with diffuse dark brown area on anterior part of branchiostegal membrane and isthmus; in male ventral surface of head entirely blackish as the frenum and the pelvic disk or entirely brownish as the frenum and the pelvic disk . . . . . ***S. essi***
7b: A medium species, > 26 mm SL. Anal fin length 23.3-26.8% SL; caudal fin length 21.2-26% SL; in male ventral surface of head mostly black with a white mentum; ventral surface of head in female whitish or slightly pigmented with usually a blackish ring around the mentum. . . . . ***S. tiola***

Comparative material

Schismatogobius bruynisi. – ZMA 111196, Holotype, Eme River, Honitetu, Western Ceram, Indonesia. MNHN 2016-0291, 1 specimen, Vanga River, Kolombangara [= Kolobangara], Solomon Islands, 18 Nov. 2015, tag 11926, coll. Keith *et al*. MNHN 2016-0289, 1 spm, Lokapava River, Choiseul, Solomon Islands, 21 Oct. 2014, tag 11933 coll. Keith *et al*. MNHN 2016-0290, 1 spm, Lokapava River, Choiseul, Solomon Islands, 21 Oct. 2014, tag 11938, coll. Keith *et al*.

Schismatogobius marmoratus. – ZMB 6756, Holotype, Loquilócun, Samar Island, Philippines, coll. F. Tagor.

Schismatogobius vanuatuensis. – MNHN 2003-1557, Holotype, Matentas River, Santo Island, 23 Jul. 2003, coll. Keith, Marquet and Keith. MNHN 2003-1558, Paratypes, 5 spms, Matentas River, Santo Island, 23 Jul. 2003, coll. Keith, Marquet and Keith. MNHN 2016-0283 (tag 6916), 1 spm, Manga River, Kolombangara Island, Solomon Islands, 19 Nov. 2015, coll. Keith *et al*. MNHN 2016-0284 (tag 05484), 1 spm, Vanga River, Kolombangara, Solomon, 18 Nov. 2016, coll. Keith *et al*. MNHN 2016-0285 (tag 06936), 1 spm, Poitete River, Kolombangara, Solomon, 15 Nov. 2016, coll.

Keith *et al*. MNHN 2016-0286 (tag 06911), 1 spm, Poitete River, Kolombangara, Solomon, 15 Nov. 2016, coll. Keith *et al*. MNHN 2016-0287, 1 spm, tag 05487, Liva River, Kolombangara, Solomon, 11 Nov. 2016, coll. Keith *et al*. NTM S.16447-001, 2 spms, Tetepare Island, Solomon, 2 Sep. 2006, coll. Jenkins & Boseto.

Schismatogobius fuligimentus. – MNHN 2002-149 to MNHN 2002-151, 3 spms, Lembi River, New Caledonia, 1999, coll. Marquet. MNHN 2002-152, 1 spm, Pourina River, New Caledonia, Jul. 2000, coll. Chloé 3. MNHN 2016-0288 (tags 13629, 13631, 13633, 13634), 4 spms, New Caledonia, 2014.

Schismatogobius ampluvinculus. – ASIZP0072682, 1 spm, Taiwan, 10 Oct. 2011, coll. Chang. ASIZP0072683, 1 spm, Taiwan, 10 Oct, 2011, coll. Chang. ASIZP0072684, 1 spm, 10 Oct. 2011, Taiwan, coll. Chang. BLIH 19890087, 1 spm, Iriomote-jima Island, Okinawa, Japan, 22 Aug. 1989, coll. Aizawa *et al*. BLIH 19890761, 5 spms, Nakama River (upstream), Iriomote-jima Island, Okinawa, Japan, 10 Oct. 1989, coll. Sakamoto *et al*. BLIH 19930057, 8 spms, Nakama River (upstream), Iriomote-jima Island, Okinawa, Japan, 12 Sep. 1993, coll. Sakamoto *et al*. BLIH 1989761, 2 of 5 spms, Iriomote-jima, Japan, 10-20 Oct.1981. NMMBA 1183, 1 spm, Ta-wu River, Taitung, Taiwan, 12 Nov. 2002, coll. Han.

Schismatogobius vitiensis. – WAM P32351.001, paratypes, 5 spms, Buca River, Viti Levu, Fiji, 29 Aug. 2003, coll. Pogonowski & Koto. AMS I.42900-001, 1 spm, Savura Creek, Viti Levu Island, Fiji, 11 Feb. 2003, coll. Boseto and Malo.

Schismatogobius deraniyagalai. – SMF 24057, 1 of 3 spms, Sri Lanka, Jonklass leg. SMF 24058, 10 of 24 spms, Atweltota, Sri Lanka, Sep. 1989. USNM 268297, 2 of 3 spms, tributary of Gin Ganga, Kanneliya Forest, Sri Lanka, 8 Jul. 1969, coll. Smith-Vaniz.

Schismatogobius roxasi. – CAS 30968, holotype, San Jose, Panay, Philippines, February 1926, coll. F. Reveche. NMMBA 2731, 4 spms, Kon-Tsi River, Pingtung, Taiwan, 10 Feb. 1995, coll. Chen.

Gobiosoma pallida. – CAS 12869 (SU 28609), holotype, Sitankai, Sulu Archipelago, Philippines, Aug. 1931, coll. Herre; SU 16962, paratype, 1 of 3 spms, Philippines.

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REFERENCES

AKIHITO, 1986. - Some morphological characters considered to be important in gobiid phylogeny. *In:* Indo-Pacific Fish Biology: Proceedings of the Second International Conference on Indo-Pacific Fishes (Uyeno T., Arai R., Taniuchi T. & Matsuura K., eds), pp. 629-639. Tokyo: Ichthyological Society of Japan.

AKIHITO, HAYASHI M. & YOSHINO T., 1988. - Suborder Gobioidei. *In*: The Fishes of the Japanese Archipelago, second edition (Masuda H., Amaoko K., Araga C., Uyeno T. & Yoshino T., eds), pp. 236-289, 445. Tokyo: Tokai Univ. Press.

ALLEN G.R., 1989. - Freshwater Fishes of Australia. 240 p. Neptune City: TFH Publications.

ALLEN G.R., HORTLE K.G. & RENYAAN S.J., 2000. - Freshwater Fishes of the Timika Region, New Guinea. 175 p. Timika: Freeport Indonesia.

ALLEN G.R., MIDGLEY S.H. & ALLEN M., 2002. - Field Guide to the Freshwater Fishes of Australia. 394 p. Perth: Western Australian Museum.

ASWANI S., 2000. - Changing identities: the ethnohistory of Roviana predatory head-hunting. *J. Polynesian Soc*., 109(1): 39-70.

BIRDSONG R.S., MURDY E.O. & PEZOLD F., 1988. - A study of the vertebral column and median fin osteology in gobioid fishes with comments on gobioid relationships. *Bull. Mar. Sci*., 42: 172-214.

CHEN I.S., HAN C.C. & FANG L.S., 1995a. - A new record of freshwater gobiid fish *Schismatogobius roxasi* (Pisces: Gobiidae) from southeastern Taiwan. *Bull. Nat. Mus. Nat. Sci*., 6: 135-137.

CHEN I.S., SHAO K.T. & FANG L.S., 1995b. - A new species of freshwater goby *Schismatogobius ampluvinculus* (Pisces: Gobiidae) from southeastern Taiwan. *Zool. Stud*., 34: 202-205.

CHEN I.S., SÉRET B., PÖLLABAUER C. & SHAO K.T., 2001. - *Schismatogobius fuligimentus*, a new species of freshwater goby (Teleostei: Gobiidae) from New Caledonia. *Zool. Stud*., 40(2): 141-146.

FELSENSTEIN J., 1981. - Evolutionary trees from DNA sequences: a maximum likelihood approach. *J. Mol. Evol*., 17: 368-376.

HERRE A.W.C.T., 1927. - Gobies of the Philippines and the China Sea. *Monogr. Bur. Sci*., 23: 1-352.

HOESE D.F. & LARSON H.K., 2006. - Gobiidae. Gobies. *In*: Zoological Catalogue of Australia. Vol. 35, Parts 1-3. Fishes (Hoese D.F., Bray D.J., Paxton J.R. & Allen G.R., eds), pp. 1612-1697. Canberra: ABRS & CSIRO Publishing.

JENKINS A.P. & BOSETO D., 2005. - *Schismatogobius vitiensis,* a new freshwater goby (Teleostei: Gobiidae) from the Fiji Islands. *Ichthyol. Expl. Freshw*., 16(1): 75-82.

KEITH P., MARQUET G. & WATSON R.E., 2004. - *Schismatogobius vanuatuensis,* a new species of freshwater goby from Vanuatu (Teleostei: Gobioidei). *Cybium,* 28(3): 237-241.

KIMURA M., 1980. - A simple method for estimating evolutionary rate of base substitutions through comparative studies of nucleotide sequences. *J. Mol. Evol.*, 16: 111-120.

KOTTELAT M. & PETHIYAGODA R., 1989. - *Schismatogobius deraniyagalai*, a new goby from Sri Lanka: description and field observations. *Spixiana*, 12: 315-320.

LANFEAR R., CALCOTT B., SYW H. & GUINDON S., 2012. - PartitionFinder: combined selection of partitioning schemes and substitution models for phylogenetic analyses. *Mol. Biol. Evol.*, 29(6): 1695-1701.

LARSON H.K., 2001. - A revision of the gobiid fish genus *Mugilogobius* (Teleostei: Gobioidei), with discussion of its systematic placement. *Rec. West. Aus. Mus.,* Suppl., 62: 1-233.

PUSEY B.J., KENNARD M.J. & ARTHINGTON A.H., 2004. - Freshwater Fishes of North-Eastern Australia. 684 p. Collingwood, Victoria: CSIRO Publishing.

RAMBAUT A., 2007. - FigTree v1.3.1. Available at http://tree.bio.ed.ac.uk/software/figtree/.

RAMBAUT A. & DRUMMOND A.J., 2007. - Tracer v1.4 Available at http://beast.bio.ed.ac.uk/Tracer.

RONQUIST F., TESLENKO M., VAN DER MARK P., AYRES D.L., DARLING A., HÖHNA S., LARGET B., LIU L., SUCHARD M.A. & HUELSENBECK J.P., 2012. - MrBayes 3.2: efficient Bayesian phylogenetic inference and model choice across a large model space. *Syst. Biol.*, 61: 539-542.

SANZO L., 1911. - Distribuzione delle papille cutanee (organi ciatiformi) e suo valore sistematico nei Gobi. *Mitt. Zool. Stat. Neapel,* 20: 249-328.

SCHMIDA G., 2008. - A Wild Australia Guide, Freshwater Fishes. 96 p. Archerfield, Queensland: Steve Parrish Publishing.

TORNABENE L., CHEN Y. & PEZOLD F., 2013. - Gobies are deeply divided: phylogenetic evidence from nuclear DNA (Teleostei: Gobioidei: Gobiidae). *Syst. Biodivers.*, 11(3): 345-361.

WARD R.D., ZEMLAK T.S., INNES B.H., LAST P.R., HEBERT P.D.N., 2005. - DNA barcoding Australia's fish species. *Philos. Trans. R. Soc. Lond.,* B 360: 1847-1857.