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Cryptocentrus nanus, a new species of dwarf shrimpgoby from Fiji (Teleostei: Gobiidae)

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Abstract

A new species of alpheid-shrimp-associated goby is described from Fiji based on 9 specimens, 17.2–23.4 mm SL. Diagnostic features include an exceptionally small size at maturity, a uniform black color, possession of vomerine teeth, a rounded caudal fin, 65–81 scales in the longitudinal series, 0–15 predorsal scales, body depth at pelvic-fin origin 4.4–5.2 in SL, snout length 4.4–8.4 in HL, and caudal-peduncle depth 3.3–3.8 in HL.

Key words: taxonomy, systematics, ichthyology, coral-reef fishes, gobies, alpheid shrimp, symbiosis, Pacific Ocean, biogeography.

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Introduction

Shrimp-associated gobies are common inhabitants of sand and mud substrates throughout the tropical Indo-Pacific region. The shrimp excavates and continually maintains a burrow, which is generally shared with one or two fish inhabitants. A variety of gobies associate with shrimps: 13 genera and approximately 150 species are currently known (Eschmeyer *et al*. 2018), of which *Amblyeleotris* Bleeker, 1874 (39 species), *Cryptocentrus* Valenciennes in Cuvier & Valenciennes, 1837 (36 species), and *Vanderhorstia* Smith, 1949 (29 species) contain the majority of species. While conducting a survey of the marine fishes of Fiji (Greenfield & Randall 2016), the first author observed a small, black, shrimp-associated goby living mainly at sites where the research vessel was anchored. Nine specimens were eventually collected from three different locations, and subsequently identified as a species of *Cryptocentrus*. Our first impression was that it perhaps represented a juvenile of a previously described species due to its small size (17.2–23.4 mm SL). However, histological examination of one of the smallest specimens revealed that it was a mature female with oocytes. Moreover, the specimens possess vomerine teeth, an unusual feature known to occur in only one other member of the genus, *Cryptocentrus multicinctus* Allen & Randall, 2010. We describe herein the new species as the 37th species in the genus *Cryptocentrus.*

Materials and Methods

Type specimens are deposited at the California Academy of Sciences, San Francisco, CA, USA (CAS), United States Museum of Natural History-Smithsonian, Washington DC, USA (USNM), and Western Australian Museum, Perth, Australia (WAM).

Lengths are given as standard length (SL), measured from the median anterior point of the upper lip to the base of the caudal fin (posterior end of the hypural plate); body depth is measured at both the origin of the pelvic fins and the origin of the anal fin, and body width at the origin of the pectoral fins; head length (HL) is taken from the upper lip to the posterior end of the opercular membrane, and head width over the posterior margin of the preoperculum; orbit diameter is the greatest fleshy diameter, and interorbital width the least bony width; snout length is measured from the median anterior point of the upper lip to the nearest fleshy edge of the orbit; upper-jaw length from the same anterior point to the posterior end of the maxilla; cheek depth is the least depth measured perpendicular from the ventral edge of the suborbital to the fleshy edge of the orbit; caudal-peduncle depth is the least depth, and caudal-peduncle length the horizontal distance between verticals at the rear base of the anal fin and the caudal-fin base; lengths of spines and rays are measured to their extreme bases; caudal- and pectoral-fin lengths are the length of the longest ray; pelvic-fin length is measured from the base of the pelvic-fin spine to the tip of the longest pelvic-fin soft ray.

Morphometric data presented as percentages of the standard length given in Table 1. Values for the holotype are presented first in the text, followed by the range of all type specimens.

Terminology and abbreviations for cephalic sensory-canal pores and papilla rows follow those presented by Akihito (1984). Scales in longitudinal series are counted from the scale above the pectoral-fin base, continuing in a longitudinal row to the posterior edge of the hypural plate; scales in transverse series are counted from the origin of the anal fin anterodorsally to the base of the first dorsal fin; outer gill rakers are counted on the first gill arch, those on the upper limb listed first; rudiments are included in the counts.

Measurements were made to the nearest 0.1 mm using an ocular micrometer or dial calipers. Cyanine Blue 5R (acid blue 113) stain and an airjet were used to make the cephalic sensory-canal pores and scales more obvious (Akihito *et al*. 1993, 2002, Saruwatari *et al*. 1991). The anterior scales on the body are only about one-third of the diameter of those on the caudal peduncle, making the anterior scales very difficult to count on these small specimens. The format of this paper follows Allen & Randall (2011) for ease of comparison with descriptions of other *Cryptocentrus* species.

Cryptocentrus nanus, n. sp.

Blackdwarf Shrimpgoby

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Figures 1–5; Table 1.

Holotype. CAS 244342, 23.4 mm SL female, Fiji, Yadua Island, south side, Talai Harbor, –16.8300°, 178.2801°, 10.7 m, sand, clove oil, field number G02-134, D.W. Greenfield & K.R. Longenecker, 3 April 2002.

Paratype. CAS 244343, 22.1 mm male & 18.7 mm sex undetermined, taken with the holotype; CAS 244344, head only, female, and shrimp, Fiji, Yadua Island, south side, Talai Harbor, –16.8300°, 178.2801°, 9.1 m, sand, rotenone, field number G02-83, D.W. Greenfield, R. Langston, K. Longenecker & K. Tang, 17 March 2002; CAS 244345, 21.3 mm SL male, Fiji, Vanua Balavu Island, Bay of Islands, –17.1782°, 179.0148°, 8.2 m, sand, rotenone, field number G03-17, D.W. Greenfield, R. Langston & K.R. Longenecker, 6 January 2003; WAM P.34846-001, 18.3 mm male, Fiji, Vanua Balavu Island, Bay of Islands, –17.1782°, 179.0148°, 8.2 m, sand, rotenone, field number G03-17, D.W. Greenfield, R. Langston & K.R. Longenecker, 6 January 2003; WAM P.34847-001, 17.2 & 17.8 males, Fiji, Yadua Island, south side, Talai Harbor, –16.8300°, 178.2801°, 9.1 m, sand, rotenone, field number G02-83, D.W. Greenfield, R. Langston, K.R. Longenecker & K. Tang, 17 March 2002; USNM 440399, 18.1 mm female, Fiji, Yadua Island, south side, Talai Harbor, –16.8300°, 178.2801°, 9.1 m, sand, rotenone, field number G02-83, D.W. Greenfield, R. Langston, K.R. Longenecker & K. Tang, 17 March 2002.

Diagnosis. Dorsal-fin elements IV-I,10; anal-fin elements I,8–I,9; pectoral-fin rays 16; scales in longitudinal series 65–81; predorsal scales 0–15; anterior scales cycloid, posterior scales ctenoid; anterior part of breast, prepelvic region, and pectoral-fin base naked; head naked except on side of nape and predorsal region, where scales extend anteriorly to about level of middle of operculum; body depth at pelvic-fin origin 4.4–5.2, mean 4.8; vomerine teeth present; gill opening extending forward to a vertical at posterior edge of preoperculum or slightly anterior; dorsal-fin spines progressively longer to fourth, longest 1.6–2.7 in HL; caudal fin rounded, 2.7–3.1 in HL; pectoral fins reaching level of anus or just beyond (3.7–4.7 in SL); pelvic fins reaching posteriorly to anus (3.6–4.3 in SL); live individuals black, fins black with clear distal margins; adults mature at 23.4 mm SL or less.

Description. Dorsal-fin elements VI-I,10; anal-fin elements I,8 (3), I,9 (5); all dorsal- and anal-fin soft rays branched, last to base, both portions of last ray branched; pectoral-fin rays 16, most branched; pelvic-fin rays I,5,

Figure 1. *Cryptocentrus nanus*, live holotype, CAS 244342, 23.4 mm SL female, Yadua Island, Fiji, aquarium photograph (D.W. Greenfield).

all soft rays branched, fifth rays joined medially with membrane and frenum thin but fully developed; branched caudal-fin rays 13; 4 upper and 4 lower caudal-fin rays unsegmented; segmented caudal-fin rays 17; longitudinal scale series 70 (65–81); transverse scale rows 31 (28–33); predorsal scales 15 (0–15); circumpeduncular scales 30 (24–30); gill rakers 3 + 12; pseudobranch with 8 short fleshy lobes (rakers and pseudobranch counts from paratype CAS G02-83, a detached head).

Body moderately elongate, depth at pelvic-fin origin 4.8 (4.4–5.2) in SL; depth at anal-fin origin 6.2 (5.3–6.3) in SL; width at pectoral-fin origin 3.1 (2.4–3.7) in HL; head length 3.0 (2.5–3.0) in SL; head width 2.4 (2.3–3.2) in HL; snout short, length 5.5 (4.4–8.4) in HL; orbit diameter 4.0 (3.4–4.0) in HL, interorbital space very narrow, least width 25.7 (18.7–30.5) in HL; caudal-peduncle depth 3.7 (3.3–3.8) in HL; caudal-peduncle length 2.0 1.9–2.3) in HL.

Mouth terminal, oblique, forming an angle of about 40° to horizontal axis of body; mouth large, maxilla extending just past posterior edge of orbit; upper-jaw length 2.0 (2.0–2.6) in HL; sides of upper and lower jaws with row of small, pointed teeth, front of jaws with 3 rows of larger teeth, with some enlarged posteriorly curved canines on each side; vomer with patch of about 6–20 conical teeth (see Fig. 8A); edge of lips smooth; tongue with broadly rounded tip; no distinct mental flap. Gill opening broad, extending forward to a vertical just past vertical at posterior edge of preoperculum; gill membranes attached to side of isthmus, no free fold across isthmus; gill rakers short and slender, about half length of longest gill filaments of first arch. Posterior naris large, round, in front of eye at level of bottom of pupil; anterior narial tube anteroventral to posterior naris, just reaching posterior margin of upper lip when folded forward.

Pattern of cephalic sensory-canal pores and papilla rows is illustrated in Fig. 2. Anterior oculoscapular-canal pores B′, C (single), D (single), E, F, and H′; preopercular-canal pores N and O′; right and left sides of anterior oculoscapular canal fused medially in interorbital space.

Scales on anterior half of body small and cycloid, increasing in size posteriorly and becoming ctenoid under second dorsal fin to caudal-fin base; scales on lateral sides of body extending forward to top of pectoral-fin base, those on nape extending anteriorly to about level of middle of operculum; remainder of head, prepelvic region, pectoral-fin base, and anterior portion of breast naked; no scales on fins except for caudal-fin base.

Origin of first dorsal fin just behind rear base of pelvic fins, oblique length from anterior tip of upper lip to first-dorsal-fin origin 2.6 (2.4–2.6) in SL; dorsal-fin spines slender and flexible, none filamentous; first dorsal-fin spine 2.4 (1.7–4.1) in HL; second to fifth dorsal-fin spines subequal, fourth slightly longer, 1.8 (1.6–2.7) in HL; last membrane of first dorsal fin ending before origin of second dorsal fin; oblique length from anterior tip of upper lip to second-dorsal-fin origin 1.6 (1.6–1.7) in SL; spine of second dorsal fin 2.1 (2.1–3.6) in HL; longest dorsal-fin soft ray broken in holotype (1.7–2.0) in HL; origin of anal fin below first dorsal-fin soft ray, preanal length 1.6 (1.6) in SL; anal-fin spines 3.9 (3.1–4.0) in HL; sixth anal-fin soft ray longest, 1.6 (1.5–1.8) in HL; caudal fin longer than head with rounded posterior margin, length 3.0 (2.7–3.1) in SL; pectoral fins rounded, middle rays longest, reaching to or past level of anus, length in paratypes 3.7–4.7 in SL (broken in holotype); prepelvic length 3.1 (2.9–3.7) in SL; adpressed pelvic fins reaching to anus, 3.6

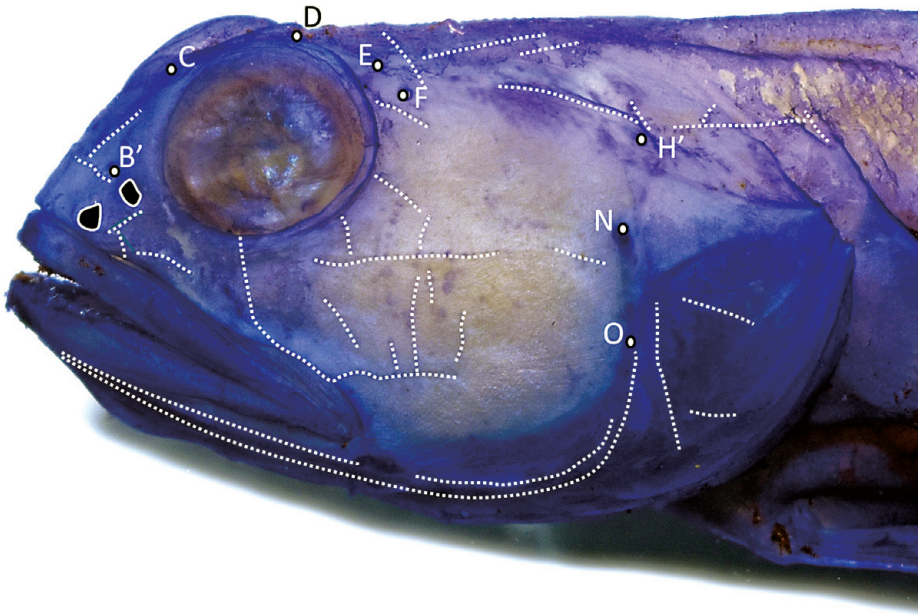

Figure 2. *Cryptocentrus nanus*, lateral view of head of holotype, CAS 244342, 23.4 mm SL female, with cephalic sensory-canal pores and main rows of papillae indicated by white dots and broken lines respectively. Nares are shown with white-edged black marks (G.R. Allen).

TABLE 1

Proportional measurements of type specimens of *Cryptocentrus nanus*, n. sp. as percentages of the standard length

	holotype	paratypes							mean for all types
	CAS 244342	CAS 244343	CAS 244343	CAS 244345	WAM P.34846	USNM 440399	WAM P.34847	WAM P.34847	
Sex	female	male	imm	male	male	fem	male	male	
Standard length (mm)	23.4	22.1	18.7	21.3	18.3	18.1	17.2	17.8	
Body depth (pelvic origin)	20.9	22.6	19.2	19.5	19.9	20.4	22.1	22.5	20.9
Body depth (anal origin)	16.0	17.6	16.0	16.0	16.3	18.8	18.0	15.7	16.8
Body width	10.5	13.6	13.1	9.4	10.9	12.7	10.7	10.7	11.4
Head length	32.9	33.0	35.0	35.2	36.0	33.7	34.0	33.7	34.2
Head width	13.9	14.0	14.2	11.0	13.6	14.4	13.9	12.6	13.4
Snout length	6.0	7.5	5.3	5.2	4.9	5.5	4.1	4.5	5.4
Orbit diameter	8.1	8.6	10.4	9.4	9.5	9.9	8.7	9.3	9.2
Interorbital width	1.3	1.3	1.9	1.6	1.6	1.1	1.1	1.0	1.4
Cheek depth	2.1	2.7	3.5	2.3	2.4	1.6	2.0	2.2	2.3
Upper-jaw length	16.7	15.1	13.9	15.2	15.2	15.5	14.8	15.7	15.3
Caudal-peduncle depth	9.0	9.7	9.0	10.8	9.8	10.2	9.6	11.2	9.9
Caudal-peduncle length	16.2	16.3	18.2	15.5	16.9	16.6	16.0	19.9	16.9
Pre first dorsal length	38.5	41.6	39.6	38.7	40.3	41.4	41.0	42.4	40.4
Pre second dorsal length	58.1	59.7	59.3	59.1	59.9	61.3	59.0	59.8	59.5
Preanal length	60.2	61.8	63.4	64.3	61.3	63.0	61.6	60.1	62
Prepelvic length	31.8	32.6	27.3	33.8	29.4	33.1	33.1	31.2	31.5
Base of first dorsal fin	17.1	17.6	13.4	11.7	16.9	17.7	14.2	16.8	15.7
First dorsal spine	13.7	19.4	12.8	12.0	14.2	-	14.2	11.2	13.9
Fourth dorsal spine	18.4	18.3	21.3	17.4	13.1	17.1	19.5	14.3	17.4
Fifth dorsal spine	15.8	13.6	15.0	14.8	-	14.1	13.9	19.7	15.3
Spine of second dorsal fin	15.4	12.0	13.1	11.3	13.1	-	9.3	12.6	12.4
Longest dorsal ray	-	16.7	17.4	20.6	19.6	19.3	19.8	-	18.9
Base of anal fin	19.6	22.4	20.8	19.5	18.0	19.9	15.7	18.2	19.3
Anal spine	8.3	8.6	8.8	10.8	11.4	9.9	9.3	9.8	9.6
Longest anal ray	20.1	19.9	23.5	21.1	19.6	26.2	19.2	21.3	21.4
Caudal-fin length	33.3	32.3	32.6	35.4	37.0	33.7	36.6	31.2	34
Pectoral-fin length	-	22.6	27.2	25.6	27.2	24.6	26.2	30.9	26.3
Pelvic-spine length	9.0	9.7	9.1	10.3	12.0	9.7	12.0	7.9	10
Pelvic-fin length	24.8	24.9	26.2	27.0	27.2	24.3	27.3	29.2	26.4

Figure 3. *Cryptocentrus nanus*, preserved holotype, CAS 244342, 23.4 mm SL female, Yadua Island, Fiji (G.R. Allen).

(3.0–3.8) in SL; pelvic-fin spine about one-third length of longest pelvic-fin ray; pelvic frenum thin, membrane reaching tip of pelvic-fin spines.

Color of live holotype. (Fig. 1) Body, nape, and top of head mostly uniformly black, front and lower half of head slightly lighter, a scattering of distinct melanophores on lower half of cheek; proximal half of first dorsal fin black, distal half clear with scattering of small melanophores; second dorsal fin proximal two-thirds black, distal third clear; caudal fin black, distal margin clear; anal fin with proximal one-third light brown, center crossed by black band, distal third with light brown band then a darker band, entire fin with thin clear margin; pelvic fin black; pectoral fins clear.

An underwater photograph from Palau (see Fig. 5), which may represent the same species (see Distribution below), shows scattered small blue spots on the body. Since the photograph of the holotype was taken in a small aquarium, if there were blue coloration, it might not show under such stressed conditions.

Color of preserved holotype. (Fig. 3) Background color of head and body light yellow; scattering of small melanophores on side of body between first dorsal fin and ventral aspect; area on abdomen under pelvic fins rusty brown; side of cheek behind eye with scattered small melanophores; first and second dorsal fins clear; caudal fin with dark brown on proximal half, more intense distally; anal fin clear with dark brown on distal margin; pelvic fins dark rusty brown.

Color of preserved paratype. (Fig. 4) Background color of head and body light yellow with rusty tinge; front half of head, nape, and dorsum under dorsal fins rusty; nape and sides of body with scattering of relatively large melanophores, larger melanophores above, under, and below pectoral fin; pectoral-fin base with scattered melanophores; center of cheek, area below preoperculum, and gular region with concentrations of small melanophores; pelvic fins dark brown to black; first and second dorsal fins brown, darkest at membrane at basal area at end of first dorsal fin; anal fin brown with black distal margin; caudal fin brown.

Figure 4. *Cryptocentrus nanus*, preserved paratype, CAS 244345, 21.3 mm SL male, Vanua Balavu Island, Fiji (G.R. Allen).

Figure 5. Underwater photograph of small black shrimpgoby, possibly *Cryptocentrus nanus*, from Palau, Micronesia (courtesy Hiroshi Nagano).

Etymology. The specific epithet is from both the Latin and Greek noun *nanus* (dwarf), referring to the new species' particularly small size compared to other species in the genus. It is treated as a noun in apposition.

Distribution and habitat. The new species is currently known only from Fiji, but possibly occurs also at Palau based on a photograph by Hiroshi Nagano of a similarly colored goby (Fig. 5), illustrated as *Cryptocentrus* D in Myers (1999: 240, Plate 152J). The habitat consists of sand bottoms in 8.2–10.7 m depth. The alpheid-shrimp partner remains unidentified, but a specimen is deposited in the fish collection of CAS as CAS 244344.

Comparisons. *Cryptocentrus nanus* is nearly identical to the dark-phase juvenile of the widely distributed (E. Africa to New Caledonia) *Cryptocentrus fasciatus* (Playfair in Playfair & Günther, 1867). The only apparent color pattern difference is the presence of small blue spots on the head and sides in juvenile *C. fasciatus* (Fig. 6) and their apparent absence in *C. nanus*. The two species also share similar meristic features and are most reliably separated by the presence of vomerine teeth in *C. nanus* and their absence in *C. fasciatus*. Also, the latter species attains a much larger size, at least 95 mm TL, and adults exhibit a wide range of color variation (Fig. 7).

The only other *Cryptocentrus* species with vomerine teeth is *Cryptocentrus multicinctus* Allen & Randall, 2011, reported from Indonesia, Papua New Guinea, Palau, and the Marshall Islands. It has a dense patch of vomerine teeth, containing approximately 20–25 teeth, whereas the patch in *C. nanus* appears variable: the holotype has only 6 vomerine teeth (Fig. 8), whereas the largest paratype has about 20 teeth. Other differences between *C. nanus* and *C. multicinctus* (respectively) include scales on the posterior half of the body ctenoid vs. all cycloid; depth of the body at the pelvic-fin origin 4.4–5.2 in SL vs. 5.4–5.6 in SL; snout length 4.4–8.4 (mean 6.6) in HL vs. 5.1–5.5 in HL; caudal-peduncle depth 3.3–3.8 in HL vs. 3.0–3.2; a more rounded and longer caudal fin (length 2.7–3.1 in HL) vs. more lanceolate and shorter (length 3.1–3.3 in HL). Finally, *C. multicinctus* has a very different color pattern (Fig. 9).

Remarks. It has now been established that two species of *Cryptocentrus* posess vomerine teeth. Among the various genera of shrimp gobies, this feature was previously thought to be unique to *Stonogobiops* Polunin & Lubbock, 1977 and has been cited as useful for differentiating *Stonogobiops* from the closely related *Cryptocentrus* and *Myersina* Herre, 1934 (e.g. Hoese & Randall 1982, Winterbottom 2002, Satapoomin & Winterbottom 2002). It should be noted, however, that the vomerine tooth patch of both *Cryptocentrus* species is notably different from that of *Stonogobiops*, which are characterized by 1–4 relatively large recurved teeth on each half of the vomer. It is highly likely that this feature has evolved independently in the two genera and thus would not indicate a close

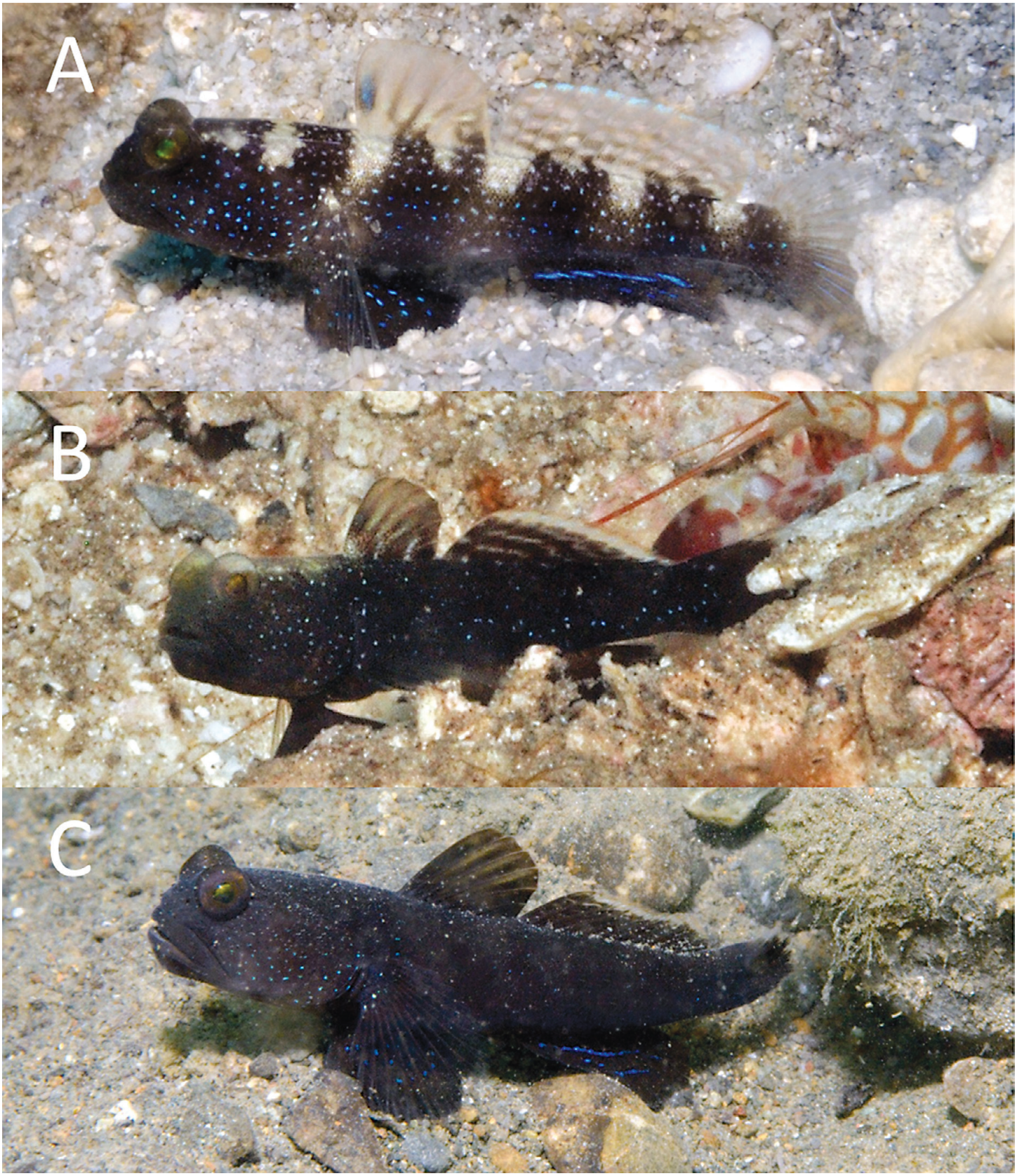

Figure 6. *Cryptocentrus fasciatus*, dark juveniles approx. 20-30 mm SL: A) Andaman Islands; B) Milne Bay, Papua New Guinea; and C) Milne Bay, Papua New Guinea (G.R. Allen).

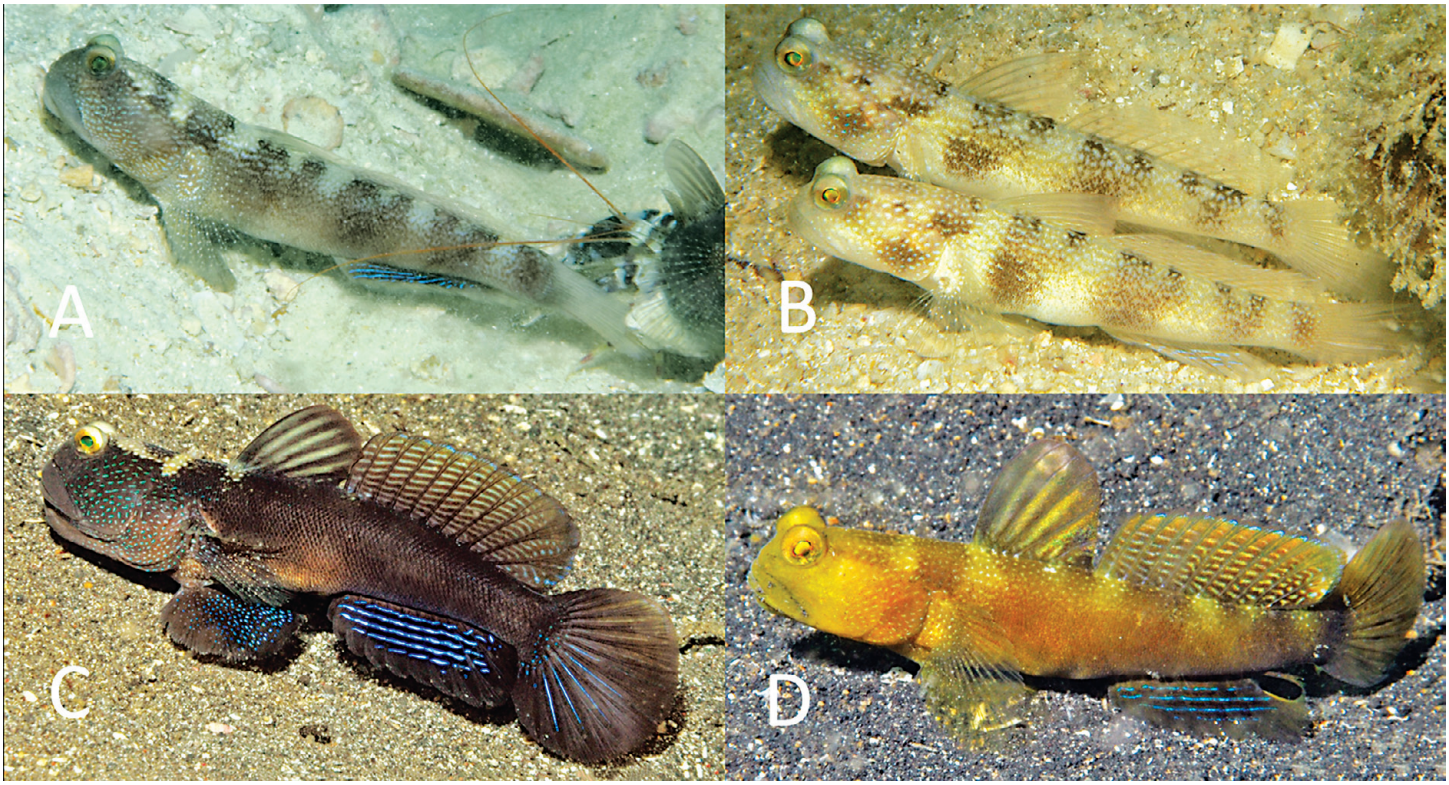

Figure 7. *Cryptocentrus fasciatus*, variable adult coloration, approx. 60–80 mm SL: A) West Papua Province, Indonesia; B) Similan Islands, western Thailand; C) North Sulawesi, Indonesia; and D) North Sulawesi, Indonesia (G.R. Allen).

relationship with *Stonogobiops*. Further studies, including phylogenetic analyses, would be required to clarify generic boundaries and inter-relationships among the numerous species of shrimpgobies.

The exceptionally small size of this species is particularly noteworthy compared to other members of the genus, which generally have a maximum size ranging from about 45–90 mm SL. The small size at maturity of *C. nanus* was confirmed by gobiid expert Kathleen S. Cole, who sectioned and stained a damaged specimen (approx. 17 mm SL, not retained) and observed mature oocytes.

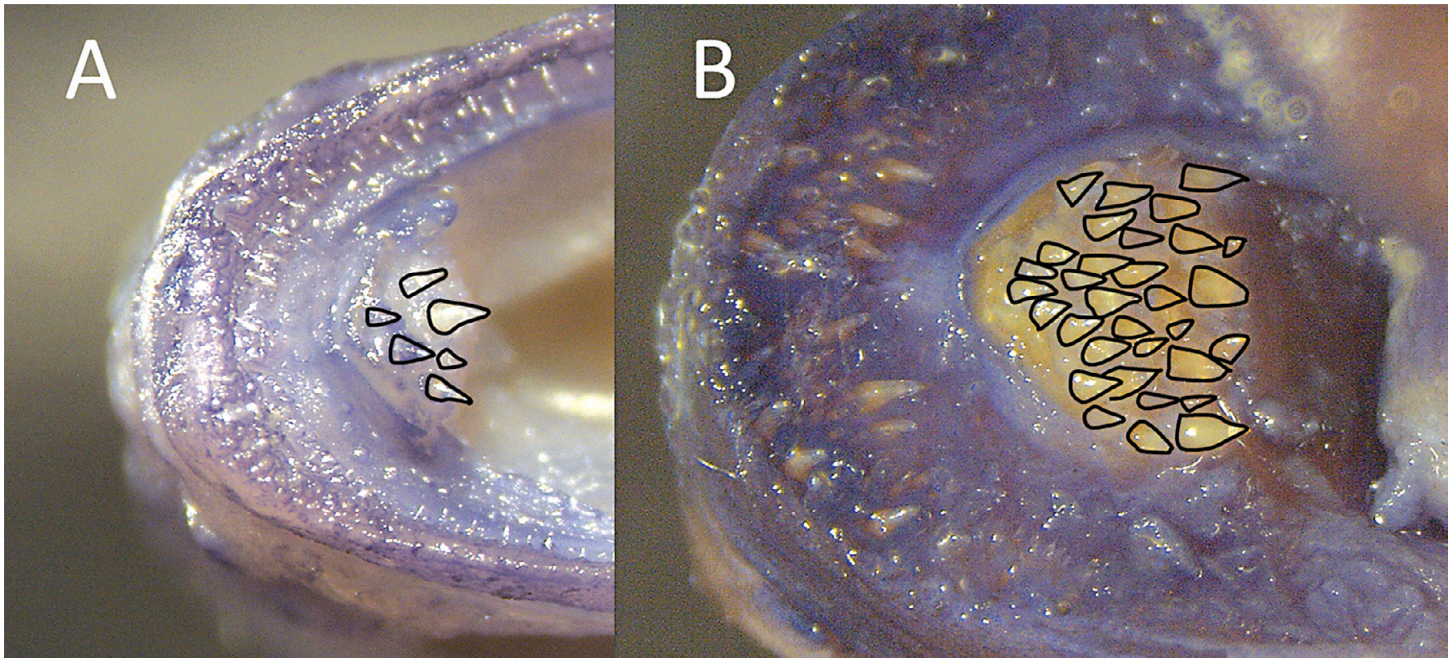

Figure 8. Photomicrograph of vomerine teeth (outlined in black) of *Cryptocentrus*: A) *C. nanus*, holotype, 23.4 mm SL; and B) *C. multicinctus*, 63.7 mm SL (WAM P.33267-001), New Britain, Papua New Guinea (G.R. Allen).

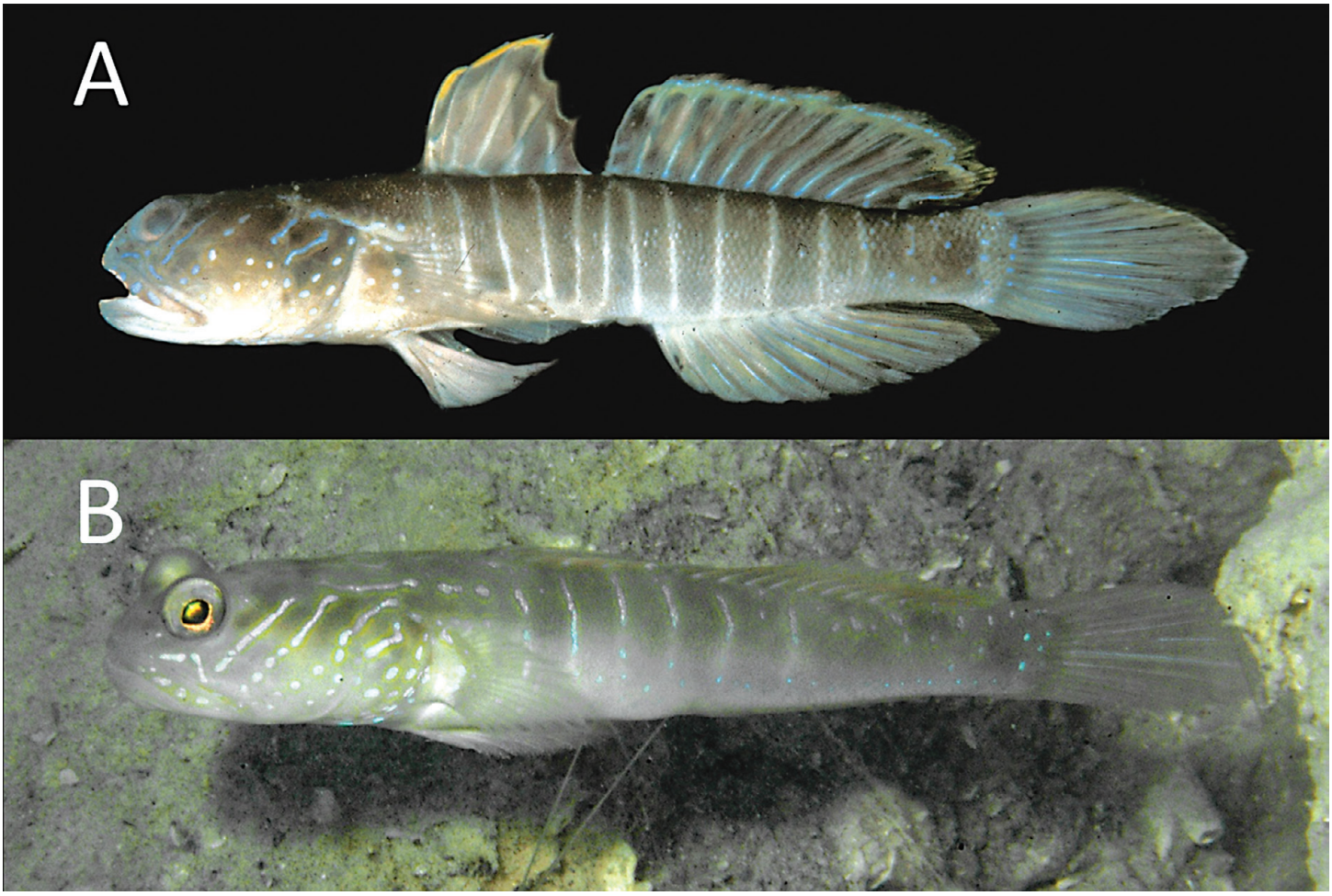

Figure 9. *Cryptocentrus multicinctus*, New Britain, Papua New Guinea: A) fresh holotype, BPBM 39019, 58.5 mm SL (J.E. Randall); B) underwater photograph, approx. 60 mm SL (G.R. Allen).

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