

A New Species of *Cryptoplax* (Mollusca, Polyplacophora, Cryptoplacidae) Described from Southern Japan

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Abstract A new chiton species *Cryptoplax brunoi* is described from the Ryukyu Islands, southern Japan. The new species has long been confused with a widespread Indo-West Pacific species, *Cryptoplax burrowi* (E. A. Smith, 1884), because of its close resemblance. It is distinguishable from the latter by having more fleshy, brownish girdle that is lacking greenish maculation, narrower tegmentum of the intermediate valves, wider, and flared articulation of the tail valve, and finely grooved, club-shaped dorsal spicules. Among five syntypes for *C. burrowi*, four syntypes in one of two lots were emphasized in Smith's original description while the single syntype in a second lot is here identified as belonging to the new species. One of the four syntypes corresponding to the more familiar widespread species is here designated as the lectotype of *C. burrowi*.

Key words: chiton, Acanthochitonina, *Cryptoplax*, new species, taxonomy, West Pacific.

Introduction

The species of *Cryptoplax* de Blainville, 1818 are medium to large chitons that have elongated, worm-like bodies. They have relatively small shell valves that for many species do not even in contact with each other for the posterior four of their eight valves. A typical *Cryptoplax* species lives in a very narrow space for its body, which requires flexibility of the body such as interstices of dead coral blocks, holes in rocks, among the holdfasts of kelps whereas other chitons are more likely to be found on the underside of rocks. Currently, 18 extant species are currently accepted (Molluscabase, plus see Park *et al.*, 2022); these are mostly restricted to the shallow waters of the tropical Indo-West Pacific except for some species found in warm temperate regions of eastern Asia or southern Australia.

The present author obtained 22 specimens of a distinctive *Cryptoplax* species from the Ryukyu Islands in southern Japan, with a peculiar wide, flared articulation in the tail valve, which expands laterally and even posteriorly beyond the tegmentum. This feature resembles the similar condition of a specimen illustrated in Haddon (1886: plate 3, fig 11k) as *C. burrowi* (E. A. Smith, 1884). This figure was drawn by E. A. Smith based on the specimen kept in the Natural History Museum, London, and provided to Haddon. However, taxonomic examination of the syntypes of *C. burrowi* kept in Natural History Museum revealed that the syntypes consist of two species: one is supposed to be the species figured in Haddon (1886), and the other is considered to be *C. burrowi*. They have been confused for long time, and there are some synonymous names, but no species with such a wide articulation of the tail valve has yet been described with other scientific names than

"*C. burrowi*" to date. Here the species collected from the Ryukyu Islands is described as a new species.

Material and Methods

All examined specimens are deposited in the molluscan collection of the Department of Zoology, National Museum of Nature and Science, Tsukuba (NSMT). The valves, girdle scales and spicules, and the radula were imaged by the scanning electron microscope (SEM) JEOL-LV6380, Jeol Co., Tokyo. Preparation for the examination by SEM followed Sirenko (2012) with modification: The boiling time in maceration was shorter, about 1–3 minute; girdle elements and radula were dried with a critical point dryer JCPD-5, Jeol Co. The girdle scales and spicules and a part of the radula were observed also with light microscope, AxioImager® M1 light microscope with AxioCam® HRC image capture equipment controlled by AxioVision® ver. 4.8, Carl Zeiss, Jena. Those hard parts were mounted on glass slides with Entellan neu® Merck, Darmstadt.

Underwater photograph (Fig. 1C) was taken with a digital camera TG-2 housed in the underwater housing PT-053, and a flash UFL-3, Olympus Imaging Corp., Tokyo.

Taxonomy

Class Polyplacophora Gray, 1821

Order Chitonida Thiele, 1909

Suborder Acanthochitonina Bergenhayn, 1955

Superfamily Cryptoplacoidea H.
and A. Adams, 1858

Family Cryptoplacidae H. and A. Adams, 1858

Genus *Cryptoplax* de Blainville, 1818

Type species: *Chiton larvaeformis* (de Blainville MS) Burrow, 1815, subsequent designation by Gray, 1821.

Distribution: Indo-West Pacific and southern Australia; Miocene–Recent

Cryptoplax brunoi n. sp.

(Figs. 1–5)

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Cryptoplax burrowi: Haddon, 1886: 42 (in part), pl. 3 fig. 11; Pilsbry, 1893: 54 (in part), pl. 9 fig. 7–10; Bednall, 1897: 158 (in part, as doubtful record from South Australia); ?Nierstrasz, 1905: 71 (in part), fig. 143; ?Thiele, 1909: 56; Iredale and Hull, 1925: pl. 12, fig. 32; ?Sliker, 2000: 54 (in part), pl. 15, fig. 11; ?Schwabe, 2005: 54 (in part), pl. 2, fig. 12. [all not of *Chiton* (*Chitonellus*) *burrowi* E. A. Smith, 1884]

Type material: Holotype. NSMT-Mo 82405, BL 60.0 mm, Kuroshima Island, 24°14'16"N, 123°59'25"E, on reef, in dead coral block, 25 Aug. 1992, leg. M. Osawa. Paratypes. NSMT-Mo 82406–82416, 17 specimens, BL 35.7–67.5 mm, same locality of the holotype, Aug–Sept 1992 and Aug. 1993, leg. M. Osawa; NSMT-Mo 82417, 1 specimen, BL 38.7 mm, Yarabuzaki, Ishigakijima Island, Yaeyama Islands, 24°25'53"N, 124°04'06"E, under rock at low tide level, 16 May 2007, leg. T. Kosuge; NSMT-Mo 82418, 1 specimen, BL 20.9 mm, Inoda, Ishigakijima Island, 24°27'N, 124°15'–16'E, on dead coral block at 2 m, 27 July 2007, leg. T. Kosuge; NSMT-Mo 82404, 1 specimen, BL 52.5 mm, Off Iriomotejima Island between Uehara and Hatomajima Island, Yaeyama Islands, 24°27'14"N, 123°48'30"E, under dead coral block at 7.4 m, 20 July 2019, leg. T. Fujita; NSMT-Mo 76700, 1 specimen, BL. ca. 50 mm, Sukomo beach, Kakeromajima Island, Amami Islands, 3 m, 26 May 1989, leg. I. Soyama.

Type locality: Kuroshima Island, Yaeyama Islands, southwestern Japan.

Type depository: National Museum of Nature and Science, Tsukuba.

Etymology: Named after Dr. Bruno Dell'Angelo who is a specialist of both extant and fossil chitons of the world.

Diagnosis: Large sized chiton with very narrow tegmentum, especially in valve IV. Tegmentum pinkish or brick red in head valve, brick red or yellow with fine orange maculation in remain-

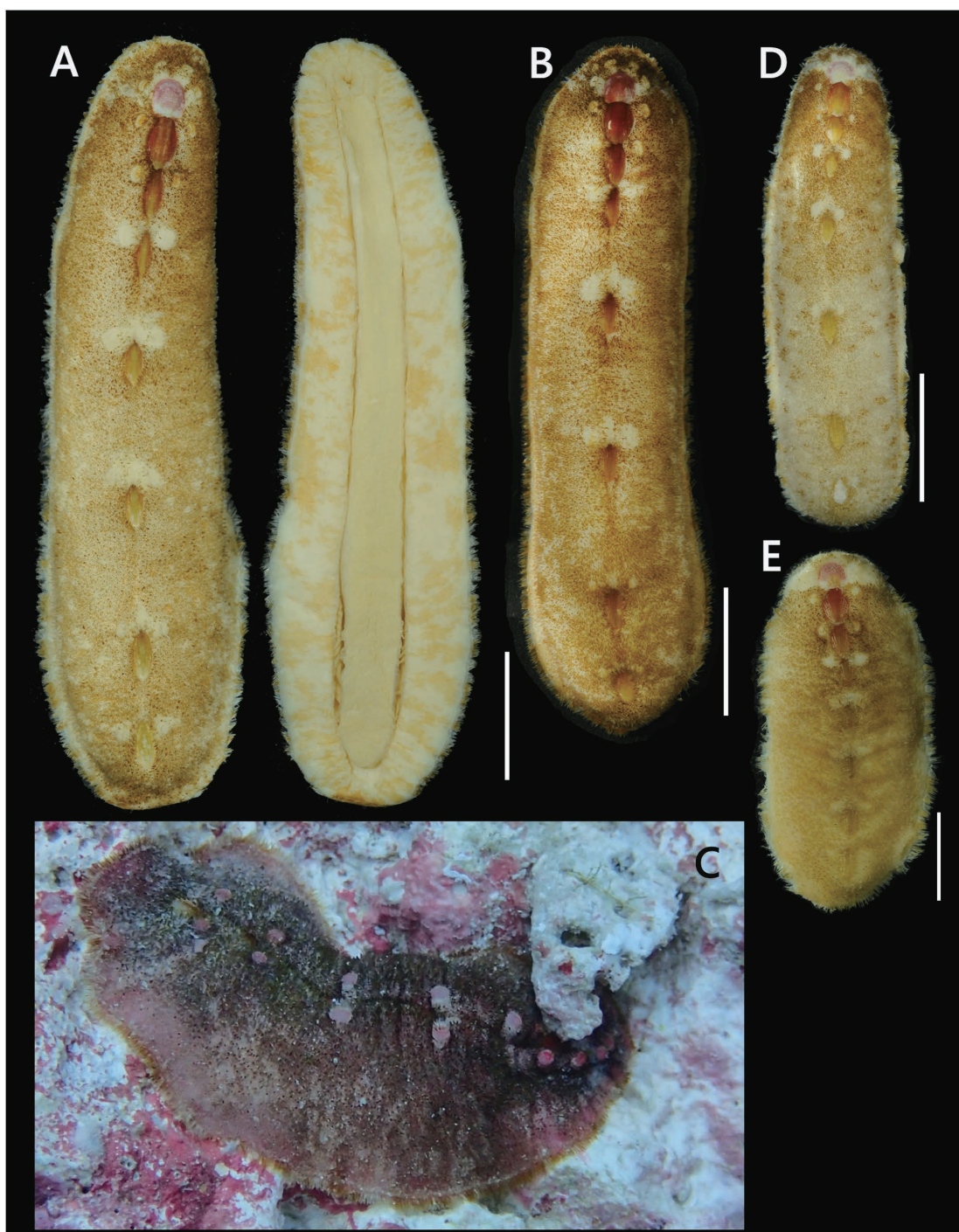


Fig. 1. *Cryptoplax brunoi* n. sp. Habitus. A, B, D, E, preserved specimens; C, specimen in situ, underwater photograph (by T. Fujita). A, holotype (NSMT-Mo 82405), Kuroshima Island, BL 60.0 mm, dorsal and ventral views; B, paratype (NSMT-Mo 82404), Iriomotejima Island, BL 52.5 mm, dorsal view; C, same specimen with B, underwater photograph; D, paratype (NSMT-Mo 82411), Kuroshima Island, BL 43.0 mm, dorsal view; E, paratype (NSMT-Mo 82413), Ishigakijima Island, BL 22.5 mm, dorsal view. Scales: 10 mm for A, B, D; 5 mm for E.

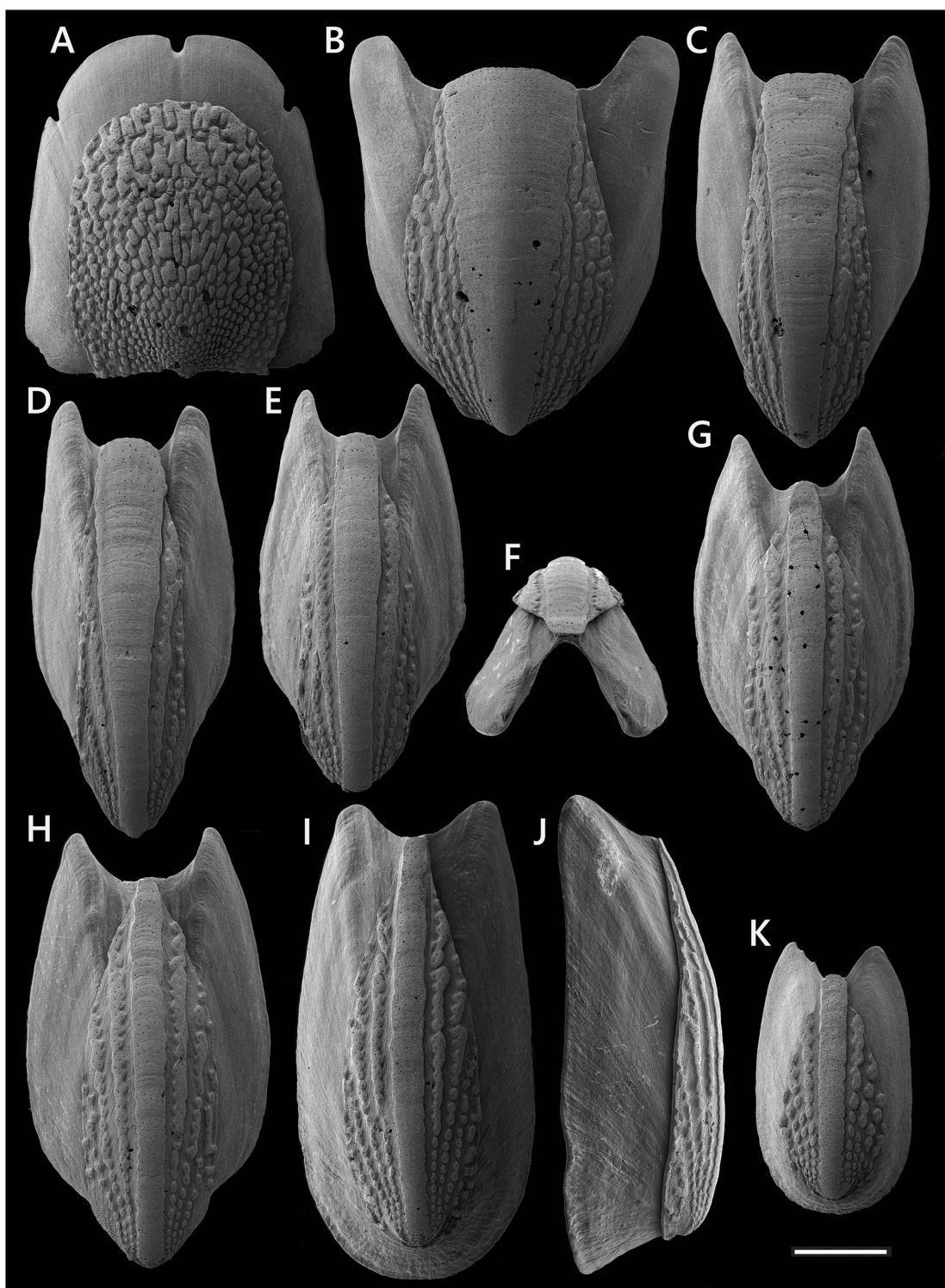


Fig. 2. *Cryptoplax brunoi* n. sp. SEM images of the valves. A–J, holotype (NSMT-Mo 82405): A, valve I, dorsal view; B, valve II, dorsal view; C, valve III, dorsal view; D, valve IV, dorsal view; E, valve V, dorsal view; F, valve V, frontal view; G, valve VI, dorsal view; H, valve VII, dorsal view; I, valve VIII, dorsal view; J, valve VIII, lateral view; K, paratype (NSMT-Mo 82413, same specimen with Fig. 1E), valve VIII, dorsal view. Scale: 1 mm for A–K.

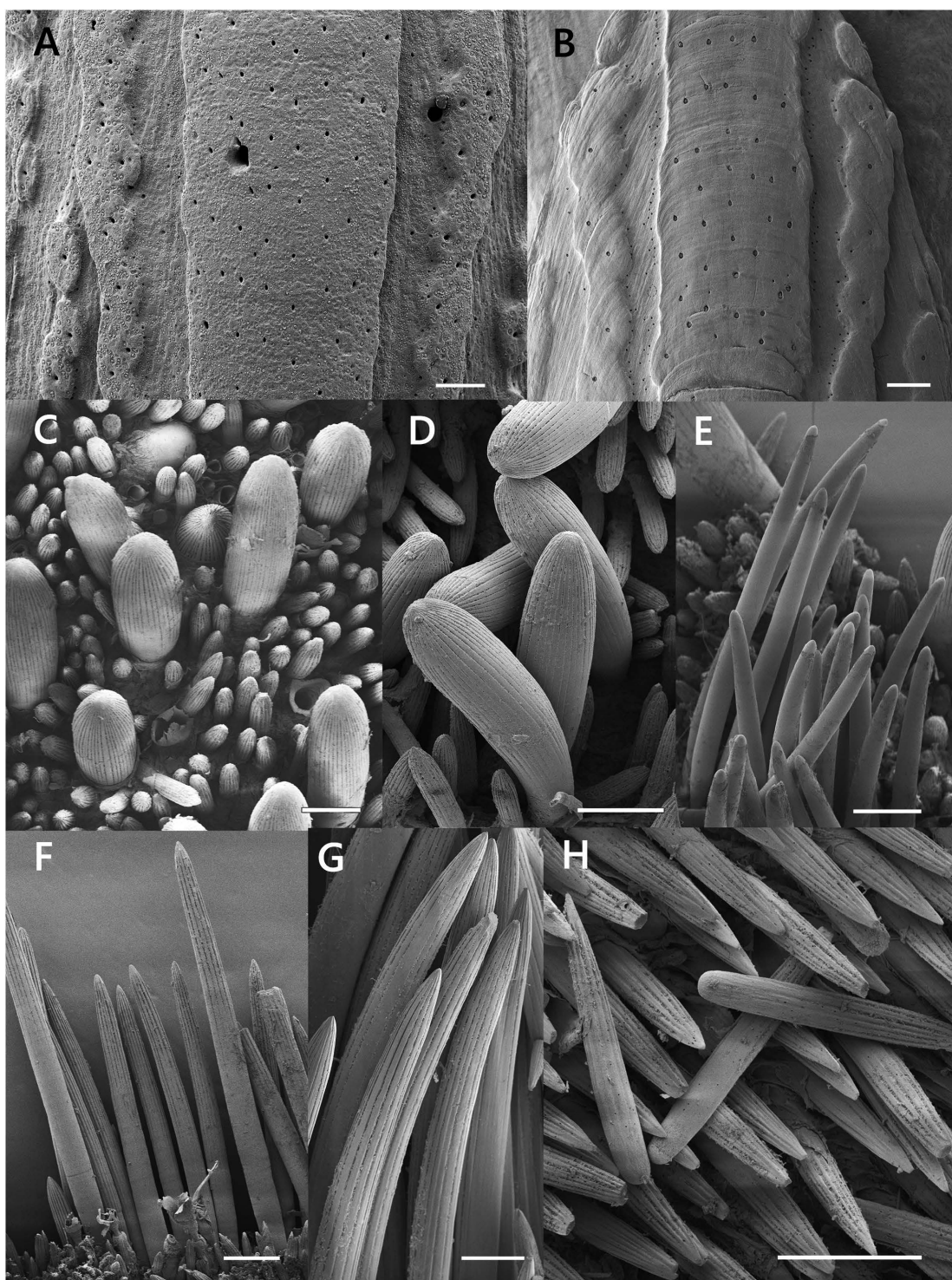


Fig. 3. *Cryptoplax brunoi* n. sp. SEM images of the valves and girdle spicules. A, C, E, F, H, holotype (NSMT-Mo 82405); B, D, G, paratype (NSMT-Mo 82404). A, B, detail of tegmentum in jugal and pleurolateral areas; C, D, dorsal spicules; E, tuft needles; F, G, marginal needles; H, ventral spicules. Scales: 100 µm for A–F; 50 µm for G, H.

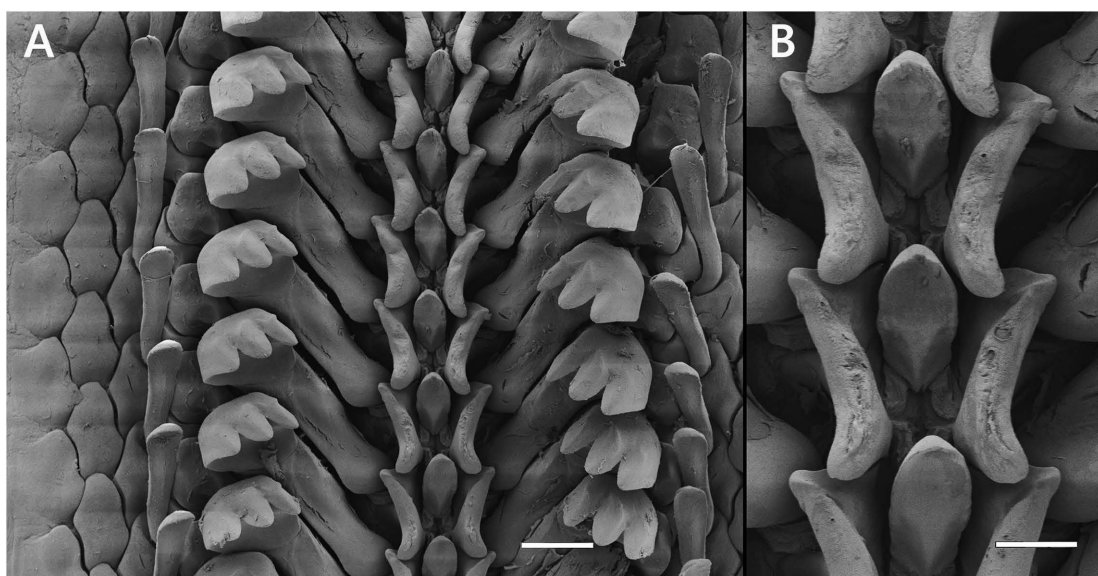


Fig. 4. *Cryptoplax brunoï* n. sp. SEM images of the radula. A, B, holotype (NSMT-Mo 82405). A. radula, dorsal view; B. central part of radula, dorsal view. Scales: 100 μ m for A, 50 μ m for B.

ing valves. Tail valve with widely flared insertion plate that expands laterally and even posteriorly beyond the tegmentum. Perinotum light grayish brown with finely grooved club-shaped spicules and minute obtusely pointed spicules. Hyponotum beige with obsolete light brownish maculation.

Description of the holotype: Animal large, 60.0 mm $\times$ 14 mm, vermicular. Tegmentum reduced to small and narrow, especially in valves IV, which is almost linear in appearance. Size of tegmentum widest and shortest at head valve, narrowest at valve IV, longest at tail valve. Valve VI shortest among intermediate valves. Valves I–III in contact with each other, valve IV shortly separated, and valves V–VIII widely separated. Color of tegmentum pinkish in head valve, brick red in valves II and III, yellow with fine orange maculation in valves IV–VIII. Perinotum light grayish brown, beige in sutural tufts and girdle margin. Hyponotum beige with obsolete brownish maculation (Fig. 1A).

Outline of tegmentum horseshoe-shaped in head valve, wide, oval in valve II, narrow, spindle-shaped in valves III–VIII. Mucro of tail valve not raised, located near posterior end (Fig. 2A–J).

Jugum wide wedge-shaped in valve II, narrow wedge-shaped in valves III and IV, parallel sided in remaining valves, nearly smooth on both surface and side margins. Jugal macroaesthetes roughly quincuncially distributed; no microaesthete on jugum (Fig. 3A). Head valve sculptured with rather fine pustules which are irregular in shape and often merged with neighboring pustules. Pleurolateral areas of valves II–VIII sculptured with longitudinal series of round to rectangular pustules, which are gradually increasing in size and fused into riblets anteriorly, and arranged in slightly divergent 5–6 rows in valves II and VIII, 3–4 rows in the valves III–VII. Each pustule with 1–3 macroaesthetes on top. Microaesthetes sparsely distributed along inner basal portion of riblets and prepustular area of pustules; no microaesthete on top of pustules (Fig. 3A).

Articulamentum rather thick, white in color. Insertion plate of head valve rather long, which is approximately 1/3 of the length of the tegmentum. Sutural laminae moderately projected anteriorly with round anterior tip in valve II–VII, whereas less projected in tail valve. Insertion plate of tail valve wide, flared postero-ventrally, with weak radial grooves on posterior surface.

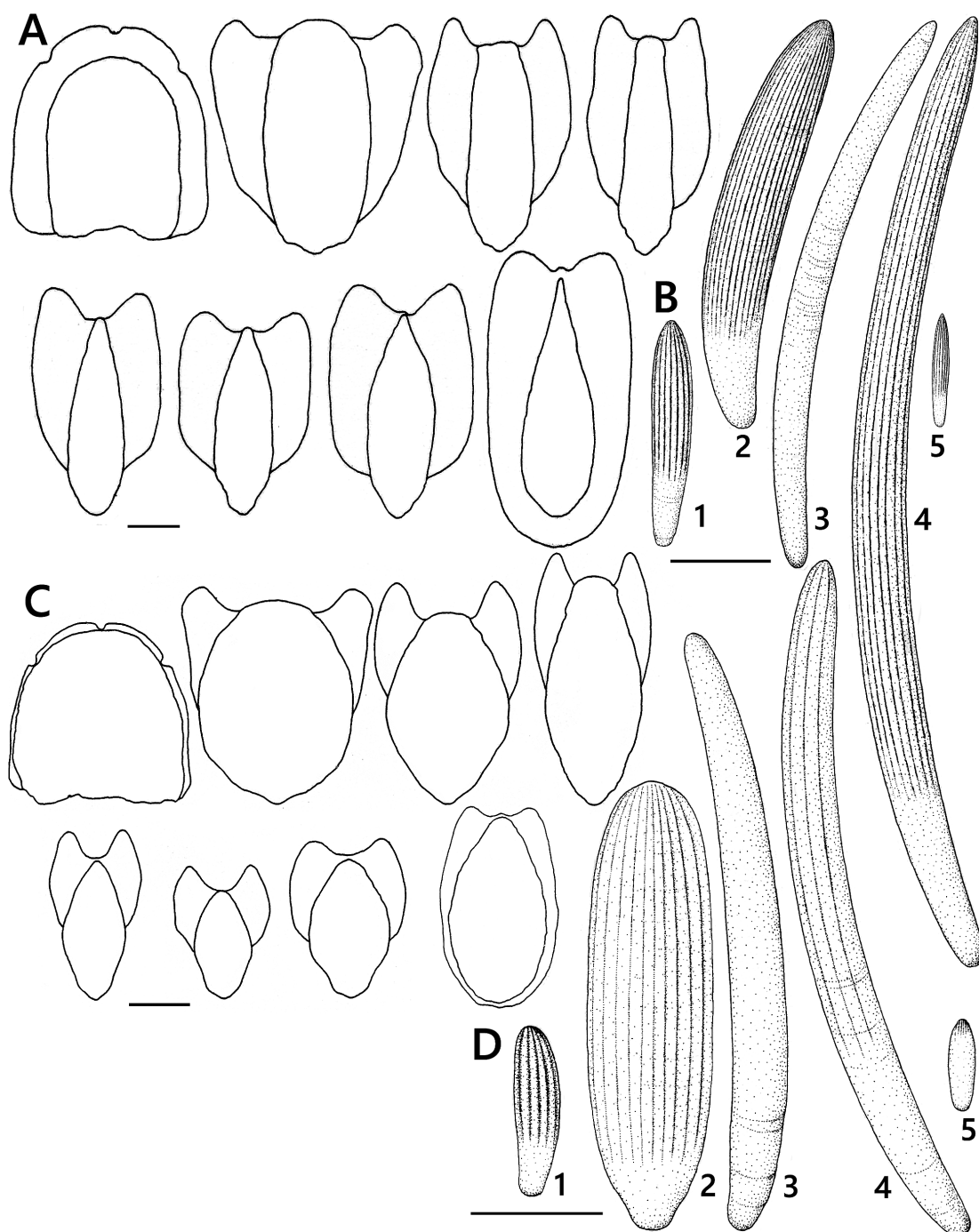


Fig. 5. Comparisons of valve shape and girdle spicules in *Cryptoplax brunoi* n. sp. and *C. burrowi* (E. A. Smith, 1884). A, B, *C. brunoi*, n. sp., paratype (NSMT-Mo 76700). C, D, *C. burrowi* (NSMT-Mo 76701, from Kakeromajima Island, Amami Islands, Japan, BL. ca. 40 mm). A, C, outline of the valves. B, D, girdle spicules: 1, small dorsal spicule; 2, large dorsal spicule; 3, spicule of the tuft; 4, marginal spicule; 5, ventral spicule. Scale for A, C: 1 mm; B, D: 100 μ m.

Slit formula 3/0/0 (Fig. 2A–J).

Perinotum densely covered with thick, slightly curved, finely grooved, cylindrical, obtusely pointed spicules of two distinct sizes (Fig. 3C). Larger one club-shaped, weakly curved, up to 550×115 (length) $\times$ 115 (width) μm ; smaller one nearly straight, up to $260 \times 40 \mu\text{m}$. Needles of sutural tufts long, slender, slightly curved, smooth, bluntly pointed, up to $800 \times 43 \mu\text{m}$ (Fig. 3E). Marginal spicules long, slender, slightly curved, finely grooved, pointed at tip, up to $860 \times 50 \mu\text{m}$ (Fig. 3F). Spicules on hyponotum small, lanceolate in outline, deeply grooved, pointed at tip, up to $115 \times 15 \mu\text{m}$ (Fig. 3H).

Arrangement of gills merobranchial, abanal type. Holotype specimen with 18 gills on each side. Gonopore located between posterior 8th and 9th gills, nephridiopore situated between posteriormost two gills.

Radula 10.4 mm in length with 54 rows of mature teeth. Central tooth small, narrow, roughly spatula-shaped in outline of posterior surface which is concaved in the distal half, keeled in the basal portion and rounded, weakly angulate at the dorsal edge; anterior process of central tooth short, propped basally. Centro-lateral (first lateral) tooth with shallow groove at inner surface of antero-dorsal corner. Head of major lateral tooth with three denticles of nearly equal length, which have weak transverse ridge-line, and obtusely pointed tip. Major uncinal tooth narrow with obtuse tip (Fig. 4).

Additional description on paratypes: Color of perinotum darker, and with reddish tint on sutural tufts and girdle margin in living animal (Fig. 1C), which became similar color with the holotype by preservation in ethanol (Fig. 1B). Perinotum occasionally with brownish dots on whole dorsal surface (Fig. 1D), and/or lighter cream color portion in anterior end (Fig. 1D, E).

Fig. 3B, D, G, and Fig. 5A, B showing features of paratypes NSMT-Mo 82404 and 76700, respectively, which match well with those of the holotype.

Articulamentum of tail valve considerably wide even in specimen of BL 22.5 mm (Fig. 2K).

Distribution: Only known from the Ryukyu Islands, Japan, and Port Moller, North Queensland, Australia so far, but may widespread in tropical and subtropical West Pacific.

Remarks: The present species has perhaps long been confused with *Cryptoplax burrowi* (E. A. Smith, 1884). Two years after the publication of the original description of *C. burrowi*, Haddon (1886) included drawings of the valves identified as of *C. burrowi*. Those drawing were made by E. A. Smith reported to be based on a specimen kept in the Natural History Museum, London. The valves of those drawings, especially the tail valve with its flared articulamentum closely resembles that of the present new species. The drawings were also reproduced in Pilsbry (1893) together with the color figure of the animal in Reeve (1847, species 3). That figure was presented as “*Chitonellus larvaeformis*” by Reeve was distinguished from what is presently known as *Cryptoplax larvaeformis* (de Blainville MS, Burrow, 1815) by E. A. Smith (1884) as a new species, *C. burrowi*. Nierstrasz (1905) was the first to illustrate the girdle spicules of *C. burrowi*. However, Nierstrasz showed (1905, pl. 5, figs 141–143) two distinct types of larger dorsal spicules, one is flat, scoop-shaped, and another is club-shaped, the latter of which is identical with those of the present new species. Then, Thiele (1909) examined other specimens from Makassar, Indonesia, and noted that the spicules of *C. burrowi* were club-shaped. Iredale and Hull (1925) were first to notice the confusion, concluding that Smith had confused *C. burrowi* with another species with a flared articulamentum of its tail valve, as illustrated in Haddon (1886). Subsequently, Leloup (1940) showed that the valves of *C. burrowi* are identical with those shown by Nierstrasz (1905), that is, the articulamentum of the tail valve is narrow, different from that of the figure in Haddon (1886, 11k) here regarded as *C. brunoii* n. sp., and the larger dorsal girdle spicules of *C. burrowi* are flat, scoop-shaped. Dell’Angelo *et al.* (2010) also pointed out the taxonomic confusion of *C. burrowi*. Revisiting the original description of *C. burrowi*,

Smith described the body to have “a buff colour, copiously mottled with green”. Also, Reeve (1847) described the species 3, as “*Chitonellus larvaeformis*”, has a red and green marble pattern. The present new species never has green or greenish maculation on the girdle. Specimens with such greenish pattern have flat, scoop-shaped dorsal girdle spicules and narrow articulamentum in the tail valve (personal observations). For this study, I was fortunately provided with an opportunity to examine two lots of the syntypes of *C. burrowi* deposited in the Natural History Museum, London: NHMUK 1881.11.10.100 from Port Molle, Queensland, and NHMUK 1992.053 from Port Adelaide (in error *vide* Iredale and Hull, 1925). The former lot consists of one soft body kept in ethanol, and 7 disarticulated dried valves, among which the tail valve is missing. This specimen has club-shaped dorsal girdle spicules, and the features of the valves also match with those of *C. brunoi* n. sp. The drawings in Haddon (1886, Fig. 11) provided by E. A. Smith are presumed to be based on this specimen. The latter lot 1992.053 consists of four dried specimens, and five valves are disarticulated. All the four specimens were of a single species and have scoop-shaped flat dorsal girdle spicules. The label indicates “fig’d in Reeve, 1847. Conch. Icon., 4 *Chitonellus*, sp. 3, pl. 1, fig.3 as *larvaeformis*”. Thus, the syntype of the first lot is a different species from the four syntypes in the second lot. E. A. Smith originally described *C. burrowi* as a new name for *C. “larvaeformis”* that was erroneously identified by Reeve (1847), but later he provided the drawing of the valves of the specimen from the first lot to Haddon (1886: Fig. 11). However, *C. burrowi* is considered to be the species with its name-baring syntype 1992.053 because, as Iredale and Hull (1925) remarked, “E. A. Smith regarded the figure given by Reeve for his ‘*Chitonellus larvaeformis*’ as sufficiently exact to represent his species,” and he described the color of the species as “a buff colour, copiously mottled with green.” In order to avoid further confusion and to fix the identity of *Cryptoplax burrowi*, the largest

specimen, BL 58mm among four syntypes NHMUK 1992.053 is herein designated as the lectotype (NHMUK 1992.053/1), and all the remaining syntype specimens (including the one in a different lot identified as *C. brunoi* n.sp.) are regarded as paralectotypes.

Of the synonymous names for *C. burrowi*, none is based on one or more type specimen(s) with such a wide articulamentum of the tail valve. This leaves the specimen in the first lot described above without an available name, justifying its description as *C. brunoi* n. sp. It differs from *C. burrowi* by the following: the tegmentum of the head valve is the shortest of all valves (that of valves V–VII are clearly shorter than the head valve in *C. burrowi*); the valves are narrower, which is most obvious for valves II and IV (Fig. 5); the tail valve has a flared articulamentum; the girdle is more fleshy brownish than *C. burrowi*, lacking greenish maculation; and the dorsal girdle spicules are large and club-shaped, among longer finely grooved marginal spicules (Fig. 5).

Cryptoplax hartmeyeri Thiele, 1911, *Cryptoplax mjoebergi* Bergenhayn, 1933, and *Cryptoplax vittata* Ang, 1967 resemble the present new species by having small intermediate valves V–VII. The first two species were synonymized with *C. burrowi* by Leloup (1940). They have flat, striated spicules. The identity of *C. vittata* is unclear, but the articulamentum of the tail valve is not wide as the present new species.

E. A. Smith (1903) reported *Cryptoplax burrowi* from Hulule Island, Maldives. However, due to the taxonomic confusion mentioned above, the specimen needs to be re-identified.

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