

TWO NEW *SIPHONALIA* (GASTROPODA, BUCCINIDAE) FROM NORTHEAST TAIWAN

SHUQIAN ZHANG^{1,2}, SUPING ZHANG^{1,2} & CHIH-YEH LEE³

¹Laboratory of Marine Organism Taxonomy and Phylogeny, Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China;

²Center for Ocean Mega-Science, Chinese Academy of Sciences, 7 Nanhai Road, Qingdao 266071, China;

³233 Wusheng Street, Keelung City, Taiwan

Abstract Two new species belonging the genus *Siphonalia* Adams, 1863 are described from relatively shallow water (100-180m) off Kueishan Island, northeast Taiwan. *Siphonalia minor* sp. nov. is most similar to *Siphonalia vanattai* Pilsbry, 1905 (a species also occurring at Kueishan Island) in general shell shape, but can be distinguished from it by having a slightly broader shell, convex spire whorls, different colour pattern, and most notably, by having 6–7 widely spaced whitish spiral cords along the body whorl. *Siphonalia teres* sp. nov. can be clearly distinguished from other congeners by having a medium sized shell with a moderately short spire, and sculptured upper teleoconch whorls in combination with a smooth body whorl.

Key words Buccinoidea, Kuieshan Island, protoconch, radula

INTRODUCTION

Members of the Buccinidae Rafinesque, 1815 occur in nearly all marine habitats, ranging from pole to pole and from intertidal zone to hadal depths. However, the genus, *Siphonalia* Adams, 1863, has a relatively narrower distribution, being limited to coast of southern Japan (Okutani, 2000), China (Zhang, 2008a; Zhang & Zhang, 2018), and Vietnam (Parth, 1996), at depths that extend from the subtidal zone to the continental shelf (most 10–300m) on sandy or muddy bottom. In Chinese waters, the genus is known to be represented by at least nine species, ranging from the Yellow Sea (~33°N) in the north to the Nansha Islands (~5°N) in the south, with the highest biodiversity in Taiwan (see Table 1). It is beyond the scope of the present paper to discuss the biogeographic details or to produce a revision of this taxonomically quite confusing genus.

In recent years, several buccinid specimens collected from shallow water off Kueishan Island were sent to the authors. Morphological studies revealed that two of them represent hitherto undescribed species belonging to genus *Siphonalia*. In the present study, we described these two species and compare them to similar congeners.

MATERIALS AND METHODS

Specimens were collected from shallow water off Kueishan Island (also called Turtle Mountain Island), a small island about 11km off Yilan County, northeast Taiwan (approximately 24°50'~24°51'N 121°56'~121°57'E). The Island was formed by volcanic activity about 1.65 Ma ago, and experienced a series of volcanic eruption events until 20 ka ago (Juang *et al.*, 2011). The northeast prevailing wind blows strongly in winter and the warm Kuroshio Current passes northward through this area in summer (Chu, 1971). The malacofauna in the area has been preliminarily investigated by various authors (Jung & Lai, 1999; Huang *et al.*, 2013; Chan *et al.*, 2016).

For morphological study, shells were observed using stereomicroscope. Measurements were taken using calipers, with accuracy to 0.1mm. A radula from *Siphonalia teres* sp. nov. was extracted and cleaned with 10% NaOH at 60°C for 1–2 h, washed in distilled water, air dried, and coated with gold for examination by scanning electron microscopy (SEM). Radula from *S. minor* sp. nov. was unattainable due to premature rotting of the soft parts because of poor preservation. Type specimens have been deposited in the Marine Biological Museum of Chinese Academy of Sciences (MBMCAS).

The following abbreviations are used in the text: BMNH, British Museum of Natural History, London; MBMCAS, Marine Biological Museum

Table 1 List of Recent *Siphonalia* species from Chinese waters. (species arranged in alphabetical order)

Species	Distribution	References
<i>Siphonalia borshengjungi</i> Lai, 2019	Taiwan Strait	Lai, 2019
<i>Siphonalia cassidariaeformis</i> (Reeve, 1846)	Taiwan	Kuroda, 1941; Zhang, 2008a
<i>Siphonalia minor</i> sp. nov.	Kueishan Island, Taiwan	this study
<i>Siphonalia fusoides</i> (Reeve, 1846)	East China Sea; Taiwan	Qi, 2004; Wu & Lee, 2005; Zhang, 2008a; Zhang, 2008b
<i>Siphonalia leei</i> Zhang & Zhang, 2018	Kueishan Island, Taiwan	Zhang & Zhang, 2018
<i>Siphonalia marybethi</i> Parth, 1996	South China Sea	Zhang & Zhang, 2018
<i>Siphonalia nanshaensis</i> Zhang & Zhang, 2018	Nansha Islands	Zhang & Zhang, 2018
<i>Siphonalia nigrobrunnea</i> Lee & Chen, 2010	Kueishan Island, Taiwan	Lee & Chen, 2010
<i>Siphonalia spadicea</i> (Reeve, 1847)	Yellow Sea; East China Sea; Taiwan	Zhang 2008a; Zhang 2008b
<i>Siphonalia vanattai</i> Pilsbry, 1905 ¹	Kueishan Island, Taiwan	Wu & Lee, 2005
<i>Siphonalia teres</i> sp. nov.	Kueishan Island, Taiwan	this study

¹Identified by Wu & Lee (2005) as *Siphonalia cassidariaeformis* (Reeve, 1846).

of Chinese Academy of Sciences, Qingdao; NMR, Natural History Museum Rotterdam.

SYSTEMATICS

Class Gastropoda Cuvier, 1797

Superfamily Buccinoidea Rafinesque, 1815

Family Buccinidae Rafinesque, 1815

Genus *Siphonalia* A. Adams, 1863

Type species: *Buccinum cassidariaeforme* Reeve, 1846 (by subsequent designation); Recent and fossil, Japan.

Siphonalia minor sp. nov.
(Figs 1–4)

urn:lsid:zoobank.org:act:10ECEE98-EF45-4729-BF63-DA5E6DE4DA13

Holotype One specimen, MBMCAS registration number: MBM286514 (length 20.7mm, width 11.5mm), August 2006.

Paratype One specimen MBM286515, (length 18.1mm, width 10.0mm) collected together with holotype from the type locality.

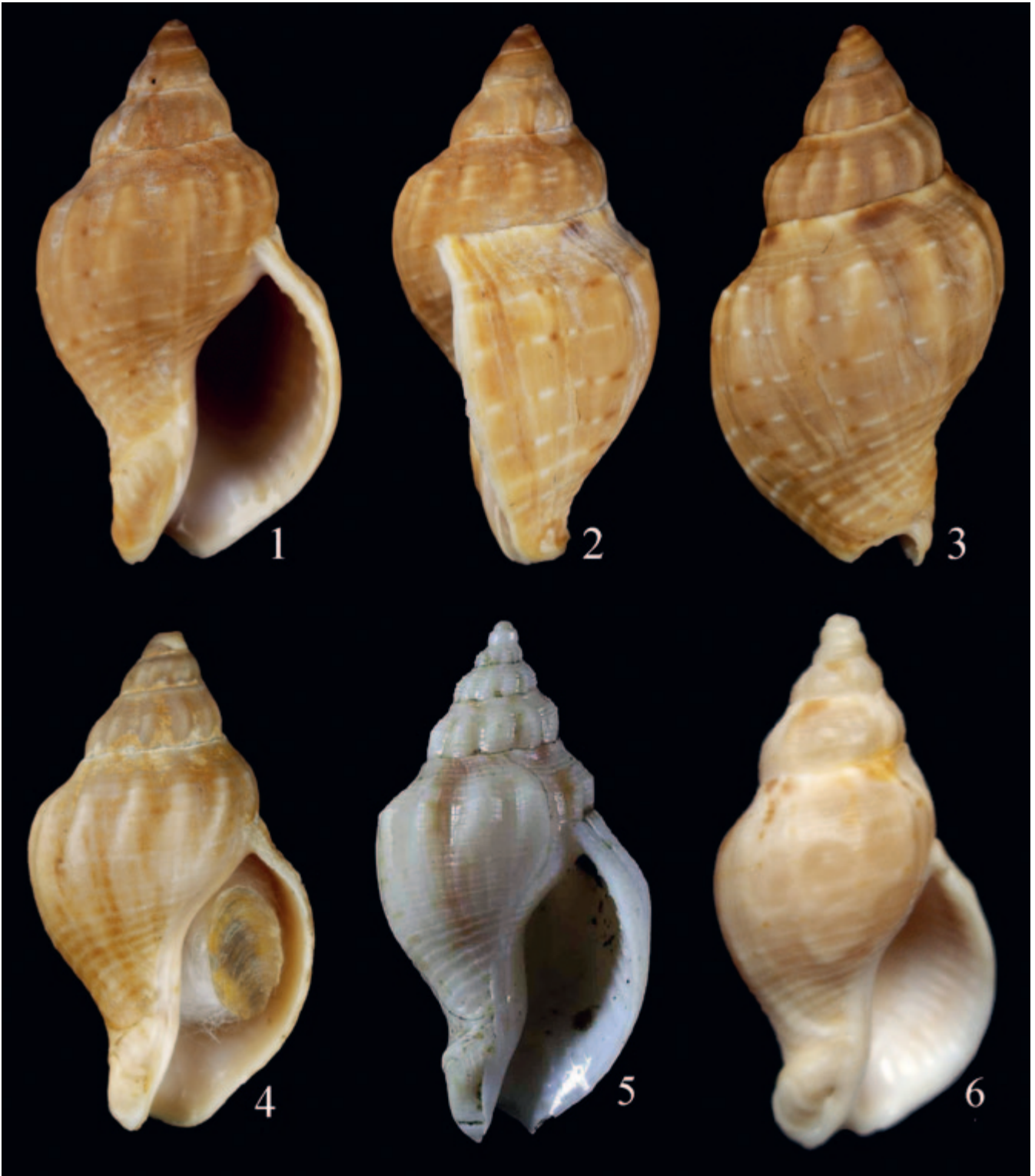
Type locality Sandy sediment, Kueishan Island, Taiwan, 24°53'50"N 122°00'42"E, 100m deep.

Description Shell (Figs 1–4) small for genus (up to 20.7mm high), thick, solid, broadly fusiform,

with low, conical spire (1/4 of total shell length, spire angle ~60°), large, shouldered body whorl, broadly ovate aperture, and short, wide, open siphonal canal. Protoconch acute, smooth, partly eroded. Transition to teleoconch indistinct. Teleoconch with up to 4¼ convex, evenly rounded whorls. Suture adpressed, slightly undulate. Spiral sculpture along spire whorls consisting of evenly spaced spiral cords (4 along first whorl, 6 along penultimate whorl); body whorl with 3 closely-spaced spiral cords on subsutural slope, patterned with 7 distantly spaced whitish lines mottled with brown dots below shoulder and 5 (6 in paratype) closely-spaced spiral cords along base. Axial sculpture of low, rounded axial ribs (12 on penultimate whorl, 11 on body whorl), extending from suture to suture on spire whorl, more pronounced on periphery of body whorl. Aperture large (1/2 of total shell length), ovate, offset from coiling axis of the shell by ~20°. Siphonal canal short, wide, slightly recurved, with prominent fasciole. Outer lip rather thick, with sharp edge, internally about 14 ridges of different strength; columellar lip smooth with weak callus. Shell colour uniformly yellowish, patterned with 7 distantly spaced whitish lines mottled with brown dots just below shoulder. Operculum ovate, with terminal nucleus.

Soft parts and radula unknown.

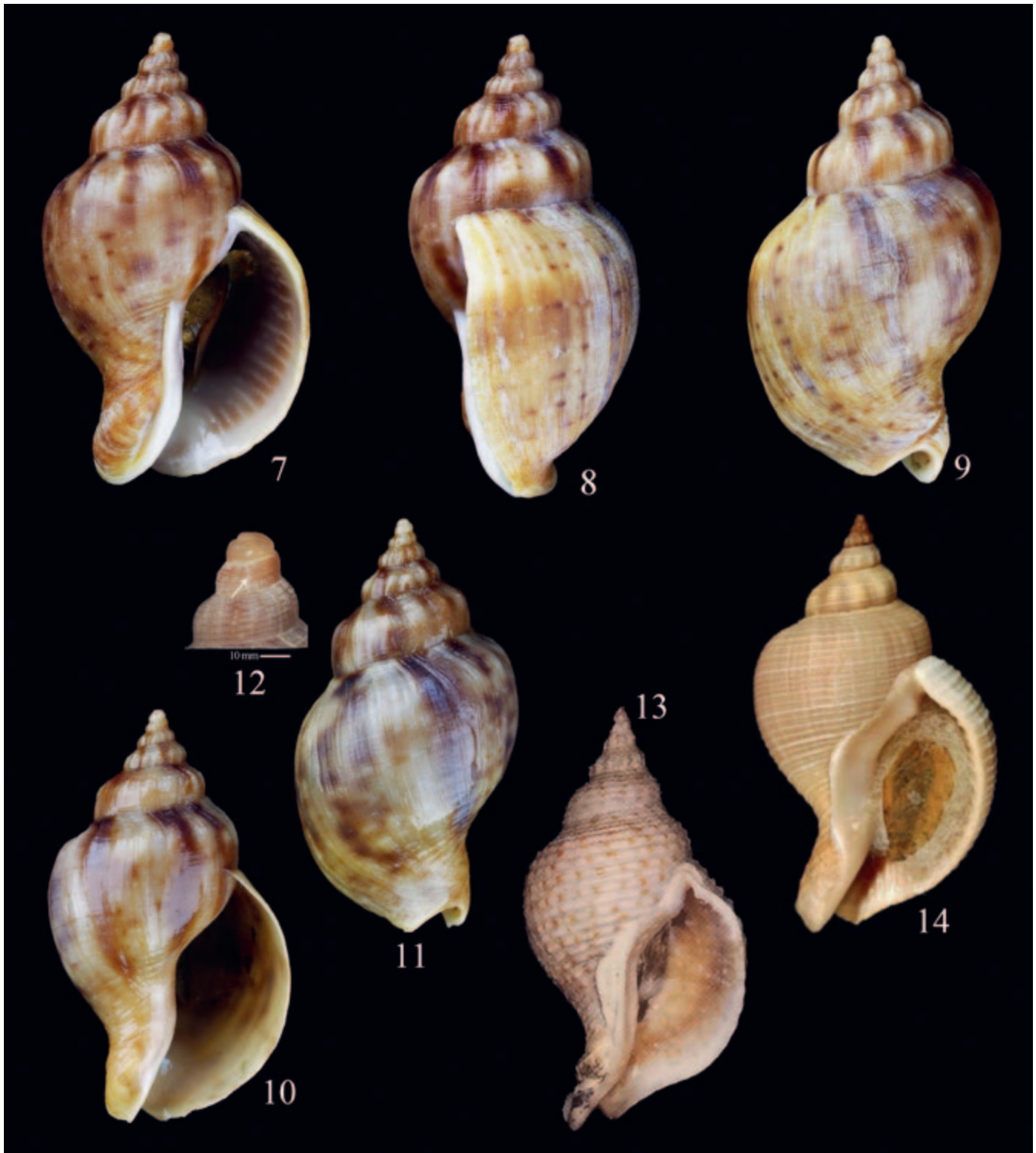
Derivation of name Latin, *minor*, meaning less or small, refers to small shell size of new species.



Figures 1–6 Shells of *Siphonalia* species. 1–4 *Siphonalia minor* sp. nov. 1–3 Holotype, 20.7mm, Kueishan Island, (MBM286514). 4 Paratype, 18.1mm, Kueishan Island, (MBM286515). 5 *Siphonalia vanattai* Pilsbry, 1905, 25.0mm, Kueishan Island. 6 *Siphonalia borshengjungi* Lai, 2019, holotype, 30.0mm, photo courtesy of Kin-Yang Lai.

Comparisons So far, *Siphonalia minor* sp. nov. may represent the smallest known member of the genus (adult shell size up to 20.7mm high).

Only a single congener, *S. vanattai* Pilsbry, 1905, which also can be found at Kueishan Island, has a comparable, but slightly larger, shell size.



Figures 7–14 *Siphonalia teres* sp. nov. 7–9 Holotype, 40.2mm, Kueishan Island, 180m deep, (MBM286521). 10–11 Paratype, 37.4mm, Kueishan Island, 180m deep, (MBM286522). 12 Protoconch of paratype, arrow indicates the transition to teleoconch. 13 *Siphonalia pfefferi* Sowerby III, 1900, holotype, 44.6mm, (BMNH 1900.5.22.88) taken by Kevin Webb, NHMUK Photographic Unit. 14 *Siphonalia trochulus* (Reeve, 1843), 45mm, Japan, (NMR 48880).

S. vanattai is similar to *S. minor* in shell shape and proportions, but differs by its slender shell with a rounded protoconch, the shouldered spire

whorls, more developed and more narrowly spaced spiral cords along the shell surface, and the different colouration (see Fig 5).

S. borshengjungii Lai, 2019 from Taiwan Strait is similar in shell sculpture (see Fig. 6) but differs from *S. minor* sp. nov. by its more slender shell with rounded protoconch, the more convex body whorl without shoulder, and a larger adult shell size (30mm *vs.* 20.7mm).

Siphonalia teres sp. nov.
(Figs 7–12, 15–16)

urn:lsid:zoobank.org:act:CA349DF9-EB30-4425-B5FA-34339A52013E

Holotype One specimen, MBMCAS registration number: MBM286521 (length 40.2mm, width 23.2mm), August 1999.

Paratype One specimen, MBMCAS registration number: MBM286522 (length 37.4mm, width 20.4mm) collected together with holotype from the type locality.

Type locality Sandy sediment, 1.5–2km north-east of Kueishan Island, Taiwan, 180m deep.

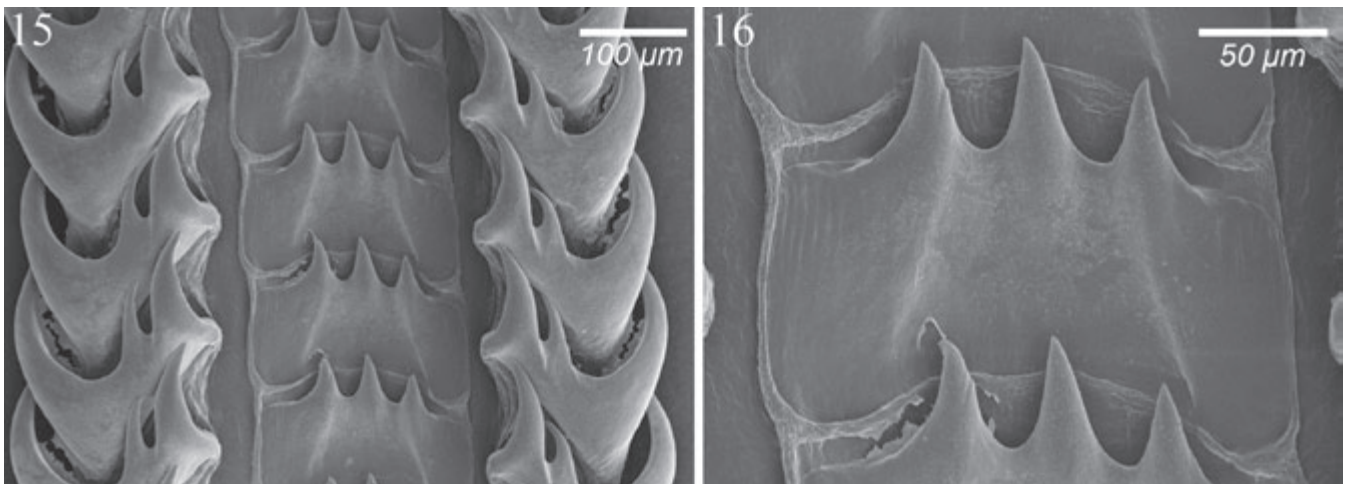
Description Shell (Figs 7–12) of medium size for genus (up to 40.2mm high), thick, solid, small conical spire (1/4 shell height, spire angle $\sim 50^\circ$), large, rounded body whorl, semi-ovate aperture, and short, wide, dorsally deflected siphonal canal. Protoconch consisting of 2 smooth, papilla-like whorls, sculptured with 2 strong peripheral spiral cords and several weak, curved axial threads prior to transition to teleoconch. Teleoconch with 5 convex, rounded whorls. Suture constricted. Spiral sculpture starting with 5–6 spiral cords on first whorl, their number gradually increasing to

18 on penultimate whorl, their strength becoming reduced and absent on upper part of the body whorl. Instead, body whorl with 9 sub-equidistantly spaced lines mottled with white and brown dots. Axial sculpture consisting of well developed, rounded ribs, extending from suture to suture on spire whorls (14 on first whorl, 13 on penultimate whorl), becoming weak and obscure on body whorl. Aperture large (3/5 of total shell length), broadly ovate, offset from coiling axis by $\sim 20^\circ$. Siphonal canal short, wide, slightly curved, with prominent fasciole. Outer lip with sharp edge, internally sculptured with about 17 strong ridges of unequal strength; columellar lip smooth, callus thick. Shell colour yellowish, patterned with irregular, longitudinal orientated brown blotches and 9 sub-equidistantly spaced lines mottled with white and brown dots. Operculum ovate, with terminal nucleus.

Radula (Figs 15–16). Rachidian tooth with three cusps. The rightmost one slightly smaller compared to the other two. The leftmost cusp with a small secondary cusp. Basal plate roughly rectangular, concave along anterior edge. Lateral teeth with three strong, sickle-like cusps, outer one largest, middle one smallest.

Derivation of name The name is a Latin adjective meaning “smooth”, referring to the smooth sculpture.

Comparisons *Siphonalia teres* sp. nov. is characterised by its medium sized shell with small, low spire, and large, rounded body whorl, sculpture developed on spire whorls but becoming reduced



Figures 15–16 Radula of *Siphonalia teres* sp. nov. **15** Intact radular segment. **16** Rachidian tooth. Dissected from holotype.

on body whorl. These features can readily separate the new species from its congeners.

Two species from Japan, *S. pfefferi* Sowerby III, 1900 and *S. trochulus* (Reeve, 1843), have a similar shell shape (see Figs 13, 14 respectively).

S. pfefferi differs from *S. teres* sp. nov. by its more acute spire, the more expressively patterned shell with noticeable and regularly arranged brown spots, by its strong sculpture of well developed spiral cords, the slightly longer siphonal canal, the well accentuated and deeper anal notch and by its much broader columellar callus that forms an extensive wing.

S. trochulus differs from *S. teres* sp. nov. by its more acute spire, the red-brown colour, the stronger sculpture of fine spiral cords, the slightly longer siphonal canal, and by its much broader columellar callus.

S. cassidariaeformis var. *funerea* Pilsbry, 1895 from Japan somewhat resembles the new species in general shell shape, and the presence of irregular, longitudinal brown blotches, but, like other forms of *Siphonalia cassidariaeformis*, differs from *S. teres* sp. nov. by its larger shell, the typical, strongly shouldered whorls, and the developed sculpture consisting of stronger spiral cords and axial ribs on all whorls including the body whorl.

ACKNOWLEDGEMENTS

We would like to express our sincere thanks to Koen Fraussen for help with the taxonomic discussions. Anna Holmes kindly provided valuable comments and suggestions on the earlier version of the manuscript. Photos of type specimens of *Siphonalia borshengjungii* and *Siphonalia pfefferi* were kindly provided by Kin-Yang Lai and Andreia Salvador, respectively. This research was financially supported by the National Natural Science Foundation of China (31750002).

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