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Contribution to the knowledge of Triviidae XXII. New species in the genus *Trivellona* Iredale, 1931

(Mollusca, Gastropoda)

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Two new species of the genus *Trivellona* Iredale, 1931 – *Trivellona pulchra* spec. nov. and *Trivellona enricoschwabei* spec. nov. – are described from the Philippines and East China Sea. The new species are thoroughly compared with their congeners *Trivellona opalina* (Kuroda & Cate in Cate, 1979) and *Trivellona schepmani* (Schilder, 1941). *Trivellona pulchra* spec. nov. is especially distinguished by its unique ribbing and outline. *Trivellona enricoschwabei* spec. nov. differs by the ovate shell outline with a narrow aperture. Species of the genus *Trivellona* are deep water Triviidae mainly known from the central Indo-Pacific.

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Introduction

Recently, our revisions of the fossil and Recent species of *Trivellona* Iredale, 1931, an interesting group of deep water Triviidae were published (Fehse & Grego 2004, 2009). We studied all types of living and fossil *Trivellona* species besides of several hundreds of additional shells. We noted the existence of new taxa and mentioned them as "*Trivellona* sp. indent. A to E" (Fehse & Grego 2009: pl. 10, fig. 47; pl. 11, figs 49, 50; pl. 15, figs 61, 62; appendix IV, fig. U). We restrained to describe these species because only less than five specimens were available to confirm the intraspecific variability. In the meantime additional specimens of "*Trivellona* sp. indent. C" were found in the deep water of Aliguay Island, Philippines and could be obtained by the authors. This species is described in this study as *Trivellona pulchra* spec. nov. It is a very attractive species with fine and numerous, close-set ribs and coloured terminals.

Several dozens of specimens of another undescribed *Trivellona* species were dredged from deep waters of the East China Sea. These specimens are similar to *Trivellona schepmani* (Schilder, 1941) and induced a comparison based on type material in which we have found the differences to be consistent. Therefore, we have decided to describe the new taxon as *Trivellona enricoschwabei* spec. nov.

The genus *Trivellona* maintains the world record size among the Triviidae with almost 50 mm but also small species of 5 mm are known (Fehse & Grego 2007). Their shells possess a uniquely shaped anal and siphonal canal and a sharply edged outer labral margin. They first appeared in the Tethyan Early Miocene of India, Japan, Indonesia and especially southern Australia. Living species occur in the tropical Indo-Pacific in depths from 20 to more than 700 m (Dolin 2001). The greatest diversity is observed in the deep waters of New Caledonia and the Philippines. Live specimens have been observed on a variety of substrates as coarse and fine sand, on coral sand, silt, small pebble, tunicates and rocks. Most species have a white shell, few are beige to brown. Unfortunately, the soft parts and the biology of most species are still

unknown. Up to now the western Indian Ocean and the Red Sea are almost a white gap concerning the occurrence of *Trivellona* species. However, further researches will surely produce a larger number of new species because few shells are known to the senior author. Additional information is given in Fehse & Grego (2009).

Abbreviations

DFB	coll. Dirk Fehse, Berlin, Germany
JGS	coll. Jozef Grego, Bansá Bystrica, Slovakia
MBI	coll. Marty Beals, Inglewood, U.S.A.
RMNH	Naturalis, Leiden, The Netherlands (Rijksmuseum van Natuurlijke Historie)
ZMA	Zoological Museum, University of Amsterdam, The Netherlands
ZMS	Bavarian State Collection of Zoology, Germany
LT	number of labral teeth
CT	number of columellar ribs
RR	number of dorsal ribs
L	length of shell in mm
W	width of shell in mm
H	height of shell in mm

Taxonomy

Trivioidea Troschel, 1863
Triviidae Troschel, 1863
Triviinae Troschel, 1863

Trivellona Iredale, 1931

Type species: *Trivellona excelsa* Iredale, 1931 by monotypy.

Detailed descriptions of the genus are given in Fehse & Grego (2004, 2009).

Trivellona pulchra spec. nov.
Figs 2–6

Trivellona sp. indet. C – Fehse & Grego 2004, 2009: pl. 15, fig. 61.

Types. Empty shells were dredged at Aliguay Island, near Dipolog, Mindanao, Philippines in depths of 150 m in rubble. **Holotype**: ZSM 20100398. – **Paratypes**: No. 1: DFB 7850-1; No. 2: DFB 7850-2; No. 3: DFB 7850-3; No. 4: DFB 7850-4; No. 5: DFB 7850-5; No. 6: MBI T0189; No. 7: JGS T0190; MBI T0199. All material comprises empty shells from type locality that were obtained from different reliable sources.

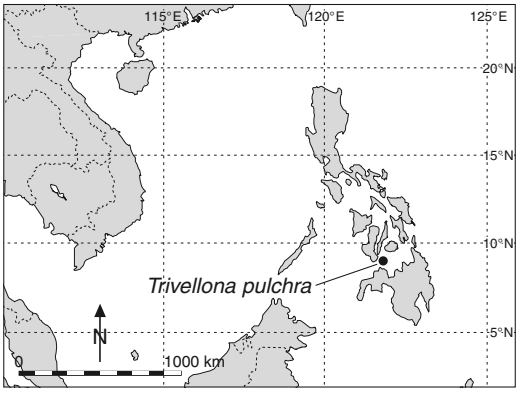
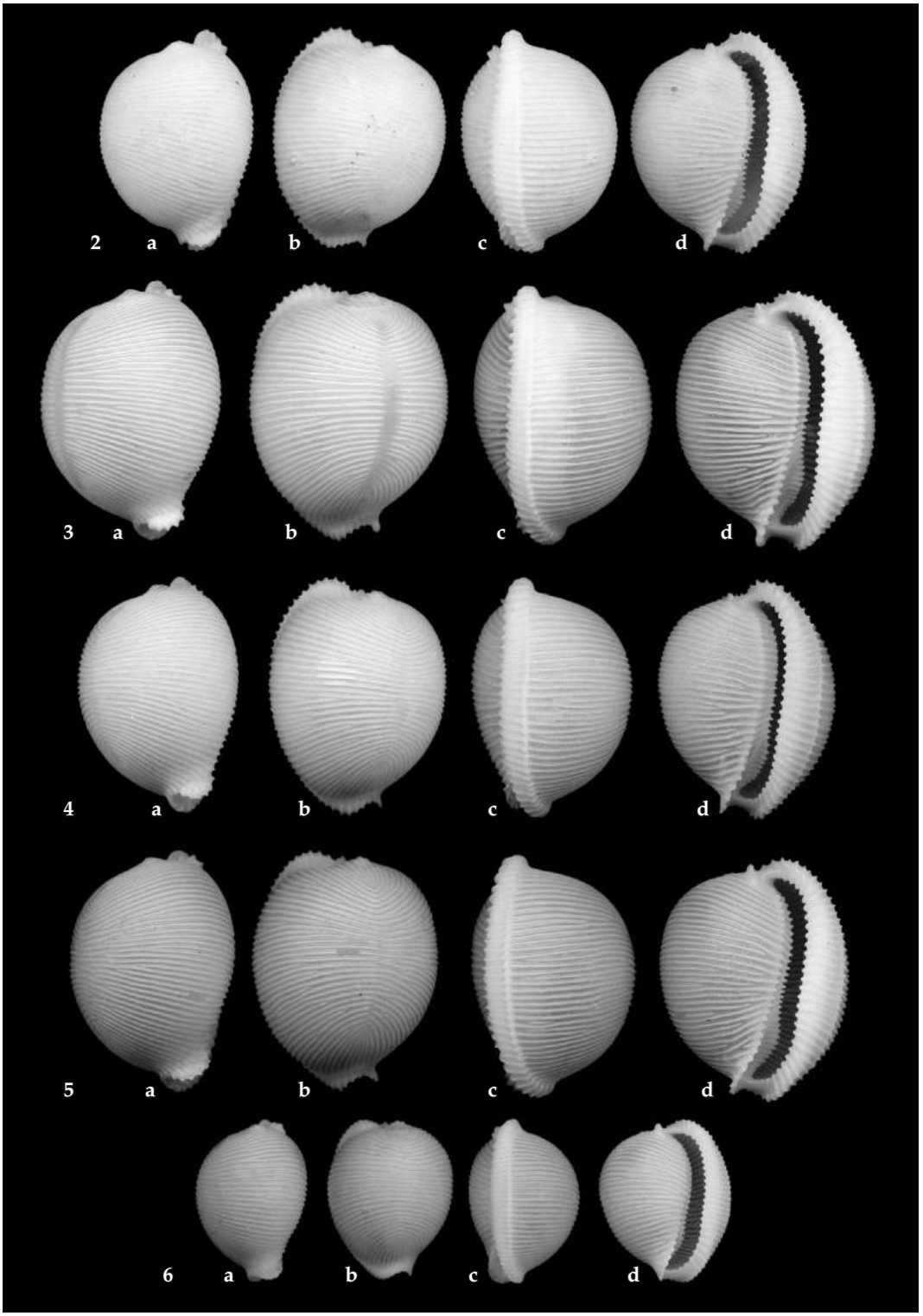


Fig. 1. Distribution of *Trivellona pulchra* spec. nov. within the Philippines.

Description

Shell medium sized (see Table 1), lightweight, somewhat fragile, globose. Spire slightly elevated, covered with terminal ribs. Body whorl somewhat pyriform, globose, rounded, approximately 90 % of total shell height; anterior terminal produced, tip indented; posterior terminal slightly so. Anal canal indented. Dorsum evenly rounded, highly elevated, completely covered by very fine, close-set ribs with a slight mid-dorsal depression; occasionally ribs bisected mid-dorsally. Ventrum convex, with terminal collars straight. Aperture relatively narrow, curved especially towards the canals. Labrum narrow, straight at its mid-portion, curved anteriorly and posteriorly, posteriorly projecting, roundly keeled on ventrum, anteriorly flattened, bearing on its inner margin fine denticles. Outer labral margin angularly callused with a sharp ridge on shoulder and with posterior-most labral denticles projected. Siphonal and anal canals following shell profile; bordered adapically by a weak and abapically by a large ventral side wall. Columella narrow, straight, tapering steeply inwards, without a carinal ridge. Parietal lip roundly callused, slightly projected, anteriorly ridged, bearing fine ribs, which become even finer, slightly obscured onto the columella. Fossula short, broadly concave, not clearly delimited from the rest of the columella. Inner fossular edge slightly protruding.

Figs 2- 6. *Trivellona pulchra* spec. nov. **2.** Holotype, ZSM, coll. No. 20100398. **3.** Paratype 1, DFB, coll. No. 7850-1, slightly subadult. **4.** Paratype 4, DFB, coll. No. 7850-1. **5.** Paratype 6, MBI, coll. No. T0189. **6.** Paratype 8, MBI, coll. No. T0199. **a**, right lateral view; **b**, dorsal view; **c**, left lateral view; **d**, ventral view. ▷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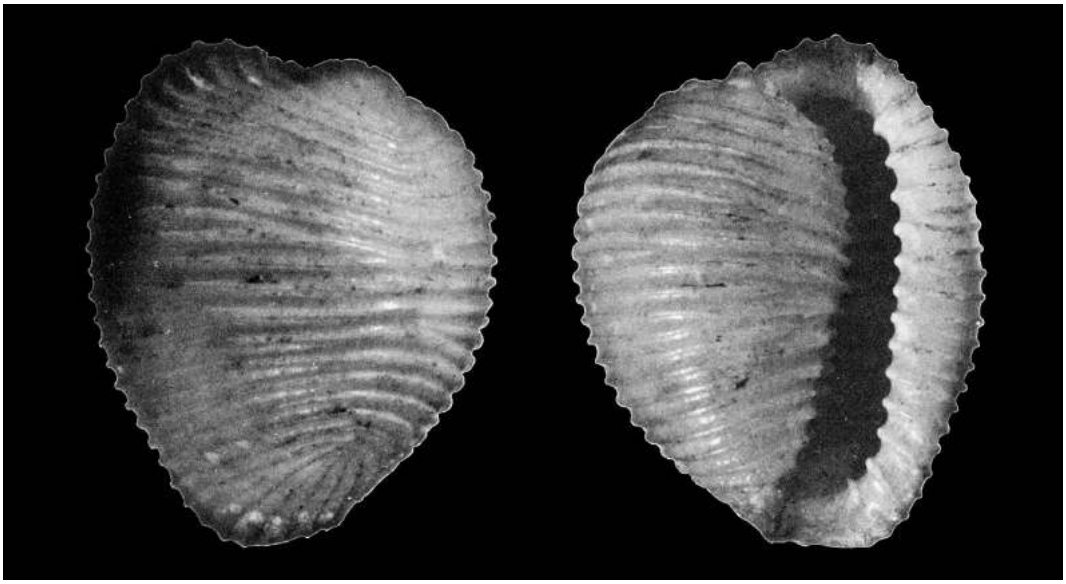


Fig. 7. *Trivellona schepmani* (Schilder, 1941), lectotype [after Cate 1979].

Shell colour white with terminal collars pale red-brown.

No information available on soft parts and radula.

Variation. The available shells are very uniform in their appearance (Table 1). Their inflation varies a bit. The inner fossular margin is more or less protruded. The number of dorsal ribs varies between 36 and 44, of labral denticles between 25 and 29, of parietal ribs between 23 and 27 and of terminal ribs that cover the spire between 5 and 7.

Etymology. From the Latin adjective 'pulcher', meaning beautiful.

Distribution. Only known from the type locality (Fig. 1).

Discussion

Trivellona pulchra spec. nov. is similar to *Trivellona opalina* (Kuroda & Cate in Cate, 1979) concerning its fine and close-set ribbing, but the new species differs in several aspects of the shell morphology.

Table 1. Dimensions of *Trivellona pulchra* spec. nov. Length refers to the greatest anterior/posterior measurement. refers to the greatest lateral (left-right) measurement with the shell at rest on the ventrum. Height refers to the maximum globosity from the ventrum through to the dorsal extremity. Columellar respectively labral denticles at the anterior and posterior end of the parietal respectively labral lip have been counted as full teeth. The count of the dorsal ribs follows the definition by Schilder (1933: p. 288, text-fig. 6)

Specimens (catalogue numbers)	Length (in mm)	Width (in mm)	Height (in mm)	CT	LT	RR	
ZSM 20100398	16.6	13.4	11.5	24	26	40	H
DFB 7850-1	19.4	15.6	13.0	27	28	44	P1
DFB 7850-2	19.0	15.9	13.4	27	26	40	P2
DFB 7850-3	18.0	14.7	12.6	23	28	36	P3
DFB 7850-4	17.9	14.0	12.0	25	28	38	P4
DFB 7850-5	16.0	13.1	11.0	25	29	36	P5
MBI T0189	18.2	14.7	12.5	24	27	36	P6
JGS T0190	17.7	14.2	11.2	23	26	36	P7
MBI T0199	12.3	9.7	8.1	23	25	36	P8

Trivellona opalina has a pyriform shell outline with both terminals produced, whereas *T. pulchra* has a very characteristic ovate shell outline with the posterior terminal only slightly produced. The ribbing is even finer in the new species. The shape of the labrum and aperture differ. *Trivellona pulchra* spec. nov. possesses projecting labral denticles at the posterior-most outer labral margin. The fossula is shorter and its inner margin is more protruded in the new species.

Other species of similar shell size are *Trivellona eos* (Roberts, 1913), *Trivellona kiiensis* (Kuroda & Cate in Cate, 1979) and *Trivellona finleyi* (Beals, 2001). In all of these taxa the ribbing is coarser and/or less close-set. The special ribbing makes *T. pulchra* unmistakable. *Trivellona eos* and *T. finleyi* have a dorsal sulcus, whereas the new species shows occasionally just a slight depression.

Our researches have shown that *Trivellona sibogae* (Schepman, 1909) has sometimes a fine ribbing too, but the shell is smaller reaching a maximum of 13 mm in length, whereas the length of fully matured shells of *T. pulchra* starts at a minimum of 12 mm. The shell outline distinguishes both species immediately, because *T. sibogae* has a pyriform shaped shell and *T. pulchra* an ovate one. According to their outline, the body whorl is sub-triangular in *T. sibogae* and semi-circular in *T. pulchra*. *Trivellona sibogae* does not show even a dorsal depression and the dorsum is often higher elevated than in *T. pulchra* (*T. sibogae* up to 75 % vs. *T. pulchra* up to 70 %). The shells of *T. sibogae* are uniformly white, whereas those of *T. pulchra* have pale red-brown terminal collars in live taken or fresh dead specimens.

Trivellona syzygia Dolin, 2001 off Norfolk Ridge, 23°41'S 168°00'E, S New Caledonia (Dolin, 2001: 228, figs 19a, 19b, 38a, 38b) is only at first sight similar to *T. pulchra*. However, their shell shapes differ considerably. The new species is more inflated and ovate, almost spherical, whereas *T. syzygia* is rather pyriform. The ribs in *T. pulchra* are also finer and the labrum is lesser thickened. The shell of *T. syzygia* is always white, while the terminal collars of *T. pulchra* are pale red-brown.

Trivellona schepmani (Schilder, 1941)
Fig. 7

Trivia sibogae forma *minor* Schepman, 1909: 140, pl. 11, fig. 4 [name preoccupied].

Pseudotrivia schepmani Schilder, 1941 – Cate 1979: 35, pl. 9, figs 35, 35a.

Trivellona schepmani (Schilder, 1941) – Fehse & Grego 2004, 2009: 29, pl. 4, fig. 21, pl. 6, fig. 29, pl. 8, fig. 39; appendix IV, figs S.1, S.2.

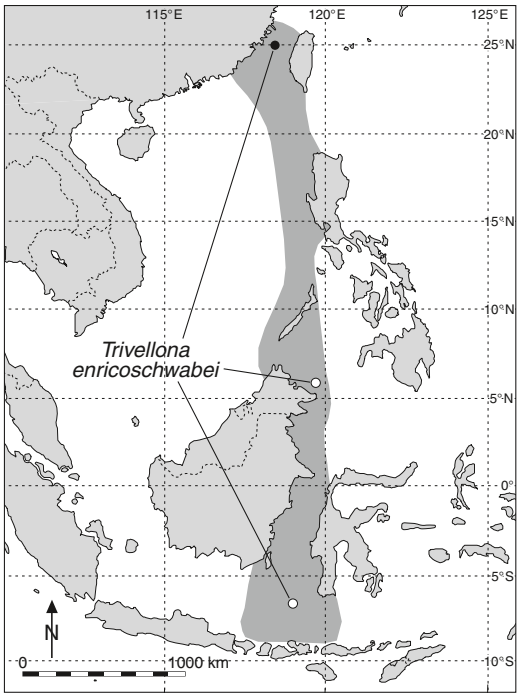


Fig. 8. Distribution of *Trivellona enricoschwabei* spec. nov. ●, type locality; ○, further findings.

Non *Trivellona schepmani* (Schilder, 1941) – Dolin 2001: 229, text figs 20a, 20b [= *Trivellona bealsi* Rosenberg & Finley, 2001].

Non *Trivellona schepmani* (Schilder, 1941) – Fehse & Grego 2004, 2009: pl. 3, figs 14–16 [= *Trivellona enricoschwabei* spec. nov. herein].

Types. Lectotype: "East of Sailus-Besar, Paternoster Islands, Netherlands East Indies; in up to 36 metres of water; coral and Lithothamnion bottom" (Schepman 1909: 140). – **Paralectotypes**: "Stat. 095. Siboga Expedition 1899–1900, Philippines, Sulu Sea; 5°43.5'N, 119° 40'E, stony bottom, dredged at 522 m; 26.vi.1899." (Schepman 1909: 140), Naturalis Leiden, RMNH, Mol. 97289.

Remarks

Schepman (1909: 140) already noted differences among his type specimens of *Trivellona sibogae* when he wrote, "Two specimens from Stat. 95 are still smaller, being only 7½ Mill. in length, … the ribs are slightly coarser, the teeth of the right margin less numerous (15 and 17), … I prefer to keep them under one name with the variety [*minor*], instead of describing a new species …". The name *'Trivia minor'*, however, was a preliminary homonym being

preoccupied by *Trivia pulex* var. *minor* Dautzenberg, 1889. Schilder (1941: 74) renamed Schepman's *'Trivia minor'* as *Pseudotrivia schepmani* without examining the type specimens. We confirmed Schepman's observations (Fehse & Grego 2004: 30).

The lectotype (designated by Cate 1979) of *Trivellona schepmani* was re-described in Fehse & Grego (2004). Additional specimens of *T. sibogae* and *T. schepmani* were identified and studied especially from off Aliguay Island near Dipolog, NE Mindanao, Philippines (Fehse & Grego, 2004). Schepman's paralectotypes 1 to 3 (ZMA 03.09. 027 and ZMA 03.09.028) of *Trivia sibogae* Schepman, 1909 were provisionally assigned to Schilder's *T. schepmani*. In 2004 we already observed the inflated shells of the paralectotypes, but we explained them as intraspecific.

Also now we could base our research on the lectotype of *T. schepmani* only on the photos in Cate's review of the Triviidae (1979: pl. 9, figs 35, 35a), because the lectotype is still not returned since 2001 (pers. comm. with H. Dekker and R. Moolenbeek, March 2011). The examined paralectotypes 1 to 3 of *T. schepmani* are consistent with the Chinese shells that are studied herein (see below). Since 2004, several dozen further specimens of *T. schepmani* could be studied and the distinguishing features are persistent (see below) to the new species. Therefore, the new taxon is described in this study as *Trivellona enricoschwabei* spec. nov.

Trivellona enricoschwabei spec. nov.
Figs 9–12

Trivellona schepmani (Schilder, 1941) – Fehse & Grego 2004, 2009: pl. 3, figs 14–16.

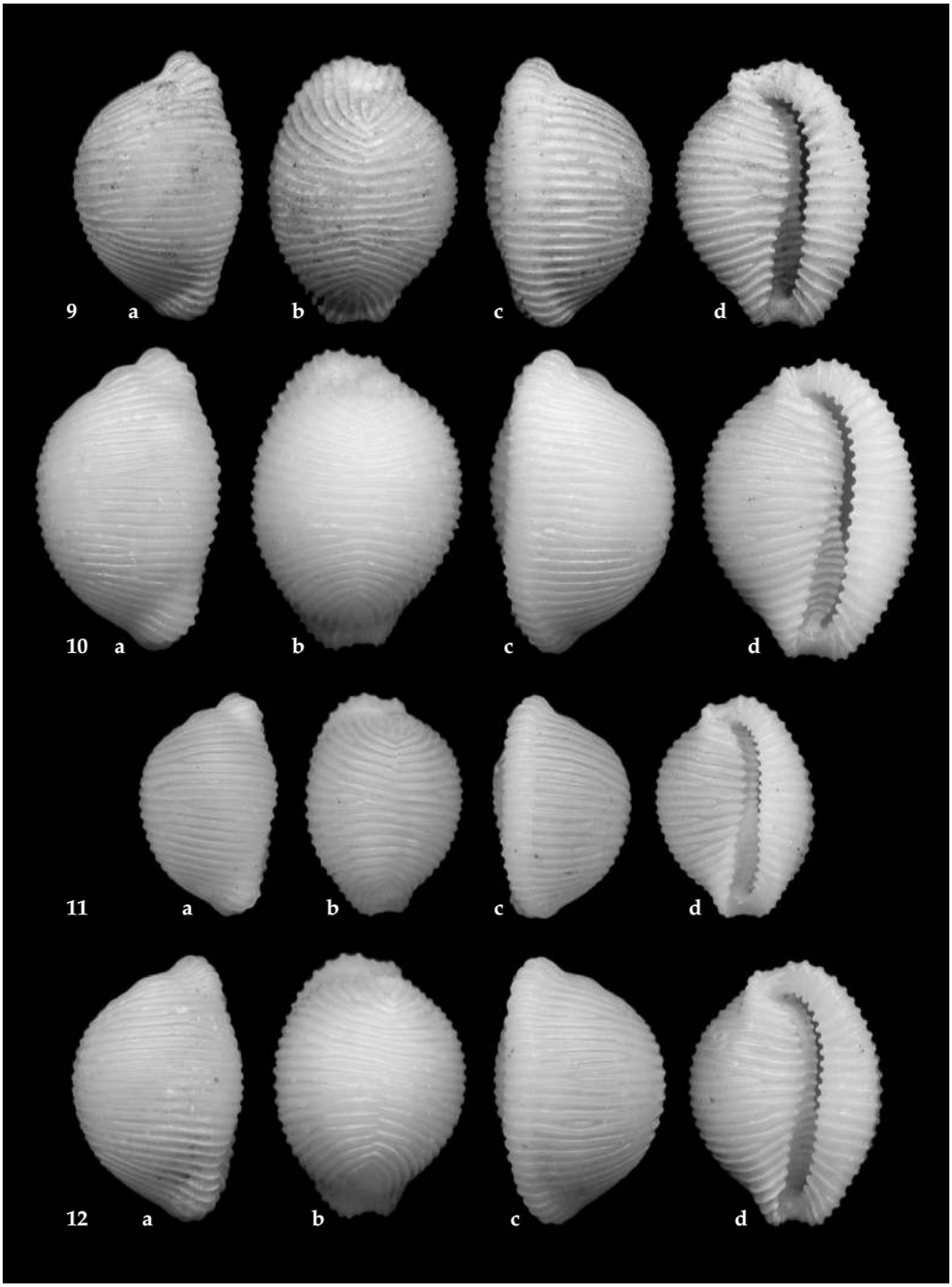
Types. Holotype: ZSM 20110214, 26°15'N 124°42'E, off Xiamen (prov. Fujinan), near Chilwei Island, E China Sea; trawled at 360 m depth. – **Paratypes**: Nos. 1–2: "Stat. 95, 5°43.5'N., 119°40'E, Sulu Sea, 522 M, Stony bottom" (Schepman 1909: 140), ZMA 03.09.027; No. 3: "East of Sailus-Besar, Paternoster Islands, Netherlands East Indies; in up to 36 metres of water; coral and Lithothamnion bottom" (Schepman 1909: 140), ZMA 03.09.28; Nos. 4–5: Off Xiamen, near Chilwei Island, E China Sea; trawled at 100–130 m; Nos. 6–8: Off Xiamen, near Chilwei Island, E China Sea; dredged at 170 m on gravel and sand; Nos. 9–13: Off Xiamen, near Chilwei Island, E China Sea; trawled at 360 m. All material comprises empty shells from type locality that were obtained from different reliable sources.

Description

Shell small sized (see Table 2), lightweight, somewhat fragile, globose. Spire covered by terminal ribs. Body whorl somewhat semi-circular, globose, rounded, approximately 90 % of total shell height; anterior terminal produced, tip blunt; posterior terminal slightly so. Dorsum evenly rounded, not much elevated, completely covered with coarse, close-set ribs. Ventrum convex, with terminal collars straight. Aperture narrow, curved especially towards the

Table 2. Dimensions of *Trivellona enricoschwabei* spec. nov. Length refers to the greatest anterior/posterior measurement. Width refers to the greatest lateral (left-right) measurement with the shell at rest on the ventrum. Height refers to the maximum globosity from the ventrum through to the dorsal extremity. Columellar respectively labral denticles at the anterior and posterior end of the parietal respectively labral lip have been counted as full teeth. The count of the dorsal ribs follows the definition by Schilder (1933: p. 288, text-fig.).

Specimens (catalogue numbers)	Length (in mm)	Width (in mm)	Height (in mm)	CT	LT	RR	
ZSM 20110214	6.9	5.0	4.2	16	18	22	H
ZMA 03.09.027-1	7.5	5.9	5.0	15	17	18	P1
ZMA 03.09.027-2	7.5	5.8	5.1	14	19	20	P2
ZMA 03.09.028	7.0	5.5	4.6	15	17	22	P3
DFB 10023-1	6.0	4.3	3.6	16	20	18	P4
DFB 10023-2	6.2	4.4	3.8	18	20	22	P5
DFB 9102-1	5.9	4.2	3.5	17	18	20	P6
DFB 9102-2	6.2	4.1	3.6	16	19	22	P7
DFB 9102-3	7.4	5.1	4.3	17	21	24	P8
DFB 9360-1	7.7	5.4	4.6	18	20	26	P9
DFB 9360-2	7.0	5.0	4.3	17	17	26	P10
DFB 9360-3	5.6	4.1	3.5	16	20	22	P11
DFB 9360-4	6.8	5.1	4.3	16	20	20	P12
JGS T0565	6.8	5.0	4.3	15	19	20	P13



Figs 9- 12. *Trivellona enricoschwabei* spec. nov. **9.** Holotype, ZSM, coll. No. 20110214. **10.** Paratype 8, DFB, coll. No. 9360-1, slightly subadult. **11.** Paratype 11, DFB, coll. No. 9360-4. **12.** Paratype 12, DFB, coll. No. 9360-5. **a**, right lateral view; **b**, dorsal view; **c**, left lateral view; **d**, ventral view.

canals. Labrum narrow, straight at its mid-portion, curved anteriorly and posteriorly, roundly keeled on ventrum, bearing on its inner margin denticles. Outer labral margin slightly roundly callused. Siphonal and anal canals following shell profile; bordered adapically and abapically by weak ventral side walls. Columella narrow, straight, tapering steeply inwards, without a carinal ridge. Parietal lip roundly callused, slightly projected, bearing ribs, which become finer onto the columella. Fossula short, concave, not clearly delimited from the rest of the columella. Inner fossular edge slightly protruding.

Shell colour overall white.

No information available on soft parts and radula.

Variation. The length varies between 5.6 and 7.7 mm (see Table 2). The posterior terminal is more or less produced. The terminal collars can be slightly recurved. The number of dorsal ribs varies between 18 and 26, of labral denticles between 17 and 21, of parietal ribs between 14 and 18, and of terminal ribs that cover the spire between 2 and 3.

Etymology. The name of the species honours Mr. Enrico Schwabe from ZSM.

Distribution. From Chilwei Island, E China Sea (type locality) in the north to the Sulu Sea, Philippines and Java Sea in the south in depths between 100 and 360 m on gravel and sand (Fig. 8).

Discussion

Trivellona enricoschwabei spec. nov. is similar to its congeners *T. schepmani* and *T. dolini* Fehse & Grego, 2004. The new species differs from *T. schepmani* by the ovate shell outline with the obscured spire. The aperture is narrower in *T. enricoschwabei*. The posterior labral portion is not projected as in *T. schepmani*. Also the shell is more inflated in the latter. The anterior labral portion is declivous in *T. schepmani* and its dorsum is higher elevated. *Trivellona dolini* has a globose shell with produced terminals and spire. The labrum is broader in *T. dolini* especially in its mid-portion and is distinctly declivous at the anterior portion. The labral denticles are coarser in *T. enricoschwabei* and less numerous (17–19 vs. 20–22 in *T. dolini*). There is a dorsal depression in *T. dolini* where the ribs are occasionally bisected and/or slightly knob-like thickened (Fehse & Grego 2004: 41, pl. 23, fig. 95). Such a depression is not observable in *T. enricoschwabei*.

Acknowledgement

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