

# New insights gained from museum collections: Deep-sea barnacles (Crustacea, Cirripedia, Thoracica) in the Muséum National d'Histoire Naturelle, Paris, collected during the *Karubar* expedition in 1991

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## Abstract

An examination of the deep-sea barnacles (Cirripedia, Thoracica) collected by the *Karubar* expedition to Indonesia (1991) and deposited in the Muséum National d'Histoire Naturelle, Paris, identified 40 species contained in three families of stalked and five families of acorn barnacles. Information on these species is presented, including descriptions, updated distributions and images to aid species identification. Thirty of the species, treated herein, are new records for the Indonesian Kei Islands and Tanimbar Island, which increases the total number of species recorded from Kei Islands, Aru Island and Tanimbar Island to 40. This study demonstrates the value of museum collections as a resource in biodiversity science.

## Key Words

acorn barnacles, Indonesian biodiversity, new record, stalked barnacles, taxonomy

## Introduction

In 1991, scientists from France and Indonesia conducted collaborative research through the *Karubar* expedition in Indonesia. The acronym for this expedition, which collected the material reported on herein, is a contraction of the names of the Kei, Aru and Tanimbar Islands. These Islands attracted attention after Professor Th. Mortensen's Danish expedition to the Kei Islands (1914–16). Mortensen suggested that the Islands were an ideal place for a marine laboratory to study deep-sea fauna, as he had found stalked crinoids, elasipods and other abyssal creatures at depths of 200–400 m around the Kei Islands (Crosnier et al. 1997).

The *Karubar* expedition was part of the MUSOR-STOM-Tropical Deep-Sea Benthos programme (1976–

present). This programme was a collaboration between the Muséum National d'Histoire Naturelle (MNHN), Paris and the Institut de Recherche pour le Développement (IRD) (formerly ORSTOM), to explore the deep-sea fauna of the tropical Indo-Pacific. As the programme was inspired and guided by carcinologists, it is not surprising that ~ 33% of the papers resulting from these cruises concern crustaceans, especially crabs, lobsters and shrimps (Richer de Forges et al. 2013).

Publications on the thoracic barnacles collected by the *Karubar* expedition are those of Buckeridge (1994, 1997) who focused on barnacles from the suborder Verrucomorpha. He reported six species of verrucomorph barnacles: *Newmaniverruca albatrossiana* (Pilsbry, 1912), *Altiverruca navicula* (Hoek, 1913), *Brochiverruca dens*

(Broch, 1932), *Metaverruca recta* (Aurivillius, 1898), *Rostratoverruca intexta* (Pilsbry, 1912) and *R. kruegeri* (Broch, 1922). Here, we present a study of the remaining barnacle material collected by the *Karubar* expedition, to cover the entire taxonomic range of deep-sea barnacles collected by this expedition.

## Material and methods

In total, 459 specimens were studied at the Muséum National d'Histoire Naturelle (MNHN), of which 89 specimens were studied in detail at the Museum für Naturkunde (MfN), Berlin, Germany. Species were determined on external shell morphology and mouthpart and arthropodal characters, as described in Darwin (1852, 1854), Hoek (1883, 1907, 1913), Pilsbry (1890, 1907, 1916), Annandale (1905, 1906, 1908, 1909, 1910, 1913, 1916), Broch (1916, 1922, 1931), Foster (1974, 1978, 1980, 1981), Newman and Ross (1971, 1976), Rosell (1981, 1989, 1991), Calman (1918, 1919), Ren (1989), Chan et al. (2009, 2010) and Shalaeva and Boxshall (2014).

Hard body parts, such as the shell (parietes) and the opercular plates, were studied using a Leica M125 stereomicroscope. Soft body parts, such as mouthparts and cirri, were studied using an Axioskop 20 light microscope. Mouthparts and cirri were mounted on glass slides and examined under a light microscope. Images were taken using a stereomicroscope with a digital camera (Leica Microsystems M205C and Leica Z16 APo-A).

In the "Taxonomic account" section, the diagnosis is followed by description, type species and localities and known distributions for each species are given. Each species is listed under its current valid binomen and all known synonyms are also provided. Photographs of each species are provided to facilitate their recognition.

In the "Material examined" section, there are four station codes dependent on the type of dredge used and are listed as follows: DW for dredge Warén, ED (drague épibenthique) for epibenthic dredge, CP (chalut à perche) for beam trawl and CC (chalut à crevettes) for otter trawl (shrimp).

Measurements were made using digital callipers (accurate to 0.1 mm) as follows: for acorn barnacles, basal length of shell (LB), basal width (WB), orifice length (LO), orifice width (WO) and carinal height (H); for stalked barnacles, total height (TH), capitular height (CH), diameter of base of capitulum (DBC), distance between carina and scutum (CS), scutal length (LS), scutal width (WS), tergal length (LT) and tergal width (WT).

## Results

Morphological analyses of all the samples revealed 40 species from three families of stalked barnacles (Heteralepadidae: two genera, three species; Poecilasmataceae: four genera, five species; Scalpellidae: twelve genera, 21 species) and five families of acorn barnacles (Verrucidae:

two genera and species; Pachylasmataceae: one genus and species; Archaeobalanidae: three genera, six species; Pyrgomatidae: one genus and species; Balanidae: one genus and species).

A list of the species of Cirripedia collected during the *Karubar* expedition and deposited in the Muséum National d'Histoire Naturelle (MNHN) Paris is presented, including additional information on substrate, as well as the depth where the sample was found (Suppl. material 1: Table S1).

## Taxonomic account

Class HEXANAUPLIA Oakley, Wolfe, Lindgren & Zaharoff, 2013

Subclass THECOSTRACA Gruvel, 1905

Infraclass CIRRIPEDIA Burmeister, 1834 (= Cirrhipèdes Lamarck, 1806)

Superorder THORACICA Darwin, 1854

Order LEPADIFORMES Buckeridge & Newman, 2006

Suborder HETERALEPADOMORPHA Newman, 1987

**Diagnosis.** Capitulum and peduncle without calcareous armament. According to Buhl-Mortensen and Mifsud (2017), Heteralepadomorpha consists of seven families of poorly known Pedunculata.

## Family HETERALEPADIDAE Nilsson-Cantell, 1921

Heteralepadidae Nilsson-Cantell, 1921: 245

Lepadidae Darwin, 1852: 8 (part.)

**Diagnosis.** Capitulum naked, thick-walled, globular, supported by stout peduncle; filamentary appendage at base of cirrus I; caudal appendage multi-segmented; cirri ctenopod or acanthopod, rarely lasiopod.

**Type genus.** *Heteralepas* Pilsbry, 1907a.

**Remarks.** The family consists of two genera: *Heteralepas* Pilsbry, 1907a and *Paralepas* Pilsbry, 1907a.

## Genus *Heteralepas* Pilsbry, 1907

*Alepas* Darwin, 1852: 156, pl. III, figs 5, 6.

*Heteralepas* (*Heteralepas*) Pilsbry, 1907a: 100.

*Heteralepas* s. str. – Newman, 1960: 109.

**Diagnosis.** Filamentary appendage present at base of cirrus I, short; posterior rami of cirri V and VI shorter and more slender than anterior rami.

**Type species.** *Alepes rex* Pilsbry, 1907c: 186, fig. 3, pl. IV fig. 7; type locality: Kauai Island, Hawaiian waters.

### *Heteralepas japonica* (Aurivillius, 1892)

Figure 1

*Alepes japonica* Aurivillius, 1892: 125. – 1894: 28, pl. II figs 14, 15, pl. VIII, figs 3, 7, pl. IX, fig. 3.

*Alepes indica* Gruvel, 1901: 259. – 1905a: 162, fig. 179.

*Heteralepas (Heteralepas) japonica*. – Pilsbry, 1907a: 101.

*Heteralepas (Heteralepas) japonica* var. *alba* Krüger, 1911: 34, pl. 1, fig. 2b.

*Heteralepas (Heteralepas) dubia* Broch, 1922: 288, fig. 38.

*Heteralepas japonica*. – Pilsbry 1911: 71, fig. 4. – Zevina et al. 1992: 31, fig. 19. – Chan et al. 2009a: 61. – Chan et al. 2009b: 88–91, figs 2A–D, 3A–D, 4, 5. – Pitriana et al. 2020: 12, fig. 3.

**Material examined.** Tanimbar Island: 1 specimen, MNHN-IU-2019-4877, stn. CP 46, 08°01'S, 132°51'E, 271–273 m depth, 29 October 1991.

**Diagnosis.** Capitulum rounded, plates absent; wall of capitulum thick; orifice crenulated with no more than two crests on carinal region; cirrus VI with caudal appendage; maxillule strongly notched.

**Description.** Capitulum and peduncle yellowish. Orifice slightly protuberant, crenulated, occupying one half to one third capitular length, parallel to or at oblique angle to capitulum; integument thick, chitinous. Cirrus I with anterior rami (20-segmented) shorter than posterior rami (25-segmented); cirrus VI with long caudal appendage, 24-segmented, 2/3 length of anterior ramus. Mandibles with four large teeth excluding inferior angle; maxillule strongly notched, two large setae at upper angle, blade-shaped setae on cutting margin; labrum concave with numerous teeth. Measurements of specimen: height of ca-

pitulum 18.50 mm, width 12.82 mm, thickness 5.97 mm; length of peduncle 15.26 mm, width 5.55 mm.

**Distribution.** Singapore; Indo-west Pacific: Indian Ocean; Australia; Malay Archipelago; Vietnam; Condor Island; South China Sea; East China Sea; Taiwan, Philippines; South Japan; NE New Zealand; fouling hard rock substrata, crabs, gorgonians, antipatharians, deep-sea cables; 48–500 m depth (Jones and Hosie 2016). Recently, the species has also been recorded from the Lifamatola Sea and the Halmahera Sea, Indonesia (Pitriana et al. 2020). In this study, *Heteralepas japonica* was found at Tanimbar Island, Indonesia.

**Type locality.** Hirado Strait, Japan, 146 m depth (Aurivillius 1892).

### Genus *Paralepas* Pilsbry, 1907

*Alepes* Darwin, 1852: 156 (part.).

*Heteralepas (Paralepas)* Pilsbry, 1907a: 100, fig. 34A.

*Paralepas* s. str. – Newman, 1960: 108.

**Diagnosis.** Maxillule slightly notched; filamentary appendages well-developed; posterior and anterior rami of cirri V and VI similar in length; segments of cirri V and VI square-shaped, each armed with semi-circular brush of many setae on anterior face.

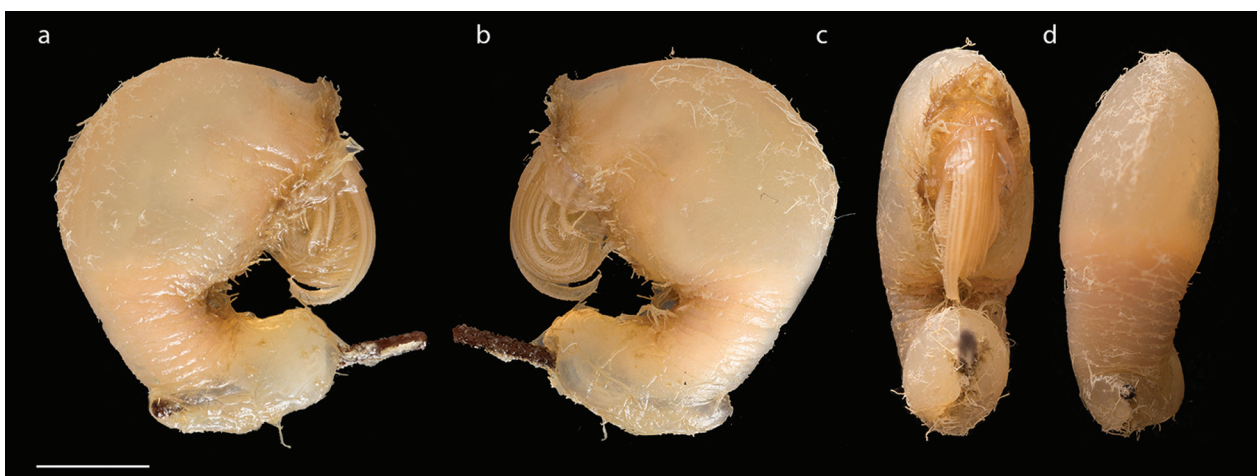
**Type species.** *Alepes percarinata* Pilsbry, 1907c: 185, fig. 2, pl. IV, fig. 8; type locality: Molokai, Hawaiian waters.

### *Paralepas minuta* (Philippi, 1836)

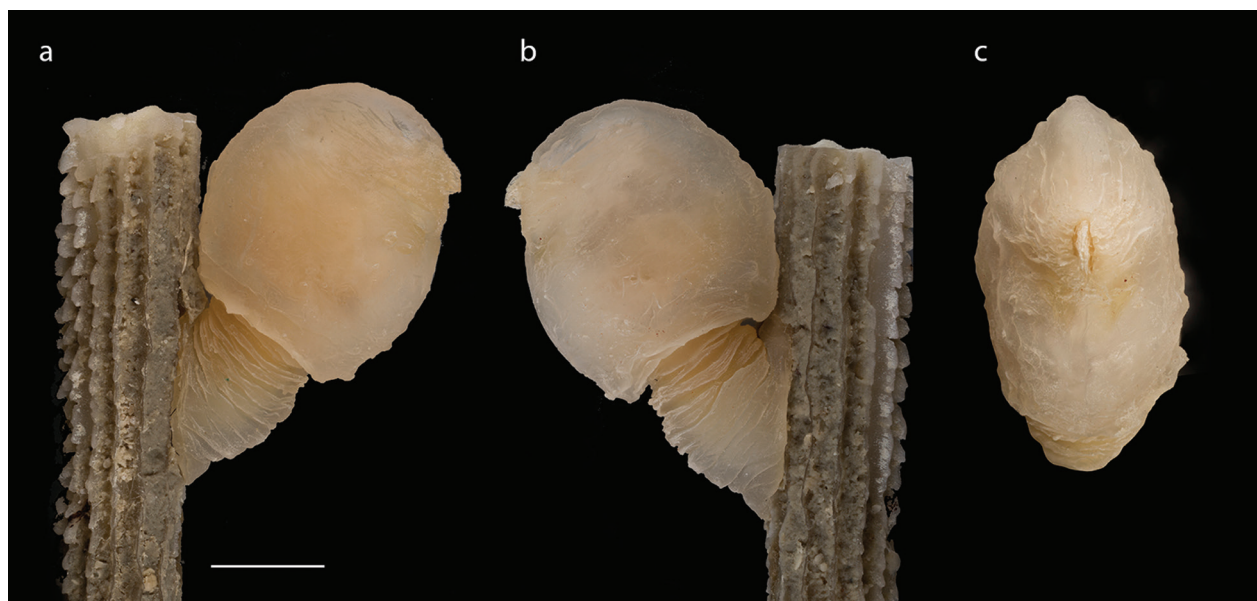
Figure 2

*Alepes minuta* Philippi, 1836: 254, pl. 12, fig. 23.

*Alepes (Paralepas) minuta*. – Weltner, 1897: 239.



**Figure 1.** *Heteralepas japonica* (Aurivillius, 1892) (MNHN-IU-2019-4877). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** anterior view, orifice; **d.** posterior view, capitulum and peduncle. Scale bar: 6 mm (a–d).



**Figure 2.** *Paralepas minuta* (Philippi, 1836) (MNHN-IU-2019-4882). **a.** left lateral view, capitulum and peduncle; **b.** right lateral view, capitulum and peduncle; **c.** anterior view, orifice. Scale bar: 5 mm (a–c).

*Heteralepas (Paralepas) minuta*. – Broch, 1927b: 18, fig. 4, pl. 1, figs 1, 2.  
*Paralepas minuta nipponica* Utinomi, 1970: 342.

*Paralepas minuta*. – Stubbings 1967: 240. – Newman 1960: 109. – Chan et al. 2009b: 66, figs 55–57.

**Material examined.** – Kei Islands: 6 specimens, MNHN-IU-2019-4882, Stn. CP 25, 05°30'S, 132°52'E, 336–346 m depth, 26 October 1991, attached to dead stem of gorgonian.  
– Tanimbar Island: 4 specimens, MNHN-IU-2019-4883, Stn. CP 85, 09°22'S, 131°14'E, 240–245 m depth, 4 November 1991, attached to spine of sea urchin.

**Diagnosis.** Capitulum yellowish with globular shape; anterior and posterior rami of cirrus V and VI similar in length.

**Description.** Capitulum yellowish, globose, small-sized, externally smooth; orifice crenulated; peduncle rather short. Segments of rami of cirrus I wide, anterior ramus (9-segmented) shorter than posterior ramus (13-segmented); cirrus VI with short caudal appendage, 8-segmented. Penis annulated, setae sparsely distributed over most of surface, a few longer setae towards tip. Maxillule notched, two large and one small setae at upper angle; mandible with four major teeth; labrum concave, with numerous teeth. Measurements of specimen: height of capitulum 8.34 mm, width 6.67 mm, thickness 4.53 mm; length of peduncle 3.84 mm, width 2.60 mm.

**Distribution.** Java Sea (Indonesia); Mediterranean Sea; West Africa; Indo-west Pacific: Indian Ocean; Australia; Malay Archipelago; Taiwan; Japan; Philippines; Northern New Zealand; 485–736 m depth; attached to spines of cidarids (Jones and Hosie 2016). In this study, *Paralepas minuta* was found at Kei Islands and Tanimbar Island, Indonesia.

**Type locality.** Mediterranean Sea (Chan et al. 2009b).

**Remarks.** *Paralepas minuta* (Philippi, 1836) can be distinguished from *Paralepas ovalis* (Hoek, 1907) by the presence of triangular scutal areas and from *Paralepas nodulosa* Broch, 1922 by the absence of “well defined, scanty, almost thorn-like warts” (Broch 1922).

### *Paralepas morula* (Hoek, 1907)

Figure 3

*Alepas morula* Hoek, 1907: 35, pl. IV, figs 9–12.

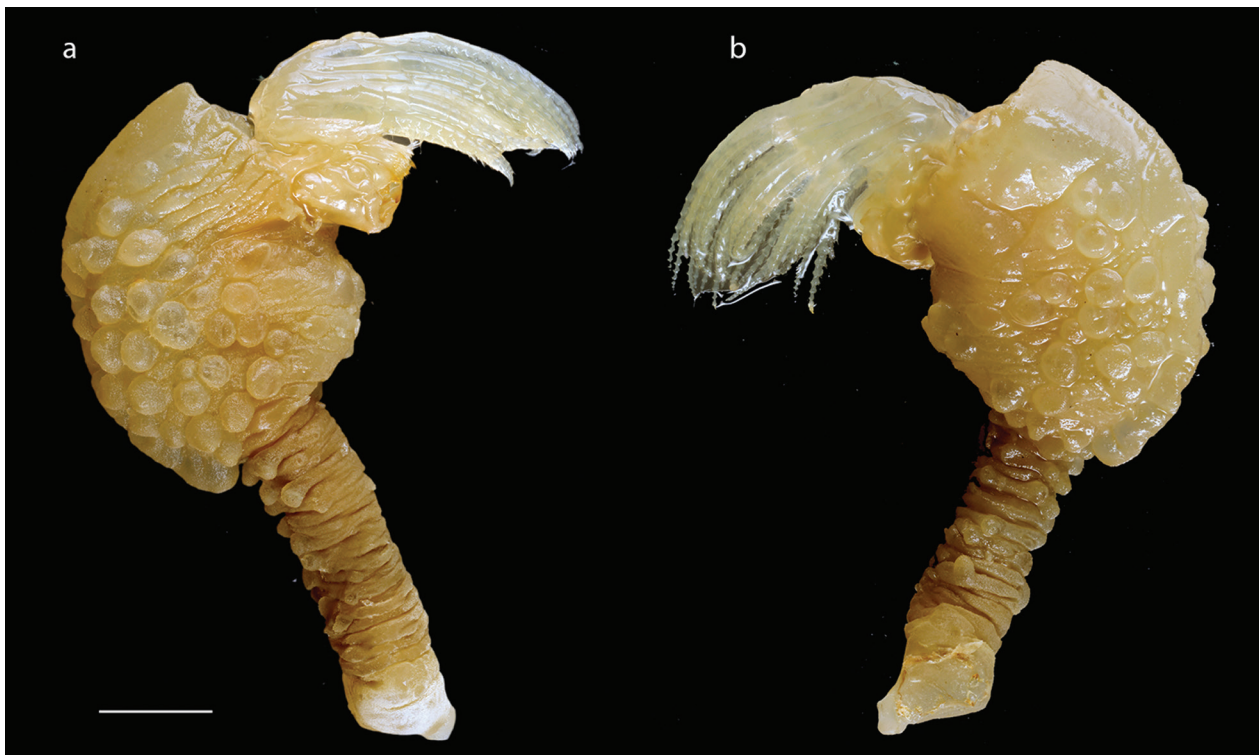
*Heteralepas (Paralepas) morula*. – Broch, 1922: 28, fig. 34.

*Paralepas morula*. – Newman, 1960: 109.

**Material examined.** – Tanimbar Island: 45 specimens, MNHN-IU-2019-4878, Stn. CP 54, 08°21'S, 131°43'E, 836–869 m depth, 30 October 1991, attached to spine of sea urchin.

**Diagnosis.** Capitulum globular with numerous tubercles on surface, scuta absent, orifice small, not protuberant, peduncular length more than half capitular length.

**Description.** Capitulum and peduncle yellowish. Capitulum globular with thick, chitinous, large warts all over surface. Peduncle rather long, narrower than capitulum; surface bearing tubercles, smaller than those of capitulum. Cirrus I placed rather far from cirrus II; cirri II–VI similar, length and number of segments slightly increasing from second to sixth; cirrus VI with 7-segmented caudal appendage. Penis indistinctly segmented, few long hairs towards tip. Maxillule notched, two large setae on upper notch; mandibles with three major teeth, inferior angle considered



**Figure 3.** *Paralepas morula* (Hoek, 1907) (MNHN-IU-2019-4878). **a.** left lateral view, capitulum and peduncle; **b.** right lateral view, capitulum and peduncle. Scale bar: 3 mm (**a, b**).

as fourth tooth; labrum with continuous row of numerous short, strong, blunt teeth. Measurements of specimen: height of capitulum 5.14 mm, width 3.69 mm, thickness 1.81 mm; length of peduncle 5.08 mm, width 1.31 mm.

**Distribution.** Flores Sea (Indonesia); Philippines; Bass Strait, N of Tasmania; attached to spines of echinoids, for example, *Histocidarid elegans* (Agassiz, 1879); 182–538 m depth (Jones and Hosie 2016). In this study, *Paralepas morula* was found at Tanimbar Island, Indonesia.

**Type locality.** Bali Sea, North of Lombok; 538 m depth (Hoek 1907).

**Remarks.** Most of the smaller specimens do not show the warts that are characteristic of this species.

### Suborder LEPADOMORPHA Pilsbry, 1916

Lepadomorpha Pilsbry, 1916: 14 (Lepadidae *sensu* Darwin, 1852).  
Lepadoidea Darwin, 1852: 8 (*nom. trans.* Zevina 1978a, b).

### Family POECILASMATIDAE Annandale, 1910

Lepadidae Darwin, 1852: 8 (part.). – Pilsbry 1907a: 72 (part.).  
Lepadinae. – Gruvel, 1905: 104 (part.).  
Poecilasmatinae Annandale, 1910a: 84.  
Poecilasmatidae. – Nilsson-Cantell, 1921: 253.

Trilasmatae Nilsson-Cantell, 1934: 40. – Hiro 1937a: 79. – Krüger 1940: 29.

**Diagnosis.** Capitulum with up to five plates, including tergum and scutum; scutum in some species split into two (resulting in seven plates); some or all plates may be degenerate or absent; umbos of terga apical, those of carina and scuta fundamentally basal; peduncle without calcareous scales; maxillule not stepped; cirrus I widely separated and much shorter than posterior cirri; caudal appendages uniarticulate, spinose.

**Type genus.** *Poecilasma* Darwin, 1852: 99.

### Genus *Dianajonesia* Koçak & Kemal, 2008

*Temnaspis* Fischer, 1884: 357. – Broch 1931: 30.  
*Poecilasma* (part). – Darwin, 1852: 99. – Pilsbry 1907a: 82. – Nilsson-Cantell 1921: 253.  
*Dianajonesia* Koçak & Kemal, 2008: 2.

**Diagnosis.** Capitulum with five plates, approximate or variously reduced; scutum divided into two parts; apex of carina extending to, or slightly overlapping basal end of terga, basally terminating in disc.

**Type species.** *Poecilasma fissa* Darwin, 1852: 109, pl. II, fig. 4, pl. X, fig. 29.

***Dianajonesia amygdalum* (Aurivillius, 1894)**

Figure 4

*Poecilasma amygdalum* Aurivillius, 1894: 10, pl. 1, figs 4–6, pl. 8, fig. 4. – Nilsson-Cantell 1921: 262, fig. 46d–g, pl. 3, fig. 6.  
*Poecilasma fissum* (non Darwin). – Hoek, 1907: 8 (part.).  
*Trilasmis fissum hawaiense*. – Pilsbry, 1928: 306, pl. 24, figs 1–8.  
*Trilasmis (Temnaspis) amygdalum*. – Hiro, 1937a: 85, fig. 69.  
*Temnaspis amygdalum amygdalum*. – Zevina, 1982: 70, fig. 62.  
*Temnaspis amygdalum*. – Utinomi, 1966: 5. – Dong et al. 1982: 77.  
*Dianajonesia amygdalum*. – Koçak & Kemal, 2008: 2.

**Material examined.** – Tanimbar Island: 2 specimens, MNHN-IU-2019-4861, Stn. CP 79, 09°16'S, 131°22'E, 239–250 m depth, 3 November 1991, attached to crab leg.

**Diagnosis.** Capitulum broadly oval, with five smooth plates; carina not extending to area between terga; peduncle with circles of small protuberances; cirri short.

**Description.** Capitulum yellowish, with five transparent, smooth plates. Scutum bilobed, occludent segment narrow, bow-shaped; tergum sub-triangular, nearly half as broad as long. Carina very narrow, slightly curved downwards, end blunt. Peduncle yellow, plainly ringed, spines absent. Cirrus I with anterior ramus wider than posterior ramus. Maxillule notched, with two strong teeth in upper part; mandible with four teeth, fourth pectinated, placed very close to inferior angle; labrum with row of minute teeth. Measurements of specimen: basal diameter of capitulum 0.94 mm; capitular height 7.03 mm; total height 10.40 mm; scutal width 4.11 mm; scutal length 5.85 mm; tergal width 1.00 mm; tergal length 3.13 mm.

**Distribution.** Indo-west Pacific: Indian Ocean; Madagascar through Malaysia, Hong Kong, South China Sea; Taiwan;

Philippines; South Japan; tropical West and central Pacific Ocean to Fiji and Hawaii; attached to decapod crustaceans; shallow water (Jones and Hosie 2016). In this study, *Dianajonesia amygdalum* was found at Tanimbar Island, Indonesia.

**Type locality.** Nordwacher Island, Thousand Islands, Java Sea (Aurivillius 1894).

***Dianajonesia excavatum* (Hoek, 1907)**

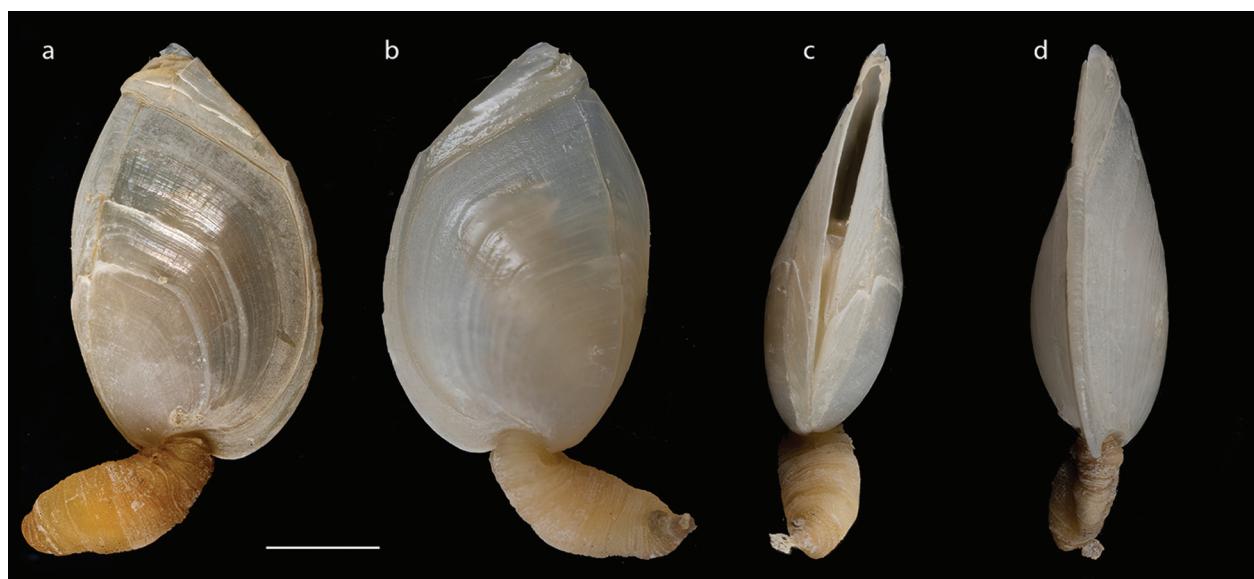
Figure 5

*Poecilasma excavatum* Hoek, 1907: 10, pl. I, figs 5–10.  
*Poecilasma tridens*. – Weltner 1922: 80, pl. 4, fig. 19 (non Aurivillius).  
*Poecilasma (Temnaspis) excavatum*. – Nilsson-Cantell 1925: 16, fig. 5, pl. 1, fig. 1.  
*Trilasmis (Temnaspis) excavatum*. – Hiro 1937b: 412.  
*Dichelaspis (Dichelaspis) tridens*. – Stubbings 1936: 7, fig. 2. (non Aurivillius).  
*Trilasmis excavatum*. – Nilsson-Cantell 1938: 9.  
*Temnaspis excavatum*. – Broch 1931: 31, fig. 10. – Dong et al. 1982: 77.  
*Dianajonesia excavatum*. – Koçak & Kemal, 2008: 2.

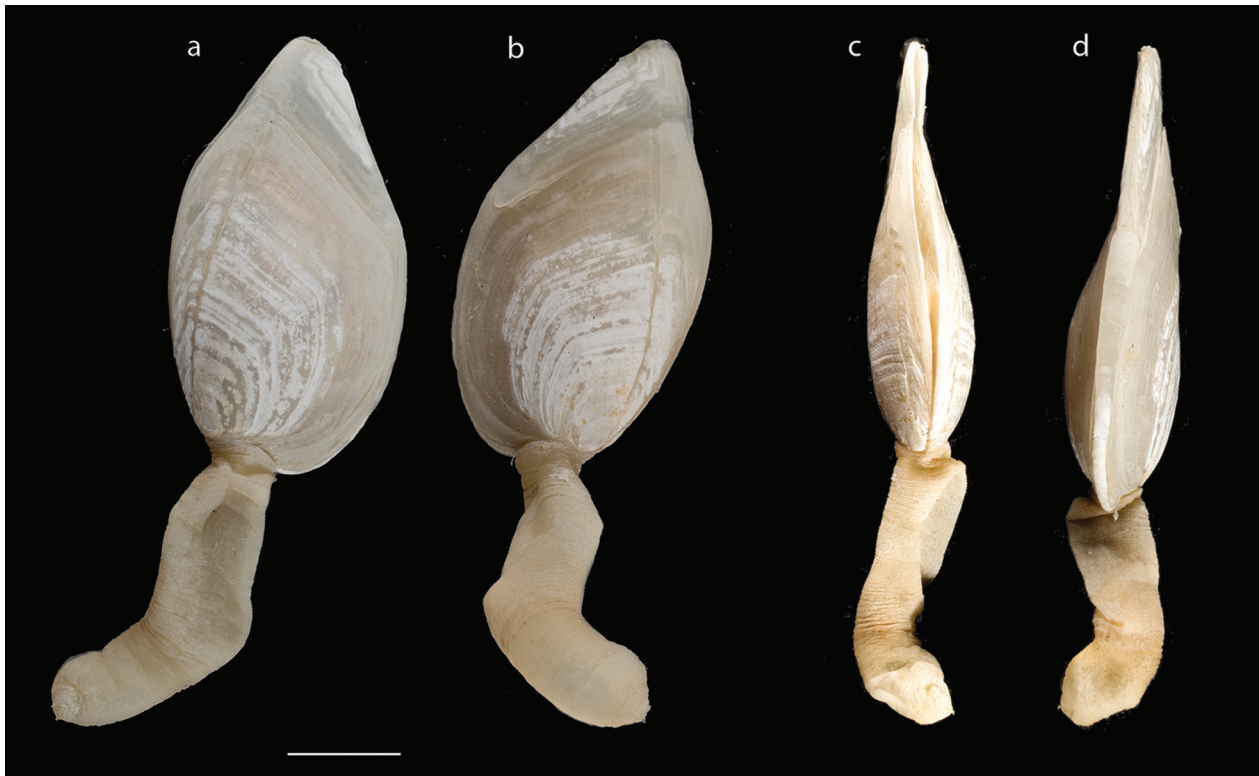
**Material examined.** – Tanimbar Island: 3 specimens, MNHN-IU-2019-4859, Stn. CP 78, 09°06'S, 131°24'E, 284–295 m depth, 3 November 1991.

**Diagnosis.** Capitulum with scutum divided into two segments parallel to occludent margin; tergum with excavation in scutal margin near occludent margin, receiving tip of occludent segment of scutum.

**Description.** Capitulum oval, apex pointed, slightly thick, swollen. Scutum with larger segment strongly bowed, basal margin short, apex pointed; smaller segment bowed, terminating in point at base, tergal margin rounded, fitting exactly



**Figure 4.** *Dianajonesia amygdalum* (Aurivillius, 1894) (MNHN-IU-2019-4861). **a.** left lateral view, capitulum and peduncle; **b.** right lateral view, capitulum and peduncle; **c.** anterior view, orifice; **d.** posterior view, carina. Scale bar: 2 mm (**a–d**).



**Figure 5.** *Dianajonesia excavatum* (Hoek, 1907) (MNHN-IU-2019-4859). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** anterior view, orifice; **d.** posterior view, carina. Scale bar: 2 mm (**a–d**).

into excavation of tergum. Tergum triangular, characteristic excavation at scutal margin near occludent margin. Carina narrow, terminating in spatula-shaped disc. Cirrus I with anterior and posterior rami subequal (each five-segmented); cirri II–VI longer, more slender; cirrus VI with caudal appendages. Penis thick, ringed, especially mid-length, terminating in narrower, curved part. Maxillule notched, two large teeth on upper side; mandible with four teeth, large distance between first and second teeth. Labrum convex, with numerous blunt teeth. Measurements of specimen: basal diameter of capitulum 1.06 mm; capitular height 7.12 mm; total height 12.69 mm; scutal width 3.08 mm; scutal length 6.09 mm; tergal width 1.30 mm; tergal length 3.47 mm.

**Distribution.** Indo-west Pacific: East coast of Africa (Zanzibar); Gulf of Aden; Indonesia; Malay Archipelago; South China Sea; East China Sea; Philippines; South Japan (Goto Island); attached to echinoid spines, crustaceans; palinurids and cirripedes; 189–600 m depth (Jones and Hosie 2016). In this study, *Dianajonesia excavatum* was found at Tanimbar Island, Indonesia.

**Type locality.** Siboga station 253; 5°48.2'S, 132°15'E; depth: 304 m; bottom: grey clay, hard and crumbly (Hoek 1907).

### Genus *Dichelaspis* Darwin, 1852

*Dichelasmis* Darwin, 1852: 115.  
*Heptalasmis*. Agassiz, 1842: 178.

*Octolasmis* Gray, 1825: 100. – Pilsbry 1907a: 93.

**Diagnosis.** Capitulum with five plates; scutum with two distinct segments, united at rostral angle; carina generally extending up between terga, terminating downwards as imbedded disc (fork- or cup-shaped).

**Type species.** *Octolasmis warwicki* Gray, 1825: 100. – 1830: pl. VI, fig. 16.

### *Dichelaspis orthogonia* Darwin, 1852

Figure 6

*Dichelaspis orthogonia* Darwin, 1852: 130, pl. II, fig. 10a, b.

*Dichelaspis versluysi* Hoek, 1907: 28, pl. III, figs 8–13.

*Octolasmis (Dichelaspis) orthogonia*. – Pilsbry, 1907a: 94.

*Octolasmis orthogonia*. – Krüger, 1911: 462. – Pilsbry 1911: 70, pl. 11, figs 6, 7. – Broch 1922: 279. – 1931: 38, fig. 14. – Nilsson-Cantell 1925: 21, fig. 8. – 1928: 18, fig. 8. – Hiro 1933: 55, fig. 16, pl. 2, figs 5a, 5. – 1937a: 91, fig. 71. – 1937b: 415, fig. 12. – Stubbings 1963: 327, fig. 1. – Dong et al. 1982: 79. – Zevina et al. 1992: 26, fig. 15. – Chan 2009: 68, fig. 2 B and fig. 17A–F.

**Material examined.** – Kei Islands: 4 specimens, MNHN-IU-2019-4864, Stn. CP 27, 05°33'S, 132°51'E, 314–304 m depth, 27 October 1991.

– Tanimbar Island: 6 specimens, MNHN-IU-2019-4862, Stn. DW 24, 05°32'S, 132°51'E, 230–243 m depth, 26 October 1991.



**Figure 6.** *Dichelaspis orthogonia* Darwin, 1852 (MNHN-IU-2019-4864). **a.** left lateral view capitulum and peduncle; **b.** right lateral view, capitulum and peduncle. Scale bar: 2 mm (**a–b**).

**Diagnosis.** Capitulum flattened; five plates, separated by thin membrane; scutum consisting of two distinct segments, with point of junction perfectly calcified; base of carina oval.

**Description.** Capitulum and peduncle yellowish. Scutum with basal segment narrow, L-shaped; tergum triangular, three prominent ridges at scutal margin; base of carina crescent-formed cup. Cirrus I with anterior ramus (6-segmented) shorter than posterior ramus (8-segmented); cirrus VI with small caudal appendage. Maxillule notched, three large setae on upper notch; mandible with four teeth, inferior angle produced into single strong spine; labrum concave, with numerous teeth. Measurements of specimen: basal diameter of capitulum 1.89 mm; capitular height 8.69 mm; total height 10.47 mm; scutal width 3.5 mm; scutal length 7.16 mm; tergal width 0.80 mm; tergal length 6.53 mm.

**Distribution.** Indo-west Pacific: East and South African Coast, Indian Ocean, Australia, Indonesia, Malay Archipelago, Vietnam, South China Sea, East China Sea, Philippines, Taiwan, South Japan; attached to hydroid, gorgonians, antipatharians, sea urchin spines, nylon cord,

sometimes fouling; 14–818 m depth (Jones and Hosie 2016). In this study, *Dichelaspis orthogonia* was found at Kei Islands and Tanimbar Island, Indonesia.

**Type locality.** Unknown.

**Remarks.** The type locality of this species is unknown. The species was re-discovered in the Malay Archipelago by the *Siboga* Expedition in 40–112 m depth (Hoek 1907) and the *Albatross* Expedition, off Kagoshima Gulf, Japan, in 87 m depth (Pilsbry 1907d).

#### Genus *Glyptelasma* Pilsbry, 1907

*Glyptelasma* Pilsbry, 1907a: 87.

**Diagnosis.** Capitulum with five approximate, fully calcified plates; scutum quadrangular, umbone subcentral; carina becoming larger towards base; peduncle short.

**Type species.** *Megalasma* (*Glyptelasma*) *subcarinatum* Pilsbry, 1907a: 91, pl. VII, figs 1–5; type locality: Atlantic Ocean, East of New Jersey, USA.



***Glyptelasma gracile* (Hoek, 1883)**

Figure 7

*Poecilasma gracile* Hoek, 1883: 46, pl. II, figs 2–4.*Megalasma gracile gracilius*. – Pilsbry, 1907a: 88, pl. V, fig. 16, pl. VII, figs 6–9.*Megalasma gracile*. – Nilsson-Cantell 1938: 10.*Megalasma (Glyptelasma) gracile*. – Zevina 1982: 84, fig. 74.*Glyptelasma gracile*. – Jones et al. 2001: 239.

**Material examined.** – Tanimbar Island: 14 specimens, MNHN-IU-2019-4873, Stn. CP 54, 08°21'S, 131°43'E, 836–869 m depth, 30 October 1991, attached to spine of sea urchin; 1 specimen, MNHN-IU-2019-4875, Stn. CC 57, 08°19'S, 131°53'E, 603–620 m depth, 31 October 1991; 3 specimens (1 adult, 2 juveniles), MNHN-IU-2019-4876, Stn. CP 73, 08°29'S, 131°33'E, 840–855 m depth, 2 November 1991, attached to spines of sea urchins.

**Diagnosis.** Capitulum with five plates; carina enlarged, keel-shaped; tergum with basal point truncated; maxillule notched; caudal appendages with relatively-long spines at tip.

**Description.** Capitulum whitish, peduncle brownish. Capitulum compressed, striated, about twice as long as broad. Scutum with apex pointed; tergum basally truncated, flat, oblong. Carina flat, very narrow, enlarged, keel-shaped in basal region. Cirrus I with anterior and posterior rami equal length; cirrus II–VI long, slender; cirrus VI with small caudal appendages. Penis with few

long hairs towards tip. Maxillule notched, with strong teeth on upper side; mandible with four teeth; labrum with row of small teeth on crest. Measurements of specimen: basal diameter of capitulum 1.45 mm; capitular height 10.44 mm; total height 13.99 mm; scutal width 4.79 mm; scutal length 9.01 mm; tergal width 1.87 mm; tergal length 5.07 mm.

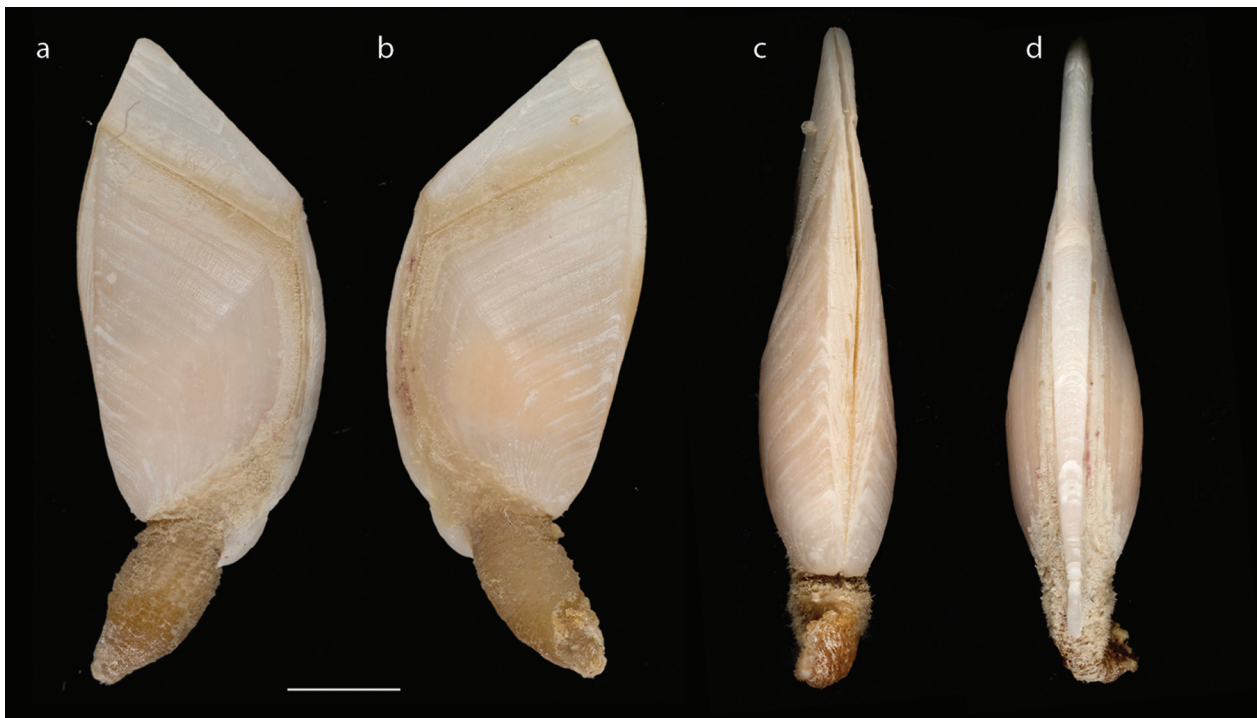
**Distribution.** West-southwest Pacific: from Australia (Sydney) to Indonesia (Sumbawa) and the Philippines (northwest Panay Island); East Indian Ocean; attached to glassy spicule of hexactinellid sponge, fragments of sea urchin tests, spines of cidarids; 395–935 m depth (Jones and Hosie 2016). In this study, *Glyptelasma gracile* was found at Tanimbar Island, Indonesia.

**Type locality.** *Challenger* expedition Station 164a (off Sydney, Australia); 34°13'S, 151°38'E; depth 125 m; bottom: grey ooze (Hoek 1883).

**Genus *Megalasma* Hoek, 1883***Megalasma* Hoek, 1883: 50. – Pilsbry 1907a: 87.

**Diagnosis.** Capitulum with five strong, calcified plates; scutal umbones subcentral; apex of carina sometimes slightly overlapping basal end of terga, progressively becoming broader towards base; peduncle very short.

**Type species.** *Megalasma striatum* Hoek, 1883: 51, pl. II, figs 5–9, pl. VII, figs 8, 9.



**Figure 7.** *Glyptelasma gracile* (Hoek, 1883) (MNHN-IU-2019-4875). **a.** left lateral view, capitulum and peduncle; **b.** right lateral view, capitulum and peduncle; **c.** anterior view, orifice; **d.** posterior view, carina. Scale bar: 2 mm (a–d).

***Megalasma striatum* Hoek, 1883**

Figure 8

*Megalasma striatum* Hoek, 1883: 51, pl. II, figs 5–9, pl. VII, figs 8, 9. – Broch 1931: 270, figs 29, 30.

*Megalasma (Megalasma) elegans*. – Zullo & Newman, 1964: 355, fig. 2a–i.

*Megalasma (Megalasma) striatum*. – Zevina 1982: 80, fig. 71. – Chan 2009: 66, figs 2A, 16 A–H.

**Material examined.** – Kei Islands: 1 specimen, MNHN-IU-2019-4868, Stn. CP 09, 05°23'S, 132°29'E, 368–389 m depth, 23 October 1991; 1 specimen, MNHN-IU-2019-4869, Stn. CP 16, 05°17'S, 132°50'E, 315–349 m depth, 24 October 1991, attached to sea urchin spine; 2 specimens, MNHN-IU-2019-4866, Stn. CP 17, 05°15'S, 133°01'E, 439–459 m depth, 24 October 1991.

– Tanimbar Island: 1 specimen, MNHN-IU-2019-4867, Stn. CP 46, 08°01'S, 132°51'E, 271–273 m depth, 29 October 1991; 4 specimens (3 attached to sea urchin spine), MNHN-IU-209-4870, Stn. DW 49, 08°00'S, 132°59'E, 206–210 m depth, 29 October 1991; 6 specimens, MNHN-IU-2019-4871, Stn. CP 85, 09°22'S, 131°14'E, 240–245 m depth, 4 November 1991, attached to spines of sea urchin.

**Diagnosis.** Capitulum ovate, occludent margin almost same length as carinal margin; capitular plates heavily calcified, markedly sculptured with radial striations between grooves of growth lines; peduncle short, covered by capitulum.

**Description.** Capitulum white, with five calcified plates, surfaces strongly striated. Scutum with basal margin rotated; tergum triangular in lateral view; carina with dorsal roof widening apically on either side of midline groove. Cirrus I with anterior ramus wider than posterior ramus.

Maxillule with three strong setae at upper angle separated by wide notch; mandible with four teeth, lower angle sharp. Measurements of specimen: basal diameter of capitulum 2.14 mm; capitular height 9.36 mm; total height 9.36 mm; scutal width 3.81 mm; scutal length 7.28 mm; tergal width 1.58 mm; tergal length 4.29 mm.

**Distribution.** West-southwest Pacific, Indo-west Pacific, East coast of Africa, Indian Ocean, north Australia, Indonesia, Malay Archipelago, East China Sea, South China Sea, Taiwan, Philippines, south Japan to New Zealand; attached to echinoid spines, antipatharians, gorgonians, glassy spicule of hexactinellid sponges, corallines; 125–984 m depth (Jones and Hosie 2016). In this study, *Megalasma striatum* was found at Kei Islands and Tanimbar Island, Indonesia.

**Type locality.** Philippine Archipelago (Hoek 1883).

**Order SCALPELLIFORMES Buckeridge & Newman, 2006**

Scalpellioidea Pilsbry, 1916: 14 (*nom. trans.* Zevina, 1978).

Scalpelliformes Buckeridge & Newman, 2006: 22.

**Family SCALPELLIDAE Pilsbry, 1907**

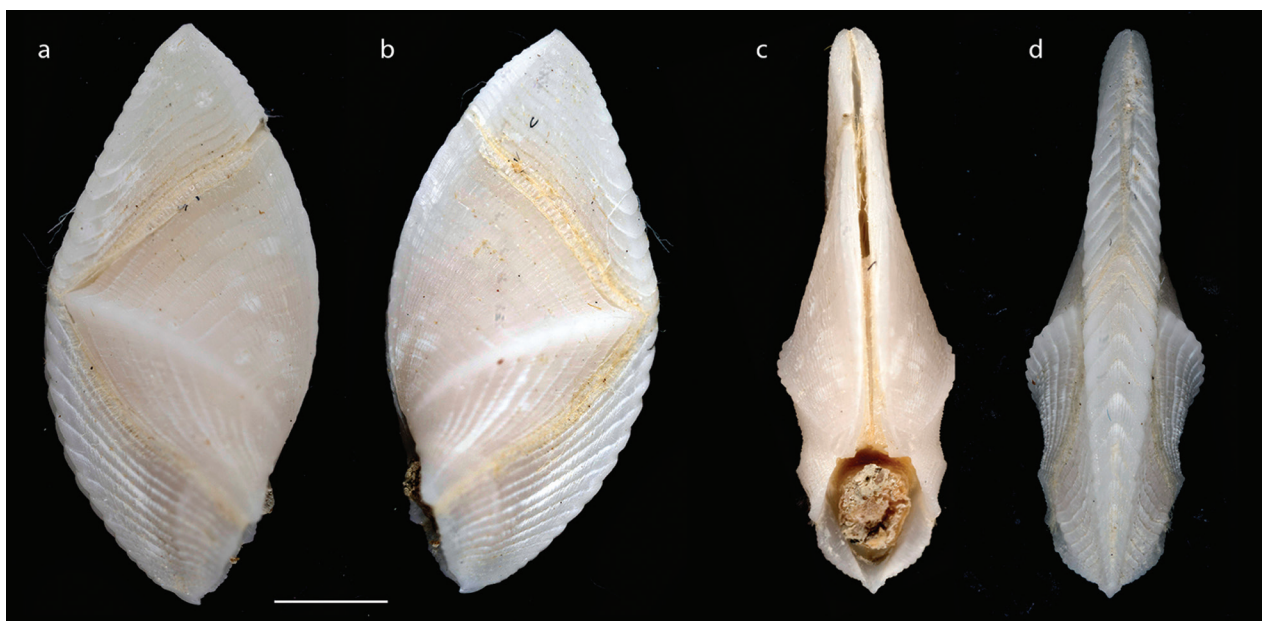
Pollicipedidae Gray, 1825: 100 (part.). – Annandale 1909: 63 (part.).

Lepadidae Darwin, 1852: 8 (part.).

Polyaspididae Gruvel, 1905: 8, 16 (part.; rejected by Pilsbry, 1907a, because family group name not derived from generic name).

Scalpellinae Pilsbry, 1907a: 3 (part.).

Scalpellidae. – Krüger, 1911: 7. – Pilsbry 1916: 4. – Nilsson-Cantell 1921: 162. – Foster 1978: 38. – Zevina 1978a: 999. – Buckeridge 1983: 27. – Gale 2016: 296.



**Figure 8.** *Megalasma striatum* Hoek, 1883 (MNHN-IU-2019-4868). **a.** left lateral view, capitulum; **b.** right lateral, capitulum; **c.** anterior view, capitulum and peduncle; **d.** posterior view, carina. Scale bar: 2 mm (**a–d**).

**Diagnosis.** Capitulum with fully or partially calcified plates; peducle with calcareous or phosphorus scales. According to Gale (2016), the Scalpellidae have a maximum of 14 plates i.e. carina, rostrum, paired scuta, terga, upper latera, carinolatera, rostromlatera and inferior median latera; and rarely 13 plates, due to secondary loss of the rostrum.

### Subfamily SCALPELLINAE Pilsbry, 1907

Scalpellinae Pilsbry, 1907a: 4. – Zevina 1978a: 1002. – Zevina 1981: 93. – Gale 2016: 296.  
Pollicipedidae. – Annandale, 1909: 63 (part.).

**Diagnosis.** Formerly, the subfamily was characterised by a subapical carinal umbo, inflexed carina and subapical umbones of the upper and inframedian latus (Zevina 1978a). Gale (2016) characterised the subfamily by the broad, low, straplike and gently incurved rostromlatus. The rostrum is broader than high, rectangular, trapezoidal or triangular and its large, triangular, lateral surfaces contact the interior of the rostromlatus. The articulation surface between the rostrum and rostromlatus extends over the entire height of both plates.

**Type genus.** *Scalpellum* Leach, 1817: 68.

### Genus *Diotascalpellum* Gale, 2016

*Diotascalpellum* Gale, 2016: 297.

**Diagnosis.** Scalpellines without specialised contact between carina and carinolatus, merely a crescentic concavity on interior of plate that forms a rim slightly overlapping the upper latus; umbo of carinolatus upright, only slightly incurved, dorsal margin gently convex; inframedian surface of carinolatus well demarcated, slightly inset.

### *Diotascalpellum rubrum* (Hoek, 1883)

Figure 9

*Scalpellum rubrum* Hoek, 1883: 91, pl. IV fig. 18. – Pilsbry 1911: 62, text-fig. 1, pl. VIII, figs 1–4. – Calman 1918b: 122–123. – Broch 1922: 237. – Nilsson-Cantell 1927: 745–747, text-fig. 2. – 1931: 2. *Trianguloscalpellum rubrum*. – Zevina 1981: 316–317, fig. 240. – Rosell 1986: 89, text-fig. 1a. – 1991: 22, fig. 1f, g. – Huang 1994: 517. – 2001: 318. – Jones et al. 2001: 254. – Young 2001: 464, fig. 7. – Jones 2007: 292. – Shalaeva and Boxshall 2014: 49, fig. 34. *Diotascalpellum rubrum*. – Gale 2016: 297, figs 2A, 6U–Y, 11Q–T, 13K–M, 18A–G.

**Material examined.** – Kei Islands: 2 specimens, MNHN-IU-2019-4925, Stn. CP 09, 05°23'S, 132°29'E, 368–389 m depth, 23 October 1991; 1 specimen, MNHN-IU-2019-4926, Stn. CP 16, 05°17'S, 132°50'E, 330–350 m depth, 24 October 1991, attached to gorgonian.

**Diagnosis.** Capitulum with 14 plates, smooth, white and reddish coloured; carina simply, strongly bowed, roof slightly convex with umbo at apex; rostrum triangular, distinct; upper latus quadrangular, large; infra-median latus triangular.

**Description.** Capitulum flat, rather broad, not covered by distinct membrane. Scutum with occludent margin arched, forming with tergal margin a triangular portion projecting over tergum. Tergum surpassing scutal area with occludent margin almost straight. Upper latus quadrangular, angle at apex between scutal and tergal margins distinctly projecting over scutum. Rostrum small, triangular; rostromlatus very low, quadrangular; infra-median latus small, triangular, umbo at apex; carinal latus larger than other latera with carinal margin arched. Cirrus I with anterior and posterior rami almost same length; cirrus VI with long caudal appendages. Maxillule not notched, with large spine on upper side, cutting edge almost straight; mandible with three large teeth excluding inferior angle. Measurements of two specimens: height of capitulum 12.51–20.57 mm, width 7.39–10.55 mm, thickness 4.09–6.51 mm; length of peduncle 5.10–7.76 mm, width 4.36–6.62 mm.

**Distribution.** Java Sea, Indonesia. Pacific: western central and northwest; Philippines; Kagoshima Sea and Sagami Bay, Japan; 133–551 m depth (Shalaeva and Boxshall 2014). In this study, *Diotascalpellum rubrum* was found at Kei Islands, Indonesia.

**Type locality.** Philippines, 12°43'N, 122°10'E; depth, 180 m and 207 m; bottom, mud (near Luzon) (Hoek 1883).

### Genus *Regioscalpellum* Gale, 2016

*Regioscalpellum* Gale, 2016: 298.

**Diagnosis.** Concave scalpellines; internal surface upper latus covered by epidermis, short carinal margin present on carinolatus; carinolatus with incurved umbones, lateral margin strongly convex.

**Type species.** *Scalpellum regium* Thomson, 1873; type locality: Stn 61: Atlantic, Western Central (North Western Atlantic Basin); 5,210 m depth.

### *Regioscalpellum moluccanum* (Hoek, 1883)

Figure 10

*Scalpellum moluccanum* Hoek, 1883: 104, pl. V figs 3, 4; 1907: 56, 85, pl. VII, fig. 13. – Gruvel 1905: 76, fig. 85. – Nilsson-Cantell 1927: 747, fig. 3. *Arcoscalpellum moluccanum*. – Newman & Ross, 1971: 60. – Jones et al. 1990: 6, 27. – Jones 1992: 172–175, figs 18, 19. *Trianguloscalpellum moluccanum*. – Jones, 2012: 371, table 2. – Shalaeva and Boxshall 2014: 45, fig. 31.



**Figure 9.** *Diotascalpellum rubrum* (Hoek, 1883) (MNHN-IU-2019-4925). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 5 mm (a–d).

*Regioscalpellum moluccanum*. – Gale, 2016: 298.

**Material examined.** – Tanimbar Island: 3 specimens, MNHN-IU-2019-4909, Stn. CP 38, 07°40'S, 132°27'E, 620–666 m depth, 28 October 1991; 1 specimen, MNHN-IU-2019-4910, Stn. DW 49, 08°00'S, 132°59'E, 206–210 m depth, 29 October 1991; 1 specimen, MNHN-IU-2019-4911, Stn. CC 57, 08°19'S, 131°53'E, 603–620 m depth, 31 October 1991; 1 specimen, MNHN-IU-2019-4912, Stn. CP 52, 08°03'S, 131°48'E, 1244–1266 m depth, 30 October 1991.

**Diagnosis.** Capitulum with 14 plates, surface covered by chitinous, almost smooth membrane; carina simply, not strongly bowed, apex projecting freely, roof not flat; umbo of the carina apical; upper latus almost triangular.

**Description.** Capitulum inflated, subtriangular, apices of plates projecting freely through membrane, growth lines fairly distinct. Scutum trapezoid, umbo apical. Tergum large, oval, truncated, very pointed, extending between upper latus and carina. Carina simply, slightly bowed, roof slightly convex, apex projecting freely. Upper latus quadrangular; rostrum very small, carinate; rostral latus trapeziform; infra-median latus triangular, moderately small; carinal margins of carinal latera convex, touching each other at base and below middle of carina. Peduncle stout, slightly thinner below apex. Cirrus I unequal, anterior ramus oval, posterior ramus more slender; cirrus VI with long caudal appendages. Maxillule not notched, large spine on upper side, cutting edge almost straight;

mandible with three large teeth excluding inferior angle. Measurements of five specimens: height of capitulum 7.88–14.89 mm, width 4.81–10.65 mm, thickness 2.15–5.24 mm; length of peduncle 3.38–9.13 mm, width 2.09–6.04 mm.

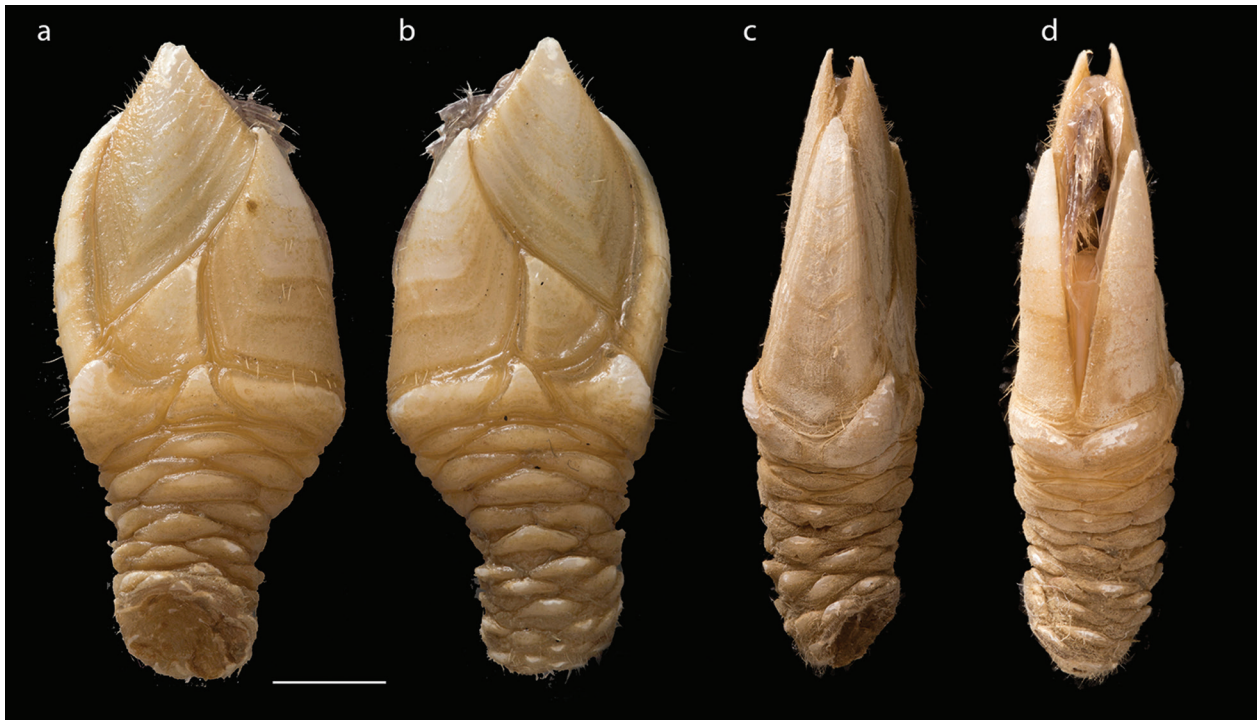
**Distribution.** Pacific, Central and Southwest; Tasman Sea, north-eastern Australia; 788–2,745 m depth (Jones 2012; Shalaeva and Boxshall 2014). In this study, *Regioscalpellum moluccanum* was found at Tanimbar Island, Indonesia.

**Type locality.** Banda Sea (4°21'S, 129°7'E); Challenger stn 195; 2,606 m depth; bottom temp. 3 °C; substrate grey ooze (Hoek 1883).

### Genus *Scalpellum* Leach, 1817

*Scalpellum* Leach, 1817: 68. – Darwin 1852: 21. – Hoek 1883: 59. – Gruvel 1905: 23. – Pilsbry 1907d: 181. – Tarasov and Zevina 1957: 126. – Zevina 1978a: 1002. – 1981: 94. – Gale 2016: 297.  
*Strictoscalpellum* Broch, 1924: 14.

**Diagnosis.** Scalpellines with carinal and scutal umbones subapical; carinolatus with horn-like projection, often recurved, extending beyond carinal margin; inframedian latus rectangular to slightly trapezoidal, with low umbo; upper latus rhomboidal with subapical umbo; rostrum rectangular, pyramidal, with large sub-umbonal surface.



**Figure 10.** *Regioscalpellum moluccanum* (Hoek, 1883) (MNHN-IU-2019-4909). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** carinal view showing the capitulum and peduncle; **d.** rostral view showing the capitulum and peduncle. Scale bar: 4 mm (a–d).

**Type species.** *Lepas scalpellum* Linnaeus, 1767: 1109.

**Type locality.** Unknown.

### *Scalpellum* sp.

Figure 11

**Material examined.** – Tanimbar Island: 1 specimen, MNHN-UI-2019-4929, Stn. DW 49, 08°00'S, 132°59'E, 206–210 m depth, 29 October 1991.

**Diagnosis.** Capitulum with 14 fully calcified plates; tergum triangular; inframedian latus broad, quadrilateral with umbo near to basal; upper latus rhomboidal, umbo sub-apical; carinal lateral horn-shaped, with angle extending beyond carina.

**Description.** Capitulum subtriangular, covered by membrane. Tergum triangular, occludent and basal margins slightly convex; scutum quadrangular, basal and upper latus margins concave; upper latus pentagonal; rostral latus quadrangular; inframedian latus broad, rectangular, umbo close to basal margin; carinolatus horn-shaped with slightly deep transverse furrows, umbo at basi-carinal angle; carina convex, umbo apical. Cirrus I with rami unequal, anterior ramus broader than posterior ramus; both rami densely covered with long setae. Maxilla subtriangular, with dense long setae; maxillule notched, with numerous setae; mandible with three teeth, inferior angle with large cuspidate setae. Measurements of specimen: height of ca-

pitulum 15.90 mm, width 10.29 mm, thickness 4.58 mm; length of peduncle 6.97 mm, width 5.67 mm.

**Distribution.** In this study, *Scalpellum* sp. was found in Tanimbar Island, Indonesia.

### *Scalpellum stearnsi* Pilsbry, 1890

Figure 12

*Scalpellum magnum* Darwin, 1852: 18, pl. I, fig. 1.

*Scalpellum calcariferum* Fischer, 1891: 116.

*Scalpellum stearnsii* var. *gemina* and var. *robusta* Hoek, 1907: 69, pl. VI, figs 2, 3, 8–12.

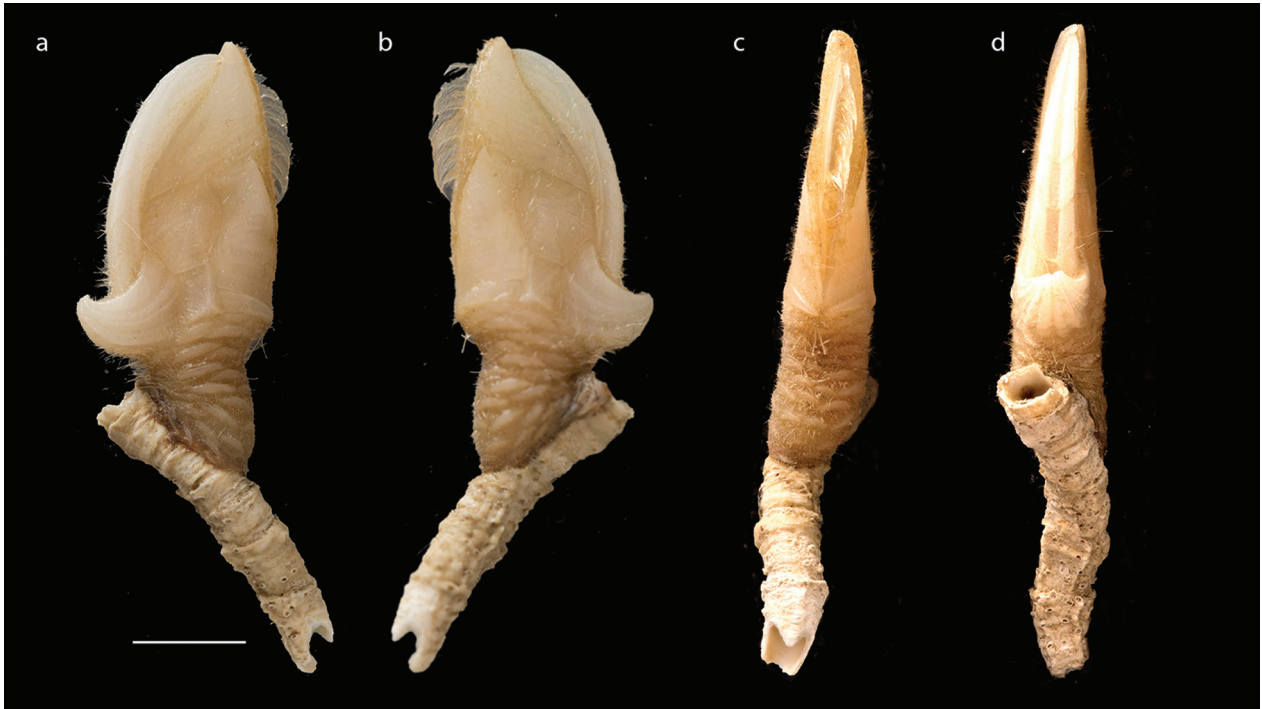
*Scalpellum stearnsii* var. *inerme* Annandale, 1916a: 293.

*Scalpellum stearnsii* forma *typica* Broch, 1931: 16.

*Scalpellum stearnsii* Pilsbry, 1890a: 96. – 1890b: 441, pl. IV, figs 1–5. – 1907a: 14, pl. 4, figs 1–5. – Nilsson-Cantell 1921: 175. – 1934: 33. – Broch 1922: 235, fig. 6. – Hiro 1933: 22, fig. 4, pl. 1, figs 5, 5a. – 1939a: 237. – Zevina 1981: 98, fig. 68. – Rosell 1991: 15. – Jones 1992: 146, figs 1, 2. – Liu and Ren 2007: 226, fig. 95. – Chan et al. 2009b: 89, figs 73–76. – Chan et al. 2010: 24, figs 2C, 18A–G.

*Scalpellum stearnsi*: Gruvel, 1905: 44, fig. 46. – Gale 2016: fig. 5, table 1.

**Material examined.** – Tanimbar Island: 1 specimen, MNHN-IU-2019-4888, Stn. CP 71, 08°38'S, 131°44'E, 477–480 m depth, 2 November 1991; 1 specimen, MNHN-IU-2019-4889, Stn. CC 58, 08°19'S, 132°02'E, 457–461 m depth, 31 October 1991; 6 specimens, MNHN-IU-2019-4890, Stn. CC 42, 07°53'S, 132°42'E, 350–354 m depth, 28 October 1991; 3 specimens,



**Figure 11.** *Scalpellum* sp. (MNHN-UI-2019-4929). **a.** left lateral view, capitulum and peduncle; **b.** right lateral view, capitulum and peduncle; **c.** rostral view, capitulum and peduncle; **d.** carinal view. Scale bar: 7 mm (**a–d**).

MNHN-IU-2019-4891, Stn. CP 69, 08°42'S, 131°53'E, 356–368 m depth, 2 November 1991; 5 specimens, MNHN-IU-2019-4892, Stn. CC 41, 07°45'S, 132°42'E, 393–401 m depth, 28 October 1991; 5 specimens, MNHN-IU-2019-4893, Stn. CP 59, 08°20'S, 132°11'E, 399–405 m depth, 31 October 1991, 2 specimens attached to glass rope sponge.

– Kei Islands: 8 specimens, MNHN-IU-2019-4894, Stn. CP 06, 05°49'S, 132°21'E, 287–298 m depth, 22 October 1991.

**Diagnosis.** Capitulum rhomboidal, compressed; carina strongly angled at umbo; scutum large, umbo at tergo-occludent angle; tergum triangular; inframedian latus pentagonal; carinolateral horn-shaped.

**Description.** Capitulum with 14 fully calcified plates. Scutum large, longer than broad, apex slightly projecting over tergum; tergum large, triangular, apex erect, slightly recurved. Carina distinctly bent near middle, umbo distant from apex. Cirrus I with anterior ramus oval (12-segments), posterior ramus slender, long (15-segments); cirri II–VI slender, long, rami almost equal length; cirrus VI with short caudal appendages (six segments). Maxillule not notched, with numerous setae; mandible with six teeth excluding inferior angle. Measurements of five specimens: height of capitulum 31.69–52.00 mm, width 28.20–40.11 mm, thickness 11.19–18.56 mm; peduncle length 28.29–86.59 mm, width 11.39–17.94 mm.

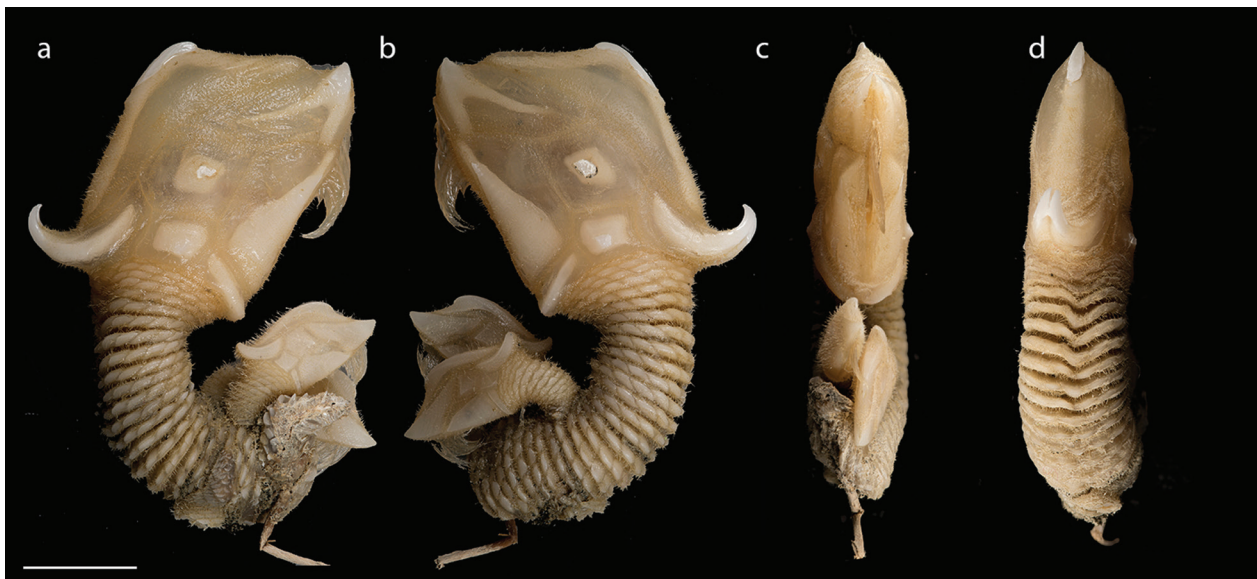
**Distribution.** Indo-west Pacific: Indian Ocean, off Nicobar Island; Indonesia: Java Sea, Bali Straits; north west &

north east Australia; Malay Archipelago; Celebes; Sulu Arch.; Sulu Sea; South China Sea; East China Sea; Philippines; Taiwan; east coast of south Japan, Sagami Bay, off Hondo; attached to mollusc shells, anchor filaments of hexactinellid sponges, telegraph cables, carapaces of crabs, stones; 146–2117 m depth (Jones and Hosie 2016). In this study, *Scalpellum stearnsi* was found at Tanimbar Island and Kei Islands, Indonesia.

**Type locality.** East coast of Japan, between the Bay of Tokyo and the Inland Sea (Jones 1992).

**Remarks.** For the first time, *Scalpellum stearnsi* was found in Japan and described by Pilsbry (1890). During the *Siboga* expedition (1899), *S. stearnsi* was collected from different locations in the Malay Archipelago with the depths varying from 204 m to 450 m. Hoek (1907) found intraspecific variations of the shell plate morphology. He then divided *S. stearnsi* into two groups, i.e. variety *robusta* and var. *gemina*, which differed in the shape of the tergum. The species *S. stearnsi* in this study belongs to the group of var. *gemina* because of the V-shaped tergum.

*Scalpellum stearnsi* has a low period of larval development (Ozaki et al. 2008) and a slow growth rate (Yusa et al. 2018). This can result in the broad geographical distribution of this species. Recently, Lin et al. (2020) examined the diversity and genetic differentiation of populations of *S. stearnsi* from the East China Sea, West Philippine Basin, Sulu Sea and Caroline Trenches, which resulted in four distinct clades of *S. stearnsi*.



**Figure 12.** *Scalpellum stearnsi* Pilsbry, 1890 (MNHN-IU-2019-4888). **a.** left lateral view, capitulum and peduncle; **b.** right lateral view, capitulum and peduncle; **c.** rostral view, capitulum and peduncle; **d.** carinal view. Scale bar: 14 mm (a–d).

### Subfamily MEROSCALPELLINAE Zevina, 1978

Meroscalpellinae Zevina, 1978b: 1343.

**Diagnosis.** Capitulum with 14 or 13 plates, reduced in differing stages or proportions; carina with two umbo positions; females considered rarer than hermaphrodites; males sac-like, usually without plates, rarely with two or four reduced plates.

**Type genus.** *Meroscalpellum* Zevina, 1978b: 1346.

### Genus *Alcockianum* Zevina, 1978

*Alcockianum* Zevina, 1978b: 1345.

**Diagnosis.** Plates strongly reduced; partly obscured under heavy cuticle; tergum double branched, depressed at base; scutum triangular; upper lateral triangular; mid-lateral very small, umbo apical; caudal appendages very long; hermaphrodites.

**Type species.** *Scalpellum alcockianum* Annandale, 1905: 82; type locality: Gulf of Manaar and Andaman Sea.

### *Alcockianum persona* (Annandale, 1916)

Figure 13

*Scalpellum persona* Annandale, 1916a: 295, pl. IV, fig. 3; pl. V, figs 7, 8; pl. VI, figs 3–5. – Calman 1918b: 120. – Nilsson-Cantell 1934: 44, pl. 5, fig. 2.

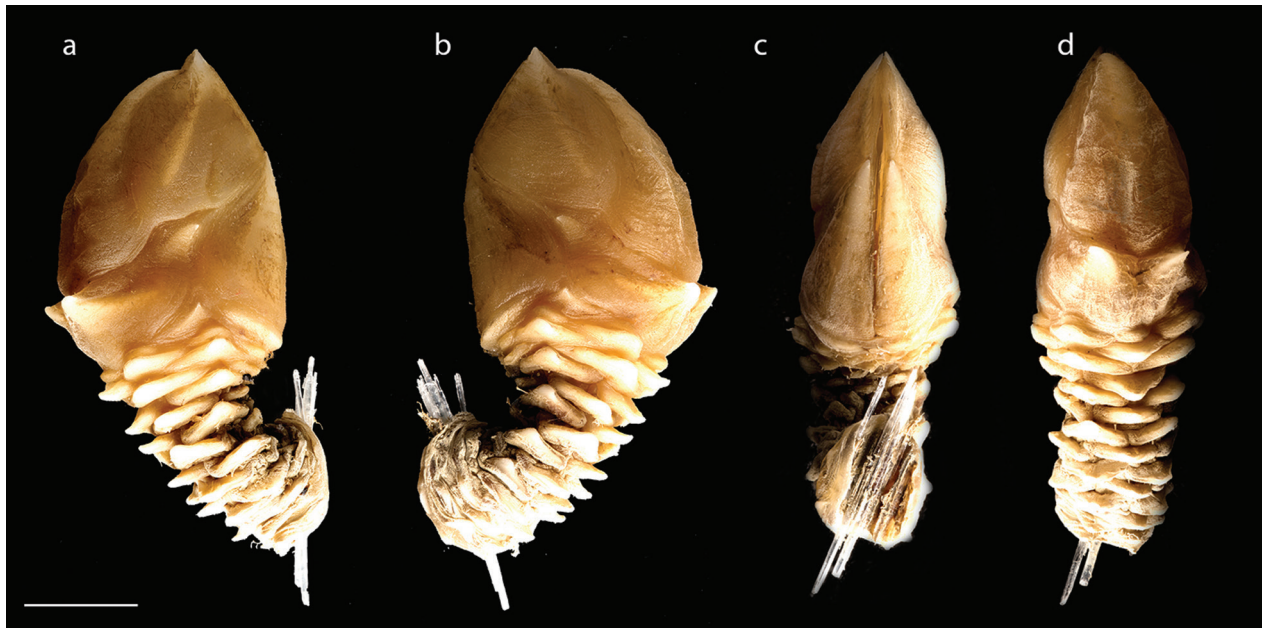
*Graviscapellum persona* Foster, 1980: 527, figs 1e, 2.

*Alcockianum persona* Zevina, 1978b: 1345. – 1981: 150–151, fig. 107. – Jones 1992: 151–154, figs 4, 5.

**Material examined.** – Tanimbar Island: 2 specimens, MNHN-IU-2019-4903, Stn. CP 71, 08°38'S, 131°44'E, 477–480 m depth, 2 November 1991; 5 specimens, MNHN-IU-2019-4904, Stn. CC 21, 05°14'S, 133°00'E, 688–694 m depth, 25 October 1991 attached to glass rope sponge; 1 specimen, MNHN-IU-2019-4905, Stn. CC 40, 07°46'S, 132°31'E, 443–468 m depth, 28 October 1991; 5 specimens, MNHN-IU-2019-4906, Stn. CC 57, 08°19'S, 131°53'E, 603–620 m depth, 31 October 1991.

**Diagnosis.** Capitulum with plates buried or obscure; plates reduced in size; tegum reduced, forming four-pointed star; scutum small; peduncle armed with distinct circles of large, calcareous scales.

**Description.** Capitulum brownish, large, ovoid, inflated, with 13 capitular plates, including a vestigial rostrum, plates embedded and mostly concealed by thick, opaque membrane. Scutum small, widely separated from all remaining plates except tergum, margins not excavated or deeply concave; tergum reduced in form as four-pointed star, with two rays greatly and two rays slightly produced. Carina reduced in size, apex approaching terga, widely separated from remaining plates. Peduncle cylindrical, similar length to capitulum, with large calcareous scales arranged in alternating rows. Cirrus I with anterior ramus oval (8-segments), posterior ramus slender, long (12-segments); cirri II–VI slender, long, rami almost equal length; cirrus VI with caudal appendages; caudal appendages 1/3 length of cirrus VI, 15-segmented, tapering distally. Penis rather short, smooth, pointed. Maxilla bilobed, dense setae on margin. Maxillule relatively large, with broad, shallow excavation on lower margin occupying more than half margin, remainder of margin obliquely subtruncate; mandible with three main teeth in addition to inner angle, which is variously divided, broad as a whole. Measurements of five



**Figure 13.** *Alcockianum persona* (Annandale, 1916) (MNHN-IU-2019-4903). **a.** left lateral view, capitulum and peduncle; **b.** right lateral view, capitulum and peduncle; **c.** rostral view, capitulum and peduncle; **d.** carinal view. Scale bar: 9 mm (a–d).

specimens: height of capitulum 17.71–35.06 mm, width 12.91–28.06 mm, thickness 4.96–18.20 mm; length of peduncle 13.42–28.67 mm, width 6.66–10.79 mm.

**Distribution.** Indonesian Seas, eastern Australia, New Zealand; 109–915 m depth (Jones 1992). In this study, *Alcockianum persona* was found at Tanimbar Island, Indonesia.

**Type locality.** Timor Sea (10°22'30"S, 120°7'30"E); 109–366 m depth: bottom temp. 13.1 °C (Jones 1992).

#### Genus *Annandaleum* Newman & Ross, 1971

*Annandaleum* Newman & Ross, 1971: 122. – Zevina 1978b: 1346.

**Diagnosis.** Capitulum of female with 14 partially calcified plates; tergum in shape of inverted V; scutum with moderately long apicolateral arm, 1/4 to 1/2 length of tergal margin; basal margin of scutum entire; upper latus pentagonal to triangular or subrectangular, with or without short depending arm; carinolatus as high as or slightly higher than wide, umbo at basicarinal angle; inframedian latus higher than wide, vase-shaped, umbo submedial to basal; rostralatus wider than high, commonly less than twice height of inframedian latus; caudal appendage relatively long.

**Type species.** *Scalpellum subflavum* Annandale, 1906.

#### *Annandaleum japonicum* (Hoek, 1883)

Figure 14

*Scalpellum japonicum* Hoek, 1883: 67, pl. III, figs 9, 10. – Annandale 1906: 131, fig. 3. – Pilsbry 1911: 66, pl. II, figs 1–3. – Weltner 1922:

69, taf. II, fig. 4. – Hiro 1937 b: 392. – Tarasov and Zevina 1957: 144, figs 46, 47. – Zevina 1969: 68. – 1970: 257–259, figs 5, 6.

*Scalpellum chitinosum* Hoek, 1907: 73.

*Scalpellum curiosum* Hoek, 1907: 49.

*Scalpellum japonicum biramosum* Pilsbry, 1911: 68, fig. 4. – Weltner 1922: 69, taf. II, fig. 5. – Nilsson-Cantell 1938: 7.

*Scalpellum japonicum metapleurum* Pilsbry, 1907b: 360.

*Annandaleum japonicum biramosum* Chan et al., 2009b: 98–99, fig. 80. – Chan et al. 2010: 17–18, figs 2A, 14, 15.

*Annandaleum japonicum*. – Newman & Ross, 1971: 122. – Zevina 1981: 166–167. – Jones et al. 2001: 251. – Young 2001: 465, fig. 8. – 2007: 23, fig. 22.

**Material examined.** – Tanimbar Island: 4 specimens, MNHN-IU-2019-4932, Stn. CP 53, 08°18'S, 131°41'E, 1026–1053 m depth, 30 October 1991.

**Diagnosis.** Capitulum with 14 partly calcified plates; carina with flat roof; apex of tergum curved towards carina; rostral latus trapezoidal in shape; peduncle short.

**Description.** Capitulum yellowish, with 14 plates separated by broad, chitinous spaces. Peduncle short, curved, scales large, not numerous. Scutum long, narrow; umbo apical, divided into two segments, occludent segment large, increasing in width from upper to lower part, other segment very narrow. Tergum divided into occludent and carinal segments, with triangular, chitinous portion between, umbo apical, distinctly recurved. Cirrus I unequal, anterior ramus oval, posterior ramus slender long; cirrus VI with caudal appendages. Maxillule slightly notched, two long and one short setae on upper side; mandible with three teeth excluding inferior angle; labrum cutting edge straight, very fine teeth on cutting edge. Measurements of the four specimens: height of ca-





**Figure 14.** *Annandaleum japonicum* (Hoek, 1883) (MNHN-UI-2019-4932). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 2 mm (**a–d**).

pitulum 9.56–12.73 mm, width 4.67–7.13 mm, thickness 1.85–3.21 mm; length of peduncle 3.37–4.77 mm, width 1.83–3.27 mm.

**Distribution.** Eastern Indian Ocean; Northwest and Western Central Pacific; Malay Archipelago; Japan; Taiwan; Indonesia; attached to shell of gastropod, gorgonians, rocks; 805–6,810 m depth (Jones and Hosie 2016). In this study, *Annandaleum japonicum* was found at Tanimbar Island, Indonesia.

**Type locality.** Pacific, Northwest (off Nagoya, south of Japan); 1,017 m depth (Shalaeva and Boxshall 2014).

#### *Annandaleum laccadivicum* (Annandale, 1906)

Figure 15

*Scalpellum laccadivicum* Annandale, 1906b: 393. – 1908: pl. I, figs 3, 4. – 1913: 235; 1916b: 129, pl. vii, fig. 6. – Calman 1918b: 124. – Hiro 1933: 31, text figs 7, 8, pl. I, figs 11–11b. – 1937b: 392. – Stubbings 1936: 26. – Nilsson-Cantell 1938: 25.

*Scalpellum subflavum* Annandale, 1906b: 397. – Newman and Ross 1971: 122.

*Scalpellum polymorphum* Hoek, 1907: 80, pl. 7, figs 9–11. – Weltner 1922: 72.

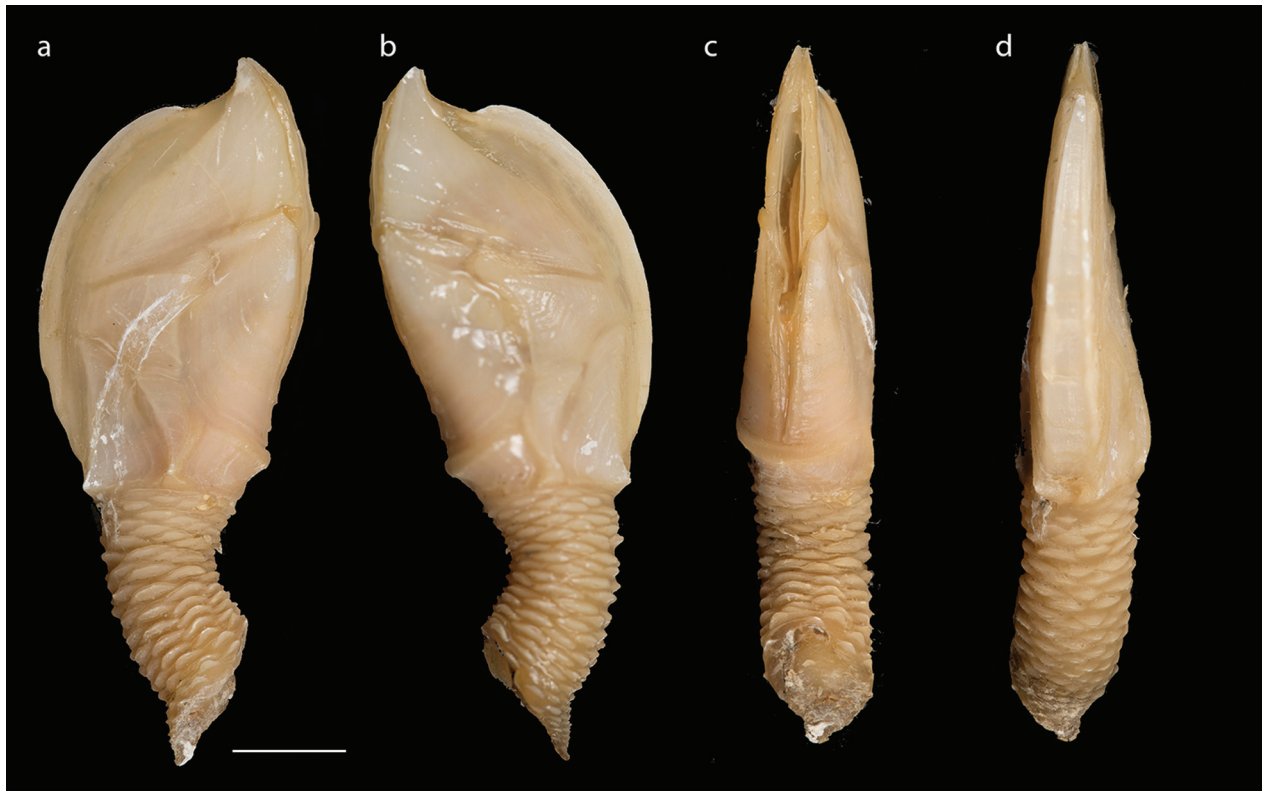
*Scalpellum molliculum* Pilsbry, 1911: 68, pl. 10, figs 4, 5.

*Annandaleum laccadivicum* Rosell, 1991: 16, fig 1a. – Zevina 1981: 170, fig. 121. – Jones et al. 2001: 251. – Chan et al. 2009b: 102–103.

**Material examined.** – Tanimbar Island: 1 specimen, MNHN-IU-2019-4931, Stn. CP 54, 08°21'S, 131°43'E, 836–869 m depth, 30 October 1991, attached to gastropod shell.

**Diagnosis.** Capitulum regularly oval; carina simply bowed; tergum almost triangular; scutum subtriangular; upper latus large, perfectly calcified part irregularly triangular, constricted above; rostral latus quadrangular; peduncle at least half as long as capitulum.

**Description.** Capitulum compressed; 13 plates completely covered by fine, hairless membrane. Peduncle half length of capitulum, stout, cylindrical, armed with small, transversely elongated plates. Scutum subtriangular, lateral margin excavated with tooth above excavation blunt, short, simple; tergum almost triangular, scutal margin excavated, but not very boldly, occludent margin slightly, regularly convex outwards. Carina simply bowed, umbo subterminal, in contact with terga above or just entering between them. Cirrus I unequal, anterior ramus oval, posterior ramus slender, long; cirri II–VI slender, long, rami almost equal lengths; cirrus VI with long, slender caudal appendages. Maxillule slightly notched, two major setae on upper side; mandible with four teeth. Measurements of specimen: height of capitulum 18.88 mm, width 11.41 mm, thickness 6.30 mm; length of peduncle 11.45 mm, width 4.89 mm.



**Figure 15.** *Annandaleum laccadivicum* (Annandale, 1906) (MNHN-IU-2019-4931). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 5 mm (a–d).

**Distribution.** Gulf of Oman, Arabian Sea, Sri Lanka, Japan (Chan et al. 2009b). In this study, *Annandaleum laccadivicum* was found at Tanimbar Island, Indonesia.

**Type locality.** Laccadive Sea, 2,077 m depth; on living shells of *Dentalium* (Annandale 1906).

#### *Annandaleum lambda* (Annandale, 1910)

Figure 16

*Scalpellum lambda* Annandale, 1910b: 115. – 1916a: pl. VII, figs 6, 6a, pl. VIII, figs 12–15.

*Scalpellum longius* Annandale, 1913: 234.

*Annandaleum lambda*. – Newman & Ross, 1971: 122. – Jones, 1992: 154, fig. 6.

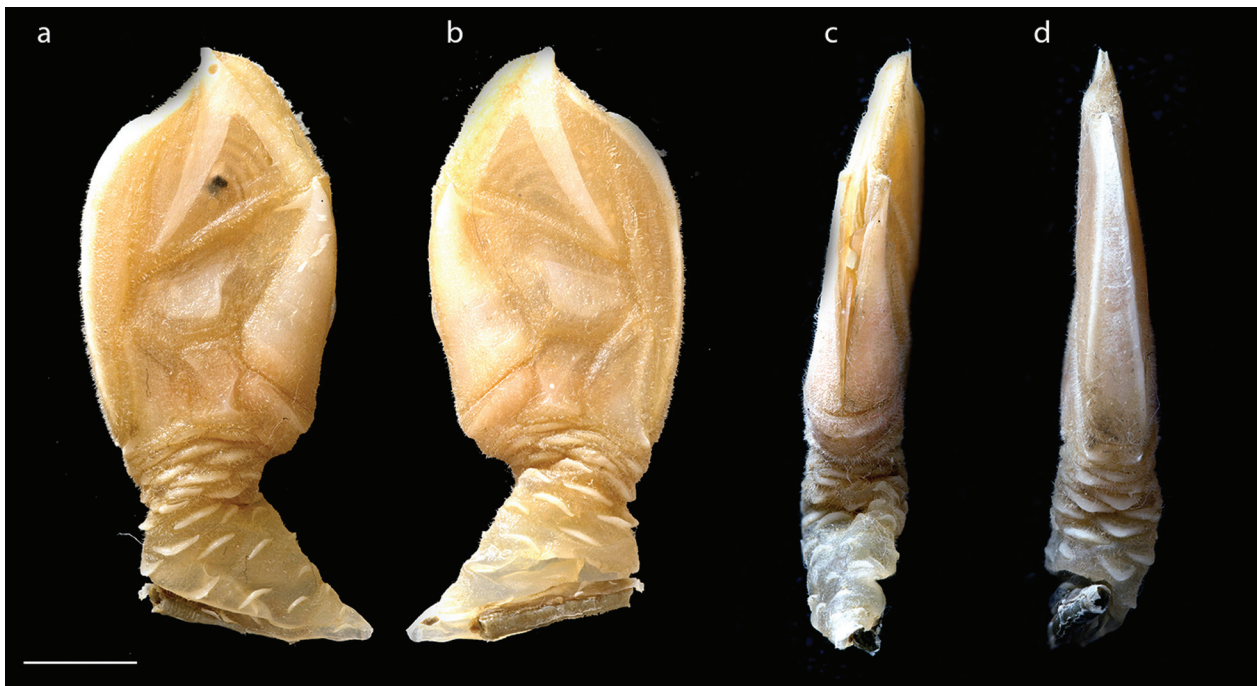
**Material examined.** – Tanimbar Island: 10 specimens, MNHN-IU-2019-4915, Stn. CP 52, 08°03'S, 131°48'E, 1244–1266 m depth, 30 October 1991; 1 specimen, MNHN-IU-2019-4913, Stn. CP 53, 08°18'S, 131°41'E, 1026–1053 m depth, 30 October 1991; 1 specimen, MNHN-IU-2019-14, Stn. CP 89, 08°39'S, 131°08'E, 1058–1084 m depth, 5 November 1991, attached to pumice.

**Diagnosis.** Capitulum narrow; carinal margin strongly curved; laterally compressed; bearing fourteen imperfect-

ly formed, thin, smooth, translucent plates, eight formed like a Greek lambda.

**Description.** Capitulum with 14 plates. Peduncle shorter than capitulum, cylindrical, rather slender, expanded at base. Tergum lambda-shaped, with prominent tooth on carinal margin just above point where apex of carina approaches it. Scutum shaped similarly, but occludent branch much stouter, with vertical ridge running nearer to lateral than occludent margin. Cirrus I unequal, anterior ramus oval, posterior ramus slender, long; cirri II–VI slender, long, with rami almost equal length; cirrus VI with long, slender caudal appendages. Maxillule not notched, two major setae on upper side; mandible with four teeth including inner angle. Measurements of five specimens: height of capitulum 16.61–24.27 mm, width 8.73–14.49 mm, thickness 3.17–6.31 mm; length of peduncle 5.54–15.27 mm, width 3.73–6.26 mm.

**Distribution.** Indo-Pacific from off Zanzibar, Indian Ocean, eastern Australia; Sumbawa, Indonesia; Malay Arch.; SW of Calatagan Pt, Philippines; S Japan (S of Honda I.), SW Pacific; attached to shells of bivalves; 234–2077 m depth (Jones and Hosie 2016). In this study, *Annandaleum lambda* was found at Tanimbar Island, Indonesia.



**Figure 16.** *Annandaleum lambda* (Annandale, 1910) (MNHN-IU-2019-4915). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 6 mm (**a–d**).

**Type locality.** Eastern Indian Ocean ( $13^{\circ}54'15''\text{N}$ ,  $94^{\circ}02'15''\text{E}$ ), Investigator Stn. 372; 1,176 m depth (Jones 1992).

#### Genus *Litoscalpellum* Newman & Ross, 1971

*Litoscalpellum* Newman & Ross, 1971: 108. – Zevina 1978b: 1344. – Liu and Ren 1985: 196. – 2007: 228.

**Diagnosis.** Capitulum with 14 plates, mostly not reduced; tergum with straight basal margin or shallow notch; scutum with straight, smooth basal margin; upper latus triangular or elongate, commonly with slightly hollowed-out basal margin, rarely with deep notch; inframedian latus narrow, triangular or quadrilateral, umbo apical; caudal appendages present.

**Type species.** *Litoscalpellum fissicarinatum* Newman & Ross, 1971: 108, pl. XC, text-fig. 55.

#### *Litoscalpellum juddi* (Calman, 1918)

Figure 17

*Scalpellum juddi* Calman, 1918b: 116, text-figs 5–7.

*Scalpellum regulus* Calman, 1918b: 113, text-fig. 4.

*Litoscalpellum juddi* Zevina, 1981:135–136, fig. 94.

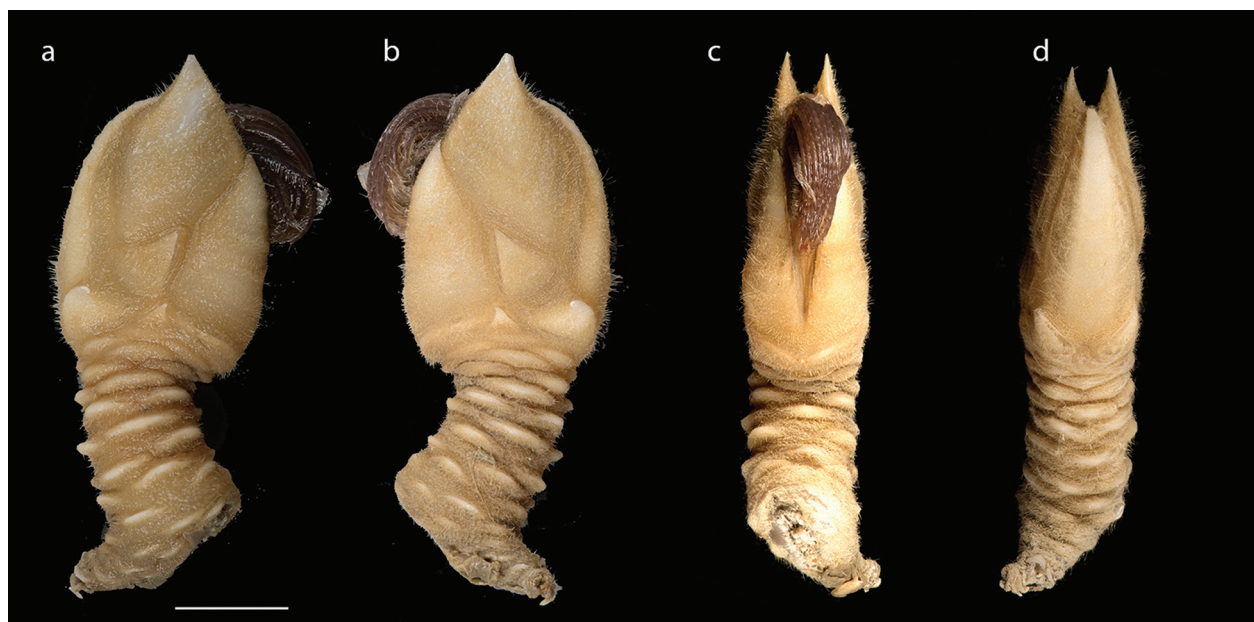
**Material examined.** – Tanimbar Island: 5 specimens, MNHN-IU-2019-4896, stn. CC 56,  $08^{\circ}16'\text{S}$ ,  $131^{\circ}59'\text{E}$ ,

549–552 m depth, 31 October 1991; 1 specimen, MNHN-IU-2019-4898, stn. CP 71,  $08^{\circ}38'\text{S}$ ,  $131^{\circ}44'\text{E}$ , 477–480 m depth, 2 November 1991; 6 specimens, MNHN-IU-2019-4901, stn. CP 72,  $08^{\circ}36'\text{S}$ ,  $131^{\circ}33'\text{E}$ , 676–699 m depth, 2 November 1991.

**Diagnosis.** Capitulum compressed, oval, notched above; surface covered with very short velvety pubescence, areas of valves defined by grooves, lines of growth strongly marked; carina flattened.

**Description.** Capitulum with 14 plates, cartilaginous thick. Tergum irregularly triangular, apex projecting above carina, recurved. Scutum triangular, basal width more than half height, apex overlapping tergum. Carina evenly curved, apex projecting freely for short distance, touching or entering between terga, its base rounded, widely separated from carinal latera; roof strongly convex. Upper latus triangular with base convex. Rostrum triangular; inframedian latus small, triangular, base deeply embedded. Peduncle with large transverse plates, not overlapping (widely spaced). Cirrus I unequal, anterior ramus oval, posterior ramus slender, long; cirrus VI with caudal appendages. Maxillule with oral edge sinuous, a large seta at its proximal third, another at its distal end; mandible with four teeth. Measurements of five specimens: height of capitulum 16.94–39.25 mm, width 11.39–28.28 mm, thickness 5.20–19.89 mm; length of peduncle 15.02–52.02 mm, width 5.63–16.87 mm.

**Distribution.** In this study, *Litoscalpellum juddi* was found at Tanimbar Island, Indonesia.



**Figure 17.** *Litoscalpellum juddi* (Calman, 1918) (MNHN-IU-2019-4898). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 11 mm (**a–d**).

**Type locality.** 11°0'S, 121°30'E (Java-Australia), 720 m depth (Calman 1918b).

#### *Litoscalpellum recurvirostrum* (Hoek, 1883)

Figure 18

*Scalpellum recurvirostrum* Hoek, 1883: 77–79, pl. III, figs 11, 12, pl. VIII, figs 9, 10.

*Arcoscalpellum recurvirostrum*. – Newman & Ross, 1971: 79–80, fig. 39.

*Litoscalpellum recurvirostrum*. – Zevina, 1974: 214. – 1981: 127, 128, fig. 88. – Shalaeva and Boxshall 2014: 13, fig. 6.

**Material examined.** – Kei Islands: 1 specimen, MNHN-IU-2019-4934, Stn. CP 05, 05°49'S, 132°18'E, 296–299 m depth, 22 October 1991; 1 specimen, MNHN-IU-2019-4936, Stn. CP 09, 05°23'S, 132°29'E, 368–389 m depth, 23 October 1991.

– Tanimbar Island: 4 specimens, MNHN-IU-2019-4935, Stn. CP 83, 09°23'S, 131°00'E, 285–297 m depth, 4 November 1991; 16 specimens, MNHN-IU-2019-4937, Stn. CP 69, 08°42'S, 131°53'E, 356–368 m depth, 2 November 1991.

**Diagnosis.** Capitulum plates separated, covered by fine membrane; carina slightly angularly bent; upper latus trapeziform; inframedian latus triangular; peduncle with scattered, calcareous scales.

**Description.** Capitulum with 14 plates, lines of growth not distinct, plates separated by broad, membranous interspaces. Scutum elongate quadrangular, broader at base than in upper half; umbo apical, slightly projecting outwards. Tergum triangular; carina bowed; upper latus trapeziform; inframedian latus very small, triangular. Peduncle cylindrical with numerous calcareous scales scattered over surface.

Cirrus I with rami unequal, anterior ramus oval, posterior ramus slender, long, segments very hairy. Maxilla bilobed; maxillule notched, two large setae above notch; mandible with three teeth, inferior angle pectinated. Measurements of five specimens: height of capitulum 16.15–26.05 mm, width 9.24–16.59 mm, thickness 4.45–8.18 mm; length of peduncle 7.25–20.90 mm, width 4.13–8.95 mm.

**Distribution.** Indian Ocean, Antarctic and Southern (South of the Kerguelen Islands); known depth range 195 to 274 m (Shalaeva and Boxshall 2014). In this study, *Litoscalpellum recurvirostrum* was found at Kei Islands and Tanimbar Island, Indonesia.

**Type locality.** Between Kerguelen and Heard Islands; 52°4'S, 71°22'E; depth: 270 m; bottom temperature: 1.8 °C; bottom: rocks (Hoek 1883).

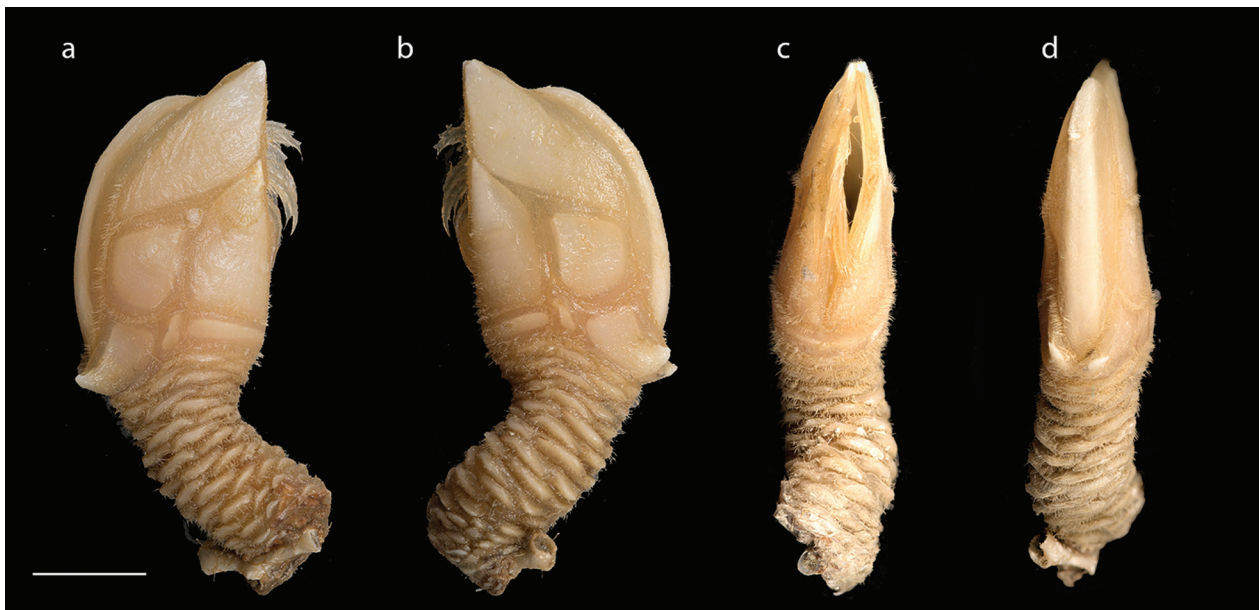
#### *Litoscalpellum walleni* Newman & Ross, 1971

Figure 19

*Litoscalpellum walleni* Newman & Ross, 1971: 116, pl. X E text-fig. 60.

**Material examined.** – Tanimbar Island: 1 specimen, MNHN-IU-2019-4927, Stn. CP 91, 08°44'S, 131°05'E, 884–891 m depth, 5 November 1991.

**Diagnosis.** Capitulum with 14 plates; inframedian latus triangular, very small, narrow; carina with flat roof; rostrum minute; scutum lacking prominent apicolateral arm; maxilla subtriangular, slightly trilobate; maxillule slightly notched with teeth diverging laterally from cutting edge; caudal appendage multi-articulate, slightly shorter than first segment of cirrus VI.



**Figure 18.** *Litoscalpellum recurvirostrum* (Hoek, 1883) (MNHN-UI-2019-4934). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 6 mm (**a–d**).



**Figure 19.** *Litoscalpellum walleni* Newman & Ross, 1971 (MNHN-UI-2019-4927). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 4 mm (**a–d**).

**Description.** Capitulum elongate, higher than broad; plates ornamented with growth lines. Carina bowed, roof slightly convex, bounded by angles. Tergum triangular; scutum with lateral margin concave; upper latus roughly quadrangular; carinal latus higher than wide;

rostral latus quadrangular, slightly broader than high; rostrum minute, narrow, essentially rectangular. Cirrus I unequal, anterior ramus shorter, broader than posterior ramus; both rami densely covered with long setae. Mandible with four teeth including inferior angle, inferior

angle serrate along basal margin with four spines. Measurements of specimen: height of capitulum 14.56 mm, width 8.09 mm, thickness 2.50 mm; length of peduncle 7.52 mm, width 3.89 mm.

**Distribution.** Southeast Pacific Ocean (Newman and Ross 1971). In this study, *Litoscalpellum walleni* was found at Tanimbar Island, Indonesia.

**Type locality.** northeast of Peter I Island, southeast Pacific Ocean; 65°50'S, 88°56'W; depth: 4,502 m (Newman and Ross 1971).

#### Subfamily ARCOSCALPELLINAE Zevina, 1978

Arcoscalpellinae Zevina, 1978b: 1346. –1981: 184. – Liu and Ren 2007: 238.

**Diagnosis.** Capitulum with plates packed very closely; carina slightly convex; umbo of scutum and tergum apical.

**Type genus.** *Arcoscalpellum* Hoek, 1907: 57.

#### Genus *Amigdoscalpellum* Zevina, 1978

*Arcoscalpellum* Hoek, 1907: 85 (in part). – Newman and Ross 1971: 42 (part).

*Amigdoscalpellum* Zevina, 1978b: 1349. – Foster 1980: 527. – Liu and Ren 1985: 206. – 2007: 251.

**Diagnosis.** Capitulum of female or hermaphrodite with 13 or 14 completely calcified plates; scutum and tergum with umbones apical; carina evenly bent, umbo apical or sub-apical; middle latera narrowly triangular, baton-like, small, umbo apical, not reaching upper latera; carinolatera typically with umbo orientated in middle part of carinal area, not extending beyond rim of capitulum; caudal appendages usually uni-articulate, but possibly absent or extended to seven segments; basically females with dwarf males.

**Type species.** *Scalpellum manum* Zevina, 1973: 843, figs 1–7; type locality: Indian Ocean, 12°18'S, 112°43'E.

#### *Amigdoscalpellum costellatum* (Withers, 1935)

Figure 20

*Scalpellum elongatum* Hoek, 1883: 93, pl. IV, figs 8, 9. – Nilsson-Cantell 1928: 8, fig. 4. – 1931: 3, text-fig.1. – 1938: 7.

*non Scalpellum (Arcoscalpellum) elongatum.* – Steenstrup, 1837: 409.

*Scalpellum (Scalpellum) elongatum.* – Stubbings, 1936: 25, text-fig. 10.

*Scalpellum (Arcoscalpellum) costellatum* Withers, 1935: 279.

*Arcoscalpellum buccinum* Newman & Ross, 1971: 55, pl. VIII, figs 22, 23.

*Arcoscalpellum costellatum.* – Foster, 1978: 56, pl. 7B, C, fig. 33.

*Amigdoscalpellum costellatum.* – Foster, 1980: 527–529, fig. 3J. – Zevina 1981: 270–271, fig. 204. – Jones et al. 1990: 5 – Jones 2012: 371,

376 – Poltarukha 2013: 52–53, fig. 1. – Shalaeva and Boxshall 2014: 16, fig. 9.

**Material examined.** – Tanimbar Island: 2 specimens, MNHN-IU-2019-4922, Stn. CC 21, 05°14'S, 133°00'E, 688–694 m depth, 25 October 1991, attached to glass rope sponge.

**Diagnosis.** Capitulum triangular; plates ornamented with radial ridges, covered by sparsely hirsute integument; carina with roof deeply grooved; scutum with apex overlapping tergum; inframedian latus triangular, very small.

**Description.** Capitulum yellowish, with 13 fully calcified plates. Peduncles short with scales slightly overlapping in the middle part. Scutum with pit for complementary males, above shallow pit for adductor muscle. Carina wide in lower part, ribbed in upper part. Upper latus with straight sides; rostrum appearing externally as inverted triangle. Cirrus I unequal, anterior ramus oval, posterior ramus slender, long; cirrus VI with very short caudal appendages. Maxillule with notch between two or three stout setae at upper angle, group of more slender setae on cutting edge; mandible with three teeth excluding inferior angle; labrum cutting edge slightly concave, numerous pointed teeth on cutting edge. Measurements of two specimens: height of capitulum 12.44–13.88 mm, width 6.97–7.52 mm, thickness 2.77–3.47 mm; length of peduncle 2.99–3.15 mm, width 2.94–3.24 mm.

**Distribution.** Indian Ocean, Eastern and Western; Pacific, Southwest and Western Central; Atlantic, Southeast and Eastern central; 110–2,397 m depth (Shalaeva and Boxshall 2014). In this study, *Amigdoscalpellum costellatum* was found at Tanimbar Island, Indonesia.

**Type locality.** 1. Station 135: Island of Tristan da Cunha; depth: 110 m, 137 m, 183 m, 274 m, 1,006 m, 1,829 m, 2,012 m; bottom: rocky, shells. 2. Station 164a: off Sydney, 34°13'S, 151°38'E; depth: 750 m; bottom: grey ooze. 3. Station 169: off East Cape, Auckland, 37°34'S, 179°22'E; depth: 1,280 m; bottom temperature: 4.2 °C; bottom: grey ooze (Hoek 1883).

#### *Amigdoscalpellum tenue* (Hoek, 1883)

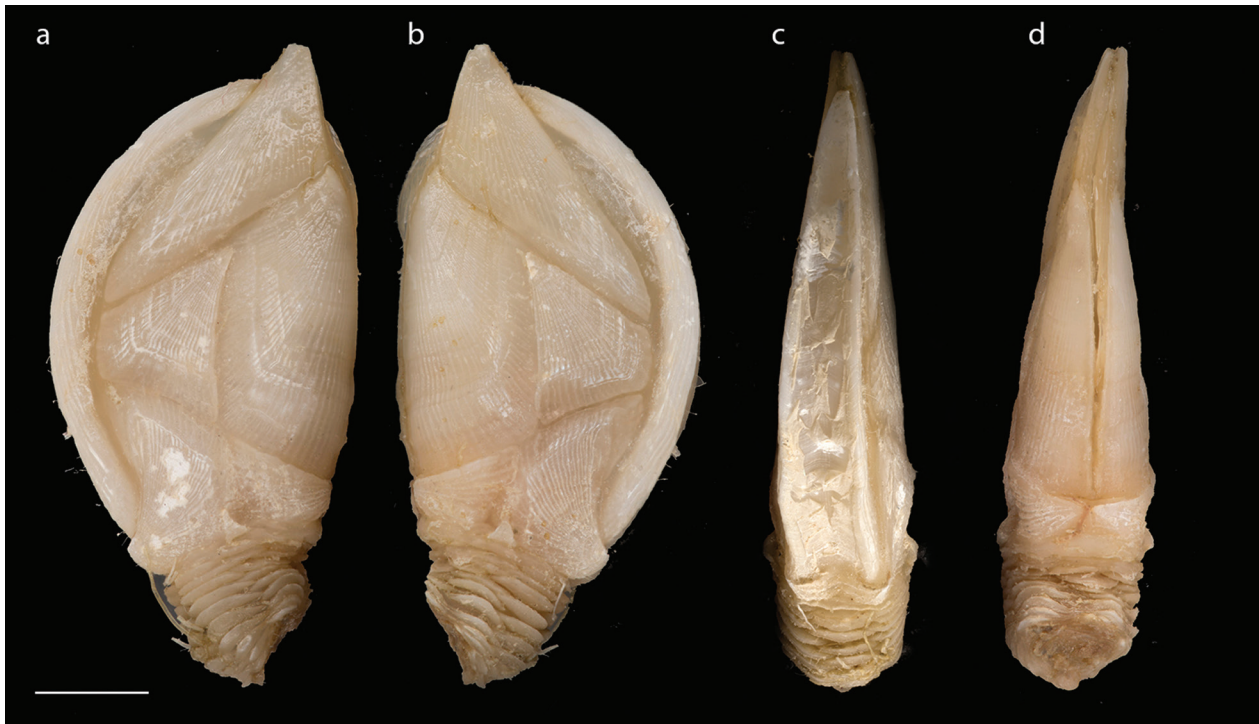
Figure 21

*Scalpellum tenue* Hoek, 1883: 119, pl. IV, figs 20, 21, pl. X, fig. 6. – Gruvel 1912: 345. – Nilsson-Cantell 1938: 8.

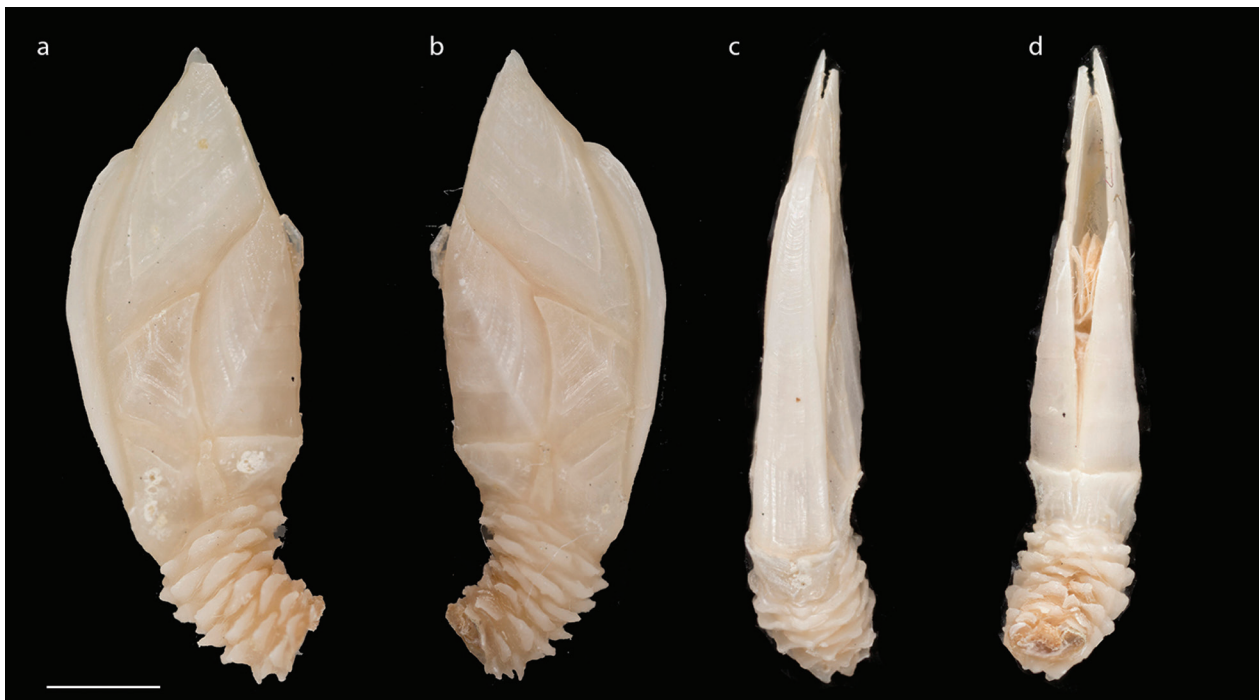
*non Scalpellum tenue* Annandale, 1906a: 142.

*Amigdoscalpellum tenue.* – Zevina 1981: 292–293, fig. 220 (2). – Shalaeva and Boxshall 2014: 17, fig. 10.

**Material examined.** – Kei Islands: 1 specimen, MNHN-IU-2019-4921, Stn. CP 20, 05°15'S, 132°59'E, 769–809 m depth, 25 October 1991.



**Figure 20.** *Amigdoscalpellum costellatum* (Withers, 1935) (MNHN-IU-2019-4922). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** carinal view; **d.** rostral view showing the capitulum and peduncle. Scale bar: 3 mm (a–d).



**Figure 21.** *Amigdoscalpellum tenue* (Hoek, 1883) (MNHN-IU-2019-4921). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** carinal view showing the capitulum and peduncle; **d.** rostral view showing the capitulum and peduncle. Scale bar: 2 mm (a–d).

**Diagnosis.** Capitulum with 13 fully calcified plates; carina slightly bowed, umbo at apex; upper latus trapeziform; inframedian latus small, narrow; carinal latus not projecting beyond carina; peduncle short, cylindrical.

**Description.** Capitulum yellowish, elongate-oval shape; surface with distinct lines of growth. Carina large, simply bowed. Scutum with umbo at apex, slightly recurved, projecting slightly over tergum; tergum triangular, stout,

broad, apex recurved, scutal margin almost straight. Upper latus quadrangular, apex slightly projecting over scutum. Rostral latus quadrangular, scutal and basal margins parallel. Carinal latus quadrangular, carinal margin almost straight. Cirrus I unequal, anterior ramus oval, posterior ramus more slender. Maxillule with notch between two or three stout setae at upper angle, a group of more slender setae on cutting edge; mandible with three teeth excluding inferior angle; labrum with numerous blunt teeth on straight, cutting edge. Measurements of specimen: height of capitulum 7.26 mm, width 3.74 mm, thickness 1.40 mm; length of peduncle 3.00 mm, width 1.99 mm.

**Distribution.** Indian Ocean, Antarctic and Southern (North East of Prince Edward Island); known depth 2,516 m (Shalaeva and Boxshall 2014). In this study, *Amigdoscalpellum tenue* was found at Kei Islands, Indonesia.

**Type locality.** 46°46'S, 45°31'E; depth: 2,475 m; bottom temperature: 1.5 °C; bottom: globigerina ooze (Hoek 1883).

#### Genus *Catherinum* Zevina, 1978

*Acroscalpellum* Hoek, 1907: 85. – Newman and Ross 1971: 42 (part). – Liu and Ren 1985: 202.

*Catherinum* Zevina, 1978b: 1348.

**Diagnosis.** Capitulum with 13 or 14 plates; inframedian latus very narrow, bacilliform, umbo sub-medial; umbo of upper latus apical or sub-apical; carinal latus broad,

umbo sub-basiscarinal, not extending beyond carinal margin; caudal appendages long.

**Type species.** *Scalpellum recurvitergum* Gruvel, 1902; type locality: Atlantic Ocean, SW of Azores.

#### *Catherinum rossi* (Rao & Newman, 1972)

Figure 22

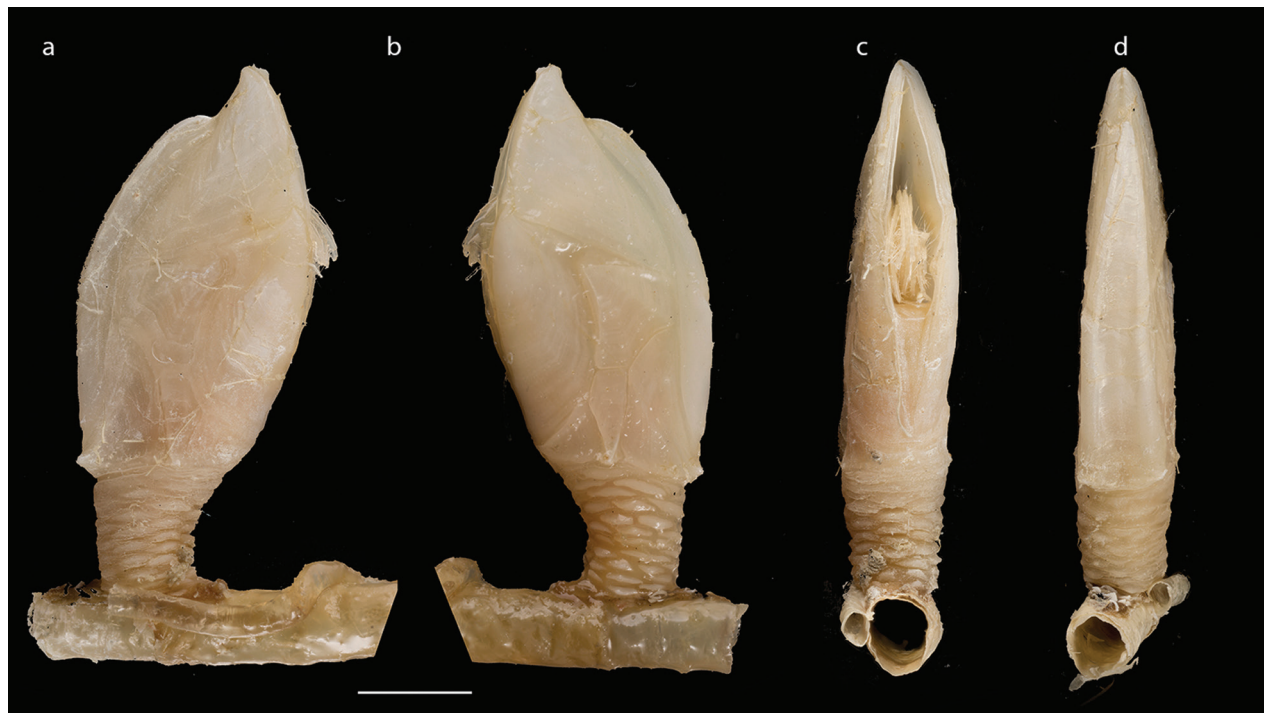
*Acroscalpellum rossi* Lakshmana Rao & Newman, 1972: 82, fig. 7.

*Catherinum rossi*. – Zevina, 1978b: 1348. – Liu and Ren 1985: 203, fig. 12, pl. 2, figs 11–14. – 2007: 250, fig. 108. – Chan et al. 2009b: 113, figs 92–94.

**Material examined.** – Tanimbar Island: 1 specimen, MNHN-IU-2019-4933, Stn. DW 02, 05°47'S, 132°13'E, 209–240 m depth, 22 October 1991.

**Diagnosis.** Capitulum smooth, elongate, 14 fully calcified plates; inframedia latus rectangular, not constricted; rostrum large, ovo-triangular; caudal appendages short.

**Description.** Capitulum long, narrow, sparsely covered with hairs, plates separated by narrow, chitinous interspaces, marked with growth lines. Occludent margin strongly convex; carinal margin irregularly straight; apex slightly retroverted towards carinal side. Carina long, simply bowed; roof flat; parietes well developed towards distal half of plate. Tergum triangular, occludent margin short, convex, scutal and basal margins almost straight,



**Figure 22.** *Catherinum rossi* (Rao & Newman, 1972) (MNHN-IU-2019-4933). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 3 mm (a–d).



carinal margin concave. Scutum with umbo apical, overlapping occludent margin of tergum. Upper latus triangular; carinal latus twice as long as broad; inframedian latus rectangular; rostral latus nearly rectangular in outline; rostrum large, elongate triangular, broad above, pointed below. Cirrus I unequal, anterior ramus oval, posterior ramus more slender; cirrus VI with caudal appendages. Maxillule not notched stout spine along the cutting edge; mandible with three teeth excluding inferior angle. Measurements of specimen: height of capitulum 9.67 mm, width 5.52 mm, thickness 2.58 mm; length of peduncle 2.79 mm, width 2.29 mm.

**Distribution.** East China Sea, Pacific Ocean, Taiwan (Chan et al. 2009b). In this study, *Catherinum rossi* was found at Tanimbar Island, Indonesia.

**Type locality.** Stn. 3, Hess Guyot (17°53.2'N, 174°24.8'W), 1,692–1,735 m depth (Sigsbee beam trawl); Stn. 1, Allison Guyot (18°31.0'N, 179°36.0'W), 1,413–1,645 m depth (otter trawl) (Rao and Newman 1972).

### Genus *Planoscalpellum* Zevina, 1978

*Arcoscalpellum* Hoek, 1907: 85 (part).

*Planoscalpellum* Zevina, 1978b: 1347.

**Diagnosis.** Upper latus with umbo on scutal margin; inframedian latus with umbo apical or sub-basal; carinal latus with umbo on carinal part, may be protruding.

**Type species.** *Scalpellum planum* Hoek, 1883; type locality: 42°42'S, 134°10'E; depth: 4,755 m; bottom temperature: 0.2 °C; bottom: red clay.

### *Planoscalpellum distinctum* (Hoek, 1883)

Figure 23

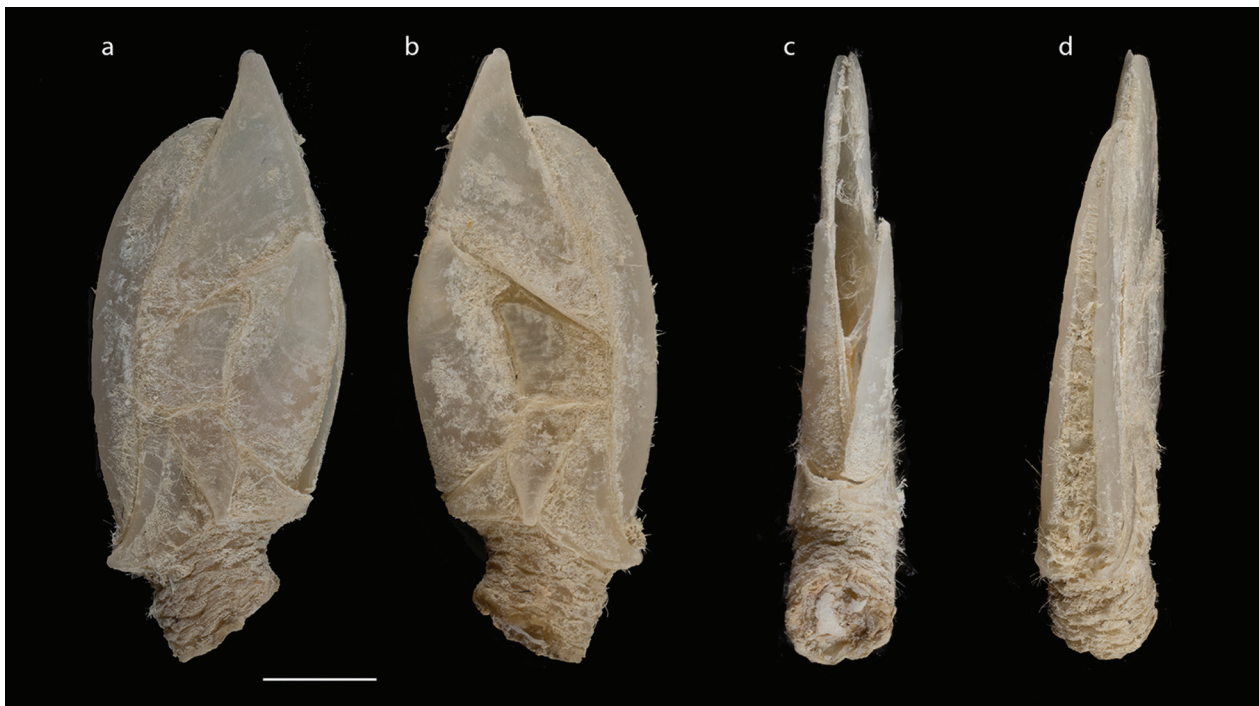
*Scalpellum distinctum* Hoek, 1883: 111–112, pl. VI, figs 10, 11. – 1907: 83, pl. VII, fig. 12 – Nilsson-Cantell 1927: 750, text-fig. 4.

*Planoscalpellum distinctum*. – Zevina, 1981: 186–187. – Foster and Buckeridge 1995 a: 360–361, fig. 7(A–C) – Shalaeva and Boxshall 2014: 36, fig. 22.

**Material examined.** – Tanimbar Island: 2 specimens, MNHN-IU-2019-4928, Stn. DW 49, 08°00'S, 132°59'E, 206–210 m depth, 29 October 1991.

**Diagnosis.** Capitulum with 13 plates separated from each other by distinct chitinous interspaces; scutum almost triangular; upper latus hexagonal, large.

**Description.** Capitulum flattened, elongate-oval shape; plates with distinct growth lines, separated from each other by rather broad chitinous interspaces. Scutum triangular, occludent margin arched, umbo of scutum apical, apex slightly turned upwards. Tergum triangular, occludent margin not very long. Carina simply bowed. Upper latus irregularly hexagonal, rostral latus irregularly quadrangular, infra-median latus in the form of wine-glass, carinal latus irregularly quadrangular. Pe-



**Figure 23.** *Planoscalpellum distinctum* (Hoek, 1883) (MNHN-IU-2019-4928). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 2 mm (a–d).

duncle short, with very small, numerous, calcareous scales. Cirrus I unequal, anterior ramus oval, posterior ramus more slender; cirrus VI with short caudal appendages. Maxillule notched, three stout spines on the upper side; mandible with three teeth, excluding inferior angle. Measurements of two specimens: height of capitulum 6.80–7.90 mm, width 3.68–4.36 mm, thickness 1.24–1.26 mm; length of peduncle 1.39–2.49 mm, width 1.80–2.04 mm.

**Distribution.** Pacific, Western Central; known depth range 1,302 to 2,745 m (Shalaeva and Boxshall 2014). In this study, *Planoscalpellum distinctum* was found at Tanimbar Island, Indonesia.

**Type locality.** 2°33'S, 144°4'E; depth: 1,926 m; bottom temperature: 2.1 °C; bottom: Globigerina ooze (Hoek 1883).

### Genus *Teloscalpellum* Zevina, 1978

*Arcoscalpellum* Hoek, 1907: 85 (sectio, part.). – Newman and Ross 1971: 42 (part.); Section V. – Pilsbry 1907: 47 (part.).  
*Teloscalpellum* Zevina, 1978b: 1350. – Liu and Ren 1985: 212. – 2007: 257.

**Diagnosis.** Capitulum with 13 or 14 plates; carinal lateral umbo at basi-carinal angle, angle not extending beyond carinal margin; inframedian latus triangular or rod-like-shaped, umbo apical or sub-apical; caudal appendage multi-segmented.

**Type species.** *Scalpellum spicatum* Zevina, 1975.

### *Teloscalpellum ecaudatum* (Calman, 1918)

Figure 24

*Scalpellum ecaudatum* Calman, 1918b: 106, text-fig. 2.

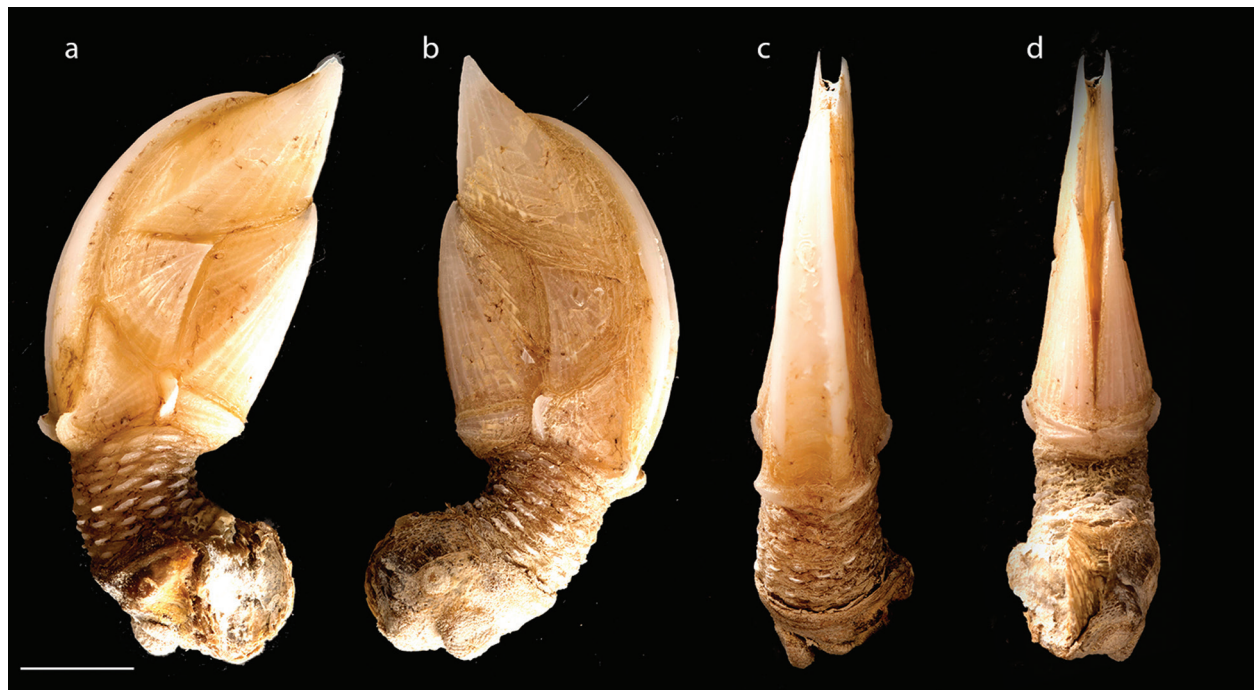
*Teloscalpellum ecaudatum*. – Zevina, 1981: 365, fig. 282. – Chan 2009: 55, figs 1E, 7.

**Material examined.** – Kei Islands: 1 specimen, MNHN-IU-2019-4917, Stn. CP 35, 06°08'S, 132°45'E, 390–502 m depth, 27 October 1991.

– Tanimbar Island: 1 specimen, MNHN-IU-2019-4918, Stn. CP 59, 08°20'S, 132°11'E, 399–405 m depth, 31 October 1991.

**Diagnosis.** Capitulum compressed, elongated; 14 plates, sculptured with radiating ribs; inframedian latus triangular; rostro-lateral plates very low; penis and caudal appendages absent.

**Description.** Capitulum with all plates strongly ribbed, lines of growth marked by fine, inconspicuous striation. Tergum with occludent margin straight, carinal margin convex, but straight concave near apex. Scutum with occludent margin convex, other margins straight, apex slightly overlapping tergum. Carina evenly curved with flat roof bordered by strong ridges; upper latus quadrangular; rostrum small, triangular, overlapped at sides by rostral latera; inframedian latus very narrow. Peduncle shorter than capitulum, covered with strong scales. Cir-



**Figure 24.** *Teloscalpellum ecaudatum* (Calman, 1918) (MNHN-IU-2019-4917). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** carinal view; **d.** rostral view showing the capitulum and peduncle. Scale bar: 5 mm (a–d).

rus I with unequal rami (anterior ramus: 11 segmented, posterior ramus: 13 segmented). Maxilla globular with serrulate setae; maxillule not notched; mandible with three major teeth, lower margin with three to four denticles. Measurements of two specimens: height of capitulum 12.07–18.59 mm, width 6.17–11.47 mm, thickness 2.68–5.41 mm; length of peduncle 6.30–8.33 mm, width 3.21–5.41 mm.

**Distribution.** Java Sea, Indonesia; Philippines (Chan 2009). In this study, *Teloscalpellum ecaudatum* was found at Kei Islands and Tanimbar Island, Indonesia.

**Type locality.** Java Sea; 7°35'S, 114°30'30"E; 132–315 m depth (Calman 1918b).

### Genus *Trianguloscalpellum* Zevina, 1978b

*Arcoscalpellum* Hoek, 1907: 85 (part). – Pilsbry 1907a: 47. – Newman and Ross 1971: 42 (part).

*Trianguloscalpellum* Zevina, 1978b: 1349. – Liu and Ren 1985: 205.

**Diagnosis.** Capitulum of female or hermaphrodite with 13 or 14 completely calcified plates; tergum and scutum with umbones apical; middle latera triangular, sometimes quadrangular, with apical umbo reaching upper latera; carinolatera triangular or subtriangular with apical umbo; caudal appendages distinctly long.

**Type species.** *Scalpellum balanoides* Hoek, 1883: 129, pl. V, fig. 15, pl. X, fig. 11, pl. XI, figs 1–3; type locali-

ty: 5°42'S, 132°25'E; depth: 236 m; bottom: mud; it was found attached to an arm of a *Comatula* or *Pentacrinus*.

### *Trianguloscalpellum balanoides* (Hoek, 1883)

Figure 25

*Scalpellum balanoides* Hoek, 1883: 129, pl. V, fig. 15, pl. X, fig. 11, pl. XI, figs 1–3. – Broch 1922: 242, fig. 10 – Weltner 1922: 63, taf. II, fig. 7, taf. III, fig. 8. – Nilsson-Cantell 1931: 2. – Hiro 1937b: 42, fig. 33.

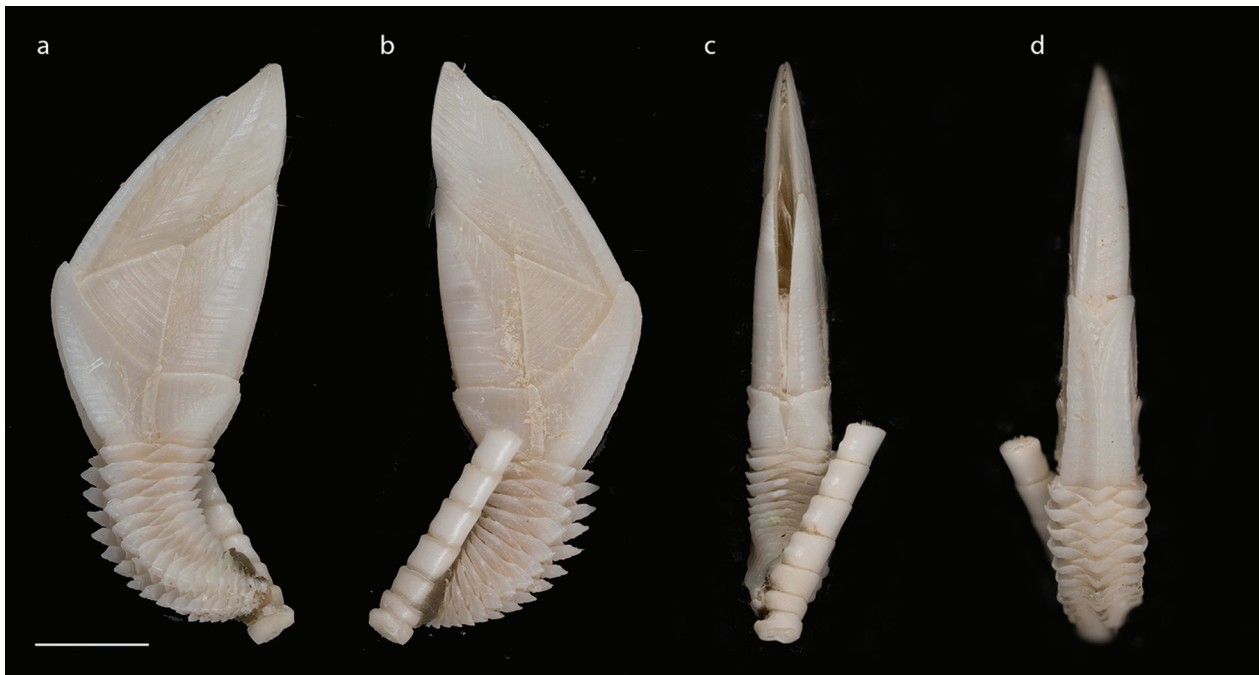
*Scalpellum gonionotum* Pilsbry, 1907b: 360. – Pilsbry 1911: 65, pl. IX, figs 2–4. – Hiro 1937a: 43.

*Trianguloscalpellum balanoides*. – Zevina, 1978b: 1349. – 1981: 294, fig. 221. – Liu and Ren 1985: 210, fig. 16, pl. XI, figs 15–17. – 2007: 256–257, fig. 111. – Rosell 1991: 20–22, fig. 2c, d. – Huang 1994: 517. – 2001: 318. – Jones et al. 2001: 253. – Young 2001: 464, fig. 7. – Jones 2007: 292. – Chan et al. 2009b: 116, figs 95, 96. – Shalaeva and Boxshall 2014: 40, fig. 26.

**Material examined.** – Kei Islands: 1 specimen, MNHN-IU-2019-4923, Stn. CP 16, 05°17'S, 132°50'E, 330–350 m depth, 24 October 1991, attached to crinoid.

– Tanimbar Island: 2 specimens, MNHN-IU-2019-4924, Stn. CP 86, 09°26'S, 131°13'E, 223–225 m depth, 4 November 1991.

**Diagnosis.** Capitulum with 13 fully calcified plates, covered by thin membrane; carina and extremely short, simply bowed without distinct roof; umbo of carina at apex; upper latus triangular; carinal latus almost as high as carina, umbo apical, carinal latus very large, almost similar size to tergum.



**Figure 25.** *Trianguloscalpellum balanoides* (Hoek, 1883) (MNHN-IU-2019-4923). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 2 mm (a–d).

**Description.** Capitulum flat, narrow at base, same breadth as peduncle. Scutum about twice as long as broad; occludent margin almost straight, umbo at apex. Tergum triangular, the same size as scutum. Carina very short, simply, not very strongly, bowed, umbo at apex. Upper latus triangular, carinal margin absent. Rostral latus quadrangular, umbo at apex of angle formed by rostral and scutal margins. Infra-median latus elongate, triangular, umbo apical. Carinal latus very large, convex, umbo at top of carinal margin. Cirrus I unequal, posterior ramus more slender than anterior ramus; cirrus VI with caudal appendages. Maxillule distinctly notched, two stout spines on upper side; mandible with three teeth excluding inferior angle. Measurements of specimen: height of capitulum 8.20 mm, width 4.40 mm, thickness 1.75 mm; length of peduncle 5.06 mm, width 2.10 mm.

**Distribution.** Pacific, Western Central; South and East China Sea; South of Sumatra, Banda Sea, Indonesia; Vietnam; Philippines; Taiwan; South of Japan; attached to crinoids, hydroids; 220–1,097 m depth (Jones et al. 2001; Chan et al. 2009b; Shalaeva and Boxshall 2014). In this study, *Trianguloscapellum balanoides* was found at Kei Islands and Tanimbar Island, Indonesia.

**Type locality.** 5°42'S, 132°25'E; depth: 232 m; bottom: mud; attached to arm of a *Comatula* or *Pentacrinus* (Hoek 1883).

#### *Trianguloscapellum hirsutum* (Hoek, 1883)

Figure 26

*Scapellum hirsutum* Hoek, 1883: 88, pl. IV, fig. 19. – Gruvel 1905: 66, fig. 74. – Pilsbry 1907a: 25.

*Arcoscapellum hirsutum*. – Newman & Ross, 1971: 62–64, fig. 28.

*Trianguloscapellum hirsutum*. – Zevina, 1981: 309, fig. 233. – Chan et al. 2009b: 119–121, figs 100–102. – Chan et al. 2010: 13,

figs 1F, 9A–H. – Jones 2012: 371, 376. – Shalaeva and Boxshall 2014: 44, fig. 29.

**Material examined.** – Tanimbar Island: 1 specimen, MNHN-IU-2019-4908, Stn. CP 91, 08°44'S, 131°05'E, 884–891 m depth, 5 November 1991.

**Diagnosis.** Capitulum with 14 plates covered by membrane, covered by very long hairs; carina simply bowed, umbo at apex, roof flat; upper latus triangular; rostrum very narrow stripe distinctly visible at surface.

**Description.** Capitulum small, long hairs covering plates. Scutum elongate, convex, more than twice as long as broad. Tergum large, elongate rhomboid, umbo at apex. Carina simply bowed, roof flat. Upper latus almost triangular, carinal-basal margin arched. Rostrum small, linear-shaped. Rostral latus quadrangular, basal and scutal margins parallel. Infra-median latus triangular, umbo apical. Carinal latus with irregular shape, umbo near apex. Peduncle short. Cirrus I with rami unequal, anterior ramus oval, posterior ramus more slender; cirrus VI with caudal appendages. Maxillule not notched, two stout spines on upper side; mandible with three teeth excluding inferior angle. Measurements of the specimen: height of capitulum 12.18 mm, width 6.50 mm, thickness 3.74 mm; length of peduncle 4.10 mm, width 3.43 mm.

**Distribution.** Borneo, Indonesia; Pacific, Western Central and Southeast; Australia; Taiwan; Antarctica; attached to gastropod shells, rocks; 1,502–1,965 m depth (Chan et al. 2010; Jones 2012; Shalaeva and Boxshall 2014). In this study, *Trianguloscapellum hirsutum* was found at Tanimbar Island, Indonesia.

**Type locality.** Pacific, Western Central (Moluccas Sea); 0°48'S, 120°58'E; depth: 252 m; bottom temperature: 2.4 °C; bottom: rock (Hoek 1883).



**Figure 26.** *Trianguloscapellum hirsutum* (Hoek, 1883) (MNHN-IU-2019-4908). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** carinal view; **d.** rostral view showing the capitulum and peduncle. Scale bar: 5 mm (a–d).

**Genus *Verum* Zevina, 1978**

*Arcoscalpellum* Pilsbry, 1907: 47 (part). – Newman and Ross 1971: 42 (part).

*Verum* Zevina, 1978b: 1348.

**Diagnosis.** Capitulum of female or hermaphrodite, with 13–14 completely calcified plates; tergum with carinal margin straight or slightly to moderately recurving; scutum with or without short apico-lateral arm, umbo apical; carina with apical or subapical umbo, evenly curved or angularly flexed; upper latera sub-triangular or pentagonal, umbo apical or subapical; middle latera narrow, triangular or quadrangular, umbo basal or sub-basal; carinolatera short, umbo basal to sub-basocarinal, usually not or slightly projecting beyond rim of capitulum; caudal appendages short.

**Type species.** *Scalpellum zenkevichi* Zevina, 1972: 44, fig. 3; type locality: Pacific Ocean, 24°27'S, 70°42'E.

***Verum australicum* (Hoek, 1883)**

Figure 27

*Scalpellum australicum* Hoek, 1883: 118, pl. V, fig. 11. – Weltner 1922: 63. – Nilsson-Cantell 1938: 7.

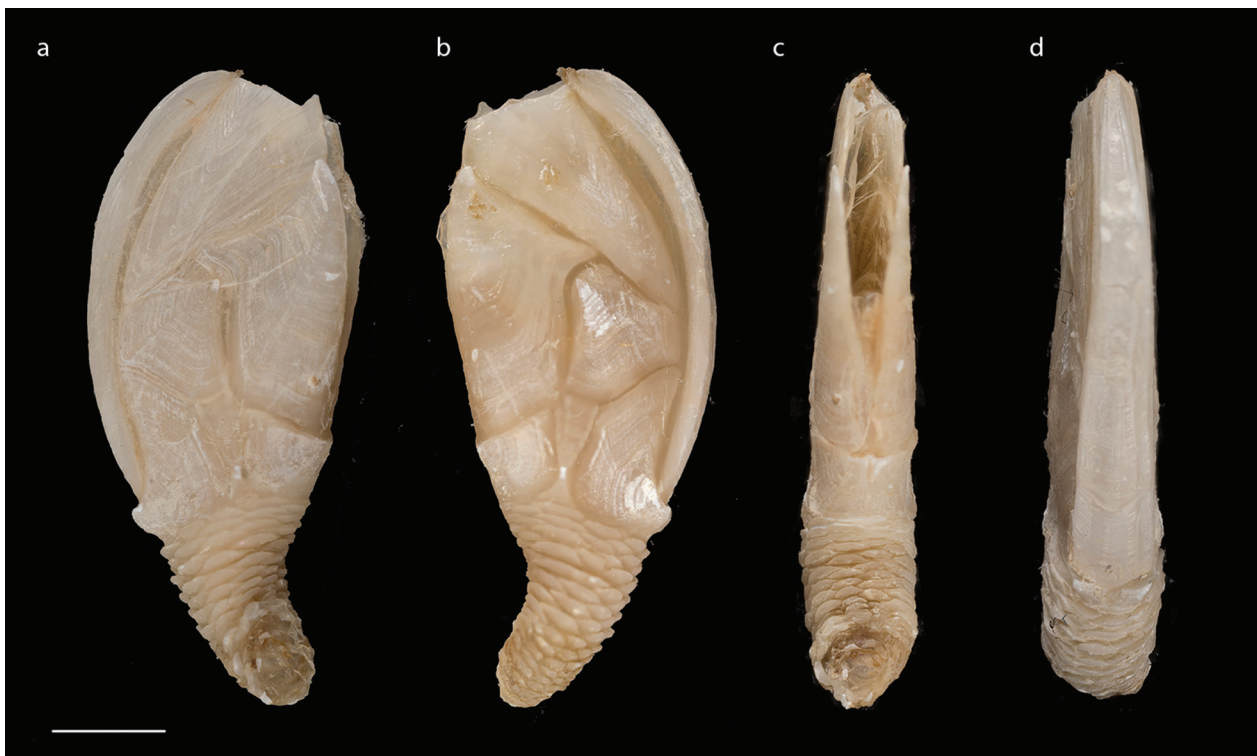
*Verum australicum*. – Zevina, 1981: 223–224, fig. 160. – Jones et al. 1990: 5. – Jones 1992: 156–160, figs 7–8. – Jones 2012: 371, 376. – Shalaeva and Boxshall 2014: 52, fig. 36.

**Material examined.** – Tanimbar Island: 1 specimen, MNHN-IU-2019-4930, Stn. CP 86, 09°26'S, 131°13'E, 223–225 m depth, 4 November 1991.

**Diagnosis.** Capitulum with 13 plates closely locked together, surface smooth with slightly prominent ridges; carina simply bowed with flat roof; upper latus trapeziform; inframedian latus elongate, narrow; carinal latus with umbo projecting beyond carina.

**Description.** Capitulum elongate-oval, flat with distinct ridges and furrow. Scutum slightly convex, umbo apical, occludent margin arched. Tergum triangular, umbo apical, distinctly recurved. Rostral latus irregularly quadrangular; infra median latus narrow, umbo near base; carinal latus quadrangular. Peduncle slightly conical, short, scales near capitulum larger than those near base. Cirrus I unequal, anterior ramus oval, posterior ramus more slender; cirri II to VI very long, rami subequal, segments elongate; cirrus VI with caudal appendages. Maxillule not notched, large spine on upper side, cutting edge almost straight; mandible with three large teeth excluding inferior angle. Measurements of specimen: height of capitulum 10.33 mm, width 6.09 mm, thickness 2.08 mm; length of peduncle 4.62 mm, width 2.24 mm.

**Distribution.** Indian Ocean, Western; Pacific Western Central and Southeast; Zanzibar; known depth range 463–2,561 m (Shalaeva and Boxshall 2014). In this study, *Verum australicum* was found at Tanimbar Island, Indonesia.



**Figure 27.** *Verum australicum* (Hoek, 1883) (MNHN-IU-2019-4930). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 3 mm (a–d).

**Type locality.** between New Guinea and Australia (12°08'S, 145°10'E): Challenger station 184: depth: 2,561 m: bottom temperature: 1.8 °C; substrate grey ooze (Hoek 1883).

***Verum carinatum* (Hoek, 1883)**

Figure 28

*Scalpellum carinatum* Hoek, 1883: 76, pl. III, figs 7, 8. – Pilsbry 1907a: 53, fig. 18. – Gruvel 1920: 20. – Barnard 1925: 3. – Broch 1953: 7. – Weisbord 1977: 243–244, pl. 27, figs 3, 4.

*Scalpellum imperfectum* Pilsbry, 1907a: 75, fig. 30, pl. IV, figs 15–18. – Annandale 1913: 233. – Barnard 1924: 47. – MacDonald 1929: 537. – Broch 1953: 9. – Stubbings 1961: 11, text-fig. 2. – 1967: 234.

*Meroscalpellum imperfectum*. – Newman & Ross, 1971: 119, text-fig. 62.

*Verum carinatum*. – Zevina, 1981: 225–226, fig. 163. – Shalaeva and Boxshall 2014: 53, fig. 37.

**Material examined.** – Kei Islands: 1 specimen, MNHN-IU-2019-4920, Stn. DW 18, 05°18'S, 133°01'E, 205–212 m depth, 24 October 1991.

**Diagnosis.** Capitulum with 14 plates separated by chitinous interspaces, surface smooth; carina bowed, angularly bent, with flat roof; upper latus irregular pentagonal; inframedian latus large, wine-glass-shaped.

**Description.** Capitulum elongate, plates covered by thin, chitinous membrane. Scutum elongated, apex pointed, occludent margin very convex. Tergum flat, triangular, apex very recurved, occludent margin very arched. Carina with umbo at top of flat roof. Upper

latus flat, irregular pentagonal; rostrum narrow, elongated; rostral lateral convex with rostral margin short; inframedian latus wine-glass-shaped; carinal latus flat, large. Peduncle short, calcareous scales distinct. Cirrus I unequal, anterior ramus broader than posterior ramus; cirri II to VI long, rami equal; cirrus VI with caudal appendages. Maxillule not notched, two large spines on upper side, cutting edge almost straight; mandible with three large teeth excluding inferior angle. Measurements of specimen: height of capitulum 9.14 mm, width 4.53 mm, thickness 1.74 mm; length of peduncle 2.54 mm and width 2.20 mm.

**Distribution.** Atlantic, excluding polar areas; Pacific, Southeast. Known depth range 600 to 2,400 m (Shalaeva and Boxshall 2014). In this study, *Verum carinatum* was found at Kei Islands, Indonesia.

**Type locality.** Station 135, near the Island of Tristan da Cunha; depth: 1,800 m; bottom: rock, shells (Hoek 1883).

***Verum novaezelandiae* (Hoek, 1883)**

Figure 29

*Scalpellum novae-zelandiae* Hoek, 1883: 124, pl. V, figs 7, 8. – 1907: 100, pl. VIII, figs 4, 4a; 1913: 14. – Weltner 1897: 249. – 1922: 71. – Annandale 1905: 83. – 1906b: 389. – 1908: pl. 5, fig. 7. – 1913: 231. – Broch 1927a: 540, fig. 512.

*Scalpellum Novae-Zelandiae*. – Gruvel, 1905: 88, fig. 99.

*Scalpellum (Scalpellum) novae-zelandiae*. – Calman, 1918b: 123.

*Arcoscalpellum novaezelandiae*. – Foster, 1978: 65, pl. 8D, fig. 39.



**Figure 28.** *Verum carinatum* (Hoek, 1883) (MNHN-IU-2019-4920). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** rostral view showing the capitulum and peduncle; **d.** carinal view. Scale bar: 3 mm (a–d).



**Figure 29.** *Verum novaezelandiae* (Hoek, 1883) (MNHN-IU-2019-4919). **a.** left lateral view showing the capitulum and peduncle; **b.** right lateral view showing the capitulum and peduncle; **c.** carinal view; **d.** rostral view showing the capitulum and peduncle. Scale bar: 3 mm (**a–d**).

*non Scalpellum Novae-Zelandiae.* – Gruvel, 1902: 54, pl. 2, figs 12, 13, 15. – Gruvel 1912: 346 (= *V. parazelandiae* Young, 1998b).

*Verum novaezelandiae.* – Zevina, 1978b: 1348. – Zevina 1981: 228, fig. 165. – Chan et al. 2009b: 17, figs 1I, 12A–H, 13A–D. – Chan et al. 2010: 17, figs 11–13. – Shalaeva and Boxshall 2014: 53, fig. 39.

**Material examined.** – Tanimbar Island: 1 specimen, MNHN-IU-2019-4919, Stn. CP 87, 08°47'S, 130°49'E, 1017–1024 m depth, 5 November 1991.

**Diagnosis.** Capitulum with 13 plates covered by very thin, chitinous membrane; carina simply bowed, flat roof with umbo apical; upper latus quadrangular or rather pentagonal, lower edge being truncated; inframedian latus elongate, quadrangular; carinal latus large, elongate, umbo near base; peduncle short.

**Description.** Capitulum flatted, elongate, plates separated by narrow, chitinous interspaces. Scutum quadrangular, umbo apical, occludent margin arched. Tergum triangular with umbo slightly produced apex. Carina with bowed, flat roof, increasing little in width from upper to lower. Upper latus irregularly trapeziform; rostral latus with umbo at top of rostral margin; infra-median latus irregular, quadrangular, elongate, narrow; carina latus quadrangular. Cirrus I unequal, anterior ramus broader than posterior ramus; cirrus VI with short caudal appendages. Maxillule slightly notched, two large spines on upper side; mandible with three large teeth excluding inferior angle; labrum slightly convex, with numerous teeth. Measurements of specimen: height of capitulum

13.46 mm, width 6.98 mm, thickness 2.99 mm; length of peduncle 6.02 mm, width 3.23 mm.

**Distribution.** Indo-west Pacific: Eastern Africa, Gulf of Aden, eastwards to New Zealand; Philippines; Taiwan; attached to sunken wood, gorgonians, glassy spicule of hexactinellid sponges; 822–4850 m depth (Shalaeva and Boxshall 2014; Jones and Hosie 2016). In this study, *Verum novaezelandiae* was found at Tanimbar Island, Indonesia.

**Type locality.** 37°34'S, 179°22'E; depth: 1,260 m; bottom temperature: 4.2 °C; bottom: grey ooze (Hoek 1883).

## Order SESSILIA Lamarck, 1818

### Suborder VERRUCOMORPHA, Pilsbry 1916

Verrucomorpha Pilsbry, 1916: 14. – Newman et al. 1969: 281. – Newman and Ross 1971: 135. – Newman 1987: 8. – 1996: 501. – Buckeridge 1994: 89. – Young 1998: 74.

**Diagnosis.** Shell asymmetrical with four plates (carina, rostrum, tergum and scutum), base membranous or calcareous.

### Family VERRUCIDAE Darwin, 1854

Verrucidae Darwin, 1854: 495. – Gruvel 1905: 169. – Withers 1935: 323. – Newman et al. 1969: 281. – Newman and Ross 1971: 135. – Buckeridge 1994: 89. – Young 1998: 74.

**Diagnosis.** Scutum and tergum without depressor muscles; movable only on one side; other side immovable, united with rostrum and carina.

### Genus *Alteriverruca* Pilsbry, 1916

*Verruca* Section D *Altiverruca* Pilsbry, 1916: 40.

*Altiverruca* Pilsbry, 1916: 40 – Newman et al. 1969: 282. – Newman and Ross 1971: 135. – Ren 1984b: 172. – Buckeridge 1994: 92. – Young 1998: 77.

**Diagnosis.** Verrucids with erect form; bases of plates not inflected. Operculum close to vertical, myophore absent.

**Type species.** *Verruca hoeki* Pilsbry, 1907.

### *Altiverruca navicula* (Hoek, 1913)

Figure 30

*Verruca navicula* Hoek, 1913: 134, figs 4–6. – Nilsson-Cantell 1927: 778, figs a–f.

*Altiverruca navicula*. – Buckeridge 1994: 100, fig. 5. – Chan et al. 2009b: 280, figs 245–247. – Chan et al. 2010: 29, figs 2E, 21, 22.

**Material examined.** – Tanimbar Island: 3 specimens, MNHN-IU-2019-4941, Stn. CP 91, 08°44'S, 131°05'E, 884–891 m depth, 5 November 1991, attached to peduncle of *Alcockianum persona* (Annandale, 1916).

**Diagnosis.** Shell not depressed; carina and rostrum interlocking with single rib from each plate; movable plates large, scutum with four articular ribs, tergum with six articular ribs, growth lines very distinct; caudal appendages long.

**Description.** Shell yellowish. Movable scutum elongately triangular, apex distinctly beaked, projecting freely; sur-

face with numerous articular ridges. Movable tergum large, quadrangular; surface with strongly developed, curved axial articular ridge. Carina and rostrum irregular quadrangular, with carina higher, rostrum broader. Fixed tergum with two parts: (1) triangular portion very narrow at apex, slightly broader in its inferior (2) flat and broad part at a rear portion of shell. Fixed scutum pointed with distinctly beaked apex; composed of broader, nearly flat, triangular portion and narrower inflected portion, only widening towards its inferior. Base of shell elongatedly oval-shaped. Cirrus I with rami very unequal (anterior ramus: 12-segmented, posterior ramus: 28-segmented); cirrus VI with caudal appendages. Maxilla bilobed, fringed with setae, except on the notch; maxillule widely notched, horizontally elongated, two large spines above notch, numerous dense setae at notch; mandible with three teeth excluding inferior angle; labrum slightly concave, conical teeth on cutting margin.

**Distribution.** Pacific Ocean (Chan et al. 2010). In this study, *Altiverruca navicula* was found at Tanimbar Island, Indonesia.

**Type locality.** (1) 9°3.4'S, 119°56.7'E; depth 959 m; bottom: globigerina ooze. (2) 3°37.7'S, 131°26.4'E; depth 924 m; bottom: fine grey mud (Hoek 1913).

### Genus *Newmaniverruca* Young, 1998

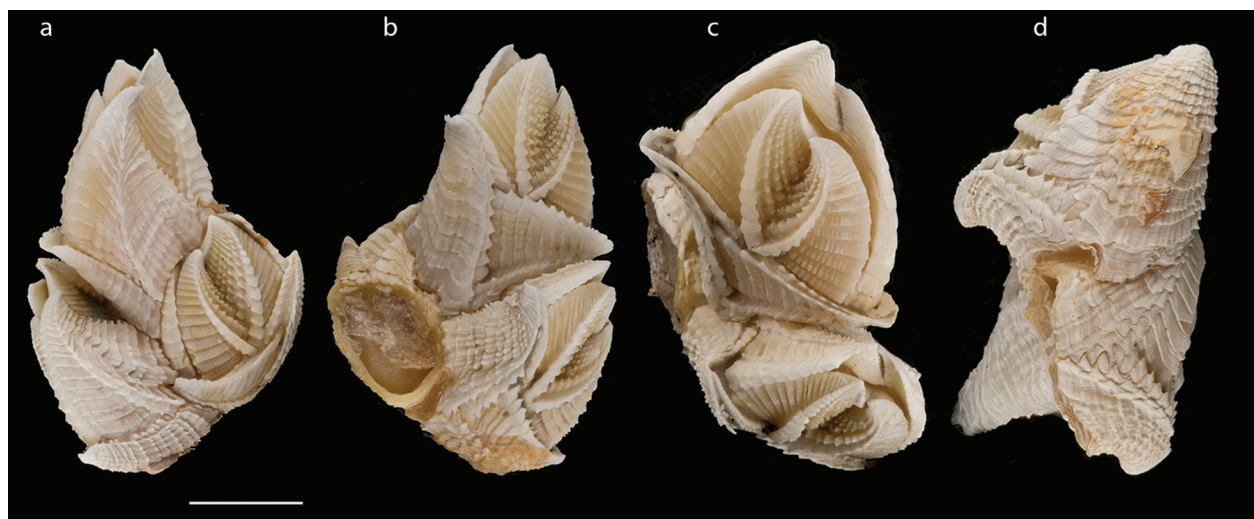
*Verruca* Section B: *Verruca*, Group of *Verruca alba* Pilsbry, 1916: 25 (part.).

*Verruca* Section B: *Verruca*, Group of *Verruca calotheca* Pilsbry, 1916: 30 (part.).

*Verruca* (*Verruca*): Foster, 1979: 68 (part.). – Zevina 1987: 1812 (part. – Buckeridge 1994: 90 (part.).

*Newmaniverruca* Young, 1998: 77.

**Diagnosis.** Shell with four plates (carina, rostrum, scutum and tergum); operculum parallel to base.



**Figure 30.** *Altiverruca navicula* (Hoek, 1913) (MNHN-IU-2019-4941). **a.** left lateral view; **b.** right lateral view; **c.** upper lateral view; **d.** lower lateral view. Scale bar: 7 mm (**a–d**).



**Type species.** *Verruca albatrossiana* Pilsbry, 1912: 292. – 1916: 47; type locality: East of Luzon, Philippines.

***Newmaniverruca albatrossiana* (Pilsbry, 1912)**

Figure 31

*Verruca albatrossiana* Pilsbry, 1912: 292. – 1916: 47. – Buckeridge 1994: 91, fig. 1a–f. – Buckeridge 1997: 129.

*Verruca grex* Hoek, 1913: 142, pl. XI, figs 7–13, pl. XIII, figs 11–13.

*Verruca (Euverruca) albatrossiana*. – Broch, 1931: 45.

*Verruca (Verruca) albatrossiana*. – Ren, 1984: 168, fig. 2, pl. 1 (7–11).

*Newmaniverruca albatrossiana*. – Young, 1998: 77. – Chan 2009: 74, figs 2G, 22A–I.

**Material examined.** – Kei Islands: 1 specimen, MNHN-IU-2019-4942, Stn. CC 21, 05°14'S, 133°00'E, 688–694 m depth, 25 October 1991, attached to glass rope sponge.

**Diagnosis.** Rostrum and fixed scutum with unusual length; rostrum low, fixed scutum larger than fixed tergum.

**Description.** Movable plates parallel to base, wall of parietal vertically ribbed; fixed scutum without internal pit. Movable scutum with crescentic ridge and longitudinal striations; movable tergum with articular ribs and diagonal rib. Apices of fixed scutum and tergum contiguous. Carina occupying carino-rostral wall, apices marginal. Cirrus I with rami unequal and serrulate setae; cirrus VI with caudal appendages. Maxilla globular, with fringing setae; maxillule notched, two large setae on upper side; mandible with three teeth excluding inferior angle.

**Distribution.** Indo-west Pacific: NW Australia; South China Sea; China; Philippines; attached to cidaroid spines (e.g. *Stereocidaris indica philippinensis* Mortensen, 1928), 345–620 m depth (Jones and Hosie 2016). In this study, *Newmaniverruca albatrossiana* was found at Kei Islands, Indonesia.

**Type locality.** East of Luzon, Philippines (Pilsbry 1912).

**Suborder BALANOMORPHA Pilsbry, 1916**

Operculata tribe Symetrica Gruvel, 1905: 189.

Balanomorpha Pilsbry, 1916: 47 (Balanidae *sensu* Darwin, 1854).

**Diagnosis.** Peduncle absent; shells bilaterally symmetrical on either side of rostrocarinal axis; shell with parietal plates of carina, rostrum and one to three pairs of lateral plates, all separate from one another, variously fused or totally concrescent; base membranous or calcareous; hermaphroditic or with dwarf males.

**Family BATHYLASMATIDAE Newman & Ross, 1971**

Bathylasmatidae Newman & Ross, 1971: 138 (part.). – Newman and Ross 1976: 37, 45 (part.).

Bathylasmatinae Newman & Ross, 1976: 37, 45. – Buckeridge 1983: 68. – Newman 1996: 502. – Buckeridge 1999: 522. – Jones 2000: 231, tables 1, 2.

**Diagnosis.** Shell with four or six plates; wall solid or permeated by single row of chitin-filled longitudinal canals; radii absent; one or both rami of cirri I and cirri II sometimes antenniform; labrum without notch in crest.

**Subfamily HEXELASMINAE Newman & Ross, 1976**

Hexelasminae Newman & Ross, 1976: 37, 46.

**Diagnosis.** Shell with six plates, infiltrated by chitin-filled tubes; basis calcareous; scuta parallel to basis; tergum with distinct spur; cirrus II resembling cirrus I more than cirrus III.

**Type genus.** *Hexalasma* Hoek, 1913.



**Figure 31.** *Newmaniverruca albatrossiana* (Pilsbry, 1912) (MNHN-IU-2019-4942). **a.** left lateral view; **b.** right lateral view; **c.** upper lateral view; **d.** lower lateral view. Scale bar: 3 mm (a–d).

### Genus *Hexelasma* Hoek, 1913

*Hexelasma* Hoek, 1913: 244 (part.). – Utinomi 1965: 13. – Jones 2000: 240, figs 51, 64, tables 28–30.

*Aptolasma* Newman & Ross, 1971: 158.

**Diagnosis.** Parietes solid; radii absent; plates with a carina, paired carinolatera and latera and a rostrum without any sign of fusion; caudal appendages absent.

**Type species.** *Hexelasma velutinum* Hoek, 1913: 246 (part.); type locality: Indonesia, 6°08'S, 121°19'E (Siboga Station 105).

### *Hexelasma arafurae* Hoek, 1913

Figure 32

*Hexelasma arafurae* Hoek, 1913: 251, pl. 25, figs 12–16. – Utinomi 1965: 11. – Newman and Ross 1971: 155. – 1976: 46. – Foster 1981: fig. 6F–H. – Jones 2000: 246, fig. 51, tables 28–31.

*Aptolasma arafura*. – Foster, 1978: 79.

**Material examined.** – Kei Islands: 2 specimens, MNHN-IU-2019-4851, Stn. DW 18, 05°18'S, 133°01'E, 205–212 m depth, 24 October 1991.

**Diagnosis.** Shell with very wide orifice; alae broadly-triangular with summits oblique; scutum folded longitudinally, articular ridge slightly prominent, deep pit for adductor muscle; tergum beaked, with prominent articular ridge, spur very broadly rounded; inner side of scutum and tergum orange-coloured.

**Description.** Shell yellowish, conical, with six plates. Orifice diamond-shaped; scutum triangular elongated with protruding growth-ridges; tergum smaller than scutum,

apex beaked, carinal margin rounded, growth-ridges less distinct than on scutum. Cirrus I with unequal rami (anterior ramus: 8-segmented; posterior ramus: 12-segmented), dense long setae on surface areas. Cirrus II with equal rami, dense long setae. Cirri IV–VI with equal rami with numerous segments; segments almost without exception furnished with two pairs very long, stiff, needle-like spines along inner faces. Measurements of specimen: basal length of shell 14.32 mm, orifice length 8.00 mm, carinal height 12.39 mm, orifice width 6.49 mm, basal width 13.76 mm.

**Distribution.** Arafura Sea, Indonesia; 205–560 m depth (Jones and Hosie 2016). In this study, *Hexelasma arafurae* was found at Kei Islands, Indonesia.

**Type locality.** Indonesia; Siboga stat. 262; 5°54'S, 132°49'E; 560 m depth; bottom: solid bluish-grey mud (Hoek 1913).

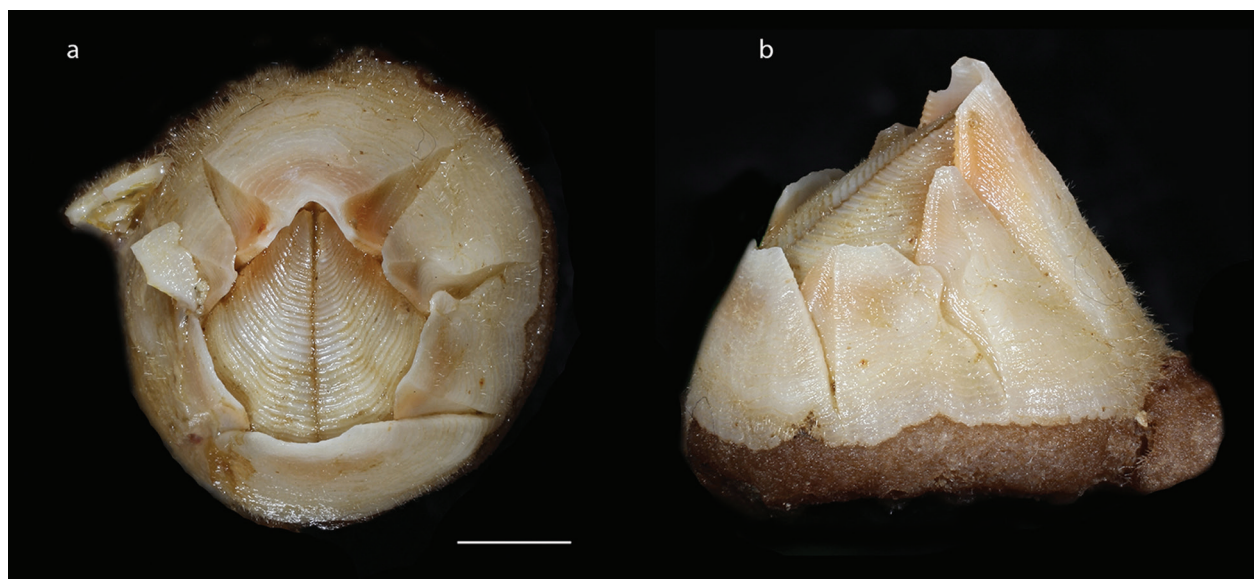
### Superfamily BALANOIDEA Leach, 1817

Balanidae Leach, 1817: 68 – Pilsbry 1916: 48 – Newman et al. 1969: 284 – Newman and Ross 1976: 38, 49 – Newman 1993: 408.

Balaninae – Darwin, 1854: 175.

Balanoidea – Newman, 1996: 502.

**Diagnosis.** Shell wall composed of four or six plates (rostrum, carina and one to three pairs of laterals); parietes solid or tubiferous, when tubiferous rarely secondarily filled; radii solid or tubiferous. Basis commonly calcareous, solid or permeated by tubes, rarely membranous; when basis calcareous, internal surfaces of compartments commonly with uniform ribs; when calcareous commonly forming complex interdigitations with wall. Opercular plates occlude aperture; articulations between the pairs generally shallow or fused. Cirrus I with rami subequal or grossly unequal; cirri II



**Figure 32.** *Hexelasma arafurae* Hoek, 1913 (MNHN-IU-2019-4851). **a.** view from above; **b.** right lateral view. Scale bar: 4 mm (**a, b**).

and III with rami never antenniform; cirrus III resembling II more than IV; caudal appendages absent; penis with basidorsal point. Labrum thin, never bullate; crest with pronounced medial incision; mandible quadri- or quinquentoid; second and following teeth with one or more subsidiary cusps; fifth tooth often vestigial; inferior angle commonly molariform.

### Family ARCHAEOBALANIDAE Newman & Ross, 1976

Archaeobalanidae Newman & Ross, 1976: 38, 49.

**Diagnosis.** Shell with four or six plates; parietes solid, rarely tubiferous; tubes uniformly or irregularly arranged; radii solid; basis commonly calcareous, rarely tubiferous.

### Subfamily ARCHAEOBALANINAE Newman & Ross, 1976

Archaeobalaninae Newman & Ross, 1976: 38, 49.

**Diagnosis.** Shell with four or six plates; parietes solid or tubiferous; when tubiferous, tubes uniformly arranged in single row; interlaminar figures simple; basis calcareous or membranous, when membranous wall solid.

**Type genus.** *Archaeobalanus* Menesini, 1971: 19.

### Genus *Conopea* Say, 1822

*Conopea* Say, 1822: 323.

*Conoplea* Gray, 1825: 98, 103.

*Balaninus* Costa, 1839: 181.

*Balanus* Section B Darwin, 1854: 216.

*Patella-Balanus* Hoek, 1913: 160, 162, 221.

**Diagnosis.** Shell firm, strong, with six thick compartments; parietes with or without pores; radii solid with summits parallel to basal margin of parietes and denticulated sutural margins; basis calcareous, elongated along carino-rostral axis, boat-shaped; orifice smooth, not dentated; scutum with simple growth ridges; penis with basidorsal point; attached to gorgonians or antipatharians.

**Type species.** *Conopea elongata* Say, 1822; type locality: eastern Florida, USA.

### *Conopea cymbiformis* (Darwin, 1854)

Figure 33

*Balanus cymbiformis* Darwin, 1854: 221, pl. 3, fig. 5a, b. – Broch 1931: 85, fig. 29a, b. – Nilsson-Cantell 1938: 55, pl. 2, fig. 3. – Utinomi 1962: 219, fig. 2. – Dong et al. 1982: 103.

*Balanus proripiens* Hoek, 1913: 228, pl. 24, figs 1–3, pl. 24, figs 1–3. – Nilsson-Cantell 1921: 331, fig. 70c, d.

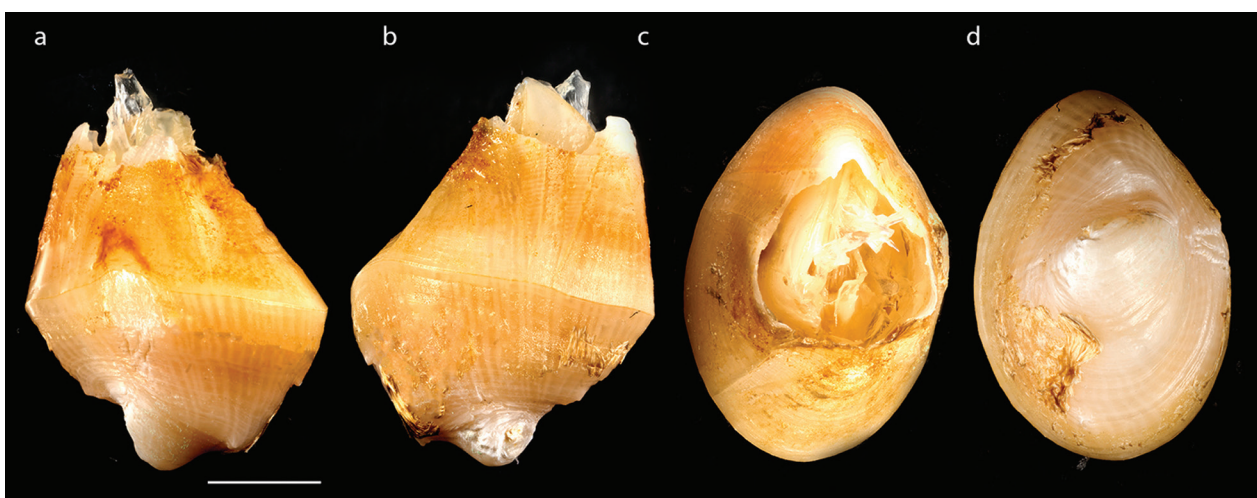
*Pyrgoma jedani* Hoek, 1913: 262, pl. 27, figs 3–8.

*Conopea cymbiformis*. – Newman & Ross, 1976: 55.

**Material examined.** – Kei Islands: 9 specimens, MNHN-IU-2019-4823, Stn. DW 30, 05°39'S, 132°56'E, 111–118 m depth, 26 October 1991; 1 specimen, MNHN-IU-2019-4824, Stn. DW 22, 05°22'S, 133°01'E, 82 m depth, 25 October 1991.

**Diagnosis.** Shell irregularly conical; orifice oval with swollen border; basis irregularly cup-formed; scutum and tergum triangular, not calcified together; spur of tergum feebly developed.

**Description.** Shell yellowish with orange rust-brown in proximal areas. Carina, carinolatera and latera with pale orange-brown and rust red-brown longitudinal stripes, latter may have oblique white spots. Radii with pale orange-brown and rust red-brown horizontal striation. Oper-



**Figure 33.** *Conopea cymbiformis* (Darwin, 1854) (MNHN-IU-2019-4823). **a.** left lateral view; **b.** right lateral view; **c.** view from above; **d.** basal view. Scale bar: 3 mm (a–d).

cular plates with scutum pink-brown, transparent; tergum transparent white. Shell may appear longer and lower, due to elongation of carina and rostrum or low and comparatively shorter, due to development of rostrum alone or more upright and comparatively higher, with neither carina nor rostrum elongated. Cirrus I with unequal rami (anterior ramus: 7-segmented; posterior ramus: 12-segmented). Cirri II–VI with equal rami, numerous segments. Penis very long, delicate hairs scattered over surface, a few more disposed near tip. Labrum deeply notched, two small teeth on each side of notch. Mandibles with five teeth, inferior angle not distinctly separated from fifth; distance between tips of first and second teeth slightly more than that between those of second and third teeth; third tooth larger; fourth and fifth smaller than others. Maxillule with straight edge and numerous large setae. Measurements of specimen: basal length of shell 7.73 mm, orifice length 4.60 mm, carinal height 8.70 mm, orifice width 3.88 mm, basal width 4.94 mm.

**Distribution.** Indo-west Pacific: Indian Ocean; Gulf of Aden, India, east to Fiji and NW to Indonesia, N Australia, Malay Arch.; China; Philippines; S Japan; Fiji Is; attached to coenosarc of gorgonians or antipatharians; littoral–453 m depth (Jones and Hosie 2016). In this study, *Conopea cymbiformis* was found at Kei Islands, Indonesia.

**Type locality.** Near Madras, India; attached to a gorgonian (Darwin 1854).

#### *Conopea navicula* (Darwin, 1854)

Figure 34

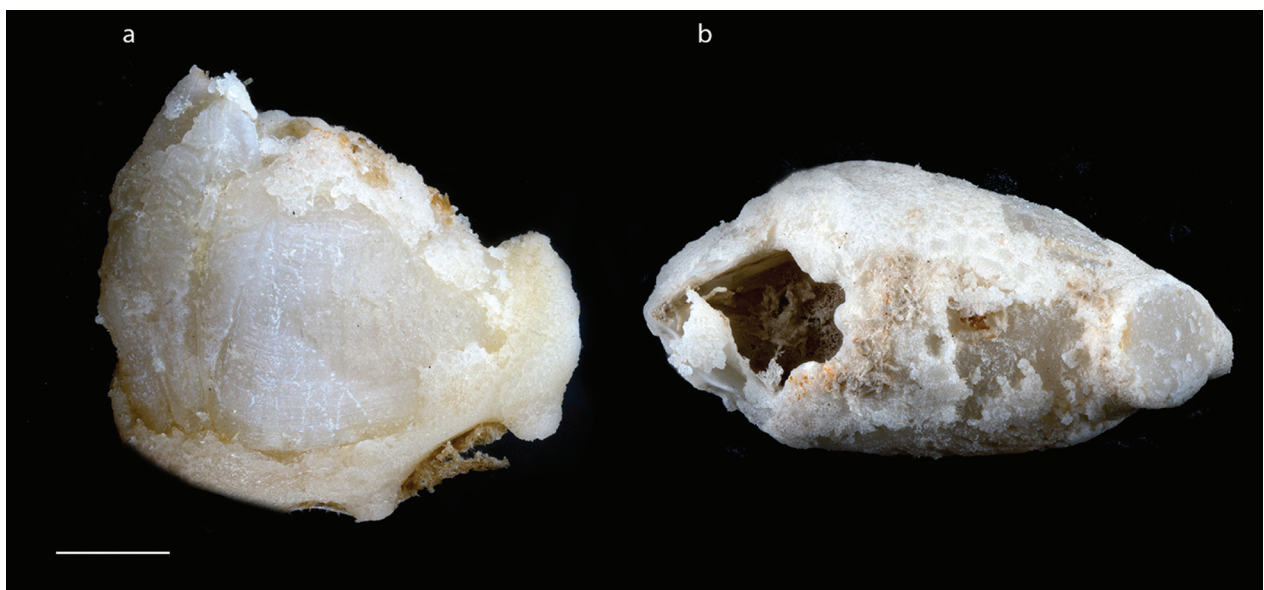
*Balanus navicula* Darwin, 1854: 221, pl. 3, fig. 6a–d. – Hoek 1913: 223, pl. 22, fig. 26, pl. 23, figs 1–3. – Stubbings 1936: 48. – Utinomi 1962: 74, fig 1. – Dong et al. 1982: 103.  
*Acasta spinitergum* Foster, 1982: 209, fig. 4d.

*Conopea navicula*. – Newman & Ross, 1976: 55.

**Material examined.** – Tanimbar Island: 12 specimens, MNHN-IU-2019-4821, Stn. CP 82, 09°32'S, 131°02'E, 215–219 m depth, 4 November 1991 attached to gorgonian; 4 specimens, MNHN-IU-2019-4822, Stn. DW 49, 08°00'S, 132°59'E, 206–210 m depth, 29 October 1991, attached to gorgonian.

**Diagnosis.** Shell with parietes and basis not porose; carino-lateral compartments very narrow, almost same width from top to bottom; radii with smooth sutural edges; scutum externally striated longitudinally.

**Description.** Specimens covered with coenosarc of coral, except orifice. Easily recognisable species due to narrow carino-lateral plate, which is nearly same width at top as bottom; scutum externally longitudinally striated; parietal plates studded with calcareous points. Parietal plates pearly white, solid, superficially appearing to possess longitudinal tubes, growth lines horizontal. Alae moderately developed. Basis calcareous. Size small. Rostrum well developed, concave, lying at angle of ~ 45°. Laterals very well developed. Carino lateral parietes thin, radii and alae well developed. Carina tall, about half width of rostrum. External surfaces of all parietes with very small, calcareous studs, regularly spaced, arranged along horizontal growth lines. Opercular plates sunk down into orifice. Cirrus I with unequal rami (anterior ramus: 5-segmented; posterior ramus: 7-segmented). Cirrus II with unequal rami (anterior ramus: 6-segmented; posterior ramus: 9-segmented). Cirri III–VI with subequal rami more slender, longer, with segments more elongate. Penis very long, tapering towards tip, bearing few, very minute hairs. Maxillule with straight edge with numerous large setae. Mandibles with five teeth and inferior angle. Measurements of four specimens: basal length of



**Figure 34.** *Conopea navicula* (Darwin, 1854) (MNHN-IU-2019-4822). **a.** left lateral view; **b.** orifice view. Scale bar: 1 mm (**a, b**).

shell 2.23–4.22 mm, orifice length 1.09–2.02 mm, carinal height 2.04–3.09 mm, orifice width 0.94–1.59 mm, basal width 1.79–2.80 mm.

**Distribution.** Indo-west Pacific, from Gulfs of Aden and Persia, India, Malaysia, Indonesia, Gulf of Siam, to southern Japan; 45–220 m depth (Jones and Hosie 2016). In this study, *Conopea navicula* was found at Tanimbar Island, Indonesia.

**Type locality.** Madras, India; attached to gorgonian (Darwin 1854).

### Genus *Solidobalanus* Hoek, 1913

*Solido-Balanus* Hoek, 1913: 159, 192.

*Balanus (Solidobalanus)*. – Pilsbry, 1916: 220.

*Solidobalanus*. – Newman & Ross, 1976: 23, 50.

**Diagnosis.** Shell parietes solid, six plates; radii solid, well developed, with denticulate sutural edges; basis calcareous, solid; complementary male, when present, in pit of rostral plate of hermaphrodite.

**Type species.** *Balanus auricoma* Hoek, 1913: 198, pl. XVIII, figs 20–22, pl. XIX, figs 1–7; type locality: Ternate, Indonesia (Siboga station 136).

### Subgenus *Solidobalanus* Hoek, 1913

*Solido-Balanus* Hoek, 1913: 159, 192.

*Balanus (Solidobalanus)*. – Pilsbry, 1916: 220.

*Solidobalanus*. – Newman & Ross, 1976: 23, 50.

**Diagnosis.** Parietes and radii rather thick, smooth, without pores; basis flat, calcareous; rostrum not very elongated; radii with strongly septate sutural edges; tergal spur narrow; crests for lateral depressor muscles of scutum absent; adductor ridge weak or absent; tergum flat or with

shallow furrow without infolded sides; conspicuous teeth on anterior margins of fourth cirri absent.

**Type species.** *Balanus auricoma* Hoek, 1913: 198, pl. XVIII, figs 20–22, pl. XIX, figs 1–7; type locality: Ternate, Indonesia (Siboga station 136).

### *Solidobalanus auricoma* (Hoek, 1913)

Figure 35

*Balanus (Solidobalanus) auricoma* Hoek, 1913: 198, pl. XVIII, figs 20–22, pl. XIX, figs 1–7. – Broch 1922: 323, fig. 62. – 1931: 71. – Foster 1978: 100, fig. 60. – Rosell 1981: 303.

*Solidobalanus (Solidobalanus) auricoma*. – Newman & Ross, 1976: 50.

*Solidobalanus auricoma*. – Foster, 1981: 364, fig. 2G. – Rosell 1991: 38.

**Material examined.** – Tanimbar Island: 2 specimens, MNHN-IU-2019-4842, Stn. CP 45, 07°54'S, 132°47'E, 302–305 m depth, 29 October 1991, shell only; 10 specimens, MNHN-IU-2019-4841, Stn. DW 49, 08°00'S, 132°59'E, 206–210 m depth, 29 October 1991, attached to sea urchin spines; 1 specimen, MNHN-IU-2019-4838, Stn. CP 82, 09°32'S, 131°02'E, 215–219 m depth, 4 November 1991, attached to antipatharian; 7 specimens, MNHN-IU-2019-4847, Stn. CP 85, 09°22'S, 131°14'E, 240–245 m depth, 4 November 1991, attached to spines of sea urchin; 63 specimens, MNHN-IU-2019-4850, Stn. CP 86, 09°26'S, 131°13'E, 223–225 m depth, 4 November 1991, attached to spines of sea-urchins.

– Kei Islands: 1 specimen, MNHN-IU-2019-4849, Stn. CP 05, 05°49'S, 132°18'E, 296–299 m depth, 22 October 1991, attached to lateral plate of *Chirona tenuis*; 1 specimen, MNHN-IU-2019-4844, Stn. CP 12, 05°23'S, 132°37'E, 413–436 m depth, 23 October 1991, attached to antipatharian; 6 specimens, MNHN-IU-2019-4848, Stn. CP 16, 05°17'S, 132°50'E, 330–350 m depth, 24 October 1991, attached to dead gorgonian, spines of sea-urchins, arm of crinoid; 3 specimens, MNHN-IU-2019-4840, Stn. CP 35, 06°08'S, 132°45'E, 390–502 m depth, 27 October 1991; 1 specimen,



**Figure 35.** *Solidobalanus auricoma* (Hoek, 1913) (MNHN-IU-2019-4850). **a.** upper lateral view from above; **b.** left lateral view; **c.** right lateral view; **d.** basal view. Scale bar: 2 mm (a–d).

MNHN-IU-2019-4843, Stn. CP 36, 06°05'S, 132°44'E, 210–268 m depth, 27 October 1991.

**Diagnosis.** Shell flatly-conical, colour reddish basally, whitish apically; radii narrow, summits slightly oblique; opercular plates with golden hairs along occludent margins; scutum with articular ridge slightly prominent, adductor ridge absent; tergum narrow, scutal margin distinctly dentated.

**Description.** Shell with plates ribbed longitudinally. Shell colour brownish-pink to dull rose-pink, ribs tending to white, colour often faded with specimens appearing uniform white. Parietes of carinolatera very narrow, with single, conspicuous, longitudinal ridge. Scutum with occludent margin straight, surface indistinctly ridged, pit for adductor muscle scarcely visible. Tergum short, narrow, scutal margin straight, unusually distinctly dentated, carinal margin short, convex, depressor muscle crests moderately well developed. Opercular plates with long, golden setae fringing occludent margins, especially distally. Cirri I–II with rami slightly unequal, covered with setae; cirri III–VI longer, more slender, dense setae on inner face. Mandible with four teeth, second to fourth with accessory cusps, lower angle molariform with three blunt cusps in series, lower edge with row of stiff setae. Measurements of five specimens: basal length of shell 6.11–8.18 mm, orifice length 4.18–5.83 mm, carinal height 4.11–6.30 mm, orifice width 2.58–3.19 mm, basal width 4.51–5.96 mm.

**Distribution.** Banda Sea (Moluccas, Indonesia); SW Australia; New Zealand; New Caledonia; Philippines to southern Japan; Malaysian water; Gulf of Oman, Persia. 27–502 m depth (Jones and Hosie 2016). In this study, *Solidobalanus auricomus* was found at Kei Islands and Tanimbar Island, Indonesia.

**Type locality.** Ternate anchorage; 27 m depth; bottom: mud and stone; numerous specimens on the surface of pieces of rock (Hoek 1913).

### *Solidobalanus pseudauricomus* (Broch, 1931)

Figure 36

*Balanus (Solidobalanus) pseudauricomus* Broch, 1931. – Utinomi 1949: 97, fig. 4.

*Solidobalanus (Solidobalanus) pseudauricomus*. – Newman & Ross, 1976: 51. – Jones 2007: 294.

**Material examined.** – Kei Islands: 46 specimens, MNHN-IU-2019-4818, Stn. CP 25, 05°30'S, 132°52'E, 336–346 m depth, 26 October 1991, 30 specimens attached to gorgonian, 16 specimens attached to coral; 6 specimens, MNHN-IU-2019-4825, Stn. CP 27, 05°33'S, 132°51'E, 304–314 m depth, 27 October 1991; 1 specimen, MNHN-IU-2019-4826, Stn. CP 05, 05°49'S, 132°18'E, 296–299 m depth, 22 October 1991, attached to crinoid; 13 specimens, MNHN-IU-2019-4827, Stn. CP 16, 05°17'S, 132°50'E, 330–350 m depth, 24 October 1991; 2 specimens, MNHN-IU-2019-4828, Stn. DW 22, 05°22'S, 133°01'E, 82 m depth, 25 October 1991, 1 specimen attached to gorgonian stem; 8 specimens, MNHN-IU-2019-4830, Stn. CP 05, 05°49'S, 132°18'E, 296–299 m depth, 22 October 1991, 5 specimens attached to gorgonian, 1 specimen attached to crinoid.

– Tanimbar Island: 11 specimens, MNHN-IU-2019-4839, Stn. CP 86, 09°26'S, 131°13'E, 223–225 m depth, 4 November 1991, several specimens attached to spines of sea urchins (associated with *Solidobalanus auricomus* (Hoek, 1913)).

**Diagnosis.** Shell with smooth, glossy white plates, coloured stripes absent; internal plates with thick, solid, finely ribbed longitudinally; base non-porous, radially ribbed.

**Description.** Shell plates white, stripes absent. Several specimens with pale pink tinge, one with pale brownish-pink parietes with small, narrow ellipsoidal whitish spots, latter orientated longitudinally producing reticulated effect. Radii whitish, pink tinge along distal borders. Scutal growth lines without longitudinal striations; articular ridge absent; pit for adductor muscle small, round. Tergum with



**Figure 36.** *Solidobalanus pseudauricomus* (Broch, 1931) (MNHN-IU-2019-4818). **a.** left lateral view; **b.** orifice view; **c.** basal view; **d.** right lateral view. Scale bar: 4 mm (a–d).

shallow, wide furrow running from apex to base. Cirrus I with unequal (anterior ramus: 7-segmented; posterior ramus: 15-segmented). Cirrus II with rami subequal (anterior ramus: 11-segmented; posterior ramus: 12-segmented). Cirri I and II with very dense, long setae on surface areas. Cirri III–VI with rami slightly subequal, rounded. Penis sturdy, not long. Labrum with very shallow notch, three or four irregularly arranged, blunt teeth on each side. Maxillule with distinct, narrow notch with two large setae on upper side. Mandibles with five teeth, second and third bifid and fifth is rudimentary. Measurements of five specimens: basal length of shell 6.23–12.08 mm, orifice length 4.63–9.62 mm, carinal height 3.48–13.22 mm, orifice width 3.24–6.33 mm, basal width 5.66–9.56 mm.

**Distribution.** Manado Bay (Indonesia); Japan (Broch 1931–1932). In this study, *Solidobalanus pseudauricomus* was found at Kei Islands and Tanimbar Island, Indonesia.

**Type locality.** Manado Bay, Indonesia (1°31'N, 124°47'E), 500 m depth; Japan (32°25'N, 128°33'E), 400 m depth (Broch 1931–1932).

**Remarks.** In the type description, Broch (1931–1932) commented that the specimens were white, without stripes. However, several of the specimens collected by KARUBAR had a pale pink tinge and one specimen (from station DW22) had pale brownish-pink parietes with small, narrow ellipsoidal whitish spots, the latter orientated longitudinally, thus producing a reticulated effect. Raddii whitish with pink tinge along distal borders.

### Genus *Striatobalanus* Hoek, 1913

*Balanus* Section F (part.) Darwin, 1854: 277.

*Chirona* Gray, 1825: 37. – Pilsbry, 1916: 204.

*Balanus* (*Striato-Balanus*) Hoek, 1913: 159, 179.

*Chirona* (*Striatobalanus*). – Newman & Ross, 1976: 23, 50 (as subgenus).

*Striatobalanus*. – Jones, 2004: 150.

**Diagnosis.** Parietes and radii without pores; radii usually narrow; scutum striated longitudinally with adductor ridge; tergum furrow deep; cirrus I with rami very unequal in length.

**Type species.** *Balanus amaryllis* var. (a), var. (b) Darwin, 1854: 279, pl. 7, fig. 6a–c.

**Type locality.** Unknown.

### *Striatobalanus amaryllis* (Darwin, 1854)

Figure 37

*Balanus amaryllis* var. (a), var. (b) Darwin, 1854: 279, pl. 7, fig. 6a–c. – Hoek 1913: 179, pl. 15, figs 17–21, pl. 16, figs 1–4. – Pilsbry 1916: 217. – Nilsson-Cantell 1925: 329. – Hiro 1936: 624. – 1939c: 243. – Stubbings 1936: 174. – Utinomi 1962: 216. – 1969: 88.

*Balanus amaryllis dissimilis* Lanchester, 1902: 369, pl. XXXIV, figs 3–3C, with var. *clarovittata* Lanchester, 1902: 370.

*Balanus amaryllis* var. *a* (= *Balanus roseus* Lamarck, 1818). – Gruvel 1905: 250, with var. *b* (*niveus*). – Gruvel, 1905: 250 (= *Balanus amaryllis* var. *b* Darwin, 1854: 279)).

*Balanus* (*Chirona*) *amaryllis*. – Nilsson-Cantell 1921: 329, pl. 3, fig. 9. – Rosell 1981: 302.

*Balanus amaryllis* forma *euamaryllis*. – Broch, 1922: 321.

*Balanus amaryllis* forma *laevis* Broch, 1931: 67, fig. 24.

*Balanus* sp. Dong & Mao, 1956: 290, fig. 8.

*Chirona* (*Striatobalanus*) *amaryllis*. – Newman & Ross, 1976: 50.

*Chirona amaryllis*. – Foster, 1981: 350.

*Balanus amaryllis*. – Dong et al., 1982: 95.

*Balanus amaryllis euamaryllis* Dong et al., 1982: 96, fig. A–C.

*Chirona amaryllis*: Zevina et al., 1992: 72, fig. 49.

*Striatobalanus amaryllis*. – Jones, 2004: 150. – Chan et al. 2009b: 222, 190–192.

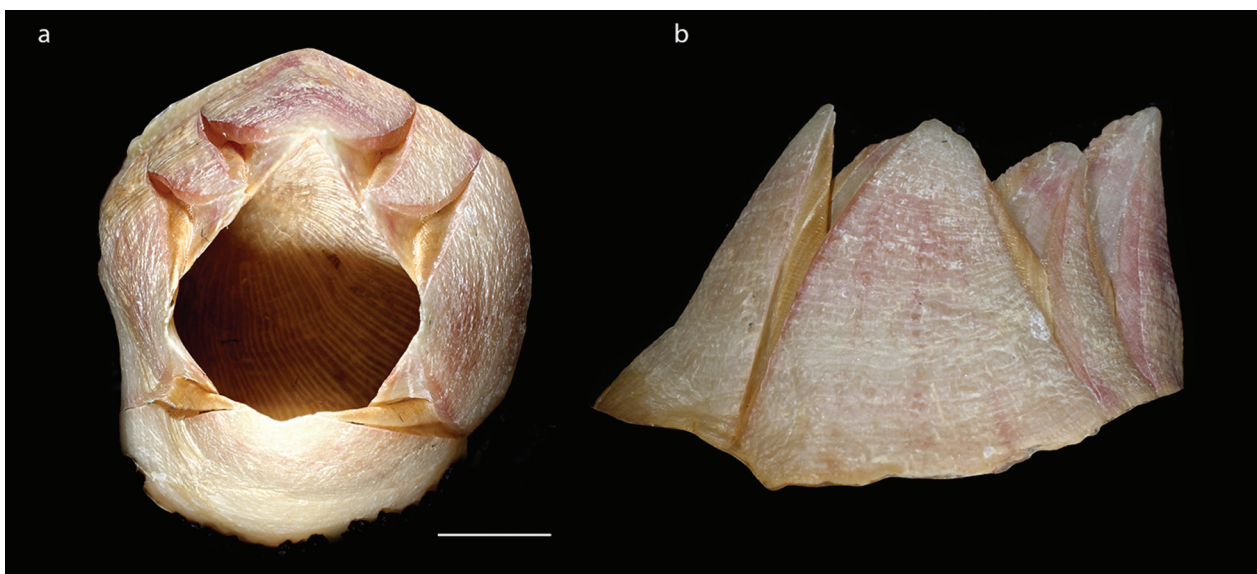


Figure 37. *Striatobalanus amaryllis* (Darwin, 1854) (MNHN-IU-2019-4814). a. orifice view; b. right lateral view. Scale bar: 3 mm (a, b).

**Material examined.** – Tanimbar Island: 1 specimen (only shell), MNHN-IU-2019-4814, Stn. CP 65, 09°14'S, 132°27'E, 174–176 m depth, 1 November 1991, attached to broken sea urchin shell.

**Diagnosis.** Shell conical; orifice large, pentagonal, toothed; shell colour pinkish, lighter transparent stripes run longitudinally over surface; radii very narrow, reddish, upper margins very oblique; alae broader, lighter colour.

**Description.** Shell conical; tips of rostrum and carina slightly curved inwards. Orifice large, pentagonal, toothed. Colour yellowish-white, with slightly darker longitudinal lines on main parts of plates. Radii with very oblique summits, broadest a little distance from the orifice, narrower towards basis. Alae broader than radii, summits rounded. Specimen without scutum, tergum and soft parts. Measurements of specimen: basal length of shell 16.76 mm, orifice length 9.13 mm, carinal height 9.89 mm, orifice width 7.24 mm, basal width 15.14 mm.

**Distribution.** Arafura Sea, Indonesia. Indo-west Pacific: South and East Africa, Indian Ocean; Australia (N); Singapore; Malay Arch.; Cambodia; Gulf of Thailand; Mouth of Bassac; Vietnam (Bay of Nhatrang; Lien Chien, Tourane; Codor Is); Hong Kong; S China Sea; China; Philippines; Taiwan; Japan (S); attached to rocks, gastropod shells, rusting iron, fouling species; sublittoral, 5–500 m depth (Jones and Hosie 2016). In this study, *Striatobalanus amaryllis* was found at Tanimbar Island, Indonesia.

**Type locality.** Unknown.

### *Striatobalanus tenuis* (Hoek, 1883)

Figure 38

*Balanus tenuis* Hoek, 1883: 154, pl. 13, figs 29–33. – 1913: 190, pl. 17, figs 14–19, pl. 18, fig. 1. – Gruvel 1905: 247, fig. 275. – Pilsbry

1916: 216. – Barnard 1924: 74. – Nilsson-Cantell 1925: 34, fig. 13, pl. 1, figs 5, 6. – 1927: 785. – 1938: 46. – Broch 1931: 70. – Hiro 1937b: 439, fig. 24. – Utinomi 1962: 216. – 1968: 174. – 1969: 88, fig. 6. – Utinomi and Kikuchi 1966: 6.

*Balanus albus* Hoek, 1913: 185, pl. 16, figs 12, 13, pl. 17, figs 1–6. – Stubbings 1936: 41, fig. 18.

*Chirona (Striatobalanus) tenuis*. – Newman & Ross, 1976: 50. – Rosell 1989: 33, pl. 10g. – 1991: 38.

*Balanus (Chirona) tenuis*. – Ren & Liu, 1978: 161, fig. 22, pl. 7, figs 6–10. – Nilsson-Cantell 1921: 302.

*Balanus tenuis*. – Dong et al., 1982: 97, fig. A–C.

*Chirona tenuis*. – Zevina et al., 1992: 74, fig. 50.

*Striatobalanus tenuis*. – Jones, 2004: 152. – Liu and Ren 2007: 363, fig. 161. – Chan 2009: 74, fig. 2H and fig. 23A–G.

**Material examined.** – Kei Islands: 5 specimens, MNHN-IU-2019-4820, Stn. CC 10, 05°21'S, 132°30'E, 329–389 m depth, 23 October 1991; 1 specimen (shell only), MNHN-IU-2019-4835, Stn. CP 16, 05°17'S, 132°50'E, 330–350 m depth, 24 October 1991.

– Tanimbar Island: 1 specimen, MNHN-IU-2019-4832, Stn. DW 49, 08°00'S, 132°59'E, 206–2010 m depth, 29 October 1991; 1 specimen (shell only), MNHN-IU-2019-4833, Stn. CP 65, 09°14'S, 132°27'E, 174–176 m depth, 1 November 1991; 4 specimens (shell only), MNHN-IU-2019-4834, Stn. CP 79, 09°16'S, 131°22'E, 239–250 m, 3 November 1991; 1 specimen (only shell), MNHN-IU-2019-4813, Stn. CP 85, 09°22'S, 131°14'E, 240–245 m, 4 November 1991, attached to shell of gastropod; 2 specimens, MNHN-IU-2019-4819, Stn. CP 86, 09°26'S, 131°13'E, 223–225 m depth, 4 November 1991, attached to gastropod shells.

**Diagnosis.** Shell colour whitish to yellowish; surface smooth, glossy; orifice pentagonal shaped, deeply toothed; radii narrow, summits very oblique, slightly concave; basis solid; scutum with longitudinal striations; tergum with short, rather broad spur.

**Description.** Shell with six plates, conical; orifice large, distinctly toothed; radii well-developed; basis thin, ribbed, solid. Scutum triangular, not elongated, with longitudinal



**Figure 38.** *Striatobalanus tenuis* (Hoek, 1883) (MNHN-IU-2019-4820). **a.** orifice view; **b.** left lateral view; **c.** right lateral view; **d.** basal view. Scale bar: 10 mm (a–d).



striations; tergum slightly beaked, exhibiting traces of longitudinal striations, spur short, slightly narrow, depressor crests distinctly developed. Cirri I to VI with rami slightly equal in length, transparent and orange-coloured. Penis rather long, sparse, minute hairs on the surface, tapering towards tip, distinctly hairy at tip. Maxillule with edge slightly straight, all the setae similar sized. Mandibles with five teeth, fourth and fifth small. Measurements of five specimens basal length of shell 18.92–28.30 mm, orifice length 13.78–16.29 mm, carinal height 18.02–20.24 mm, orifice width 10.15–13.70 mm, basal width 20.51–28.03 mm.

**Distribution.** Arafura Sea, Indonesia; Indo-west Pacific: S Africa; Persian Gulf; Indian Ocean; Australia (N); Singapore; Malay Arch.; Vietnam; Hong Kong; S China Sea; E China Sea; Philippines; Taiwan; Japan (S); W Pacific; attached to crabs, gastropod, bivalve, shells solitary coral, bark of coconut, gorgonians, antipatharians, stones; 7–551 m depth (Jones and Hosie 2016). In this study, *Striatobalanus tenuis* was found at Kei Islands and Tanimbar Island, Indonesia.

**Type locality.** West of Mindoro, Philippines; 6°8'N, 121°19'E; depth: 275 m, at coral-bottom (Hoek 1913).

#### Family PYRGOMATIDAE Gray, 1825

Balanidae Leach, 1817: 68 (part.). – Darwin 1854: 33 (part.).

Balaninae. – Nilsson-Cantell, 1921: 306 (part.).

Pyrgomatidae Gray, 1825: 102. – Newman 1996: 503.

Pyrgomatinae. – Ross & Newman, 1973: 149.

**Diagnosis.** Wall of four plates wholly conrescent; parietes solid or tubiferous; when tubiferous, tubes occur between outer lamina and sheath or between external ribs of wall; interlaminar figures complex, essentially arborescent; radii solid; basis calcareous, rarely tubiferous, membranous in *Pyrgopsella*.

#### Subfamily MEGATREMAOTINAE Holthuis, 1982

Bosciinae Newman & Ross, 1976: 59.

Megatrematinae Holthuis, 1982: 319.

**Diagnosis.** Wall of four plates wholly conrescent; opercular valves normal; tergum with weakly developed lateral depressor muscle crests or crests lacking; when shell conrescent, sheath with paired sulci.

**Type genus.** *Megatrema* Sowerby, 1823, by original designation (Holthuis 1982).

#### Tribe PYRGOMINI Ross & Pitombo, 2002

Pyrgominini Ross & Pitombo, 2002: 58.

**Type genus.** *Pyrgomina* Baluk & Radwanski, 1967.

#### Genus *Pyrgomina* Baluk & Radwanski, 1967

*Pyrgomina* Baluk & Radwanski, 1967b: 691, pl. 1–2.

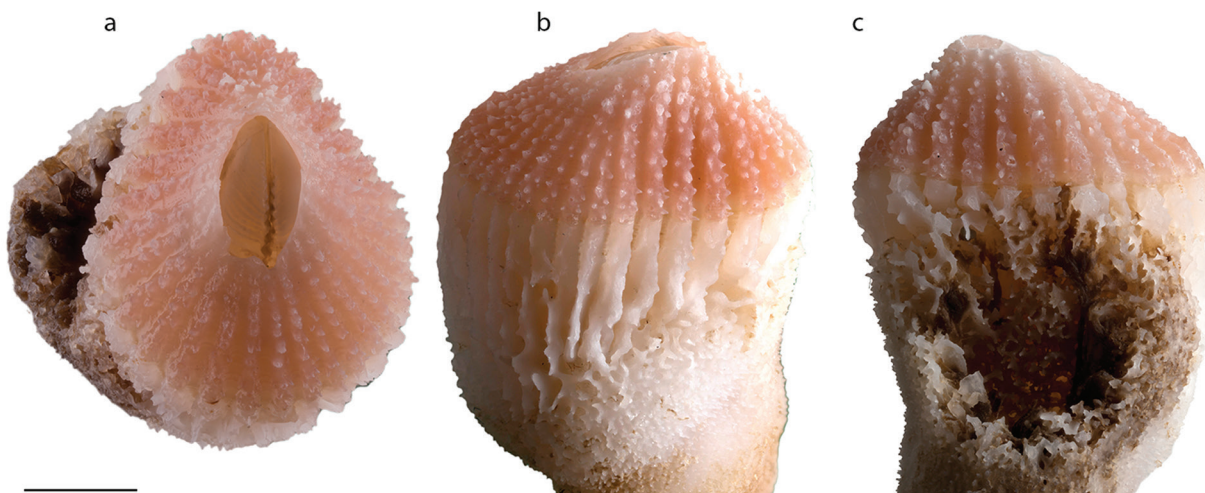
**Type species.** *Pyrgomina seguenzai* Baluk & Radwanski, 1967a: 485.

**Type locality.** Pliocene (Piacenzian Stage); Gournes, Iraklion nomarchia, Island of Crete, Greece, 35°06'N, 25°47'E; host coral unknown (Ross and Pitombo 2002).

#### *Pyrgomina* sp.

Figure 39

**Material examined.** – Tanimbar Island: 1 specimen, MNHN-IU-2019-4817, Stn. CP 86, 09°26'S, 131°13'E, 223–225 m depth, 4 November 1991, attached to coral.



**Figure 39.** *Pyrgomina* sp. (MNHN-IU-2019-4817). **a.** orifice view; **b.** left lateral view; **c.** right lateral view. Scale bar: 2 mm (a–c).

**Diagnosis.** Shell purple-pinkish, tall, conical; orifice oval; base permeated by pores, expanded out of the coral; tergum and scutum subtriangular.

**Description.** Shell stands exerted on the coral, externally furnished with ribs, lower part rounded with radiating ribs; orifice oval, small and narrow. Scutum triangular, basal margin curved; tergum triangular with narrow spur. Cirrus I with rami unequal (anterior ramus: 10-segmented; posterior ramus: 15-segmented); posterior ramus of cirrus IV without spines. Maxilla globular; maxillule not notched, eight large setae on straight cutting edge; mandible with five major teeth. Measurements of specimen: basal length of shell 7.46 mm, orifice length 2.42 mm, carinal height 10.45 mm, orifice width 1.41 mm, basal width 6.15 mm.

**Distribution.** *Pyrgomina* sp. was found at Tanimbar Island, Indonesia.

### Family BALANIDAE Leach, 1817

Balanidae Leach, 1817: 68. – Gray 1825: 104. – Darwin 1854: 33 (part.). – Pilsbry 1916: 48. – Nilsson-Cantell 1921: 306. – Newman and Ross 1976: 59. – Foster 1978: 95. – Buckeridge 1983: 103. – Newman 1996: 503. – Pitombo 2004: 262. – Chan et al. 2009b: 229.

**Diagnosis.** Shell with four or six plates; parietes tubiferous; tubes arranged in single uniform row formed between inner and outer lamina, supplementary tubes may form basally; interlaminar figures complex, arborescent; radii solid or tubiferous, more-or-less developed; basis calcareous, commonly tubiferous; caudal appendages absent; penis commonly with basidorsal point.

### Subfamily AMPHIBALANINAE Pitombo, 2004

*Amphibalaninae* Pitombo, 2004: 263.

**Diagnosis.** Shell with four or six plates; parietal tubes with one or more rows, commonly transverse septa; radii with transverse teeth on sutural edge with denticles on lower side only; alae not cleft; basis with single tubiferous; scutum with conspicuous adductor ridge; tergum with well-developed depressor muscle crests, growth lines in tergum spur display an obvious change in direction; second maxilla with smooth anterior margin of distal lobe, acuminate setae with enlarged, modified tips.

### Genus *Amphibalanus* Pitombo, 2004

*Amphibalanus* Pitombo, 2004: 263.

**Diagnosis.** Shell with four or six plates; parietal tubes with one or more rows, commonly transverse septa; radii with transverse teeth on sutural edge, with denticles on

lower side only; alae not cleft; basis with single tubiferous; scutum with conspicuous adductor ridge; tergum with well-developed depressor muscle crests, growth lines in tergum spur display an obvious change in direction; second maxilla with smooth anterior margin of distal lobe, acuminate setae with enlarged, modified tips. Cirrus III with inner face of endopod with pinnate setae, rarely bifurcate (complex) setae.

**Type species.** *Balanus amphitrite* Darwin, 1854: 240 (part.), pl. 5, fig. 2a–d, i–k, m–o; type locality: Natal, South Africa.

### *Amphibalanus amphitrite* (Darwin, 1854)

Figure 40

*Balanus amphitrite* Darwin, 1854: 240 (part.), pl. 5, fig. 2a–d, i–k, m–o. – Weltner 1897: 264. – Hoek 1913: 167. – Pilsbry 1916: 89. – Zevina et al. 1992: 89, fig. 61. – Puspasari et al. 2001: 7.

*Balanus amphitrite* var. (1) *communis* Darwin, 1854: 240, pl. 5, fig. 2e, h, l.

*Balanus amphitrite communis*. – Nilsson-Cantell, 1921: 311, fig. 64.

*Balanus amphitrite* forma *hawaiiensis* Broch, 1922: 314, fig. 56 (part.).

*Balanus amphitrite* forma *denticulata* Broch, 1927b: 133, fig. 14 (part.).

*Balanus amphitrite hawaiiensis*. – Hiro, 1937c: 432, figs 20, 21.

*Balanus amphitrite cochiniensis* Nilsson-Cantell, 1938b: 43, fig. 11a–e.

*Balanus amphitrite* var. *fluminensis* Oliveira, 1941: 21, pl. 4, fig. 4, pl. 5, figs 1, 2, pl. 8, figs 1–5.

*Balanus amphitrite* var. *aeratus* Oliveira, 1941: 22, pl. 4, fig. 5, pl. 9, figs 1–4.

*Balanus amphitrite herzi* Rogers, 1949: 28, pl. 1, figs 6, 12–15.

*Balanus amphitrite franciscanus* Rogers, 1949: 29, pl. 1, figs 5, 7, 16–19.

*Balanus amphitrite* var. *columnarius* Tarasov & Zevina, 1957: 179, 184, fig. 68 a–e.

*Balanus amphitrite denticulata* Henry, 1959: 192, pl. 1, fig. 5, pl. 3, fig. 7, upper row right.

*Balanus amphitrite amphitrite*. – Harding, 1962: 274, pl. 1a–g, pl. 2a–k. – Dong et al. 1982: 90, fig. A–E. – Rosell 1981: 302.

*Balanus amphitrite* var. *Hawaiiensis*. – Stubbings, 1963b: 15.

*Amphibalanus amphitrite*. – Pitombo, 2004: 263, 274, figs 2A, B, 7A, B, 8C. – Chan et al. 2009b: 241. – Chen et al. 2014: 1071. – Pochai et al. 2017: 27, fig. 9. – Pitriana et al. 2020: 42, fig. 21.

**Material examined.** – Tanimbar Island: 4 specimens, MNHN-IU-2019-4815, Stn. CP 52, 08°03'S, 131°48'E, 1244–1266 m depth, 30 October 1991.

**Diagnosis.** Primary parietal tubes with transverse septa; exterior of shell with longitudinal purple striations, horizontal striations absent; tergum short with wide spur; cirri III–VI with erect teeth below posterior angles of distal; cirrus III without complex setae.

**Description.** Shell six-plated, conical, round; externally smooth, white with groups of well-spaced, dark purple vertical stripes; horizontal striations on shell surface absent. Interior of paries with single row of tubes; radii solid, wide; alae with summits moderately oblique; basis



**Figure 40.** *Amphibalanus amphitrite* (Darwin, 1854) (MNHN-IU-2019-4815). **a.** orifice view; **b.** right lateral view; **c.** basal view. Scale bar: 4 mm (a–c).

porose, calcareous. Scutum externally striped, occludent margin toothed, lateral depressor muscle pit small. Tergum with spur wider than long, less than its own width from basi-scutal angle. Cirrus I with unequal rami (anterior ramus: 10-segmented; posterior ramus: 16-segmented). Cirrus II with slightly equal rami (anterior ramus: 10-segmented; posterior ramus: 12-segmented). Cirrus III with rami subequal (anterior ramus: 12-segmented; posterior ramus: 13-segmented). Cirri IV–VI with rami subequal, longer, more slender. Penis moderately long, tapering distally, sparse, minute hairs on surface, distinctly hairy distally. Labrum deeply notched, numerous teeth on each side. Maxilla without notch below upper pair of spines, nine spines between upper and lower pairs, few short spines on inferior angle; lower pair of spines usually on slight prominence, which may be sometimes moderately strong or strong. Mandible with five teeth, inferior angle with second tooth bifid. Measurements of four specimens: basal length of shell 5.27–12.10 mm, orifice length 3.81–7.89 mm, carinal height 3.64–5.65 mm, orifice width 2.72–5.22 mm, basal width 4.62–12.03 mm.

**Distribution.** Cosmopolitan in tropical and subtropical waters. Bermuda & SE USA to Brazil; England and West Europe to South coast of Africa Red, Black and Mediterranean Seas; Suez Canal; SE Africa; Indian Ocean; Australia; Singapore; Malaysia; Réam (Cambodia); Gulf of Siam; Vietnam; Condor Island; Tang Trien (South Annam); Cauda Nhatrang; Hongay, Tonkin; S China Sea; Hong Kong; China; Bohai Sea; Taiwan; Philippines; Japan; South Honsyu, Kyusyu & Ryukyu Island; Vladivostok; Hawaii; central California to SW Mexico; fouling species; lower littoral to sublittoral (Jones and Hosie 2016). Recently, also recorded from Ambon Island and Saparua Island, Indonesia (Pitriana et al. 2020). In this study, *Amphibalanus amphitrite* was found at Tanimbar Island, Indonesia.

**Type locality.** Natal, on a piece of bamboo (Darwin 1854).

**Remarks.** Known as an important fouling species of ships and marine installations. The suggestion of anti-fouling paint on the bases of the specimens examined suggests that these specimens were probably knocked off the ship during trawling operations, explaining the great depth at which these specimens were collected, as the normal depth range is 0–9 m.

## Discussion

Prior to the *Karubar* expedition, 24 species of barnacles had been collected from the Kei Islands and Aru Island by the *Siboga* expedition (Hoek 1913). Other pertinent reference works to the barnacles from these islands are Jones et al. (2001) and Jones and Hosie (2016), who recorded 15 species from the Kei Islands and Aru Island.

In addition to the works of Hoek (1913), Jones et al. (2001) and Jones and Hosie (2016), Broch (1931–1932) reported on 67 species of barnacles collected by the Danish expedition to the Kei Islands (1922) and deposited in the Zoological Museum of Copenhagen University. In his report, only four species, *Euscalpellum rostratum* (Darwin, 1851), *Lepas (Anatifa) anatifera* Linnaeus, 1758, *Conchoderma virgatum* Spengler, 1789 and *Acasta dentifer* (Broch, 1922), were explicitly collected in the Kei Islands. The other barnacle species recorded were collected at other places along the route of this expedition, such as Lampung Bay, Krakatau, Java Sea, Sunda Strait, Makassar Strait, Tual, Banda Neira, Ambon and Saparua Bay.

The lists of Hoek (1913), Broch (1931–1932), Jones et al. (2001) and Jones and Hosie (2016) record a total of 25 species from the Kei Islands, Aru Island and Tanimbar Island. The results currently recorded herein reveal that 40 species are now recorded from these Islands.

Of the 40 species herein, ten are recorded in previous studies: *Megalasma striatum* Hoek, 1883 (listed in Hoek (1913)); *Scalpellum stearnsi* Pilsbry, 1890 (listed in Hoek (1913)); *Annandaleum japonicum* (Hoek, 1883)

(listed in Hoek (1913)); *Annandaleum laccadivicum* (Annandale, 1906) (listed in Hoek (1913)); *Regioscalpellum moluccanum* (Hoek, 1883) (listed in Hoek (1913)); *Altiverruca navicula* (Hoek, 1913) (listed in Hoek (1913) and Buckeridge (1994)); *Newmaniverruca albatrossiana* (Pilsbry, 1912) (listed in Hoek (1913) and Buckeridge (1994)); *Hexelasma arafurae* Hoek, 1913 (listed in Hoek (1913) and Jones and Hosie (2016)); *Solidobalanus auricomus* (Hoek, 1913) (listed in Hoek (1913) and Jones et al. (2001)); *Striatobalanus tenuis* (Hoek, 1883) (listed in Hoek (1913) and Jones and Hosie (2016)). The remaining 30 species can, therefore, be considered as new records for the Kei Islands and Tanimbar Island.

The present study and previous works on the barnacles of the Kei Islands, Aru Island and Tanimbar Island, especially the works of Hoek (1883, 1907, 1913), Broch (1922, 1931–1932), Buckeridge (1994, 1997), Jones et al. (2001) and Jones and Hosie (2016), enrich our knowledge of the barnacle fauna of these islands. This study demonstrates once more the value of museum collections as a resource in biodiversity science.

The result of this study also strengthens the statement of Hoeksema (2007) that the Indo-Malayan region (which extends from East Indonesia to the Philippines and the Solomon Islands) is a centre of maximum marine biodiversity. Darwin (1854) demonstrated that this area had greater species richness than elsewhere in the world at the time. He named it the East Indian Archipelago (including the Philippines, Borneo, New Guinea, Sumatra, Java, Malacca and the eastern coast of India) and categorised it as his third province of barnacles. In this province, he found 37 barnacle species, the largest number known at that time, compared with the other provinces.

Regarding the biodiversity of barnacles, the Indo-Malayan region as the centre of benthic biodiversity has not been replaced by other areas. In recent times, many studies and expeditions have been conducted in this area, revealing many more species of barnacles. For example, three expeditions have been undertaken within Philippine waters from 1976 until 1985 through MUSORSTOM Cruises and the collections the U.P. Marine Biological Laboratory at Puerto Galera, Oriental Mindoro (Rosell 1991; Chan 2009). Overall, the three of scientific cruises of MUSORSTOM collected 78 species of barnacles, 43 of which are new records and 12 species are new to science (Rosell 1991). Through the Philippine Panglao expedition (2005), Chan (2009) has also increased the number of barnacles from the Philippines, reporting 20 barnacle species with two new to science.

Similar to the Philippine waters, eastern Indonesian waters also have a high diversity of barnacles. Recently, it has been revealed that the Moluccan Islands in eastern Indonesia have 97 species of barnacles, 23 of which are new records and two species are still awaiting their species descriptions (Pitriana et al. 2020). Furthermore, this number will increase with the results of the study of the barnacles from Karubar expedition (1991) that have revealed 40 species of barnacles.

The results of the studies of barnacles from the Philippines and eastern Indonesian waters reconfirm the Indo-Malayan region as the epicentre of marine biodiversity.

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## References

- Agassiz A (1879) Preliminary report on the Echini of the Exploring Expedition of H.M.S. "Challenger". Sir C. Wyville Thomson Chief of Civilian Staff. Proceedings of the American Academy of Arts and Sciences, new series 6: 190–212. <https://doi.org/10.2307/25138537>
- Agassiz L (1842) Nomenclator Zoologicus: Continens Nomina Systematica Generum Animalium tam Viventium quam Fossilium, Secundum Ordinem Alfabeticum Disposita, Adjectis Auctoribus, Libris, in Quibus Reperiuntur, anno Editionis, Etymologia et Familiis, ad quas Pertinent, in Singulis Classibus. Soloduri: Jent et Gassmann, 1564 pp. <https://doi.org/10.5962/bhl.title.49761>
- Annandale N (1905) Malaysian Barnacles in the Indian Museum, with a list of the Indian Pedunculata. Memoirs of the Asiatic Society of Bengal 1: 73–84.
- Annandale N (1906a) Report on the Cirripedia collected by Professor Herdman at Ceylon, in 1902. Report to the Government of Ceylon on the pearl oyster fisheries of the Gulf of Manaar 5: 137–150.
- Annandale N (1906b) Natural history notes from the R.I.M.S. "Investigator", Captain I.H. Heming, R.N., commanding. Series III, No 12. Preliminary report on the Indian Stalked Barnacles. The Annals and Magazine of Natural History 7(17): 389–400. <https://doi.org/10.1080/00222930608562544>
- Annandale N (1908) Crustacea (Entomostraca). Illustrations of the Zoology of the Royal Indian Marine Survey Ship Investigator: under the command of Commander T.H. Hemming 2: plates III–V.

- Annandale N (1909) An account of the Indian Cirripedia Pedunculata. Part I. Family Lepadidae (sensu stricto). *Memoirs of the Indian Museum* 2(2): 59–137.
- Annandale N (1910a) Report on the Cirripedia Pedunculata collected by Dr Th Mortensen in the Gulf of Siam. *Videnskabelige Meddelelser fra dansk Naturhistorisk Forening i København* 1910: 81–86.
- Annandale N (1910b) Description of a new species of *Scalpellum* from the Andaman Sea. *Records of the Indian Museum* 5(2): 115–116.
- Annandale N (1913) The Indian Barnacles of the subgenus *Scalpellum*. *Records of the Indian Museum* 9(4): 227–236.
- Annandale N (1916a) Barnacles from deep-sea telegraph cables in the Malay Archipelago. *Journal of the Straits Branch of the Royal Asiatic Society* 74: 281–302.
- Annandale N (1916b) Three plates to illustrate the Scalpellidae and Iblidae of Indian seas, with synonymy and notes. *Memoirs of the Indian Museum* 6(2): 127–131.
- Aurivillius CWS (1892) Neue Cirripeden aus dem Atlantischen, Indischen und Stillen Ocean. *Öfversigt af Kongliga Vetenskaps-Akademiens Förhandlingar* 3: 123–135.
- Aurivillius CWS (1894) Studien über Cirripeden. *Kungliga Svenska Vetenskaps-Akademiens Handlingar* 26(7): 1–107. [pl. 1–9.]
- Aurivillius CWS (1898) Cirripèdes nouveaux provenant des campagnes scientifiques de S.A.S. le Prince de Monaco. *Bulletin de la Société zoologique de France* 23: 189–98.
- Baluk W, Radwanski A (1967a) Miocene cirripeds domiciled in corals. *Acta Palaeontologica Polonica* 12(4): 457–521.
- Baluk W, Radwanski A (1967b) *Pyrgomina* gen. n., an aberrant cirriped and its Pliocene and Recent representatives. *Bulletin de L'Academie Polonaise des Sciences* 15(11): 691–695.
- Barnard KH (1924) Contributions to the Crustacean Fauna of South Africa. Cirripedia. *Annals of the South African Museum* 20(1): 1–103.
- Barnard KH (1925) Report on a collection of Cirripedia (barnacles) from South African waters. *Fisheries and Marine Biological Survey, Union of South Africa, Report* 4(6): 1–5.
- Broch H (1916) Results of Dr. E. Mjöberg's Swedish scientific expedition to Australia 1910–1913. VIII Cirripeden. *Kungliga Svenska Vetenskapsakademiens Handlingar* 52(8): 1–16. <https://doi.org/10.5962/bhl.part.1499>
- Broch H (1922) Studies on Pacific Cirripedes. *Papers from Dr Th. Mortensen's Pacific Expedition 1914–1916* (10). *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening* (Copenhagen) 73: 215–358.
- Broch H (1924) Cirripedia Thoracica von Norwegen und dem Norwegischen Nordmeere. Eine Systematische und biologisch-Tiergeographische studie. *Videnskapsselskapets Skrifter. L. Mat. Naturv. Klasse* 17: 1–121.
- Broch H (1927a) Ordnung der Crustacea Entomostraca: Cirripedia. In: *Kukenthal F, Krumbach T (Eds) Handbuch der Zoologie*, 3(5). De Gruyter, Berlin, 503–552.
- Broch H (1927b) Report on the Crustacea Cirripedia. *Cambridge Expedition to the Suez Canal, 1924. Transactions of the Zoological Society of London XXII Part II*(1): 133–138. <https://doi.org/10.1111/j.1096-3642.1927.tb00327.x>
- Broch H (1931–1932) Indo-Malayan Cirripedia. *Papers from Dr Th. Mortensen's Pacific Expedition 1914–1916. Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening* (Copenhagen) 91: 1–146.
- Broch H (1953) Cirripedia Thoracica. *The Danish Ingolf-Expedition* 3: 1–17.
- Brown T (1844) *Illustrations of the Recent Conchology of Great Britain and Ireland, with the Description and Localities of all the Species, Marine, Land, and Fresh Water.* Smith Elder & Company, London, 144 pp. <https://doi.org/10.5962/bhl.title.10336>
- Buckeridge JS (1983) Fossil barnacles (Cirripedia: Thoracica) of New Zealand and Australia. *New Zealand Geological Survey, Palaeontological Bulletin* 50: 1–151. [14 pls.]
- Buckeridge JS (1994) Cirripedia Thoracica: Verrucomorpha of New Caledonia, Indonesia, Wallis and Futuna Islands. In: *Crosnier A (Ed.) Resultats des Campagnes MUSORSTOM, 12, Memoires du Muséum National d'Histoire Naturelle* 4: 87–126.
- Buckeridge JS (1997) Cirripedia Thoracica: New ranges and species of Verrucomorpha from the Indian and Southwest Pacific Oceans. In: *Crosnier A (Ed.) Resultats des Campagnes MUSORSTOM. 18, Memoires du Muséum National d'Histoire Naturelle* 176: 125–149.
- Buckeridge JS (1999) A new deep sea barnacle, *Tetrachaelasma tasmanicum* sp. nov. (Cirripedia: Balanomorpha) from the South Tasman Rise, South Pacific Ocean. *New Zealand Journal of Marine and Freshwater Research* 33(4): 521–532. <https://doi.org/10.1080/00288330.1999.9516897>
- Buckeridge JS, Newman WA (2006) A revision of the Iblidae and the stalked barnacles (Crustacea: Cirripedia: Thoracica), including new ordinal, familial and generic taxa, and two new species from New Zealand and Tasmanian waters. *Zootaxa* 1136: 1–38. <https://doi.org/10.11646/zootaxa.1136.1.1>
- Buhl-Mortensen L, Mifsud C (2017) A new pedunculate barnacle (Cirripedia: Heteralepadidae) from the Mediterranean with notes on reproduction. *Zootaxa* 4319(3): 561–578. <https://doi.org/10.11646/zootaxa.4319.3.8>
- Burmeister H (1834) Beiträge zur Naturgeschichte der Rankenfusser (Cirripedia). *G Reimer, Berlin*, 60 pp. <https://doi.org/10.5962/bhl.title.8822>
- Calman WT (1918a) The type specimen of *Poecilasma carinatum* Hoek. *Annals and Magazine of Natural History* 9(1): 401–408. <https://doi.org/10.1080/00222931808562335>
- Calman WT (1918b) On barnacles of the genus *Scalpellum* from deep-sea telegraph cables. *Annals and Magazine of Natural History* 9(1): 96–124. <https://doi.org/10.1080/00222931808562293>
- Calman WT (1919) On barnacles of the genus *Megalasma* from deep sea telegraph cables. *Annals and Magazine of Natural History* 9(4): 361–374. <https://doi.org/10.1080/00222931908673905>
- Chan BKK (2009) Shallow water and deep sea barnacles (Crustacea, Cirripedia Thoracica) collected during the Philippine Panglao 2005 Expedition, with description of two new species. *Raffles Bulletin of Zoology, Supplement* 20: 47–82.
- Chan BKK, Tsang LM, Shih FL (2009a) Morphological and genetic differentiations of the stalked barnacle *Heteralepas japonica* Aurivillius, 1892, with description of a new species of *Heteralepas* Pilsbry, 1907, from the Philippines. *Raffles Bulletin of Zoology, Supplement* 20: 83–85.
- Chan BKK, Prabowo RE, Lee KS (2009b) Crustacean Fauna of Taiwan: Barnacles, Volume I – Cirripedia: Thoracic excluding the Pyrgomatidae and Acastinae (Chan TY series ed.). *National Taiwan Ocean University, Keelung*, 1–297. [figs. 250.]
- Chan BKK, Prabowo RE, Lee KS (2010) North West Pacific deep-sea barnacles (Cirripedia, Thoracica) collected by the Taiwan expeditions, with descriptions of two new species. *Zootaxa* 2405: 1–47. <https://doi.org/10.11646/zootaxa.2405.1.1>
- Chen HN, Tsang LM, Chong VC, Chan BKK (2014) Worldwide genetic differentiation in the common fouling barnacle,

- Amphibalanus amphitrite*. Biofouling 30(9): 1067–1078. <https://doi.org/10.1080/08927014.2014.967232>
- Costa OG (1839) Cirropodi. Corrispondenza Zoologica, Fauna Reg. Molluchi Cirropedi, Napoli, 1. Azzolino & Compagno, Napoli, 194 pp. [pls. 12]
- Crosnier A, Richer DFB, Bouchet P (1997) La campagne KARUBAR en Indonésie, au large des îles Kai et Tanimbar. Résultats des campagnes MUSORSTOM 16: 9–26.
- Darwin C (1852) A Monograph of the Subclass Cirripedia, with Figures of all the Species. The Lepadidae; or, Pedunculated Cirripedes. Ray Society, London, 400 pp. [pls. 10] [1851 published 1852]
- Darwin C (1854) A Monograph on the Subclass Cirripedia with Figures of all the Species. The Balanidae, the Verrucidae, etc. Ray Society, London, 684 pp. [pls. 30] [1854 published 1855]
- Dong YM, Mao JR (1956) Preliminary report on Cirripedia of Zhoushan in Zhejiang. Journal of the Zhejiang Normal Institute 2: 283–296.
- Dong YM, Dai A, Jiang X, Chen S, Chen Y, Cai R (1982) Illustrations of Animals from China. Crustacea (Vol. 1). Science Press, Beijing, 114 pp.
- Ellis J (1758) An account of several rare species of barnacles. Philosophical Transactions, London 50(2): 845–855. <https://doi.org/10.1098/rstl.1757.0114> [read 21 December 1758, published 1759]
- Fischer P (1884) Cirripèdes de l'Archipel de la Nouvelle-Calédonie. Bulletin de la Société zoologique de France 9: 355–360.
- Fischer P (1891) Description d'une nouvelle espèce de *Scalpellum* du Japon. Bulletin de la Société zoologique de France 16(189): 116–118.
- Foster BA (1974) The barnacles of Fiji, with observations on the ecology of barnacles on tropical shores. Pacific Science 28(1): 34–56.
- Foster BA (1978) The Marine Fauna of New Zealand: Barnacles (Cirripedia: Thoracica). New Zealand Oceanographic Institute Memoir 69: 1–160.
- Foster BA (1980) Further records and classification of scalpellid barnacles (Cirripedia: Thoracica) from New Zealand. New Zealand Journal of Zoology 7: 523–531. <https://doi.org/10.1080/03014223.1980.11760684>
- Foster BA (1981) Cirripedes from ocean ridges north of New Zealand. New Zealand Journal of Zoology 8(3): 349–367. <https://doi.org/10.1080/03014223.1981.10430614>
- Foster BA (1982) Shallow water barnacles from Hong Kong. In: Morton BS, Tseng CK (Eds) The Marine Flora and Fauna of Hong Kong and Southern China. Hong Kong University Press, Hongkong, 207–232.
- Foster BA, Buckeridge JS (1995a) Barnacles (Cirripedia, Thoracica) of seas off Reunion Island and the East Indies. Bulletin du Muséum National d'Histoire Naturelle. Section A: Zoologie Biologie et Ecologie Animales 16: 345–382.
- Foster BA, Buckeridge JS (1995b) Barnacles (Cirripedia: Thoracica) of seas off the Straits of Gibraltar. Bulletin du Muséum National d'Histoire Naturelle. Section A: Zoologie Biologie et Ecologie Animales 17: 163–191.
- Gale AS (2016) Phylogeny of the deep-sea cirripede family Scalpellidae (Crustacea, Thoracica) based on shell capitular plate morphology. Zoological Journal of the Linnean Society 176: 266–304. <https://doi.org/10.1111/zoj.12321>
- Gray JE (1825) A synopsis of the genera of cirripedes arranged in natural families, with a description of some new species. Annals of Philosophy, new series 10(2): 97–107.
- Gray JE (1830) Spicilegia Zoologica; or Original Figures and Short Systematic Descriptions of New and Unfigured Animals. Part 2. Treüttel, Würtz & Co., London, 9–12. [pls. 7–11]
- Gravel A (1901) Diagnoses de quelques espèces nouvelles de Cirripèdes. Bulletin du Muséum d'Histoire naturelle, Paris 7: 256–263.
- Gravel A (1902) Cirripèdes. Expéditions scientifiques du ‘Travailleur’ et du ‘Talisman’ pendant les années 1880, 1881, 1881 and 1883 7: 1–178. [Masson, Paris]
- Gravel A (1905) Monographie des Cirripèdes au Théostracés. Masson et cie, Paris, 472 pp.
- Gravel A (1912) Mission Gravel sur la côte occidentale d'Afrique (1909–1910) et collection du Muséum d'Histoire naturelle. Les Cirripèdes. Bulletin du Muséum national d'Histoire naturelle Paris 18(6): 344–350.
- Gravel A (1920) Cirripèdes provenant des campagnes scientifiques de S.A.S. le Prince de Monaco, 1885–1931. Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert 1er Prince de Monaco 53: 1–89.
- Harding JP (1962) Darwin's type specimens of varieties of *Balanus amphitrite*. Bulletin of the British Museum (Natural History), Zoology 9(7): 273–296. [pls. 1–10] <https://doi.org/10.5962/bhl.part.16343>
- Henry DP (1959) The distribution of the *amphitrite* series of *Balanus* in North American waters. In: Ray DL (Ed.) Marine Boring and Fouling Organisms, Friday Harbor Symposium. University Washington Press, Seattle, 190–203. [pls. 1–4]
- Henry DP, McLaughlin PA (1967) A revision of the subgenus *Solidobalanus* Hoek (Cirripedia Thoracica) including a description of a new species with complementary males. Crustaceana 12(1): 43–58. <https://doi.org/10.1163/156854067X00693>
- Hiro F (1933) Report on the Cirripedia collected by the surveying ships of the Imperial Fisheries Experimental Station on the continental shelf bordering Japan. Records of the Oceanographic Works in Japan 5: 11–84.
- Hiro F (1935) A study of cirripeds associated with corals occurring in Tanabe Bay. Records of Oceanographic Works, Japan 7(1): 45–72.
- Hiro F (1936) Report on the Cirripedia collected in the Malayan waters by the ship ‘Zhuho-Maru’. Japanese Journal of Zoology 6(19): 621–636.
- Hiro F (1937a) Order Thoracica I. (Cirripedia Pedunculata) Subclass Cirripedia (Class Crustacea). Fauna Nipponica 9: 1–116. [In Japanese]
- Hiro F (1937b) Studies on Cirripedian fauna of Japan. II. Cirripeds found in the vicinity of the Seto Marine Biological Laboratory. Memoirs of the College of Science, Kyoto University, Series B 12: 385–478.
- Hiro F (1939a) Distribution of littoral barnacles in Formosa. Zoological Magazine Tokyo 51: 1–128.
- Hiro F (1939b) Studies on the cirripedian fauna of Japan IV. Cirripeds of Formosa (Taiwan), with some geographical and ecological remarks on the littoral forms. Memoirs of the College of Science, Kyoto Imperial University, Series B 15: 245–284.
- Hiro F (1939c) Studies on the Cirripedian fauna of Japan III. Supplementary notes on the Cirripeds found in the Vicinity of Seto. Memoirs of the College of Science, Kyoto University, Series B 15: 237–244.
- Hoek PPC (1883) Report on the Cirripedia collected by H.M.S. Challenger during the years 1873–76. Report of the Scientific Results from the Exploratory Voyages of H.M.S. Challenger, Zoology 8: 1–169. <https://doi.org/10.5962/bhl.title.12873>
- Hoek PPC (1907) Pedunculata. The Cirripedia of Siboga Expedition. Siboga-Expeditie, Monograph 31a: 1–127. <https://doi.org/10.5962/bhl.title.63641>

- Hoek PPC (1913) The Cirripedia of the Siboga Expedition. B. Cirripedia Sessilia. Siboga-Expeditie Monographie 31b: 129–275.
- Hoeksema BW (2007) Delineation of the Indo-Malayan centre of maximum marine biodiversity: the Coral Triangle. Biogeography, time, and place: distributions, barriers, and islands. Springer, Dordrecht, 117–178. [https://doi.org/10.1007/978-1-4020-6374-9\\_5](https://doi.org/10.1007/978-1-4020-6374-9_5)
- Holthuis LB (1982) The nomenclature of some coral-inhabiting barnacles of the family Pyrgomatidae (Cirripedia, Balanomorpha). Crustaceana 43(3): 316–320. <https://doi.org/10.1163/156854082X00272>
- Huang ZG (1994) Cirripedia. In: Huang ZG (Ed.) Marine Species and their Distribution in China's Seas. China Ocean Press, Beijing, 516–523.
- Jones DS (1992) Scalpellid barnacles (Cirripedia: Thoracica) from the northeastern and central eastern Australian continental shelf and slope. Memoirs of the Queensland Museum 32(1): 145–178.
- Jones DS (2000) Crustacea Cirripedia Thoracica: Chionelasmatoidea and Pachylasmatoidea (Balanomorpha) of New Caledonia, Vanuatu and Wallis and Futuna Islands, with a review of all currently assigned taxa. In Crosnier A (Ed.) Résultats des Campagnes MUSORSTOM (Vol. 21). Mémoires du Muséum national d'Histoire naturelle 184: 141–283.
- Jones DS (2004) Barnacles (Cirripedia: Thoracica) of the Dampier Archipelago, Western Australia. In: Jones DS (Ed.) Report on the results of the Western Australia Museum/Woodside Energy Limited Partnership to explore the Marine Biodiversity of the Dampier Archipelago, Western Australia 1998–2002. Records of the Western Australian Museum, Supplement 66: 121–157. <https://doi.org/10.18195/issn.0313-122x.66.2004.121-157>
- Jones DS (2007) The Cirripedia of New Caledonia. In: Payri CE, Richer de Forges B (Eds) Compendium of Marine Species from New Caledonia. Institut de Recherche pour le Développement, Nouméa, 289–294.
- Jones DS (2012) Australian barnacles (Cirripedia: Thoracica), distributions and biogeographical affinities. Integrative and Comparative Biology 52(3): 366–387. <https://doi.org/10.1093/icb/ics100>
- Jones DS, Anderson JT, Anderson DT (1990) Checklist of the Australian Cirripedia. Technical Reports of the Australian Museum 3: 1–38. <https://doi.org/10.3853/j.1031-8062.3.1990.76>
- Jones DS, Hewitt MA, Sampey A (2001) A checklist of the Cirripedia of the South China Sea. Raffles Bulletin of Zoology. National University of Singapore 48: 233–308.
- Jones DS, Hosie AM (2016) A checklist of the barnacles (Cirripedia: Thoracica) of Singapore and neighbouring waters. Raffles Bulletin of Zoology 34: 241–311.
- Koçak AÖ, Kemal M (2008) Notes on the nomenclature of some genus group names in Arthropoda. Miscellaneous Papers, Centre for Entomological Studies, Ankara 138: 1–2.
- Krüger DP (1911) Beiträge zur Cirripedenfauna Ostasiens. In: Doflein F (ed.) Beiträge zur Naturgeschichte Ostasiens. Kongelige Bayerische Akademie der Wissenschaften, Munich Mathematische-physikalische Klasse, Abhandlungen Supplement-Band 2(6): 1–72.
- Krüger DP (1940) Cirripedia. In: Bronns HG (Ed.) Klassen und Ordnungen des Tierreichs, 5 (Abt. 1, Buch 3): 1–560.
- Laksmana RMV, Newman WA (1972) Thoracic Cirripedia from Guyots of the mid-pacific mountains. Transactions of the San Diego Society for Natural History 17(6): 69–94. <https://doi.org/10.5962/bhl.part.19960>
- Lamarck JBPA de M de (1806) Discours d'Ouverture du Cours des Animaux sans Vertèbres, prononcé dans le Muséum d'Histoire naturelle en mai 1806. Paris, 1806 pp. [8 volumes.]
- Lanchester WF (1902) On the Crustacea collected during the Skeat Expedition to the Malay Peninsula. Proceedings of the Zoological Society of London 2(3): 363–381.
- Leach WE (1817) Distribution, systématique de la class Cirripèdes: par la même. Journal de Physique de Chimie et d'Histoire naturelle 85: 67–69.
- Lin HC, Cheang CC, Cobari L, Chan BKK (2020) Trans-Pacific genetic differentiation in the deep-water stalked barnacle *Scalpellum stearnsii* (Cirripedia: Thoracica: Scalpellidae). Deep-Sea Research Part 1: Oceanographic Research Papers. <https://doi.org/10.1016/j.dsr.2020.103359>
- Linnaeus C (1758) Systema Naturae per Regna tria Naturae, Secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis. Editio decima, reformata. Laurentii Salvii: Holmiae, Stockholm, 824 pp. <https://doi.org/10.5962/bhl.title.542>
- Linnaeus C (1767) Systema Naturae per Regna tria Naturae. Tomus I (2). Editio duodecima, reformata. Laurentii Salvii, Holmiae [=Stockholm], 533–1237.
- Liu RY, Ren XQ (1985) Studies on Chinese Cirripedia (Crustacea). VI. Suborder Lepadomorpha. Studia Marina Sinica 25: 179–281. [in Chinese]
- Liu RY, Ren XQ (2007) Fauna Sinica. Invertebrata (Vol. 42). Crustacea Cirripedia Thoracica. Science Press, Beijing, 633 pp. [in Chinese]
- MacDonald R (1929) A report on some cirripedes collected by S.S. "Albatross" in the Eastern Pacific during 1892 and 1904. Bulletin of the Museum of Comparative Zoology at Harvard College 69(15): 527–538.
- Menesini E (1971) Nuove specie di *Balanus* (Cirripedia) dell' Eocene edell' Oligocene del bacina di Parigi. Bolletino della Societa Paleontologica Italiana 10: 19–34.
- Newman WA (1960) Five pedunculate cirripeds from the Western Pacific, including two new forms. Crustaceana 1(1): 100–116. <https://doi.org/10.1163/156854060X00159>
- Newman WA (1987) Evolution of cirripedes and their major groups. In: Southward AJ (Ed.) Barnacle Biology. Crustacean Issues 5. AA Balkema, Rotterdam, 3–42. <https://doi.org/10.1201/9781315138053-1>
- Newman WA (1993) Darwin and cirripedology. In: Truesdale J (Ed.) The History of Carcinology. Crustacean Issues, 8. AA Balkema, Rotterdam, 349–434. <https://doi.org/10.1201/9781003077633-20>
- Newman WA (1996) Sous-Classes des Cirripèdes (Cirripedia Burmeister, 1834) Superordres des Thoraciques et des Acrothoraciques (Thoracica Darwin, 1854 – Acrothoracica Gruvel, 1905). In: Forest J (Ed.) Traité de Zoologie, Anatomie, Systématique, Biologie, 7, Crustacés, Fasciculus 2, Généralités (suite) et Systématique. Masson, Paris, 453–540.
- Newman WA, Ross A (1971) Antarctic Cirripedia: monographic account based on specimens collected chiefly under the United States Antarctic Research Program, 1962–1965 (Vol. 14). American Geophysical Union, Washington, 257 pp.
- Newman WA, Ross A (1976) Revision of the balanomorph barnacles; including a catalog of the species. Memoirs of San Diego Society of Natural History 9: 1–108.
- Newman WA, Abbott DP (1980) Cirripedia: the barnacles. Intertidal Invertebrates of California: 504–535. <http://decapoda.arthroinfo.org/pdfs/31753/31753.pdf>.
- Newman WA, Zullo VA, Withers TH (1969) Cirripedia. In: Moore RC (Ed.) Treatise of Invertebrate Palaeontology, Part R: Arthropoda 4(1). Geological Society of America and the University of

- Kansas, Lawrence, Kansas, R206–R295. [figs. 1–119.] <https://doi.org/10.17161/dt.v0i0.5628>
- Nilsson-Cantell CA (1921) Cirripeden-studien. Zur Kenntnis der biologie, anatomie und systematik dieser gruppe, Zoologiska Bidrag Från Uppsala 7: 75–395. <https://doi.org/10.5962/bhl.title.10682>
- Nilsson-Cantell CA (1925) Nueu und wenig bekannte Cirripeden aus den Museen zu Stockholm und zu Upsala. Arkiv for Zoologie 18A(3): 1–46.
- Nilsson-Cantell CA (1927) Some barnacles in the British Museum (Nat. Hist.). Proceedings of the Zoological Society of London 1927(3): 743–790. <https://doi.org/10.1111/j.1469-7998.1927.tb07432.x>
- Nilsson-Cantell CA (1928) Studies on cirripeds in the British Museum (Natural History). Annals and Magazine of Natural History 10(2): 1–39. <https://doi.org/10.1080/00222932808672845>
- Nilsson-Cantell CA (1931) Cirripeds from the Indian Ocean and Malay Archipelago in the British Museum (Natural History), London. Arkiv for Zoologie 23A(18): 1–12.
- Nilsson-Cantell CA (1934) Cirripeds from the Malay Archipelago in the Zoological Museum of Amsterdam. Zoologische Mededeelingen 17: 31–63.
- Nilsson-Cantell CA (1938) Cirripedes from the Indian Ocean in the collection of the Indian Museum, Calcutta. Memoirs of the Indian Museum 13(1): 1–81. [28 figs. [3 pls]]
- Oakley TH, Wolfe JM, Lindgren AR, Zaharoff AK (2013) Phylotranscriptomics to bring the understudied into the fold: Monophyletic Ostracoda, fossil placement, and pancrustacean phylogeny. Molecular Biology and Evolution 30(1): 215–233. <https://doi.org/10.1093/molbev/mss216>
- Oliviera LPH de (1941) Contribuicao ao conhecimento dos coustaceos do Rio de Janeiro, suborder ‘Balanomorpha’ (Cirripedia, Thoracica). Memoirs of the Institute Oswaldo Crus 36(1): 1–31. [text fig. 1, pls. 1–11.] <https://doi.org/10.1590/S0074-02761941000100004>
- Ozaki Y, Yusa Y, Yamato S, Imaoka T (2008) Reproductive ecology of the pedunculated barnacle *Scalpellum stearnsii* (Cirripedia: Lepadomorpha:Scalpellidae). Journal of the Marine Biological Association of the United Kingdom 472(88): 77–83. <https://doi.org/10.1017/S0025315408000131>
- Philippi RA (1836) Cirripedia. Enumeratio Molluscorum Siciliae cum Viventium tum in Tellure Tertiaria Fossilium, Quae in Itinere suo Observavit (Vol. 1). Schropp, Berolini [= Berlin], 267 pp. [pls. 1–12] <https://doi.org/10.5962/bhl.title.100735>
- Pilsbry HA (1890a) Description of *Scalpellum stearnsii* sp. nov. The Nautilus 4: 1–96.
- Pilsbry HA (1890b) Description of a new Japanese *Scalpellum*. Proceedings of the Academy of Natural Sciences, Philadelphia 42: 441–443.
- Pilsbry HA (1907a) The barnacles (Cirripedia) contained in the collections of the United States National Museum. Bulletin of the United States National Museum 60: 1–122. <https://doi.org/10.5479/si.03629236.60.1>
- Pilsbry HA (1907b) Notes on some Pacific cirripedes. Proceedings of the Academy of Natural Sciences, Philadelphia 59: 360–362.
- Pilsbry HA (1907c) Cirripedia from the Pacific coast of North America. Bulletin of the United States Bureau of Fisheries, Washington 26(617): 193–204.
- Pilsbry HA (1907d) Hawaiian Cirripedia. Cirripedia from the Pacific Coast of North America. Bulletin of the United States Bureau of Fisheries, Washington, XXVI (No. 617): 179–204. [figs. 1–4, pls. 6–11.]
- Pilsbry HA (1911) Barnacles of Japan and Bering Sea. Bulletin of the United States Bureau of Fisheries, Washington, XXIX, 1909, 739: 61–84. [pls. VIII–XVII]
- Pilsbry HA (1912) Diagnoses of new barnacles from the Philippine Archipelago and China Sea. Proceedings of the United States National Museum 42(1902): 291–294. <https://doi.org/10.5479/si.00963801.1904.291>
- Pilsbry HA (1916) The sessile barnacles (Cirripedia) contained in the collections of the United States National Museum; including a monograph of the American species. Bulletin of the United States National Museum 93: 1–366. <https://doi.org/10.5479/si.03629236.93.1>
- Pilsbry HA (1928) Littoral barnacles of the Hawaiian Islands and Japan. Proceedings of the Academy of Natural Sciences, Philadelphia 79: 305–317.
- Pitombo FB (2004) Phylogenetic analysis of the Balanidae (Cirripedia: Balanomorpha). Zoologica Scripta 33(3): 261–276. <https://doi.org/10.1111/j.0300-3256.2004.00145.x>
- Pitriana P, Valente L, von Rintelen T, Jones DS, Prabowo RE, von Rintelen K (2020) An annotated checklist and integrative biodiversity discovery of barnacles (Crustacea: Cirripedia) from the Moluccas, East Indonesia. ZooKeys 945: 17–83. <https://doi.org/10.3897/zookeys.945.39044.figure17>
- Pochai A, Kingtong S, Sukparangsi W, Khachonpisitsak S (2017) The diversity of acorn barnacles (Cirripedia, Balanomorpha) across Thailand’s coasts: The Andaman Sea and the Gulf of Thailand. Zoosystematics and Evolution 93: 13–34. <https://doi.org/10.3897/zse.93.10769>
- Poltarukha OP (2013) Barnacles (Cirripedia: Thoracica) from the Equatorial East Pacific. Russian Journal of Marine Biology 39(1): 51–57. <https://doi.org/10.1134/S1063074013010070> [in Russian]
- Puspasari IA, Yamaguchi T, Kojima S (2001) Phylogeny of the *Balanus amphitrite* complex occurring in Japan (Cirripedia: Balanidae) inferred from mitochondrial COI gene and morphology. Sessile Organisms 18(1): 7–17. <https://doi.org/10.4282/sosj.18.7>
- Ren XQ (1983) Five new species of Suborder Lepadomorpha (Cirripedia: Thoracica) from Chinese waters. Oceanologia et Limnologia Sinica 14: 74–87. [in Chinese]
- Ren XQ (1984) Studies on Chinese Cirripedia (Crustacea). IV. Family Verrucidae. Studia Marina Sinica 23(9): 165–178.
- Ren XQ (1986) Studies on Chinese Cirripedia (Crustacea). VII. Family Pyrgomatidae. Studia Marina Sinica 26(7): 129–153.
- Ren XQ (1989) Two new species and one new record of Cirripedia Thoracica from South China Sea. Institute of Oceanology, Academia Sinica, Qingdao 20(5): 466–473.
- Ren XQ, Liu JY (1978) Studies on Chinese Cirripedia (Crustacea). I. Genus *Balanus*. Studia Marina Sinica 13: 119–196.
- Richer DFB, Chan TY, Corbari L, Lemaitre R, Macpherson E, Ah Yong ST, Ng PKL (2013) The Musorstom-TDSB deep-sea benthos exploration program (1976–2012): An overview of crustacean discoveries and new perspectives on deep-sea zoology and biogeography. In: Ah Yong ST, Chan TY, Corbari L, Ng PKL (Eds) Tropical Deep-Sea Benthos 27. Muséum national d’Histoire naturelle, Paris: 13–66 (Mémoires du Muséum national d’Histoire naturelle: 204). ISBN: 978-2-85653-692-6.
- Rogers F (1949) Three new subspecies of *Balanus amphitrite* from California. Journal of Entomology & Zoology, Claremont College 41: 23–32. [1 pl.]
- Rosell NC (1981) Crustacea – Cirripedia. Résultats des Campagnes MUSORSTOM 1 – Philippines. 1976. 1. Mémoires ORSTOM 91: 277–307.



- Rosell NC (1986) Barnacles. Guide to the Flora and Fauna of the Philippines (Vol. 7). National Resources Management Center, Ministry of Natural Resources, The Philippines, 79–164.
- Rosell NC (1989) Thoracic Cirripeds from the MUSORSTOM 2 Expedition. In: Forest J (Ed.) Résultats des Campagnes MUSORSTOM, Volume 5. Mémoires du Muséum national d'Histoire naturelle (A) 144: 9–35.
- Rosell NC (1991) Crustacea Cirripedia Thoracica: MUSORSTOM 3 Philippines collection. In: Crosnier A (Ed.) Résultats des Campagnes MUSORSTOM (Vol. 9). Mémoires du Muséum national d'Histoire naturelle (A) 152: 9–61.
- Ross A, Newman WA (1973) Revision of the coral-inhabiting barnacles (Cirripedia: Balanidae). Transactions of the San Diego Natural History Society 17(12): 136–173. [figs. 1–25.]
- Ross A, Pitombo FB (2002) Notes on the coral-inhabiting Megatrematinae and the description of a new tribe, new genus and three new species (Cirripedia: Sessilia: Pyrgomatidae). Sessile Organisms 19(2): 57–68. <https://doi.org/10.4282/sosj.19.57>
- Say T (1822) An account of some marine shells of the United States. Journal of the Academy Natural Sciences Philadelphia 2(2): 221–248. [302–325.]
- Shalaeva K, Boxshall G (2014) An illustrated catalogue of the scalpellid barnacles (Crustacea: Cirripedia: Scalpellidae) collected during the HMS “Challenger” expedition and deposited in the Natural History Museum, London. Zootaxa 3804(1): 1–63. <https://doi.org/10.11646/zootaxa.3804.1.1>
- Sowerby GB (1823) The genera of recent and fossil shells, for the use of students in Conchology and Geology, with original plates by James Sowerby (nos. i–xvii), continued by J. de C. Sowerby (nos. xviii–xlii). GB Sowerby, London. [No pagination, 270 plates] [1821–1834]
- Steenstrup J (1837) Om Forverdenens Dyrarter af de tvende Familier Anatiferae (Gray) og Pollicipedidae (Gray). Krøyer's Naturhistoriske Tidsskrift 1: 396–415.
- Stubbings HG (1936) Cirripedia. The John Murray Expedition 1933–34. Scientific Reports, Zoology 4(1): 1–70.
- Stubbings HG (1961) Cirripedia Thoracica from tropical West Africa. Scientific results of the Danish Expedition to the coasts of tropical West Africa, 1945–1946. Atlantide Reports 6: 7–41.
- Stubbings HG (1963a) Cirripedia from South Vietnam. Videnskabelige Meddelelser Naturhistorisk Forening i København 125: 327–335.
- Stubbings HG (1963b) Cirripedia of the tropical South Atlantic coast of Africa. Expédition Océanographique belge dans les eaux côtières africaines de l'Atlantique sud (1948–1949). Research Science 3(10): 1–39.
- Stubbings HG (1967) The cirriped fauna of tropical west Africa. Bulletin of the British Museum (Natural History), Zoology 15(6): 229–319. [pl. 1.] <https://doi.org/10.5962/bhl.part.27518>
- Tarasov NE, Zevina ZB (1957) Cirripedia Thoracica of the Seas of USSR. Fauna Russian Natural Science 69, 6(1): 1–267. [In Russian]
- Utinomi H (1949) Further notes on cirripeds from the Ogasawara Islands. Pacific Science 3(1): 93–99. <https://doi.org/10.5134/174435>
- Utinomi H (1962) Studies on the cirripedian fauna of Japan. VIII Thoracic cirripeds from Western Kyusu. Publications of the Seto Marine Laboratory 10(2): 211–239. [figs. 1–12.] <https://doi.org/10.5134/175313>
- Utinomi H (1965) A giant Antarctic barnacle *Hexelasma antarcticum* Borradaile (Cirripedia Thoracica). Scientific Reports of the Japanese Antarctic Research Expedition 1956–1962, Series E, 25: 1–15. [figs. 1–4. [pls. 1–2]]
- Utinomi H (1966) Recent immigration of two foreign barnacles into Japanese waters. Proceedings of the Japanese Society of Systematic Zoology 2: 36–39.
- Utinomi H (1968) Pelagic, shelf and shallow water cirripedia from the Indo West Pacific. Videnskabelige Meddelelser Naturhistorisk Forening i København 131: 161–186. [pls. 1–2]
- Utinomi H (1969) Cirripedia of the Iranian Gulf. Videnskabelige Meddelelser Naturhistorisk Forening i København 132: 79–94.
- Utinomi H (1970) Studies on the cirripedian fauna of Japan 9. Distributional survey of the thoracic cirripedes in the southeastern part of the Japanese Sea. Publications of the Seto Marine Laboratory 17(5): 339–372. [figs. 1–72.] <https://doi.org/10.5134/175604>
- Utinomi H, Kikuchi T (1966) Fauna and flora of the sea around the Amakusa Marine Biological Laboratory. Amakusa Marine Biology Laboratory, Kyushu University 6: 1–12. [fig. 1.]
- Weisbord NE (1977) Scalpellid barnacles (Cirripedia) of Florida and surrounding waters. Bulletin of American Paleontology 72(299): 235–311.
- Weltner W (1897) Verzeichnis der bisher beschriebenen recenten Cirripeden-Arten. Mit Angabe der im Berliner Museum vorhandenen species und ihrer fundorte. Archiv für Naturgeschichte, Jahrbücher 63(1): 227–280.
- Weltner W (1922) Cirripedia der Deutschen Tiefsee-Exped. Wissenschaftliche Ergebnisse der Deutschen Tiefsee- Expedition auf dem Dampfer ‘Valdivia’ 1895–1899 23(2): 61–112.
- Withers TH (1935) Catalogue of Fossil Cirripedia in the Department of Geology (Vol. 2). Cretaceous. British Museum (Natural History), London, 534 pp.
- WoRMS Editorial Board (2020) World Register of Marine Species. <https://www.marinespecies.org> at VLIZ. [Accessed 2020-06-07]
- Young PS (1998) Cirripedia (Crustacea) from the “Campagne Biacores” in the Azores region, including a generic revision of Verrucidae. Zoosystema 20: 31–92.
- Young PS (2001) Redescription of *Scalpellopsis striatociliata* Broch, 1922, with a discussion on its phylogenetic position and the peduncular plate pattern in scalpellids. Journal of Crustacean Biology 21(2): 456–468. <https://doi.org/10.1163/20021975-99990147>
- Young PS (2007) The Scalpellomorpha (Crustacea, Cirripedia), with a list of extant species (except the Calanticidae). Galathea Report 21: 7–73.
- Yusa Y, Yasuda N, Yamamoto T, Watanabe HK, Higashiji T, Kaneko A, Nishida K, Høeg JT (2018) Direct growth measurements of two deep-sea scalpellid barnacles, *Scalpellum stearnsii* and *Graviscalpellum pedunculatum*. Zoological Study 57: 1–29.
- Zevina GB (1969) Cirripedia Thoracica. In: Kort VG (Ed.) The Biology of the Pacific Ocean. Deep Sea Bottom Fauna (Vol. 2). Nauka, Moscow, 66–68. [in Russian]
- Zevina GB (1970) Cirripedia Thoracica from North West Pacific. Trudy Instituta Oceanologii Akademii Nauk SSSR 86: 252–276. [in Russian]
- Zevina GB (1972) Benthic Lepadomorpha (Cirripedia) from the southeast Pacific. Crustaceana 22: 39–63. <https://doi.org/10.1163/156854072X00660>
- Zevina GB (1974) The Cirripedia Thoracica of the Kerguelen Islands. Crustaceana 27: 209–215. <https://doi.org/10.1163/156854074X00433>
- Zevina GB (1975) Cirripedia Thoracica of the American Caribbean. Trudy Instituta Oceanologii Akademii, Nauk USSR 100: 233–258. [in Russian]

- Zevina GB (1978a) A new classification of the family Scalpellidae Pilsbry (Cirripedia, Thoracica). Part 1. Subfamilies Lithotryinae, Calanticiinae, Pollicipinae, Scalpellinae, Brochiinae and Scalpellopsinae. *Zoologicheskii Zhurnal* 57 (7): 998–1007. [in Russian]
- Zevina GB (1978b) A new classification of the Scalpellidae (Cirripedia, Thoracica). Part 2. Subfamilies Arcoscalpellinae and Meroscalpellinae. *Zoologicheskii Zhurnal* 57(9): 1343–1352. [in Russian]
- Zevina GB (1981) Barnacles of the Suborder Lepadomorpha (Cirripedia, Thoracica) of the world oceans. I: Family Scalpellidae. *Fauna SSSR* 127: 1–398. [in Russian]
- Zevina GB (1982) Barnacles of the suborder Lepadomorpha (Cirripedia, Thoracica) of the world ocean. Part 2. Guides to the fauna of the USSR-Zoologicheskii Institut Akademy Nauk SSSR, Leningrad, 223 pp. [162 figs. [in Russian]]
- Zevina GB (1987) Deep-sea Verrucomorpha (Cirripedia, Thoracica) of the Pacific. 1. The North Pacific. *Zoologicheskii Zhurnal* 66(12): 1812–1821. [in Russian]
- Zevina GB, Zvyagintsev AY, Negashev SE (1992) Usonogie raki poberezh'ya V'etnama i ikh rol'v obrastanii [Barnacles of the Vietnam Coast and their role in encrustation]. Vladivostok, Dal'nauka, 142 pp. [figs. 69, tables 8. [in Russian]]
- Zullo VA, Newman WA (1964) Thoracic Cirripedia from a South East Pacific Guyot. *Pacific Science* 18: 355–372.

## Supplementary material 1

### Tables S1–S39

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Data type: Checklist table of species and morphometric for each species

Explanation note: **Table S1.** Checklist of barnacle species collected during the Karubar expedition (1991) and deposited in MNHN, Paris. **Tables S2–39.** Morphometric/measurements for each species.

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