Lucinidae of the Philippines: highest known diversity and ubiquity of chemosymbiotic bivalves from intertidal to bathyal depths (Mollusca: Bivalvia)

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ABSTRACT

From the Philippines at the centre of Indo-West Pacific marine diversity we record 78 species and 42 genera from 7 subfamilies of the chemosymbiotic bivalve family Lucinidae. Sixty species were identified from over 16,000 lucinid specimens collected in the central Philippines from the PANGLAO 2004 Biodiversity Project and the PANGLAO 2005 Deep-Sea Cruise. Other species were identified from samples collected by other expeditions to the area (ESTASE 2, MUSORSTOM 2 & 3 and AURORA 2007) and from existing museum collections. Twenty-six new species and three new genera, *Opalocina*, *Easmithia* and *Jallenia* are described. Notable are the five species of *Myrtina*, and seven *Notomyrtea* recognised and *Pseudolucinisca* recorded for the first time outside of South and Western Australia. Species range in size from 1.5 to 87 mm, with 37 species smaller than 15 mm and 11 less than 5 mm, including some of the most abundant. Lucinidae have a wide habitat distribution and a total bathymetric range from the intertidal to 2570 m with up to 27 species occurring between 100-300 m. Deeper water assemblages, dominated by species of Leucosphaerinae, Myrteinae and *Cardiolucina*, begin at depths of *ca.* 100 m with a turnover of species to 1000 m with 3 species recorded from 2570 m. Protoconchs of 53 species were examined and these demonstrate different strategies of larval development. Deeper water species of Leucosphaerinae, Myrteinae and *Cardiolucina* tend to have large P1 with a very narrow PII stage indicating a short non-feeding pre-settlement stage while many shallow water species in the Lucininae have larger PII stages, often with many growth increments, indicating a longer, feeding planktonic stage. Microsculpture characters at magnifications to 2000x, examined for the first time, indicate a strong taxonomic signal with Myrteinae possessing mesh-like pitted structures and Codakiinae linear pitting, while Leucosphaerinae lack these structures. The Philippine lucinid fauna is by far the most diverse yet recorded demonstrating that chemosymbiosis is a common and widespread nutritional strategy and not confined to extreme or unusual habitats.

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RÉSUMÉ

Les Lucinidae des Philippines (Mollusca : Bivalvia) : une diversité exceptionnelle de bivalves chémosymbiotiques présents à toutes les profondeurs de la côte aux grands fonds.

Les Philippines sont au centre de la richesse de la province marine Indo-Pacifique. Le présent travail y documente 78 espèces de Lucinidae, une famille de bivalves chémosymbiotiques, classées dans 42 genres et 7 sous-familles. L'examen de 16.000 spécimens échantillonnés par le PANGLAO 2004 Biodiversity Project et le PANGLAO 2005 Deep-Sea Cruise a révélé la présence de 60 espèces. D'autres proviennent d'autres expéditions récentes conduites dans l'archipel (ESTASE 2, MUSORSTOM 2 et 3, AURORA 2007) ou encore de l'examen des collections de musées. Vingt-six espèces et les trois genres *Opalocina*, *Easmithia* et *Jallenia* sont décrits comme nouveaux. Cinq espèces de *Myrtina*, sept espèces de *Notomyrtea* et le genre *Pseudolucinisca* sont signalés pour la première fois en dehors de l'Australie méridionale et occidentale. La taille adulte des espèces va de 1,5 à 87 mm ; 37 espèces font moins de 15 mm, dont onze moins de 5 mm, parmi lesquelles certaines des espèces les plus abondantes. Les Lucinidae occupent une gamme d'habitats étendue, avec une répartition bathymétrique s'étendant de la côte à 2750 mètres, et pas moins de 27 espèces dans la tranche 100-300 m. Les guildes de grande profondeur sont dominées par les espèces de Leucosphaerinae, Myrteinae et le genre *Cardiolucina* ; ces assemblages démarrent vers 100 mètres, avec divers remplacements faunistiques se succédant jusqu'à 1000 mètres, et trois espèces encore présentes à 2750 m. Les protoconques des 53 espèces qui ont pu être examinées montrent différentes stratégies de développement larvaire. Les espèces d'eau profonde de Leucosphaerinae, Myrteinae et *Cardiolucina* ont en général des grosses protoconques I et une protoconcque II étroite, indiquant un court stade lécitotrophe avant la métamorphose. Au contraire, la plupart des espèces de Lucininae de petits fonds ont des protoconques II plus grandes, souvent avec plusieurs stries de croissance, indiquant un stade larvaire planctotrophe de plus longue durée. Les éléments de la microsculpture, examinés pour la première fois à des grossissements de x2000, ont révélé un fort signal taxonomique : les Myrteinae sont caractérisés par des structures de puits en réseau, alors que ces puits sont alignés chez les Codakiinae, et qu'ils sont absents chez les Leucosphaerinae. La faune de Lucinidae des Philippines est de loin la plus diverse qui ait été documentée à ce jour ; cette diversité montre que la chémosymbiose est une stratégie commune et répandue, et qu'elle n'est en rien confinée à des habitats extrêmes ou inhabituels.

INTRODUCTION

Lucinidae are by far the most diverse of all chemosymbiotic bivalve families with more than 400 living species distributed from latitudes 70° N to 55° S at water depths from the intertidal zone down to 2500 m (Taylor & Glover 2000; 2006). Although lucinids are often considered to be a predominantly shallow water family, new research is revealing a surprising diversity in bathyal habitats (Salas & Woodside 2002; Holmes *et al.* 2005; Oliver & Holmes 2006; Cosel & Bouchet 2008; Taylor & Glover 2009a, Oliver *et al.* 2011; Taylor *et al.* 2014). They occupy a broad range of shallow habitats, from mud and sheltered sands, mangrove sediments, seagrass beds, sites of high organic input such as sewage disposal sites and locations where sunken vegetation accumulates. Additionally they live in coral reef associated habitats including seagrass, lagoon sands and amongst boulders in reef flats. In deeper water, lucinids are associated with oxygen minimum zones, hydrocarbon seeps, mud volcanoes, sunken vegetation and hydrothermal vents (Taylor & Glover 2010). Shallow water lucinids can reach population densities of several thousand per square metre (Meyer *et al.* 2008; Heide *et al.* 2012) and abundant lucinids have also been recorded associated with hydrocarbon seeps (Callender & Powell 2000). Living lucinids vary in size from a few millimetres to lengths of 150 mm but an Eocene fossil reached over 300 mm (Taylor & Glover 2009b).

The symbiosis between lucinid bivalves and sulphide-oxidising bacteria housed in the ctenidia is now well known through numerous investigations (*e.g.*, Giere 1985; Dando *et al.* 1986; Reid & Brand 1986; Distel & Felbeck 1987; Frenkiel & Mouëza 1995; Frenkiel *et al.* 1996; Gros *et al.* 1996, 2000; Ball *et al.* 2009). All studied species, representing a broad spectrum of taxa and sampled from a wide range of habitats, possess symbionts and the chemosymbiosis is presumed obligate for the family. Experiments by Gros *et al.* (2003; 2012) have shown how the symbionts are acquired by environmental transmission from the sediment. Nevertheless, lucinids are functionally capable of particulate feeding (Duplessis *et al.* 2004) and their hind guts may contain algal and sediment material.

Continuing systematic studies of Lucinidae from both shallow (Glover & Taylor 2007; Glover & Taylor 2008; Glover, Taylor & Williams 2008; Taylor & Glover 2009a) and deep-water habitats (Glover, Taylor & Rowden 2004; Cosel 2006;

Oliver & Holmes 2006; Cosel & Bouchet 2008; Taylor & Glover 2009a; Okutani 2011; Oliver *et al.* 2011) have demonstrated that diversity has been grossly underestimated, with a plethora of new species and genera described within the last 15 years. Despite this activity it is clear from recent and continuing intensive sampling of subtidal and bathyal habitats in the tropical Indo-West Pacific, particularly by French research cruises, that there are numerous undescribed species. Moreover, undescribed species will be present amongst samples from older deep-water expeditions such as the Albatross collections from Philippines, held in the USNM.

Although we are generally aware that lucinid species richness is highest in the central IWP, the 'Coral Triangle' of diversity, this has never been adequately documented and the most diverse lucinid fauna recorded to date is the 34 species from less than 200 m resulting from wide scale sampling of sites around New Caledonia (Glover & Taylor 2007). The 2004, 2005 Panglao Marine Biodiversity Project expeditions to the central Philippines involving intensive sampling of shallow habitats and deeper sites to over 1000 metres (Bouchet *et al.* 2009; Richer de Forges *et al.* 2009) recovered large quantities of lucinids, many of new species or previously poorly known taxa. In this paper we document this lucinid fauna from the Panglao area and combine it with other samples from earlier French MNHN/ORSTOM expeditions to the central Philippines: MUSORSTOM 2 in 1980, MUSORSTOM 3 in 1985 (Forest 1986, 1989) and ESTASE 2 in 1984 (Labeyrie 1990). Also we examined material from the AURORA 2007 expedition to eastern Luzon. All this material, together with records from existing museum collections, has been combined to provide a synthesis of the Lucinidae of the Philippines to a depth of 2500 m. Some of the larger deep-water lucinid species from the Philippines collected during the MUSORSTOM 2 & 3 expeditions were described and documented by Cosel & Bouchet (2008) and are briefly reviewed herein.

The earliest compilation of Philippine lucinids was by Fr. Castro de Elera (1896) who mentioned 20 species of which 12 are valid Philippine records. Hidalgo (1904-5) listed 18 species of lucinids, including three species of *Corbis* (=*Fimbria*), but three of these are based on records with erroneous localities and one is an ungulinid. The same species are listed by Faustino (1928) with two additions. Most recently, 41 species from the Philippines were illustrated by Poppe & Tagaro (2011) but there are a some misidentifications; for example two shells, pl. 1067, figs 6-8 identified as *Myrtea lamellosa* and *M. tanimbarenis*, belong in the Semelidae. Some live-collected lucinids from both Panglao expeditions were included in a molecular phylogenetic analysis (Taylor *et al.* 2011) and Brissac *et al.* (2010) characterised bacterial symbionts of six lucinids from PANGLAO 2005.

In addition to descriptions of new species and genera we also include novel morphological data such as details of hinge teeth, larval shell (protoconch) and microsculpture for many previously described species. Protoconch characters are poorly known for lucinids and the Philippine data provides insights into systematics, life history strategies and dispersal capabilities of the species. Microsculptural characters revealed by scanning electron microscopy (SEM) have potential application in phylogenetic analysis. One previously described Philippine species, *Notomyrtea scitulum* (A. Adams, 1853), is illustrated for the first time.

MATERIAL AND METHODS

The main focus of this study are the collections made around Panglao Island, Bohol, Philippines by the shallow water PANGLAO 2004 expedition (see overview and stations see Bouchet *et al.* (2009), together with the deeper water stations sampled during the PANGLAO 2005 expedition (see Richer de Forges *et al*. 2009). For PANGLAO 2004, 306 stations were sampled around Panglao Island, on the southeastern tip of Bohol Island, central Philippines, using a wide variety of techniques including intertidal hand collection, SCUBA collecting, SCUBA suction pump, substrate brushing, dredge and trawl at depths from 0-190 m. The deeper water offshore sampling of PANGLAO 2005 around southwestern Bohol Island and between Negros and Mindanao islands totalled 74 stations from 60-2300 m using beam trawl and Warén dredge. Coordinates and details of all the Panglao stations yielding Lucinidae are listed in the Appendix 1 & 2. Additional material was obtained from the AURORA 2007 cruise off eastern Luzon, for details see Bouchet & Santos (2007). Also included are species from the MUSORSTOM 2 & 3 expeditions to the north central Philippines (station details in Forest

1986, 1989) some of these previously described by Cosel & Bouchet (2008). Additionally, lucinids were recovered from one station of ESTASE 2 (Labeyrie 1990) off the southern Philippines.

Most of the lucinid material consisted of single valves and live-collected specimens were uncommon. In the "material examined" sections we have recorded single valves and paired valves – the latter equivalent to live-collected although we have not examined every paired valve for presence of a body. In the analysis of relative abundance paired and single valves were counted as one.

In descriptions we categorise overall size of the lucinids as follows: very small 1.5-5 mm, small 5-15 mm, medium 15-40 mm, large > 40 mm.

Where possible we have examined existing type material including collections of AM, ANSP, MNHN, RMNH, NHM UK, NMV, NMW and USNM.

Scanning electron microscopy (SEM) was used to illustrate small species, details of hinge teeth and protoconch features, and microsculptural characters such as pits and pores visible at magnifications up to *ca.* 2000x. All measurements were made from SEM images. In this study we follow Salas & Gofas (1997) in using the term protoconch rather than prodissoconch for the larval shell and the standard division (Ockelmann 1965) into protoconch I (PI) secreted by the shell gland and protoconch II (PII) secreted by the larval mantle edge. PI +PII is the maximum length of the protoconch in microns, PI is the length of protoconch I. PII was classified into 4 character states: 1) a narrow rim less than 8 mm; 2) a broader rim 8-15 mm; 3) small number (up to 5) distinct growth increments; 4) more than 5 growth increments.

All measurements in millimetres unless otherwise stated.

ABBREVIATIONS

Repositories

AM Australian Museum, Sydney;
ANSP Academy of Natural Sciences of Drexel University, Philadelphia;
LSL Linnean Society of London;
MHNG Muséum d'Histoire naturelle, Geneva;
MNHN Muséum national d'Histoire naturelle, Paris;
NHMUK The Natural History Museum, London;
NMV Museum Victoria, Melbourne;
NMW National Museum of Wales, Cardiff;
NSMT National Science Museum, Tokyo;
RMNH Naturalis Biodiversity Center, Leiden;
UMUT University Museum, Tokyo;
USNM National Museum of Natural History, Washington;
UUZM Uppsala University Zoological Museum;
ZMA Zoological Museum Amsterdam collections now in Naturalis Biodiversity Center, Leiden (RMNH).

Specimens

H shell height;
IWP Indo-West Pacific Oceans;
L shell length;
LV, **lv** left valve;
mm millimetre;
pv paired valves either live or with articulated valves;
PI protoconch I, length measured;
PII protoconch II length measured;

RV, **rv** right valve;
T tumidity single valve;
µm micron;
v single valve.

Station data
For PANGLAO 2004 stations the prefix indicates samples obtained by:
B brushing;
D and G dredge;
M intertidal collection;
R SCUBA hand collecting;
S SCUBA-operated suction pump;
T trawl.

For PANGLAO 2005 the prefix to station number denotes:
CC shrimp trawl;
CP beam trawl;
DW Warén dredge.

RESULTS

For ease of narrative we first provide the systematic descriptions of the Philippine lucinid fauna and follow this with an account of the diversity, distribution and abundance of the species. For well-known or recently documented species we provide short descriptions but full details and figures are given for new and poorly known taxa.

SYSTEMATIC ACCOUNT

Family LUCINIDAE Fleming, 1828

The phylogenetic analysis of the Lucinidae (Taylor *et al.* 2011, 2014) provided the framework for a new classification of the family into seven subfamilies. Further molecular analyses (unpubl. data) of additional taxa support this grouping. The order and grouping of genera into subfamilies used here follows this classification.

Subfamily PEGOPHYSEMINAE Taylor & Glover, 2011

In molecular analyses, *Anodontia alba* Link, 1807, the type species of *Anodontia*, does not group with the other '*Anodontia*' species. For this reason we combined these into a new subfamily, the Pegophyseminae, and elevated the subgenera of *Anodontia* used in Taylor & Glover (2005) to full generic status (Taylor *et al.* 2011).

Genus ***PEGOPHYSEMA*** Stewart, 1930

Pegophysema Stewart, 1930: 185.

Type species. *Lucina schrammi* Crosse, 1876, by original designation.

DIAGNOSIS — Shells large, thin, inflated; outer surface with irregular, rounded, commarginal ridges. Ligament internal, shallowly to deeply inset. Anterior adductor scar short, detached for 70% of length. Pallial line entire, with secondary pallial attachment scars (Taylor & Glover 2005: fig. 2) extending posteriorly from below anterior adductor scar.

Pegophysema philippiana (Reeve, 1850) comb. nov.

Figures 1A, B; 2A

Lucina philippiana Reeve, 1850: pl. 5, *Lucina* species 23a, b.
Anodontia (Pegophysema) philippiana – Taylor & Glover 2005: 303, figs 21A-D; 2007: 114, figs 2C, D.
Anodontia edentula (Linnaeus, 1758) – Sotto & Cosel 1982: 57. — Poppe & Tagaro 2011: 136, pl. 1063, fig. 1. — Geduspan *et al.* 2008: 36, fig. 1.
Anodontia stearnsiana (Oyama, 1954) – Poppe & Tagaro 2011: 136, pl. 1063, fig. 5.

TYPE MATERIAL — 3 syntypes NHMUK 1963122, 1963123/1-2.

TYPE LOCALITY — Not recorded.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn D8, 1-4 m, 1 v. – Stn M3, 0-2.5 m, 5 v. – Stn M5, 0-2 m, 2 v. – Stn M9, 0.5 m, 19 v. – Stn M11, 0-3 m, 1 pv, 3 v. – Stn M24, 0-1 m, 3 v. – Stn M26, 0-2 m, 8v. – Stn M44, 0 m, 2v. – Stn M61, 0 m, 1v; – Stn R78, 2-4 m, 1 v.

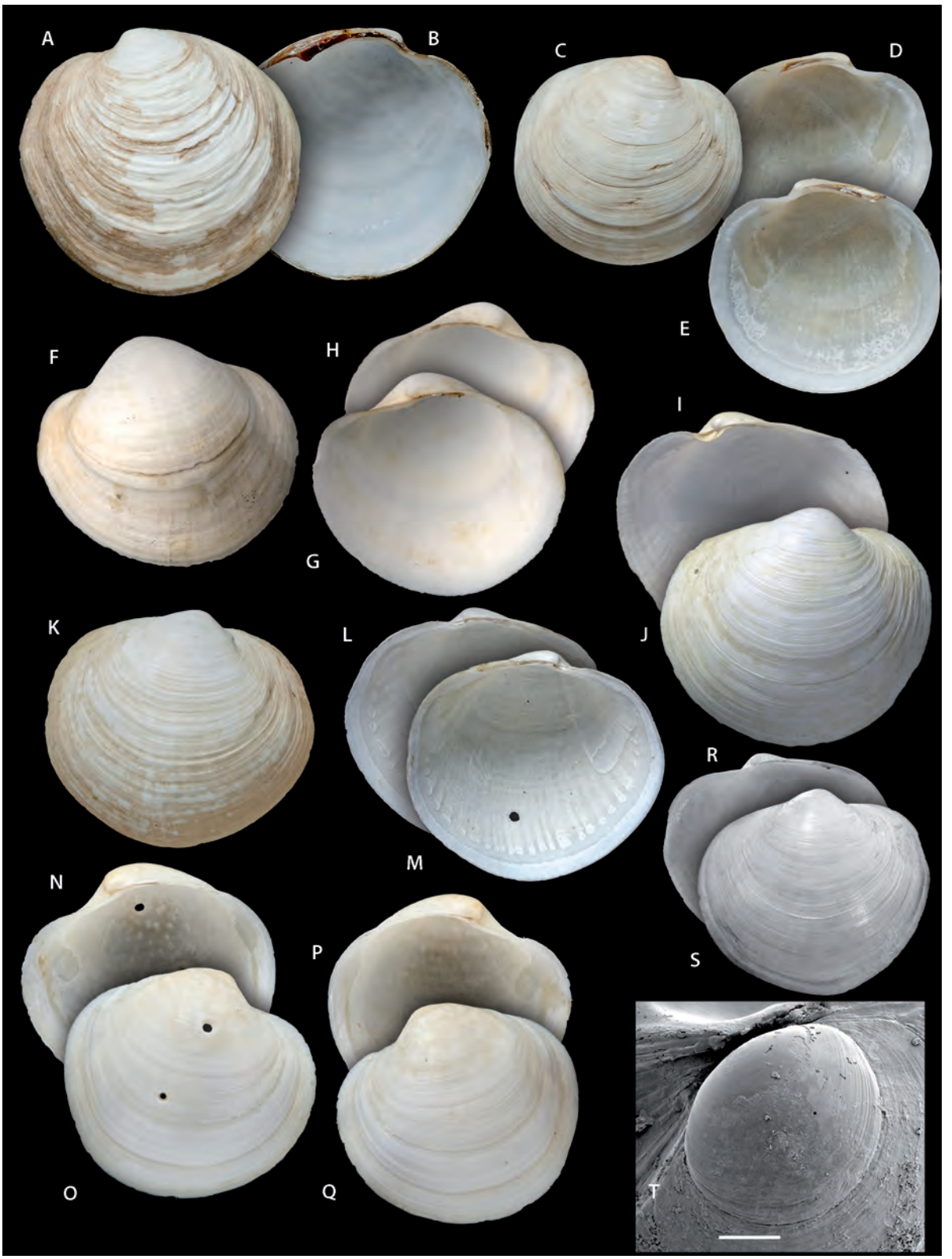
DISTRIBUTION — A deeply burrowing species inhabiting mangrove fringes, with a wide geographical range from East Africa to New Caledonia.

DESCRIPTION — See Taylor & Glover (2005) for details. Shell large, L to 71, H to 60, inflated, subspherical, thick brown periostracum. Ligament deeply inset laterally.

REMARKS — This species is commonly identified in the Philippines as *Anodontia edentula* (Linnaeus, 1758) (*e.g.*, Sotto & Cosel 1982; Lebata & Primavera 2001; Primavera *et al.* 2002; Geduspan *et al.* 2008) but Taylor & Glover (2005) explained why the name *P. philippiana* should be used for this exploited mangrove-associated species. A molecular study by Geduspan *et al*. (2008) showed that '*A. edentula*' from the Philippines was identical with a sample of *P. philippiana* from northwestern Australia. *Pegophysema bialata* (Pilsbry, 1895) distributed from India, Thailand, China southern Japan, is similar in size but has a straight hinge line, a shallowly inset ligament and lacks secondary pallial attachment scars.

FIGURE 1

Pegophyseminae. — **A**, **B**, *Pegophysema philippiana* (Reeve, 1850), exterior and interior of left valve, PANGLAO 2004 stn M3. L 43 mm. **C**-**E**, *Euanodontia ovum* (Reeve, 1850), exterior of right and interiors of left and right valves, PANGLAO 2004 stn M19. L 24.8 mm. **F**-**H**, *Cryptophysema ovulum* (Reeve, 1850), NMW Z.1955.158.11243, exterior of left valve and interior of right and left valves, Philippines, no details. L 27.5 mm. **I**, **J**, *Cryptophysema insulosa* (Taylor & Glover, 2005), holotype MNHN IM-2000-21095, exterior of right valve and interior of right and left valves, MUSORSTOM 3 stn CP141. L 31.2 mm. **K**-**M**, *Cryptophysema vesicula* (Gould, 1850), exterior and interior of right valve, PANGLAO 2004 stn M51. L 31 mm. **N**, **O**, *Euanodontia hawaiensis* (Dall, Bartsch & Rehder, 1938), interior and exterior of right valve, PANGLAO 2004 stn M2. L 13.0 mm. **P**, **Q**, *Euanodontia hawaiensis* (Dall, Bartsch & Rehder, 1938), interior and exterior of left valve, PANGLAO 2004 stn M3. L 12.9 mm. **R**, **S**, *Cavatidens bullula* (Reeve, 1850), lectotype of *Lucina bullula* Reeve, 1850, NHMUK 1963184, interior and exterior of right valve. L 15.3 mm. **T**, *Euanodontia ovum* (Reeve, 1850), protoconch, PANGLAO 2004 stn S14. Scale bar = 50 µm.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Genus ***EUANODONTIA*** Taylor & Glover, 2005

Euanodontia Taylor & Glover, 2005: 310.

Type species. *Lucina ovum* Reeve, 1850, by original designation.

DIAGNOSIS — Small to medium sized shells, near circular in outline. Outer shell smooth except for growth increments, ligament internal, deeply inset laterally. Pallial line entire, anterior adductor scar narrow and relatively short, detached from pallial line for 55-70% of length at an angle of 30-40°.

Euanodontia ovum (Reeve, 1850) comb. nov.

Figures 1C-E; 2B

Lucina ovum Reeve, 1850: pl. 5, *Lucina* species 21.
Anodontia (Euanodontia) ovum – Taylor & Glover 2005: 310, figs 12A, 28A-H.

TYPE MATERIAL — 2 syntypes NHMUK 1963195/1-2.

TYPE LOCALITY — Philippines, Isle of Burias.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn B2, 5 m, 1 v. – Stn B3, 8 m, 3 v. – Stn B9, 8 m, 1v. – Stn B38, 17-18 m, 1 v. – Stn D1, 2 m, 1 v. – Stn D4, 0-2 m, 1 v. – Stn D7, 2-3 m, 1 v. – Stn D12, 2-4 m, 3 v. – Stn D13, 2-3 m, 3 pv. – Stn D14, 0-4 m, 1 v. – Stn M2, 0-2 m, 1 v, – Stn M3, 0-2.5 m, 14 v. – Stn M6, 0 m, 1 pv, 4 v. – Stn M7, 0-3 m, 3 v. – Stn M9, 0.5 m, 18 v. – Stn M10, 0-3 m, 6 v. – Stn M11, 0-3 m, 3 v. – Stn M19, 0-2 m, 6 pv, 42 v. – Stn M23, 0-1 m, 1 v. – Stn M24, 0-1 m, 1 pv, 5 v. – Stn M 44, 0 m, 1v. – Stn M 40, 0-3 m, 2 v. – Stn M47, 0-1 m, 1 v. – Stn M51, 0 m, 9 v. – Stn R14, 6-8 m, 1 v. – Stn R45, 3-7 m, 2 v. – Stn S3, 6 m, 2 v. – Stn S6, 1-4 m, 1 pv, 5 v. – Stn S14, 5-12 m, 3 pv, 14 v. – Stn S16, 15-18 m, 2 v. – Stn S17, 6 m, 12 v. – Stn S22, 15-20 m, 3 v. – Stn S25, 21 m, 2 v. – Stn S42, 15-20 m, 5 v. – Stn S43, 2-3 m, 1 v. – PANGLAO 2005: stn CP2334, 606-631 m, 2 v. – Stn CP2348, 196-216 m 2 v. – Stn CP2381 259-280 m, 1 v. – Stn CP2383 338-351 m, 1 v. – Stn CP2392, 242-400 m, 1 v. – Stn CP2395 382-434 m, 2 v. – Stn CP2396, 607-673 m, 1 v. – Stn CP2397, 642-669 m, 4 v. – Stn CP2407, 256-268 m, 1 v. – Stn CP2409, 200-257 m, 1 v.

DISTRIBUTION — Widespread across IWP from Red Sea to Marshall Islands.

DESCRIPTION — See Taylor & Glover (2005) for details. Shell medium L to 39, H to 36, circular in outline, ligament deeply inset, internal, anterior adductor scar narrow, detached from pallial line for 2/3 of length at an angle of 30°, inner shell often yellow. Protoconch (Figure 1T): PI + PII 188 µm, PII with prominent growth increments.

REMARKS — *Euanodontia ovum* is a common shallow water species from sea grass habitats and we regard the deeper records from PANGLAO 2005 as allochthonous.

Euanodontia hawaiensis (Dall, Bartsch & Rehder, 1938) comb. nov.

Figures 1N-Q; 2C

Loripinus hawaiensis Dall, Bartsch & Rehder, 1938: 127, pl. 34, figs 11, 12.
Anodontia (Euanodontia) hawaiensis – Taylor & Glover 2005: 312, figs 11A, 12A, 30, 31.

TYPE MATERIAL — Holotype USNM 337404.

TYPE LOCALITY — Hawaii, Honolulu Harbor, 6-8 fathoms [11-15 m].

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn M2, 0-2 m, 1 v. – Stn M3, 0-2.5 m, 1 v. – Stn S15, 4-6 m, 1 v. – Stn S13, 8-15 m, 1 v.

DISTRIBUTION — A poorly known species from atolls and islands in IWP from Aldabra Atoll to Hawaii.

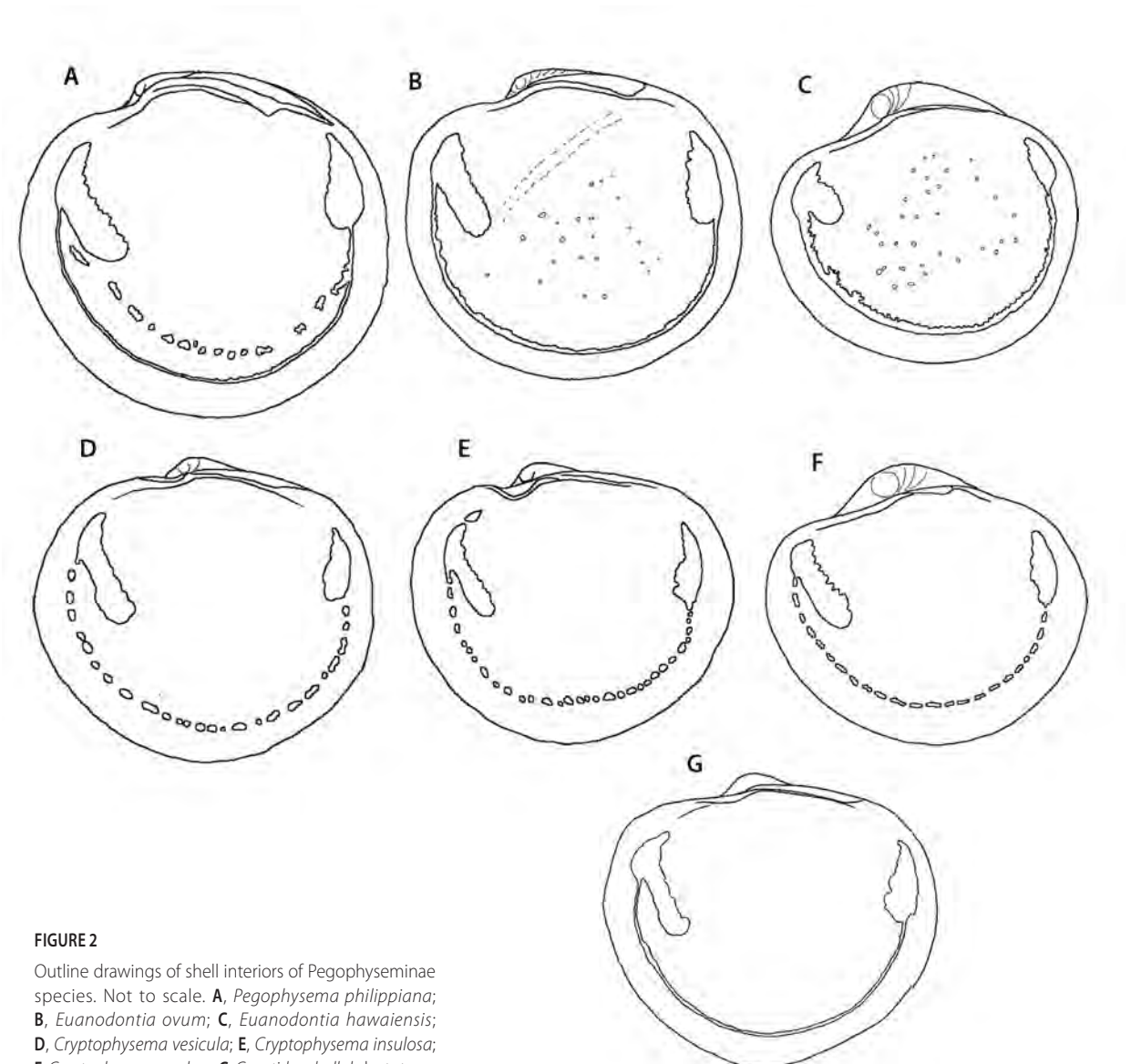


FIGURE 2

Outline drawings of shell interiors of Pegophyseminae species. Not to scale. **A**, *Pegophysema philippiana*; **B**, *Euanodontia ovum*; **C**, *Euanodontia hawaiensis*; **D**, *Cryptophysema vesicula*; **E**, *Cryptophysema insulosa*; **F**, *Cryptophysema ovulum*; **G**, *Cavatidens bullula* lectotype.

DESCRIPTION — See Taylor & Glover (2005) for details. Shell medium L to 25, H to 23, inflated, anterior adductor short detached for 1/2 of length and often lobate along the dorsal edge, pallial line entire, sometimes broader under the adductor scar.

Genus ***CRYPTOPHYSEMA*** Taylor & Glover, 2005

Cryptophysema Taylor & Glover, 2005: 316.

Type species. *Lucina vesicula* Gould, 1850, by original designation.

DIAGNOSIS — Shell subcircular, smooth. Lunule prominent, scooped, slightly to deeply impressed. Ligament internal, laterally inset. Pallial line divided into discrete muscle attachment scars.

Cryptophysema vesicula (Gould, 1850) comb. nov.

Figures 1K-M; 2D

Lucina vesicula Gould, 1850: 256; 1852: 414, pl. 36, figs 525a, b.
Anodontia (Cryptophysema) vesicula – Taylor & Glover 2005: 317, figs 12B, 35A-D.

TYPE MATERIAL — Lectotype USNM 427779, cited as holotype by Johnson 1964: 167 (inadvertent lectotype selection).

TYPE LOCALITY — Tonga, Tongatapu.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn D1, 2 m, 5 v. – Stn M2, 0-2 m, 4 v. – Stn M3, 1 v; 0-2.5 m, 1 v. – Stn M7, 0-3 m, 1 v. – Stn M13, 0-3 m, 2 v. – Stn M19, 0-2 m, 1v. – Stn M20, 0-2 m, 1 v. – Stn M51, 0 m, 1v. – Stn M 52, 0-1 m, 1v. – Stn R23, 1-5 m, 4 v. – Stn S6, 1-4 m, 1 v.

DISTRIBUTION — IWP from northern Red Sea to Tonga.

DESCRIPTION — See Taylor & Glover (2005) for details. Shell large L to 48 mm, H to 44 mm, subcircular, ligament internal, slightly inset, lunule narrow, scooped. Anterior adductor scar detached for 2/3 of length at an angle of 26°, pallial line discontinuous (Figure 2D), divided into small blocks with tracks of these visible on the internal shell surface.

Cryptophysema insulosa Taylor & Glover, 2005

Figures 1I, J; 2E

Cryptophysema insulosa Taylor & Glover, 2005: 317, figs 11B, 12B, 35E-I.

TYPE MATERIAL — Holotype MNHN IM-2000-21095, paratype USNM 293504.

TYPE LOCALITY — Philippines, 11°45'N, 122°45'E, 40-44 m [MUSORSTOM 3: stn CP141].

OTHER MATERIAL EXAMINED — **Philippines**. AURORA 2007: stn CP2653, 83 m, 1 v.

DISTRIBUTION — Philippines and Indonesia.

DESCRIPTION — See Taylor & Glover (2005) for details. Shell medium to L to 34, H to 30, characterised by the short and very deeply scooped lunule and pallial line divided into small blocks (Figure 2E).

REMARKS — *Cryptophysema insulosa* is known from only a few specimens. It is similar to *C. vesicula* (Gould, 1850) but has a more inflated shell, a deeply scooped lunule, a shallower ligament and occurs at depths of more than 40 m.

Cryptophysema ovulum (Reeve, 1850) comb. nov.

Figures 1F, G; 2F

Lucina ovulum Reeve, 1850: pl. 10, fig. 58.
Anodontia (?*Cryptophysema*) *ovulum* – Taylor & Glover 2005: 321 figs 11b, 12b, 39.

TYPE MATERIAL — Holotype NHMUK 1963187.

TYPE LOCALITY — Mauritius.

OTHER MATERIAL EXAMINED — Philippines, no details, NMW Z.1955.158.11243.

DISTRIBUTION — Red Sea to Fiji.

DESCRIPTION — See Taylor & Glover (2005) for details. Shell medium L to 32, H to 30, inflated, ligament short, internal, pallial line discontinuous in short elongate blocks.

REMARKS — An uncommon species, rare in collections and often confused with other small pegophysemines. It was not identified amongst the Panglao material or from other French expeditions.

Genus ***CAVATIDENS*** Iredale, 1930

Cavatidens Iredale, 1930: 391, 406.

Type species. *Cavatidens omissa* Iredale, 1930, by original designation.

DIAGNOSIS — Small, thin-shelled, ligament narrow shallowly impressed, anterior adductor scar narrow detached for 3/4 of length at a broad angle of 30°. Pallial line thin, entire.

Cavatidens bullula (Reeve, 1850) comb. nov.

Figures 1R, S; 2G

Lucina bullula Reeve 1850: pl. 10, fig. 35.
Anodontia (Cavatidens) bullula – Taylor & Glover 2005: 323, figs 41G-L.

TYPE MATERIAL — Lectotype NHMUK 1963184.

TYPE LOCALITY — Not known.

REMARKS — Although previously recorded from Malampaya, Palawan and west Samar in the Philippines (Taylor & Glover 2005) no specimens were identified from Panglao collections and the distribution of this species needs further study in conjunction with the type material.

Subfamily LEUCOSPHAERINAE Taylor & Glover, 2011

The subfamily Leucosphaerinae, with up to 15 genera from shallow water to 800 m, was introduced for a well-supported clade in molecular analyses (Taylor *et al.* 2011) although there are no consistent morphological characters that unify the group. Features such as absence of radial sculpture, strongly asymmetric lunule, small or inconspicuous cardinal teeth and lack of lateral teeth are present in many.

Genus ***LEUCOSPHAERA*** Taylor & Glover, 2005

Leucosphaera Taylor & Glover, 2005: 331.

Type species. *Lucina (Loripinus) salamensis* Thiele & Jaeckel, 1931, by original designation.

DIAGNOSIS — Shells small (L <12 mm), inflated, thin-shelled, white to translucent. Outline ovate. Sculpture of regularly spaced, fine commarginal lamellae. Hinge teeth absent, small knob lies below the umbones of both valves contiguous with thin flange on the anterior part of the hinge. Ligament narrow, short, set in shallow groove. Anterior adductor muscle scar short, ovoid to reniform in outline, slightly detached from the pallial line. Pallial line entire, sometimes with dorsal extensions. Shell margin with thin peripheral groove.

REMARKS — From our observations *Leucosphaera* species are widely distributed in subtidal muddy habitats in the IWP to depths of *ca*. 160 m. The diaphanous, fragile shells have been little studied and usually confounded with juvenile '*Anodontia*' (Taylor & Glover 2005). The Japanese species, *Leptaxinus oyami* Habe, 1962 (p.124, pl. 56, fig. 14), currently classified in the Thyasiridae (Matsukuma 2000: pl. 464, fig. 9), is a *Leucosphaera* species. Molecular analyses place *Leucosphaera* (with *L.* cf. *diaphana* Glover & Taylor, 2007 as the sequenced specimen from PANGLAO 2004 stn S27) as sister taxon to all other species in the Leucosphaerinae (Taylor *et al*. 2011).

Leucosphaera philippinensis n. sp.

Figures 3A-Q; 4A

Leucosphaera cf. *diaphana* Glover & Taylor, 2007 – Taylor *et al.* 2011, fig. 7 a.

TYPE MATERIAL — Holotype USNM 302061, 1 whole shell, (L 11.9, H 11.4, T 4.7; Figures 3A-D). Paratypes USNM 1232841 [1 lv (L 8.4, H 7.0; Figures 3E, F); 1 lv (L 10.4, H 9.3; Figures 3G, H); 1 rv (L 8.2, H 6.9; Figures 3I, J); and 24 (unfigured)].

TYPE LOCALITY — Philippines, Palawan, Linapacan Strait, Observatory Island, 11°37.15'N, 119°48.45'E, 84 m [Albatross: stn 5335].

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn G1, 100 m, 8 v. – Stn L51-60, 43-62 m, 1 v. – Stn L45, 80-90 m, 1 v. – Stn S20, 10 m, 2 v. – Stn S27, 12 m, 1 pv. – Stn T5, 84-87 m, 1 v. – Stn T6, 34-82 m, 3 v. – Stn T9, 97-120 m, 8 v. – Stn T10, 117-124 m, 1 v. – Stn T11, 78-95 m, 1 pv. – Stn T14, 101-110 m, 5 v. – Stn T18, 80-100 m, 7 v. – Stn T19, 10-26 m, 1 v. – Stn T26, 123-135 m, 4 v. – Stn T27, 106-137 m, 23 v. – Stn T32, 60-62 m, 8 v. – Stn T34, 145-163 m, 2 v. – Stn T36, 95-128 m, 1 v. – PANGLAO 2005: stn CP2344, 128-142 m, 1 v.

DESCRIPTION — Shell small, white, semi-translucent in juveniles, L to 12.0, H to 11.4, T 4.7, subcircular, anterior margin often extended and rostrate in older specimens, sculpture of fine commarginal lamellae and growth lines, radial sculpture absent. Protoconch (Figure 3N): PI + PII 184 µm, PI 94 µm, smooth, PII with many regular growth increments. Dorsal areas weakly defined, lunule shallow, lanceolate; hinge with narrow flange in both valves, wider in LV and extended as small knob under the umbones in RV. Normal cardinal and lateral teeth absent. Ligament short, in narrow groove. Anterior adductor scar very short, rounded, detached for 1/4 of length, posterior scar ovoid; pallial line entire, sometimes with dorsal spurs, secondary pallial attachment scars sometimes present just inside the pallial line. Outer shell margin smooth with narrow rim, inner shell smooth with mantle attachment points. Pallial blood vessel scar sometimes visible.

REMARKS — *Leucosphaera* species closely resemble each other in shape and hinge morphology but *L. philippinensis* n. sp. is larger and thicker shelled than both *L. salamensis* (Thiele & Jaeckel, 1931) from the western Indian Ocean and *L. diaphana* Glover & Taylor, 2007 from New Caledonia.

ETYMOLOGY — Derived from Philippines, the type locality.

Genus ***ALUCINOMA*** Habe, 1958

Alucinoma Habe, 1958: 181.

Type species. *Alucinoma soyae* Habe, 1958, by monotypy.

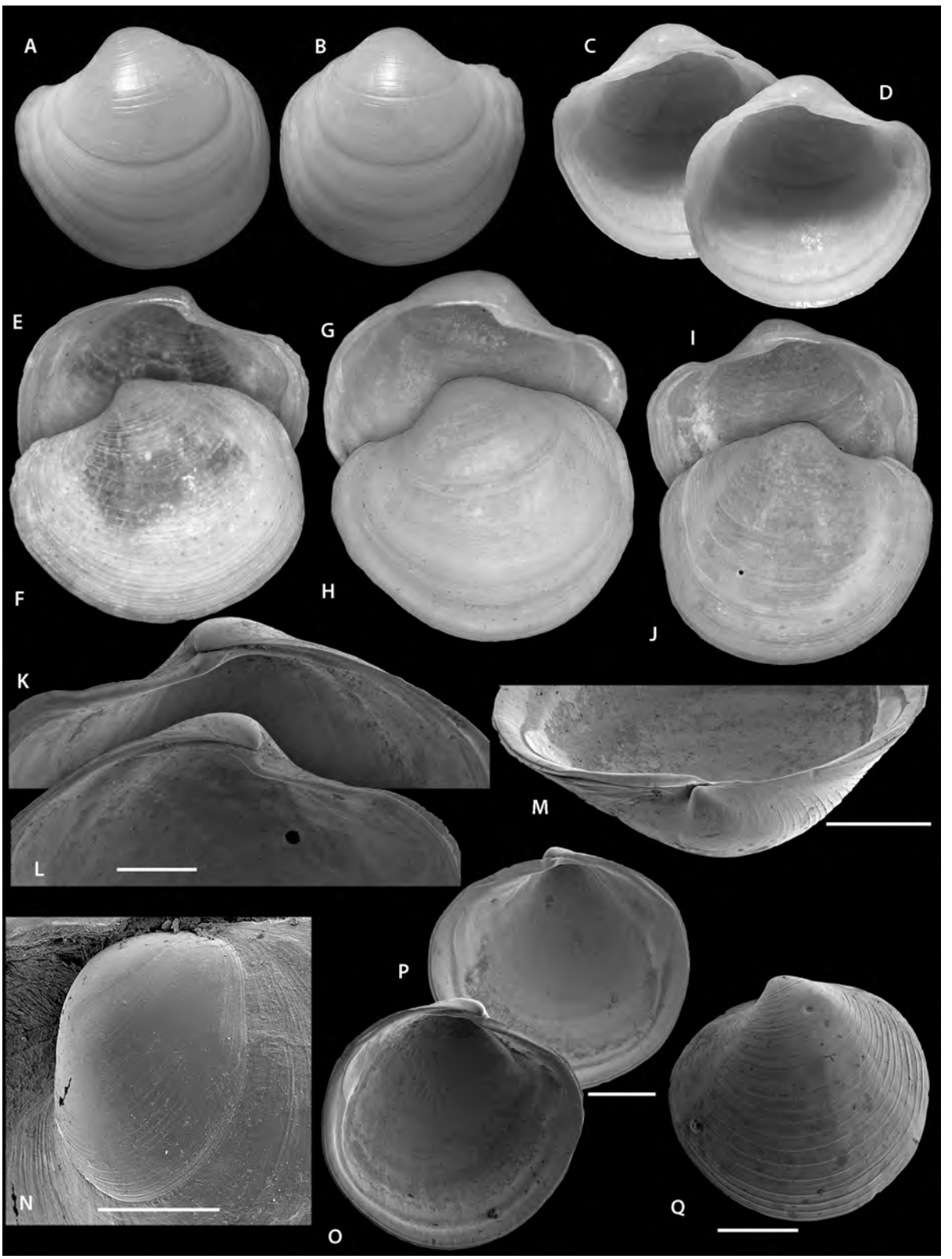
DIAGNOSIS — Shells small, subcircular, compressed. Shell surface centrally smooth with commarginal lamellae prominent at anterior and posterior margins, projecting dorsally as scales. Hinge plate narrow, edentulous. Anterior adductor scar long, detached for about 1/2 of length, lying close to the pallial line. Pallial line discontinuous. Interior margin smooth.

REMARKS — The genus was synonomised with *Gonimyrtea* by Chavan (1969) but reinstated by Cosel & Bouchet (2008). *Alucinoma* species are very similar in shell morphology to *Dulcina* spp. (see below) and in molecular analysis (unpublished) species of both genera form a well-supported subclade within the Leucosphaerinae. The distinctions between these two genera as described by Cosel & Bouchet (2008) appear minor but for the present we retain their separate status.

Alucinoma alis Cosel & Bouchet, 2008

Figures 4B; 5A-K

Alucinoma alis Cosel & Bouchet, 2008: 191, figs 54A-K, 56A-C, 57.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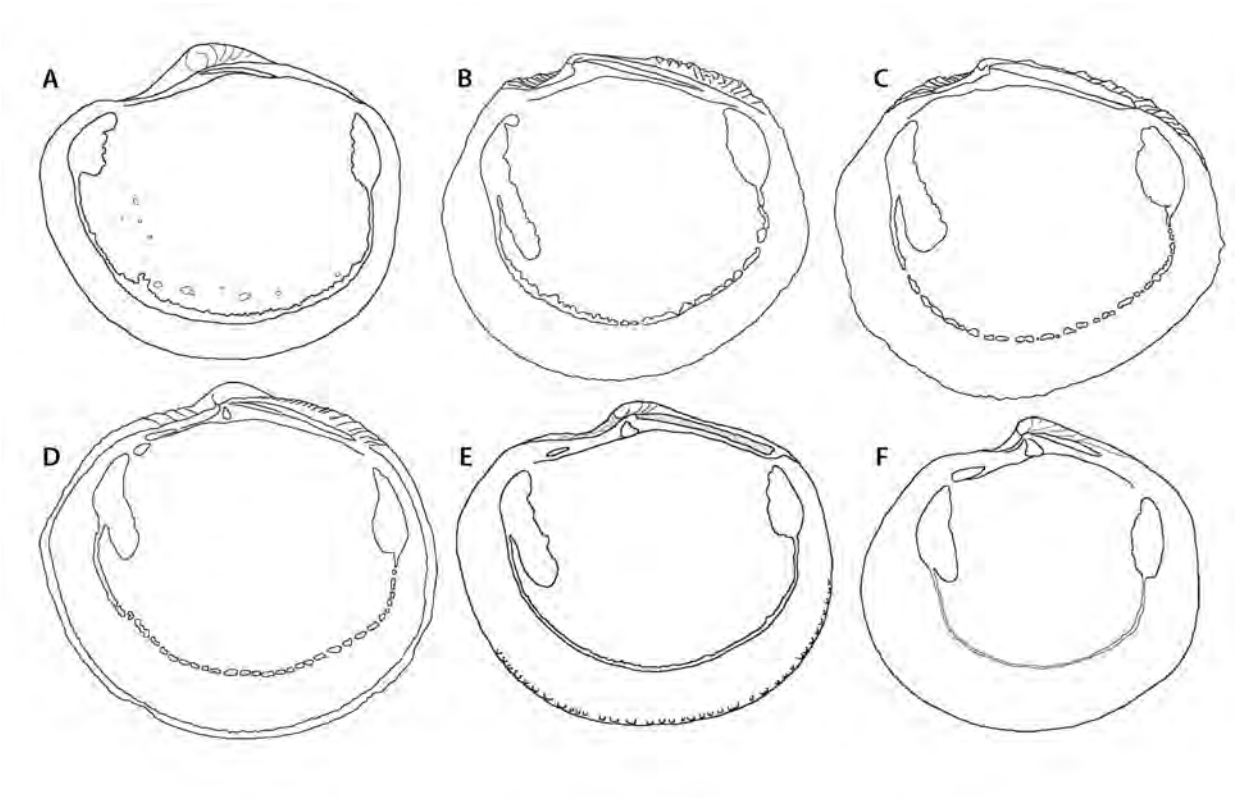


FIGURE 4

Outline drawings of shell interiors of *Leucosphaera*, *Alucinoma*, *Dulcina*, *Pseudolucinisca* and *Gonimyrtea*. Not to scale. **A**, *Leucosphaera philippinensis*; **B**, *Alucinoma alis*; **C**, *Dulcina musorstomi*; **D**, *Pseudolucinisca kantori*; **E**, *Gonimyrtea profunda*; **F**, *Gonimyrtea celata*.

FIGURE 3

Leucosphaera philippinensis n. sp. — **A**-**D**, holotype USNM 302061, exterior of left and right valves, interior right and left valves, Palawan, Philippines. L 11.9 mm; **E**, **F**, paratype USNM 1232841, exterior and interior of left and right valves. L 8.4 mm; **G**, **H**, paratype USNM,1232841, interior and exterior of left and right valves. L 10.4 mm; **I**, **J**, paratype USNM 1232841, interior and exterior right and left valves. L 8.2 mm; **K**, **L**, detail of right and left hinge. Scale bar = 1.0 mm; **M**, dorsal view of hinge of left valve, PANGLAO 2004 stn T27. Scale bar = 1.0 mm; **N**, protoconch, PANGLAO 2004 stn T27. Scale bar = 100 µm; **O**, **P**, interior of left and right valves, PANGLAO 2004 stn T27. Scale bar = 1.0 mm; **Q**, exterior of left valve, PANGLAO 2004 stn T27. Scale bar = 1.0 mm.

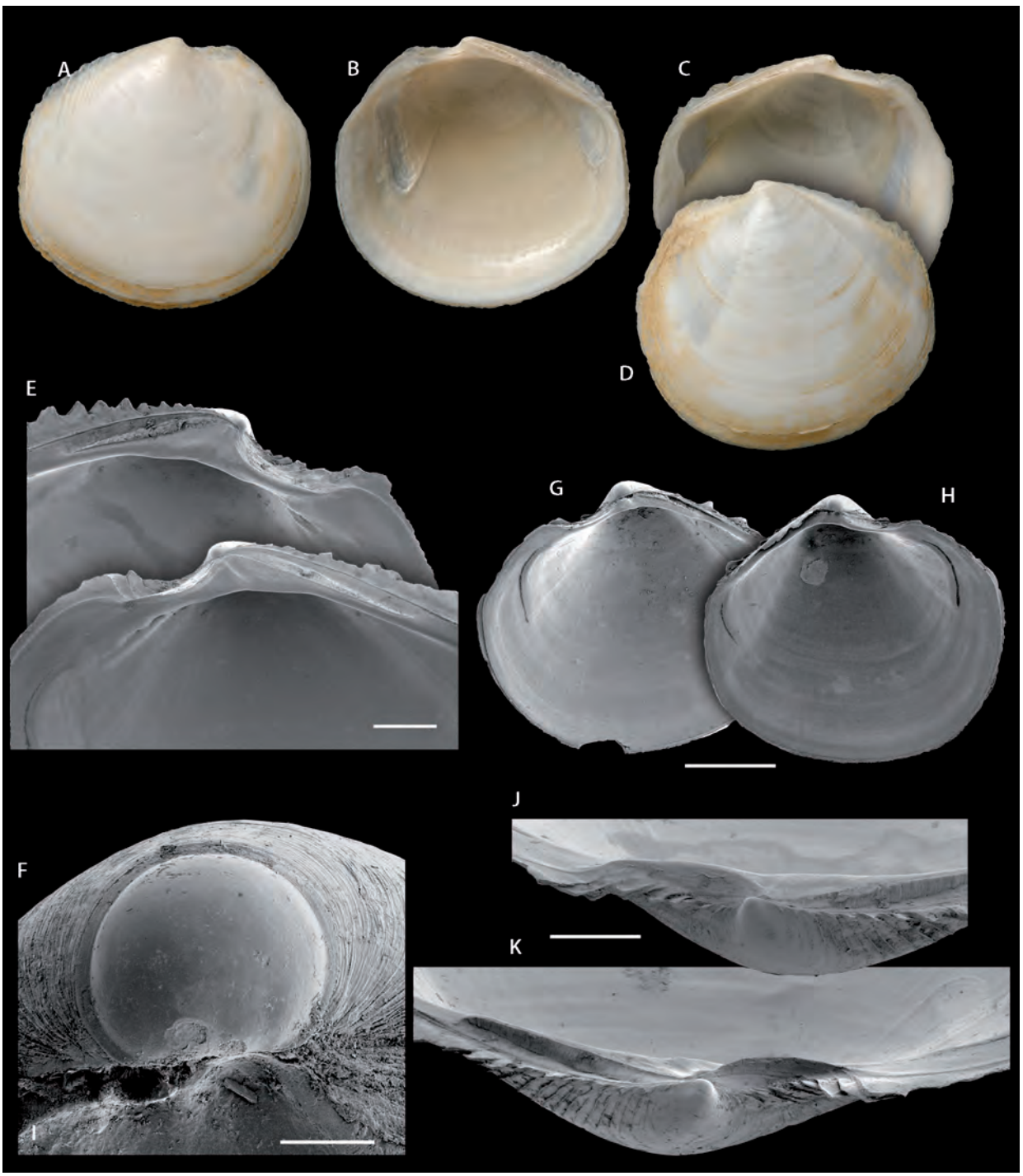


FIGURE 5

Alucinoma alis Cosel & Bouchet, 2008 — **A**, **B**, exterior and interior of right valve, PANGLAO 2005 stn CP2340. L 18.3 mm; **C**, **D**, exterior and interior of left valve, PANGLAO 2005 stn CP2340. L 21.2 mm; **E**, **F**, detail of hinge of left and right valves, PANGLAO 2005 stn CP2392. Scale bar = 1.0 mm; **G**, **H**, interior of juvenile shells, MUSORSTOM stn CP106 Scale bar = 1.0 mm; **I**, protoconch, MUSORSTOM 3 stn CP106. Scale bar = 100 µm; **J**, **K**, dorsal views of hinge in right and left valves, PANGLAO 2005 stn CP2392. Scale bar = 1.0 mm.

TYPE MATERIAL — Holotype MNHN IM-2000-20740, 2 paratypes MNHN IM-2000-20741.

TYPE LOCALITY — Solomon Islands, north of Honiara, Guadalcanal, 9°23'S, 159°57'E, 302-396 m [SALOMON 1: stn DW1746].

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn T4, 82 m, 1 v. – Stn T25, 160-210 m, 1 v. – PANGLAO 2005: stn CP2331, 255-268 m, 4 v. – Stn CP2332, 396-418 m, 3 v. – Stn CP2340, 271-318 m, 158 v. – Stn CP2341, 544-712 m, 14 v. – Stn CP2348, 196-216 m, 29 v. – Stn CP2349, 219-240 m, 33 v. – Stn CP2358, 569-583 m, 1 v. – Stn CP2360, 357-372 m, 1 v. – Stn CP2362, 679-684 m, 1 v. – Stn CP2372, 255-301 m, 1 v. – Stn CP2381, 259-280 m, 2 v. – Stn CP2383, 338-351 m, 7 v. – Stn DW2391, 323-336 m, 8 v. – Stn CP2392, 242-400 m, 144 v. – Stn CP2393, 356-396 m, 7 v. – Stn CP2395, 382-434 m, 10 v. – Stn CP2405, 387-453 m, 7 v. – Stn CP2406, 334-387 m, 11 v. – Stn CP2407, 256-268 m, 2 v. – MUSORSTOM 3: stn CP106, 640-668 m, 6 v. – Stn CP125, 388-404 m, 3 v. – Stn CP139, 240-267 m, 2 v. – AURORA 2007: stn DW2706, 478-480 m, 2 v.

DISTRIBUTION — Solomon Islands and central Philippines, empty shells in 82-679 m.

DESCRIPTION — Shell medium, L to 23.6, H to 21.0, compressed, subcircular, broadly rounded anterior margin, posterior slightly tapering. Shell smooth with sculpture of fine growth lines, periostracum light brown. Protoconch (Figure 5I): PI+PII 265 µm, PI 240 µm with PII a narrow rim with some growth increments. Hinge narrow, edentulous, anterior adductor scar long, divergent for half its length, pallial line discontinuous. Shell interior surface glossy. See Cosel & Bouchet (2008) for further details.

REMARKS — The type species, *Alucinoma soyae* Habe, 1958 (UMST 39881) from the Western Japan Sea and Shikoku at depths of 100-150 m, is the only other known species in the genus (Habe 1958a). From images of the holotype and the figure in Matsukuma (2000: pl. 463, fig. 20), where it was classified as *Gonimyrtea, A. soyae* is similar in size and general shell morphology to *A. alis* but appears to have more prominent commarginal sculpture that is elevated along the dorsal margin. As a result of further study of numerous shells from PANGLAO 2005 we think that the specimen sequenced for molecular analysis in Taylor *et al.* (2011), and named *Dulcina karubari* Cosel & Bouchet, 2008 from station CP2331 in the Bohol Sea should now be indentified as *Alucinoma alis*.

Genus ***DULCINA*** Cosel & Bouchet, 2008

Dulcina Cosel & Bouchet, 2008: 177.

Type species. *Dulcina guidoi* Cosel & Bouchet, 2008, by original designation.

DIAGNOSIS — Shells to *ca.* 45 mm long, laterally compressed. Subcircular, broader anteriorly and tapering posteriorly. Sculpture from smooth to more elevated, widely spaced commarginal lamellae. Lunule narrow, sunken, asymmetric. Ligament long, sunken in escutcheon. Hinge narrow, edentulous, sometimes faint vestige of cardinal tooth. Anterior adductor muscle scar long, lies close to and detached from pallial line for about 1/2 of length. Pallial line discontinuous divided into small bead-like units. Shell margin smooth.

REMARKS — Introducing the new genus Cosel & Bouchet (2008) described five new species, three of these from the Philippines, *Dulcina guidoi*, *D. minor*, *D. musorstomi*, with *D. karubari* from Indonesia, 215-466 m and *D. madagascarensis* from south western Madagascar, 425-550 m. Only *D. musorstomi* was recovered from the PANGLAO 2005 samples.

Dulcina guidoi Cosel & Bouchet, 2008

Figures 6A-C

Dulcina guidoi Cosel & Bouchet, 2008: 178, figs 46A-G, 49A.
Dulcina guidoi – Poppe & Tagaro 2011: 150, pl. 1070, figs 4a, b.

TYPE MATERIAL — Holotype MNHN IM-2000-20727, paratype MNHN IM-2000-20728.

TYPE LOCALITY — Central Philippines, north of Mindoro, 13°39'N, 120°43'E, 520-550 m [MUSORSTOM 2: stn CP25].

DISTRIBUTION — Central Philippines, 520-640 m.

DESCRIPTION — See Cosel & Bouchet (2008) for details. Shell large, L to 46, H to 37 with generally smooth exterior of irregular growth lines and very low commarginal lamellae.

Dulcina minor Cosel & Bouchet, 2008

Figures 6D, E

Dulcina minor Cosel & Bouchet, 2008: 184, figs 51A-E, 52B.
Dulcina minor – Poppe & Tagaro 2011: 150, pl. 1070, figs 2a, b.

TYPE MATERIAL — Holotype MNHN IM-2000-20733, 7 paratypes MNHN IM-2000-20734-20737.

TYPE LOCALITY — North central Philippines, off Luzon, near Lubang, 14°01'N, 120°19'E, 191-195 m [MUSORSTOM 2: stn CP64].

DESCRIPTION — See Cosel & Bouchet (2008) for details. Shell medium size, L to 26, H to 23, with densely spaced, commarginal lamellae that curve ventrally.

DISTRIBUTION — Known from the type locality and nearby at depths of 190-210 m.

Dulcina musorstomi Cosel & Bouchet, 2008

Figures 4C; 6F-M

Dulcina musorstomi Cosel & Bouchet 2008: 186, figs 52A, 53A-H.
Dulcina musorstomi – Poppe & Tagaro 2011: 154, pl. 1072, figs 1a, b.

TYPE MATERIAL — Holotype MNHN IM-2000-20738, 11 paratypes IM-2000-MNHN 20739.

TYPE LOCALITY — Central Philippines, NW of Samar, San Bernadono Strait, 11°29'N, 124°11'E, 205-214 m [MUSORSTOM 3: stn CP143].

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2005: stn CP2331, 255-268 m, 2 v. – Stn CP2348, 196-216 m, 1 v. – Stn CP2340, 271-318 m, 9 v. – Stn CP2349, 219-240 m, 3 v. – Stn CP2381, 259-280 m, 1 v. – Stn CP2409, 220-257 m, 6 v.

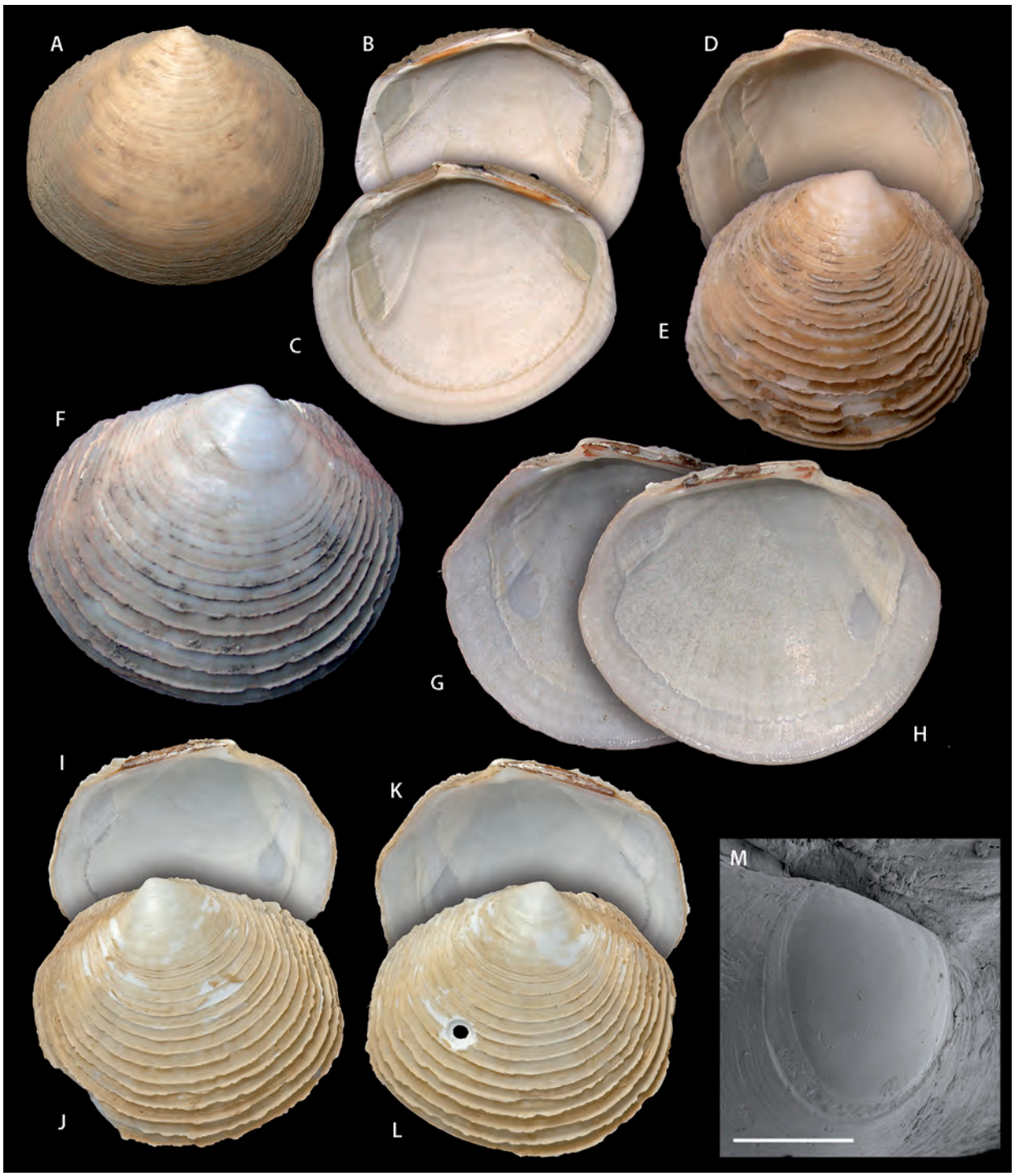


FIGURE 6

Dulcina species — **A**-**C**, *Dulcina guidoi* Cosel & Bouchet 2008, holotype MNHN IM-2000-20727, exterior of right valve and interior of both valves, L 42.4 mm. — **D**, **E**, *Dulcina minor* Cosel & Bouchet 2008, holotype MNHN IM-2000-20733, exterior and interior of right valve. L 22.1 mm. — **F**-**M**, *Dulcina musorstomi* Cosel & Bouchet 2008. **F**-**H**, holotype MNHN IM-2000-20738, exterior of right valve and interior of both valves. L 34.7 mm; **I**-**L**, exterior and interior of left and right valves of whole shell, PANGLAO 2005 stn CP2349. L 32.1 mm; **M**, protoconch, PANGLAO 2005 stn CP2340. Scale bar = 100 µm.

DISTRIBUTION — Central Philippines, 214-271 m, East China Sea between 576-594 m (Okutani 2011).

DESCRIPTION — See Cosel & Bouchet (2008) for details. L to 36, H to 34, with prominent, thin, regularly spaced, commarginal lamellae that are absent from the first 10-15 mm of the umbonal region of the shell. Protoconch (Figure 6M): PI +PII 173 µm, PI 146 µm, PII a narrow rim.

Genus ***GONIMYRTEA*** Marwick, 1929

Gonimyrtea Marwick, 1929: 912.

Type species. *Loripes concinna* Hutton, 1885, by original designation.

DIAGNOSIS — Shell small to medium, subcircular to ovate, higher than long, inflated. Sculpture of closely-spaced thin, low commarginal lamellae. Right valve with single cardinal tooth and small anterior and posterior laterals; left valve with two cardinal teeth and small anterior and posterior laterals. Lunule narrow lanceolate. Ligament short, curved. Anterior adductor scar detached for about 1/5 - 1/2 of length.

REMARKS — As noted by Glover & Taylor (2007) there has been much confusion concerning the concept of this genus following from Chavan's (1969) illustration of an Eocene species with little resemblance to the type and also his assignment of *Alucinoma* as a synonym. Although we originally placed this genus (based on shell morphology) in the Myrteinae (Taylor *et al.* 2011) continuing molecular analyses (Taylor *et al.* 2014) suggests that it should be classified in the subfamily Leucosphaerinae, although the type species has not yet been investigated. As well as the type from New Zealand we include *Gonimyrtea avia* Glover & Taylor, 2007 and *G. fidelis* Glover & Taylor, 2007 from around New Caledonia (Glover & Taylor 2007), *G. ferruginea* Taylor & Glover, 2013 and two new species from the Philippines described below.

Gonimyrtea celata n. sp.

Figures 4F; 7A-M

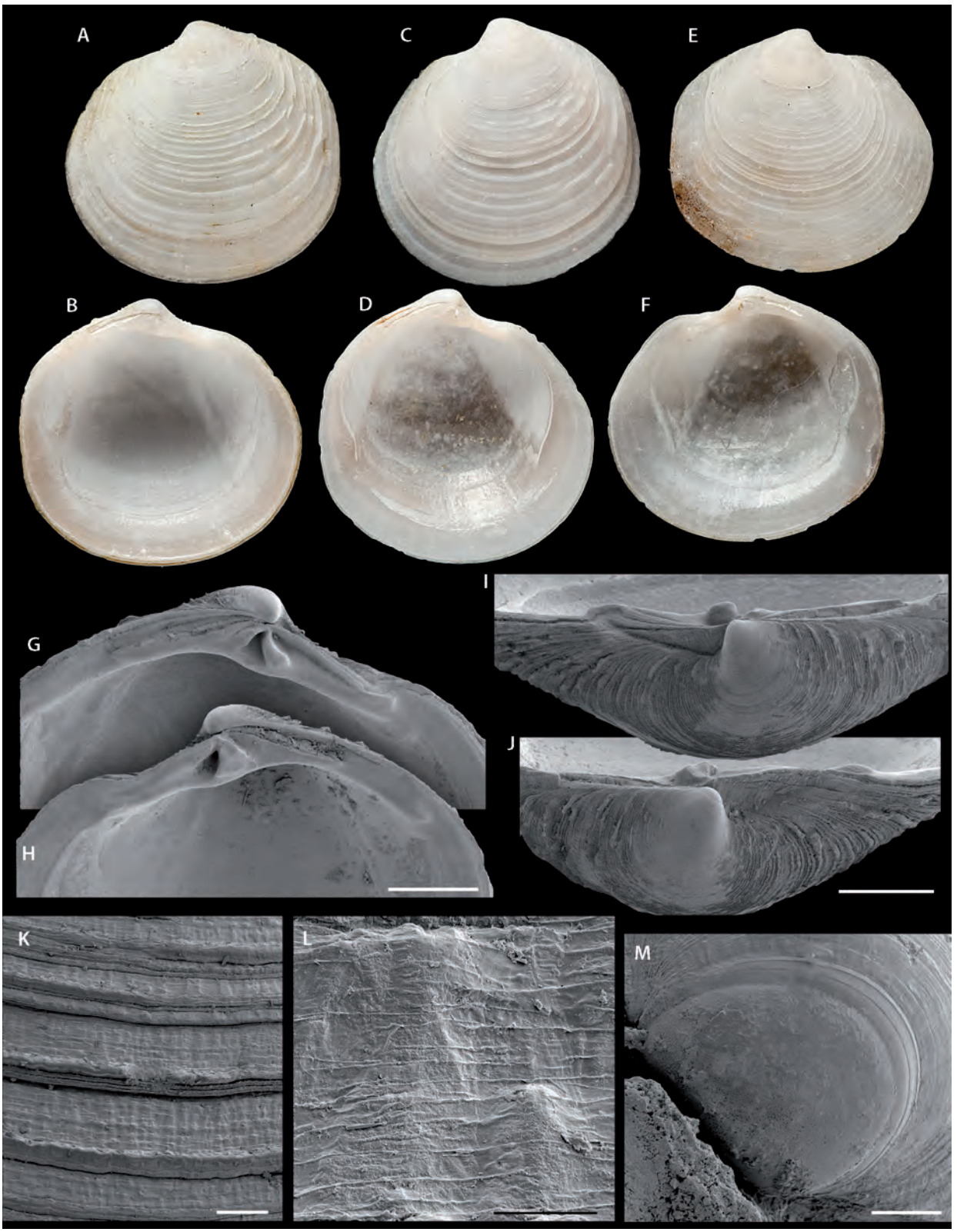
TYPE MATERIAL — Holotype lv MNHN IM-2000-26552, 3 paratypes MNHN IM-2000-26553-26555 (as listed below).

TYPE LOCALITY — Philippines, Panglao Island, 9°35.3'N, 123°50.5'E, 5 m [PANGLAO 2004: stn S1].

MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn B2, 9°33.0'N 123°46.5'E, 5 m, 1 lv paratype MNHN IM-2000-26554 (L 7.9, H 7.9, T 2.0; Figures 7C, D). – Stn B4, 9°33.2'N, 123°48.3'E, 24 m, 1 rv paratype MNHN IM-2000-26555 (L 7.4, H 6.8, T 1.8; Figures 7E, F). – Stn B38, Balicasag Island, 17-18 m, 3 v. – Stn S1, Panglao Island, 9° 35.3'N, 123° 50.5'E, 5 m, 1 lv, holotype MNHN IM-2000-26552 (L 8.5, H 8.1, T 2.4; Figures 7A, B, G, I), 1 rv, paratype MNHN IM-2000-26553 (L 6.0, H 5.6, T 1.7; Figures 7G-J). – Stn S21, 4-12 m, 3 v. – MUSORSTOM 3: stn DR140, 93-99 m, 1 v.

FIGURE 7

Gonimyrtea celata n. sp. — **A**, **B**, holotype MNHN IM-2000-26552, exterior and interior of left valve, PANGLAO 2004 stn S1. L 8.5 mm; **C**, **D**, paratype MNHN IM-2000-26554, exterior and interior of left valve, PANGLAO 2004 stn B2. L 7.9 mm; **E**, **F**, paratype MNHN IM-2000-26555, exterior and interior of right valve, PANGLAO 2004 stn B4. L 7.4 mm; **G**, **H**, details of hinge of left (holotype) and right (paratype MNHN IM-2000-26553) valves. Scale bar 1.0 mm; **I**, **J**, dorsal views of left (holotype) and right (paratype MNHN IM-2000-26553) valves. Scale bar 1.0 mm; **K**, paratype MNHN IM-2000-26554, detail of sculpture. Scale bar = 200 µm; **L**, microsculpture. Scale bar = 20 µm; **M**, protoconch. Scale bar = 50 µm.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DISTRIBUTION — Central Philippines, from shallow reef slopes and overhangs.

DESCRIPTION — Shell, small, buff white, L to 8.5, H to 8.1, T 2.4, subcircular, H/L 0.96, T/L 0.27, dorsal areas not demarcated. Sculpture of irregular commarginal lamellae, slightly elevated dorsally, and intercalating at anterior. Fine radial threads in interspaces. Lunule short, lanceolate, asymmetric, larger portion in RV. Ligament short, in shallow groove. Protoconch (Figure 7M): PI + PII 183 µm, PI 153 µm, PII a broad rim. Microsculpture of fine lines. Hinge: RV with single cardinal tooth and small anterior lateral tooth; LV with two cardinal teeth, anterior larger, lateral teeth absent. Anterior adductor muscle scar long, detached for 1/5 of length, posterior adductor scar ovoid, pallial line entire, shell margin smooth, interior glossy.

REMARKS — *Gonimyrtea celata* n. sp. differs from the other Philippine species, *G. profunda* n. sp. (see below) in its much smaller size, thicker shell and less detached anterior adductor muscle scar. It resembles the rare *Gonimyrtea avia* Glover & Taylor, 2007 from reef habitats in the Lansdowne Fairway Banks, Coral Sea (Glover & Taylor 2007) but has coarser commarginal lamellae. The species referred to as "*Lucina*' unidentified species' by Zuschin & Oliver (2003: 106, figs 23.7-23.12) from Safaga, northern Red Sea, is very similar to *G. celata*.

ETYMOLOGY — Latin *celata*, concealed, hidden, alluding to the rarity of this species.

Gonimyrtea profunda n. sp.

Figures 4E; 8A-Q

TYPE MATERIAL — Holotype pv MNHN IM-2000-26556, 172 paratypes MNHN IM-2000-26557, 2 NHMUK 20130650 (as listed below).

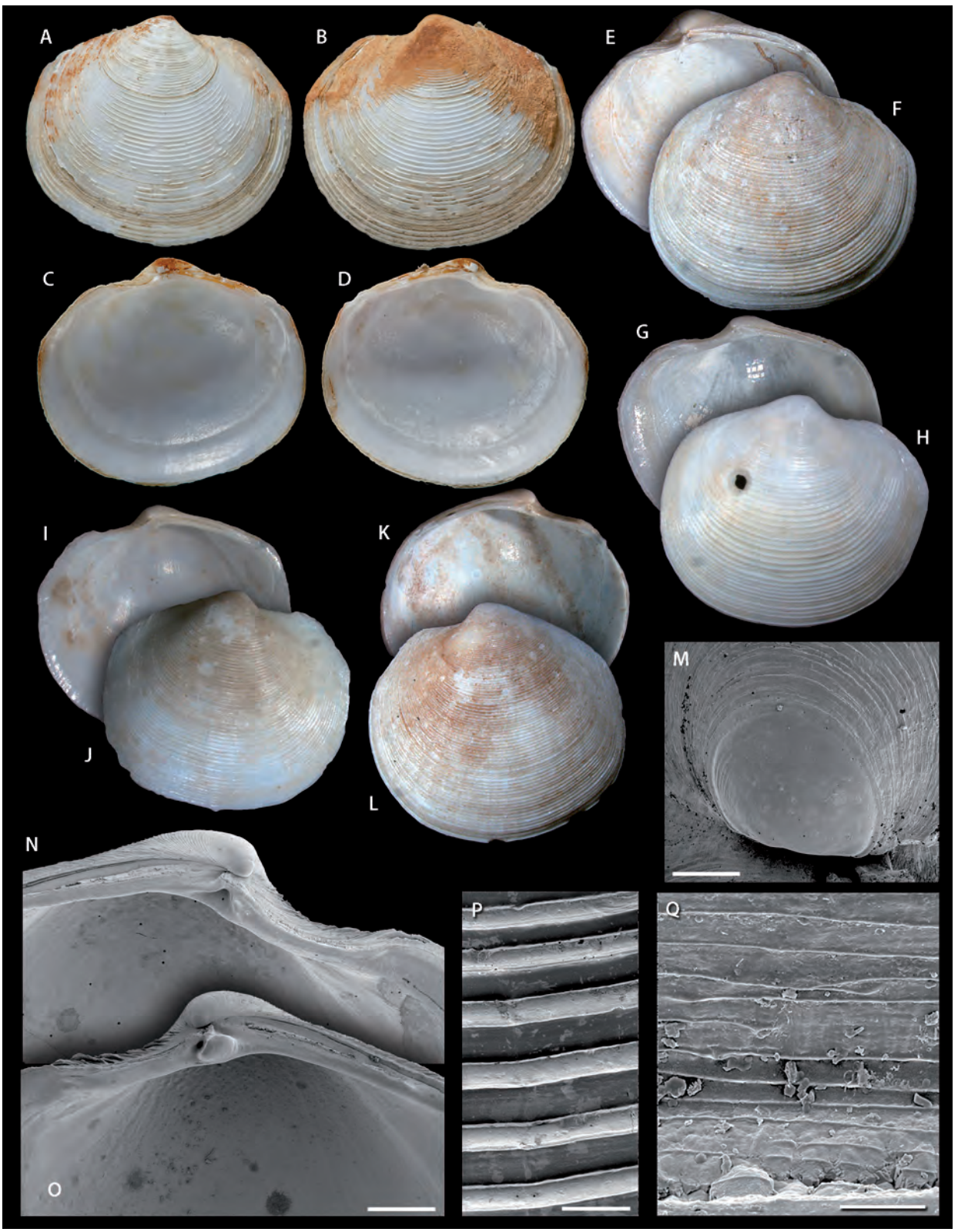
TYPE LOCALITY — Philippines, Bohol/Sulu Seas sill, 8°51'N, 123°10'E, 982-989 m [PANGLAO 2005: stn CP2385].

MATERIAL EXAMINED — Philippines. PANGLAO 2005: stn CP2358, 569-583 m, 1 v. – Stn CP2361, 543-613 m, 1 v. – Stn CP2362, 679-684 m, sand, 172 v paratypes MNHN IM-2000-26557 (L 18.4, H 16.6, T 6.2, L 15.2, H 13.1, T 4.1; Figures 8E, F, I, J); 1 rv paratype NHMUK 20130650 (Figures 8G, H); 1 lv paratype NHMUK 20130650 (Figures 8K, L), 2 rv. – Stn CP2384, 624-647 m, 6 v. – Stn CP 2385, 982-989 m, 1 pv, holotype MNHN 26556 (L 12.6, H 10.9, T 3.5; Figures 8A-D). – Stn CP2394, 470-566 m, 2 v. – AURORA 2007: stn DW2706, 478 m, 2 v. – Stn CP2749, 473 m, 1 v. – Stn DW 2677, 499 m, 2 v. – Stn CP2695, 357-367 m, 1 v.

DISTRIBUTION — Philippines, alive in 982-989 m, empty shells from 367-982 m.

FIGURE 8

Gonimyrtea profunda n. sp. — **A**-**D**, holotype MNHN IM-2000-26556, exterior and interior of both valves, PANGLAO 2005 stn CP2385. L 12.6 mm; **E**, **F**, paratype MNHN IM-2000-26557, interior and exterior of right valve, PANGLAO 2005 stn CP2362. L 18.4 mm; **G**, **H**, paratype NHMUK 20130650, interior and exterior of right valve, PANGLAO 2005 stn CP2362. L 13.4 mm; **I**, **J**, paratype MNHN IM-2000-26657, interior and exterior of right valve, PANGLAO 2005 stn CP2362. L 15.2 mm; **K**, **L**, paratype NHMUK 20130650, interior and exterior of left valve. L 16.5 mm; **M**, protoconch, PANGLAO 2005 stn CP2362. Scale bar = 100 µm; **N**, **O**, details of hinge teeth of right and left valves, PANGLAO 2005 stn CP2362. Scale bar = 1.0 mm; **P**, commarginal lamellae, PANGLAO 2005 stn CP2362. Scale bar = 200 µm; **Q**, detail of microsculpture, PANGLAO 2005 stn CP2362. Scale bar = 10 µm.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DESCRIPTION — Small to medium size, L to 18.9, H to 17.3, T 6.3, subcircular, longer than high. H/L 0.91, moderately inflated, T/L 0.31, thin-shelled, white, umbones low. Sculpture of fine, closely spaced, slightly blunt, commarginal lamellae, radial sculpture absent. Sulci absent, posterior margin slightly truncate. Lunule lanceolate, slightly asymmetric, larger part in RV. Ligament long, in shallow groove; escutcheon narrow, marked by slightly elevated margin. Microsculpture of fine lines. Protoconch (Figure 8M): PI + PII 270 µm, PI smooth 252 µm, PII a narrow 18 µm rim. Hinge thin, RV with single cardinal and small anterior lateral teeth, no posterior lateral teeth; LV with two very small, thin cardinals and no lateral teeth. Anterior adductor scar medium long, detached for 1/2 length at angle of 5°. Pallial line continuous. Pallial blood vessel scar absent. Inner shell surface glossy with radial striations, outside pallial line sometimes slightly fluted and finely denticulate at margin.

REMARKS — *Gonimyrtea profunda* n. sp. is much larger than the type species, *G. concinna* (Hutton, 1985), thinner shelled and with a less robust hinge but is similar in shape, commarginal sculpture, character of the adductor muscle scar, presence of radial grooves on the interior shell outside of the pallial line and the slightly denticulate shell margin. The most similar species is *Gonimyrtea ferruginea* Taylor & Glover, 2013 from New Caledonia and Vanuatu at depths of 350-650 m; this is larger, with more widely spaced commarginal lamellae and a longer, deeper lunule. It can be distinguished additionally from the two species from New Caledonia, *G. avia* Glover & Taylor, 2007 and *G. fidelis* Glover & Taylor, 2007, by its longer adductor muscle scar and denticulate margin.

ETYMOLOGY —Latin *profundus,* meaning deep.

Genus ***MYRTINA*** Glover & Taylor, 2007

Myrtina Glover & Taylor, 2007: 120.

Type species. *Myrtina porcata* Glover & Taylor, 2007, by original designation.

DIAGNOSIS — Shells small, subcircular in outline with fine commarginal lamellae that are sometimes elevated along the dorsal margin, radial sculpture absent, hinge with cardinal teeth in both valves and small lateral teeth, the largest anterior and more prominent in the RV, lunule usually strongly asymmetric, anterior adductor scar short and pallial line usually entire.

REMARKS — Although *Myrtina* was originally described from New Caledonia (Glover & Taylor 2007) with only two known species, it is more widespread and diverse with seven species in offshore waters from 80 to over 1000 m, ranging from Philippines, Japan, New Caledonia and off Zanzibar in the northwest Indian Ocean. Originally, *Myrtina* was thought to be close to Myrteinae (Glover & Taylor 2007; Taylor *et al.* 2011), based on shell sculpture and in particular the elevated dorsal lamellae but molecular evidence for *Myrtina galatea* n. sp. (see below) (as UGS-1 in Taylor *et al.* 2011) and *Myrtina reflexa* Taylor & Glover, 2013 from the western Indian Ocean places it in the subfamily Leucosphaerinae and distant from Myrteinae. *Myrtina* resembles other members of Leucosphaerinae, for example *Dulcina* and *Alucinoma,* which have similar shell sculpture and, in particular, the lack of radial elements, although neither of these genera possess cardinal and lateral teeth. An additional feature is that the three genera all retain visible tracks of the adductor muscle scars on the internal surface of the shell.

Myrtina adamsiana (Habe, 1958) comb. nov.

Figures 9A-M; 10A

Lucinoma adamsiana Habe, 1958b: 28.
Lucinoma adamsianum – Okutani & Hashimoto 1997: 277, figs 6-7. — Higo *et al.* 2001: 456, species B605. — Matsukuma 2000: 931, pl. 463, fig. 17.

TYPE MATERIAL — Holotype lv UMST 39920 (L 15.5, H 14.5, T 3.6).

TYPE LOCALITY — Japan, off Yamaguchi Prefecture, Honshu, Japan Sea, 34°29.3'N, 131°00'E, 93 m.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn T2, 152 m, 3 v. – Stn T5, 84-87 m, 2 v. – Stn T6, 34-82 m, 3 v. – Stn T9, 97-120 m, 14 v. – Stn T10, 117-124 m, 3 v. – Stn T27, 106-137 m, 3 v. – Stn T28, 80 m, 2 v. – Stn T36, 95-128 m, 25 v. – Stn T37, 134-190 m, 1 v. – PANGLAO 2005: stn DW2376, 189-219 m, 1 v. – Stn CP2380, 150-163 m, 5 v.

DISTRIBUTION — Philippines and southern Japan, 40-200 m.

DESCRIPTION — Shell small, white, subcircular, L to 15.5, H to 14.5, shallow posterior and anterior sulci, dorsal margin with slightly elevated commarginal lamellae. Umbones central and prominent. Sculpture of fine, closely spaced, commarginal lamellae. Microsculpture of fine growth lines only. Protoconch (Figure 9M): PI+ PII 196 µm, PI 180 µm, smooth, PII a rim with growth lines. Lunule shallow, smooth, asymmetric, larger in LV, ligament long, in shallow groove. Hinge plate thin, RV with single, narrow, cardinal tooth, anterior lateral tooth, LV with two small cardinal teeth, lateral teeth obscure. Anterior adductor scar short, rounded, detached for 1/4 length, posterior scar ovoid. Pallial line discontinuous, beaded. Pallial blood vessel scar not visible. Shell margin smooth, inner shell surface glossy, with radial lines.

REMARKS — *Myrtina adamsiana* (Habe, 1958) is usually placed in *Lucinoma* in Japanese literature (*e.g.*, Okutani & Hashimoto 1997; Matsukuma 2000), but it lacks most of the features of that genus, including the long anterior adductor and large cardinal teeth. It differs from other *Myrtina* species from the Philippines in its larger size, less inflated and more elongate shell, lower umbones, more closely spaced commarginal lamellae, less elevated sculpture along the dorsal margins and a discontinuous or beaded pallial line. The similar species, *M. leptolira* Glover & Taylor, 2007, from New Caledonia has finer commarginal lamellae.

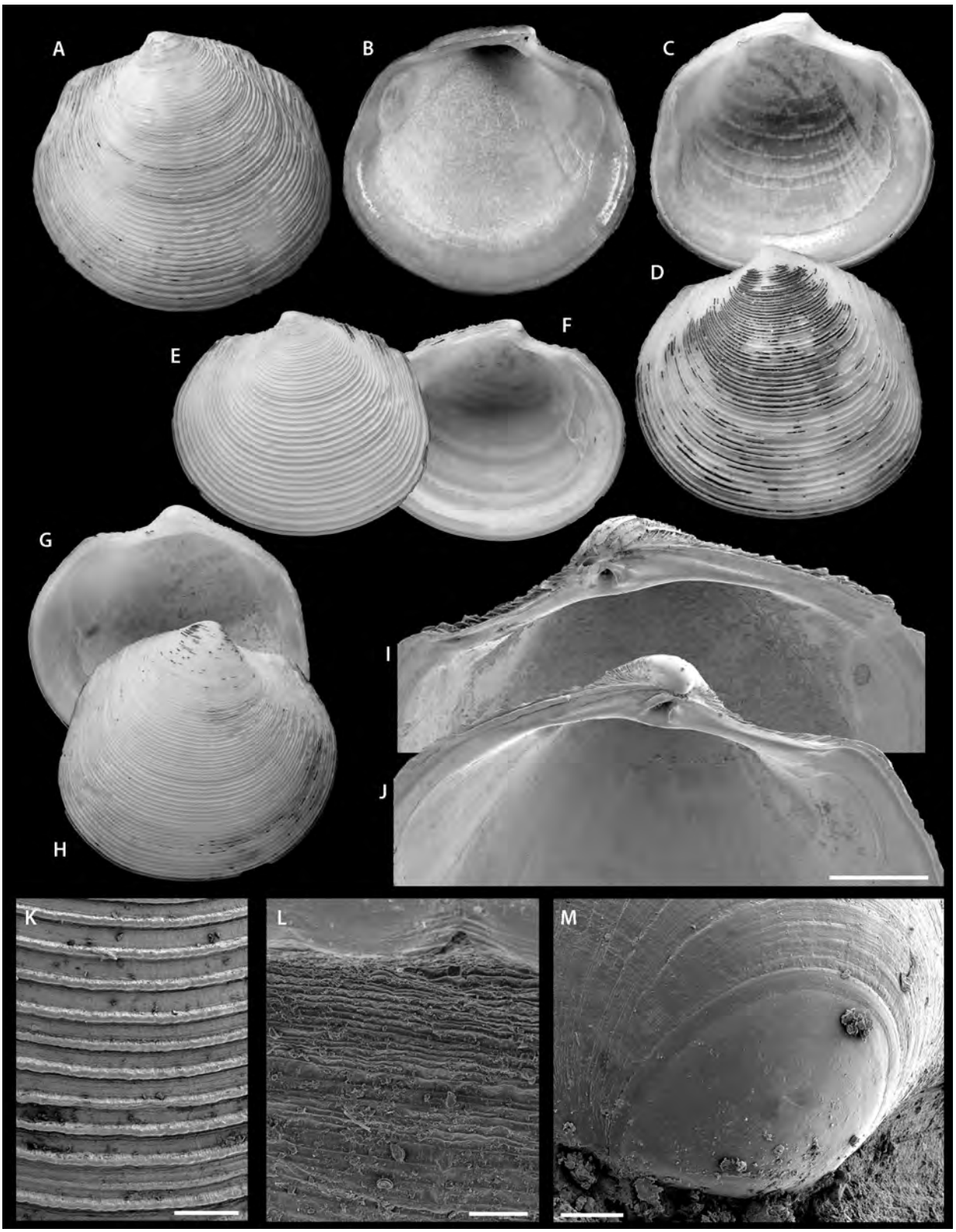
Myrtina boholensis n. sp.

Figures 10B, 11A-L

TYPE MATERIAL — Holotype MNHN IM-2000-26559, 15 paratypes MNHN IM-2000-26560, 2 NHMUK 20130651 (as listed below).

TYPE LOCALITY — Philippines, West Pamilacan Island, 9°29'N, 123°56'E, 95-128 m [PANGLAO 2004: stn T36].

MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn T1, 83-102 m, 2 v. – Stn T2, 150 m, 19 v. – Stn T10, 117-124 m, 1 v. – Stn T13, 90-100 m, 2 v. – Stn T25, 160-210 m, 2 v. – Stn T26, 123-135 m, 1 v. – Stn T27, 106-137 m, 7 v. – Stn T34, 145-163 m, 1 v. – Stn T36, West Pamilacan Island, 9°29'N, 123°56'E, 95-128 m, 1 rv, holotype MNHN IM-2000-26559 (H 4.9, L 5.0; Figures 11A, B), 1 lv (H 4.1, L 4.2; Figures 11C, D) and 14 v (unfigured) paratypes MNHN IM-2000-26560; 2 v paratypes (unfigured) NHMUK 20130651. – Stn T37, 134-190 m, 1 v. – Stn T39, 100-138 m, 2 v. – Stn P1, 90-200 m, 1 v. – PANGLAO 2005: stn DW 2400, 111-115 m, 3 v. – AURORA 2007: stn DW2739, 96 m, 1 v. – Stn CP2749, 473 m, 2 v. – MUSORSTOM 3: stn DR130, 178-195 m, 1 v.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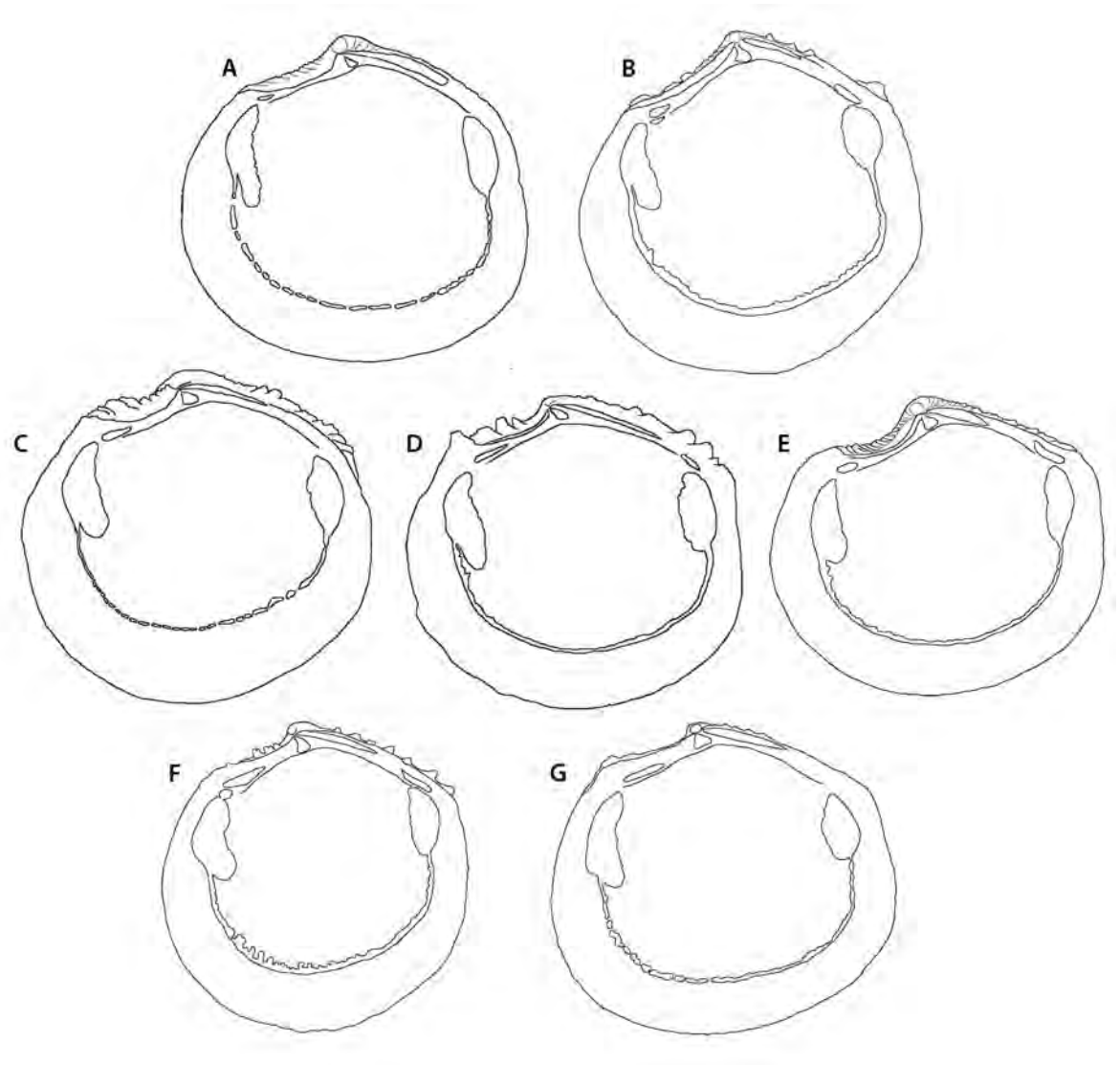


FIGURE 10

Myrtina and *Opalocina* species: outline drawings of shell interiors. **A**, *Myrtina adamsiana*; **B**, *Myrtina boholensis*; **C**, *Myrtina galatea*; **D**, *Myrtina spinosa*; **E**, *Myrtina vicina*; **F**, *Opalocina majuscula*; **G**, *Opalocina persica*.

FIGURE 9

Myrtina adamsiana (Habe, 1958) — **A**, **B**, holotype UMST 39920, left valve, Japan Sea. L15.5 mm; **C**, **D**, interior and exterior of left valve, PANGLAO 2005 stn CP2380. L 13.7 mm; **E**, **F**, exterior and interior of left valve, PANGLAO 2005 stn CP2380. L 12.2 mm; **G**, **H**, interior and exterior of right valve, PANGLAO 2005 stn CP2380. L 14.3 mm; **I**, **J**, detail of hinges of right and left valves, PANGLAO 2004 stn T9. Scale bar = 1.0 mm; **K**, detail of sculpture, PANGLAO 2004 stn T9. Scale bar = 500 µm; **L**, microsculpture detail, PANGLAO 2004 stn T9. Scale bar = 20 µm; **M**, protoconch, PANGLAO 2004 stn T9. Scale bar = 50 µm.

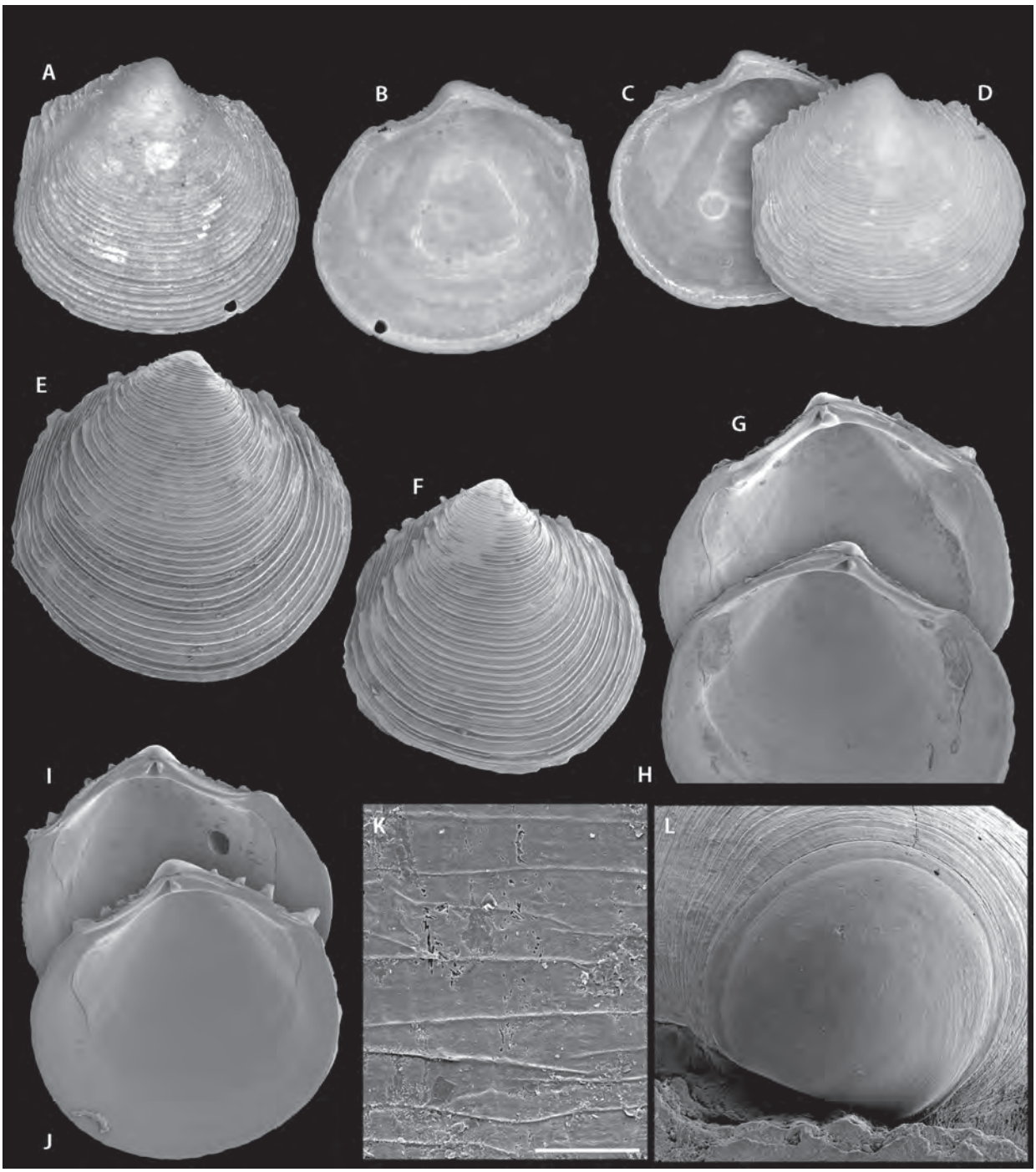


FIGURE 11

Myrtina boholensis n. sp. (all figured paratype specimens, MNHN IM-2000-26560) — **A**, **B**, holotype MNHN IM-2000-26559, exterior and interior of right valve, PANGLAO 2004 stn T36. L 5.0 mm; **C**, **D**, paratype, interior and exterior of right valve, PANGLAO 2004 stn T36. L 4.2 mm; **E**, exterior of right valve, PANGLAO 2004 stn T27. L 5.3 mm; **F**, exterior of right valve, PANGLAO 2004 stn T27. L 4.4 mm; **G**, **H**, interior of right (L 4.2 mm) and left (L 4.0 mm) valves, PANGLAO 2004 stn T27; **I**, **J**, interior of left (L 4.0 mm) and right (L 3.1 mm) valves, PANGLAO 2004 stn T27; **K**, microsculpture, PANGLAO 2004 stn T27. Scale bar = 10 µm; **L**, protoconch, PANGLAO 2004 stn T27. Scale bar = 50 µm.

DISTRIBUTION — Central Philippines, empty shells in 96-200 m, with one record in 473 m.

DESCRIPTION — Shell small, white subcircular, L to 5.0, H to 4.9 umbones prominent, posterior dorsal area with shallow sulcus and elevated commarginal sculpture along dorsal margin; anterior dorsal margin with slightly elevated lamellae. Sculpture of fine, thin, closely spaced, commarginal lamellae, interspaces with growth increments only. Microsculpture of thin, irregular folds and growth lines. Protoconch (Figure 11L): PI + PII 196 µm, P1 smooth, PII a 13 µm rim with some growth increments. Lunule shallow, asymmetric, larger part in LV; ligament thin, in shallow groove. Hinge: RV with single cardinal, with anterior lateral and small posterior lateral teeth, LV with two small cardinal teeth, lateral teeth obscure. Anterior adductor muscle scar short, rounded, detached for 1/5 length, pallial line entire. Shell margin smooth, shell interior glossy, pallial blood vessel scar not visible.

REMARKS — Of all the Philippine *Myrtina*, this species is closest to the type species, *M. porcata* Glover & Taylor, 2007 from New Caledonia. It differs in its more circular outline, higher umbones and finer commarginal lamellae. *Myrtina boholensis* n. sp. can be distinguished from *M. spinosa* n. sp. (see below) from the Philippines by its finer sculpture, smaller hinge teeth and less scooped lunule, and from *M. adamsiana* (Habe, 1958) from Panglao and Japan by its smaller size, less elongate outline and higher umbones. *Myrtina tchangsii* Xu, 2012 from 99 m in the South China Sea may be similar but better figures and examination of type material are needed for more detailed comparison.

ETYMOLOGY — Name derived from the Island of Bohol, Philippines.

Myrtina galatea n. sp.

Figures 10C, 12A-N

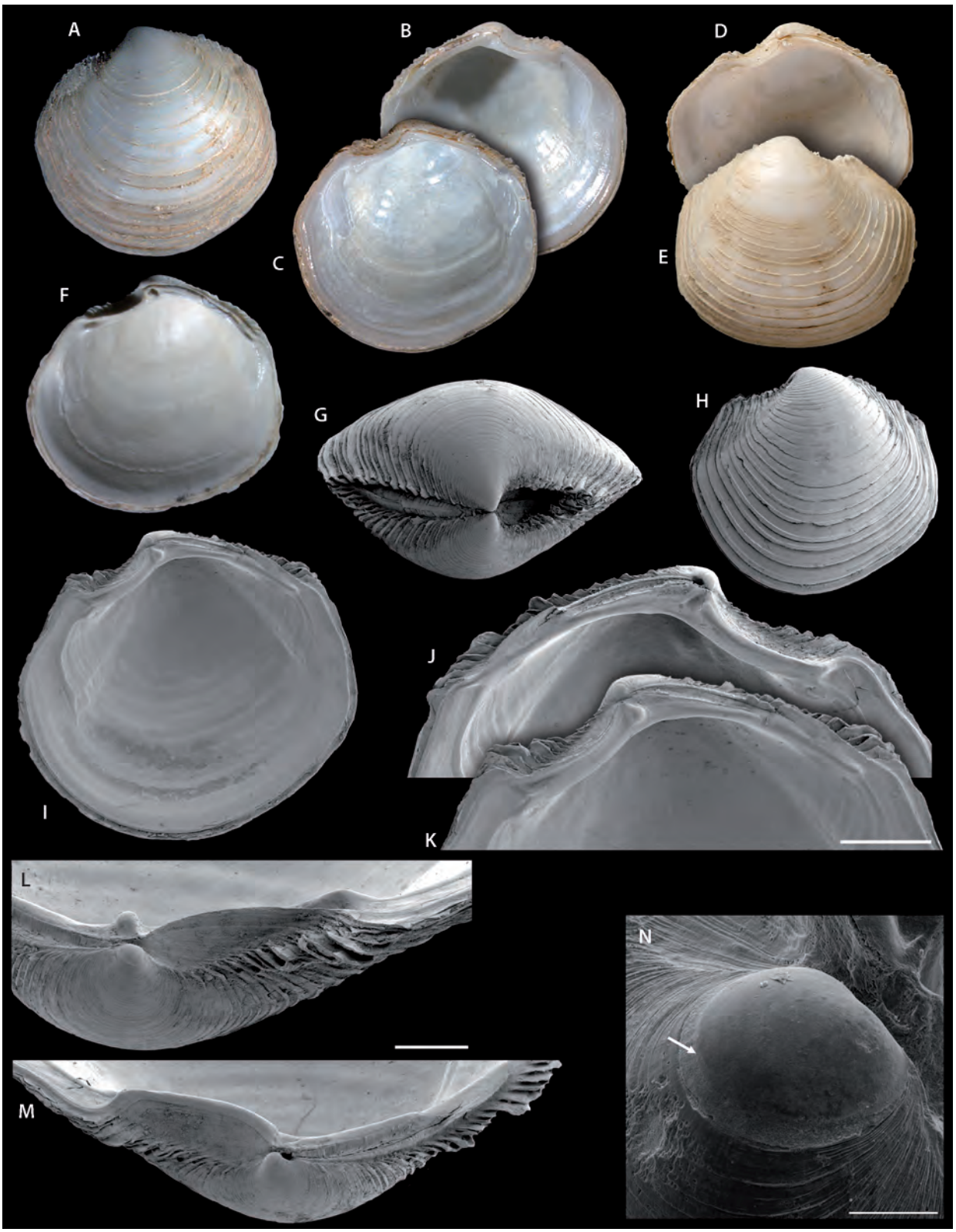
Undetermined genus and species OG78 – Brissac *et al.* 2011: figs 1c-d.
Undescribed genus and species UGS-1 – Taylor *et al.* 2011, figs 7D-E.

TYPE MATERIAL — Holotype pv MNHN IM-2000-26561, 38 paratypes MNHN IM-2000-26562-26564, 3 NHMUK 20130652 (as listed below).

TYPE LOCALITY — Philippines, Bohol Sea, Maribojoc Bay, 9°36'N, 123°42'E, 609-673 m [PANGLAO 2005: stn CP2396].

MATERIAL EXAMINED — Philippines. PANGLAO 2005: stn CP2331, 255-268 m, 1 v. – Stn CP2332, 396-418 m, 2 v. – Stn CP2333, 584-596 m, 1 pv. – Stn CP2334, 606-631 m, 1 v. – Stn CP2340, 271-318 m, 4 v. – Stn CP2341, 544-712 m, 2 pv, 22 v. – Stn CP2342, 1240-1258 m, 1 v. – Stn DW2347, 198-233 m, 1 v. – Stn CP2348, 196-216 m, 2 v. – Stn CP2349, 219-240 m, 3 v. – Stn CP2350, 602-738 m, 1 v. – Stn CP2351, 810-812 m, 1 rv paratype MNHN IM-2000-26562 (L11.0, H 10.1; Figure 12F), 3 pv paratypes NHMUK 20130652 (L 9.25, H 9.1; L 7.8, H 7.2; L 7.0, H 6.9; unfigured), 1 pv, 5 v. – Stn CP2352, 923-1260 m, 1 pv, 1 v. – Stn CP2358, 569-583 m, 1 v. – Stn CP2362, 679-740 m, 9 v. – Stn DW2364, 427 m, 107 v. – Stn CP2372, 255-301 m, 5 v. – Stn CP2380, 150-163 m, 1 pv, 42 v. – Stn CP2381, 259-280 m, 179 v. – Stn CP2384, 624-647 m, 7 v. – Stn CP2385, 982-989 m, 1 v. – Stn CP2390, 627-645 m, 5 v. – Stn CP2393, 356-396 m, 5 v. – Stn CP2394, 470-566 m, 1 pv, 23 v. – Stn CP2395, 382-434 m, 6 v. – Stn CP2396, 609-673 m, 1 pv, 33 v. – Stn CP2396, 609-673 m, 1 pv, holotype MNHN IM-2000-26561 (L 9.8, H 9.3, T 2.8; Figures 12A-C), 33 v, paratypes MNHN IM-2000-26563. – Stn CP2397, 669-712 m, 1 pv (rv damaged) (L 10.1, H 8.8; Figures 12D, E), 1 pv (L 6.2, H 5.7; Figures 12 G-H), 1 rv, (L 5.5, H 6.0; Figure 12I), 1 lv (L 6.1, H 5.9; Figure 12J) paratypes MNHN IM-2000-26564, 4 pv, 14 v. – Stn CP2398, 713-731 m, 2 pv, 10 v. – Stn CP2399, 309-342 m, 2 v. – Stn DW2401, 397-410 m, 15 v. – Stn CP2404, 481-505 m, 2 pv. – Stn CP2405, 387-453 m, 1 pv, 16 v. – Stn CP2406, 334-387 m, 4 v. – Stn CP2409, 220-257 m, 1 v. – MUSORSTOM 3: stn CP101, 194-196 m, 1 v. – Stn DR102, 192 m, 1 v. – Stn CP139, 240-267 m, 2 v. – AURORA 2007: stn CP2672, 346-276 m, 1 v. – Stn CP2695, 367-357 m, 1 v. – Stn CP2709, 244-296 m, 3 v. – Stn CP2711, 184-200 m, 1 v.

DISTRIBUTION — Central Philippines, paired valves in 163-923 m, empty shells in 163-1240 m.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DESCRIPTION — Shell small L to 10, H to 9.3, subcircular, posteriorly truncate, moderately inflated. Umbones prominent, central. Sculpture of regularly spaced, low, rounded commarginal lamellae projected into short scales along posterior dorsal margin and edges of lunule. Interspaces between lamellae smooth. Radial sculpture absent. Lamellae often worn away in central parts of shell. Microsculpture of thin growth lines. Lunule prominent, inset, broadly lanceolate, asymmetrical with greater part in left valve. Protoconch (Figure 12N): PI + PII 202 µm, PII a narrow rim. Ligament short, thin, set in a groove; escutcheon prominent, bordered by raised lamellae. Hinge: RV with single cardinal tooth and an anterior lateral tooth located above the anterior adductor scar. LV with two cardinals, anterior tooth very thin and fused with edge of the lunule, lateral teeth absent. Anterior adductor muscle scar short, detached from pallial line for about 1/5 of length, posterior scar ovoid; both muscle scars sit on slightly elevated pads, their tracks visible on the inside of the shell (Figure 12I). Pallial line continuous. Shell interior glossy, pallial blood vessel scar absent. Shell margin smooth, with ultimate commarginal lamellae forming a rim to fit opposing valve. Colour creamy white.

REMARKS — *Myrtina galatea* n. sp. is similar in size to the type species, *M. porcata* Glover & Taylor, 2007 from New Caledonia, but differs in having fewer, more widely spaced, commarginal lamellae that are sometimes obsolete in the central part of the shell. A specimen (MNHN IM-2009-10373) of this species was included in the molecular analysis (Taylor *et al.* 2011) and cited as UGS1 (undescribed genus and species) from PANGLAO 2005 stn CP2397, 642-669 m. Additionally, Brissac *et al.* (2011) sequenced the host and bacterial symbiont of a specimen from PANGLAO 2005 stn CP2360; the host sequence grouped with other species in a clade that Taylor *et al.* (2011) named Leucosphaerinae.

ETYMOLOGY — Latin *galatea,* a sea nymph.

Myrtina spinosa n. sp.

Figures 10D, 13A-N

TYPE MATERIAL — Holotype pv MNHN IM-2000-26565 (L 4.2, H 4.2,T 1.1; Figures 13A-C), 42 paratypes MNHN IM-2000-26566 [1 rv (L 6.9, H 6.8, T 1.9; Figures 13D, E); 1 lv (L 6.3, H 6.1, T 1.5; Figures 13F, G); 1 lv (L4.1, Figure 13H); 1 rv (L4.4; Figure 13I), 1 rv and 1 lv (L 4.3; Figures 13J, K); and 37 v (unfigured)]; 6 v NHMUK 20130653 (unfigured).

TYPE LOCALITY — Philippines, off north coast of Panay Island, 11°43'N, 122°34'E, 93-99 m, [MUSORSTOM 3: stn DR140].

DISTRIBUTION — Known only from the type locality.

FIGURE 12

Myrtina galatea n. sp. — **A**-**C**, holotype MNHN IM-2000-26561, exterior of left valve and interior of right and left valves, PANGLAO 2005 stn CP 2396. L 9.8 mm; **D**, **E**, paratype MNHN IM-2000-26563, exterior and interior of right valve, PANGLAO 2005 stn CP2396. L 10.1 mm; **F**, paratype MNHN IM-2000-26562, interior of right valve, PANGLAO 2005 stn CP2351. L 11.0 mm; **G**, paratype MNHN IM-2000-26564, dorsal view, PANGLAO 2005 stn CP2397. L 6.2 mm; **H**, exterior of left valve of G, PANGLAO 2005 stn CP2397. L 6.2 mm; **I**, paratype MNHN IM-2000-26564, interior of right valve, PANGLAO 2005 stn CP2397. L 5.5 mm; **J**, **K**, paratype MNHN IM-2000-26564, details of hinge of left and right valves, PANGLAO 2005 stn CP2397. Scale bar = 1.0 mm; **L**, paratype MNHN IM-2000-26564, dorsal view of hinge area of right valve, PANGLAO 2005 stn CP 2397. Scale bar = 500 µm; **M**, paratype MNHN IM-2000-26564, dorsal view of hinge area of left valve, PANGLAO 2005 stn CP2397. Scale bar = 500 um; **N**, protoconch, PANGLAO 2005 stn CP2351. Scale bar = 100 µm.

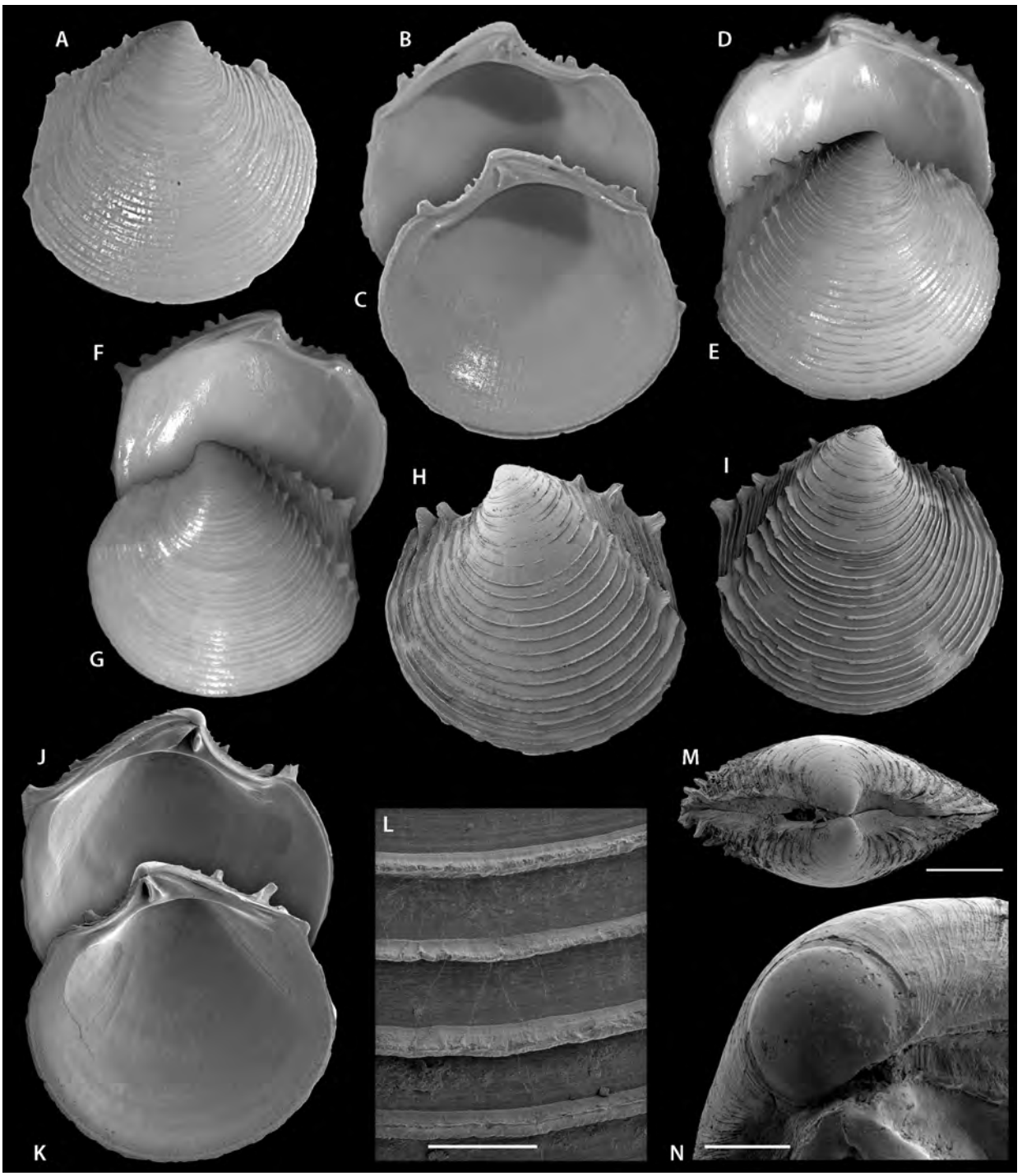


FIGURE 13

Myrtina spinosa n. sp. (All figured material from MUSORSTOM 3 stn DR140. Figured paratypes MNHN IM-2000-26566) — **A**-**C**, holotype MNHN IM-2000-26565, exterior of right valve and interiors of left and right valves. L 4.2 mm; **D**, **E**, paratype, exterior and interior of right valve. L 6.9 mm; **F**, **G**, paratype, interior and exterior of left valve. L 6.3 mm; **H**, paratype, exterior of left valve. L 4.1 mm; **I**, paratype, exterior of right valve. L 4.4 mm; **J**, **K**, paratype, interior of left and right valves. L 4.3 mm; **L**, detail of commarginal sculpture. Scale bar = 200 µm; **M**, dorsal view of paired valves. Scale bar = 1.0 mm; **N**, protoconch of K. Scale bar = 100 µm.

DESCRIPTION — Shell small, L to 10, H to 9.4; T 2.1, moderately inflated, subcircular, posteriorly truncate, umbones central, high, prominent. Posterior dorsal area prominent, demarcated by a ridge running from umbone to posterior margin; marked in juveniles by projecting raised lamellae. Sculpture of closely spaced, thin, sharp, commarginal lamellae; these more or less extended into blunt spines along the posterior dorsal margin and to a lesser extent along the anterior dorsal margin, more prominent in juveniles. Microsculpture of fine growth lines only. Posterior dorsal area with closely packed lamellae. Lunule prominent, broadly lanceolate, inset, scooped, asymmetrical, most in LV. Ligament short, inset. Escutcheon long, prominent, edged with fluted lamellae. Protoconch (Figure 13N): PI + PII 209 µm, PI smooth, PII a broad rim. Hinge: RV with single cardinal tooth and anterior and posterior lateral teeth (posterior lateral more prominent in smaller shells); LV with two cardinal teeth, posterior-most is thinner, no lateral teeth but edge of escutcheon may interlock with posterior lateral tooth of RV. Anterior adductor muscle scar short, broad, detached for 1/4 of length, posterior scar oval, both scars sit on slightly raised pads and their tracks visible. Pallial line entire. Shell interior glossy, margin smooth. Colour white.

REMARKS — This uncommon species can be distinguished from other *Myrtina* species by the prominent spines along both anterior and posterior dorsal margins, the more continuous commarginal lamellae, and the clearly defined posterior dorsal area marked by elevated lamellae. It differs from the similar *M. galatea* n. sp. in possessing higher umbones, more prominent cardinal and posterior lateral teeth, as well as occurring at shallower depths of less than 100 m.

ETYMOLOGY — Latin *spinosus*, thorny.

Myrtina vicina n. sp.

Figures 10E; 14A-M

TYPE MATERIAL — Holotype pv MNHN IM-2000-26567 (L 10.6, H 9.2, T 3.3; Figures 14A-C)., 2 paratypes MNHN IM-2000-26568 [1 lv (L 9.8, H 9.7, T 3.2; Figures 14D, E); 1 rv (L 9.2, H 8.6, T 2.9; Figures 14F, G) and 275 v (unfigured)]; 7 v NHMUK 20130654 (unfigured).

TYPE LOCALITY — Philippines, off north coast of Panay Island, 11°43'N, 122°34'E, 93-99 m [MUSORSTOM 3: stn DR140].

DISTRIBUTION —Known only from the type locality.

DESCRIPTION — Shell small, subcircular with posterior margin subtruncate, L to 11.1, H to 9.8, T 3.4. Umbones high and prominent. Posterior dorsal area demarcated with shallow sulcus with slightly elevated lamellae dorsally. Sculpture of fine, regularly spaced commarginal lamellae that are sometimes finely crinkled, with fine radial folding between the lamellae. Lunule deep, strongly asymmetric with large part in LV. Hinge: RV with small single cardinal and small posterior and larger anterior lateral teeth, RV with two cardinal teeth and no lateral teeth, though the margins of lunule and escutcheon may interlock with the teeth in RV. Protoconch (Figure 14M): P1+ PII 190 µm, PI 177 µm smooth, PII a broad rim. Anterior adductor muscle scar short, detached for 1/3 of length, with track of scar visible on inner shell surface. Pallial line entire, shell margin smooth, inner shell surface glossy, pallial blood vessel scar absent. Colour creamy white.

REMARKS — This species occurs at the same station as *M. spinosa* n. sp. (see above) and although confusingly similar at first, there are morphological differences between them. *Myrtina vicina* n. sp. for example lacks the raised spines along the dorsal margins and bordering the posterior dorsal area, has much smaller hinge teeth and a deeper lunule, also, there are pronounced radial striations between the commarginal lamellae that are lacking in all other *Myrtina* species.

ETYMOLOGY — Latin *vicinus*, near, neighbouring, reference to occurence at same station as *M. spinosa*.

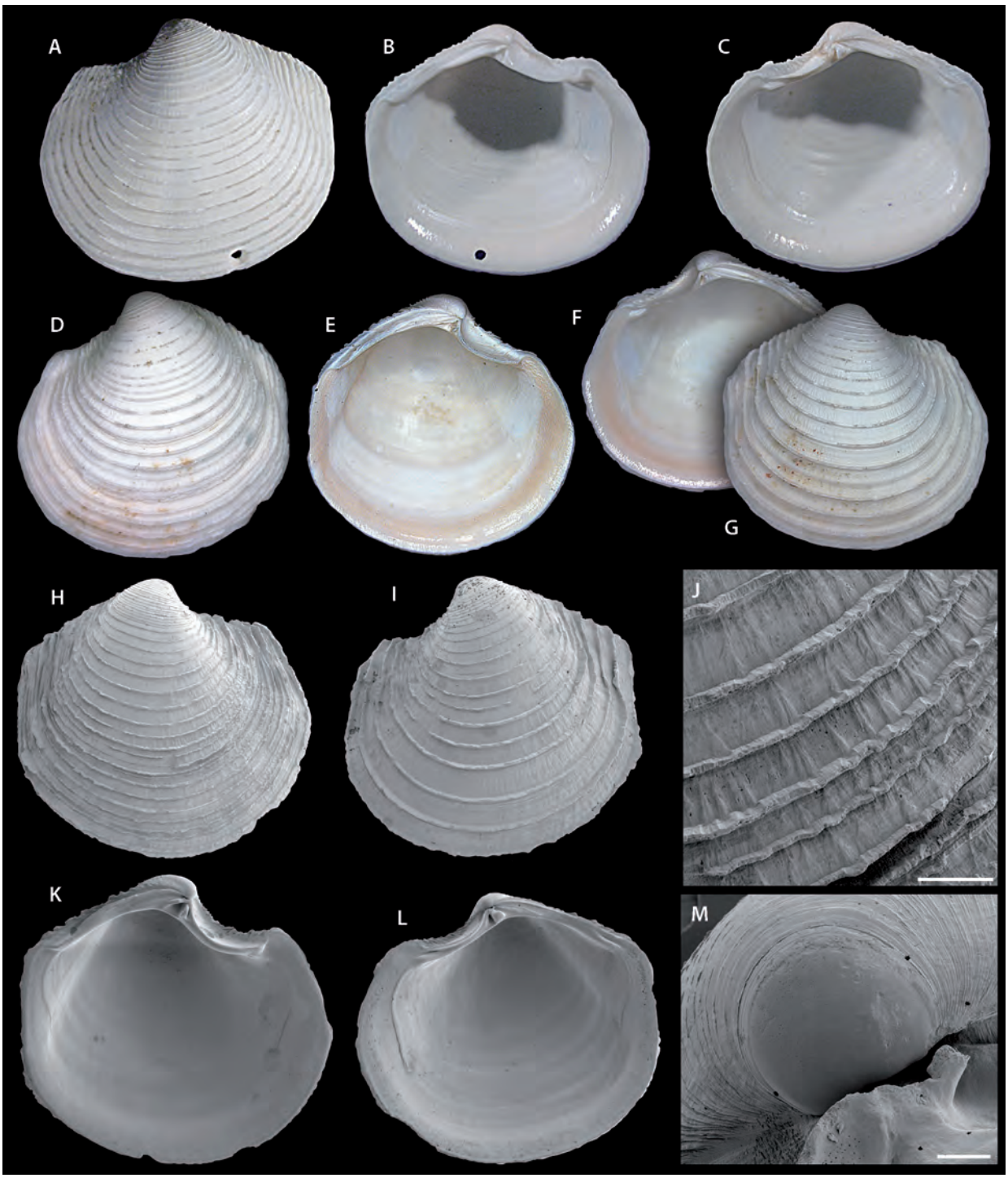


FIGURE 14

Myrtina vicina n. sp. (all figured material from MUSORSTOM 3 stn DR140. Figured paratypes MNHN IM-2000-26568) — **A**-**C**, holotype MNHN IM-2000-26567, exterior of left valve and interiors of left and right valves. L 10.6 mm; **D**, **E**, paratype, exterior and interior of left valve. L 9.8 mm; **F**, **G**, paratype, interior and exterior of right valve. L 9.2 mm; **H**, exterior of right valve. L 4.4 mm; **I**, exterior of left valve. L 5.1 mm; **J**, detail of sculpture showing radial folds. Scale bar = 200 µm; **K**, **L**, interior of left (L 4.6 mm) and right (L 4.3 mm) valves; **M**, protoconch of K. Scale bar = 50 µm.

Genus *OPALOCINA* n. gen.

Type species. *Opalocina persica* n. sp., here designated.

DIAGNOSIS — Shells very small, thin and semi-translucent, sculpture of sharp, closely spaced commarginal lamellae that are elevated at the dorsal margin, central part of shell smooth, radial sculpture absent. Protoconch, PII with numerous growth lines. Hinge with cardinal teeth in both valves and lateral teeth more prominent in RV. Lunule asymmetric, larger part in LV. Anterior adductor muscle scar short, pallial line discontinuous.

REMARKS — Molecular results (Taylor *et al.* 2011) place *Opalocina persica* n. sp. (cited as UGS-2) in the subfamily Leucosphaerinae and within this group it is most similar to species of *Myrtina* with which it shares many morphological features. *Opalocina* can be distinguished from *Myrtina* by its much smaller size, the absence of commarginal sculpture in the central part of the shell and the presence of numerous growth increments in PII of the protoconch compared to a narrow rim in all examined *Myrtina*. We consider that *Lucina fosteri* Hartman & Boss, 1965 described from near Tuléar, Madagascar is another species of *Opalocina*.

ETYMOLOGY — From Latin *opalus,* meaning opaline, in reference to slight iridescence of live-collected shells.

Opalocina persica n. sp.

Figures 10G; 15A-O

UGS-2 (undescribed genus and species) – Taylor *et al.* 2011, fig. 7k.

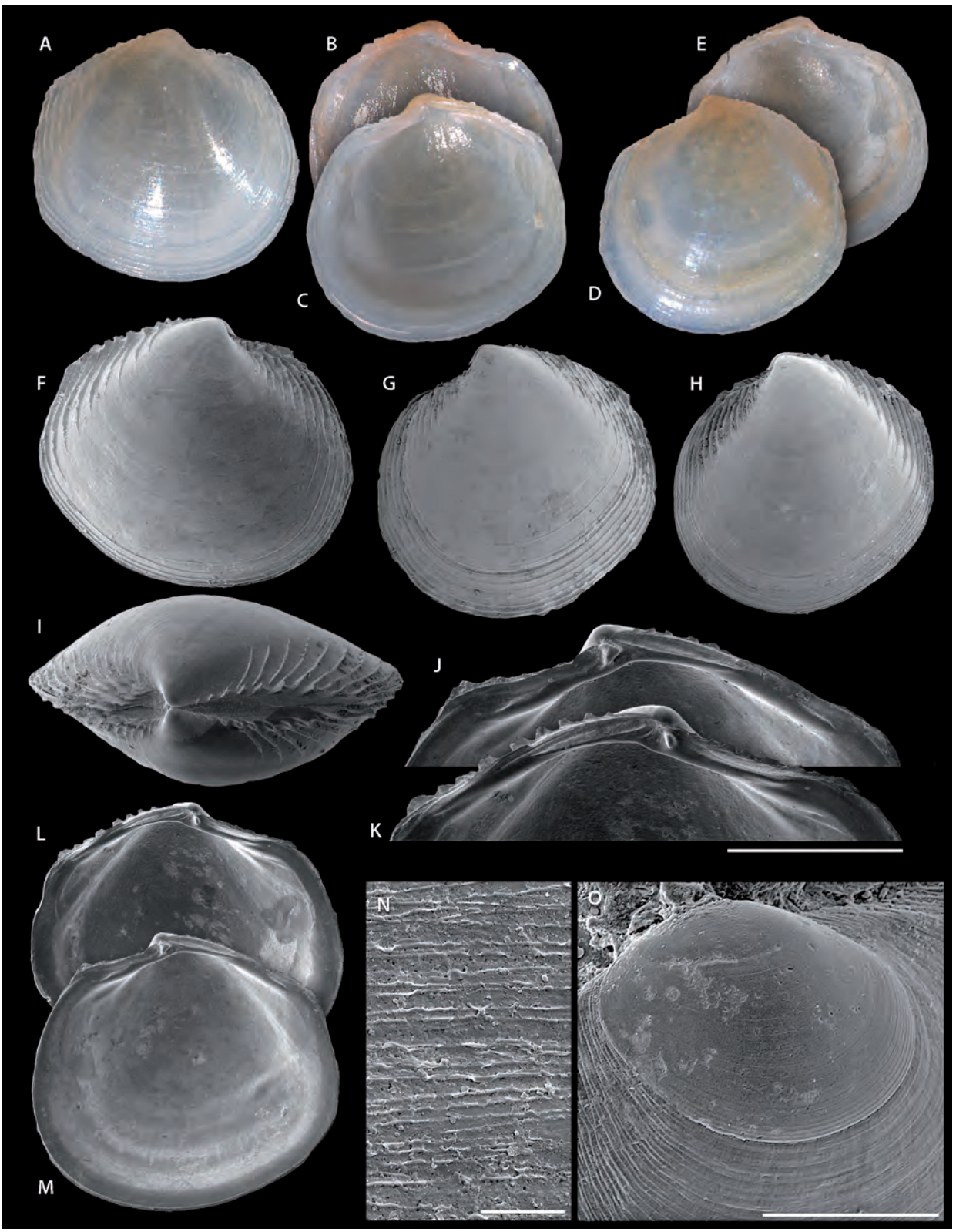
TYPE MATERIAL — Holotype pv MNHN IM-2000-26569, 84 paratypes MNHN IM-2000-26570, 10 NHMUK 20130655 (as listed below).

TYPE LOCALITY — Philippines, Bohol Island, Ubajan, 9°41.5'N, 123°51'E, 12 m, mud. [PANGLAO 2004: stn S27].

MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn S19, 3-4 m, 9 pv. – Stn S20, 10 m, 1 pv, 19 v. – Stn S21, 4-12 m, 1 pv, 2 v. – Stn S27, 12 m, 1 pv, holotype MNHN IM-2000-26569 (L 3.4, H 3.2; Figures 15A-C); 1 pv, paratype NHMUK 20130655 (L 3.2, H 3.1; Figures 15D, E); 4 v, 5 pv, paratypes NHMUK 20130655 (unfigured); 1 pv, (L 3.3, H 2.8; Figure 15F), 1 pv, (L 2.9, H 2.9; Figures 15G, I, O), 1 pv, (L 3.1, H 3.1; Figure 15H), 1 pv, (L 3.3, H 2.9; Figures 15J-M), 31 pv, 49 v (unfigured), paratypes MNHN IM-2000-26570. – Stn T19, 10 m, 2 pv, 21 v. – Stn T22, 11-20 m, 3 v.

DISTRIBUTION — Central Philippines, at depths less than 20 m.

DESCRIPTION — Small, subquadrate to ovoid, L to 4.0, H to 3.8. Thin-shelled, glossy, opaline, semi-translucent, anteriorly expanded, umbones low, at midline. Sculpture of sharp, closely spaced commarginal lamellae present at anterior and posterior dorsal areas, extending as projecting scales at posterior dorsal margin, with lower lamellae around ventral margin, middle shell areas smooth. Microsculpture of fine growth lines only. Lunule lanceolate, asymmetric, greater part in LV. Ligament external. short. Protoconch (Figure 15O): PI+PII 165 µm, PI smooth 87 µm, PII with many growth increments. Hinge thin, RV with single cardinal tooth and elongate anterior and posterior lateral teeth; LV with two small cardinals, anterior larger and more robust, and an indistinct anterior lateral tooth. Anterior adductor muscle scar short, detached from pallial line for about 1/5 of length; posterior scar ovoid. Pallial line mostly discontinuous, with dorsal projections. Shell margin smooth, glossy. Exterior shell, particularly dorsal areas, tinged with pale orange/peach colour.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REMARKS — See genus.

ETYMOLOGY — Latin *persicus,* meaning peach, a reference to pale orange-peach colour of the shell.

Opalocina majuscula n. sp.

Figures 10F; 16A-K

TYPE MATERIAL — Holotype pv MNHN IM-2000-26571, 59 paratypes MNHN IM-2000-26572, 6 NHMUK 20130656 (as listed below).

TYPE LOCALITY — Philippines, Bohol Island, Cortes, 9°41'N, 123°49'E, 160-210 m, fine sand and mud [PANGLAO 2004: stn T25].

MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn T18, 80-100 m, 6 v. – Stn T25, 160-210 m, 1 pv, holotype MNHN IM-2000-26571 (L 3.2, H 3.1), 1 pv (L 3.1, H 3.0; Figure 16B), 1 lv (L 3.5, H 3.3; Figure 16 E), 1 rv (L 4.6, H 4.5; Figure 16F), 56 v (unfigured) paratypes MNHN IM-2000-26572, 1 lv (L 4.1, H 3.9; Figure 16C) paratype NHMUK 20130656, 1 rv (L 4.0, H 3.9; Figure 16D) paratype NHMUK 20130656, 4 v (unfigured) paratypes NHMUK 20130656. – Stn T26, 123-135 m, 15 v. – Stn G1,100 m, 3 v. – PANGLAO 2005: stn CP2331, 256-263 m, 2 v. – Stn DW2339, 164-173m, 6 v. – Stn CP2348, 196 m, 13 v. – Stn CP2349, 240 m, 4 v. – Stn CP2380, 150-163 m, 2 v. – Stn CP 2407, 256m, 3 v. – MUSORSTOM 2: stn DR34, 155-167, 4 v. – Stn CP41, 166-172 m, 1 v. – MUSORSTOM 3: stn DR140, 93-99 m, 21 v. – Stn CP143, 205-214 m, 27 v.

DISTRIBUTION — Philippines, paired valves in 160-210 m, empty shells in 99-256 m.

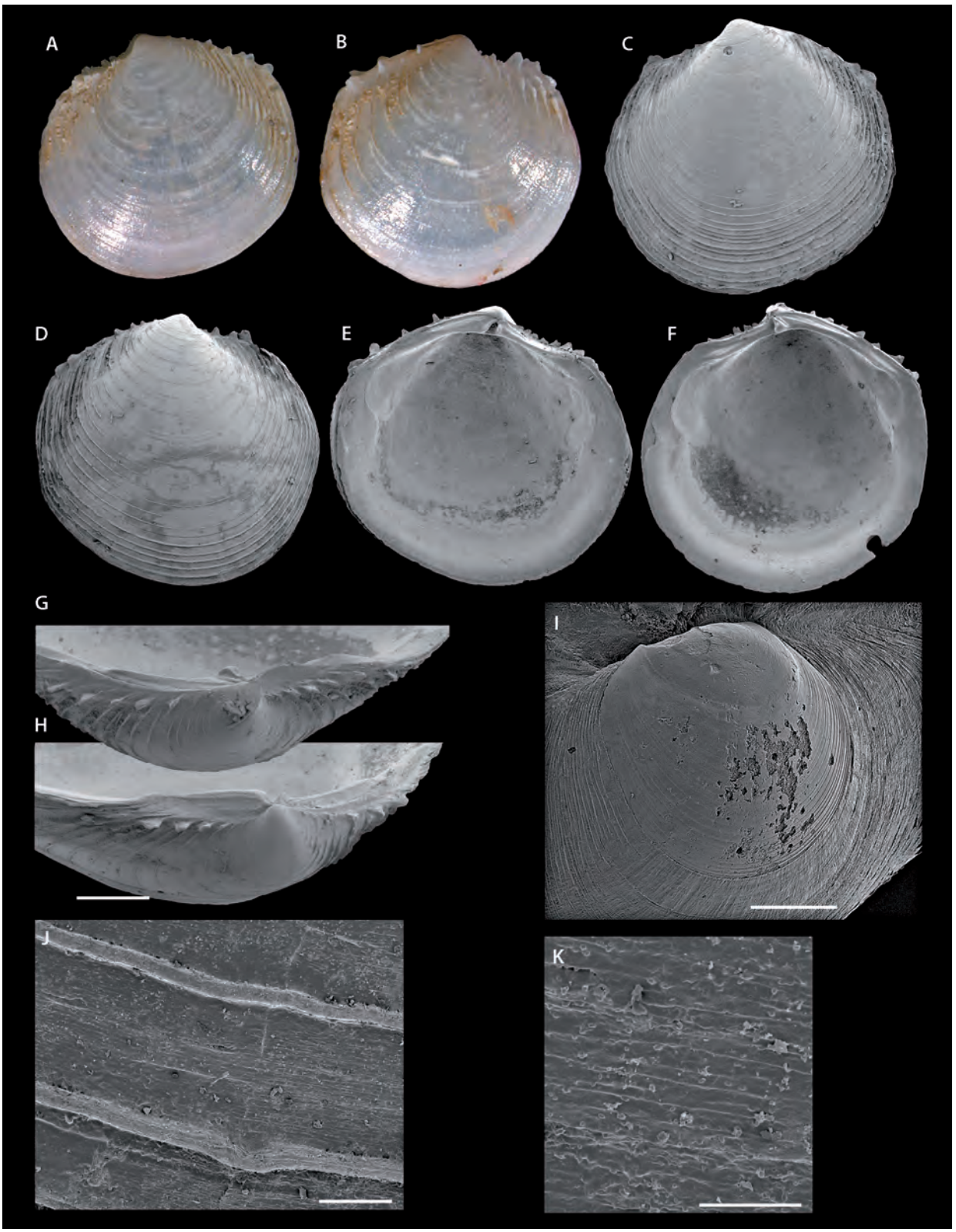
DESCRIPTION — Shell small, subovate, L to 7.4, H to 6.8, not inflated. Thin-shelled, semi-translucent, umbones low, at midline. Sculpture of sharp, closely spaced commarginal lamellae present at anterior and posterior dorsal areas, extending as projecting scales at posterior dorsal margin, lamellae are less visible and widely spaced but continuous in central dorsal part of the shell and are more prominent and closer in ventral part of shell. Microsculpture of fine growth lines. Lunule narrow and lanceolate, slightly asymmetric, greater part in LV. Ligament external. short. Protoconch (Figure 16 K): PI+PII 168 µm, PI smooth 91 µm, PII with many fine growth increments. Hinge thin, RV with single cardinal tooth and long anterior lateral, posterior lateral less distinct; LV with two small cardinals, anterior larger and more robust, lateral teeth absent. Anterior adductor muscle scar short, detached from pallial line for about 1/5 of length; posterior scar ovoid. Pallial line sometimes discontinuous, with dorsal projections. Shell margin smooth, interior glossy.

REMARKS — *Opalocina majuscula* n. sp. can be distinguished from *O. persica* n. sp. by its larger size, less translucent shell, and more prominent and continuous commarginal lamellae, and lack of orange colouring. It also occurs in deeper water from 80-260m.

ETYMOLOGY — Latin *majusculus,* somewhat greater, refers to its larger size compared to the type species.

FIGURE 15

Opalocina persica n. sp. (All material from PANGLAO 2004 stn S27. All figured paratypes, except D and E, MNHN IM-2000-26570) — **A**-**C**, holotype MNHN IM-2000-26569, exterior of right valve and interior of left and right valves. L 3.4 mm; **D**, **E**, paratype NHMUK 20130655, exterior and interior of left valve. L 3.2mm; **F**, paratype, exterior of right valve of whole shell. L 3.3 mm; **G**, paratype, exterior of left valve of whole shell. L 2.9 mm; **H**, paratype, exterior of left valve of whole shell. L 3.1 mm; **I**, dorsal view of **G**; **J**, **K**, detail of hinge of L and M. Scale bar = 1.0 mm; **L**, **M**, interior of left and right valves. L 3.3 mm; **N**, microsculpture. Scale bar = 10 µm; **O**, protoconch of G. Scale bar = 100 µm.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Genus ***PSEUDOLUCINISCA*** Chavan, 1959

Callucina (Pseudolucinisca) Chavan 1959: 516.

Type species. *Lucina lacteola* Tate, 1897 [*nom. nov. pro Lucina lactea* A. Adams, 1855, non Lamarck, 1818], by original designation. South Western Australia.
Pseudolucinisca Chavan – Glover & Taylor 2008: 450.

DIAGNOSIS — Shells to 30 mm length. Subcircular in outline, inflated, sculpture of narrow, regularly spaced commarginal lamellae; lunule highly asymmetric, with arcuate flange projecting entirely from LV. Hinge: RV with single, large, bifid cardinal tooth; LV with posterior cardinal and vestigial anterior cardinal abutting lunule extension. Pallial line discontinuous, divided into irregular blocks. Inner shell margin denticulate.

REMARKS — The type and another similar species, *P. wami*, live in shallow water around South and Western Australia (Glover & Taylor 2008). The species described below is similar in shell characters of shape, sculpture, hinge, lunule, muscle scars and extends the known range of the genus into the central IWP and to much greater depths. We regard *Lucinoma japonica* Habe, 1958 from 143 m off west Honshu, Japan as another *Pseudolucinisca* species although Higo *et al.* (1999, 2001) placed it in *Gonimyrtea* and Matsukuma (2000) in *Lucinoma*.

Pseudolucinisca kantori n. sp.

Figures 4D; 17A-P

TYPE MATERIAL — In the absence of a whole shell or paired valves of this species with a strongly asymmetric lunule we propose a syntype series rather than select a single valve as holotype. Syntypes MNHN IM-2000-26573 [rv (L 18.6, H 17.1, T 5.1; Figures 17A, B); lv (L 19.0, H 16.7, T 5.3; Figures 17C, D); rv (L 20.5, H 19.7, T 6.4; Figures 17E, F); lv (L 16.3, H 14.8, T 4.6; Figure 17G); lv (L 15.7, H 13.7, T 4.2; Figure 17H); lv (L 17.2, H 15.9, T 4.7); rv (L 15.8, H 14.5, T 4.2); rv (L 15.5, H 14.2, T 4.0); rv (L 16.8, H 15.8, T 4.8); rv (L 15.7, H 14.1, T 3.9)]; 4 v NHMUK 20130657 (unfigured).

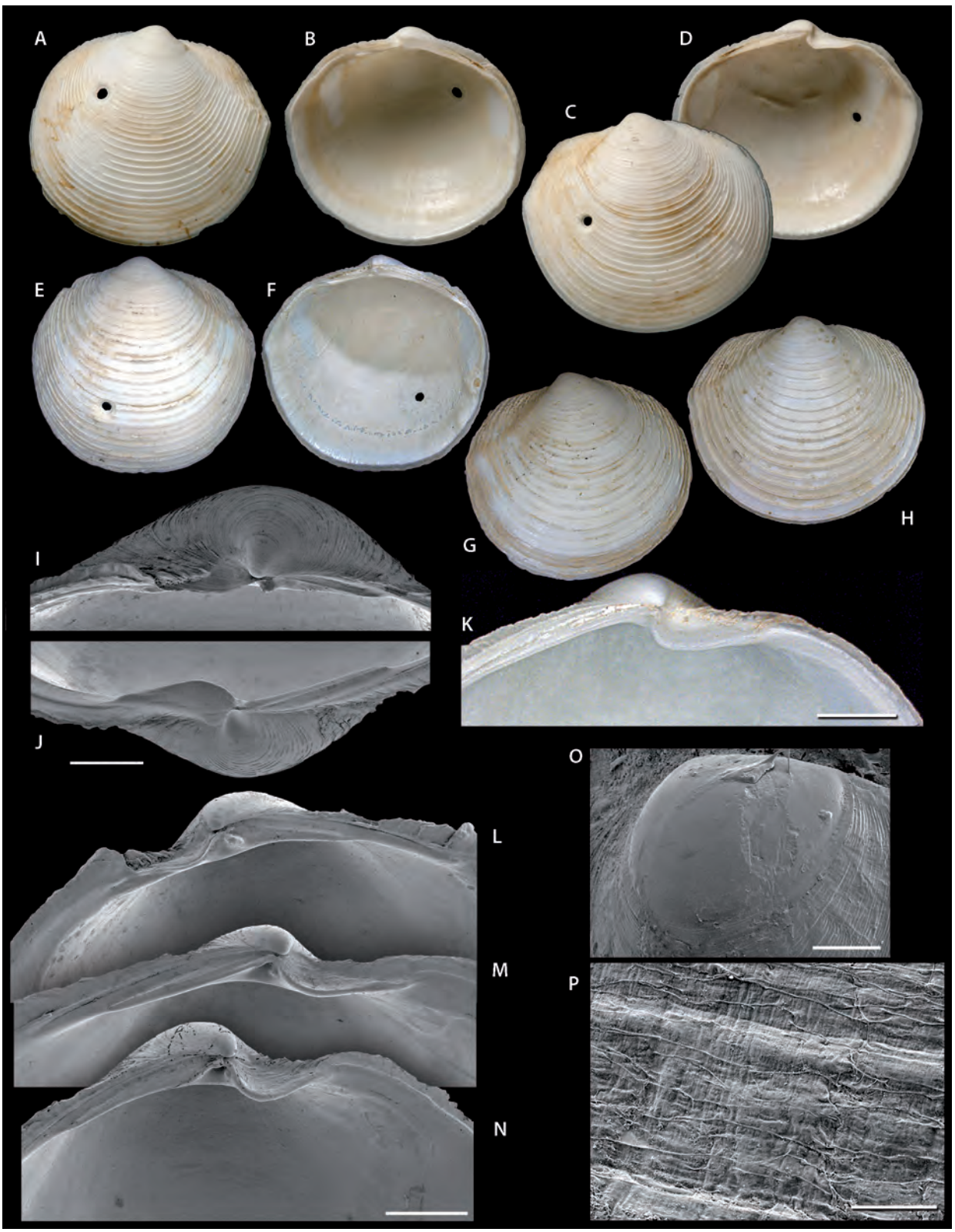
TYPE LOCALITY — Philippines, Bohol Sea, off Pamilacan Island, 9°30'N, 123°53'E, 196-216 m, [PANGLAO 2005: stn CP2348].

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn P4, 80-120 m, 1v. – Stn T3, 150 m, 6v. – Stn T25, 160-210 m, 2v. – Stn T27, 106-137 m, 2v. – Stn T31, 100-140 m, 6v. – Stn T34, 145-163 m, 2v. – Stn T37, 134-190 m, 2v. – PANGLAO 2005: stn DW2339, 164-176 m, 52 v. – Stn CP2340, 271-318 m, 7 v. – Stn CP2343, 273-356 m, 1 v. – Stn CP2344, 142-148 m, 1 v. – Stn CP2347, 198-233 m, 2 v. – Stn CP2348, 196-216 m, 96 v. – Stn CP2349, 219-240 m, 43 v. – Stn DW2364, 427 m, 1 v. – Stn CP2380, 150-163 m, 23 v. – Stn CP2381, 259-280 m, 1 v. – Stn CP2409, 220-257 m, 8 v. – MUSORSTOM 3: stn CP139, 240-267 m, 1 v.

DISTRIBUTION — Central Philippines, empty shells in 120-427 m.

FIGURE 16

Opalocina majuscula n. sp. (All figured material from PANGLAO 2004 stn T25) — **A**, holotype MNHN IM-2000-26571, exterior of left valve. L 3.2 mm; **B**, paratype MNHN IM-2000-26572, exterior of right valve. L 3.1 mm; **C**, paratype NHMUK 20130656, exterior of left valve. L 4.1 mm; **D**, paratype NHMUK 20130656, exterior of right valve. L 4.0 mm; **E**, paratype MNHN IM-2000-26572, interior of left valve. L 3.5 mm; **F**, paratype MNHN IM-2000-26572, interior of right valve. L 4.6 mm; **G**, **H**, dorsal views of right and left valves; Scale bar = 500 µm; **I**, protoconch; Scale bar = 50 µm; **J**, commarginal lamellae and interspaces. Scale bar = 50 µm; **K**, microsculpture; Scale bar = 20 µm.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DESCRIPTION — Shell medium, subcircular, L to 20.4, H to 19.6, T 6.5, H/L 0.91, T/L 0.27. Umbone central, hinge line relatively straight, anterior dorsal area defined by a low ridge. Sculpture of regular, closely spaced, sharp, slightly recurved, commarginal lamellae, interspaces with very fine radial striations. Lunule highly asymmetric, with greater part in LV. Ligament long, in shallow nymph. Protoconch (Figure 17O): PI + PII 166 µm, PI smooth with PII a rim of 11 µm. Margin of escutcheon and lunule marked by elevated commarginal lamellae. Hinge: RV with single, small cardinal tooth and small or obscure anterior lateral tooth, LV with socket for cardinal tooth only. Anterior adductor muscle scar medium long, detached for 1/2 of length at angle of 15°, posterior scar ovoid. Pallial line discontinuous, divided into small blocks. Shell margin slightly denticulate, grooved. Shell surface inside pallial line slightly glossy. Pallial blood vessel scar absent. Shell white with thin, light brown periostracum.

REMARKS — This species can be distinguished from the shallow water Western Australian species *Pseudolucinisca wami* Glover & Taylor, 2008 and *P. lacteola* (Tate, 1897) (Glover & Taylor 2008) by its smaller, thinner shell, narrower hinge plate, less massive teeth and less denticulate shell margin. '*Lucinoma*' *japonica* Habe, 1958b (holotype, UMST 39922) is similar but has a more rounded outline, more densely packed commarginal lamellae and a shorter lunule.

ETYMOLOGY — Named for our friend Yuri Kantor, well-known malacologist who assiduously preserved lucinids on several sampling expeditions to the Philippines.

Subfamily MYRTEINAE Chavan, 1969

The subfamily Myrteinae was redefined as a well-supported clade, based on molecular analyses by Taylor *et al.* (2011, 2014). It is a little known group with at least 11 living genera. Our study of museum collections shows that it is widespread and diverse in the IWP and generally more abundant in deeper water. Morphological features of the group include usually elongate shells, many with regularly spaced commarginal lamellae and radial ribbing absent except for radial threads in the interspaces. Hinges often narrow with small hinge teeth. Anterior adductor scar short or very short and posterior scar often with a dorsal cleft.

Genus ***ELLIPTIOLUCINA*** Cosel & Bouchet, 2008

Elliptiolucina Cosel & Bouchet, 2008: 136.

Type species. *Elliptiolucina magnifica* Cosel & Bouchet 2008, by original designation.

DIAGNOSIS — Shells medium to large, ovoid to rectangular, compressed. Sculpture smooth with fine growth lines and low lamellae, radial sculpture absent. Dorsal areas weakly defined. Hinge narrow, teeth obscure to absent (*E. williamsae* n. sp., described below, has an anterior lateral tooth in the right valve and minute cardinal teeth). Anterior adductor muscle scar detached for 1/2 length, posterior scar with dorsal cleft, pallial line entire.

FIGURE 17

Pseudolucinisca kantori n. sp. (All figured specimens from PANGLAO 2005 stn CP2348. All figured syntypes MNHN IM-2000-26573) — **A**, **B**, syntype, exterior and interior of right valve. L 18.5 mm; **C**-**D**, syntype, exterior and interior of left valve. L 19.0 mm; **E**, **F**, syntype, exterior and interior of right valve. L 20.5 mm; **G**, exterior of left valve. L 16.2 mm; **H**, syntype, exterior of left valve. L 15.7 mm; **I**, **J**, dorsal view of hinge areas of right valve (**I**) and left valve (**J**). Scale bar = 1.0 mm; **K**, detail of hinge of left valve, with deep asymmetric lunule. Scale bar = 3.0 mm; **L**-**N**, hinges of three juvenile shells; **L**, right valve; **M**, left valve; **N**, left valve with deep lunule. Scale bar = 1.0 mm; **O**, protoconch. Scale bar = 50 µm; **P**, microsculpture. Scale bar = 20 µm.

REMARKS — Three species were previously described by Cosel & Bouchet (2008) and one by Okutani (2011) with only *E. magnifica* recorded from the Philippines. Molecular analysis of *E. ingens* Okutani, 2011 (Hashimoto *et al.* 2011, Kuhara *et al*. 2014) confirms placement of this genus in the subfamily Myrteinae as suggested from shell morphology by Taylor *et al.* (2011). The genus *Jorgenia* Taylor & Glover, 2009 from the western Atlantic at depths of 350-800 m has similar shell morphology and may be related to *Elliptiolucina* (Taylor & Glover 2009).

Elliptiolucina magnifica Cosel & Bouchet, 2008

Figures 18J, K; 19C

Elliptiolucina magnifica Cosel & Bouchet, 2008: 137, figs 15A-F, 18A.
Elliptiolucina magnifica – Poppe & Tagaro 2011:154, pl. 1072, figs 3a, b.

TYPE MATERIAL — Holotype MNHN IM-2000-20700.

TYPE LOCALITY — Philippines, north of Mindoro, 13°39'N, 120°43'E, 520-550 m, mud [MUSORSTOM 2: stn CP25].

OTHER MATERIAL EXAMINED — **Philippines**, off Sombrero Island, *Albatross* stn 5114, 622 m, 1 lv, USNM26239.

DISTRIBUTION — Central Philippines from 550-622 m.

DESCRIPTION — Shell large, L to 80.4, thick, heavy, subrectangular. Shell more or less smooth with sculpture of very fine commarginal lirae and growth lines. Hinge plate narrow, edentulous. Anterior adductor muscle scar diverges for about 1/2 length at an angle of 25°. See Cosel & Bouchet (2008) for details.

Elliptiolucina labeyriei Cosel & Bouchet, 2008

Figures 18L, M; 19D

Elliptiolucina labeyriei Cosel & Bouchet, 2008: 139, figs 16A-I, 18B.
Elliptiolucina labeyriei – Poppe & Tagaro 2011: 154, pl. 1072, fig. 2.

TYPE MATERIAL — Holotype MNHN IM-2000-20701, paratype MNHN IM-2000-20702.

TYPE LOCALITY — Philippines, Sulu Archipelago, 4°38'N, 119°48'E, 2570 m [ESTASE 2: stn CP6].

DISTRIBUTION — Known only from the type locality.

DESCRIPTION — Large, longer than high, thin-shelled, L to 44, H to 30, compressed, sculpture of dense irregular growth lines with fine commarginal lamellae in umbonal area only, hinge plate narrow, more or less edentulate, anterior adductor short, detached for 1/2 length at angle of 5°, posterior scar with dorsal cleft, inner shell margin smooth. See Cosel & Bouchet (2008) for details.

REMARKS — At 2570 m, *E. labeyriei* co-occurred with two other lucinids, '*Myrtea' hyphalosa* n. sp. and *Lucinoma estasia* n. sp. (described below). These are the deepest living lucinids so far recorded.

Elliptiolucina williamsae n. sp.

Figures 19B; 20A-P

TYPE MATERIAL — Holotype pv MNHN IM-2000-26574, 3 paratypes MNHN IM-2000-26558, IM-2000-26575, 3 NHMUK 20130658, 20130659 (as listed below).

TYPE LOCALITY — Philippines, Bohol/Sulu seas sill, Dipolog Bay, 8°43'N, 123°19'E, 259-280 m, sand [Panglao 2005: stn CP2381].

MATERIAL EXAMINED — Philippines: PANGLAO 2005: stn CP2358, 569-583 m, 1 v. – Stn CP2359, 437-476 m, 2 v. – Stn CP2361, 516-543 m, 11 v. – Stn CP2362, 679-740 m, 1 rv (L 25.2, H 21.4, T 4.5; Figure 20 I, J) paratype MNHN IM-2000-26558; 1 pv, 35 v (2 v, paratypes NHMUK 20130658; Figures 20M, N). – Stn CP2368, 312-322 m, 1 rv, (L 30.6, H 24.0, T 6.3; Figures 20K, L) paratype NHMUK 20130659. – Stn CP2381, 259-280 m, 1 pv, holotype MNHN IM-2000-26574 (L 20.5, H 16.8, T 3.9; Figures 20A-D), 1 lv (L25.3, H 20.9, T 5.5; Figures 20E, F), 1 lv (L 22.5, H 19.4, T 5.0; Figures 20G, H) paratypes MNHN IM-2000-26575. – Stn CP2393, 356-396 m, 1 v.

DISTRIBUTION — Central Philippines, paired valves in 280-679 m.

DESCRIPTION — Shell, L to 44.1, H to 37.2, T 9.5, H/L 0.84, T/L 0.21. Subovate, longer than high, compressed, thin-shelled, periostracum pale-brown, shell white. Shell surface smooth with fine growth lines. Dorsal areas weakly defined, shallow posterior sulcus on some specimens. Umbones low. Lunule shallow, lanceolate, narrow. Ligament long, set shallow groove. Microsculpture of rows of small punctae (Figures 20O, P). Protoconch: PI + PII 210 µm, P1 smooth, with PII a narrow rim. Hinge narrow, RV with small, single cardinal tooth and anterior lateral tooth and sometimes a small posterior lateral; LV with two very small cardinal teeth, lateral teeth absent. Anterior adductor muscle scar detached for 1/2 of length at angle of 5°. Posterior scar reniform with slight dorsal cleft. Pallial line entire. Shell inside pallial line dull with mantle attachment points and radial lines. Shell margin smooth, glossy.

REMARKS — Although similar in general morphology, *E. williamsae* n. sp. differs from the other described species of *Elliptiolucina* by its smaller size and the presence of an obvious anterior lateral tooth in the right valve and minute cardinal teeth. The original diagnosis of *Elliptiolucina* Cosel & Bouchet (2008: 136) stated '…hinge plate narrow almost toothless' with only *E. labeyriei* having a vestige of a cardinal tooth.

ETYMOLOGY — Named for Suzanne Williams, our friend, colleague and collaborator in lucinid research.

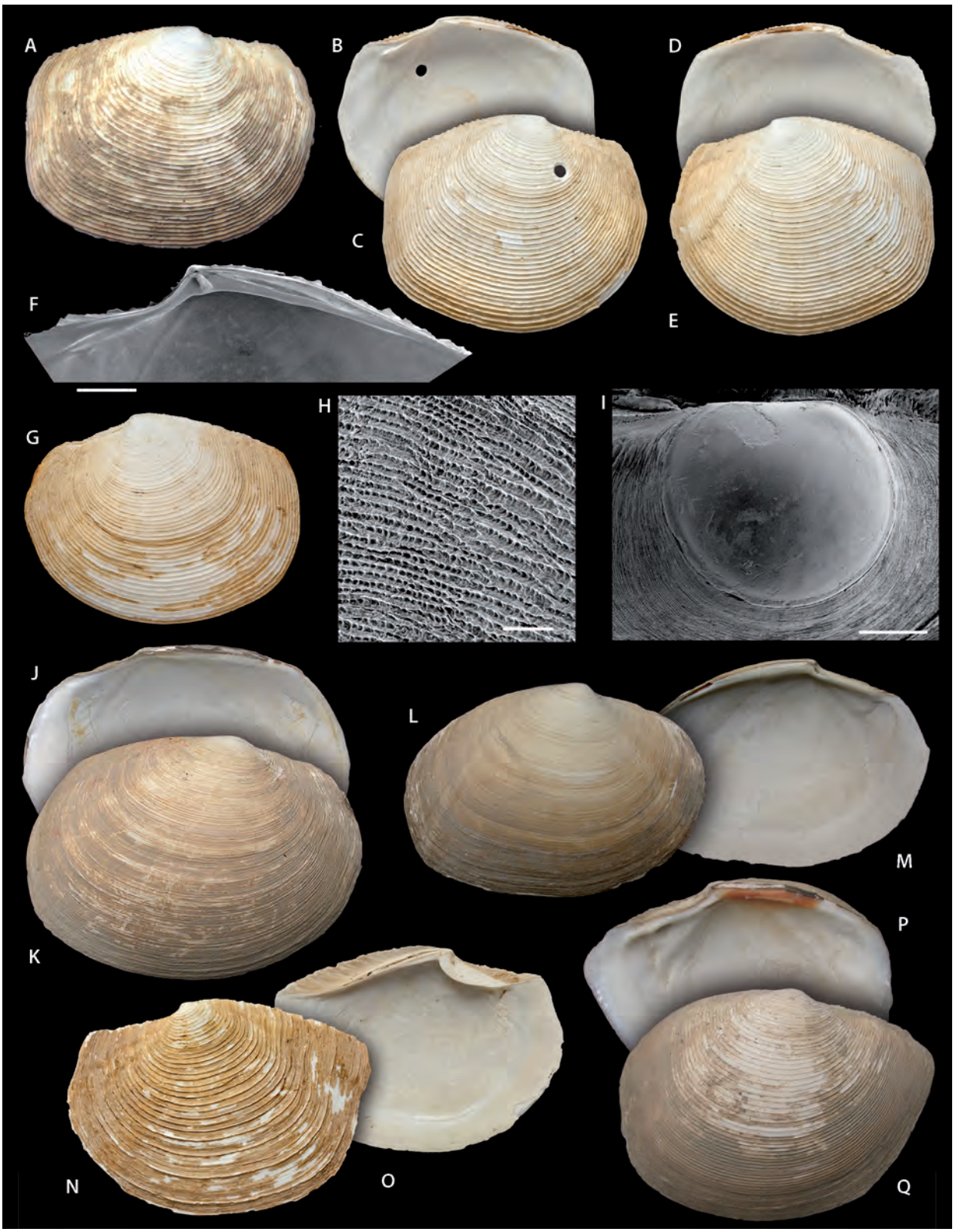
Genus ***GLOVERINA*** Cosel & Bouchet, 2008

Gloverina Cosel & Bouchet, 2008: 142.

Type species. *Gloverina vestifex* Cosel & Bouchet, 2008, by original designation.

DIAGNOSIS — Shell medium sized, compressed, longer than high, subrectangular in outline, sculpture of densely spaced commarginal lamellae, hinge line narrow with small cardinal teeth, anterior adductor scar detached for 1/3 to 1/2 length.

REMARKS — There are two known species of *Gloverina* - *G. vestifex* Cosel & Bouchet; 2008 from Indonesia and *G. rectangularis* Cosel & Bouchet, 2008 from the Philippines. Molecular analysis shows that *G. rectangularis* is related to *Myrtea* and *Notomyrtea* species in the subfamily Myrteinae (Taylor *et al.* 2011).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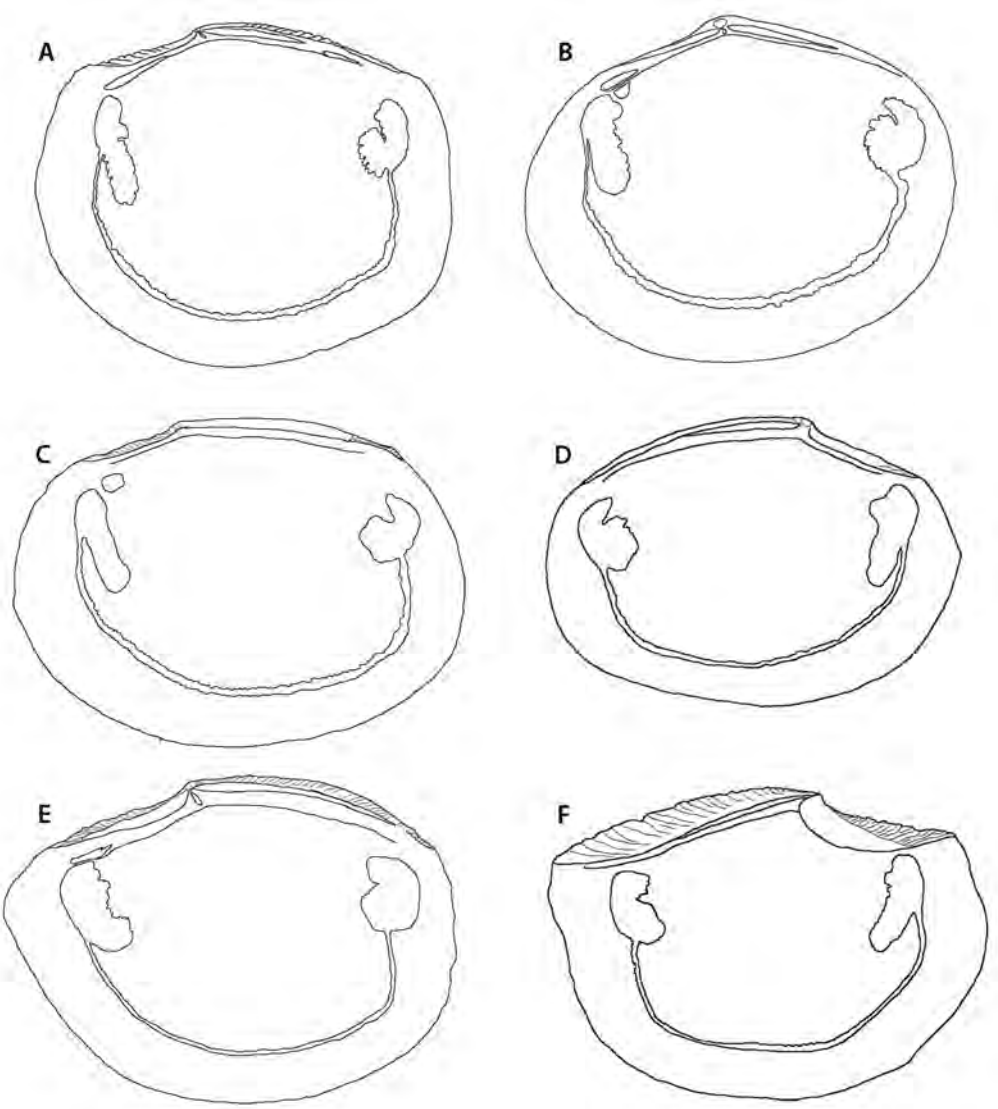


FIGURE 19

Outline drawings of shell interiors of Gloverina, Elliptiolucina, Rostrilucina and Taylorina. Not to scale. **A**, *Gloverina rectangularis*; **B**, *Elliptiolucina williamsae*; **C**, *Elliptiolucina magnifica*; **D**, *Elliptiolucina labeyrieri*; **E**, *Rostrilucina anterostrata*; **F**, *Taylorina alata*.

FIGURE 18

Gloverina, *Elliptiolucina*, *Taylorina* and *Rostrilucina* — **A**-**I**, *Gloverina rectangularis* Cosel & Bouchet, 2008. **A**, holotype MNHN IM-2000-20708, left valve. L 38.3 mm; **B**, **C**, interior and exterior of right valve, PANGLAO 2005 stn CP2335. L 37.3 mm; **D**, **E**, exterior and interior of left valve, PANGLAO 2005 stn CP 2335. L 37.0 mm; **F**, detail of hinge of right valve, PANGLAO 2005 stn DW2401 Scale bar = 1.0 mm; **G**, exterior of left valve, PANGLAO 2005 stn CP 2335. L 25.1 mm; **H**, detail of external microsculpture, PANGLAO 2005 stn DW2401. Scale bar = 10 µm; **I**, protoconch, PANGLAO 2005 stn DW2401. Scale bar = 50 µm. — **J**, **K**, *Elliptiolucina magnifica* Cosel & Bouchet, 2008, holotype MNHN IM-2000-20700, interior and exterior of right valve. L 80.4 mm. — **L**, **M**, *Elliptiolucina labeyriei* Cosel & Bouchet, 2008, paratype MNHN IM-2000-20702, exterior and interior of left valve. L 42.2 mm. — **N**, **O**, *Taylorina alata* Cosel & Bouchet, 2008, exterior and interior of left valve PANGLAO 2005 stn CP2342. L 30.6 mm. — **P**, **Q**, *Rostrilucina anterostrata* Cosel & Bouchet, 2008, holotype MNHN IM-2000-20716, exterior and interior of right valve. L 50.6 mm.

Gloverina rectangularis Cosel & Bouchet, 2008

Figures 18A-I, 19A

Gloverina rectangularis Cosel & Bouchet, 2008: 145, figs 21A-G, 22B.
Gloverina rectangularis – Poppe & Tagaro 2011: 156, pl. 1073, figs 1a, b.

TYPE MATERIAL — Holotype MNHN IM-2000-20708.

TYPE LOCALITY — Central Philippines, North of Panay Island, 13°08'N, 122°40'E, 280-440 m [MUSORSTOM 2: stn CP40].

OTHER MATERIAL EXAMINED — Philippines: PANGLAO 2005: stn CP2334, 606-631 m, 1 v. – Stn CP2335, 729-733 m, 2 pv, 2 v. – Stn CP2336, 757-760 m, 2 v. – Stn CP2341, 544-712 m, 1 pv, 5 v. – Stn CP2350, 738-798 m, 6 v. – Stn CP2362, 679-740 m, 7 v. – Stn CP2383, 338-351 m, 2 v. – Stn CP2388, 762-786 m, 4 pv. – Stn CP2389, 784-786 m, 1 pv, 13 v. – Stn CP2390, 627-645 m, 2 pv, 4 v. – Stn CP2392, 242-400 m, 1 v. – Stn CP2397, 642-669 m, 2 pv, 13 v. – Stn CP2398, 713-731 m, 3 pv, 27 v. – Stn DW2401, 397-453 m, 1 v. – Stn CP2404, 481-505 m, 1 pv, 1 v. – Stn CP2405, 387-453 m, 2 v.

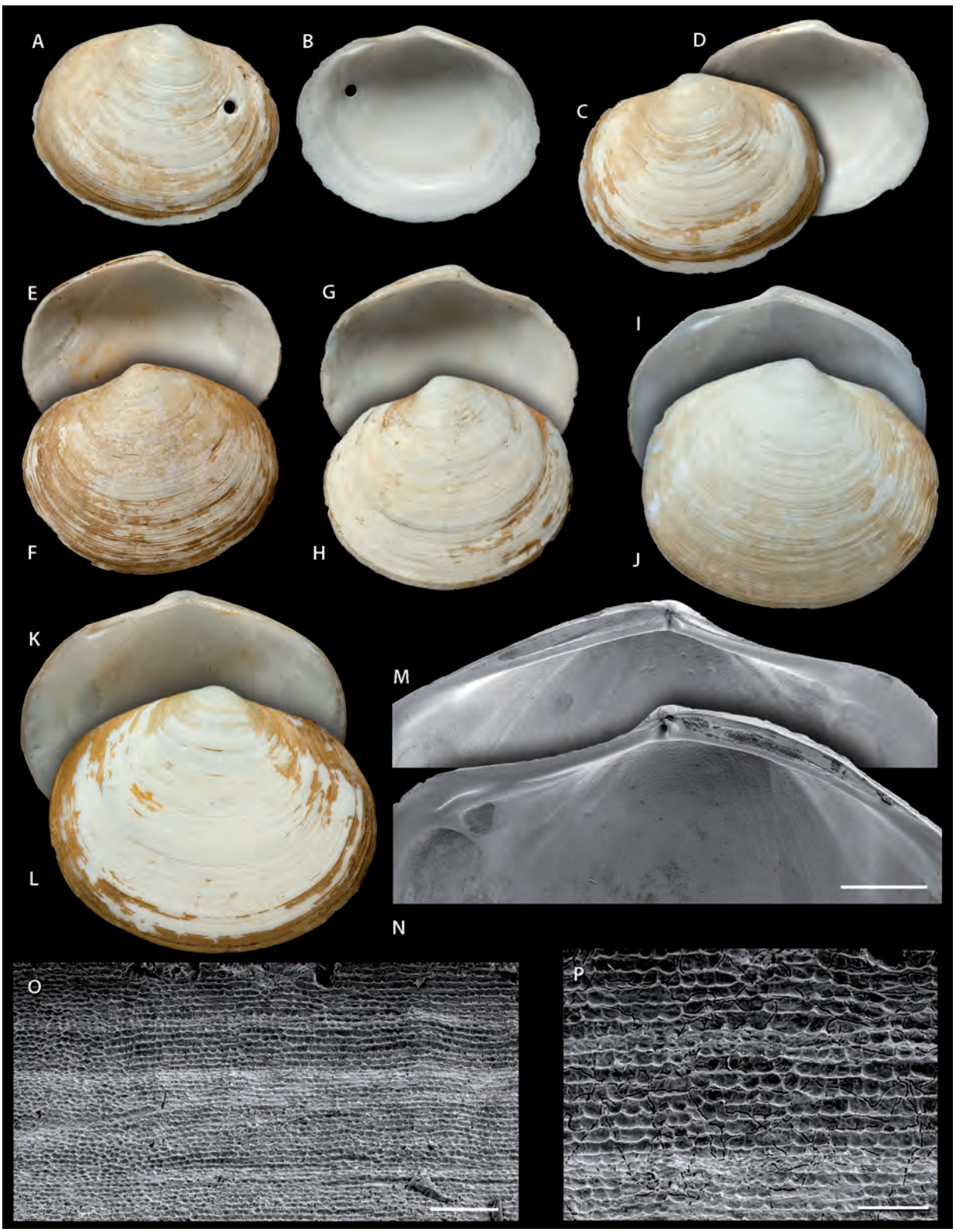
DISTRIBUTION — Known only from the Philippines, paired valves in 505-784 m, empty shells from 351 m.

DESCRIPTION — See Cosel & Bouchet (2008). Shell compressed, thin, medium sized, subrectangular, longer than high, L to 38, H to 29. Sculpture of evenly spaced, fine, commarginal lamellae, no radial sculpture. Shell microsculpture of fine linear punctations (Figure 18H). Posterior and anterior sulci shallow, with crumpled folds at anterior. Protoconch (Figure 18I): PI + PII 193 µm, P1 smooth, PII a narrow rim. Hinge narrow, RV with single cardinal tooth, anterior lateral tooth, LV with two cardinals lateral teeth obscure or absent. Anterior adductor muscle scar medium long, detached for 1/2 length, posterior scar reniform with dorsal cleft. Pallial line entire, pallial blood vessel scar absent, shell margin smooth, inner shell surface glossy with points of mantle attachment.

REMARKS — Specimens of *Gloverina rectangularis* from Panglao closely match the holotype from Panay Island, central Philippines but occur in deeper water to 780 m. Brissac *et al.* (2011) sequenced the bacterial symbiont and host from a specimen from PANGLAO 2005 stn CP2390. Their results support the placement of *G. rectangularis* in Myrteinae.

FIGURE 20

Elliptiolucina williamsae n. sp. — **A**-**D**, holotype MNHN IM-2000-26574, exterior and interior of right and left valves, PANGLAO 2005 stn CP2381. L 20.5 mm; **E**, **F**, paratype MNHN IM-2000-26575, interior and exterior of left valve, PANGLAO 2005 stn CP2381. L 25.3 mm; **G**, **H**, paratype MNHN IM-2000-26575, interior and exterior of left valve, PANGLAO 2005 stn CP2381. L 22.5 mm; **I**, **J**, paratype MNHN IM-2000-26558, interior and exterior of right valve PANGLAO 2005 stn CP2362. L 25.2 mm; **K**, **L**, paratype NHMUK 20130659, interior and exterior of right valve PANGLAO 2005 stn CP2368. L 30.6 mm; **M**, **N**, paratype NHMUK 20130658, detail of hinge of left valve and right valve, PANGLAO 2005 stn CP2362 scale bar = 1.0 mm; **O**, microsculpture, PANGLAO 2005 stn CP2362. Scale bar = 20 µm; **P**, microsculpture, PANGLAO 2005 stn CP2362. Scale bar = 10 µm.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Genus ***NOTOMYRTEA*** Iredale, 1924

Notomyrtea Iredale, 1924: 182, 206.

Type species. *Myrtea botanica* Hedley, 1918, by original designation.

DIAGNOSIS — Small, usually compressed, elongate ovoid to subtrigonal. Sculpture of regularly-spaced, thin, commarginal lamellae that are often elevated into fine scales along the dorsal margin. Irregular radial threads present between the commarginal lamellae. Hinge with two cardinal teeth in the LV and one in the RV, lateral teeth present in both valves but more prominent in RV. Anterior adductor muscle scar usually short and only slightly divergent from pallial line. Pallial line continuous, inner shell margin smooth.

REMARKS — *Notomyrtea* species have radial threads between the commarginal lamellae that are absent in *Myrtea spinifera* (Montagu, 1803) the type species of *Myrtea*. Also *Eulopia* Dall, 1901 (type species *Lucina sagrinata* Dall, 1886 from the western Atlantic) was described as a subgenus of *Myrtea* with prominent radial threads between commarginal lamellae, but relationships of this deep water western Atlantic species to other myrteas need to be established. Cosel & Bouchet (2008) referred all their species from the tropical IWP to *Myrtea* whether or not radial threads were present. To date, insufficient '*Myrtea*' species have been included in molecular analyses to resolve generic composition and relationships (Taylor *et al*. 2011; 2014).

Notomyrtea catonii n. sp.

Figures 21A-P; 22A

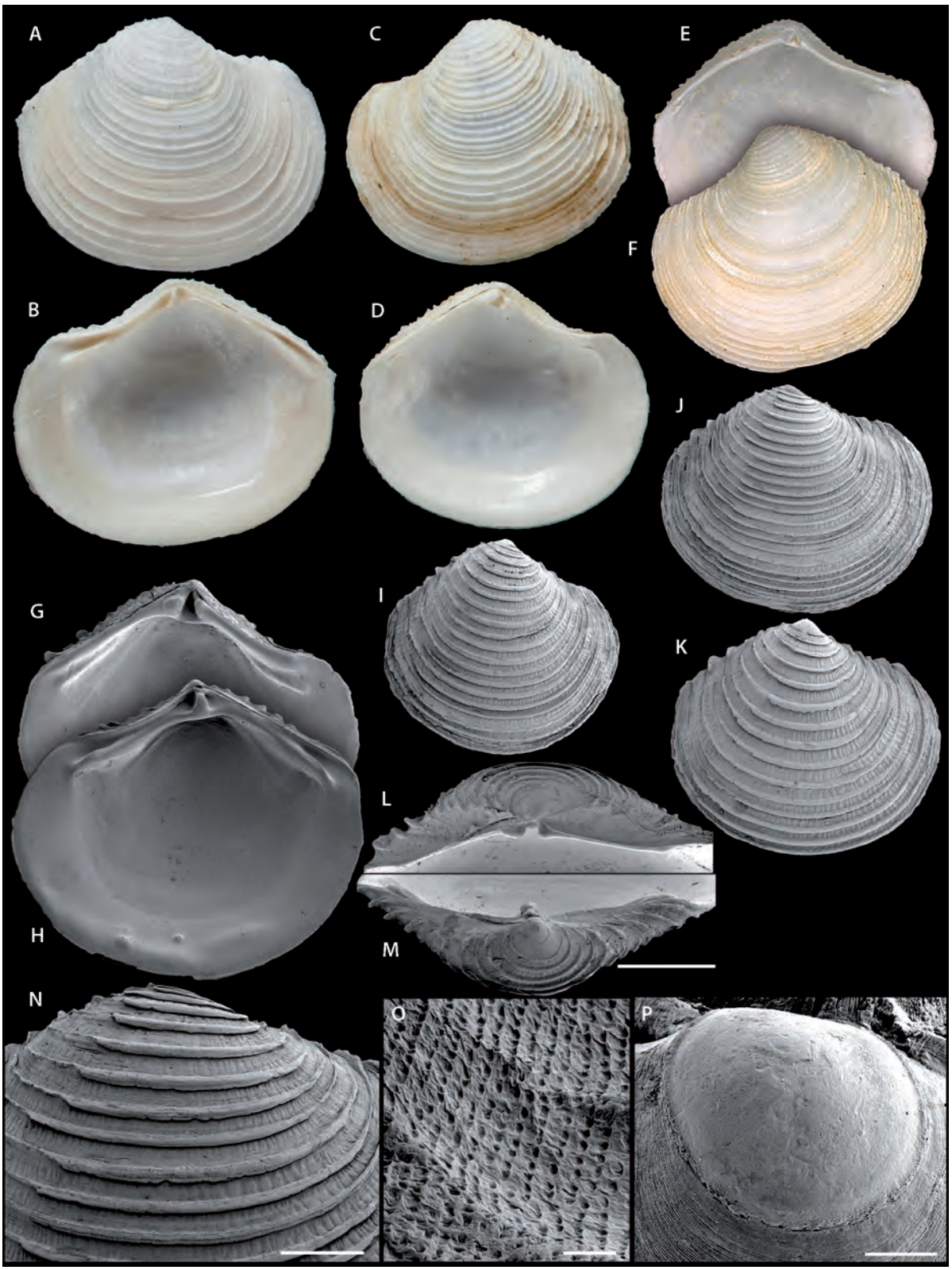
TYPE MATERIAL — 4 syntypes MNHN IM-2000-26576 [1 rv (L 7.2, H 6.1, T 1.7; Figures 21A, B); 1 lv (L 6.6, H 5.6, T 1.6; Figures 21C, D); 1 lv (L 6.8, H 5.7, T1.6) and 1 rv (L 6.0, H 5.3, T 1.5), both unfigured].

TYPE LOCALITY — Philippines, Bohol/Sulu seas sill, Dipolog Bay, 8°43'N, 123°19'E, 275-280 m, sandy [PANGLAO 2005: stn CP2381].

MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn T2, 152 m, 13 v. – Stn T25, 60-210 m, 3 v. – Stn T28, 80 m, 18 v. – Stn T31, 100-140 m, 3 v. – Stn T34, 145-163 m, 33 v. – Stn T35, 172-182 m, 2 v. – Stn T36, 95-128 m, 12 v. – Stn T39, 100-138 m, 24 v. – Stn T44, 83-86 m, 4 v. – PANGLAO 2005: stn CP2331, 255-268 m, 21 v. – Stn DW2339, 164-176 m, 104 v. – Stn CP2340, 271-318 m, 31 v. – Stn CP2343, 273-356 m, 1 v. – Stn CP2344, 128-142 m, 1 pv, 43 v. – Stn CP2348, 196-216 m, 1 pv MNHN IM-2009-10369, 154 v, 4 v NHMUK 20130669. – Stn CP2349, 219-240 m, 145 v. – Stn DW 2364, 427 m, 1 v. – Stn CP2380, 150-163 m, 2 pv, 61 v. – Stn CP2381, 259-280 m, 263 v (20 v NHMUK 20130660). – Stn CP2384, 624-647 m, 1 v. – Stn CP2393, 356-396 m, 3 v. – Stn CP2394, 470-566 m, 1 v. – Stn CP2395, 434-532 m, 2 v. – Stn CP 2396, 609-673 m, 3 v. – Stn DW2401, 397-453 m, 2 v. – Stn CP2406, 334-387 m, 4 v. – Stn CP2407, 256-268 m, 2 v. – MUSORSTOM 3: stn CP 87, 191-197 m, 2 v. – Stn CP100, 189-199 m, 5 v. – Stn CP101, 194-196 m, 9 v. – Stn DR102, 192 m, 1 v. – Stn CP139, 240-267 m, 4 v. – Stn DR140, 93-99 m, 1 v. – Stn CP143, 205-214 m, 6 v. – AURORA 2007: stn CP 2670, 180-182 m, 6 v. – Stn CP 2692, 261-372 m, 1 v.

FIGURE 21

Notomyrtea catonii n. sp. (All figured material from PANGLAO 2005 stations) — **A**, **B**, syntype MNHN IM-2000-26576, exterior and interior of right valve, stn CP2381. L 7.2 mm; **C**, **D**, syntype MNHN IM-2000-26576, exterior and interior of left valve, stn CP2381. L 6.6 mm; **E**, **F**, NHMUK 20130669, interior and exterior of left valve, stn CP2348. L 8.0 mm; **G**, **H**, interiors of left (stn CP2381) and right valves (stn CP2349). L 4.7 mm, L 4.0 mm; **I**, juvenile, exterior of right valve, stn CP2349. L 4.1 mm; **J**, exterior of right valve, stn CP2349. L 5.0 mm; **K**, exterior of right valve, stn CP2349. L 3.4 mm; **L**, **M**, dorsal views of hinge area, stn CP2381. Scale bar = 1.0 mm; **N**, detail of sculpture, stn CP2349. Scale bar = 500 µm; **O**, microsculpture, stn CP2349. Scale bar = 10 µm; **P**, protoconch, stn CP2349. Scale bar = 50 µm.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DISTRIBUTION — Known only from the Philippines, empty shells in 80-624 m.

DESCRIPTION — Shell small, white, L to 13.0, H to 10.8, T 3.4, subtrigonal with rounded ventral margin, shallow posterior sulcus, umbones prominent, sculpture of numerous closely spaced, broad commarginal lamellae, elevated along the dorsal margins. Low, radial triangular folds in the interspaces (Figure 21N). Shell microsculpture of fine growth increments and regular lines of punctae (Figure 21O). Lunule lanceolate and asymmetrical larger part in LV. Escutcheon smooth and long. Ligament short in shallow groove. Protoconch (Figure 21P): 175 μm, P1 smooth with PII a narrow 7 μm rim. Hinge: RV with single cardinal tooth and prominent anterior and posterior lateral teeth, LV with two cardinals, anterior smaller, and posterior and anterior lateral teeth. Anterior adductor scar short, detached for 1/4 length, posterior scar small, rounded with shallow cleft. Pallial line entire, shell margin smooth, interior shell surface glossy. Pallial blood vessel scar absent.

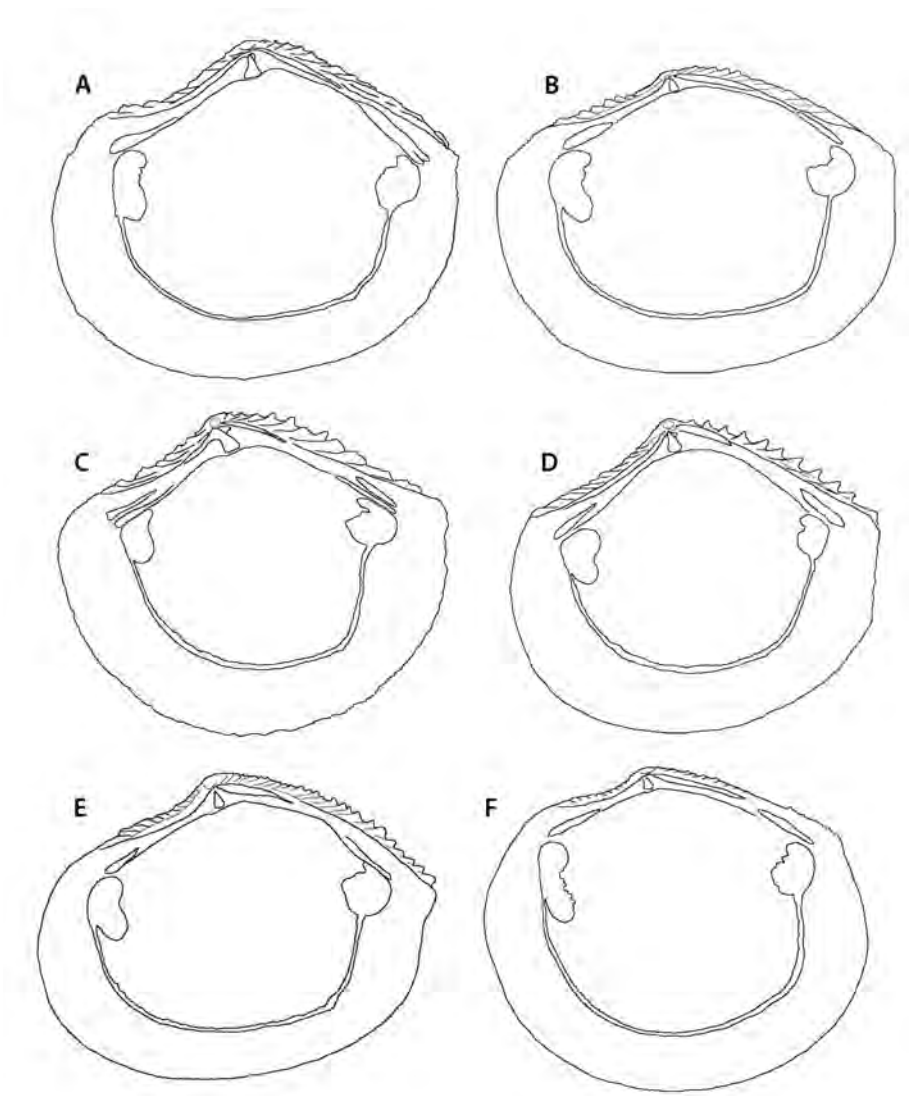


FIGURE 22

Notomyrtea species, outline drawings of shell interiors. Not to scale. **A**, *Notomyrtea catonii*; **B**, *N. fabula*; **C**, *N. flabelliformis*; **D**, *N. perfecta*; **E**, *N. scitulum*; **F**, *N. tanimbarensis*; **G**, *N. triclotae*.

REMARKS — Of the seven *Notomyrtea* species now known from the Philippines, *Notomyrtea catonii* n. sp. differs from the similar *N. fabula* (Reeve, 1850) in being less elongate, with higher umbones and having finer and fewer radial striations, more prominent elevated, rounded, commarginal lamellae that are closely spaced in the umbonal area. *Notomyrtea tanimbarensis* (Cosel & Bouchet, 2008) overlaps in depth range with *N. catonii* n. sp. but can be distinguished by the more widely spaced lamellae that lack radial striations or folds in the dorsal shell. The Japanese species, *N. soyoae* Habe, 1953, is similar but it has lower umbones, smaller teeth and more closely spaced commarginal lamellae (Habe 1953: figs 8-9; Matsukuma 2000: pl. 462, fig. 13). A sequenced specimen of *N. catonii* MNHN IM-2009-10369 from PANGLAO 2005 stn CP 2348 (cited as *Myrtea* sp. by Taylor *et al.* 2011) places it in a clade with other Myrteinae.

ETYMOLOGY — Latin *catonium,* lower world; genitive.

Notomyrtea fabula (Reeve, 1850) comb. nov.

Figures 22B, 23A-J

Lucina fabula Reeve, 1850: plate 11, fig. 69.
Myrtea fabula – Tryon 1872: 88.
Not *Myrtea fabula* – Oliver 1995: 236, fig. 1030. This is an undescribed species from the Arabian Sea.
Not *Myrtea* cf. M. *fabula* (Reeve 1850) – Poppe & Tagaro 2010: pl. 1067, figs 1-2. This is *Notomyrtea scitulum* Adams (see below).

TYPE MATERIAL — 3 syntypes NHMUK 1963177, Cuming Collection, lv (L 8.6, H 6.6, T 1.6); pv (L 6.5, H 5.1, T 1.3); pv glued to board (L 8.7, H 6.6).

TYPE LOCALITY — Philippines, Luzon, Batangas, 9-10 fathoms [16-18 m], coarse sand.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn S21, 4-12 m, 2 pv, 2 v. – Stn T10, 117-124 m, 1 v. – Stn T18, 80-100 m, 2 v. – Stn T25, 160-210 m, 1 pv, 19 v. – Stn T26, 123-135 m, 4 v. – Stn T27, 106-137 m, 1v. – PANGLAO 2005: stn DW2339, 164-176 m, 1 v. – Stn DW2348, 196-216 m, 2 v. – Stn DW2371, 172-175 m, 1 v. – Stn CP2380, 150-163 m, 3 v. – MUSORSTOM 3: stn DR140, 93-99 m, 7 v. – AURORA 2007: stn CP2654 98-107 m, 1 v. – Stn CP2665, 125-198 m, 1 v.

DISTRIBUTION — Philippines, paired valves in 12-160 m.

DESCRIPTION — Shell small, white, longer than high, sub ovate, L to 10.3, H to 7.5, T 2.1. Posterior sulcus very shallow, dorsal margins with slightly elevated commarginal lamellae. Sculpture of regularly-spaced fine, commarginal lamellae with well defined, numerous, narrow, cone-shaped radial ribs in the interspaces (Figure 23I). Microsculpture of small to obscure punctae visible only in umbonal area (Figure 23J). Lunule shallow, slightly extended, greater part in LV, ligament short in shallow groove. Protoconch (Figure 23F): 174 µm, P1 smooth with PII a narrow rim. Hinge: LV with two cardinal teeth and anterior and posterior lateral teeth, RV with single cardinal tooth and anterior and posterior lateral teeth, these more prominent in RV. Anterior adductor scar short, detached for at least 1/3 of length, posterior scar small, reniform. Pallial line entire, interior shell surface glossy. Shell margin smooth. Pallial blood vessel scar absent.

REMARKS — *Notomyrtea fabula* can be separated from all other Philippine species by the highly visible, strong radial folds in the interspaces between widely-spaced commarginal lamellae.

Notomyrtea flabelliformis (Prashad, 1932) comb. nov.

Figures 22C; 24A-J

Dentilucina (Callucina) flabelliformis Prashad, 1932: 163, pl. 5, figs 11, 12.
Myrtea flabelliformis – Cosel & Bouchet 2008: 129-30, figs 10A-E, 13D.

TYPE MATERIAL — Holotype ZMA Moll. 135274, RMNH.

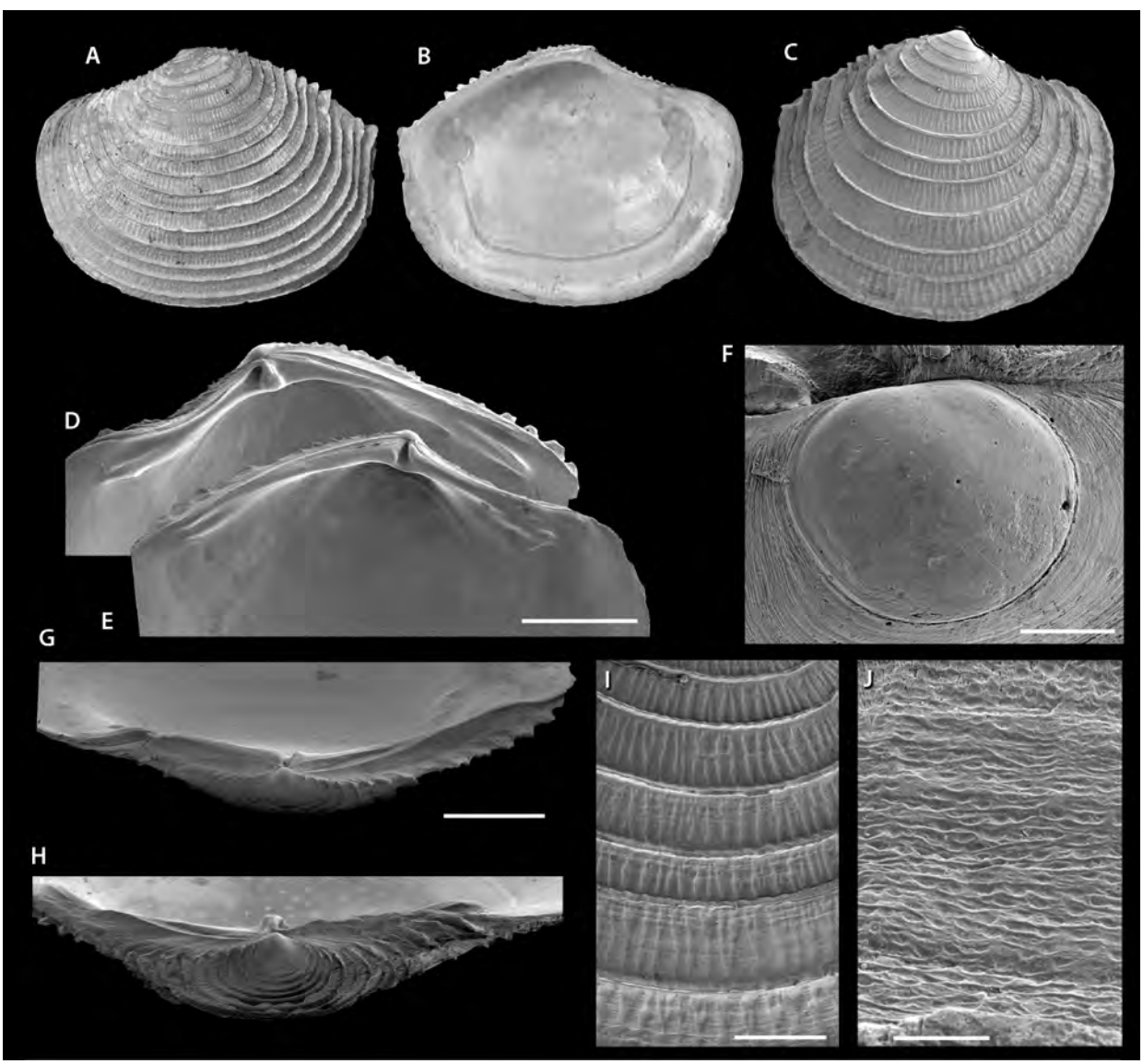


FIGURE 23

Notomyrtea fabula (Reeve, 1850). (All figured material except **A**, **B**, from PANGLAO 2004 stn T2 — **A**, **B**, syntype NHMUK 1963177 of *Lucina fabula* Reeve, 1850, exterior and interior of left valve, Batangas, Luzon, Philippines, 9-10 fathoms [16-18 m]. L 8.6 mm; **C**, exterior right valve. L 3.8 mm; **D**, **E**, details of hinge of right and left valves. Scale bar = 1.0 mm; **F**, protoconch. Scale bar = 50 µm; **G**, **H**, dorsal views of left and right valves. Scale bar = 1.0 mm; **I**, detail of sculpture. Scale bar = 500 µm; J, microsculpture. Scale bar = 10 µm.

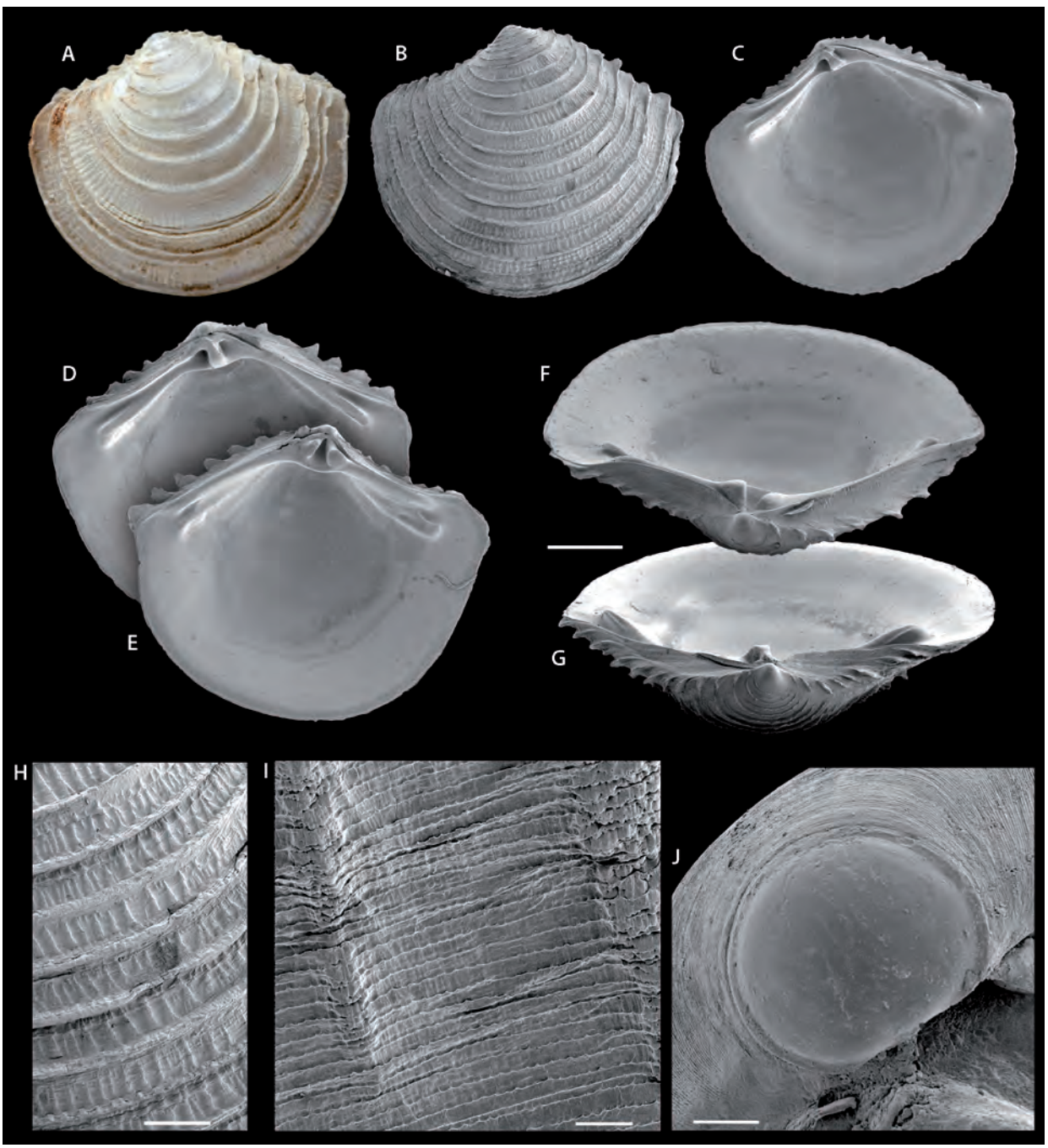


FIGURE 24

Notomyrtea flabelliformis (Prashad, 1932). (All figured specimens except A, from PANGLAO 2005 stn CP2395) — **A**, exterior of left valve, PANGLAO 2005 stn CP2351. L 6.7 mm; **B**, exterior of left valve. L 5.3 mm; **C**, interior of right valve. L 5.7 mm; **D**, **E**, interior of right and left valves. L 4.4 mm; **F**, **G**, dorsal views of left and right valves. Scale bar =1.0 mm; H, detail of sculpture. Scale bar 500 = µm; **I**, microsculpture. Scale bar 20 = µm; **J**, protoconch. Scale bar 50 = µm.

TYPE LOCALITY — Indonesia, Moluccas, off Kai Island, 5°26.6'S, 132° 32.5'E, 397 m, [*Siboga* Expedition: stn 256].

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2005: stn CP2332, 396-418 m, 2 v. – Stn CP2333, 584-596 m, 1 v. – Stn CP2340, 271-318 m, 1 v. – Stn CP2350, 602-738 m, 2 v. – Stn CP2351, 810-812 m, 1 pv. – Stn DW2364, 427 m, 3 v. – Stn CP2372, 255-301 m, 3 v. – Stn CP2381, 280 m, 2 pv. – Stn CP2388, 762-767 m, 1 pv. – Stn CP2390, 627-645 m, 1 v. – Stn CP2393, 356-396 m, 11 v. – Stn CP2394, 470-566 m, 8 v. – Stn CP2395, 434-532 m, 6 v. – Stn CP2397, 642-669 m, 1 pv, 1 v. – Stn CP2398, 713-731 m, 2 v. – Stn CP2401, 397-453 m, 9 v. – Stn CP2405, 387-453 m, 1 pv, 9 v. – Stn CP2406, 334-387 m, 3 v. – Stn CP2407, 256-268 m, 2 v.

DISTRIBUTION — Solomon Islands, Indonesia to Philippines, paired valves in 280-810 m.

DESCRIPTION — See Cosel & Bouchet (2008) for full description. Shell small, L to 8.5, H to 8.0, longer than high. Outline trigonal with rounded ventral margin, anterior shell margin extended and rounded, sculpture of fine, regularly-spaced, commarginal lamellae, interspaces with thin, regular, cone-shaped radial folds that narrow dorsally (Figure 24H). Shell microsculpture of fine growth increments with lines of small punctae (Figure 24I). Protoconch (Figure 24J): 183 µm, P1 smooth with a narrow rim and no growth increments. Hinge: RV with single cardinal and prominent posterior and lateral teeth, LV with two cardinal teeth and narrower lateral teeth. Anterior adductor scar very short, barely detached from pallial line, posterior scar small with dorsal cleft. Pallial blood vessel scar absent.

REMARKS — Specimens from the Philippines are similar to the figured holotype of *N. flabelliformis* from Indonesia and to those illustrated by Cosel & Bouchet (2008) from the Solomon Islands. *Notomyrtea flabelliformis* can be distinguished from the similar *N. catonii* n. sp. from the Philippines (see above) by the more widely-spaced, less abundant, commarginal lamellae, more curved ventral margin, larger hinge teeth and lower umbones. The specimen included in the Taylor *et al.* (2011) molecular analysis (MNHN IM-2009-10375) was from PANGLAO 2005 stn CP2388, 762-786 m and Brissac *et al.* (2011) characterised the bacterial symbiont from a specimen from the same station.

Notomyrtea perfecta n. sp.

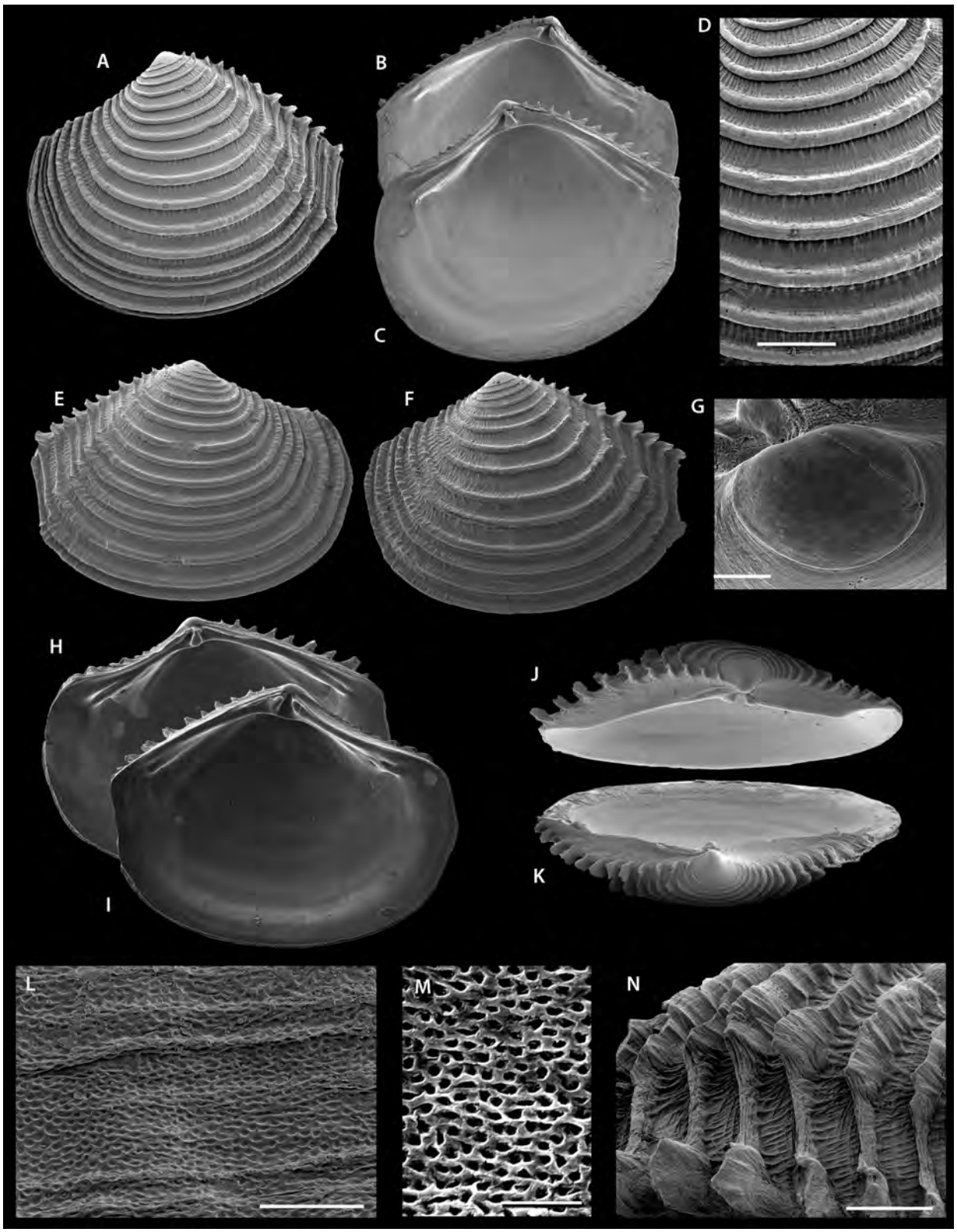
Figures 22D; 25A-N

TYPE MATERIAL — Holotype MNHN IM-2000-26577, 126 paratypes MNHN IM-2000-26578-26579, 10 NHMUK 20130661 (as listed below).

TYPE LOCALITY — Philippines, Bohol Island, west of Baclayon, 9°35.1'N, 123°51.2'E, 34-82 m, muddy sand [PANGLAO 2004: stn T6].

FIGURE 25

Notomyrtea perfecta n. sp. — **A**-**C**, holotype MNHN IM-2000-26577, exterior of left valve and interior of left and right valves, PANGLAO 2004 stn T6. L 3.2 mm; **D**, holotype, commarginal and radial sculpture. Scale bar = 500 µm; **E**, paratype MNHN IM-2000-26579, exterior of right valve, PANGLAO 2005 stn T27. L 3.5 mm; **F**, paratype MNHN IM-2000-26579, exterior of left valve, PANGLAO 2005 stn T27. L 3.3 mm; **G**, protoconch, T27 Scale bar = 50 µm; **H**, **I**, paratype MNHN IM-2000-26579, interior of right and left valves, PANGLAO 2005 stn T27. L 3.0 mm; **J**, **K**, paratype MNHN IM-2000-26578, dorsal views of left and right valves, PANGLAO 2005 stn T6. L 3.4 mm; **L**, microsculpture, PANGLAO 2005 stn T6. Scale bar = 20 µm; **M**, microsculpture fine detail, PANGLAO 2005 stn T27. Scale bar = 10 µm; **N**, detail of sculpture at posterior dorsal area, PANGLAO 2005 stn T6. Scale bar = 200 µm.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MATERIAL EXAMINED — **Philippines**: PANGLAO 2004: stn T1, 83-102 m, 4 v. – Stn T2, 152 m, 6 v. – Stn T5, 84-87 m, 31 v. – Stn T6, 34-82 m, 1 pv, holotype (L 3.2, H 2.9) MNHN IM-2000-26577, 3 pv, 29 v (1 pv and 16 v paratypes MNHN IM-2000-26578; Figures 25J, K). – Stn T9, 97-120 m, 63 v. – Stn T10, 117-124 m, 7 v. – Stn T18, 80-100 m, 4 v. – Stn T25, 160-210 m, 2 v. – Stn T27, 106-137 m, 1 rv (L 3.5, H 2.6; Figure 25E); 1 lv (L 3.3, H 2.4; Figure 25F); 1 rv (L 3.0, H 2.2, Figure 25H); 1 lv (L 2.8, H 2.2; Figure 25I), 105 v (unfigured) paratypes MNHN IM-2000-26579, 10 v (unfigured) paratypes NKMUK 20130661. – Stn T32, 60 m, 1 v. – Stn T36, 95-128 m, 4 v. – Stn T37, 134-190 m, 21 v. – Stn T41, 110 m, 1 pv, 1 v. – Stn G1, 100 m, 2 v. – PANGLAO 2005: stn CP2408, 121-137 m, 1 v.

DISTRIBUTION — Known only from the Philippines, paired valves in 82-110 m, empty shells in 60-152 m.

DESCRIPTION — Small, white, subtrigonal in outline, longer than high, umbones prominent, L to 6.0, H to 5.0, T 1.5 mm. Sculpture of regular, blunt commarginal lamellae with very fine radial threads in the interspaces, anterior and posterior radial threads cross the commarginal lamellae. Posterior sulcus prominent with lower, sharper, commarginal lamellae (Figure 25N). Commarginal lamellae elevated and bluntly spinose along the dorsal margin. Shell microsculpture of irregular network of fine punctae (Figures 25L, M). Protoconch (Figure 25G): PI + PII 164 µm, P1 smooth, PII a narrow rim. Lunule long, lanceolate slightly asymmetrical, larger in LV. Escutcheon smooth and long. Ligament short, set in shallow groove. Hinge: LV with two cardinal teeth and low anterior and posterior lateral teeth; RV with single cardinal and anterior and posterior lateral teeth that are more prominent than in LV. Anterior adductor muscle scar short, slightly detached from pallial line, posterior scar small, rounded. Pallial line entire, pallial blood vessel scar absent. Inner shell margin smooth, shell interior glossy.

REMARKS — Initially, we considered *Notomyrtea perfecta* n. sp. to be juveniles of *N. fabula* (Reeve, 1850). Although *N. perfecta* is similar in shape to *N. fabula* it is smaller, has a more prominent posterior sulcus, much finer radial threads and shell microsculpture of irregular punctuations that is absent in *N. fabula*.

ETYMOLOGY — Latin *perfectus,* perfect.

Notomyrtea scitulum (A. Adams, 1853) comb. nov.

Figures 22E; 26A-D

Gafrarium (Corbis) scitulum A. Adams, 1853: 70.
Lucina transversa E. A. Smith, 1916: 18 pl. 1, figs 9, 10. syn. nov.
Myrtea cf. *M. fabula* (Reeve, 1850) – Poppe and Tagaro: pl. 1067, figs 1, 2.

TYPE MATERIAL — *Gafrarium scitulum*: holotype NHMUK1963868, Cuming Collection (L 9.7, H 7.4, T 2.2) — *Lucina transversa*: holotype NHMUK 1914.6.17.58 (L 10.9, H 8.0, T 2.6).

TYPE LOCALITY — *G. scitulum*: Philippines, Mindoro, Puerto Galera, 10 fathoms [18.3 m]. — *L. transversa*: Puerto Galera.

DISTRIBUTION — Philippines.

DESCRIPTION — Shell small, white, L to 10.9, H to 8.0, posterior sulcus shallow, sculpture of fine, regular commarginal lamellae that are elevated along the posterior dorsal margin, numerous fine radial folds between the lamellae, also present in juvenile shell. Lunule lanceolate, ligament narrow in shallow groove. Hinge: RV with single cardinal tooth, anterior

and posterior lateral teeth, LV with two cardinal teeth, laterals absent. Anterior adductor scar, detached for 1/4 length, posterior scar reniform with dorsal cleft. Pallial line entire, shell margin smooth, inner shell surface glossy.

REMARKS — This is an overlooked species first described as a *Gafrarium* but at that time the generic concept was very different to that in use today and was classified in the Lucinoidea (Adams & Adams 1858) and included *Fimbria* species (as *Corbis*) as well as *G. scitulum*. In his review of *Fimbria* species, Nicol (1950) mentions not being able to locate the type in NHMUK but this has now been isolated. Subsequently described from the same locality, *Lucina transversa* E. A. Smith, 1916 is the same species. *Notomyrtea scitulum* closely resembles *N. fabula* (Reeve, 1850) from Luzon (see above) but differs in its much finer radial folding between the commarginal lamellae, more inflated shell, larger hinge and teeth, while the anterior adductor scar is closer to the pallial line and detached for only 1/4 of its length compared to *N. fabula* where it is detached for at least half its length and is more widely divergent from the pallial line.

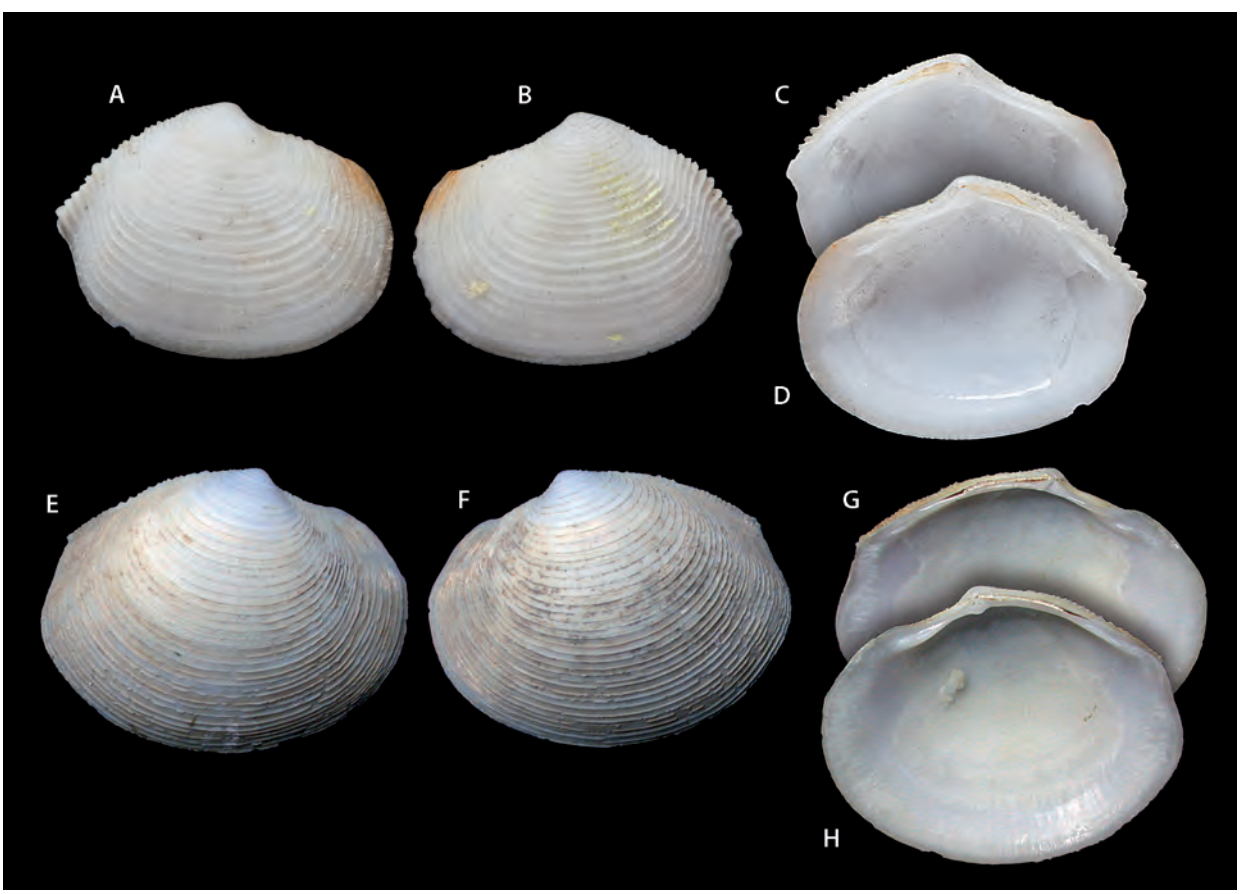


FIGURE 26

Notomyrtea scitulum (A. Adams, 1853) and *Notomyrtea triclotae* (Cosel & Bouchet, 2008) — **A**-**D**, *Notomyrtea scitulum* (Adams, 1853), exterior and interior of holotype of *Gafrarium (Corbis) scitulum* **A**. Adams 1853, NHMUK 1963868, Puerto Galera, Mindoro, Philippines, 10 fathoms [18 m]. L 9.7 mm. — **E**-**H**, *Notomyrtea triclotae* (Cosel & Bouchet, 2008), exterior and interior of holotype MNHN IM-2000-20694, NW of San Isidro, Leyte, Central Philippines, 11°12'N, 124°15'E, 379-383 m, MUSORSTOM 3 stn CP144. L 26.5 mm.

Notomyrtea tanimbarensis (Cosel & Bouchet, 2008) comb. nov.

Figures 22F; 27A-O

Myrtea tanimbarensis Cosel & Bouchet, 2008: 132, figs 12A-I, 14C.
Not *M. tanimbarenis* – Poppe & Tagaro 2011: 144, pl. 1067, figs 7, 8; this is a *Semele* species.

TYPE MATERIAL — Holotype MNHN IM-2000-20692, 2 paratypes MNHN IM-2000-20693.

TYPE LOCALITY — Indonesia, Maluku, Tanimbar Island, 9°23'S, 131°09'E, 246-275 m [KARUBAR: stn CP84].

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2005: stn CP2331, 255-268 m, 1 v. – Stn CP2340, 271-318 m, 2 pv, 176 v. – Stn CP2341, 544-712 m, 18 v. – Stn CP2342, 1240-1258 m, 1 v. – Stn CP2343, 273-356 m, 10 v. – Stn DW 2347, 198-233 m, 2 v. – Stn CP2348, 196-216 m, 85 v. – Stn CP2349, 219-240 m, 2 pv, 49 v. – Stn CP2350, 602-738 m, 1 v. – Stn CP2351, 810 m, 1 v. – Stn CP2358, 569-583 m, 3 v. – Stn CP2362, 679-740 m, 2 v. – Stn CP2380, 150-163 m, 5 v. – Stn CP2381, 259-280 m, 5 v. – Stn CP2390, 627-645 m, 3 v. – Stn CP2392, 242-400 m, 7 v. – Stn CP2393, 356-396 m, 3 v. – Stn CP2395, 434-532 m, 1 pv. – Stn CP2397, 642-669 m, 1 v. – Stn CP2398, 713-731 m, 1 pv. – Stn CP2399, 309-342 m, 2 v. – Stn CP2407, 256-268 m, 2 pv, 20 v. – Stn CP2408, 137-153 m, 2 v.

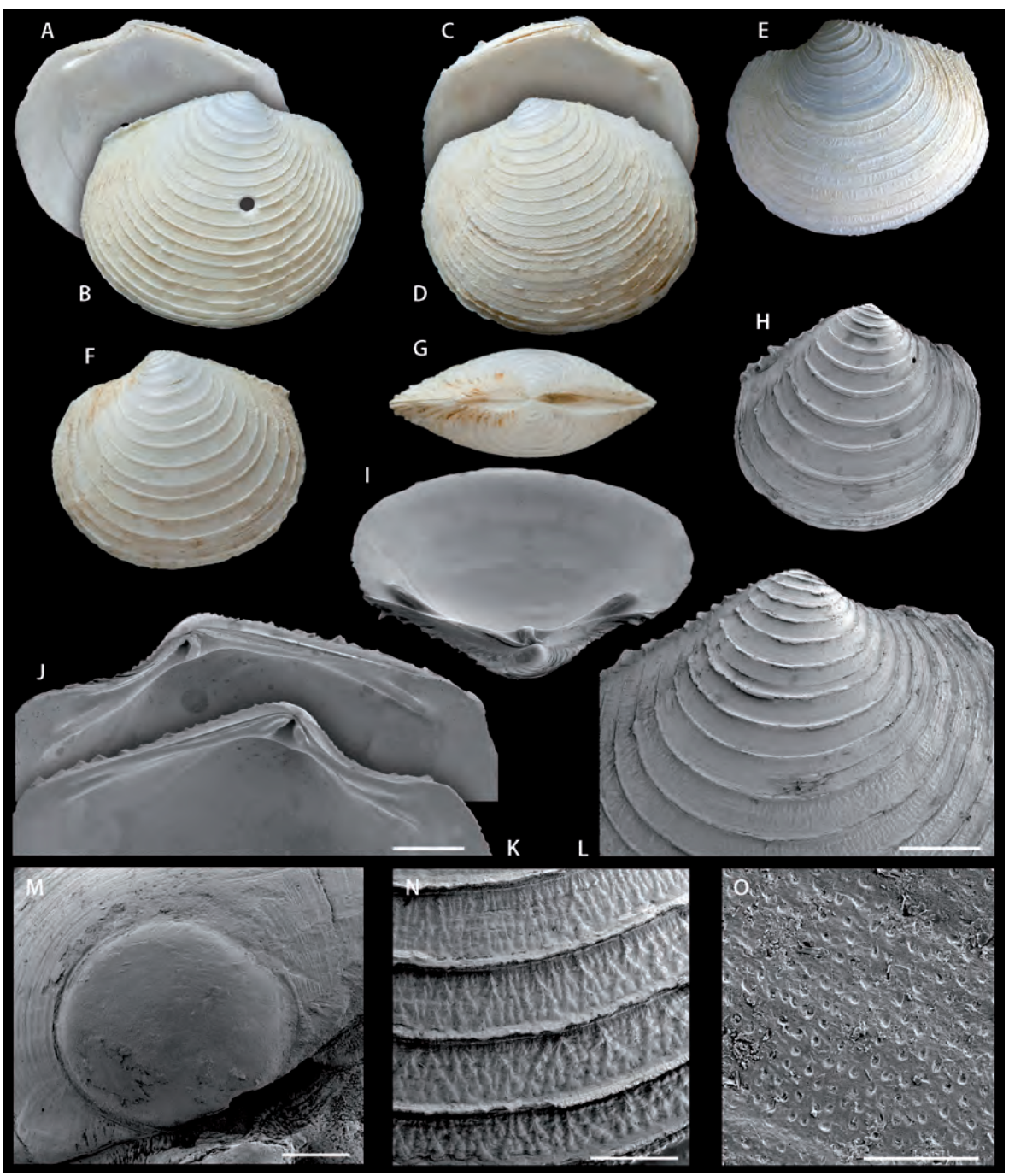
DISTRIBUTION — Philippines to Indonesia, paired valves in 240-713 m, empty shells in 153-1240 m.

DESCRIPTION — Shell white, subovate, L to 22.0, H to 18.5, T 4.8. Posterior sulcus shallow, with lower commarginal lamellae. Posterior dorsal margin straight with elevated lamellae that sometimes fuse to form raised ridge. Sculpture of regularly-spaced, sharp, commarginal lamellae; fine, irregular, branching radial folds between the lamellae in adult shell but absent in younger umbonal shell that has fine commarginals only (Figures 27H, L). Microsculpture of irregular shallow punctae (Figure 27O). Protoconch (Figure 27M): PI + PII 160 µm, P1 smooth, PII a narrow rim. Lunule shallow, lanceolate, ligament short in shallow groove. Hinge: RV with single cardinal tooth and strong posterior and anterior lateral teeth; LV with two cardinals and smaller anterior and posterior lateral teeth. Anterior adductor muscle scar short, detached for 1/2 of length, posterior scar small reniform. Pallial line entire, shell margin smooth; shell inside pallial line glossy. Pallial blood vessel scar absent. See Cosel & Bouchet (2008) for additional information.

REMARKS — This species was first described from Indonesia by Cosel & Bouchet (2008) and then known only from the Tanimbar Islands. It is easily recognised by the posterior dorsal sulcus and ridge, the long, straight posterior dorsal margin, the absence of radial threads in juvenile shells, longer anterior adductor scar and its larger size in comparison to other *Notomyrtea* species from the Philippines. It may be confused with the similar *Notomyrtea triclotae* (Cosel & Bouchet, 2008) described from the Philippines but can be distinguished by the more widely-spaced commarginal lamellae and absence of radial threads in the earlier parts of the shell. Brissac *et al*. (2011) characterised the bacterial symbionts and sequenced the host of a specimen from PANGLAO 2005, stn CP2340.

FIGURE 27

Notomyrtea tanimbarensis (Cosel & Bouchet, 2008). (All figured material from PANGLAO 2005 stations) — **A**, **B**, exterior and interior of right valve, stn CP2340. L 12.9 mm; **C**, **D**, exterior and interior of left valve, stn CP2340 L 14.3 mm; **E**, exterior of left valve, stn CP2340. L 7.0 mm; **F**, juvenile, exterior of left valve, stn CP2340. L 9.8 mm; **G**, dorsal view of D. L 9.8 mm; **H**, juvenile shell, right valve lacking radial sculpture between the commarginal lamellae, stn CP2381. L 3.9 mm; **I**, dorsal view of right valve, stn CP2381. L 4.3 mm; **J**, **K**, detail of hinge of right and left valves, stn CP2348. Scale bar = 1.0 mm; **L**, exterior of left valve showing change from early shell lacking radial folds to the complex radial sculpture of later shell, stn CP2348. Scale bar = 1.0 mm; **M**, protoconch, stn CP2348. Scale bar = 50 µm; **N**, radial sculpture in interspaces between commarginal lamellae, stn CP2348. Scale bar = 500 µm; **O**, microsculpture of pits, stn CP2348. Scale bar = 20 µm.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Notomyrtea triclotae (Cosel & Bouchet, 2008) comb. nov.

Figures 22G; 26E-H

Myrtea triclotae Cosel & Bouchet 2008: 134, figs 13A-1, 14A.

TYPE MATERIAL — Holotype MNHN IM-2000-20694, 22 paratypes MNHN IM-2000-20695.

TYPE LOCALITY — NW of San Isidro, Leyte, Central Philippines, 11°12'N, 124°15'E, 379-383 m [MUSORSTOM 3: stn CP144].

DISTRIBUTION — Known from the central Philippines between 250 to 400 m but not recorded from any of the PANGLAO stations in 2004 or 2005.

DESCRIPTION — See Cosel and Bouchet (2008) for details. Shell L to 29.4, H to 23.7, longer than higher, shell robust, sculpture of fine, low, closely spaced commarginal lamellae elevated into sharp ridge along posterior dorsal margin, very fine radial threads between lamellae absent in early shell. Lunule asymmetric. Hinge: RV with one cardinal tooth, anterior and posterior lateral teeth, LV with two cardinal teeth, anterior and posterior lateral teeth. Anterior adductor scar short, diverging for 1/3 length, pallial line entire, shell margin smooth.

Myrtea s.l. ***hyphalosa*** n. sp.

Figures 28A-M

TYPE MATERIAL — Holotype MNHN IM-2000-26580, pv (L 2.8, H 2.4), 3 paratypes MNHN IM-2000-26581 [1 pv (L 3.3, H 2.7; Figure 28E, F, J); 1 lv (L 4.1, H 3.5; Figure 28D), 1 lv (L 3.1, H 2.5; Figure 28G,)].

TYPE LOCALITY — Philippines, Sulu Archipelago, SW of Tawitawi, 4°38'N, 119°49'E, 2570 m [ESTASE 2: stn CP6].

DISTRIBUTION — Known only from the type locality.

DESCRIPTION — Shell very small, thin-shelled L to 4.1, H to 3.5, subtrigonal, ventral margin rounded, umbones elevated, posterior dorsal margin straight. Sculpture of regularly spaced, thin, commarginal lamellae, slightly elevated on dorsal areas, more closely spaced in juvenile shell, radial sculpture absent. Microsculpture of fine, irregular increments (Figure 28M). Periostracum visible, transparent. Protoconch (Figure 28L) poorly preserved: PI + PII 246 µm, PI 221 µm, PII a narrow rim. Hinge thin with small, indistinct cardinal teeth in both valves, weak lateral tooth in right valve. Anterior adductor muscle scar short, barely detached from pallial line, posterior adductor scar rounded with dorsal notch. Pallial line entire. Inner shell margin smooth.

Body with long vermiform foot, ctenidia with single demibranchs (Figure 28E).

REMARKS — The generic placement of this species is uncertain and we lack enough well-preserved material to describe it properly; the two, small live-collected specimens were coated by manganese oxide and somewhat corroded, possibly from formalin fixation. It resembles *Myrtea* and *Notomyrtea* in shape and sculpture but lacks the radial folds present in *Notomyrtea* species and the stronger hinge teeth and punctate microsculpture of both *Myrtea* and *Notomyrtea*. This species co-occurs with *Elliptiolucina labeyriei* Cosel & Bouchet, 2008 but the latter has an elongate ovoid shape. *Lucinoma estasia* n. sp. (see below) also occurs at the same site and together, at 2570 m, these are the deepest lucinids yet recorded. Superficially, the small (4.6 mm) *Myrtea minima* Okutani, 1964 [Okutani 1964: 85, fig. 7, from

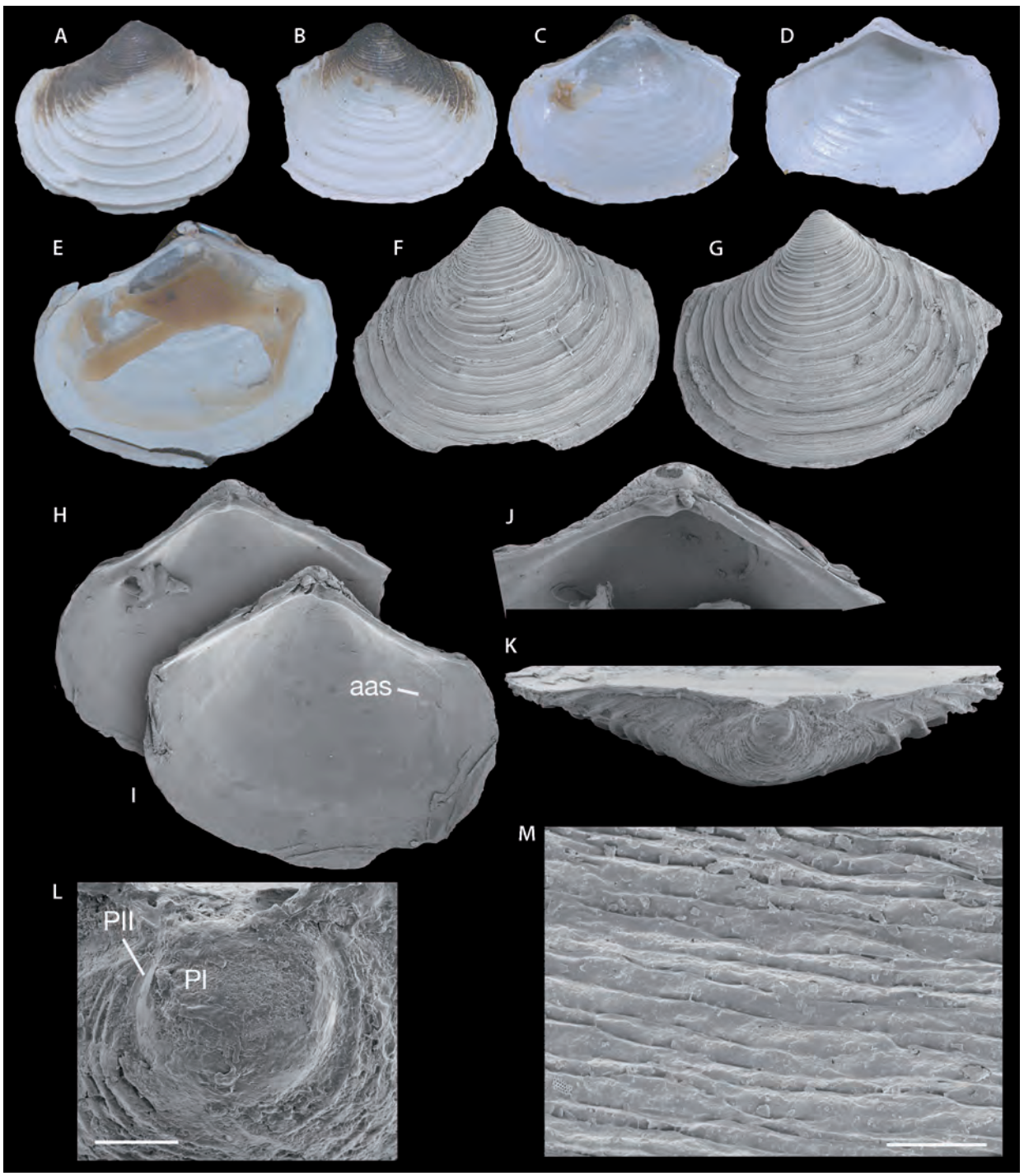


FIGURE 28

Myrtea s. l. *hyphalosa* n. sp. (Specimens from ESTASE 2 stn CP6) — **A**-**C**, holotype MNHN IM-2000-26580, exterior of left and right valves and interior of right valve. L 2.8 mm; **D**, paratype MNHN IM-2000-26581, interior of left valve. L 4.1 mm; **E**, paratype MNHN IM-2000-26581, interior of right valve with reconstituted body. L 3.3 mm; **F**, paratype MNHN IM-2000-26581, exterior of left valve. L 3.3 mm; **G**, paratype MNHN IM-2000-26581, exterior of left valve. L 3.1 mm; **H**, **I**, holotype, interior of right and left valves. Anterior adductor scar labelled; **J**, paratype MNHN IM-2000-26581, detail of hinge of right valve of E; **K**, holotype, dorsal view of left valve; **L**, protoconch of holotype. PI and PII marked. Scale bar = 100 µm; **M**, microsculpture. Scale bar = 20 µm.

620 m off Japan (Sea of Enshu-Nada)], appears similar but is much thicker shelled with robust cardinal teeth and is most likely a small or juvenile *Lucinoma* species.

ETYMOLOGY — Greek *Hyphalos*, in the deep.

Genus ***ROSTRILUCINA*** Cosel & Bouchet 2008

Rostrilucina Cosel & Bouchet 2008: 155.

Type species. *Rostrilucina garuda* Cosel & Bouchet, 2008, by original designation. Indonesia.

DIAGNOSIS — See Cosel & Bouchet (2008) for details. Large shells, compressed, with elongate, ovate, rostrate outline with anterior shell margin highly extended. Sculpture of fine commarginal lamellae, radial sculpture absent. Hinge with obscure cardinal teeth in both valves, left valve with low anterior lateral tooth, no posterior lateral teeth, right valve with low, elongate anterior lateral and small posterior lateral teeth. Anterior adductor scar very short, posterior scar with dorsal cleft.

REMARKS — Cosel & Bouchet (2008) recorded *R. garuda* from Indonesia at depths of 850 m and *R. anterorostrata* Cosel & Bouchet, 2008 in Mindoro in the central Philippines at depths of 550-640 m, but no specimens of these unusual bivalves were recovered during the PANGLAO 2004, 2005 expeditions.

Rostrilucina anterorostrata Cosel & Bouchet, 2008

Figures 18P, Q; 19E

Rostrilucina anterorostrata Cosel & Bouchet, 2008: 158, figs 31A-H, 32B

TYPE MATERIAL — Holotype MNHN IM-2000-20716, 3 paratypes MNHN IM-2000-20717.

TYPE LOCALITY — Central Philippines, north of Mindoro, 13°39'N, 120°43'E, 520-550 m. [MUSORSTOM 2: stn CP25].

DISTRIBUTION — Central Philippines from 550-640 m; East China Sea off Amani-Oshima Islands, 576-594 m (Okutani 2011).

DESCRIPTION — See Cosel & Bouchet (2008) for details. Shell robust, large, L to 55, H to 42 with pronounced rostrate anterior margin. Sculpture of numerous, dense, fine commarginal lamellae, radial sculpture absent. Hinge: RV with single cardinal tooth, small posterior and anterior lateral teeth, LV with vestigal cardinal, small posterior and anterior laterals. Anterior adductor scar short, detached for 1/3 length at 30°, posterior scar with dorsal cleft.

Genus ***TAYLORINA*** Cosel & Bouchet, 2008

Taylorina Cosel & Bouchet, 2008: 148.

Type species. *Taylorina alata* Cosel & Bouchet, 2008, by original designation. Central West-Pacific.

DIAGNOSIS — Shells small to medium size, ovate, compressed, with elevated posterior dorsal shell margin along the sunken escutcheon. Sculpture of fine commarginal lamellae, radial sculpture absent. Lunule long and deeply sunken in both valves. Hinge without teeth. Anterior adductor muscle scar short, broad and divergent from the pallial line at an angle of between 35° and 46°. Posterior scar with dorsal cleft.

REMARKS — Without molecular evidence the subfamilial position of this unusual genus of the four known deep-water species (Cosel & Bouchet 2008) is uncertain. No other myrteines have such a deeply sunken lunule, although the posterior adductor scar has a dorsal cleft similar to some myrteines including *Gloverina* and *Elliptiolucina*.

Taylorina alata Cosel & Bouchet, 2008

Figures 18N, O; 19F

Taylorina alata Cosel & Bouchet 2008: 149, figs 24A-E, 28A.
Taylorina alata – Poppe & Tagaro 2011:152, pl. 1071, figs 3a, b.

TYPE MATERIAL — Holotype MNHN IM-2000-20710.

TYPE LOCALITY — Philippines, Tablas Strait, east of Mindoro Island, 12°20'N, 121°42'E, 673-675 m [MUSORSTOM 3: stn CP122].

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2005: stn CP2342, 1240-1258 m, 1 pv, 1 v. – Stn CP2385, 982-989 m, 1 pv, 3 v. – Stn CP2389, 784-786 m, 1 v.

DISTRIBUTION — Central Philippines, paired valves in 675-1240 m.

DESCRIPTION — See Cosel & Bouchet (2008) for details. Shells longer than high, L to 31, H to 22, light, thin-shelled, highly compressed, shallow posterior and anterior sulcus. Posterior margin with short wing-like projection. Sculpture of fine, low, commarginal lamellae, radial sculpture absent. Posterior dorsal margin of the shell elevated along the escutcheon. Lunule narrow, deeply sunken, curved. Hinge teeth absent. Anterior adductor scar detached for 1/2 of length at angle of 30°. Posterior scar ovoid with dorsal cleft. Pallial line entire. Periostracum prominent, brown.

REMARKS — The samples from PANGLAO 2005 considerably increase the known depth range of the species.

Subfamily FIMBRIINAE Nicol, 1950

Although often classified as a separate family, Fimbriidae, molecular results show that *Fimbria fimbriata* groups within the Lucinidae and we now consider it as a subfamily (Williams *et al.* 2004; Taylor *et al.* 2011).

Genus ***FIMBRIA*** Megerle von Mühlfeld, 1811

Fimbria Megerle von Mühlfeld, 1811: 52.

Type species. *Fimbria magna* Megerle von Mühlfeld, 1811 [substitute name for *Venus fimbriata* Linnaeus, 1758], by monotypy.

DIAGNOSIS — Shell large, thick, ovate, inflated. Umbones low. Sculpture of radial ribs crossed by regularly spaced, commarginal lamellae, that are coarse and elevated to anterior and posterior. Hinge massive, with two cardinal teeth in each valve, a single, large anterior lateral tooth very close to cardinals, with a smaller posterior lateral located above posterior adductor scar. Anterior adductor muscle scar short, broad, reniform in outline, slightly deviating from the pallial line. Pallial line entire. Shell margin strongly denticulate.

Fimbria fimbriata (Linnaeus, 1758)

Figures 29A-C

Venus fimbriata Linnaeus, 1758: 687.
Fimbria fimbriata – Nicol 1950: 83, figs 1, 2, 4, 6, 7. — Glover & Taylor 2007: 172, fig. 42. — Poppe & Tagaro 2011: 148, pl. 1069, figs 3-5.

TYPE MATERIAL — Syntypes 1 pv and 1 v LSL 112, 113.

TYPE LOCALITY — "Oceano Indico".

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn D14, 2-4 m 1 v. – Stn G1, 100 m, 1v. – Stn R5, 5-16 m, 1 pv. – Stn R23, 1-5 m, 1 pv. – Stn R69, 2-4 m, 1 pv. – Stn R75, 3-35 m, 1 pv (live).

DISTRIBUTION — Indonesia, Philippines, Marshall Islands, New Caledonia, Fiji and Tonga.

DESCRIPTION — As for genus; L to 108, H to 87, commarginal lamellae closely spaced, rounded, often sinuous and dividing. Radial ribs more prominent to anterior and posterior. White, often blushed pink anteriorally and posteriorally, internal shell sometimes yellow.

Fimbria soverbii (Reeve, 1842)

Figures 29D-I

Corbis soverbii Reeve, 1842a: 85; 1842b: 81, pl. 58.
Corbis sowerbyi – Sowerby G.B. 1872: pl. 1, figs 2a, 2b.
Fimbria soverbii – Nicol 1950: 85, figs 3, 5, 8. — Huber 2010: 261.
Fimbria sowerbyi – Poppe & Tagaro 2011: 148, pl. 1069, figs 1-2.

TYPE MATERIAL — Syntype NHMUK 1963395; smaller of shells figured by Reeve (1842b) and Sowerby (1872: fig. 2a). Larger syntype not located.

TYPE LOCALITY — Philippines, Isle of Negros.

DISTRIBUTION — Central IWP, north Western Australia to southern Japan.

DESCRIPTION — L to 100, H to 74. Sculpture of fine radial ribs crossed by regularly spaced, thin, recurved commarginal lamellae. Lamellae crimped at anterior and posterior. Often with external, pink, radial rays, shell interior white.

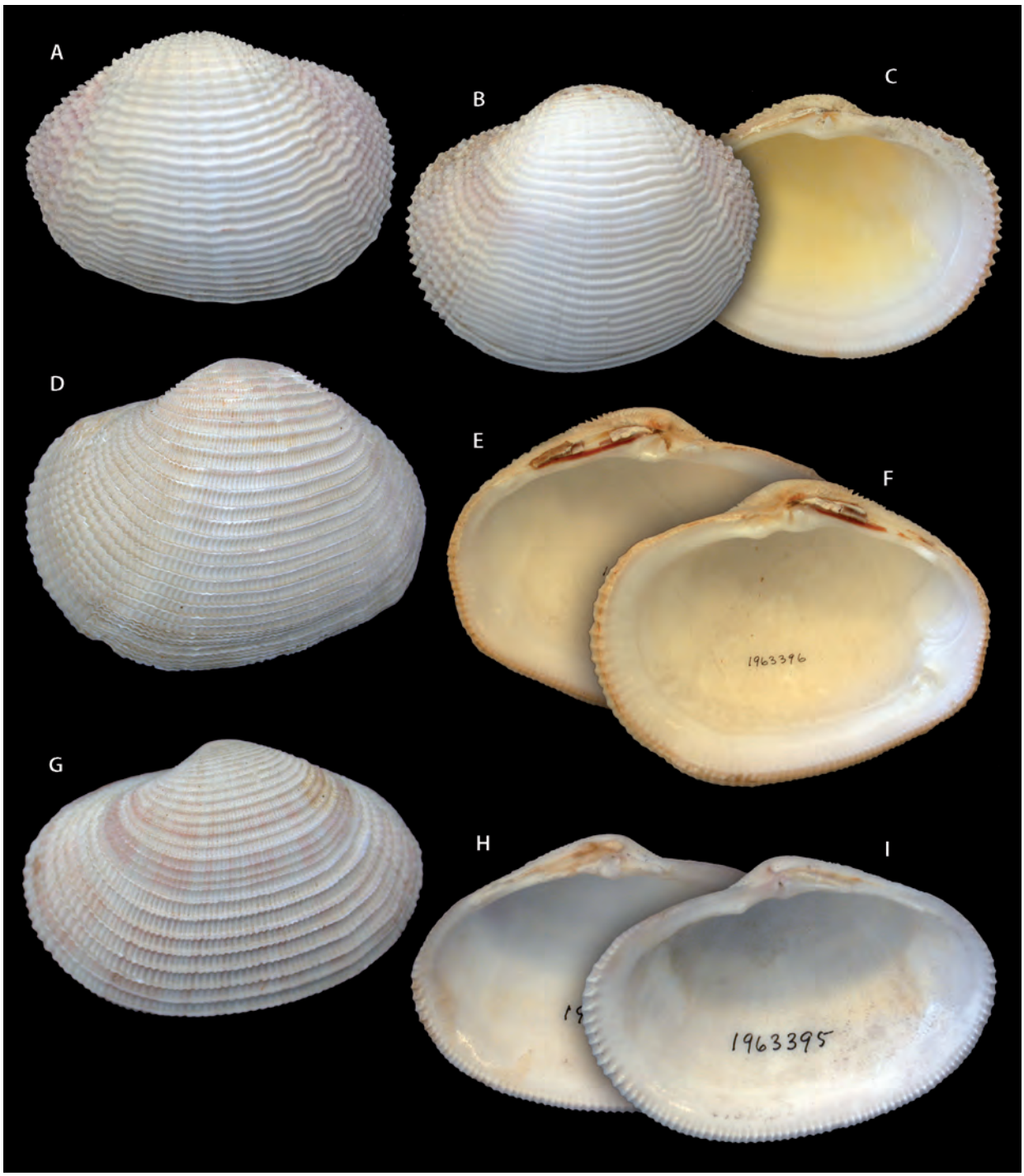


FIGURE 29

Fimbriinae species. — **A**, *Fimbria fimbriata* (Linnaeus, 1758), exterior of right valve, PANGLAO 2004 stn R69. L 63.4 mm; **B**, **C**, exterior and interior of left valve, PANGLAO 2005 stn G1. L 66.8 mm. — **D**, **F**, *Fimbria soverbii* (Reeve, 1842), NHMUK 1963396, exterior of left valve and interior of left and right valves. L 98.5 mm; **G**, **I**, *Corbis soverbii* Reeve, 1842, syntype NHMUK 1963395, Dumaguete, Philippines, Cuming Collection. L 48.3 mm.

REMARKS — *F. soverbii* can be readily distinguished from *F. fimbriata* (Linnaeus, 1758) by its thin, recurved commarginal lamellae and narrow, low, radial ribs.

Subfamily MONITILORINAE Taylor & Glover, 2011

A new subfamily with a long fossil record first introduced by Taylor *et al.* (2011) and represented at the present day by little-known species from the Indo-West Pacific.

Genus ***MONITILORA*** Iredale, 1930

Monitilora Iredale, 1930: 390, 406.

Type species. *Lucina ramsayi* E. A. Smith, 1885, by original designation.

DIAGNOSIS — Shell white, subcircular, H to 25.0, moderately inflated, light-shelled, posterior dorsal area shallowly demarcated. Sculpture of fine, rounded, closely spaced, commarginal lamellae with fine radial ribs in the interspaces. Lunule short, sunken, asymmetric with greater part in left valve. Hinge plate narrow, RV with single small cardinal and small anterior lateral tooth, LV with vestigal cardinal and no lateral teeth. Anterior adductor scar moderately long, detached for 1/2 length, dorsal part much broader than ventral extension. Pallial line entire, shell margin smooth.

REMARKS — Other species classified as *Monitilora* from Australia [*e.g.*, Lamprell & Whitehead 1992: *M. adelaidiana* Cotton & Godfrey, 1938; *M. paupera* (Tate, 1892)] belong in other genera.

Monitilora subtilis n. sp.

Figures 30C-Q; 32J

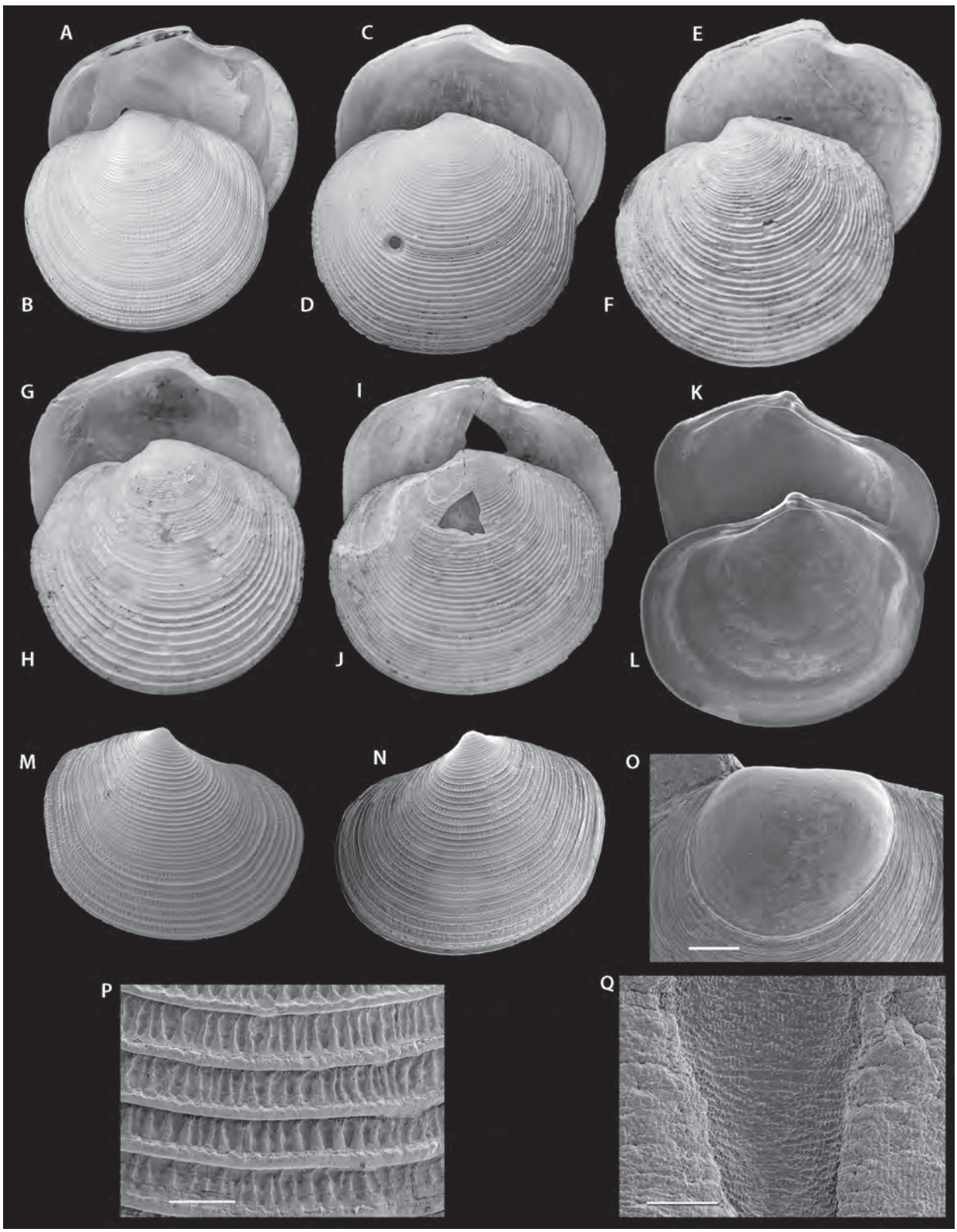
TYPE MATERIAL — Holotype MNHN IM-2000-26582, 3 paratypes MNHN IM-2000-26583-26585 (as listed below).

TYPE LOCALITY — Philippines, between Panglao and Pamilacan Islands, 9°33'N, 123°51'E, 106-137 m [PANGLAO 2004: T27].

MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn T9, 97-120 m, 2 v. – Stn T10, 117-124 m, 2 v. – Stn T27,106-137 m, 1 lv, holotype MNHN IM-2000-26582 (L 12.6, H 11.6, T 3.1; Figures 30C, D), 2 v. – Stn T31, 100-140 m, 1 lv, paratype MNHN IM-2000-26583 (L 11.0, H 9.7, T 2.5; Figures 30I, J), 1 v. – Stn T34, 145-163 m, 3 v. – Stn T36, 95-128 m, 15 v. – Stn T37, 134-190 m, 1 lv, paratype MNHN IM-2000-26584 (L 15.9, H 14.3, T 3.6; Figures 30E, F). – Stn T39, 100-138 m, 1 v. – PANGLAO 2005: stn CP 2380, 150-163 m, 1 v. – AURORA 2007: stn CP2712, 139-140 m, 1 lv, paratype MNHN IM-2000-26585 (L 18.3, H 17.3, T 4.1; Figures 30G, H), 2 v. – Stn CP 2726, 327-339 m, 1 v. – Stn CP 2758, 151-173 m, 1 v.

FIGURE 30

Monitilorinae — **A**, **B**, *Monitilora ramsayi* (Smith, 1885), NHMUK 1963207, exterior and interior of left valve, Botany Bay, NSW Australia. L 14.5 mm — **C**-**Q**, *Monitilora subtilis* n. sp.; **C**, **D**, holotype MNHN 26582, interior and exterior of left valve, PANGLAO 2004 stn T27. L 12.6 mm; **E**, **F**, paratype MNHN IM-2000-26584, interior and exterior of left valve, PANGLAO 2004 stn T37. L 15.9 mm; **G**, **H**, paratype MNHN IM-2000-26585, interior and exterior of left valve, AURORA 2007 stn CP 2712. L 18.3 mm; **I**, **J**, paratype MNHN IM-2000-26583, interior and exterior of left valve, PANGLAO 2005 stn T31. L 11.0 mm; **K**, **L**, juveniles, interior of left valve (L 3.3 mm) and right valves (L 3.4 mm), PANGLAO 2004 stn T36; **M**, exterior of right valve, juvenile, PANGLAO 2004 stn T36. L 3.8 mm; **N**, exterior of left valve, juvenile PANGLAO 2004 stn T36. L 3.1 mm; **O**, protoconch, PANGLAO 2004 stn T36. Scale bar 50 µm; **P**, detail of external sculpture, PANGLAO 2004 stn T36. Scale bar = 200 µm; **Q**, microsculpture, PANGLAO 2005 stn T36. Scale bar = 20 µm.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DISTRIBUTION — Philippines, empty shells in 120-327 m.

DESCRIPTION — Shell, white, small, subcircular, L to 24, H to 22, T 5.8. Sculpture of regular, closely spaced, sharp commarginal lamellae, interspaces with cone-shaped radial folds, tapering dorsally (Figure 30P). Microsculpture of very small denticles (Figure 30Q). Lunule short, impressed, asymmetric larger in LV, ligament set in shallow groove. Protoconch (Figure 30O): 193 µm, P1 smooth, PII a very narrow rim. Hinge: RV with single, low cardinal tooth and obscure anterior lateral tooth, LV with vestigal cardinal teeth and no lateral teeth. Anterior adductor muscle scar long, broader dorsally, narrowing ventrally, detached for 2/3 length, pallial line entire, broad. Shell outside pallial line glossy with faint radial grooves, inside pallial line with radial lines and points of mantle attachment. Pallial blood vessel scar sometimes visible. Juvenile shells (Figures 30M, N) are much more anteriorly extended.

REMARKS — Unfortunately, apart from the juvenile shells, the material available from the Philippines comprises a few unpaired valves. The type species, *Monitilora ramsayi* (E. A. Smith, 1885) from New South Wales and southern Queensland is similar (Figures 30A, B) but has a thinner shell, with a finer sculpture and radial folds that slightly intersect with commarginal lamellae giving a punctate appearance.

Outside of Australia the only described *Monitilora* species that we are aware of that could be living in the IWP is *Phacoides bonneti* Cossmann, 1923 described from the Pliocene of Karaikal, India (Cossmann 1923) and this is similar to Recent specimens in NHMUK from Madras. This species differs from *M. subtilis* n. sp. in being smaller, thin-shelled and with a shallower lunule. Further *Monitilora* shells were collected at Inhaca Island, Mozambique (MNHN Expédition INHACA 2011) and the name *Phacoides sepes* Barnard, 1964 may be applicable. Specimens from Praphat, near Ranong, Thailand and Sanur, Bali (NHMUK) would appear to be an undescribed species of *Monitilora* that differs from other *Monitilora* in its larger size, longer anterior adductor scar, more widely-spaced commarginal lamellae and stronger radial folds.

ETYMOLOGY — Latin *subtilis,* neat, fine.

Subfamily CODAKIINAE Iredale, 1937

Recently published molecular evidence groups *Lucinoma*, *Codakia, Ctena* and *Epicodakia* species, as separate subclades, in the subfamily Codakiinae (Taylor *et al.* 2011, 2014).

Genus ***LUCINOMA*** Dall, 1901

Lucinoma Dall, 1901: 806.

Type species. *Lucina filosa* Stimpson, 1851, by original designation.

DIAGNOSIS — Shells large, subcircular to tapering anteriorally, sculpture of regular commarginal lamellae, radial sculpture absent. Hinge: both valves with two cardinal teeth, anterior often bifid, RV with small anterior lateral teeth, sometimes absent; LV anterior and posterior lateral teeth present or absent. Adductor scar long, narrow, relatively straight, detached for most of length at an angle of 25°-45°. Pallial line entire, shell margin smooth.

REMARKS — The genus *Lucinoma* has a virtually worldwide distribution from intertidal to bathyal depths with more than 20 recognised species, some of which are associated with hydrocarbon seeps, mud volcanoes and oxygen minimum zones (Taylor & Glover 2010).

Lucinoma dulcinea Cosel & Bouchet, 2008

Figures 31A-N; 32A

Lucinoma dulcinea Cosel & Bouchet, 2008: 165, figs 37A, B, 41A.

TYPE MATERIAL — Holotype MNHN IM-2000-20720, 2 paratypes MNHN IM-2000-20721.

TYPE LOCALITY — Central Philippines, Leyte, NW of San Isidro, 11°12'N, 124°15'E, 379-383 m [MUSORSTOM 3: stn CP144].

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2005: stn CP2336, 757-760 m, 1 v. – Stn CP2340, 291-318 m, 6 v. – Stn CP2358, 569-583 m, 2 v. – Stn CP2362, 679-740 m, 8 v. – Stn CP2372, 255-301 m, 1 v. – Stn CP2388, 762-786 m, 2 v. – Stn CP2389, 784-786 m, 1 pv, 1 v. – Stn CP2392, 242-400 m, 1 pv, 5 v. – Stn CP2393, 396-414 m, 1 v. – Stn CP2396, 642-669 m, 1 v. – Stn CP2397, 669-712 m, 2 v. – Stn CP2398, 713-731 m, 1 pv, 4 v. – Stn CP2399, 309-342 m, 1 v.

DISTRIBUTION — Philippines, paired valves in 400-784 m, empty shells from 301 m.

DESCRIPTION — See Cosel & Bouchet (2008) for details. Shells large, L to 45, H to 41, subovate, anterior margin rostrate in outline, sculpture of thin, regularly-spaced commarginal lamellae, radial ribs absent. Microsculpture of regular, fine lines, more closely spaced with punctae in umbonal area (Figures 31M, N). Protoconch (Figure 31L): PI + PII 230 µm, PI smooth, PII a narrow 10 µm rim with growth increments. Lunule lanceolate, shallow. Ligament long, narrow. Hinge narrow, cardinal and anterior lateral teeth in both valves, posterior teeth absent. Anterior adductor scar long, narrow, detached for 3/4 of length at angle of 20°, posterior scar ovate with irregular inner margin. Pallial line entire, shell margin smooth. Periostracum light brown.

REMARKS — Although much of the material from Panglao comprises juvenile shells that are somewhat variable in shell thickness and numbers of lamellae we are confident that they can be identified as *L. dulcinea*.

Lucinoma estasia n. sp.

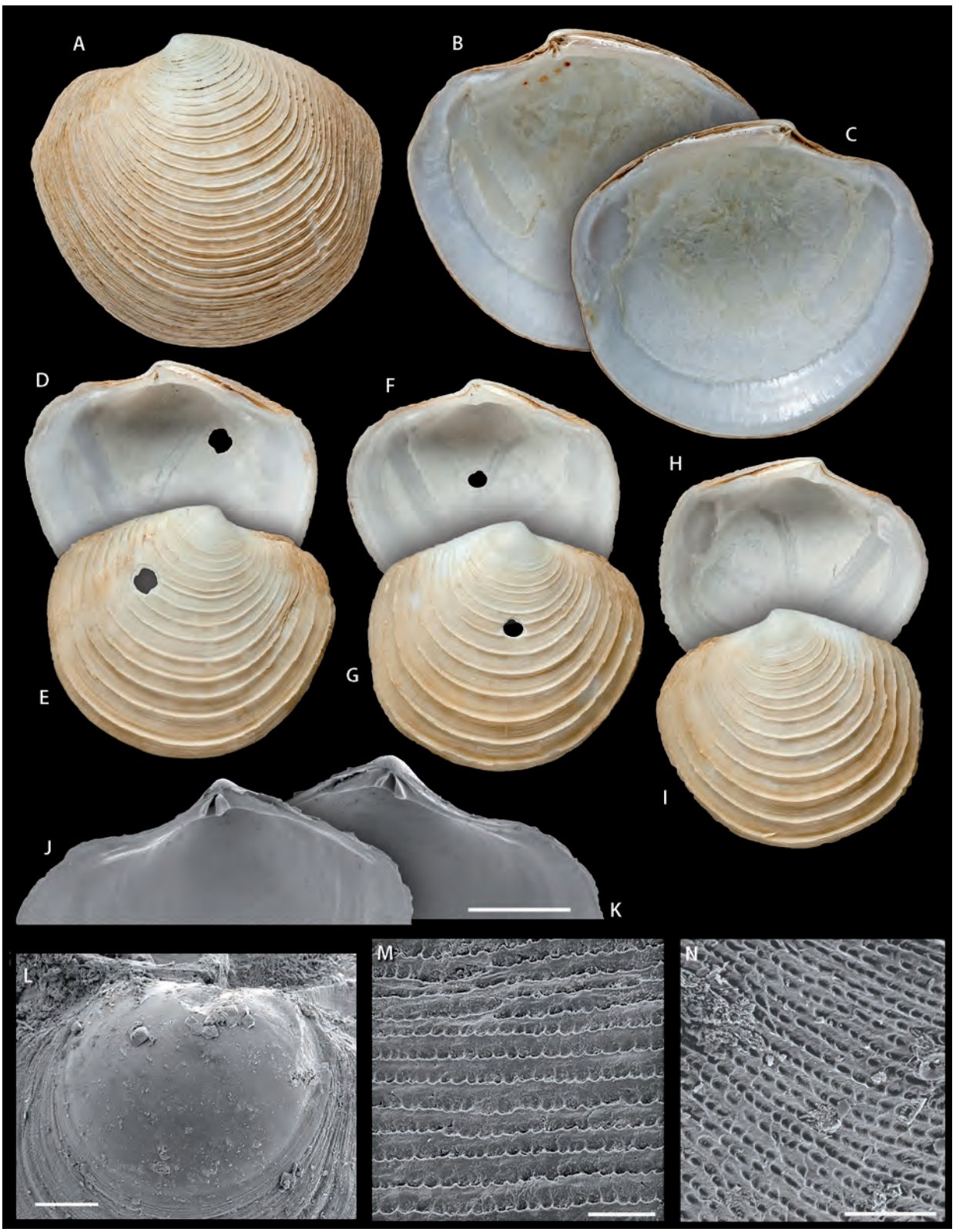
Figures 32B; 33A-H

TYPE MATERIAL — Holotype pv MNHN IM-2000-26586 (L 7.0, H 5.5, T 1.6).

TYPE LOCALITY — Philippines, Sulu Archipelago, SW of Tawitawi, 4°38'N, 119°49'E, 2570 m [ESTASE 2: stn CP6].

DISTRIBUTION — Known only from the type locality.

DESCRIPTION — Shell small ovate, longer than high, umbones prominent, anteriorly extended and rounded, posterior subquadrate, posterior dorsal area marked by low ridge. Sculpture of fine, closely spaced, low commarginal lamellae. Ligament short, in shallow groove. Microsculpture of regular fine lines with dorsally serrated edges (Figure 33H); umbonal area with lines of closely spaced punctae. Protoconch (Figure 33F): PI + PII 275 µm, PI 245 µm, PII with a few growth increments. Hinge: RV with two cardinal teeth, the posterior larger, and small anterior lateral tooth located above anterior adductor scar; LV with two cardinal teeth, the anterior larger, and small anterior lateral tooth. Anterior adductor scar medium long, detached for 2/3 of length at angle of 30°; posterior scar subovate. Pallial line entire. Shell margin smooth.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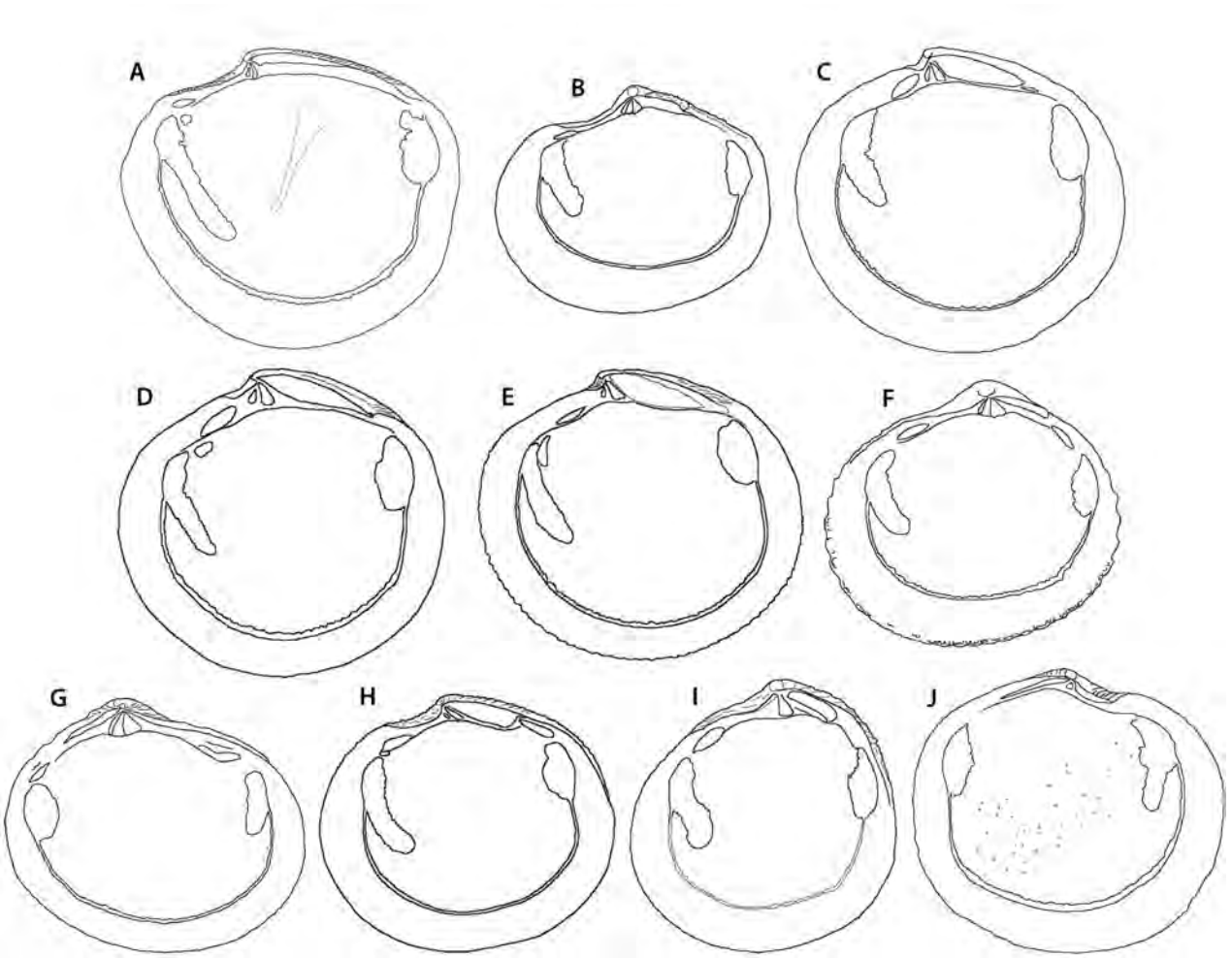


FIGURE 32

Outline drawings of interiors of valves of Codakiinae and Monitilorinae. Right valves except for *Epicodakia izuensis* and *Monitilora subtilis*. Not to scale. **A**, *Lucinoma dulcinea*; **B**, *Lucinoma estasia*; **C**, *Codakia interrupta*; **D**, *Codakia punctata*; **E**, *Codakia tigerina*; **F**, *Epicodakia sweeti*; **G**, *Epicodakia izuensis*; **H**, *Ctena bella*; **I**, *Ctena delicatula*; **J**, *Monitilora subtilis*.

FIGURE 31

Lucinoma dulcinea Cosel & Bouchet, 2008 (All figured specimens from PANGLAO 2005 stn CP2398) — **A**-**C**, exterior of left valve and interior of right and left valves. L 45.5 mm; **D**, **E**, juvenile shell, interior and exterior of right valve. L 21.0 mm; **F**, **G**, juvenile shell, interior and exterior of right valve. L 20.3 mm; **H**, **I**, juvenile shell left valve. L 20.4 mm; **J**, **K**, hinge teeth of right and left valves of juvenile shell. Scale bar = 1.0 mm; **L**, protoconch. Scale bar = 50 µm; **M**, microsculpture. Scale bar = 10 µm; **N**, detail of microsculpture of umbonal area. Scale bar = 10 µm.

REMARKS — This species, represented by only a single specimen, has many characters of *Lucinoma s. l.* but differs from *L. dulcinea* Cosel & Bouchet, 2008 (300-800 m), the only other *Lucinoma* known from the Philippines, by the much finer commarginal sculpture and microsculpture of fine lines with serrated dorsal margins. Along with *Elliptiolucina labeyriei* Cosel & Bouchet 2009 and *Myrtea s. l. hyphalosa* n. sp. (see above) that occur at the same station, ESTASE stn CP6 at 2570 metres, these are the deepest lucinids yet recorded.

ETYMOLOGY — *estasia,* derived from acronym of the ESTASE 2 cruise that recovered the specimen (Labeyrie 1989).

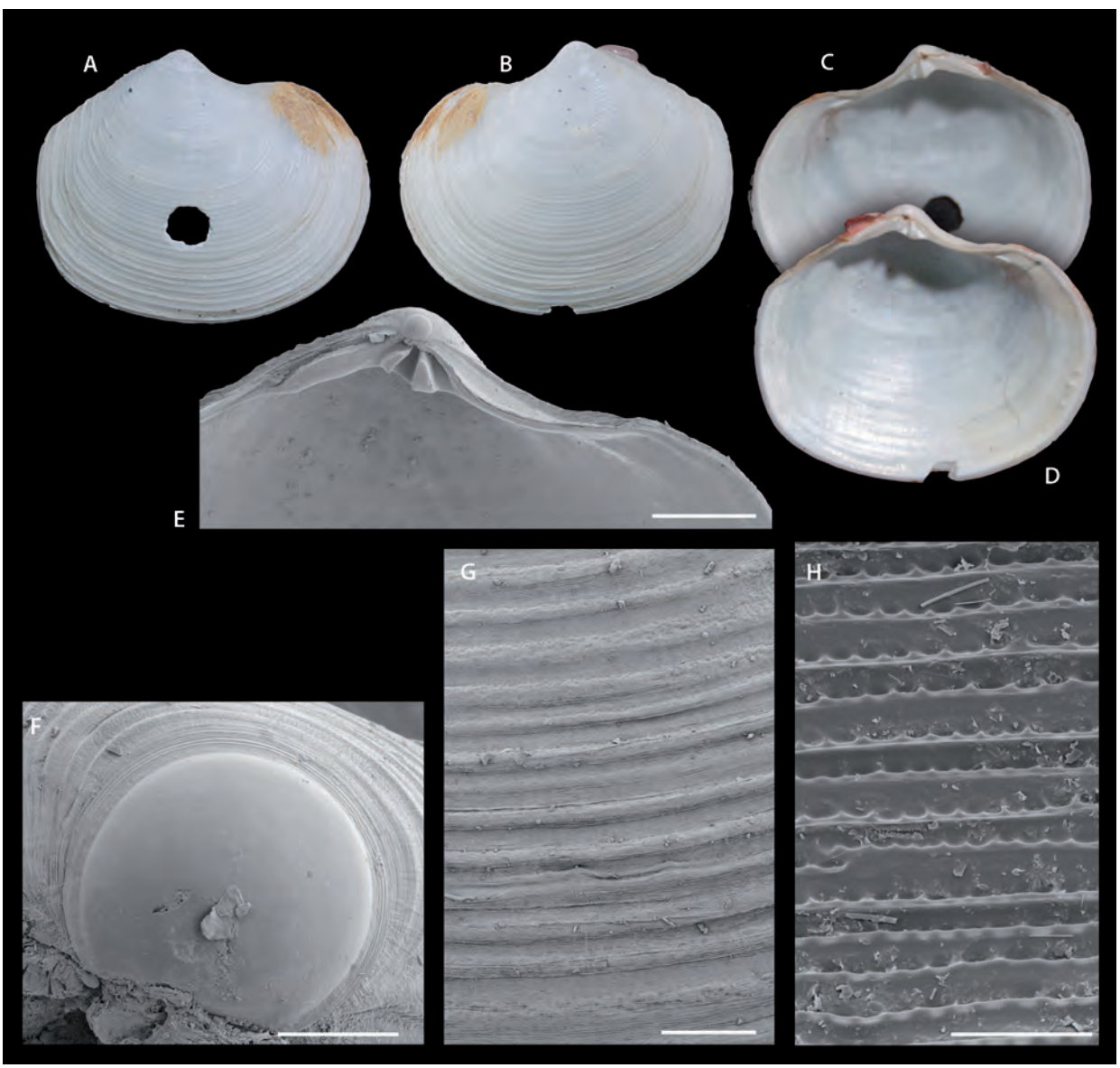


FIGURE 33

Lucinoma estasia n. sp. (All images of holotype MNHN IM-2000-26586, ESTASE 2 stn CP6) — **A**, **B**, exterior of right and left valves. L 7.0 mm; **C**, **D**, interior of right and left valves. L 7.0 mm; **E**, hinge of left valve. Scale bar = 1 mm; **F**, protoconch. Scale bar =100 µm; **G**, commarginal sculpture. Scale bar = 200 µm; **H**, microsculpture. Scale bar = 10 µm.

Genus ***EPICODAKIA*** Iredale, 1930

Epicodakia Iredale 1930: 390.

Type species. *Epicodakia consettiana* Iredale, 1930, by original designation.

Synonym:
Talocodakia Iredale, 1936: 273. Type species: *Epicodakia kennethi* Iredale, 1936, by monotypy.

DIAGNOSIS — See Glover & Taylor (2007) for details. Shell L to 21 mm, longer than high, moderately inflated. Sculpture of regularly-spaced, narrow radial ribs crossed by commmarginal lamellae producing scales on the summits of the ribs in some species. Hinge with two cardinal teeth and anterior and posterior lateral teeth in each valve. Anterior adductor scar short, detached for 1/2 of length, inner shell margin smooth or finely denticulate.

REMARKS — As discussed by Glover & Taylor (2007: 136-137) there has been considerable confusion concerning the concept of this genus and its misuse for *Ctena* species. It differs from *Ctena* in its longer, less inset ligament and the radial ribs do not bifircate or intercalate. Although usually regarded as a shallow water genus with six known species widespread in the IWP, we have found other undescribed deeper water *Epicodakia* from New Caledonia and Solomon Islands from 150-380 m.

Epicodakia izuensis (Okutani & Matsukuma, 1982) comb. nov.

Figures 32G; 34D-G; 36C, D

Wallucina izuensis Okutani & Matsukuma, 1982: 174, pl. 10, figs 7-8, text fig. 2.
Wallucina izuensis – Matsukuma 2000: 929, pl. 462, fig 10. — Higo *et al.* 2001: 159, fig. 15.5.

TYPE MATERIAL — Holotype NSMT-Mo 60042 (L 15.5), 16 paratypes NSMT-Mo 60043-48, 60182.

TYPE LOCALITY — Japan, off southeastern tip of Izu Peninsula, Honshu 34°37.4'N, 138°58.8'E, 111-123 m.

MATERIAL EXMINED — Philippines. AURORA 2007: stn CP2670, 180-187 m, 5 v (largest specimen H 12.2, L 14.1 mm, T 3.7).

DISTRIBUTION — Southern Japan, Philippines, 100-200 m.

DESCRIPTION — Shell medium, L to 21.4, H to 18.6, subovate, longer than high; sculpture of fine, closely spaced, commarginal lamellae, crossed by fine, indistinct radial threads that are more prominent anteriorly and posteriorly. Microsculpture (where preserved) of irregular rows of shallow punctae (Figure 36C). Ligament external, long narrow. Lunule narrow, lanceolate. Protoconch (Figure 36D): PI+PII 180 µm, PI 167 µm, PII with some growth lines. Hinge: LV with two cardinal teeth, anterior large and hooked, anterior and posterior lateral teeth sockets. RV with a prominent posterior and thin anterior cardinal teeth, a large projecting anterior lateral and small posterior lateral teeth. Anterior adductor scar short, detached for 1/3 of length at angle of 10°, posterior scar ovoid. Pallial line entire. Shell margin smooth, glossy.

REMARKS — The Philippine specimens appear very similar to the published figures of *Wallucina izuensis* although we have not examined the type material. First described as a *Wallucina*, this species lacks the distinctive obliquely inset internal ligament of that genus and others in the subclade around *Loripes* Poli, 1791 (Taylor *et al.* 2011). The sculpture,

hinge teeth, and anterior adductor muscle scar are broadly similar to the type species of *Epicodakia*, *E. consettiana* (Iredale, 1930) from southern Australia (Glover & Taylor 2007, figs 17, 18A). Other species of *Epicodakia*, including *E. sweeti* (Hedley, 1899) from the Philippines and western Pacific (Glover & Taylor 2007), have more prominent radial sculpture but are known only from shallow water. A likely related deeper water species of *Epicodakia* with similar subdued radial sculpture is present in the MNHN collections (EBISCO 2005, TERRASSE 2008) from New Caledonia at depths of 300-380 m.

Epicodakia sweeti (Hedley, 1899)

Figures 32F; 34A-C; 36A, B

Cardita sweeti Hedley, 1899: 495, fig. 5.
Ctena transversa Dall, Bartsch & Rehder, 1938: 131, pl. 35, figs 9-12.
Epicodakia sweeti – Glover & Taylor 2007: 140, figs 20A-H.
Epicodakia minuata (Deshayes, 1863) – Xu & Zhang 2008: 117, fig. 340.
Epicodakia divergens (Philippi, 1850) – Poppe & Tagaro 2011: 146 pl. 1068, fig. 7.

TYPE MATERIAL — *Cardita sweeti*: holotype NMV F27464C. — *Ctena transversa*: holotype USNM 337409.

TYPE LOCALITY — *C. sweeti*: Tuvalu, Funafuti Atoll. — *C. transversa*: Hawaii, Oahu, Waikiki.

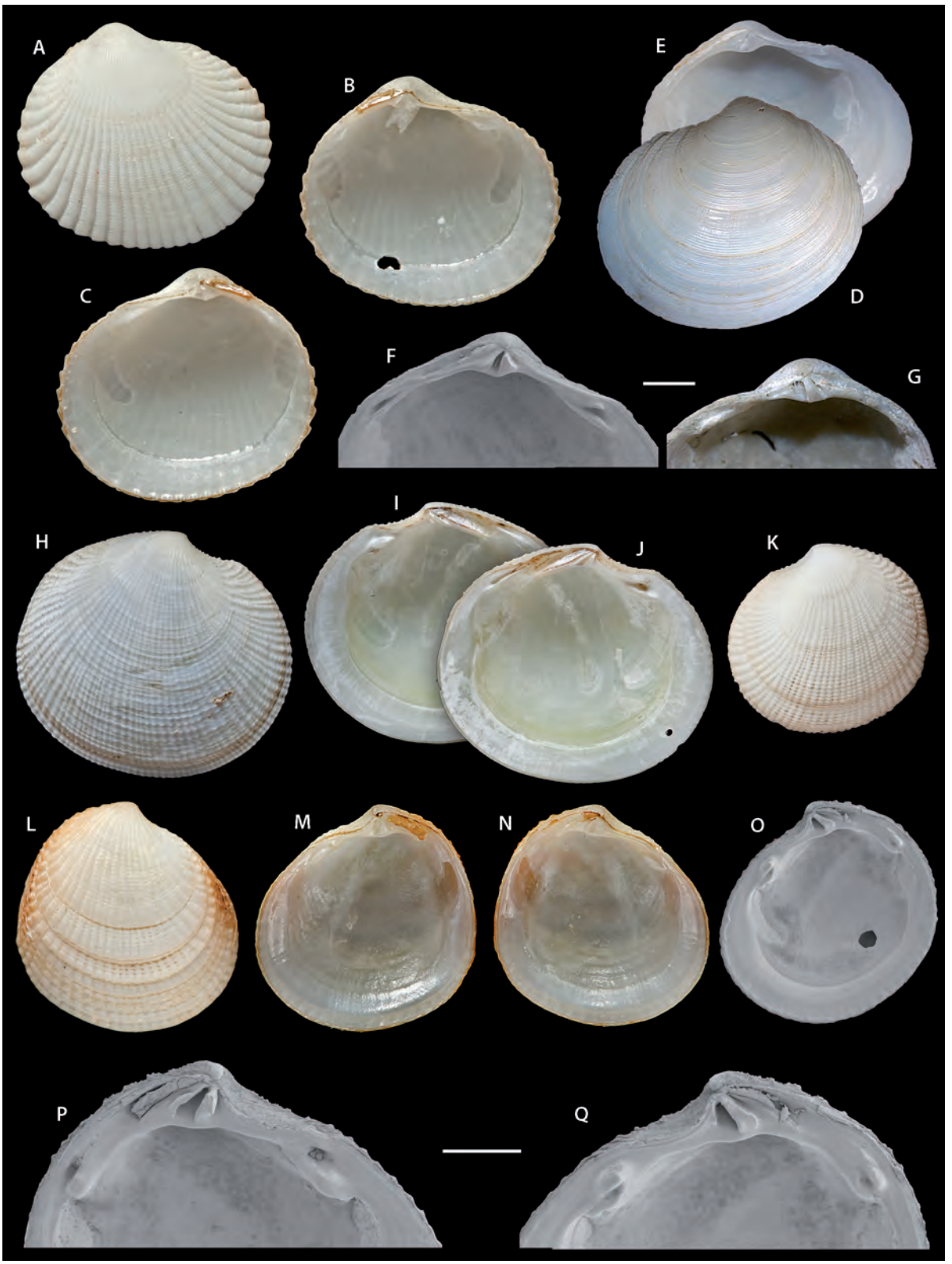
OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn B1, 8-14 m, 2 pv. – Stn B3, 8 m, 2 v. – Stn B11, 2-4 m, 1 v. – Stn B24, 38 m, 1 pv, 3 v. – Stn B28, 25 m, 4 v. – Stn B29, 26 m, 1 pv, 1 v. – Stn B30, 25 m, 2 v. – Stn B38, 17-18 m, 2 v. – Stn B40, 22 m, 3 v. – Stn L43, 60 m, 1 v. – Stn B41, 7-19 m, 1 pv. – Stn M20, 0-2 m, 1 v. – Stn R31, 10-41 m, 1 pv. – Stn R37, 28-32 m, 1 v. – Stn R38, 6-37 m, 2 v. – Stn R51, 2-52 m, 2 v. – Stn R59, 2-20 m, 2 v. – Stn S1, 5 m, 3 v. – Stn S2, 4-5 m, 2 v. – Stn S3, 6 m, 2 v. – Stn S4, 4-30 m, 1 v. – Stn S5, 2-4 m, 1pv, 2 v. – Stn S7, 1-4 m, 4 v. – Stn S8, 28-32 m, 1 pv, 1 v. – Stn S10, 6-14 m, 2 v. – Stn S12, 6-8 m, 1 pv. – Stn S13, 8-15 m, 3 v. – Stn S14, 5-12 m, 19 v. – Stn S16, 15-18 m, 1 pv. – Stn S21, 4-12 m, 2 pv, 4 v. – Stn S22, 15-20 m, 2 pv, 1 v. – Stn S24, 2-4 m, 1 v. – Stn S28, 28-32 m, 1 v. – Stn S30, 25 m, 1 v. – Stn S31, 24 m, 2 v. – Stn S32, 2-3 m, 3 v. – Stn S40, 2-4 m, 1 v. – Stn T17, 132-137 m, 1 v.

DISTRIBUTION — This species is widely distributed in intertidal to shallow water reefal habitats across the IWP from the Amirante Islands in the Indian Ocean to the Philippines and Marquesas in the Pacific. Many of the small specimens from Panglao were recovered by brushing or suction sampling from reef caves.

DESCRIPTION — See Glover & Taylor (2007) for details. Shell small to medium sized, L to 18, H to 17, white to yellowish, sculpture of *ca.* 40-60 radial ribs crossed by closely spaced commarginal lamellae producing low rounded scales on the summits of ribs. Microsculpture of regular rows of small punctae (Figure 36A). Protoconch (Figure 36B):

FIGURE 34

Codakiinae. *Epicodakia* and *Ctena* species — **A**-**C**, *Epicodakia sweeti* (Hedley, 1899), exterior of right valve and interior of left and right valves, PANGLAO 2004 stn R31. L 12.3 mm — **D**-**G**, *Epicodakia izuensis* (Okutani & Matsukuma, 1982), exterior and interior of left valve, AURORA 2007 stn DW2670. L 13.8 mm; **F**, detail of hinge of left valve, AURORA 2007 stn DW2670. Scale bar 1.0 mm; **G**, detail of hinge of right valve, AURORA 2007 stn DW2670. Scale bar 1.0 mm — **H**-**K**, *Ctena bella* (Conrad, 1837); **H**, **I**, exterior of right valve and interior of right and left valves, PANGLAO 2004 stn M3. L 28.4 mm; **K**, exterior of left valve, PANGLAO 2004 stn M3. L 17.1 mm — **L**-**Q**, *Ctena delicatula* (Pilsbry, 1904), exterior of right valve and interior of right and left valves, PANGLAO 2004 stn S4. L 8.0 mm; **O**, interior of right valve, PANGLAO 2004 stn B26. L 5.0 mm; **P**, **Q**, detail of hinge of left and right valves, PANGLAO 2004 stn B26. Scale bar 1 mm.


A
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Q

PI + PII 159 µm, PI 120 µm, PII with well-defined growth increments. Hinge with two cardinal teeth and posterior and anterior lateral teeth in each valve. Anterior adductor scar medium-long, detached for 1/2 length at angle of 15°. Pallial line thin, entire, shell margin denticulate.

REMARKS — *Epicodakia sweeti* can be distinguished from the type species, *E. consettiana* (Iredale, 1930), by its much coarser sculpture. Another little-known species, *Epicodakia obliqua* (Reeve, 1850), first described from Zoushan, China, has finer, more numerous radial ribs.

Genus ***CTENA*** Mörch, 1861

Ctena Mörch, 1861: 201.

Type species. *Lucina pectinata* Carpenter, 1857, by subsequent designation, Dall, Bartsch & Rehder, 1938. *Lucina pectinata* Carpenter is a primary homonym of *Lucina pectinata* C.B. Adams, 1852 and a secondary homonym of *Tellina pectinata* Gmelin, 1791. The name *Codakia (Jagonia) mexicana* Dall, 1901 was established as a replacement name.

DIAGNOSIS — Shell small to medium sized, subcircular. Sculpture of prominent radial ribs that bifurcate and intercalate and crossed by fine commarginal lamellae forming scales along the ribs. Hinge with two cardinal teeth and posterior and anterior lateral teeth in both valves. Ligament short, set in deep, oblique resilifer.

Ctena bella (Conrad, 1837)

Figures 32H; 34H-K; 36E, F

Lucina bella Conrad, 1837: 254, pl. 19, fig. 11.
Epicodakia bella – Poppe & Tagaro 2011: 146, pl. 1068, fig. 10.
See Glover & Taylor (2007) for full synonymy.

TYPE MATERIAL — Not located.

TYPE LOCALITY — Hawaii (see Dall *et al.* 1938).

MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn B1, 8-14 m, 1 v. – Stn B2, 5 m, 2 v. – Stn – Stn B3, 8 m, 2 v. – Stn B5, 4 m, 1 pv, 3 v. – Stn B6, 12-14 m, 1 v. – Stn B7, 4-30 m, 4 pv, 21 v. – Stn B11, 2-4 m, 3 v. – Stn B14, 2-4 m, 1 v. – Stn B18, 3-5 m, 2 v. – Stn B13, 3-5 m, 3 v. – Stn B19, 17 m, 2 v. – Stn B20, 2-8 m, 3 v. – Stn B23, 20-25 m, 1 v. – Stn B24, 38 m, 1 v. – Stn B28, 25 m, 2 v. – Stn B29, 26 m, 1 v. – Stn B30, 25 m, 2 pv, 3 v. – Stn B37, 19-20 m, 5 pv. – Stn B38, 17 m, 3 v. – Stn B40, 22 m, 2 v. – Stn D1, 2 m, 2 v. – Stn D4, 0-2 m, 6 v. – Stn D5, 0-3 m, 2 v. – Stn D7, 2-3 m, 7 v. – Stn D9, 2-4 m, 2 v. – Stn M3, 0-2.5 m, 6 pv, 10 v. – Stn M9, 0.5 m, 1 pv. – Stn M10, 0-3 m, 3 v. – Stn M15, 0-1 m, 4 v. – Stn M18, 0-1 m, 4 pv, 15 v. – Stn M19, 0-2 m, 1 v. – Stn M24, 0-1 m, 6 v. – Stn M26, 0-2 m, 1 pv. – Stn M47, 0-0.5 m, 1 pv. – Stn R66, 1-6 m, 1 pv, 1 v. – Stn S1, 5 m, 13 v. – Stn S2, 4-5 m, 3 pv, 5 v. – Stn S3, 6 m, 1 v. – Stn S4, 4-30 m, 5 pv, 6 v. – Stn S7, 1-4 m, 1 v. – Stn S5, 2-4 m, 7 pv, 2 v. – Stn S7, 1-4 m, 2 v. – Stn S8, 28-32 m, 1 v. – Stn S9, 3 m, 2 v. – Stn S10, 6-14 m, 5 pv, 6 v. – Stn S11, 2 m, 4 v. – Stn S12, 6-8 m, 3 pv, 4 v. – Stn S13, 8-15 m, 1 pv, 3 v. – Stn S14, 5-12 m, 8 pv, 31 v. – Stn S15, 4-6 m, 1 pv, 1 v. – Stn S16, 15-18 m, 3 v. – Stn S17, 6 m, 1 v. – Stn S18, 0-2 m, 1 v. – Stn S21, 4-12 m, 2 pv, 6 v. – Stn S22, 15-20 m, 2 pv, 12 v. – Stn S23, 2 m, 1 v. – Stn S24, 2-4 m, 2 v. – Stn S25, 21 m, 1 v. – Stn S28, 28-32 m, 8 v. – Stn S29, 32 m, 2 v. – Stn S31, 24 m, 2 v. – Stn S32, 2-3 m, 1 pv, 2 v. – Stn S40, 2-4 m, 4 v. – Stn S42, 15-20 m, 2 v. – Stn S43, 2-3 m, 2 v. – PANGLAO 2005: stn CP2393, 356-396 m, 1 v. – Stn DW2401, 397-410 m, 2 v.

DISTRIBUTION — Widespread across the West Pacific particularly on oceanic islands and reefs.

DESCRIPTION — Shell, white to yellow, subcircular L to 28, H to 25, sculpture of numerous fine radial ribs that bifurcate and intercalate, crossed by narrow, commarginal lamellae; ribs are more widely spaced towards the dorsal margin. Lunule lanceolate, asymmetric. Microsculpture a spongy network of punctae (Figure 36E). Protoconch (Figure 36F): PI + PII 170 µm, PI smooth 133 µm, PII with prominent growth lines. Hinge with two cardinal teeth in each valve, with anterior cardinal smaller. Large posterior and anterior laterals in each valve. Ligament set in deep, oblique resilifer. Anterior adductor scar medium long, detached for 1/2 length at angle of 15°, pallial line entire and shell margin smooth. Pallial blood vessel scar visible.

REMARKS — The widely distributed *Ctena bella* and morphologically similar, shallow water, putative species in the IWP represent a complex that requires further study. Molecular analysis by Taylor *et al.* (2011) and unpublished data show that a specimen from Panglao (MNHN IM-2009-10365) that could be identified as *C. bella* from morphology grouped closely with other *Ctena bella* from Vanuatu, Queensland and Okinawa.

Ctena delicatula (Pilsbry, 1904)

Figures 32I; 34L-Q; 36G, H

Codakia bella delicatula Pilsbry 1904: 555 pl. 41, figs 15-16.
Epicodakia delicatula – Higo *et al.* 1999: 454. — Matsukuma 2000: 929, fig. 3.
Ctena delicatula – Meyer *et al*. 2008: 45, fig. 3c.
Epicodakia bella – Xu & Zhang 2008: 117, fig. 341. — Xu 2102: 39, fig.16.

TYPE LOCALITY — Japan, Ryukyu Islands.

TYPE MATERIAL — 2 syntypes ANSP 82048 (L 11.3, H 11; L 10.5, H 11).

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn B26, 35 m, 3 v. – Stn S2, 4-5 m, 2v; S4, 4-30 m, 2pv, 1 v. – Stn S10, 6-14 m, 1pv, 3 v. – Stn S12, 6-8 m, 3 pv.

DISTRIBUTION — Philippines, Japan, Korea, China, Thailand. Recorded from intertidal rubble and rock habitats at Kungkraben Bay, Thailand (Meyer *et al*. 2008) and Hong Kong (pers. obs.).

DESCRIPTION — Shell small L to 9.8, H to 10.1, T 2.7, higher than long, posterior truncated, anterior rounded. Dorsal areas undefined. Exterior yellowish white, interior creamy white. Sculpture of *ca.* 45 low radial ribs that bifurcate and intercalate with narrow interspaces, but more widely spaced to anterior and posterior. Ribs crossed by low commarginal lamellae. Major increments prominent. Microsculpture network of irregular pits (Figure 36G). Lunule lanceolate, strongly asymmetric, most in right valve. Protoconch (Figure 36H): PI + PII 140 µm, PI 98 µm. PII with prominent increments. Ligament short, robust, deeply inset. Hinge: RV with two cardinals, posterior is larger, and strong anterior and posterior lateral teeth; LV with two cardinals, anterior is larger, with anterior and posterior laterals. Anterior adductor muscle scar medium length, detached for 1/2 of length at an angle of 20°, posterior adductor scar ovoid; pallial line entire. Shell inside and outside pallial line glossy, inner shell margin fluted.

REMARKS — Molecular results show that *Ctena delicatula* from Hong Kong and Thailand is distinct from *C. bella* (Conrad, 1837) from Panglao, Okinawa and Queensland (Taylor *et al.* 2011). *Ctena delicatula* is smaller than *C. bella*, higher than long, posteriorly truncated and usually with fewer, more closely spaced radial ribs. This species is associated with harder-substrate habitats compared to *C. bella* and the few specimens identified from Panglao are associated with reef caves or hard reef platforms with a thin covering of sediment.

Genus ***CODAKIA*** Scopoli, 1777

Codakia Scopoli, 1777: 398.

Type species. *Chama 'codak'* Scopoli, 1777, by monotypy, junior synonym of *Venus orbicularis* Linnaeus, 1758.

DIAGNOSIS — Shells medium to large, L to 150 mm, robust, discoidal, umbones low. Sculpture of numerous, fine to broad, low radial ribs crossed by fine commarginal lamellae. Dorsal areas barely demarcated. Lunule short, triangular to ovate, deeply incised. Ligament large, set in deep resilifer. Hinge: RV with two cardinal teeth and a large anterior lateral set close to cardinals, posterior lateral teeth indistinct or absent; LV with two cardinal teeth and anterior lateral. Anterior adductor scar long, detached for about 1/2 of length, pallial line entire, shell margin smooth. Shells white, often yellow internally, with margins white, rose-pink or yellow.

Codakia interrupta (Lamarck, 1818)

Figures 32C; 35G-M; 36I, J

Cytherea interrupta Lamarck, 1818: 574. Figured in Bruguière, 1797 *Tableau Encyclopédie Méthodique* pl. 279, figs 1a, 1b.
Cytherea interrupta – Chenu 1847, pl. 11, figs 1, 1a, b.
Codakia paytenorum (Iredale, 1937) – Poppe & Tagaro 2011: 140, pl. 1065, figs 1a, b.

TYPE MATERIAL — 1 syntype MHNG INVE 50347, pv (L 44.2).

TYPE LOCALITY — "Indian Ocean?".

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn D9, 2-4 m, 1 pv. – Stn M1, 0-1 m, 2 pv. – Stn M2, 0-2 m, 1 pv. – Stn M5, 0-2 m, 1 pv. – Stn M7, 0-3 m, 1 v. – Stn M19, 0-2 m, 1 v. – Stn M58, 0 m, 1 pv. – Stn R1, 5-7 m, 1 pv, 1 v. – Stn R10, 2-10 m, 1 pv. – Stn R16, 6-22 m, 1 pv. – Stn R20, 7-48 m, 1 v. – Stn R34, 1-12 m, 1 pv. – Stn R36, 3-32 m, 1 v. – Stn R38, 6-37 m, 1 pv. – Stn R50, 3-7 m, 1 pv.

DISTRIBUTION — Widespread in shallow reefal habitats in the IWP, from southern Japan to western Indian Ocean.

DESCRIPTION — Shell, subcircular, solid, L to 53.1, H to 50.0. Sculpture of low radial ribs with narrow interspaces crossed by fine, closely spaced commarginal lamellae. Radial ribs often obscure in central part of shell. Posterior dorsal area with fine, low scales. Growth halts prominent. Microsculpture of rows of shallow, semicircular pits (Figure 36I). Protoconch (Figure 36J): PI +PII 190 µm, PI smooth, PII a narrow rim with a few growth increments. Lunule small, short, deeply incised. Ligament large, in deep, wide resilifer. Hinge with two cardinal teeth and large anterior lateral teeth close to cardinals in both valves, posterior lateral teeth obscure. Anterior adductor scar short, detached from pallial line for 1/2 of length at angle of 32°. Shell margin smooth, pallial line entire. Shell interior pale to bright yellow, dorsal area often tinted pink, shell margins white.

REMARKS —*Codakia paytenorum* Iredale (1937) from the western Pacific (type locality Lord Howe Island) is often synonymised with *C. interrupta* and, although the two species are very similar in shell form, *C. interrupta* generally lacks the strong rose-coloured shell margin of *C. paytenorum* and has a shorter more widely detached anterior adductor scar. Molecular results suggest that the two species are distinct (Taylor *et al*. 2011). We are uncertain whether *C. paytenorum* occurs in the Philippines and, although it has been recorded there by Poppe & Tagaro (2011), we have not seen any specimens or figures with the distinctive rose-coloured inner margin.

FIGURE 35

Codakiinae. *Codakia* species — **A**-**C**, *Codakia punctata* (Linnaeus, 1758), exterior of left valves and interiors of right and left valves, PANGLAO 2004 stn R1. L 71.4 mm — **D**-**F**, *Codakia tigerina* (Linnaeus, 1758), exterior of left valve and interiors of right and left valves, PANGLAO 2004 stn M19. L 61.1 mm — **G**-**J**, *Codakia interrupta* (Lamarck, 1818); **G**-**I**, exterior of left valve and interiors of right and left valves, PANGLAO 2004 stn M2 L 35.9 mm; **J**, exterior of left valve, PANGLAO 2004 stn M58. L 53.3 mm — **K**-**M**, *Cytherea interrupta* Lamarck, 1818, holotype MHNG INVE 50347, exterior of right valve and interiors of right and left valves, Indian Ocean. L 44.2 mm.

Codakia punctata (Linnaeus, 1758)

Figures 32D, 35A-C

Venus punctata Linnaeus, 1758: 688.
Not *Codakia punctata* – Poppe & Tagaro 2011: 140, pl. 1065, figs 3a, b; this is *C. tigerina* (Linnaeus, 1758).

TYPE MATERIAL — Syntypes UUZM nos. 433, 1081.

TYPE LOCALITY — Indian Ocean.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn R1, 5-7 m, 1 pv. – Stn R23, 1-5 m, 1 v.

DISTRIBUTION — Widely distributed across the IWP from western Indian Ocean to SW Pacific.

DESCRIPTION — A well-known species with broad, low, radial ribs and rose-coloured inner margin.

Codakia tigerina (Linnaeus, 1758)

Figures 32E; 35D-F; 36K, L

Venus tigerina Linnaeus, 1758: 688.
Lucina (Codakia) tumida Preston, 1906: 73, fig. 7.
Codakia punctata – Poppe & Tagaro 2011: 140, pl. 1065, figs 3a, b.
Codakia tigerina – Poppe & Tagaro 2011: 142, pl. 1066, figs 1-3.

TYPE MATERIAL — *Venus tigerina*: 5 syntypes LSL 114. — *Lucina tumida:* type not located.

TYPE LOCALITY — *V. tigerina*: Indian Ocean. — *L. tumida*: Luzon, Philippines.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn B28, 25 m, 1 v. – Stn D1, 2 m, 1 v; D6, 3 m, 2 v. – Stn M1, 0-1 m, 1 pv, 3 v. – Stn M2, 0-2 m, 5 pv, 1 v. – Stn M3, 0-2 m, 2 pv. – Stn M5, 0-2 m, 3 pv. – Stn M6, 0 m, 1 pv. – Stn M7, 0-3 m, 2 v. – Stn M9, 0.5 m, 1 v. – Stn M18, 0-1 m, 3 pv. – Stn M19, 0-2 m, 2 pv, 3 v. – Stn M51, 0 m, 1 pv. – Stn R3, 5-24 m, 1 pv. – Stn R23, 1-5 m, 1 pv. – Stn R34, 1-12 m, 1 pv. – Stn R50, 3-7 m, 1 pv. – Stn S14, 5-12 m, 1 v. – Stn S17, 6 m, 1 v. – Stn S22, 15-20 m, 1 v. – Stn S23, 2 m, 3 v.

DISTRIBUTION — Widely distributed across the IWP from the Red Sea and eastern Africa to the Tuamotus.

DESCRIPTION — A large (largest Panglao specimen stn M3 - L 94.0, H 85.0), well-known species with a decussate sculpture of many thin radial ribs crossed by rounded commarginal lamellae. Microsculpture of rows of subcircular pits (Figure 36K). Protoconch (Figure 36L): PI +PII 189 µm, PI smooth 155 µm, PII with prominent growth increments.

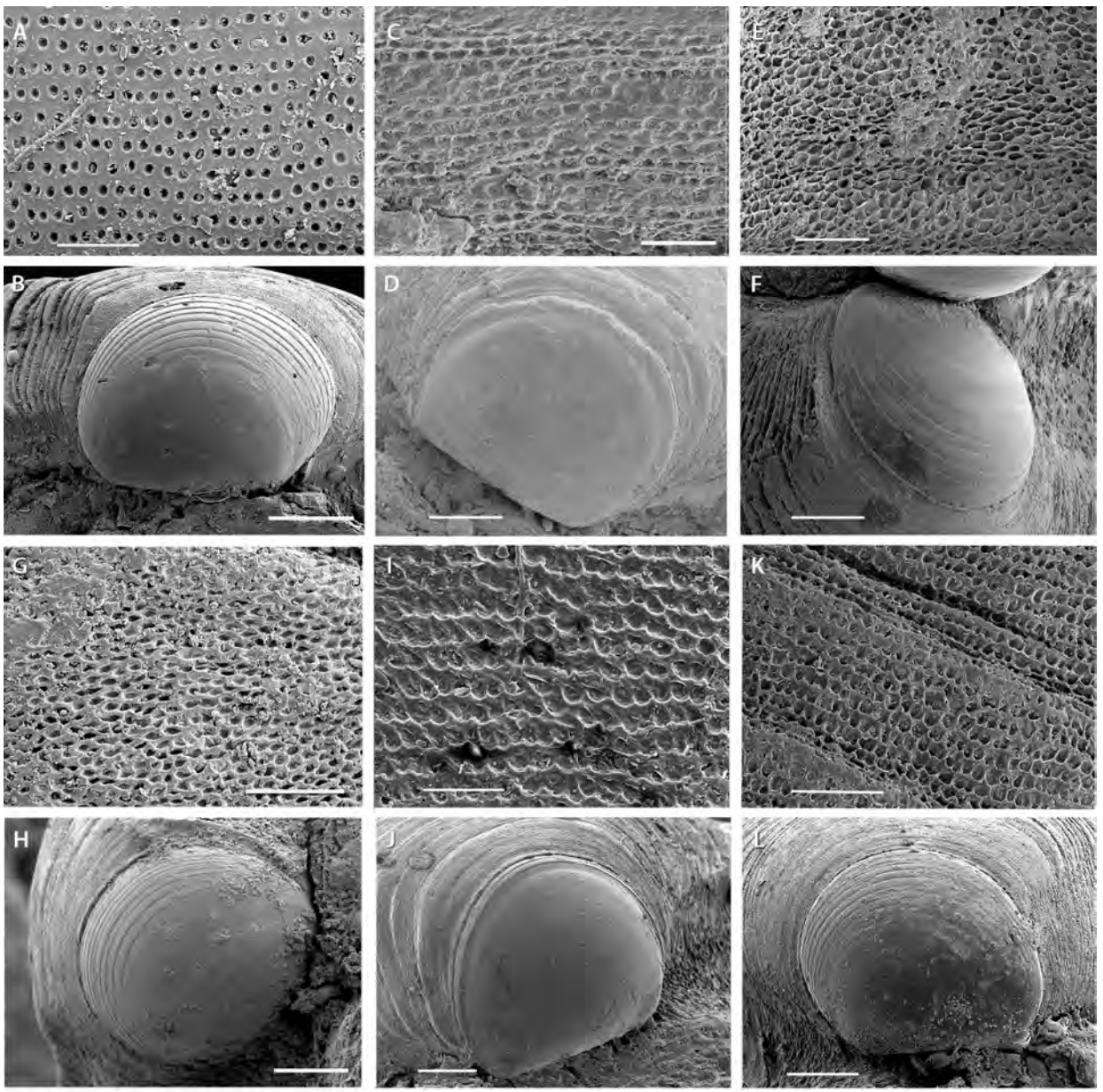


FIGURE 36

Microsculpture and protoconchs of Codakiinae — **A**, *Epicodakia sweeti*, microsculpture, PANGLAO 2004 stn S14. Scale bar =10 µm; **B**, protoconch, PANGLAO 2004 stn S14. Scale bar = 50 µm — **C**, *Epicodakia izuensis*, microsculpture, AURORA 2007 stn DW2670. Scale bar =10 µm; **D**, protoconch, AURORA 2007 stn DW2670. Scale bar =50 µm — **E**, *Ctena bella*, microsculpture, PANGLAO 2004 stn S22. Scale bar = 20 µm; **F**, protoconch, PANGLAO 2004 stn S22. Scale bar = 50 µm — **G**, *Ctena delicatula*, microsculpture, PANGLAO 2004 stn B26. Scale bar = 20 µm; **H**, protoconch, PANGLAO 2004 stn S12. Scale bar = 50 µm — **I**, *Codakia interrupta*, microsculpture, PANGLAO 2004 stn R16. Scale bar =10 µm; **J**, protoconch, PANGLAO 2004 stn R16. Scale bar = 50 µm — **K**, *Codakia tigerina*, microsculpture, PANGLAO 2004 stn D6. Scale bar = 20 µm; **L**, protoconch, PANGLAO 2004 stn D6. Scale bar = 50 µm.

Subfamily LUCININAE Fleming, 1828

This is the largest and most diverse of the lucinid subfamilies recently redefined from the classification of Chavan (1969) by molecular analyses (Taylor *et al.* 2011). It includes over 42 morphologically disparate, Recent genera, the majority of these from tropical, shallow water habitats but with some deeper water representatives such as *Bathyaustriella*, *Troendleina* spp. and *Cardiolucina quadrata*.

Genus ***FUNAFUTIA*** Glover & Taylor, 2001

Funafutia Glover & Taylor, 2001: 265, 286.

Type species. *Lucina levukana* E. A. Smith, 1885 by original designation.

DIAGNOSIS — Small, H to 6 mm, ovate, inflated, anteriorly extended, umbones high. Colour white, yellow or pink. Sculpture of prominent commarginal lamellae with finely striated interspaces. Microsculpture rows of close, fine punctae. Lunule lanceolate, impressed. Ligament internal, short, triangular. Two cardinal teeth in left valve, one in right valve, anterior and posterior lateral teeth in both valves. Anterior adductor muscle scar short and rounded, slightly detached from pallial line. Pallial line discontinuous. Shell margin finely crenulate.

REMARKS — Because of the short internal ligament we initially placed *Funafutia* near *Pillucina*, *Chavania* and *Wallucina* (Glover & Taylor 2001) although other shell characters such as external sculpture and hinge teeth were not shared. Molecular evidence from a specimen of *F. levukana* (E. A. Smith, 1885) from the Philippines indicates that there is no close relationship; *Funafutia* forms a basal branch of the subfamily Lucininae (Taylor *et al.* 2011).

Funafutia levukana (E. A. Smith, 1885)

Figures 37A-H; 38A

Lucina levukana E. A. Smith, 1885: 181, pl. 13, fig. 6.
Lucina (Codakia) oblonga Hedley, 1899: 497, fig. 51.
Funafutia levukana – Glover & Taylor 2001: 286, figs 22a-d; 2007: 166, figs 37a-f.

TYPE MATERIAL — *Lucina levukana*: 2 syntypes, decayed, NHMUK 1887.2.9.2778. — *Lucina oblonga*: 2 syntypes AM C.6157.

TYPE LOCALITY — *L. levukana*: Fiji, Levuka. — *L. oblonga*: Tuvalu, Funafuti.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn B1, 8-14 m, 6 v. – Stn B2, 5 m, 6 v. – Stn B3, 8 m, 2 v. – Stn B4, 24 m, 4 v. – Stn B5, 4 m, 1 pv. – Stn B6, 12-14 m, 1 pv, 3 v. – Stn B7 4-30 m, 7 pv, 16 v. – Stn B8, 3 m 1 pv, 1 v. – Stn B9, 8-10 m, 1 pv, 1 v. – Stn B10, 3-14 m, 3 pv, 16 v. – Stn B12, 24-27 m, 1 pv, 5 v. – Stn B13, 3-5 m, 1 pv, 10 v. – Stn B15, 2-4 m, 2 pv. – Stn B16, 20 m, 3 v. – Stn B17, 3-21 m, 1pv. – Stn B19, 17 m, 1 v. – Stn B20, 2-8 m, 3 v. – Stn B21, 20-21 m, 1 pv. – Stn B23, 20-25 m, 2 v. – Stn B28, 25 m, 3 pv. – Stn B29, 26 m, 1 pv, 1 v. – Stn B30, 25 m, 1 v. – Stn B36, 24 m, 2 pv, 3 v. – Stn B38, 17-18 m, 1 pv, 5 v. – Stn B39, 17-25 m, 7 pv, 7 v. – Stn B41, 17-19 m, 1 pv, 6 v. – Stn D1, 2 m, 1pv. – Stn L41, 90-100 m, 1 pv. – Stn L48, 100 m, 2 v. – Stn L74-75, 120-139 m, 1 v. – Stn S1, 5 m, 7pv, 8v. – Stn S2, 4-5 m, 2 pv, 7v. – Stn S3, 6 m, 4 pv, 3 v. – Stn S4,

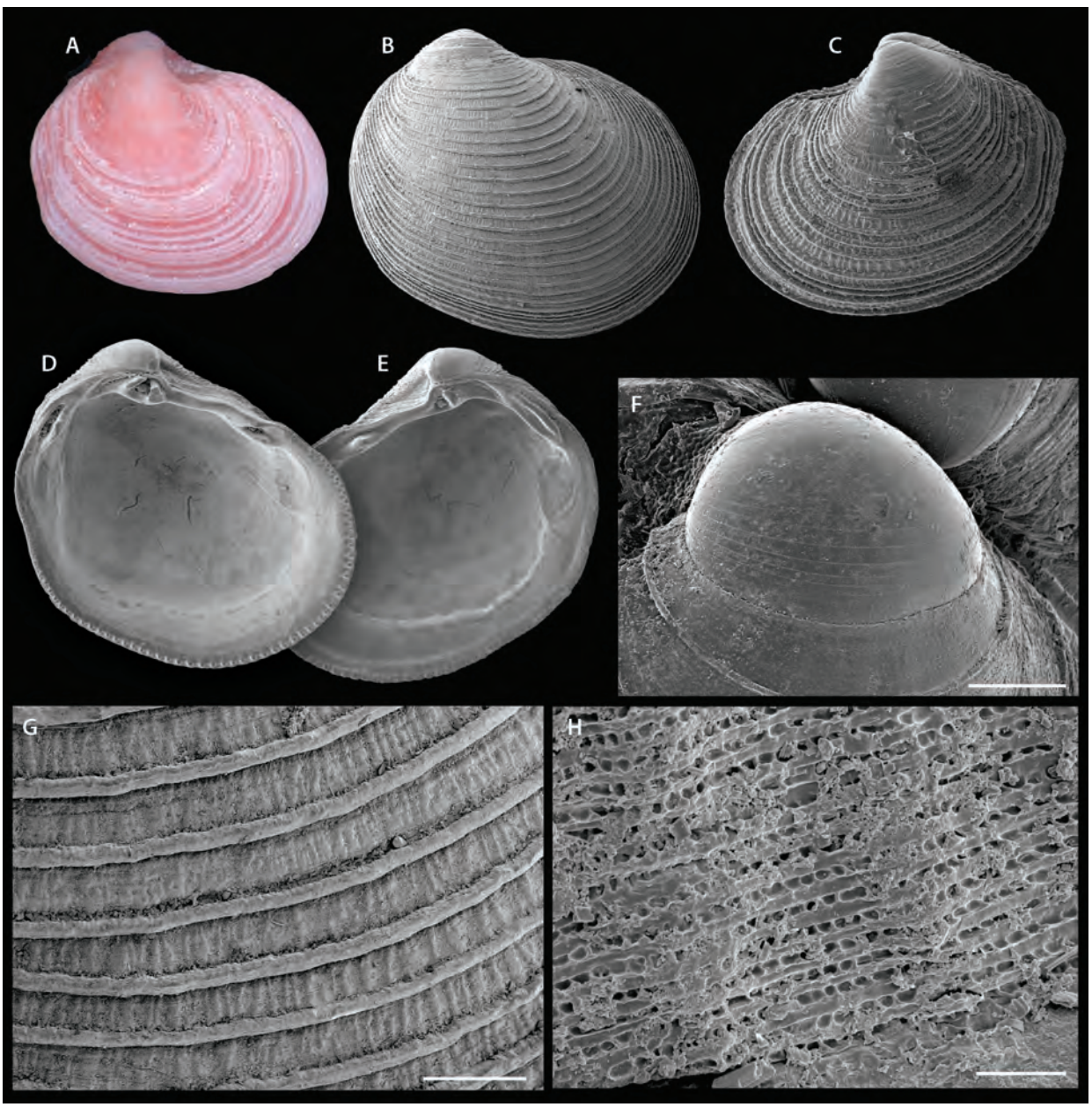


FIGURE 37

Funafutia levukana (Smith, 1885). (Figured specimens except **A**, from PANGLAO 2004 stn S14) — **A**, exterior of right valve, PANGLAO 2005 stn B7. L 4.0 mm; **B**, exterior of right valve. L 3.5 mm; **C**, juvenile, exterior of left valve. L 1.3 mm; **D**, **E**, interior of left and right valves. L (**D**) 3.0 mm, L (**E**) 3.2 mm; **F**, protoconch. Scale bar = 50 µm; **G**, detail of external sculpture. Scale bar = 200 µm; **H**, microsculpture. Scale bar = 10 µm.

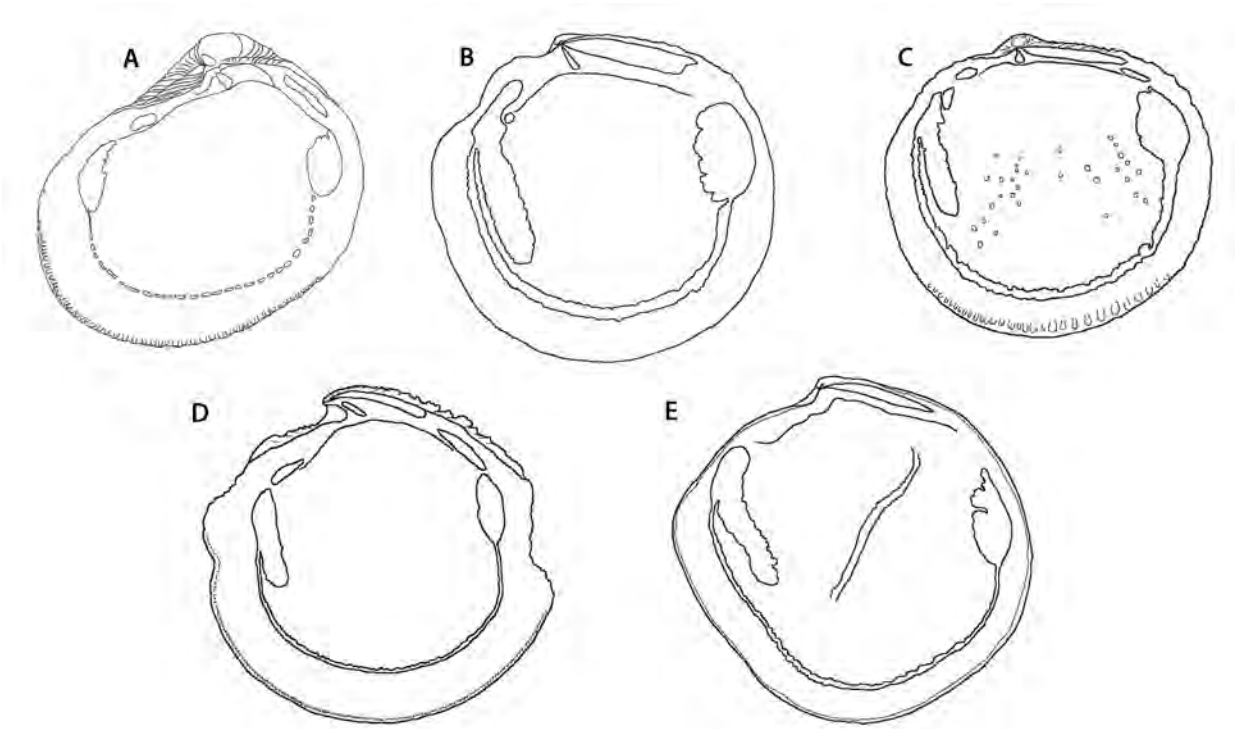


FIGURE 38

Outline drawings of shell interiors of *Funafutia*, *Discolucina*, *Lepidolucina, Lamellolucina* and *Megaxinus*. Not to scale. **A**, *Funafutia levukana*; **B**, *Discolucina virginea* (specimen from New Caledonia); **C**, *Lepidolucina venusta*; **D**, *Lamellolucina gemma*; **E**, *Megaxinus quadrangularis*.

4-30 m, 2 pv, 4 v. – Stn S5, 2-4 m, 8 pv, 8 v. – Stn S7, 1-4 m, 5 pv, 10 v. – Stn S10, 6-14 m, 1 pv, 1 v. – Stn S12, 6-8 m, 15 pv, 7 v. – Stn S13, 8-15 m, 5 pv, 4 v. – Stn S14, 5-12 m, 8 pv, 30 v. – Stn S17, 6 m, 2 pv, 4 v. – Stn S21, 4-12 m, 3 v. – Stn S24, 2-4 m, 3 pv, 4 v. – Stn S25, 21 m, 4 v. – Stn S27, 28-32 m, 5 pv, 27 v. – Stn S28, 28-32 m, 1 pv, 6 v. – Stn S29, 32 m, 1 pv, 1 v. – Stn S32, 2-3 m, 3 pv,15 v. – Stn S46, 14 m, 2 v. – PANGLAO 2005: stn DW2401, 397-410 m, 7 v (allochthonous).

DISTRIBUTION — From shallow subtidal reef and reef margins to 30 m, widespread across the IWP to Easter Island (Raines & Huber 2012).

DESCRIPTION — As for genus; H to 6.0. Microsculpture of rows of fine punctae (Figure 37H). Protoconch (Figure 37F): PI + PII 162 µm, PI smooth, 98 µm, PII with many growth increments.

Genus ***DISCOLUCINA*** Glover &Taylor, 2007

Discolucina Glover &Taylor, 2007: 146.

Type species. *Lucina virginea* Deshayes, 1832, by original designation.

DIAGNOSIS — Shell medium-large, discoidal, not inflated, with projecting, arcuate, anterior dorsal area. Sculpture of low, sharp, commarginal lamellae, radial sculpture absent. Ligament large, set in a deep groove. Hinge with obscure cardinal teeth in both valves, anterior lateral tooth short, close to cardinal tooth; anterior adductor scar long, with dorsal portion extended onto the hinge line above the lateral tooth, detached ventral part lies close to pallial line.

REMARKS — There are two described species: *D. virginea* (Deshayes, 1832), the type species from Indonesia, and *D. solomonensis* Cosel & Bouchet, 2008 from the Solomon Islands.

Discolucina virginea (Deshayes, 1832)

Figures 38B; 39A

Lucina virginea Deshayes, 1832: 379.
Lucina argentea Reeve, 1850: pl. 2, fig. 6.
Discolucina virginea – Glover & Taylor 2007: 146, figs 23B, 24A-D (with synonymy and further details). — Poppe & Tagaro 2011: 150 pl. 1070, fig. 1a, b.

TYPE MATERIAL — *Lucina virginea*: holotype MNHN IM-2000-20815, pv (L 46.9, H 43.6). — *Lucina argentea*: 3 syntypes NHMUK 1963113-4.

TYPE LOCALITY — *L. virginea*: Indonesia, Amboina. — *L. argentea*: Moluccas.

OTHER MATERIAL EXAMINED — Philippines. Panglao 2004: stn D13, 2-3 m, 1 pv. – Mindoro, Calapan, 5 pv (maximum H 44.8), MCZ.

DISTRIBUTION — Philippines, Indonesia to New Caledonia in shallow water.

DESCRIPTION — As for genus; H to 45 mm.

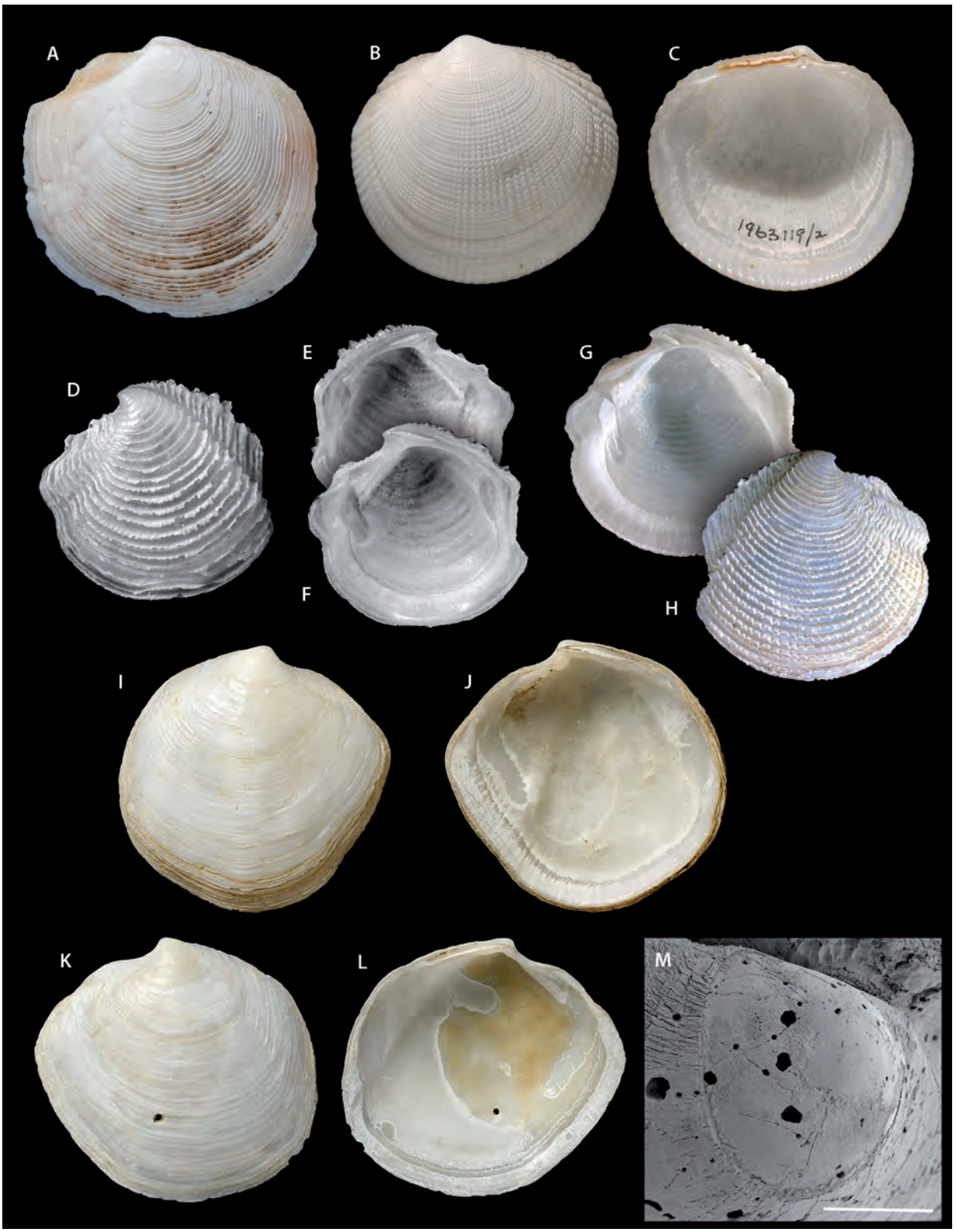
REMARKS — The single, live-collected specimen was sequenced and is supported as sister to *Lepidolucina venusta* (Philippi, 1847) (Taylor *et al.* 2011). Poppe & Tagaro (2011) give the erroneous impression that the holotype came from the Philippines at a depth of 840-855 m whereas this species, although uncommon, lives in shallow water.

Genus ***LEPIDOLUCINA*** Glover & Taylor, 2007

Lepidolucina Glover & Taylor, 2007: 142.

Type species. *Lucina venusta* Philippi, 1847, by original designation.

DIAGNOSIS — Shell small, subcircular, inflated, with 50-60 closely spaced ribs that bear low, arcuate scales directed dorsally along the length of the rib. Hinge narrow with small cardinal teeth and small anterior and posterior lateral teeth. Anterior adductor muscle scar long and detached for 3/4 of length. Internal shell margin serrate with fine denticulations.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REMARKS — Three species are known, all with the distinctive sculpture of fine, dorsally inclined scales: *L. venusta*, central IWP, *L. belepiana* Glover & Taylor, 2007 from New Caledonia and *L. odontotis* (Salisbury, 1934) from Sarawak and Thailand.

Lepidolucina venusta (Philippi, 1847)

Figures 38C; 39B, C

Lucina venusta Philippi, 1847: 206, pl. 1, fig. 2.
Lucina venusta – Reeve 1850: pl. 3, fig. 15.
Lepidolucina venusta – Glover & Taylor 2007: 142, figs 21A, B, E, H (with full synonymy)

TYPE MATERIAL — Not located.

TYPE LOCALITY — Not known.

MATERIAL EXAMINED — Philippines. AURORA 2007: stn CP2711, 184-200 m, 2 v. – Stn DW2726, 327-339 m, 1v. – Stn CP2741, 194-203 m, 1 v. – Luzon, Manila, NHMUK 1969119/2, 3 pv.

DISTRIBUTION — Central IWP from Sri Lanka, northeast Australia to Philippines and southern China.

DESCRIPTION — See generic characters above and Glover & Taylor (2007) for full description.

REMARKS — The specimens from AURORA 2007 are all small, eroded single valves and we suspect that they are derived from shallower water. The specimen illustrated here (Figures 39B, C) is that figured by Reeve (1850: pl. 3, fig. 15) from Manila.

Genus ***LAMELLOLUCINA*** Taylor & Glover, 2002

Lamellolucina Taylor & Glover, 2002: 319.

Type species. *Lamellolucina pilbara* Taylor & Glover, 2002, by original designation.

DIAGNOSIS — Subcircular with prominent, thin, sometimes serrated, regularly spaced commarginal lamellae. Anterior and posterior dorsal areas often with flared lamellae and defined by deeply incised sulci. Hinge robust with one or two cardinal teeth and prominent elongate lateral teeth in both valves. Anterior adductor scar short, detached for 1/2 to 1/3 of length. Inner shell margin finely beaded.

REMARKS — Six species are known in the IWP and one in the eastern Atlantic (Taylor & Glover 2002).

FIGURE 39

Discolucina, *Lepidolucina*, *Lamellolucina* and *Megaxinus* — **A**, *Discolucina virginea* (Deshayes, 1832), exterior of left valve, PANGLAO 2004 stn D13. L 34.0 mm — **B**, **C**, *Lepidolucina venusta* (Philippi, 1847), exterior and interior of left valve, Luzon, Philippines (NHMUK 1969119/2). L 33.6 mm — **D**-**H**, *Lamellolucina gemma* (Reeve, 1850); **D**-**F**, *Lucina gemma* Reeve, 1850, syntype NHMUK 1963175, exterior of left valve and interior of left and right valves, Bohol Island, Philippines. L 8.6 mm; **G**, **H**, exterior and interior of right valve, MUSORSTOM 3 stn DR140. L 13.3 mm — **I**-**M**, *Megaxinus quadrangularis* Cosel & Bouchet, 2008, PANGLAO 2005 stn CP2348; **I**, **J**, exterior and interior of right valve. L 30.8 mm; **K**, **L**, interior and exterior of left valve. L 32.1 mm; **M**, protoconch. Scale bar = 100 µm.

Lamellolucina gemma (Reeve, 1850)

Figures 38D; 39D-H

Lucina gemma Reeve, 1850: pl. 11, fig. 64.
Lucina gemma – Poppe & Tagaro 2011: 138, pl. 1064, figs 3, 4.
Lamellolucina gemma – Taylor & Glover 2002: 327, figs 5, 6e-i.

TYPE MATERIAL — 3 syntypes NHMUK 1963175.

TYPE LOCALITY — Philippines, Isle of Bohol.

OTHER MATERIAL EXAMINED — Philippines. MUSORSTOM 3: stn DR140, 93-99 m, 9 v.

DISTRIBUTION — China, Philippines, northern Australia.

DESCRIPTION — See Taylor & Glover (2002) for details. Shell small, L to 13.8, H to 13.5. Sculpture of 30 or more closely spaced, commarginal lamellae with finely serrated edges. Anterior dorsal area with two sulci. Lunule deeply impressed as a smooth, round pit.

REMARKS — No shells of this species were recorded during the PANGLAO 2004, 2005 or AURORA 2007 expeditions.

Genus ***MEGAXINUS*** Brugnone, 1880

Megaxinus Brugnone, 1880: 146.

Type species. *Lucina transversa* Bronn, 1831, by subsequent designation Pallary, 1904. See discussion in Glover & Taylor (1997: 7-8).

DIAGNOSIS — Small to medium size, ovate to subquadrate, compressed. Sculpture of irregular growth lines, undulations and irregular commarginal lamellae. Hinge either without teeth or with low, irregular lumps. Anterior adductor scar detached for about 2/3 of length. Periostracum thick. Shell interior with waxy texture. Inner shell margin smooth.

REMARKS — Originally known only from the Mediterranean and Eastern Atlantic, four species are now recognised from the IWP, three of these from the northwestern Indian Ocean (Glover & Taylor 1997) and *M. quadrangularis* Cosel & Bouchet, 2008 from southern India to the Philippines (see below).

Megaxinus quadrangularis Cosel & Bouchet, 2008

Figures 38E; 39I-M

Megaxinus quadrangularis Cosel & Bouchet 2008: 127, figs 8A-G, 9.
Megaxinus quadrangularis – Poppe & Tagaro 2011: 156, pl. 1073, figs 3a, b.

TYPE MATERIAL — Holotype MNHN IM-2000-20691, 6 paratypes MNHN IM-2000-20696.

TYPE LOCALITY — Philippines, west of Luzon, near Lubang Island, 14°00'N, 120°18'E, 190-198 m, mud with shell debris [MUSORSTOM 3: stn CP109].

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn P1, 90-200 m, 1v. – Stn T3, 150 m, 1 v. – Stn T31, 100-140 m, 1v. – PANGLAO 2005: stn CP2334, 128-142 m, 1 v. – Stn DW2339, 164-176 m, 1 v. – Stn CP2343, 273-356 m, 2 v. – Stn CP2348, 192-216 m, 40 v. – Stn CP2349, 219-240 m, 2 v. – Stn CP2409, 220-257 m, 17 v. **India**. Off Tuticorin, from 300-440 m, 3 shells NHMUK 20000926.

DISTRIBUTION — Northern and central Philippines to southern India, empty shells in 140-300 m.

DESCRIPTION — L to 35, H to 35, subovate to ovate, adults longer than high, younger shells less high, anterior extended and pointed, posterior margin narrowly rounded, sculpture of irregular commarginal growth lines and undulations. Protoconch (Figure 39M): PI + PII 193 µm, PII narrow rim with no growth lines visible. Lunule shallow, lanceolate, hinge edentulous with rounded irregular folds, ligament external in elongate groove. Anterior adductor muscle scar long, narrow, detached for 3/4 of length, diverging at angle of 25°, pallial blood vessel scar prominent ending posterior to adductor scar. Pallial line thick and continuous, inner shell margin smooth, shell inside pallial line irregularly thickened with exposed conchiolin layers.

REMARKS — *Megaxinus quadrangularis* is similar to *M. omanensis* E. A. Smith, 1906 from off Oman but differs in the more rostrate anterior margin although juvenile shells of both species have a similar outline.

Genus ***PILLUCINA*** Pilsbry, 1921

Pillucina Pilsbry, 1921: 382.

Type species. *Pillucina spaldingi* Pilsbry, 1921, by original designation (junior subjective synonym of *Lucina hawaiensis* E. A. Smith, 1885).

Synonym:
Sydlorina Iredale 1930: 390.

Type species. *Sydlorina sybolica* Iredale, 1930, by original designation.

DIAGNOSIS — Shells small, H to 14, inflated, sculpture of fine to broad radial ribs that often bifurcate, crossed by fine, low, commarginal lamellae; radial ribs usually more prominent on anterior and posterior shell. Hinge with two cardinal teeth in left valve and a single cardinal tooth in right valve. Posterior lateral tooth present in both valves (digitiform in two species), anterior lateral tooth present or absent. Ligament internal, located on short to elongate resilifer that widens to the posterior. Anterior adductor muscle scar short and detached from pallial line for about 1/4-1/2 of length, pallial line often discontinuous. Inner shell margin finely to coarsely crenulate. See Glover & Taylor (2001, 2007) for further details.

REMARKS — *Pillucina*, *Wallucina* and *Chavania* (see below) form a well-supported clade sister to *Loripes* in molecular analysis (Taylor *et al.* 2011) and are united by the presence of an internally inset ligament. From morphological evidence there are possibly four species groups within *Pillucina,* but their status needs to be confirmed by further molecular analysis:

*P. hawaiensis (*E. A. Smith, 1885) and *P. pacifica* Glover & Taylor, 2001;
P. australis Glover & Taylor, 2001, *P. pisidium (*Dunker, 1860*) P. neglecta* Habe, 1960, *P. copiosa* Glover & Taylor, 2007, *P. maestratii* n. sp., *P. profusa* n. sp.;
P. vietnamica Zorina, 1978 and *P. angela (*Melvill, 1899);
and *P. denticula* Glover & Taylor, 2001 and *P. pusilla* n. sp.

Pillucina maestratii n. sp.

Figures 40A-K; 41A

TYPE MATERIAL — Holotype MNHN IM-2000-26587, 58 paratypes MNHN IM-2000-26588, 18 NHMUK 20130662 (as listed below).

TYPE LOCALITY — Philippines, Bohol Island, Cortes, 9°43'N, 123°49'E, 123-135 m, mud [PANGLAO 2004: stn T26].

MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn T2, 152 m 2 v. – Stn T6, 34-82 m, 1 v. – Stn T9, 97-120 m, 1 v. – Stn T11, 78-95 m, 1 v. – Stn T14, 101-110 m, 1 v. – Stn T18, 80-100 m, 12 v. – Stn T26, 123-135 m, 1 rv, holotype MNHN IM-2000-26587 (H 2.1 L 2.0; Figure 40A); 1 lv (L 1.8, H 1.7; Figure 40B); 1 lv (L 1.9, H 1.8, Figure 40C); 1 rv (L 2.4, H 2.4; Figure 40D); 1 rv (L 1.9, H 1.8; Figure 40E); 1 lv (L 1.9, H 1.8; Figure 40F); 1 lv (L 2.3, H 2.4; Figure 40G); 1 rv (L 2.5, H 2.6; Figure 40H); 1 lv (L 2.2, H 2.3; Figure 40I); 50 v (unfigured), paratypes MNHN IM-2000-26588; 18 v, paratypes NHMUK 20130662. – Stn T28, 80 m, 2 v. – Stn T36, 95-128 m, 1 v. – PANGLAO 2005: stn DW 2400, 111-115 m, 4 v.

DISTRIBUTION — Central Philippines, 34-180 m with some deeper records possibly allochthonous.

DESCRIPTION — Shell very small, white, glossy L to 3.6, H to 3.7, subcircular to subovate, umbones prominent. Sculpture of radial ribs that are broader and stronger at anterior and posterior of shell and weak or absent in central shell. Ribs crossed by thin, regularly spaced commarginal lamellae that are stronger in central shell. Microsculpture of very fine growth lines only. Protoconch (Figure 40K): PI + PII 157 µm, PI smooth 93 µm, PII large with many prominent growth increments. Lunule short, lanceolate. Ligament short, internal. Hinge: RV with single cardinal tooth, strong posterior lateral and small anterior lateral; LV with two cardinal teeth, the anterior larger, posterior lateral tooth and anterior lateral tiny or absent. Anterior adductor muscle scar short, slightly detached from pallial line. Pallial line irregularly discontinuous. Inner shell margin denticulate, coarser at anterior and posterior.

REMARKS — *Pillucina maestratii* n. sp. differs from the larger shallow water species *P. profusa* n. sp. in its glossy, more circular shell, the absence of radial ribs in the central part of the shell, with an anterior lateral tooth and a stronger posterior lateral tooth in RV. The anterior adductor muscle is shorter and the inner shell margin is more coarsely denticulate. The protoconch of *P. maestratii* has a much larger PII with many regular growth increments compared to few in *P. profusa*.

ETYMOLOGY — Named for our colleague from MNHN, Philippe Maestrati.

Pillucina pacifica Glover & Taylor, 2001

Figures 41B; 42A-G

Pillucina pacifica Glover & Taylor, 2001: 266, figs 2a-g, 3.
Pillucina pacifica – Glover & Taylor 2007: 161, figs 33 a-c.

TYPE MATERIAL — Holotype AM C.355685.

TYPE LOCALITY — Australia, Queensland, Michaelmas Cay, 16°36'24"S, 145°58'26"E.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn B6, 12-14 m, 1 v. – Stn S3, 6 m, 4 pv, 5 v. – Stn S14, 5-12 m, 1 pv, 24 v. – Stn S16, 15-18 m, 1 v. – Stn S17, 6 m, 4 v. – Stn S21, 4-12 m, 1 v. – Stn S25, 21 m, 5 v.

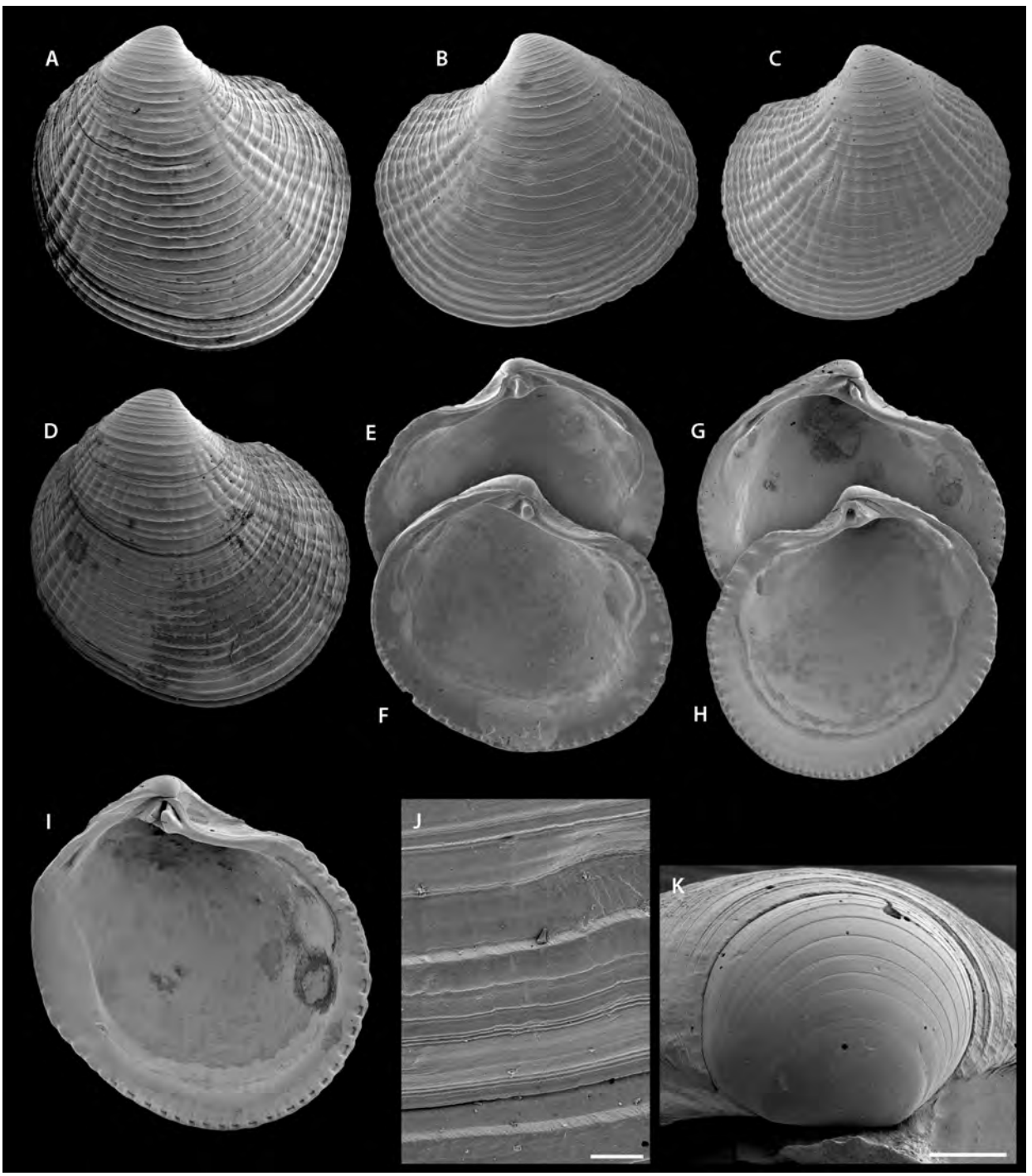


FIGURE 40

Pillucina maestratii n. sp. (All figured specimens from PANGLAO 2005 stn T26) — **A**, holotype MNHN IM-2000-26587, exterior of right valve. L 2.0 mm; **B**, paratype MNHN IM-2000-26588, exterior of left valve. L 1.8 mm; **C**, paratype MNHN IM-2000-26588, exterior of left valve. L 1.9 mm; **D**, paratype MNHN IM-2000-26588, exterior of right valve. L 2.4 mm; **E**, **F**, paratype MNHN IM-2000-26588, interiors of left and right valves. L 1.9 mm (both); **G**, **H**, paratype MNHN IM-2000-26588, interiors of left and right valves. **G** = L 2.3 mm, **H** = L 2.5 mm; **I**, paratype MNHN IM-2000-26588, interior of left valve. L 2.2 mm; **J**, detail of sculpture. Scale bar = 20 µm; **K**, protoconch. Scale bar = 50 µm.

DISTRIBUTION — Shallow water, especially reef habitats, of the west Pacific, uncommon in the Philippines.

DESCRIPTION — See Glover & Taylor (2001, 2007) for details. Shell small H to 8, inflated, obliquely ovoid, slightly higher than long. Sculpture of fine radial ribs (>50) that are slightly more prominent anteriorly and broader posteriorly, with thread-like, commarginal lamellae giving a reticulate ornament; sculpture less prominent in central part of shell. Protoconch (Figure 42G): PI +PII 163 µm, P1 79 µm, PII large, with regular growth increments. Lunule short, broad and slightly impressed. Hinge plate sinuous, with cardinal teeth located on downward projection. RV with single prominent cardinal tooth, a thin, posterior lateral tooth and a short anterior lateral. LV with two cardinal teeth of which the anterior is larger; posterior lateral tooth thin, anterior lateral indistinct. Ligament internal, short. Anterior adductor scar short, barely detached from pallial line. Pallial line discontinuous in short blocks. Shell margin finely crenulate.

REMARKS — *Pillucina pacifica* n. sp. is similar to *P. hawaiensis* (E. A. Smith, 1885), a species endemic to the Hawaiian Islands, but can be distinguished by its coarser ribbing, marginal denticulations and a more prominent anterior lateral tooth.

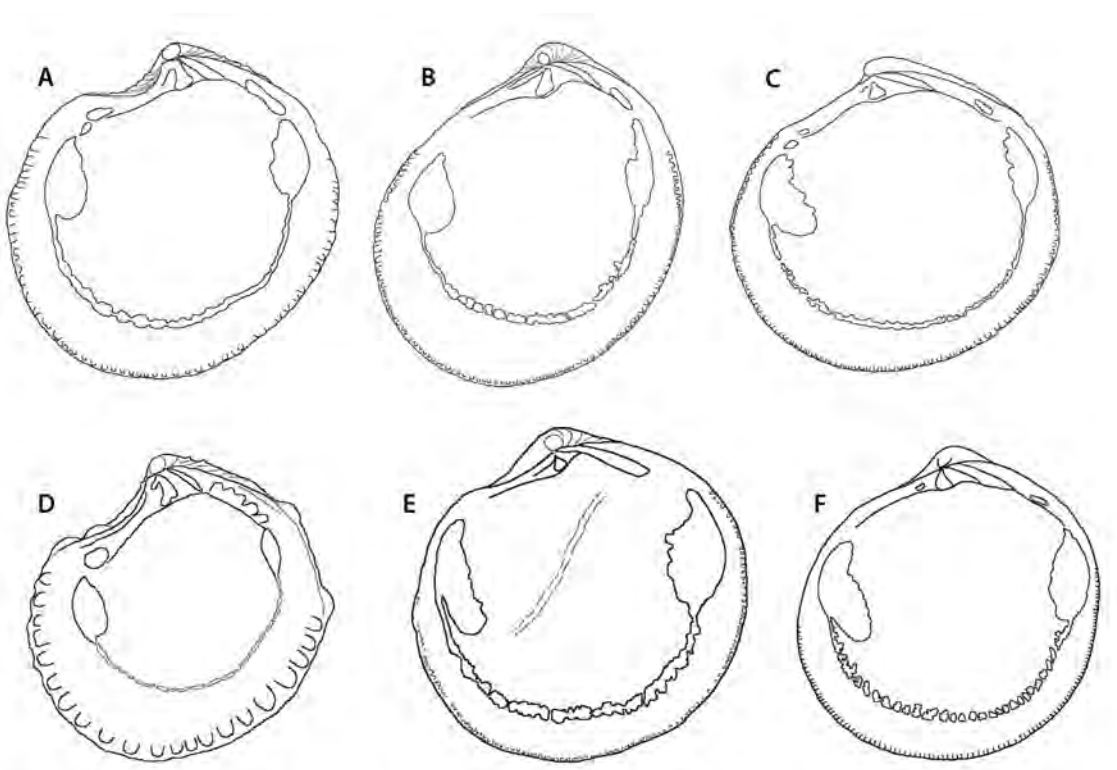


FIGURE 41

Pillucina species, outline drawings of shell interiors. Not to scale. **A**, *Pillucina maestratii*; **B**, *Pillucina pacifica*; **C**, *Pillucina profusa*; **D**, *Pillucina pusilla*; **E**, *Wallucina fijiensis*; **F**, *Chavania striata*.

Pillucina profusa n. sp.

Figures 41C; 43A-P

Not *Epicodakia transversa* (Dall, Bartsch & Rehder, 1938) – Poppe & Tagaro 2011: 146, pl. 1068, figs 8, 9.

TYPE MATERIAL — Holotype MNHN IM-2000-26589, 4 paratypes MNHN IM-2000-26590, 10 NHMUK 20130663 (as listed below).

TYPE LOCALITY — Philippines, Panglao Island, Tagbilaran Channel, 9°38'N, 123°51.4'E, 2-3m sand [PANGLAO 2004: stn D13].

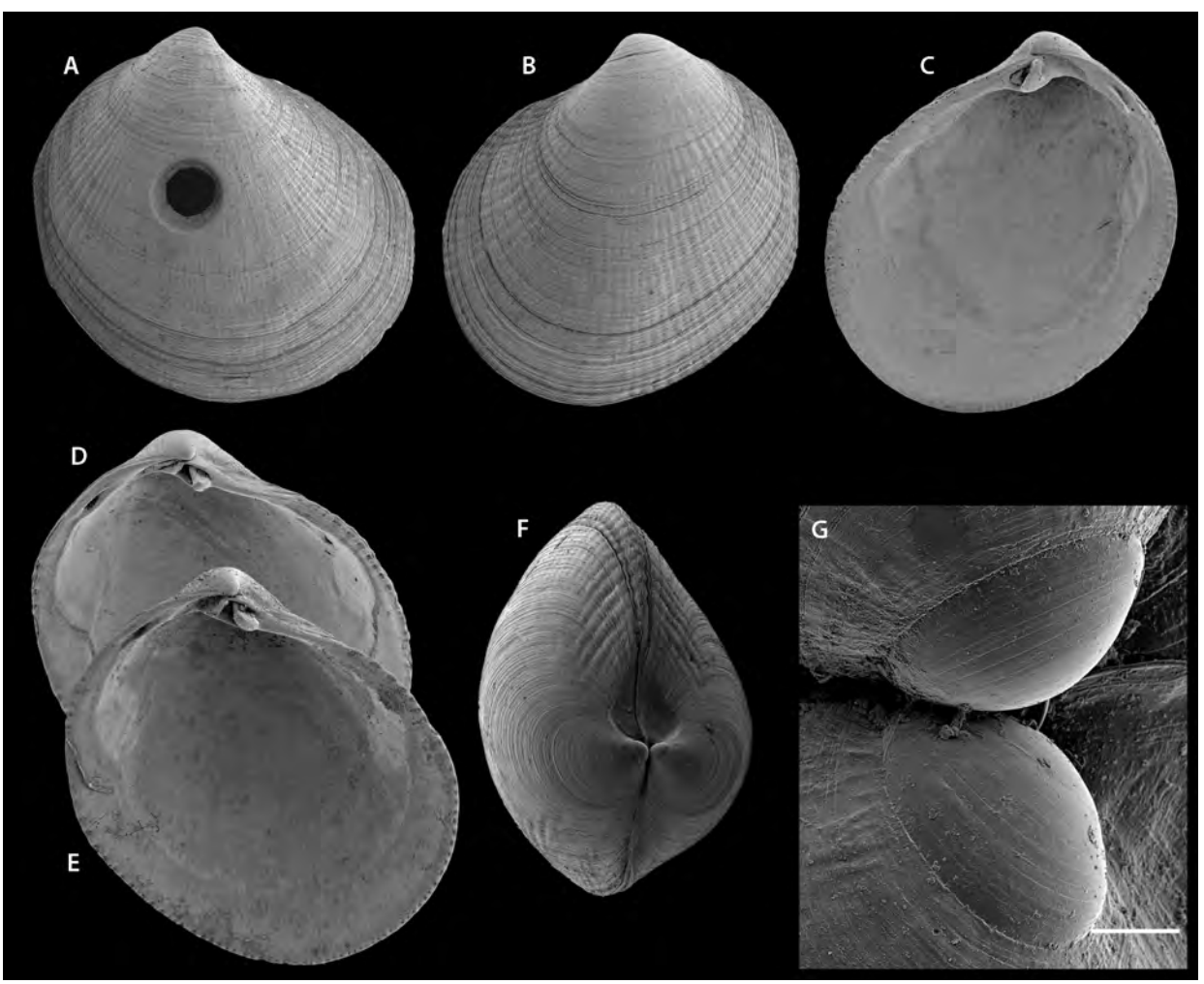
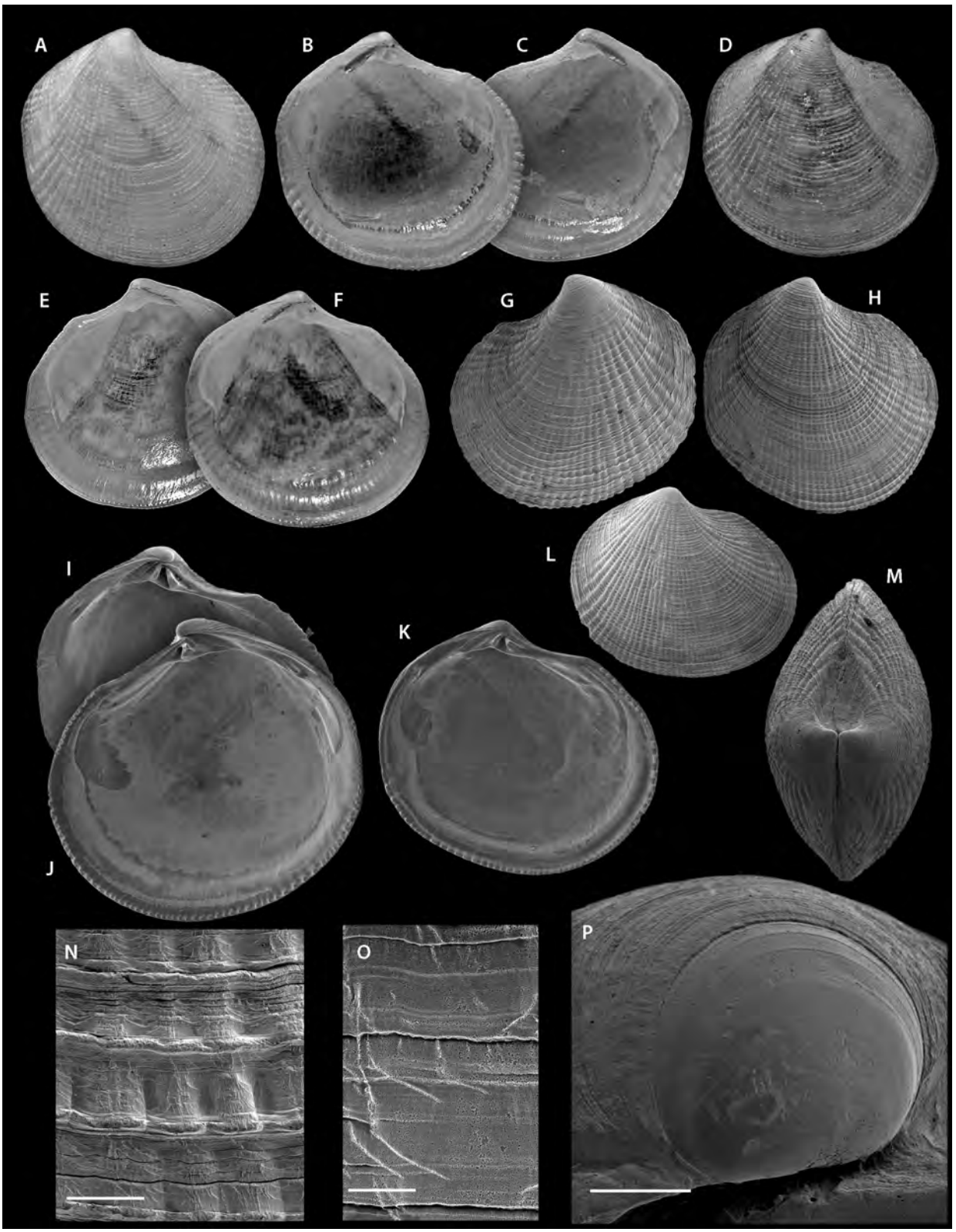


FIGURE 42

Pillucina pacifica Glover & Taylor, 2001. (All figured specimens from PANGLAO 2004 stn S14) — **A**, exterior of right valve. L 4.8 mm; **B**, exterior of left valve. L 3.6 mm; **C**, interior of right valve. L 4.1 mm; **D**, **E**, interior of two left valves. L (**D**) 3.9 mm, L (**E**) 3.8 mm; **F**, dorsal view of shell. L 2.7 mm; **G**, protoconchs of F. Scale bar = 50 µm.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MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn B1, 8-14 m, 1 v. – Stn B3, 8 m, 1 v. – Stn B5, 4 m, 1 v. – Stn B7, 4-30 m, 1 v. – Stn B8, 3 m, 2 v. – Stn B11, 2-4 m, 1 v. – Stn B14, 2-4 m, 14 v. – Stn B18, 3-5 m, 2 pv, 39 v. – Stn B20, 2-8 m, 1 v. – Stn B31, 1-2 m, 1 pv, 8 v. – Stn B34, 1-2 m, 3 pv, 14 v. – Stn B41,17-19 m 4 v. – Stn D1, 2 m, 10 pv, 400 v. – Stn D4, 0-2 m, 12 pv, 122 v. – Stn D5, 0-3 m, 36 pv, 606 v. – Stn D7, 2-3 m, 6 pv, 90 v. – Stn D8 1-4 m, 1 v. – Stn D12, 2-4 m, 6 pv, 350 v. – Stn D13, 2-3 m, 1 pv, holotype MNHN IM-2000-26589 (L 4.5, H 4.1,T 1.4); 1 pv (L 4.7, H 4.5, T 1.4; Figures 43D-F), 3 pv, paratypes MNHN IM-2000-26590 (L 4.7, H 4.0; L 4.8, H 4.5; L 3.8, H 3.6; unfigured); 10 v paratype NHMUK 20130663; 30 pv, 260 v. – Stn M3, 0-2.5 m, 5 pv,7 v. – Stn M9 , 0.5 m, 5 v. – Stn M10, 0-3 m, 9 pv, 49 v. – Stn M26, 0-2 m, 1 v. – Stn M47, 0-0.5 m, 50 pv. – Stn M51, 0 m, 4 pv, 4 v. – Stn M52, 0-1m, 2v. – Stn R23, 1-5 m, 2 v. – Stn R67, 3-3.5 m, 2 v. – Stn S1, 5 m, 5 v. – Stn S4, 4-30 m, 2 v. – Stn S6, 1-4 m, 22 v. – Stn S7, 1-4 m, 1 v. – Stn S8, 28-32 m, 4 v. – Stn S9, 3 m, 11 pv, 551 v. – Stn S11, 2 m, 54 pv, 1579 v. – Stn S13, 8-15 m, 2 pv, 2 v. – Stn S19 3-4 m, 2 pv, 4 v. – Stn S22, 15-20 m, 1 pv, 44 v. – Stn S23, 2 m, 4 v. – Stn S25, 21 m, 1 pv, 14 v. – Stn S28, 28-32 m, 1 v. – Stn S34, 2 m, 57 pv, 75 v. – Stn S38, 3-4 m, 7 pv, 15 v. – Stn S39, 3-4 m, 35 pv, 150 v. – Stn S 51, 2m, 10 v. – Stn S53, 2m, 2 v. – Stn T4, 82 m, 1 v. – Stn T5, 84-87 m, 1 v. – Stn T10, 117-124 m, 1 v. – Stn T34, 145-163 m, 1 v.

DISTRIBUTION — Philippines, predominantly intertidal in sand to 20 m, by far the most abundant lucinid in PANGLAO 2004 samples; deeper records cited above are likely allochthonous.

DESCRIPTION — Small, L to 6.1, H to 6.0, white, ovoid, higher than long, umbones prominent. Sculpture of 60-70 bifurcating radial ribs, broader at anterior and posterior, narrower and finer in central parts of shell. Radial ribs crossed by fine, thin, commarginal lamellae, central shell finely reticulate. Microsculpture of fine growth lines only (Figure 43O). Protoconch (Figure 43P): PI + PII 140 µm, PI smooth 125 µm, PII narrow with a few growth increments. Lunule heart-shaped, asymmetrical, larger in LV. Ligament short, internal. Hinge: RV with a single cardinal tooth, a small posterior lateral and a poorly defined anterior lateral; LV with two small cardinals, a small posterior lateral and no anterior lateral. Anterior adductor scar short, detached for 1/2 of length at angle of 50°. Pallial line irregularly discontinuous. Inner shell margin finely denticulate.

REMARKS — Glover & Taylor (2001) previously considered *Pillucina pisidium* (Dunker, 1860) (type locality Dejima, Nagasaki City, Japan) a wide-ranging species across the tropical IWP, but it is apparent from study of larger samples and evidence from limited molecular data that there is likely a complex of similar species. In morphology, *Pillucina profusa* n. sp. can be distinguished from Japanese *P. pisidium* by smaller adult size, lower umbones, less inflated shell, less prominent posterior lateral tooth, sculpture of finer radial ribs and finer marginal denticles, thickened shell under the anterior adductor scar and a pallial line that tends to be less divided. *Pillucina copiosa* Glover & Taylor, 2007 from intertidal to shallow shelf depths in New Caledonia has fewer radial ribs, 40-48 compared with 60-70 of *P. profusa*.

ETYMOLOGY — Latin *profusa*, abundant, a reference to the numerous specimens from shallow water around Panglao.

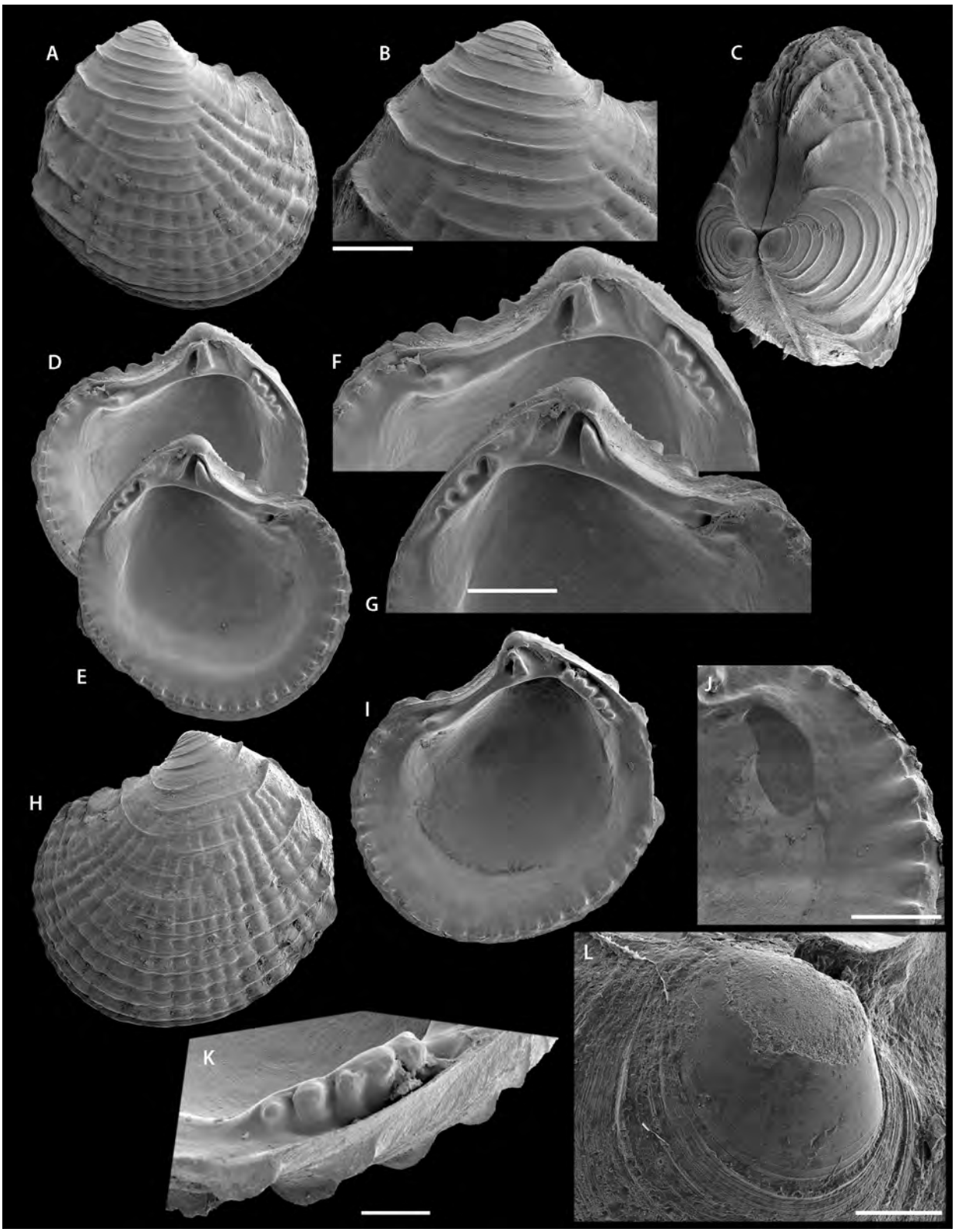
Pillucina pusilla n. sp.

Figures 41D; 44A-L

TYPE MATERIAL — Holotype MNHN IM-2000-26591, 6 paratypes MNHN IM-2000-26592, IM-2009-10362 (as listed below).

FIGURE 43

Pillucina profusa n. sp. (All figured material from PANGLAO 2004 stations) — **A**-**C**, holotype MNHN IM-2000-26589, exterior of right valve and interior of left and right valves, stn D13. L 4.5 mm; **D**-**F**, paratype MNHN IM-2000-26590, exterior of right valve and interior of right and left valves, stn D13. L 4.7 mm; **G**, exterior of left valve, stn S34. L 4.1 mm; **H**, exterior of right valve, stn S34. L 3.6 mm; **I**, **J**, interior of left valve, stn S34. L 3.0 mm; right valve stn D7. L 4.4 mm; **K**, interior of left valve, stn D7. L 4.5 mm; **L**, juvenile, exterior of right valve, stn D7. L 4.5 mm; **M**, dorsal view, stn D7. L 3.4 mm; **N**, detail of sculpture, stn S34. Scale bar = 100 µm; **O**, microsculpture, stn S34. Scale bar = 10 µm; **P**, protoconch, stn S3. Scale bar = 50 µm.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TYPE LOCALITY — Philippines, Bohol Island, Manga, 9°41.1'N, 123°51.4'E, 3-4 m, mud [PANGLAO 2004: stn S19].

MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn S19, 3-4 m, 1 pv, holotype MNHN IM-2000-26591 (L 1.2, H 1.3); 1 pv (L 1.05, H 1.1; Figure 44D-E), 1 lv (L 1.3, H 1.4; Figure 44H), 1 rv (L 1.2, H 1.2; Figure 44I), 2 pv (live-collected) (L 1.4, H 1.5; L 1.5 H 1.6; unfigured) paratypes MNHN IM-2000-26592, 1 pv, (live-collected; L 1.6, H 1.6) paratype MNHN IM-2009-10362. – Stn S20, Bohol Island, Manga, 9°41.8'N, 123°51.1'E, 10 m, mud, 1 live (H 1.9, L 1.8 mm).

DISTRIBUTION — Known only from 4-10 m in mud from Manga, Bohol, Philippines.

DESCRIPTION — Very small, glossy, L to 1.8, H to 1.9, subcircular, higher than long, inflated. Umbones prominent. Sulci and dorsal areas poorly defined. Sculpture of thin commarginal lamellae elevated to anterior and posterior. 17-25 low rounded radial ribs, divaricate in anterior part of shell. Juvenile shell with elevated commarginal lamellae but no radial ribs. Microsculpture of fine growth increments only. Protoconch (Figure 44 L): PI + PII 134 µm, P1 worn in all shells, PII with numerous growth increments. Lunule broadly lanceolate, depressed, asymmetric, larger part in left valve. Ligament short, internal, oriented parallel to cardinal teeth. Hinge: RV with single cardinal tooth, large anterior lateral tooth, and complex posterior lateral tooth consisting of 4-5 digitate folds on dorsal surface of narrow flange (Figures 44F, G, K); LV with two cardinal teeth, the anterior larger, anterior lateral socket, posterior lateral with sockets for digitiform projections of the right valve. Anterior adductor scar very short, barely detached from pallial line, pallial line irregularly discontinuous. Inner shell margin coarsely crenulate. Shell colour translucent white.

REMARKS — This rare species, found at only a single locality on Manga Island, with a maximum height of 1.9 mm, is the smallest lucinid yet recorded. It can be distinguished from the other *Pillucina* species from the Philippines by the complex, digitate, posterior lateral teeth, the thin, elevated commarginal lamellae and coarser radial ribbing. The only comparable species with similar complex posterior lateral teeth is *P. denticula* Glover & Taylor 2001 from Natal, South Africa. This is also a small species (H 3.7 mm) but has more (*ca.* 11) digitations in the posterior lateral teeth and, externally, has finer, more numerous radial ribs. Molecular analysis of *P. pusilla* n. sp. (as *Pillucina* sp. in Taylor *et al.* 2011) from PANGLAO 2004, stn S19, supported the species in a clade with other *Pillucina*, *Wallucina*, *Loripes* and *Chavania;* unpublished molecular data (mitochondrial cytochrome b gene) place it in a subgroup with *P. vietnamica* Zorina, 1978 from Thailand and the Arabian Gulf.

ETYMOLOGY — Latin *pusilla,* meaning small.

Genus ***WALLUCINA*** Iredale, 1930

Wallucina Iredale, 1930: 390, 406.

Type species. *Lucina jacksoniensis* E. A. Smith, 1885, by original designation (junior synonym of *Lucina assimilis* Angas, 1867).

FIGURE 44

Pillucina pusilla n. sp. (All figured specimens from PANGLAO 2004 stn S19) — **A**, holotype MNHN IM-2000-26591, exterior right valve. L 1.2 mm; **B**, holotype, detail of dorsal area. Scale bar 200 µm; **C**, holotype, dorsal view; **D**, **E**, paratype MNHN IM-2000-26592, interior of right and left valves. L 1.05 mm; **F**, **G**, as **D**, **E**, details of hinge of right and left valves. Scale bar 200 µm; **H**, paratype MNHN IM-2000-26592, exterior of left valve. L 1.3 mm; **I**, paratype MNHN IM-2000-26592, interior of right valve. L 1.2 mm; **J**, paratype MNHN IM-2000-26592, anterior adductor muscle scar. Scale bar 200 µm; **K**, paratype, detail of lateral teeth of right valve of I. Scale bar 100 µm; **L**, protoconch. Scale bar 50 µm.

DIAGNOSIS — Shells small, subcircular, moderately inflated, thin-shelled. Sculpture of fine, closely spaced commarginal lamellae, slightly raised to posterior, fine radial striations may be present. Hinge plate narrow; RV with single cardinal tooth and posterior lateral tooth, anterior lateral absent or very small. LV with two cardinal teeth and a posterior lateral tooth. Ligament internal, set in elongate, oblique resilifer. Anterior adductor muscle scar elongate, detached from pallial line for about 1/2 to 1/3 of length. Pallial line irregularly lobed and divided. Inner shell margin finely crenulate.

Two species are known, the type from southern Australia and *W. fijiensis* from the tropical IWP.

Wallucina fijiensis (E. A. Smith, 1885)

Figures 41E; 45A-L

Lucina (Codakia) fijiensis E. A. Smith, 1885: 184, pl. 13, fig. 9.
Lucina (?Loripes) gordoni E. A. Smith, 1885: 186, pl. 13, fig. 12.
Loripes haddoni Melvill & Standen, 1899: 200, fig. 12.
Wallucina gordoni – Maes 1967: 159, pl. 22, fig. e. — Poppe & Tagaro 2011: 156, pl. 1073, fig. 4.
Wallucina fijiensis – Glover & Taylor 2001: 289, figs 24a, b; 2007: 162, figs 34A, 35 A-J.

TYPE MATERIAL — *Lucina fijiensis*: holotype NHMUK 1887.2.9. — *Lucina gordoni*: holotype NHMUK 1887. 2.9 2886. — *Loripes haddoni*: holotype NHMUK 1899.2.23.12.

TYPE LOCALITY — *L. fijiensis*: Fiji, Levuka. — *L. gordoni*: Fiji, Levuka. — *L. haddoni*: Warrior Island, Torres Strait.

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn B14, 2-4 m, 9 v. – Stn B18, 3-5 m, 12 v. – Stn D1, 2 m, 3 v. – Stn D5, 0.3 m, 16 v. – Stn D13, 2-3 m, 3 v. – Stn D14, 2-4 m, 1 v. – Stn M3, 0.2.5 m, 4 v. – Stn M7, 0.3 m, 3 v. – Stn M9, 0.5 m, 7 v. – Stn M10, 0-3 m, 8 v. – Stn M18, 0-1 m, 1 v. – Stn P1, 90-200 m, 2 v. – Stn S3, 6 m, 1 v. – Stn S6, 1-4 m, 100 v. – Stn S7, 1-4 m, 1 v. – Stn S8, 28-32 m 3 v. – Stn S9, 3 m, 9 v. – Stn S14 5-12 m, 1 pv, 15 v. – Stn S18, 0-2 m, 11 v. – Stn S22, 15-20 m, 1 pv, 103 v. – Stn S23, 2 m, 45 v. – Stn S24, 2-4 m, 1 v. – Stn S28, 28-32 m, 5 v. – Stn S32, 2-3 m, 3 v. – Stn S40, 2-4 m, 3 v. – Stn S41, 2-4 m, 2 v.

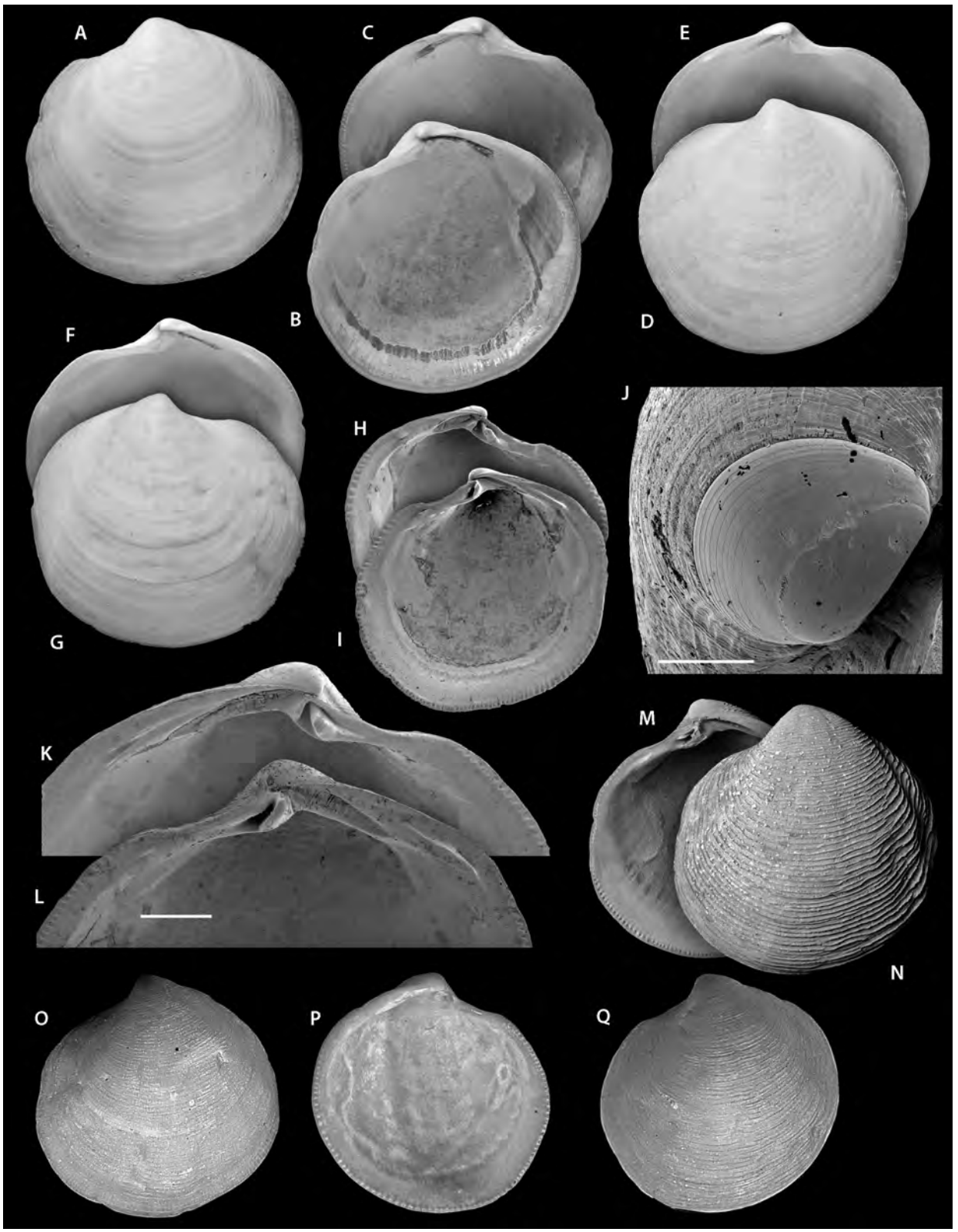
DISTRIBUTION — Eastern Indian Ocean and West Pacific, often abundant in shallow sandy habitats of 0-20 m, with deeper records from the Philippines probably allochthonous.

DESCRIPTION — See Glover & Taylor (2001, 2007) for details. As for genus. H to 15 mm. Protoconch (Figure 45J): PI + PII 135 µm, PI 107 µm smooth, with numerous growth increments.

REMARKS — *Wallucina fijiensis* can be distinguished from the southern Australian *W. assimilis* (Angas, 1867) by the more posteriorly quadrate shell, the deeper, shorter lunule and the longer ligament.

FIGURE 45

Wallucina fijiensis (Smith, 1884) — **A**-**C**, exterior of left valve and interior of right and left valves, Bantayan Island, NE of Cebu Island, Philippines, NHMUK. L 10.6 mm; **D**, **E**, interior and exterior of left valve, PANGLAO 2004 stn M9. L 10.1 mm; **F**, **G**, interior and exterior of left valve, PANGLAO 2004 stn M9. L 19.9 mm; **H**, **I**, interior of left (L 3.5 mm) and right valves (L 3.7 mm), PANGLAO 2004 stn S22; **J**, protoconch, PANGLAO 2004 stn S22. Scale bar = 50 µm; **K**, **L**, details of hinge of left and right valves, PANGLAO 2004 stn S22. Scale bar =1.0 mm — **M**-**Q**, *Chavania striata* (Tokunaga, 1906); **M**, **N**, interior and exterior of right valve, Atoll de Huon, New Caledonia (MNHN). L 8.0 mm; **O**, exterior of left valve, PANGLAO 2004 stn S14. L 9.4 mm; **P**, **Q**, interior and exterior of left valve, PANGLAO 2004 stn S8. L 5.4 mm.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Genus ***CHAVANIA*** Glover & Taylor, 2001

Chavania Glover & Taylor, 2001: 265, 282.

Type species. *Lucina erythraea* Issel, 1869, by original designation. Northern Indian Ocean.

DIAGNOSIS — Shell solid, H to 12 mm, subcircular higher than long, sculpture of fine commarginal lamellae that anastomose occasionally, fine radial ribs. Protoconch: PI large smooth, PII a narrow rim. Hinge with two cardinal teeth in LV and larger single cardinal in RV; lateral teeth vestigal or absent. Ligament short, deeply inset, anterior adductor scar short, detached from pallial line for about 1/5 of length, pallial line discontinuous, shell margin finely crenulated.

Chavania striata (Tokunaga, 1906)

Figures 41F; 45M-Q

Lasaea striata Tokunaga, 1906: 53-54, pl. 3, fig. 14.
Chavania striata – Glover & Taylor 2001: 282, figs 18 a-h; 2007: 162-166, figs 34B, 36.
See Glover & Taylor (2001, 2007) for details and full synonymy

TYPE MATERIAL — 21 syntypes UMT CM13599 and CM13753-13772.

TYPE LOCALITY — Japan, Tokyo City, Oji, (Pleistocene).

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn B4, 24 m, 1 v. – Stn B7,4-30 m,1 v. – Stn B40, 22 m, 1 v. – Stn S8, 28-32 m 1 v. – Stn S14, 5-12 m, 3 v. – Stn S23, 2 m, 1 v. – Stn T26, 123-135 m, 1 v.

DISTRIBUTION — Central IWP, India to Japan, western and northern Australia, New Caledonia.

DESCRIPTION — As for genus; H to 12 mm. See Glover & Taylor (2001, 2007) for further details.

REMARKS — Only a few worn valves were recovered from PANGLAO 2004 samples and for this reason we also illustrate a specimen from New Caledonia (Figures 45M, N).

Genus ***TROENDLEINA*** Cosel & Bouchet, 2008

Troendleina Cosel & Bouchet, 2008: 119.

Type species. *Troendleina marquesana* Cosel & Bouchet, 2008, by original designation.

DIAGNOSIS — Thin-shelled, subovate, anteriorly extended, posteriorly truncate, H to *ca.* 40 mm, sculpture of fine growth lines with fine radial threads, often obscure. Hinge narrow with small to vestigial cardinal teeth, lateral teeth absent or small. Anterior adductor scar medium long, detached for 1/2 of length.

REMARKS — A new genus proposed by Cosel & Bouchet (2008) for two deep-water species, *T. marquesana* Cosel & Bouchet, 2008 from 300-800 m in the Marquesas and Austral Islands, and *T. musculator* Cosel & Bouchet, 2008 from *ca.* 400 m in the Solomon Islands.

Troendleina suluensis n. sp.

Figures 46A-O; 47A

TYPE MATERIAL — Holotype MNHN IM-2000-26594, 19 paratypes MNHN IM-2000-26595, 3 NHMUK 201306644

TYPE LOCALITY — Philippines, Bohol/Sulu Sea sill, 8° 53'N, 123° 34'E, 543-613 m, sand [PANGLAO 2005: stn CP2361].

MATERIAL EXAMINED — Philippines. PANGLAO 2005: stn CP2339, 164-176 m, 1 v. – Stn CP2349, 219-240 m, 1 v. – Stn CP2359, 437-476 m, 2 v. – Stn CP2361, 543-561 m, 1 pv, holotype MNHN IM-2000-26594 (L 24.1, H 22.6, T 6.5), 1 rv (L 21.4, H 19.9, T 5.8; Figures 46D, E), 18 v (unfigured) paratypes MNHN IM-2000-26595; 1 lv, paratype NHMUK 20130664 (L 22.5, H 21.1, T 6.2, Figures 46 F, G), 1 rv, paratype NHMUK 20130664 (L 23.7, H 21.5, T 6.0; Figures 46H, I), 1 rv, paratype NHMUK 20130664 (L 35.5, H 31.6T 10.0; Figures 46J, K); 20 v. – Stn CP2362, 679-740 m, 19 v. – Stn CP2380, 150-163 m, 2 v. – Stn CP2409, 220-257 m, 1 v. – AURORA 2007: stn DW2670, 180-187 m, 2 v. – Stn CP2671, 269-277 m, 1 v. – Stn CP2758, 151-173 m, 1 v.

DISTRIBUTION — Philippines, mud and organic debris, paired valves in 534-561 m, empty shells in 163-679 m.

DESCRIPTION — L to 35.5, H to 34.5, T 10.0. Subcircular to slightly anteriorly extended, H/L 0.93, posterior slightly truncated, inflated, T/L 0.28. Umbones central, low, rounded. Shell surface smooth with low growth increments, often with crumpled appearance, fine radial striations, patchily visible. Microsculpture of fine, regularly spaced grooves (Figures 46N, O). Protoconch (Figure 46M): P1 + PII 163 µm, PI 80 µm smooth, PII with prominent growth increments. Lunule long, lanceolate. Ligament long, shallowly inset in nymph. Hinge plate thin. Hinge teeth poorly defined, RV with single cardinal and socket and a small anterior lateral tooth, LV with single cardinal and anterior lateral teeth. Anterior adductor muscle scar long, broad and separated from pallial line for 2/3 of length at angle of 5°; posterior adductor scar tear-drop shaped. Pallial line entire. Pallial blood vessel scar prominent, terminates at ventral tip of anterior adductor scar. Shell interior often roughly pustulose. Shell outside pallial line glossy, shell margin very finely denticulate. Colour brownish white.

REMARKS — Of the two described species (Cosel & Bouchet, 2008) of *Troendleina*, *T. musculator* and *T. marquesana*, *T. suluensis* n. sp. most closely resembles *T. musculator* from the Solomon Islands but differs in its thinner, lighter, more anteriorly extended shell, narrower ligament and more finely denticulate shell margin. In molecular analysis (Taylor *et al.* 2011), *Troendleina suluensis* (as *T.* cf. *musculator*) from PANGLAO 2005 stn CP2362, is a member of the subfamily Lucininae, in a group including *Bathyaustriella*, *Parvilucina* spp. and *Cardiolucina* spp.

ETYMOLOGY — Named for the Sulu Sea, the type locality.

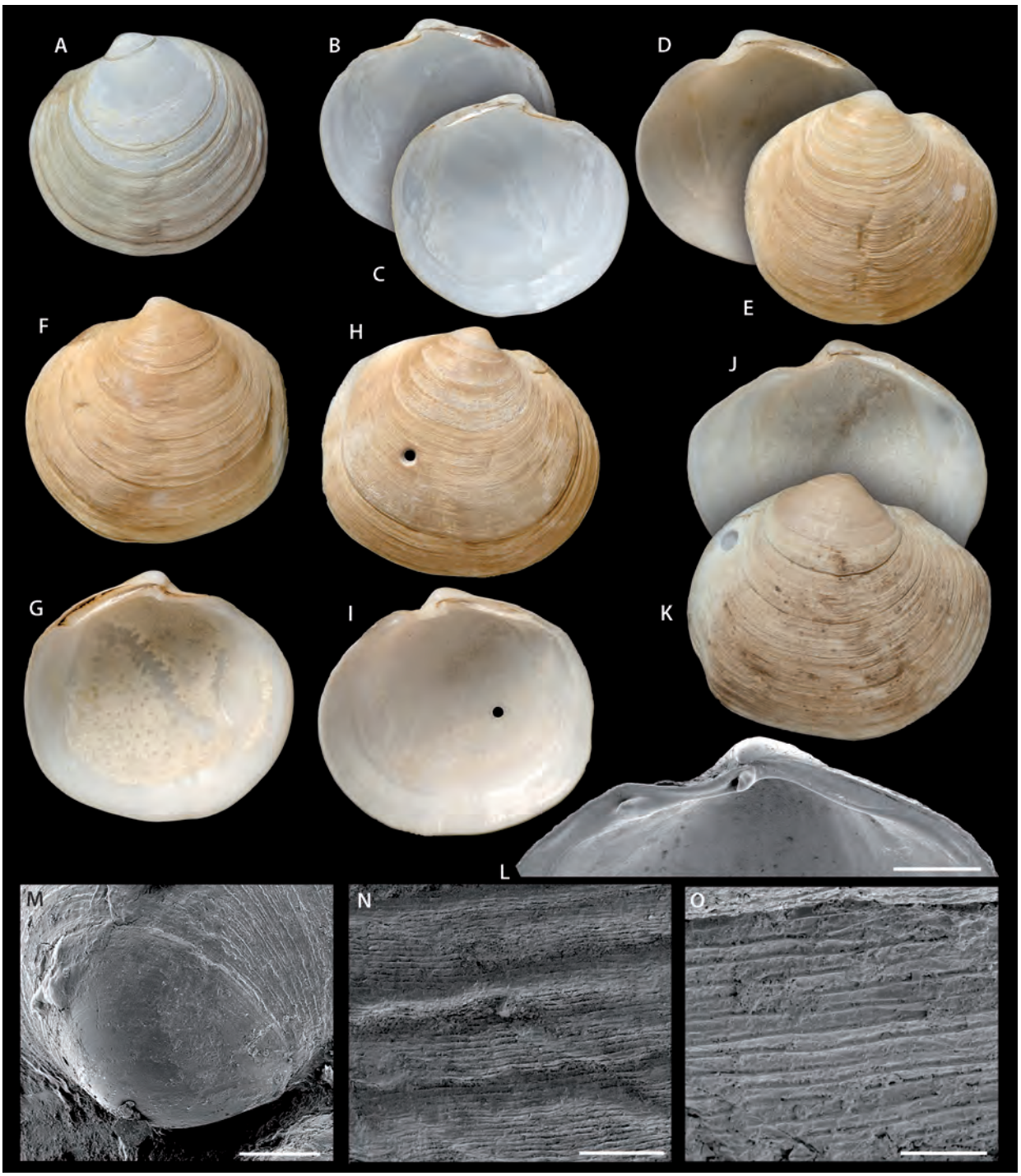


FIGURE 46

Troendleina suluensis n. sp. (Figured specimens **A**-**K** from PANGLAO 2005 stn CP2361; **L**-**O** from PANGLAO 2005 stn CP2380) — **A**-**C**, holotype MNHN IM-2000-26594, exterior and interior of right and left valves. L 24.1 mm; **D**, **E**, paratype MNHN IM-2000-26595, interior and exterior of right valve. L 21.4 mm; **F**, **G**, paratype NHMUK 20130664, exterior and interior of left valve. L 22.5 mm; **H**, **I**, paratype NHMUK 20130664, exterior and interior of right valve. L 23.7 mm; **J**, **K**, paratype NHMUK 20130664, interior and exterior of right valve. L 35.5 mm; **L**, juvenile, detail of hinge of right valve. Scale bar = 1.0 mm; **M**, protoconch. Scale bar = 50 µm; **N**, **O**, details of microsculpture. Scale bars N = 50 µm, O = 20 µm.

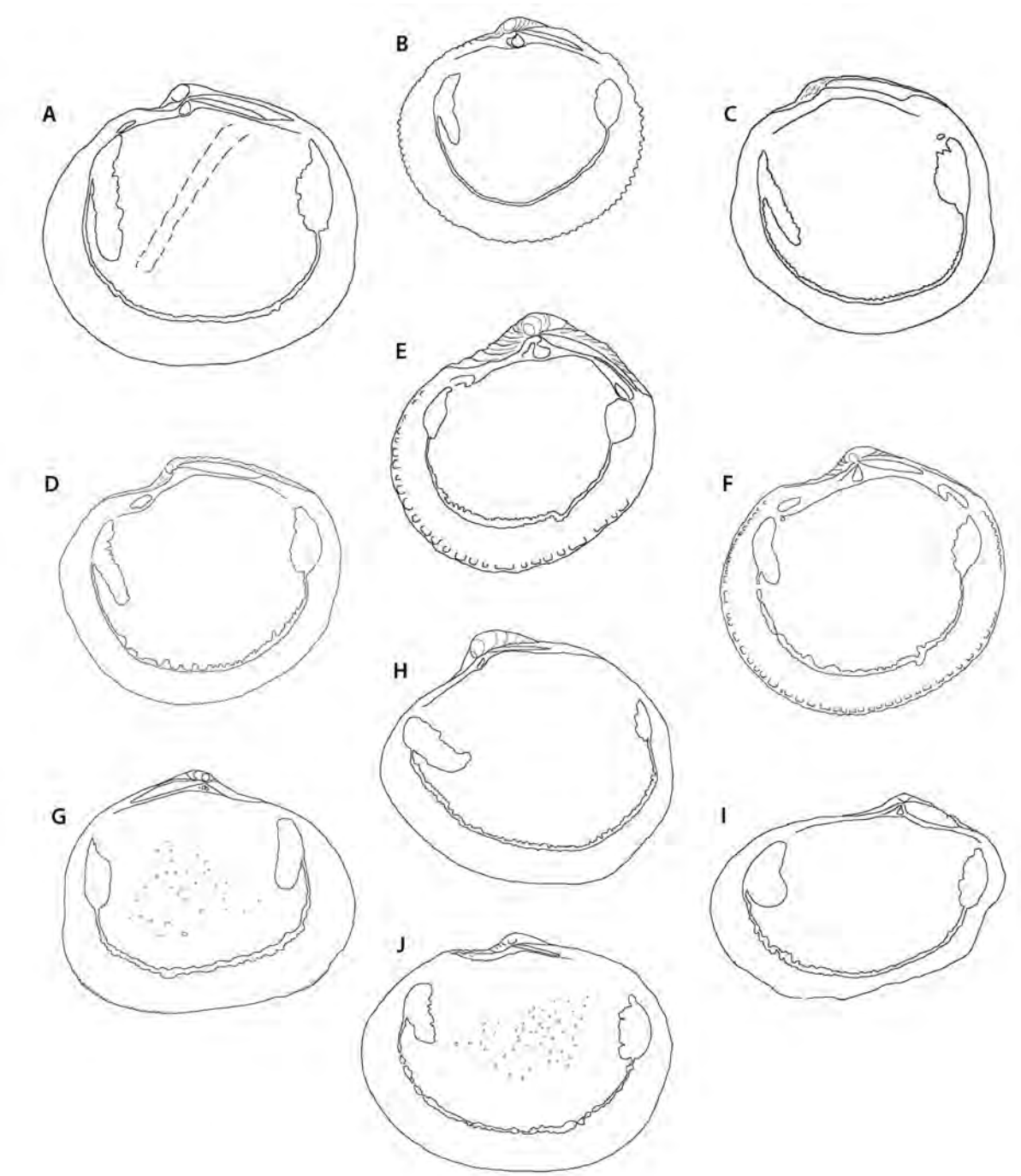


FIGURE 47

Outline drawings of shell interiors of *Troendleina*, *Divaricella*, *Austriella*, *Indoaustriella*, *Liralucina*, *Ferrocina*, *Parvidontia*, *Bretskya* and *Jallenia*. Not to scale. **A**, *Troendleina suluensis*; **B**, *Divaricella ornatissima*; **C**, *Austriella corrugata*; **D**, *Indoaustriella* cf *plicifera*; **E**, *Liralucina sperabilis*; **F**, *Liralucina lathetikosa*; **G**, *Ferrocina luzonensis*; **H**, *Parvidontia mutabilis*; **I**, *Bretskya scapula*; **J**, *Jallenia inanis*.

Genus ***DIVARICELLA*** Martens, 1880

Divaricella Martens, 1880: 321.

Type species. *Lucina (Divaricella) angulifera* Martens, 1880, by monotypy, junior synonym of *Lucina ornatissima* d'Orbigny 1846.

DIAGNOSIS — Subcircular, inflated, with prominent, divaricate ribs that extend beyond shell margin as a serrated edge. Lateral teeth absent. Anterior adductor scar close to pallial line and detached for 1/2 of length. Pallial line entire. Inner shell margin smooth.

REMARKS — See Dekker & Goud (1994) for details of species and distributions. Molecular evidence places *Divaricella irpex* (E. A. Smith, 1885) from northern Australia in the subfamily Lucininae but in a separate clade from *Divalinga* species that also have divaricate ornament (Taylor *et al.* 2011).

Divaricella ornatissima (d'Orbigny, 1846)

Figures 47B; 48H-K

Lucina ornatissima d'Orbigny, 1846: 584.
Divaricella ornatissima – Dekker & Goud 1994: 124, fig. 4 (for full synonymy). — Poppe & Tagaro 2011: 138, pl. 1064, fig. 2.

TYPE MATERIAL — Not located.

TYPE LOCALITY —Réunion.

MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn D13, 2-3 m, 1 v; – Stn T 6, 34-82 m, 1 v. – PANGLAO 2005: stn CP2712, 139-140 m, 2 v. – MUSORSTOM 3: stn DR140, 93-99 m, 1 v. – AURORA 2007: stn CP2711, 184-200 m, 2 v.

DISTRIBUTION — East Africa to Philippines.

DESCRIPTION — See Dekker & Goud (1994) for details.

REMARKS — This is the only lucinid species with a divaricate sculpture known from the Philippines; a few worn valves were recovered from Panglao samples.

Genus ***AUSTRIELLA*** Tenison-Woods, 1881

Austriella Tenison-Woods, 1881: 82.

Type species. *Austriella sordida* Tenison-Woods, 1881, by monotypy, junior synonym of *Lucina corrugata* Deshayes, 1843.

DIAGNOSIS — Shell large, H to 75, thick-shelled, subcircular, with defined posterior dorsal area, sculpture of thin, low, commarginal lamellae with broad interspaces, hinge teeth absent, anterior adductor scar long and detached for 4/5 of length, inner margin smooth. Periostracum thick, brown.

REMARKS — This is a monospecific genus, see Glover *et al.* (2008) for details of nomenclature. *Austriella corrugata* (Deshayes, 1843) is closely associated with mangrove habitats in the central IWP (Glover *et al.* 2008). The name *Eamesiella* Chavan, 1951 has been used (*e.g.*, Sotto & Cosel 1982) but is a junior synonym.

Austriella corrugata (Deshayes, 1843)

Figures 47C; 48A-D

Lucina corrugata Deshayes, 1843: 1-2, pl. 82.
Lucina philippinarum Reeve, 1850, pl. 4, figs 18a, b.
Austriella sordida Tenison-Woods, 1881: 83, figs 210-11.
Eamsiella corrugata – Sotto & Cosel 1982: 57, pl. 12, figs 1, 2.
Austriella corrugata – Glover *et al*. 2008: 27, figs 2, 3A. — Poppe & Tagaro 2011:136, figs 6, 7.

TYPE MATERIAL — *Lucina corrugata*: 3 syntypes MNHN IM-2000-20019. — *Lucina philippinarum*: figured syntype NHMUK 1884.8.26.1 — *Austriella sordida*: 1 syntype NMV F673, 4 syntypes AM C.171071.

TYPE LOCALITY — *L. corrugata*: given as Philippines on syntype label but in publication erroneously as 'Habite la mer de Californie'. — *L. philippinarum*: Philippines, Manila, Singapore. — *A. sordida*: Australia, Queensland, Port Denison.

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: 1 spm BC1265, purchased in market. – Stn M27, 0-1 m, 1 v. – Stn M50 (see Lozouet & Plaziat 2008: 80, figs 1-2). – PANGLAO 2005: stn CP2332, 396-418 m, 1 v, allochthonous specimen.

DISTRIBUTION — Central IWP, western Thailand to Ryukyu Islands, New Britain, northern Australia.

DESCRIPTION — See Glover *et al.* (2004, 2008) for details.

REMARKS — An exploited species that inhabits intertidal, peri-mangrove habitats. A specimen of *A. corrugata* from Guimaras Island, Philippines was included in an 18S rRNA molecular analysis (Geduspan *et al.* 2008) and found to be identical to a sample of the same species from northwestern Australia sequenced by Williams *et al.* (2004).

Genus ***INDOAUSTRIELLA*** Glover, Taylor & Williams, 2008

Indoaustriella Glover, Taylor & Williams, 2008: 29.

Type species. *Lucina* (*Cryptodon*) *plicifera* A. Adams, 1855.

DIAGNOSIS —Shell small, sculpture of thin, closely spaced commarginal lamellae with radial folds in anterior dorsal area; hinge without cardinal teeth, anterior and posterior teeth present or anterior lateral only. Anterior adductor muscle detached for 1/2 to 2/3 of length.

REMARKS — Four species have been described from peri-mangrove muddy habitats in the central IWP (see Glover *et al.* 2008): *Indoaustriella plicifera* (A. Adams, 1855), *I. dalli* (Lynge, 1909), *I. scarlatoi* (Zorina, 1978) and *I. lamprelli* Glover,

FIGURE 48

Austriella, *Indoaustriella* and *Divaricella* — **A**, **B**, *Austriella corrugata*, NHMUK 1963213, exterior and interior of left valve, Bay of Manila, Philippines. L 71.7 mm; **C**, **D**, *Lucina corrugata* Deshayes, 1843, syntype MNHN IM-2000-20019, exterior and interior of left valve. L 58 mm — **E**-**G**, *Indoaustriella* cf *plicifera* (A. Adams, 1855), exterior of right valve and interior of left and right valves, PANGLAO 2004 stn M50. L 10.5 mm — **H**-**K**, *Divaricella ornatissima* (d'Orbigny, 1846); **H**, **I**, interior and exterior of right valve, PANGLAO 2004 stn D13. L 14.3 mm; **J**, **K**, interior and exterior of left valve, PANGLAO 2004 stn D13. L 10.9 mm.

Taylor & Williams, 2008. *Indoaustriella plicifera* has been confused with juvenile *Austriella corrugata* but the latter lacks lateral teeth, even in the juveniles, although it occupies similar habitats and is in a closely related clade in molecular analyses. It is surprising that species of *Indoaustriella* have not been previously recorded from mangrove habitats in the Philippines.

Indoaustriella cf. ***plicifera*** (A. Adams, 1855)

Figures 47D; 48E-G

Lucina (Cryptodon) plicifera A. Adams, 1855: 225.
Indoaustriella plicifera – Glover *et al.* 2008: 30, figs 3B, C, 5 A-Q.

TYPE MATERIAL — 3 syntypes NHMUK 1963558.

TYPE LOCALITY — Borneo.

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn M50, 1 whole shell, Abatan River, 0 m, amongst *Nypa* palms in 14 ‰ salinity.

DISTRIBUTION — India to Kalimantan.

DESCRIPTION — Shell small L to 10.5, H to 9.1, compressed, thin, with brown, flaky periostracum. Anterior dorsal area with shallow sulcus and few, folded, radial ridges. Sculpture of thin, irregular commarginal lamellae that vary in thickness, with some finer commarginals between thicker commarginals. Lunule short, lanceolate. Ligament long in shallow groove. RV with single anterior lateral tooth, cardinal tooth absent, LV with anterior lateral tooth and no cardinal teeth. Anterior adductor scar elongate, detached for 2/3 of length at angle of 25°. Pallial line entire with some dorsal lobes. Shell margin smooth.

REMARKS — Only a single specimen was found in the PANGLAO 2004 material, collected amongst *Nypa* palm in the estuary of the Abatan River. It most resembles *I. plicifera* (A. Adams) (see details in Glover & Taylor 2008, figs 5A-Q) with similar lack of cardinal teeth and a single anterior lateral tooth, thin shell and absence of radial sculpture but differs in its more circular outline and finer commarginal lamellae. Other species from Southeast Asia, *I. dalli* (Lynge, 1909) from Singapore and eastern Thailand and *I. scarlatoi* (Zorina, 1978) from southern China, possess both anterior and posterior lateral teeth while *I. lamprelli* Glover, Taylor & Williams, 2008 from Queensland has much finer sculpture.

Genus ***EASMITHIA*** n. gen.

Type species. *Easmithia brevis* n. sp., here designated.

DIAGNOSIS — Shells small, semi-translucent, subovate, usually higher than long, with fine, sharp commarginal lamellae and thin radial folds in the interspaces, anterior and posterior dorsal areas with scale-like elevated lamellae. Hinge with two cardinal teeth and small to obscure anterior and posterior lateral teeth in the RV, LV without lateral teeth. Lunule lanceolate, asymmetric, greater part in RV. Anterior adductor scar short to medium long. Pallial line entire, sometimes lobate. Shell margin smooth.

REMARKS — Shells similar to the species described below are known from muddy habitats from the central IWP either under the name '*Lucina*' *desiderata* E. A. Smith, 1885 or unidentified in museum collections. Unfortunately the type of *L. desiderata* has disintegrated and only the exterior of a single valve was illustrated. We now recognise three species and introduce a new generic name for this group with their distinctive shell characters. As well as the Philippine species we provide a new description and figures for *E. desiderata* based on specimens collected from near the type locality. Molecular data for *E. brevis* n. sp. from Panglao place it within the subfamily Lucininae (Taylor *et al.* 2011). *Scabrilucina* Taylor & Glover, 2013 (type species *Cryptodon victorialis* Melvill, 1899) is related to *Easmithia* but the three included species are larger, have very fine, sharp, commarginal lamellae, lack significant radial folding in the interspaces between the lamellae and the anterior adductor scars are longer.

ETYMOLOGY — Named for E.A. Smith, British malacologist 1847-1916, who, in Smith (1885), described the bivalves from the *Challenger* Expedition.

Easmithia brevis n. sp.

Figures 49A-M; 51A

'Lucina' desiderata E. A. Smith, 1885 – Taylor *et al.* 2011: 21.
Myrtea minima Okutani, 1964 – Poppe & Tagaro, 2011: 144, pl. 1067, fig. 5.

TYPE MATERIAL — Holotype MNHN IM-2000-26596, 8 paratypes MNHN IM-2000-26597, 1 NHMUK 20130665 (as listed below).

TYPE LOCALITY — Philippines, Bohol Island, Ubajan, 9°41.5'N, 123°51.0'E, 21 m, mud [PANGLAO 2004: stn S25].

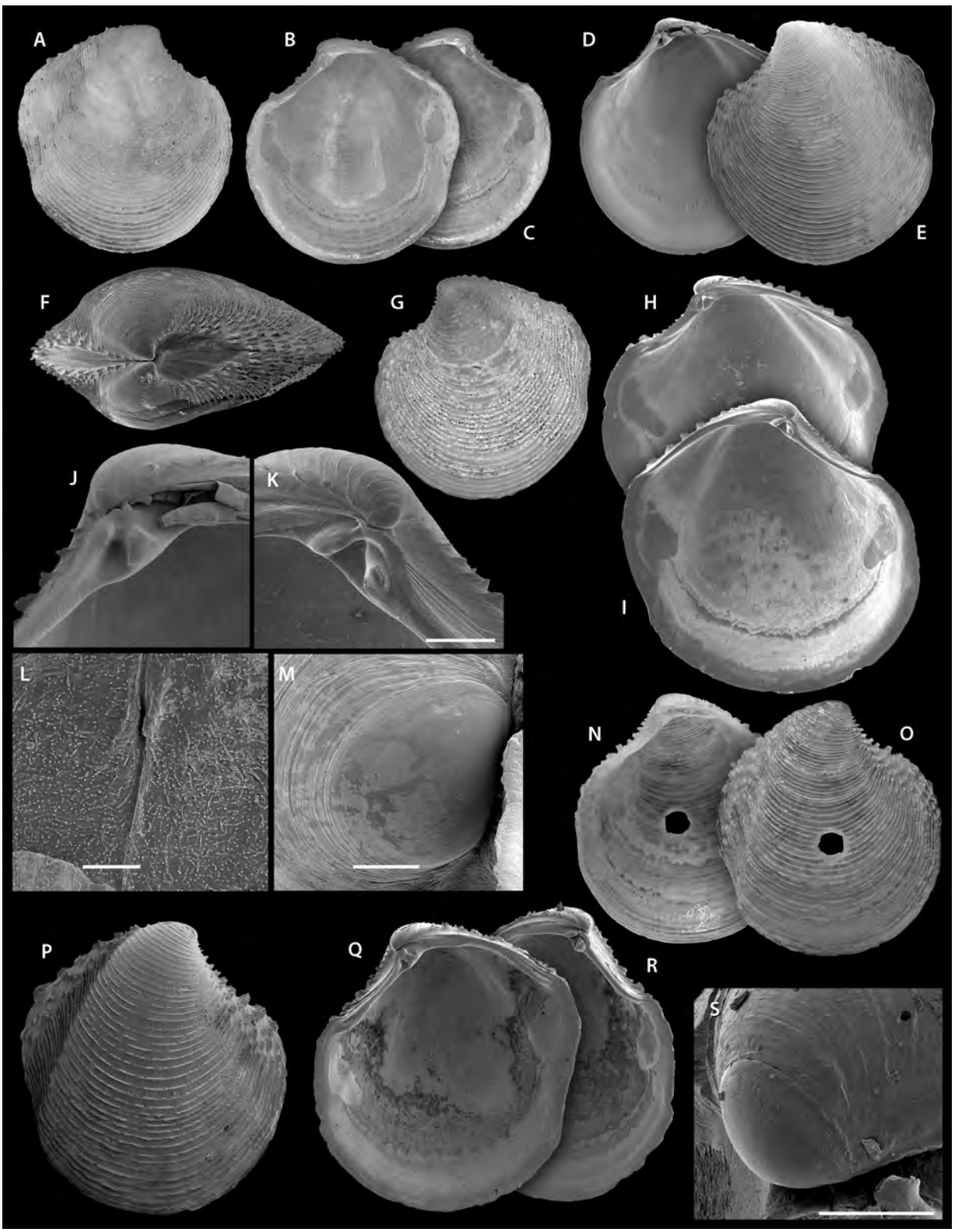
DISTRIBUTION — Central Philippines from 12 to 100 m in mud.

MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn D10, 15-22 m, 1 v. – Stn S22, 15-20 m 1 v. – Stn S25, 21 m, 1 pv, holotype MNHN IM-2000-26596 (L 4.7, H 5.1, T 1.4), 2 pv, 5 v. – Stn S27, 12 m, 1 pv, paratypes MNHN IM-2000-26597, (4.0 H 4.4; Figures 49D, E, F); 1 pv, paratype NHMUK 20130665 (L 4.1, H 4.4; Figure 49 G); 1 pv, 5 v (unfigured); 1 pv, 2 pv, 5 v. – Stn T5, 84-87 m, 1 v; T9, 97-120 m, 2 v. – Stn T10, 117-124 m 1 v. – Stn T14 101-110 m, 1 v. – Stn T18, 80-100 m, 2 v. – Stn T19, 10-26 m, 6 v. – Stn T23, 35-45 m, 2 v. – Stn T27, 106-137 m, 2 v. – Stn T39, 100-138 m, 2 v. – MUSORSTOM 3: stn DR140, 93-99 m, 58 v.

DESCRIPTION — Shells small, white, semi-translucent, L to 4.9, H to 5.2, higher than long. Posterior sulcus shallow with marginal sinus, sculpture of fine, numerous, closely spaced, sharp commarginal lamellae that become elevated in anterior and posterior dorsal area as low, irregular lobate scales. Interspaces between lamellae with faint radial threads.

FIGURE 49

Easmithia brevis n. sp. — **A**-**C**, holotype MNHN IM-2000-26596, exterior of right valve and interior of right and left valves, PANGLAO 2004 stn S25. L 4.7 mm; **D**, **E**, paratype MNHN IM-2000-26597, interior of right valve and exterior of left valve, PANGLAO 2004 stn S27. L 5.0 mm; **F**, dorsal view of D, E. L 5.0 mm; **G**, paratype NHMUK 20130665, exterior of left valve of whole shell, PANGLAO 2004 stn S27. L 4.1 mm; **H**, paratype MNHN IM-2000-26597, interior of right valve, PANGLAO 2004 stn S27, L 4.1mm; **I**, paratype MNHN IM-2000-26597, interior of left valve, PANGLAO 2004 stn S27, L 4.7 mm; **J**, **K**, detail of hinge on right and left valves, PANGLAO 2004 stn S27. Scale bar = 250 µm; **L**, detail of microsculpture, PANGLAO 2004 stn S27. Scale bar =10 µm; **M**, protoconch, PANGLAO 2004 stn S27. Scale bar = 50 µm; **N**-**S**, *Easmithia desiderata* (Smith 1885); **N**, **O**, interior and exterior of right valve, Papua New Guinea, off Port Moresby, 23 m (AM C.360758). L 5.5 mm; **P**, exterior of right valve. L 3.9 mm; **Q**, **R**, interior of left (L 3.9 mm) and right valves (L 4.2 mm); **S**, protoconch of Q. Scale bar = 100 µm.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Microsculpture finely pustulate (Figure 49L). Lunule lanceolate, long, asymmetric, larger in RV. Protoconch (Figure 49M): PI +PII 158 µm, PI 142 µm smooth, PII narrow with a few growth increments. Ligament short, inset in deep groove. Hinge teeth: LV with two cardinal teeth, no lateral teeth. RV with single cardinal, a small to obscure anterior lateral tooth and a narrow posterior lateral tooth. Anterior adductor scar short, detached for 1/5 of length. Posterior scar ovoid. Pallial line irregularly lobate. Shell margin smooth, shell surface inside pallial line with points of mantle attachment.

REMARKS — See under *E. desiderata* (E. A. Smith, 1885) below. Specimen included in molecular analysis (Taylor *et al.* 2011) from PANGLAO 2004 stn T19.

ETYMOLOGY — Latin *brevis,* short, reference to the short anterior adductor muscle scar.

Easmithia desiderata (E. A. Smith, 1885) comb. nov.

Figures 49N-S; 51B

Lucina (Loripes) desiderata E. A. Smith 1885: 185, pl. 13, figs 10-10a.
Myrtea desiderata – Hedley 1909: 428.

TYPE MATERIAL — *Lucina desiderata* was described from a single left valve but the specimen (NHMUK 1887.2.9.2783) is now disintegrated; no internal view was figured and no details of the adductor muscles were given in the original description. Size given as L 3.3, H 3.7.

TYPE LOCALITY — '…off S New Guinea 28 fthms [51 m] green mud'.

OTHER MATERIAL EXAMINED — **Papua New Guinea**. Manubada Island, off Port Moresby, 9°31'S, 147°10'E, 23 m, sticky sandy mud off sheltered NW side, 21 June 1970, W.F. Ponder & P.H. Colman, AM C.360758. **Australia**. Queensland between Cairns and Endeavour Reef 15°45S, 145°35E, 37 m, many shells, NHMUK 196483. – Hope Islands, 5-10 fathoms, AM C.044661. **Singapore**. Siglap Island, dredged, 1 pv, 1 v, NHMUK 1963484.

DISTRIBUTION — Singapore, New Guinea to Queensland, to 50 m in mud.

DESCRIPTION — Shell slightly higher than long, L to 6.8, H to 7.5, T to 2.3, semi-translucent, sculpture of fine commarginal lamellae that are strongly elevated and scale-like in posterior and anterior dorsal areas, fine radial folds in interspaces. Lunule lanceolate, asymmetric, with greater part in RV. Protoconch (Figure 49S): PI + PII 142 µm, PI smooth 130 µm, PII narrow rim with no growth increments. Hinge with two cardinal teeth in each valve, small posterior and anterior lateral teeth in RV only. Anterior adductor scar short, detached for 1/5 length, pallial line lobate, shell margin smooth.

REMARKS — We have based our description and figures on material collected from near the type locality off southern Papua New Guinea (AM C.360758). These specimens are very similar to *E. brevis* n. sp. but can be distinguished by the more prominent anterior lateral teeth, the higher shells and the protoconch that lacks any growth increment in PII. *Easmithia desiderata* can be distinguished from *E. bractea* n. sp. (see below) by the much shorter anterior adductor muscle scar, the anterior and posterior lateral teeth present in the right valve and by its much smaller size.

Easmithia bractea n. sp.

Figures 50A-O; 51C

Gonimyrtea sp. 2 – Xu & Zhang 2008: 119, fig. 349.

TYPE MATERIAL — Holotype MNHN IM-2000-26598, 4 paratypes MNHN IM-2000-26599-26600, 2 NHMUK 20130666 (as listed below).

TYPE LOCALITY — Philippines, Bohol/Sulu Seas sill, Dipolog Bay, 8°33.7'N, 123°08.6'E, 92-96 m, [PANGLAO 2005: stn DW2370].

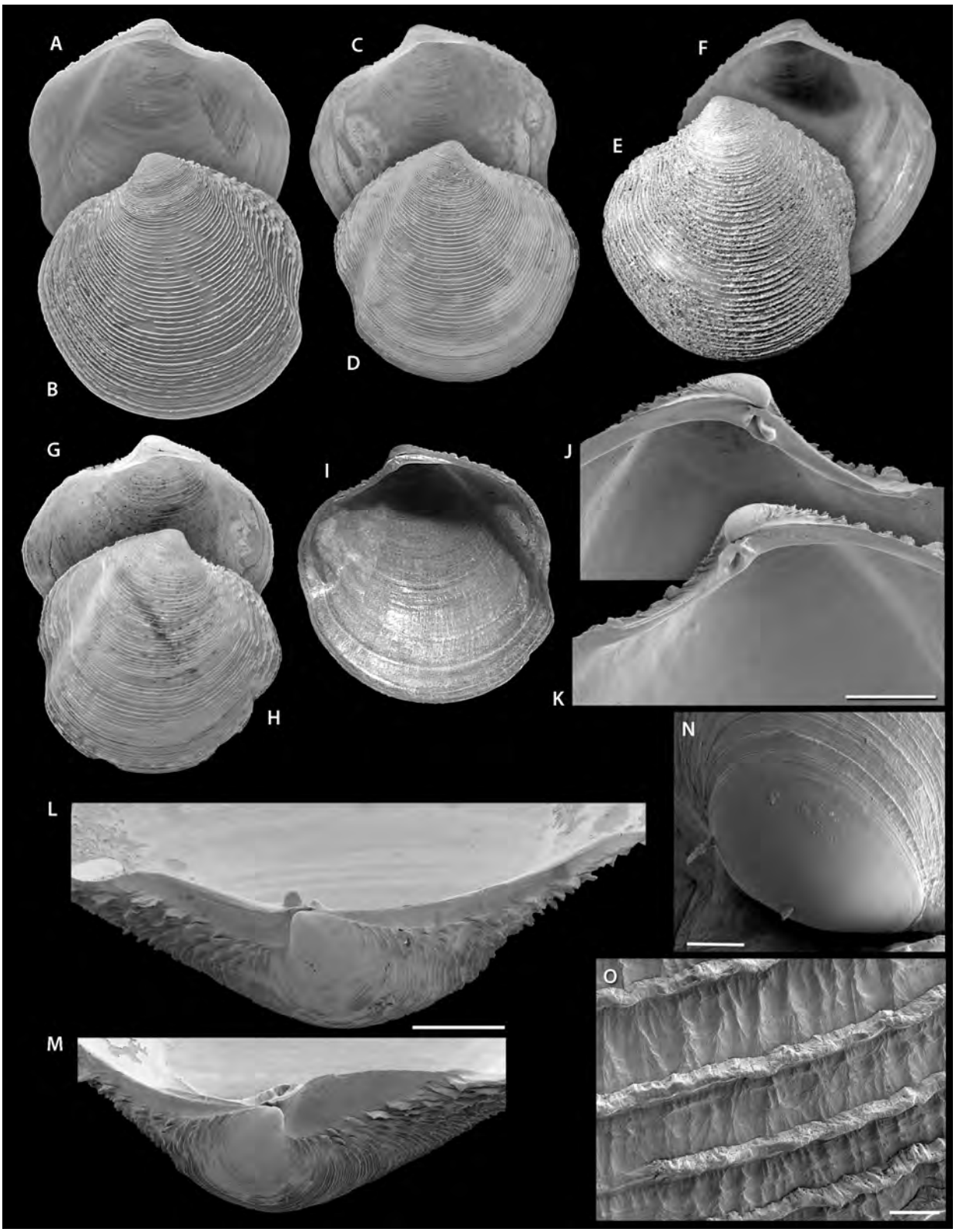
MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn G1, 100 m, 4 v; – Stn S1, 5 m, 2 v. Stn S13, 8-15 m, 1 v (figured). – Stn S14, 5-12 m, 1 v. – Stn S21, 4-12 m, 2 v. – Stn T5, 84-87 m, 1 rv, paratype NHMUK 20130666 (L 12.5, H 12.8, T 3.3, Figures 50 C, D), 1 v. – Stn T9, 97-120 m, 25 v. – Stn T10, 117-124 m, 2 v. – Stn T11, 78-95 m, 1 rv, paratype MNHN IM-2000-26600 (L 12.0, H 12.3, T 3.2; Figures 50 G, H), 2 pv, 10 v. – Stn T14, 101-110 m, 3 v. – Stn T27, 106-137 m, 2 v. – Stn T43, 70-96 m, 1 v. – PANGLAO 2005: stn DW2370, 92-96 m, 1 pv, holotype MNHN IM-2000-26598 (L 12.8, H 13.0, T 3.4), 3 lv, paratypes MNHN IM-2000-26599 (L 8.1, H 8.2; L 8.5, H 8.7; L 6.9, H 7.0; unfigured), 7 v. – AURORA 2007: stn CP 2654, 98-107 m, 5 v. – Stn CP2720, 300-301 m, 1 v. – Stn DW2738, 111-113 m, 6 v. – Stn DW 2739, 96 m, 1 lv, paratype NHMUK 20130669 (L 11.1, H 11.7, T 3.0; Figures 50 E, F), 5 v. – Stn DW2758, 151-173 m, 3 v. – MUSORSTOM 3: stn DR140, 93-99 m, 15 v. Australia. Northern Territory, Arafura Sea, north of Melville Island, 8°18'S, 134°11'E, 141 m, 1 v, AM C.360710. – Gunn Point Beach, Darwin, 2 v, NHMUK acc 2394. Papua New Guinea. Lolorua Island, 9°30'S, 147°7'E, 13-22 m, 1 v, AM C.360704.

DISTRIBUTION — From Philippines to northern Australia and New Guinea, from 20 to 170 m, in mud.

DESCRIPTION — Shell small to medium, white, thin, subcircular L to 17.9, H to 17.8, H/L 1.02, moderately inflated T/L 0.26; posterior sulcus shallow with marginal sinus, anterior sulcus absent. Sculpture of very fine commarginal lamellae elevated in posterior and anterior dorsal areas, where they are slightly foliated and crumpled. Interspaces between lamellae with fine radial striations. Protoconch (Figure 50N): PI + PII 189 µm, PI 170 µm; PII a narrow rim with few growth increments. Lunule lanceolate, more or less symmetrical, ligament short, in a shallow groove. Hinge narrow with two small cardinal teeth in LV, no lateral teeth; RV with one cardinal tooth, small obscure anterior and posterior lateral teeth. Anterior adductor scar long, thin and detached for 2/3 of length at an angle of 35°. Posterior scar reniform. Pallial line thin, continuous. Shell inside pallial line with fine, radial striations, mantle attachment points, inner shell margin smooth. Track of pallial blood vessel visible on some specimens.

REMARKS — Similar in external morphology to *E. brevis* n. sp. but larger, less high, smaller cardinal teeth and with a longer anterior adductor muscle scar. *Myrtina tonkingwanensis* Xu, 2012 (p. 51, fig. 26) from China appears similar but no details of muscle scars or hinge are present in the published figure. *Lucina gibbia* Deshayes, 1844 described from Sumatra may be either a juvenile of *Scabrilucina vitrea* (Deshayes, 1844) or part of the *Easmithia* group but it is difficult to assess from the figure alone and the type material has not been located.

ETYMOLOGY — Latin *bractea*, small scales, reference to the elevated dorsal sculpture.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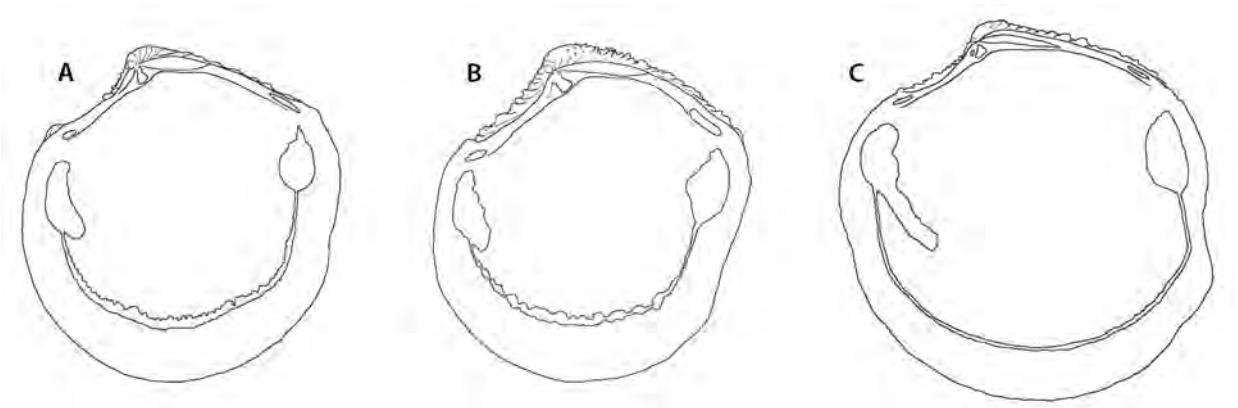


FIGURE 51

Outline drawings of shell interiors of *Easmithia* species. Not to scale. **A**, *Easmithia brevis*; **B**, *Easmithia desiderata*; **C**, *Easmithia bractea*.

FIGURE 50

Easmithia bractea n. sp. — **A**, **B**, holotype MNHN IM-2000-26598, interior and exterior of left valve, PANGLAO 2005 stn DW2370. L 12.5 mm; **C**, **D**, paratype NHMUK 20130666, interior and exterior of right valve, PANGLAO 2004 stn T5. L 12.6 mm; **E**, **F**, paratype NHMUK 20130669, exterior and interior of left valve, AURORA 2007 stn DW 2739. L 11.1 mm; **G**, **H**, paratype MNHN IM-2000-26600, interior and exterior of right valve, PANGLAO 2004 stn T11. L 12.0 mm; **I**, interior of right valve, PANGLAO 2004 stn S13. L 18.1 mm; **J**, **K**, detail of hinge of left and right valves, AURORA 2007 stn DW2739. Scale bar = 1.0 mm; **L**, **M**, dorsal views of hinges of left and right valves, AURORA 2007 stn DW2739. Scale bar = 1.0 mm; **N**, protoconch, AURORA DW2739. Scale bar = 50 µm; **O**, detail of sculpture, AURORA DW2739. Scale bar = 100 µm.

Genus *LIRALUCINA* Glover & Taylor, 2007

Liralucina Glover & Taylor, 2007: 147.

Type species. *Phacoides sperabilis* Hedley, 1909, by original designation.

DIAGNOSIS — Shells small (<10 mm), subcircular, inflated, with prominent radial ribs (up to 35) crossed by regularly spaced, very thin, commarginal lamellae. Radial ribs obsolete at posterior dorsal margin. Lunule heart-shaped to lanceolate, symmetrical. Hinge teeth small, LV with anterior lateral, two cardinal teeth and posterior lateral; RV with anterior lateral, a single cardinal and posterior lateral. Anterior adductor muscle scar short, slightly detached from pallial line. Inner shell margin crenulate.

REMARKS — Glover & Taylor (2007) introduced the genus *Liralucina* to include four species from the Indo-West Pacific with strong radial ribs compared with *Parvilucina tenuisculpta* (Carpenter, 1864), the type species of *Parvilucina* from the temperate NE Pacific. Although poorly represented in museum collections and little researched, *Liralucina* species are probably widespread and sometimes abundant from the subtidal down to 300 m.

Liralucina sperabilis (Hedley, 1909)

Figures 47E, 52A-H

Phacoides sperabilis Hedley, 1909: 427, pl. 37, fig. 18.
Liralucina sperabilis – Glover & Taylor 2007: 150, figs 25, 26A.

TYPE MATERIAL — Holotype AM C.27565.

TYPE LOCALITY — Australia, Queensland, Hope Islands, 5-10 fathoms [9-18 m].

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn S1, 5 m, 2 v. – Stn S13, 8-15 m, 1 v. – Stn S21, 4-12 m, 1 v. – Stn S22 15-20 m, 1 pv (live). – Stn S25, 21 m, 1 pv, 3 v. – Stn S27, 12 m, 1 pv, 1 v. – Stn T5, 84-87 m, 1 v (very worn). – Stn T19, 10-26 m, 1 v. – Stn T31, 24 m, 2 v.

DISTRIBUTION — Shallow water to 30 m, Australia to Philippines, New Caledonia, possibly Red Sea (Zuschin & Oliver 2003: 108, pl. 25, figs 7-11).

DESCRIPTION — Shell very small, L to 4.3, H to 4.5, robust, subcircular, anteriorly extended, moderately inflated. Umbones prominent. Sculpture of 14-18 rounded radial ribs that bifurcate and intercalate. Ribs crossed by low, narrow, widely spaced, commarginal cords. Posterior and anterior dorsal areas narrow, without radial sculpture. Microsculpture of rows of shallow, semicircular pits (Figure 52H). Protoconch (Fig. 52G): PI + PII 150 µm, PI 100 µm, PII with many fine growth lines. Lunule long, smooth, slightly impressed. Ligament short sunken. Hinge: RV with single, large cardinal and prominent, short anterior and elongate posterior lateral teeth; LV with two cardinal teeth and anterior and posterior laterals. Anterior adductor muscle scar short, slightly detached from pallial line, posterior scar ovoid. Pallial line entire. Inner shell margin coarsely dentate.

REMARKS — *Liralucina sperabilis* from the Philippine samples closely resemble a possible syntype (NHMUK 1910.9.28.72) from Hope Islands, Queensland, Australia, the type locality (Glover & Taylor 2007, figs 25 G, H). *Lucina yamakawai*

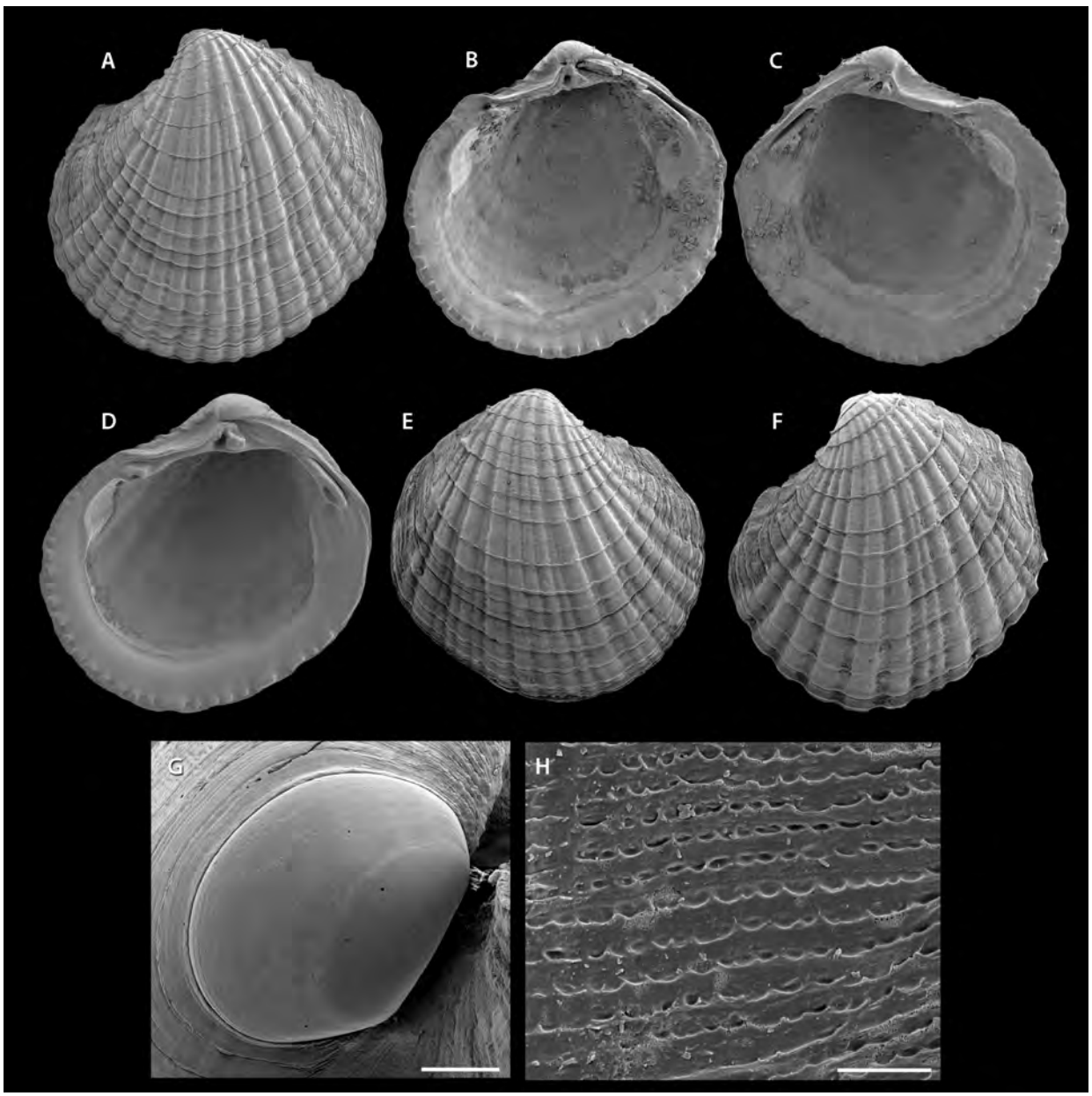


FIGURE 52

Liralucina sperabilis (Hedley, 1909). (All figured specimens from PANGLAO 2004 stn S25) — **A**-**C**, exterior of left valve and interior of right and left valves. L 2.9 mm; **D**, interior of right valve. L 2.8 mm; **E,** exterior of right valve. L 2.7 mm; **F**, exterior of left valve. L 2.4 mm; **G**, protoconch. Scale bar = 50 µm; **H**, microsculpture. Scale bar = 10 µm.

Yokoyama, 1920, classified as *Pillucina* (*Sydlorina*) in Matsukuma (2000), from Japan, is a similar species but we have not examined the type material. *Lucina pulchella* Lynge, 1909 from Thailand is also a *Liralucina* species but needs further investigation.

Liralucina lathetikosa n. sp.

Figures 47F; 53A-O

TYPE MATERIAL — Holotype MNHN IM-2000-26653, 33 paratypes MNHN IM-2000-26654, 5 NHMUK 20130667 (as listed below).

TYPE LOCALITY — Philippines, Bohol Sea, off Pamilacan Island, 9°30'N, 123°53'E, 196-216 m, sandy mud [PANGLAO 2005: stn CP2348].

MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn P4, 80-120 m, 1 v. – Stn T9, 97-120 m, 1 v. – Stn T10, 117-124 m, 1 v. – Stn T25, 160-210 m, 6 v. – Stn T27, 106-137 m, 25 v. – Stn T34, 145-163 m, 2 v. – Stn T36, 95-128 m, 2 v. – Stn T37, 134-190 m, 2 v. – PANGLAO 2005: stn DW2339, 164-176 m, 10 v. – Stn CP2343, 273-356 m, 4 v. – Stn CP2344, 128-142 m, 53 v. – Stn CP2348, 196-216 m, 1 lv, holotype MNHN IM-2000-26653 (L 6.3, H 6.0), 2 rv, (L 6.7, H 6.3; Figures 53C, D; L 6.8, H 6.3; Figures 53E, F), 31 v (unfigured) paratypes MNHN IM-2000-26654; 1 lv, paratype NHMUK 20130667 (L 7.0, H 6.6; Figures 53G, H); 2 rv, paratypes NHMUK 20130667 (L 6.3, L 5.4; Figures 53I, J); 1 lv, 1 rv, paratypes NHMUK 20130667 (L 5.3, L 5.4; Figures 53L, M); 36 v. – Stn CP2349, 219-240 m, 8 v. – Stn DW2364, 427 m, 1 v. – Stn CP2380, 150-163 m, 52 v. – Stn CP2381, 275-280 m, 7 v. – AURORA 2007: stn CP2749, 473 m, 1 v. – MUSORSTOM 3: stn CP143, 205-214 m, 50 v.

DISTRIBUTION — Philippines, empty shells in 120-473 m.

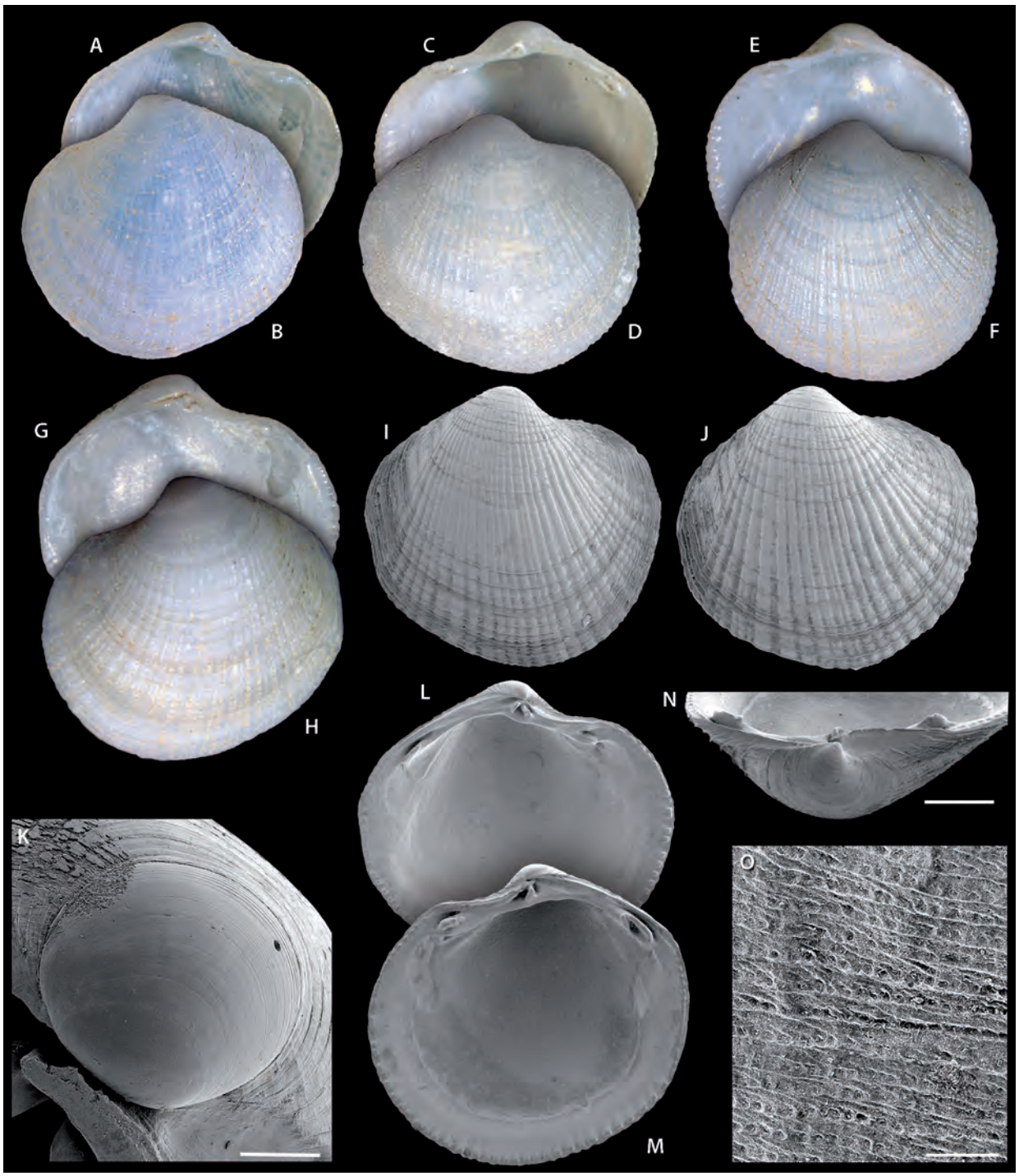
DESCRIPTION — Shells small, white to yellowish, L to 8.4, H to 7.4, T 2.8. Subcircular, slightly higher than long. Umbones prominent, central. Sculpture of *ca.* 28 low, rounded, radial ribs that intercalate and bifurcate. Ribs crossed by thin, widely-spaced, commarginal lamellae. Posterior dorsal area marked by shallow sulcus lacking radial ribs. Microsculpture very fine, roughly linear, shallow punctae (Figure 53O). Protoconch (Figure 53K): PI + PII 162 µm, P1 smooth 96 µm, PII with many regular growth increments. Ligament short, in shallow groove. Lunule short, heart-shaped. Hinge: RV with single cardinal tooth and prominent anterior and posterior lateral teeth; LV with two cardinal teeth and anterior and posterior lateral teeth. Anterior adductor muscle scar short, detached from pallial line for 1/5 of length, posterior scar ovate. Pallial line entire. Shell margin finely denticulate.

REMARKS — This new species differs from *L. sperabilis* (Hedley, 1909) in its more numerous radial ribs smaller cardinal teeth, a shallower lunule and finer microsculpture. From New Caledonia, *Liralucina craticula* Glover & Taylor 2007 and *L. lifouina* Glover & Taylor 2007 have finer and more numerous radial ribs while *L. vaubani* Glover & Taylor 2007 has a more reticulate sculpture and a very short anterior adductor scar.

ETYMOLOGY — Greek *lathetikosa*, overlooked, neglected.

FIGURE 53

Liralucina lathetikosa n. sp. (Figured specimens from PANGLAO 2004 stn CP2348, except for N) — **A**, **B**, holotype MNHN IM-2000-26653, exterior and interior of left valve. L 6.3 mm; **C**, **D**, paratype MNHN IM-2000-26654, interior and exterior of right valve. L 6.7 mm; **E**, **F**, paratype MNHN IM-2000-26654, interior and exterior of right valve. L 6.8 mm; **G**, **H**, paratype NHMUK 20130667, interior and exterior of left valve. L 7.0 mm; **I**, paratype NHMUK 20130667, exterior of right valve. L 6.3 mm; **J**, paratype NHMUK 20130667, exterior of right valve. L 5.4 mm; **K**, protoconch, PANGLAO 2004 stn T27. Scale bar = 50 µm; **L**, **M**, paratypes NHMUK 20130667, interior of left and right valves. L 5.0 mm; **N**, dorsal view of right valve. Scale bar = 1.0 mm; **O**, microsculpture. Scale bar = 10 µm.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Genus *FERROCINA* Glover & Taylor, 2007

Ferrocina Glover & Taylor, 2007: 152.

Type species. *Ferrocina multiradiata* Glover & Taylor 2007, by original designation.

DIAGNOSIS — Shell to 20 mm, thin, subovate, posteriorly truncate, sculpture of numerous fine to indistinct radial ribs crossed by fine commarginal threads. Hinge plate thin, small, single cardinal tooth in RV, two in LV, lateral teeth small or obsolete. Anterior adductor scar short, detached for 1/3 of length. Interior shell margin coarsely to finely dentate. Colour pale orange to rusty red-brown.

REMARKS — The unusual and rare genus *Ferrocina* was first recognised from Vanuatu, Fiji and New Caledonia at depths of 80-400 m (Glover & Taylor 2007). Only a few shells were found in Panglao samples.

Ferrocina luzonensis n. sp.

Figures 47G; 54A-J

TYPE MATERIAL — Holotype NHMUK 20120334/1, lv (L 13.4, H 11.3, T 3.1), paratype NHMUK 20120334/2, rv (L 10.9, H. 9.7, T 2.9), Cuming Collection.

TYPE LOCALITY — Philippines, Luzon, Bay of Batangas, 9 fthms [16.5 m], coarse sand.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn D1, 2 m, 2 v. – Stn T18, 80-100 m, 2 v. – PANGLAO 2005: stn CP2361, 563-613 m, 1 v.

DISTRIBUTION — Known only from the Philippines, 2-100 m, coarse sand. The shell from 563-613 m is most probably allochthonous.

DESCRIPTION — Shell longer than high, L to 16.6, H to 14.1, T 3.4, not inflated, anteriorly extended, anterior rounded, posteriorly truncate with shallow sulcus. Exterior with glossy, waxy appearance. Sculpture of growth increments crossed by fine radial striations. Protoconch (Figure 54J): PI + PII 165 µm, PI and PII eroded with possible growth increments in PII. Lunule inconspicuous, narrow, lanceolate. Hinge plate narrow; LV with two small cardinal teeth, the anterior smaller, lateral teeth absent, RV with single cardinal tooth. Anterior adductor scar medium-long, detached from pallial line for 1/2 of length at angle of 25°. Posterior adductor scar ovoid. Pallial line entire. Shell inside pallial line with striations or irregularly punctate. Pallial blood vessel scar visible. Shell outside pallial line smooth, shell margin finely denticulate, particularly to the anterior. Exterior and interior colour red-brown or yellow, sometimes patchy, with colour more intense in umbonal area.

REMARKS — The deeper water *F. multiradiata* from Fiji and New Caledonia (Glover & Taylor 2007) is similar but has more prominent radial ribs, a plicate shell margin and small lateral teeth. *Ferrocina brunei* Taylor & Glover (2013) from 63 m off Brunei is a smaller, patchily coloured species (L to 9 mm), with about 40 fine radial ribs, and a short anterior adductor muscle scar.

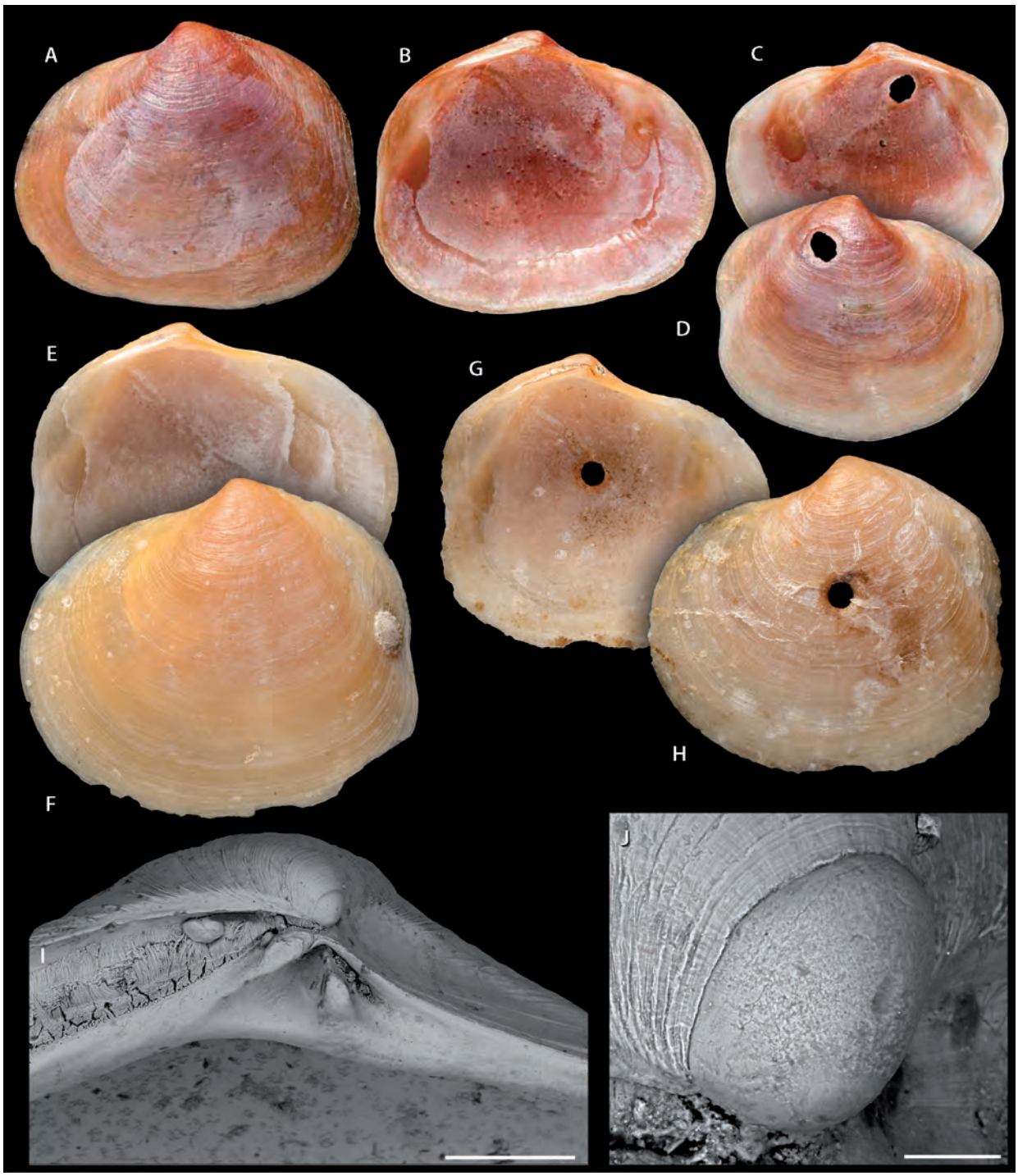


FIGURE 54

Ferrocina luzonensis n. sp. — **A**, **B**, holotype NHMUK 20120334/1, exterior and interior of left valve, Philippines, Luzon, Bay of Batangas, 9 fthms [16.5 m], coarse sand, Cuming Collection. L 13.4 mm; **C**, **D**, paratype NHMUK 20120334/2, exterior and interior of right valve, locality as above. L 10.9 mm; **E**, **F**, interior and exterior of left valve, PANGLAO 2004 stn T18. L16.4 mm; **G**, **H**, interior and exterior of left valve, PANGLAO 2004 stn T18. L 12.3 mm; **I**, hinge teeth of shell G. Scale bar = 500 µm; **J**, protoconch of shell G. Scale bar = 50 µm.

Genus *PARVIDONTIA* Glover & Taylor, 2007

Parvidontia Glover & Taylor, 2007: 168.

Type species. *Parvidontia laevis* Glover & Taylor, 2007, by original designation.

REVISED DIAGNOSIS — Shells small, thin, subcircular becoming more elongate ovate with increasing size, umbones prominent, very fine commarginal lamellae, small cardinal teeth in each valve, no lateral teeth. Anterior adductor scar narrow, detached for 4/5 of length. Pallial line entire with some dorsal extensions. Inner shell margin smooth but faint radial grooves.

REMARKS — This genus was introduced for a small, round, thin-shelled, small-toothed species from New Caledonia (Glover & Taylor 2007). Study of Philippine material revealed that adult shells differ from the juveniles that are much more rounded and less posteriorly extended and we conclude that the few small shells recovered from the New Caledonia samples were juveniles. Larger individuals are similar in shape to small, edentulous *Megaxinus* species but differ in having small cardinal teeth in both valves. From present evidence we are uncertain of the subfamilial position of *Parvidontia* but we place it provisionally within the Lucininae.

Parvidontia mutabilis n. sp.

Figures 47H; 55A-N

TYPE MATERIAL — Holotype MNHN IM-2000-26655, 2 paratypes MNHN IM-2000-26656, 1 NHMUK 20130668 (as listed below).

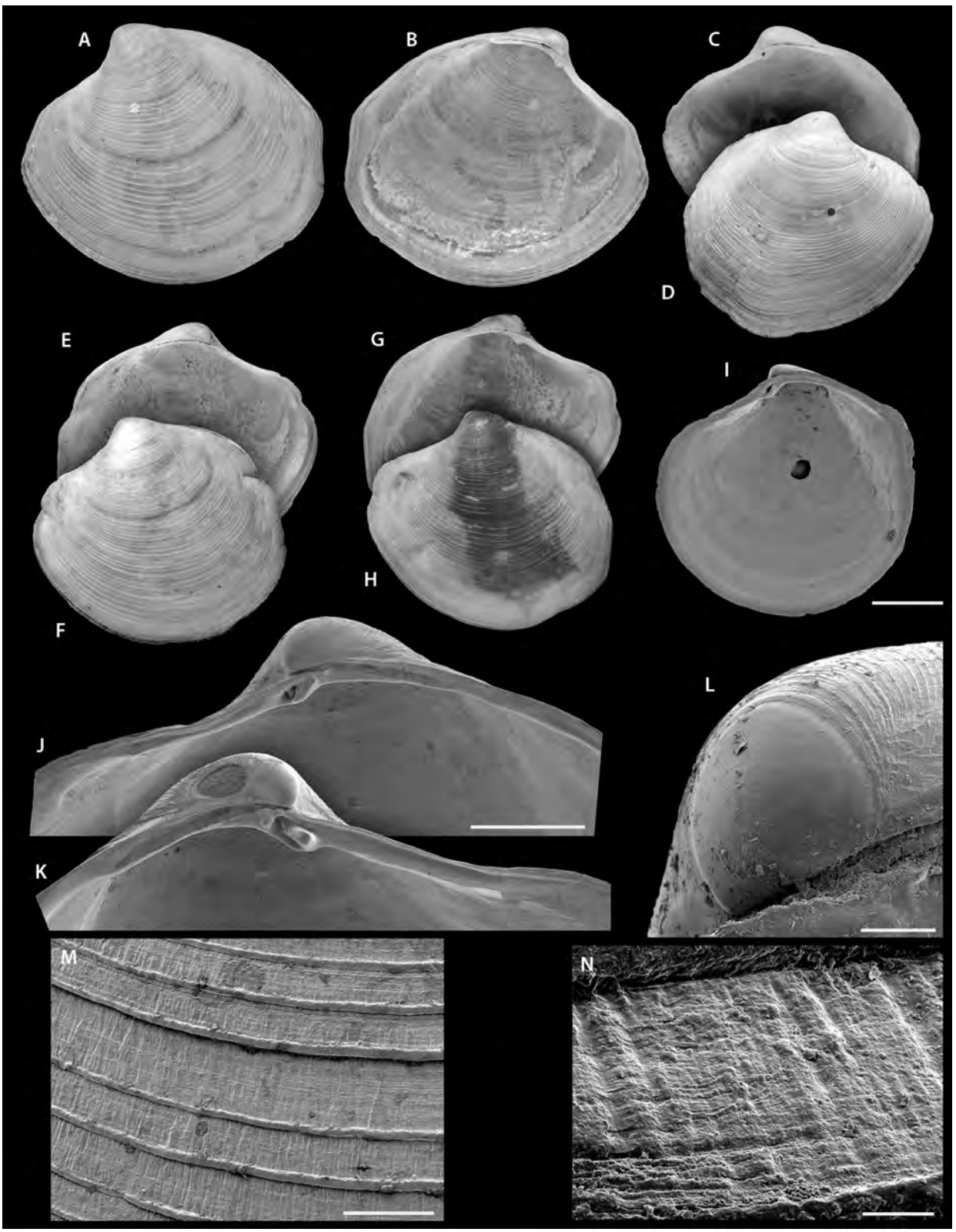
TYPE LOCALITY — Philippines, Panglao Island, off San Isidro, 9°33'N, 123°50'E, 117-124 m, mud and fine sand [Panglao 2004: stn T10].

MATERIAL EXAMINED — **Philipines**. PANGLAO 2004: stn T2, 152 m, 4 v. – Stn T5, 84-87 m, 1 v. – Stn T6, 34-82 m, 3 v. – Stn T9, 97-120 m, 1 v. – Stn T10, 117-124 m, 1 lv, holotype MNHN IM-2000-26655 (L 14.8, H 12.9, T 3.6), 2 v. – Stn T13, 90-100 m, 1 v. – Stn T27, 106-137 m, 1 rv (L 13.7, H 11.7, T 3.8; Figures 55C, D), 1 lv (L 14.1, H 11.9, T 3.8; Figures 55G, H) paratypes MNHN IM-2000-26656; 1 lv (L 13.7, H 12.6, T 3.9; Figures 55E, F) paratype NHMUK 20130668; 3 v. – Stn T28, 80 m, 4 v. – Stn T34, 145-164 m, 1 v. – Stn T36, 95-128 m, 16 v. – Stn T37, 134-190 m, 1 v. – Stn T44, 83-86 m, 3 v. – PANGLAO 2005: stn DW2339, 164-176 m, 2 v.

DISTRIBUTION — Philippines, empty shells in 80-164 m, muddy sand.

FIGURE 55

Parvidontia mutabilis n. sp. — **A**, **B**, holotype MNHN IM-2000-26655, exterior and interior of left valve, PANGLAO 2004 stn T10. L 14.8 mm; **C**, **D**, paratype MNHN IM-2000-26656, interior and exterior of right valve, PANGLAO 2004 stn T27. L 13.7 mm; **E**, **F**, paratype NHMUK 20130668, interior and exterior of left valve, PANGLAO 2004 stn T27. L 13.7 mm; **G**, **H**, paratype MNHN IM-2000-26656, interior and exterior, PANGLAO 2004 stn T27. L 14.1mm; **I**, interior of right valve, PANGLAO 2004 stn T36. Scale bar = 1.0 mm; **J**, **K**, detail of hinge of right and left valves, PANGLAO 2004 stn T36. Scale bar = 1 mm; **L**, protoconch, PANGLAO 2004 stn T36. Scale bar = 50 µm; **M**, detail of sculpture, PANGLAO 2004 stn T36. Scale bar = 200 µm; **N**, microsculpture, PANGLAO 2004 stn T36. Scale bar = 10 µm.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DESCRIPTION — Small, L to 15.0, H to 13.0, T 3.7, thin-shelled to translucent, white, subovate, anterior rostrate, posterior rounded, with prominent umbones. Shallow posterior sulcus with closely spaced lamellae. Sculpture of fine, regularly-spaced, thin, low, commarginal lamellae with very fine radial striations in interspaces. Microsculpture of fine growth increments only (Figure 55N). Protoconch (Figure 55L): PI + PII 173 µm, P1 smooth with PII a narrow rim. Ligament external, short, lunule obscure. Hinge plate narrow, teeth extremely small; RV with a single cardinal tooth, lateral teeth absent, LV with two cardinal teeth, the anterior larger and lying obliquely. Anterior adductor scar medium-long, detached for 4/5 of length diverging at an angle of 25°. Pallial line entire with some dorsal lobes. Pallial blood vessel scar not observed. Shell margin smooth to faintly dentate anteriorly. Inner shell surface slightly glossy.

REMARKS — The type species *P. laevis* Gover & Taylor, 2007 from New Caledonia is similar but *P. mutabilis* n. sp. has more prominent commarginal sculpture.

ETYMOLOGY — Latin *mutabilis,* changeable, reference to the change in shape with maturity.

Genus ***BRETSKYA*** Glover & Taylor, 2007

Bretskya Glover & Taylor, 2007: 170.

Type species. *Bretskya scapula* Glover & Taylor, 2007, by original designation.

DIAGNOSIS — Small, elongate, ovoid, highly anteriorly extended. Posterior margin sinuate, sculpture of thin, irregularly spaced commarginal lamellae. Hinge with two small cardinal teeth in LV, one in RV. Anterior adductor scar short, detached for 1/3 of length. Pallial line entire, shell margin smooth.

REMARKS — First described from the Philippines and New Caledonia with a single recognised species that is now known to inhabit crevices in sunken wood and coconut fibre (Samadi *et al.* 2010: fig. 2 'small lucinid'; Warén 2011). Molecular data place *Bretskya* in the subfamily Lucininae in a poorly supported subgroup with *Parvilucina, Troendleina* and *Bathyaustriella* (Taylor *et al.* 2011).

Bretskya scapula Glover & Taylor, 2007

Figures 47I; 56A-K

Bretskya scapula Glover & Taylor, 2007: 170, figs 40A-N.

TYPE MATERIAL — Holotype NHMUK 20050579, paratypes NHMUK 20050580, MNHN IM-2000-22682.

TYPE LOCALITY — Philippines, Bohol, Pandanan Island, Jetafe, Pipe Point, 10°10.34'N, 124°05.94'E, 5 m.

OTHER MATERIAL EXAMINED — **Philippines**. PANGLAO 2004: stn G1, 100 m, 1 v. – Stn S27, 12 m, 2 v. – Stn T6, 34-82 m, 1 v. – Stn T9, 97-120 m, 1 v. – Stn T13, 90-100 m, 2 pv. – Stn T18, 80-100 m, 4 v. – Stn T19, 10-26 m, 1 pv, 1 v. – Stn T23, 35-45 m, 1 v. – Stn T26, 123-135 m, 3 v. – StnT32, 60-62 m, 1 v. – AURORA 2007: stn DW2739, 96 m, 1 v. – MUSORSTOM 3: stn DR140, 93-99 m, 8 v.

DISTRIBUTION — Philippines, Vanuatu, New Caledonia at depths of 5-130 m.

DESCRIPTION — As for genus. Shape often irregular or distorted from habitat in wood crevices. Microsculpture of fine, raised lamellae with irregular pits (Figure 56J). Protoconch (Figure 56K): PI + PII =193 µm, PI smooth 87 µm, PII large, with many regular growth increments.

Genus ***JALLENIA*** n. gen.

Type species. *Dentilucina (Dentilucina) inanis* Prashad 1932, here designated.

DIAGNOSIS — Shell L to 20 mm, subrectangular, with an irregular shell surface. Sculpture of fine lamellae. Lunule long, sunken. Hinge with two obscure cardinal teeth in LV and one in RV, lateral teeth absent. Anterior adductor short, detached for 1/2 length. Pallial line sometimes divided, shell margin smooth, shell interior surface often with point scars of mantle attachment.

REMARKS — Cosel (2006) and Cosel & Bouchet (2008) formerly placed *D. inanis* in the genus *Tinalucina* Cosel, 2006 (type species *T. aequatorialis* Cosel, 2006 from West Africa) but this genus can be distinguished from *Jallenia* by its subcircular outline, more prominent and densely spaced commarginal lamellae and the presence of lateral teeth in both valves. Little is known of the biology and relationships of *Jallenia inanis* but it bears some resemblance in shell form and may be related to *Bretskya* (see above). It may also share a similar habitat of wood and other plant debris.

ETYMOLOGY — Named for the British marine biologist John A. Allen, in recognition of his contributions to knowledge of lucinid anatomy.

Jallenia inanis (Prashad, 1932) comb. nov.

Figures 47J; 57A-N

Dentilucina (Dentilucina) inanis Prashad, 1932: pl. 5, figs 9-10.
Tinalucina inanis – Cosel 2006: 814. — Cosel & Bouchet 2008: 191, figs 55G-I, J-M, 56G-I.
Cavatidens imajimai Habe, 1981 – Poppe & Tagaro 2011: 138, pl. 1064, fig. 1.

TYPE MATERIAL — Holotype ZMA Moll. 135310, RMNH (L 6.7, H 6).

TYPE LOCALITY — Indonesia, north coast of Sumbawa, Saleh Bay, 8°19'S, 117°41'N, 274 m [*Siboga* Expedition: stn 312].

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn G1, 100 m, 2 v. – Stn P3, 100 m, 1 pv (live). – Stn T18, 80-100 m, 2 v. – Stn T25, 160-210 m, 1 v. – Stn T26, 123-135 m, 4 v. – PANGLAO 2005: stn CP2380, 150-163 m, 1 v. – AURORA 2007: stn CP2665, 125-198 m, 1 v. – Stn DW2670, 180-187 m, 4 v. – Stn CP2715, 233-249 m, 1pv (live). – Stn CP2716, 335-356 m, 6 v. – Stn DW2738, 111-113 m, 1 v. – Stn DW2739, 96-100 m, 1 v. – Stn DW2758, 151-173 m, 1 v. – Stn CP2721, 360-367 m, 1 pv. – Stn CC2722, 313-338 m, 2 pv. – Stn CC2723, 147-156 m, 1 v. – Stn CP2762, 66 m, 1 v. – MUSORSTOM 3: stn CP66, 192-209 m, 1 v. – Stn CP100, 189-199 m, 1 v. – Stn CP112, 187-199 m, 1 v. – Stn CP139, 240-267 m, 1 pv. – Stn DR140, 93-99 m, 10 v.

DISTRIBUTION — Philippines, Indonesia to southern Japan, from 80-370 m.

DESCRIPTION —As for genus; L to 19.7, H to 16.2, T to 4.0, protoconch (Figure 57N): PI + PII 161 µm, P1 smooth 63 µm. PII large with many regular growth increments.

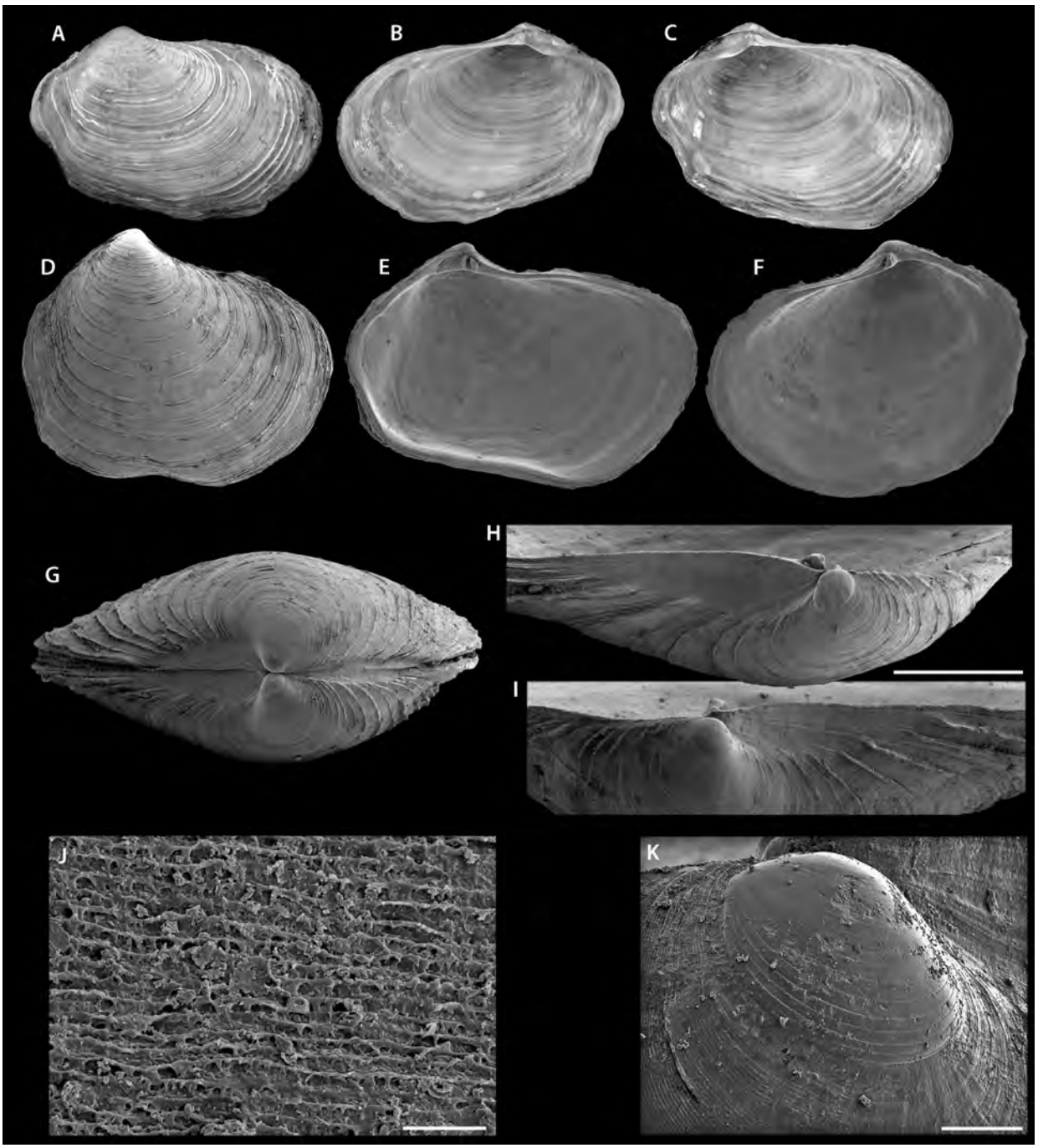


FIGURE 56

Bretskya scapula Glover & Taylor, 2007. (All figured specimens except **A**-**C** from PANGLAO 2004 stn T11) — **A**-**C**, holotype NHMUK 20050579, exterior of right valve and interior of right and left valves, Philippines, Bohol, Pandanan Island. L 6.8 mm; **D**, exterior of right valve. L 2.8 mm; **E**, interior of left valve. L 3.2 mm; **F**, interior of right valve. L 3.2 mm; **G**, dorsal view of whole shell. L 2.7 mm; **H**, **I**, dorsal view of hinge areas of left and right valves. Scale bar = 500 µm; **J**, microsculpture Scale bar = 10 µm; **K**, protoconch of I. Scale bar = 50 µm.

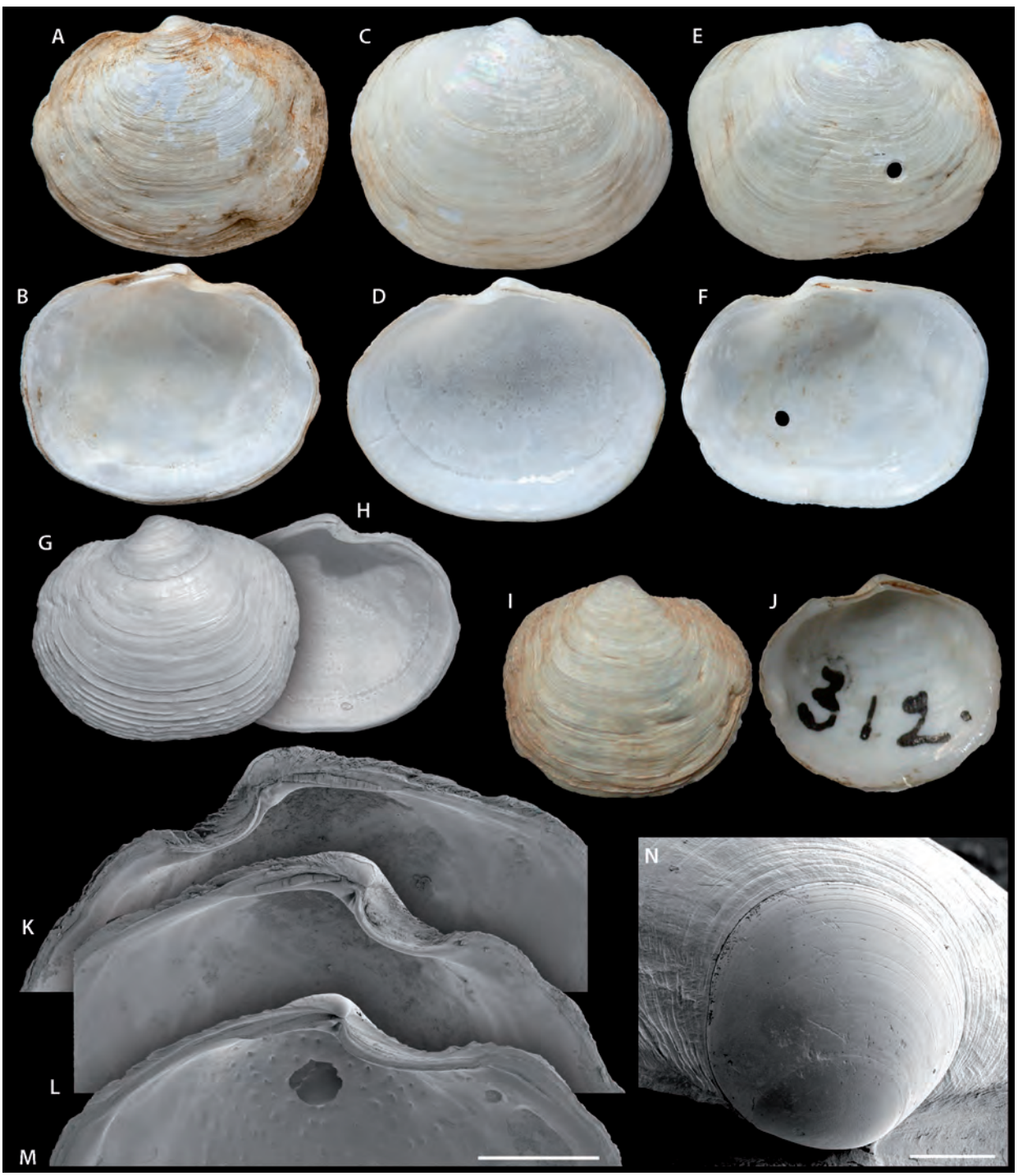


FIGURE 57

Jallenia inanis (Prashad, 1932) — **A**, **B**, exterior and interior of left valve, AURORA 2007 stn CP2716. L 13.8 mm; **C**, **D**, exterior and interior of right valve, AURORA 2007 stn CP2716. L 16.6 mm; **E**, **F**, exterior and interior of right valve, AURORA 2007 stn CP2716. L 13.5 mm; **G**, **H**, exterior and interior of left valve, MUSORSTOM 3 stn DR140. L 10.5 mm; **I**, **J**, holotype of *Dentilucina (Dentilucina) inanis*, ZMA Moll. 135310, exterior and interior of right valve. L 5.4 mm; **K**-**M**, hinge details of right valve (**K**) left valves (**L**, **M**), AURORA stn CP2717. Scale bar = 1.0 mm; **N**, protoconch showing PI and PII with prominent growth increments, PANGLAO 2004 stn T18. Scale bar = 50 µm.

REMARKS — Although known only from Indonesia and the Philippines, *Jallenia inanis* is probably more widespread in the central IWP. Figures of the holotype of *Cavatidens imajimai* Habe, 1981 (NSMT-Mo 56857) from southern Japan at 80-120 m (Higo *et al.* 2001: 160, fig. B 614) indicate that it is very similar to *J. inanis* and does not belong in the pegophysemine genus *Cavatidens*.

Genus ***CARDIOLUCINA*** Sacco, 1901

Cardiolucina Sacco, 1901 (June): 89.

Type species. *Cardium agassizii* Michelotti, 1839, by original designation.

Synonym:
Bellucina Dall, 1901 (August): 806.

Type species. *Phacoides (Parvilucina) eucosmia* Dall, 1901 [nom. nov. pro *Lucina pisum* Reeve, 1850, non J. de C. Sowerby, 1836], by original designation.

DIAGNOSIS — Usually small (<14 mm) subcircular, inflated to subspherical. Sculpture of radial ribs crossed by commarginal lamellae that are often fluted. Lunule heart-shaped, often deeply impressed. Hinge plate thick, teeth prominent, two cardinal teeth and anterior and posterior lateral teeth in both valves. Anterior adductor scar short, slightly detached from pallial line. Inner shell margin denticulate.

See Taylor & Glover (1997), Glover & Taylor (2007) and Cosel & Bouchet (2008) for further details.

REMARKS — *Cardiolucina* is one of the most speciose of Lucinidae genera and species are often abundant from the shallow intertidal to bathyal depths. In molecular analysis they form a distinct, highly supported subgroup within the Lucininae that diversified within the Miocene (Taylor *et al.* 2011). Fourteen species are now recognised in the genus: 12 from the IWP, one from southern Australia and two from the southern Atlantic. They were reviewed by Taylor & Glover (1997), but since then *C. undula* Glover & Taylor, 2007 has been described from New Caledonia and we now regard *C. macassari* (Prashad, 1932) as a distinct species rather than as a form of *C. semperiana* (Issel, 1869) (see below). Also, we previously considered that *C. semperiana* ranged eastwards as far as the Philippines but these records can now be regarded as the new species, *C. serrata,* described below. Ishikawa & Kase (2007) described multiple layers of conchiolin in the shells of the Pliocene fossil species *C. okinawaensis* (Noda, 1988) as an adaptation to resist drilling predation by naticid gastropods. From Panglao, failed naticid drillings are frequent in *C. quadrata* (Prashad, 1932).

Cardiolucina civica (Yokoyama, 1927)

Figures 58A-M; 59A

Cardium civica Yokoyama, 1927: 179, pl. 48, figs 3, 4.
Dentilucina (Bellucina) hedleyi Prashad, 1932: 163-4, pl. 5, figs 17, 18.
Bellucina civica – Kuroda, Habe & Oyama 1971: 394, pl. 118, figs 17, 18. — Poppe & Tagaro 2011: 146, pl. 1068, fig. 1.
Cardiolucina civica – Taylor & Glover 1997: 99, figs 7-9.

TYPE MATERIAL — *Cardium civica*: syntypes UMT CM24913-24914. — *Dentilucina* (*Bellucina*) *hedleyi*: holotype ZMA Moll.135313, RMNH.

TYPE LOCALITY — *C. civica*: Japan, Kaga Province, Nagaya and Kauma, Pliocene. — *D. (Bellucina) hedleyi*: Philippines, Sulu Archipelago, *Siboga* stn 105, 275 m, 6°8'N, 121°19'E.

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn T2, 152 m, 8 v. – Stn T3, 150 m, 11 v. – Stn T10, 117-124 m, 6 v. – Stn T25, 160-210 m, 1 pv, 17 v. – Stn T26, 126-135 m, 4 v. – Stn T31, 100-140 m, 12 v. – Stn T34, 145-163 m, 14 pv, 60 v. – Stn T35, 170 m, 1 v. – Stn T36, 95-128 m, 1 pv, 5 v. – Stn T37, 134-190 m, 12 v. – PANGLAO 2005: stn CP2331, 255-268 m, 12 v. – Stn DW2339, 164-176 m, 2 pv, 450 v. – Stn CP2340, 271-318 m, 30 v. – Stn CP2344, 128-142 m, 1 pv, 60 v. – Stn DW2347, 198-233 m, 4 v. – Stn CP2348, 196-216 m, 1 pv, 300 v. – Stn CP2349, 219-240 m, 83 v. – Stn CP2350, 602-738 m, 2 v. – Stn DW2364, 427 m, 1 v. – Stn DW2371, 172-175 m, 40 v. – Stn DW2376, 189-219 m, 2 v. – Stn CP2380, 150-163 m, 350 v. – Stn CP2381, 275-280 m, 69 v. – Stn CP2393, 356-396 m, 4 v. – Stn CP2399, 309-342 m, 1 v. – Stn CP2401, 397-410 m, 2 v. – Stn CP2409, 220-257 m, 5 v.

DISTRIBUTION — Eastern Indian Ocean to Fiji, Japan and Philippines from shallow water to 350 m with most records from between 150-250 m.

DESCRIPTION — Shell small, thick, L to 11.5, H to 11.5, T 4.1, outline almost circular. Shell white to yellowish white. Posterior sulcus shallow, anterior dorsal area weakly defined, sculpture of regularly spaced, rounded commarginal lamellae that are much more closely spaced in juveniles. Numerous narrow radial ribs separated by narrow interspaces. Protoconch (Figure 58J): PI +PII 182 µm, PI smooth, PII a narrow rim. Microsculpture of growth increments separated by lines of small pits (Figure 58M). Ligament short, in deep groove, lunule rounded, extremely small, lying partly under the umbones. Hinge: LV two cardinal teeth, anterior lateral tooth close to cardinal, posterior lateral present; RV with two cardinals, anterior of these small, large anterior lateral and posterior lateral. Anterior adductor scar short, detached for 1/3 of length, posterior adductor scar oval. Pallial line entire. Shell margin denticulate. Inner shell surface smooth and shiny.

REMARKS — *Cardiolucina civica* is an abundant and widespread central IWP species that occurs to depths of *ca.* 350 m. It can be distinguished from the other deep-water species from the Philippines, *C. quadrata* (Prashad, 1932) (see below), by its less quadrate, more rounded outline, more prominent commarginal and radial sculpture and less robust hinge and teeth. Huber (2015) contends that this species should be identified as *Cardiolucina hedleyi* (Pelseneer, 1911) but the name was introduced with only an anatomical drawing (Pl 14, fig 6) with no description. In our opinion there is insufficient detail to identify a particular *Cardiolucina* species. Prashad (1932) undertook formal descriptions of the Siboga bivalves and introduced the name *Dentilucina* (*Bellucina*) *hedleyi*. However, the identical *Cardium civica* Yokoyama 1927 predates this.

Cardiolucina euglypta (E.A. Smith, 1916) comb. nov.

Figures 59B; 60

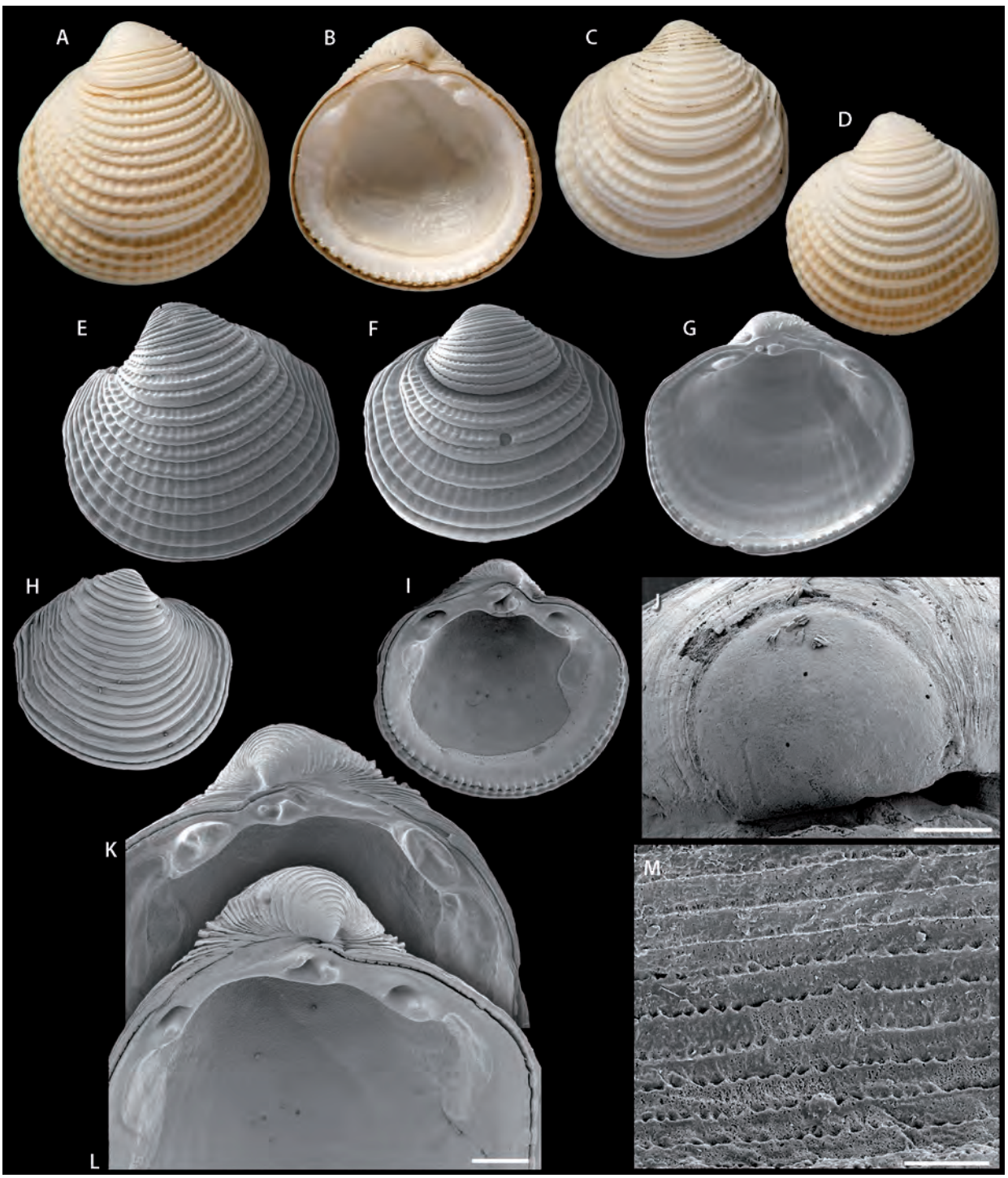
Lucina euglypta E.A. Smith, 1916: 18, pl. 1, figs 4-6.
Not *Lucina philipinarum* Hanley, 1846 – Poppe & Tagaro 2011: 138, pl. 1064, figs 5, 6.
Not *Lucina speciosa* Reeve, 1850 – Poppe & Tagaro 2011: 138, pl. 1064, figs 7, 8.

TYPE MATERIAL — 2 syntypes NHMUK 1914.6.17.56-7 (larger syntype L 16.4, H 15.4; smaller L 11.3, H 11.1).

TYPE LOCALITY — Philippines, Mindoro, Puerto Galera.

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn R9, 5-22 m, 1 pv. — Bohol Island, NHMUK, 1 pv.

DISTRIBUTION — Philippines, 5-20 m.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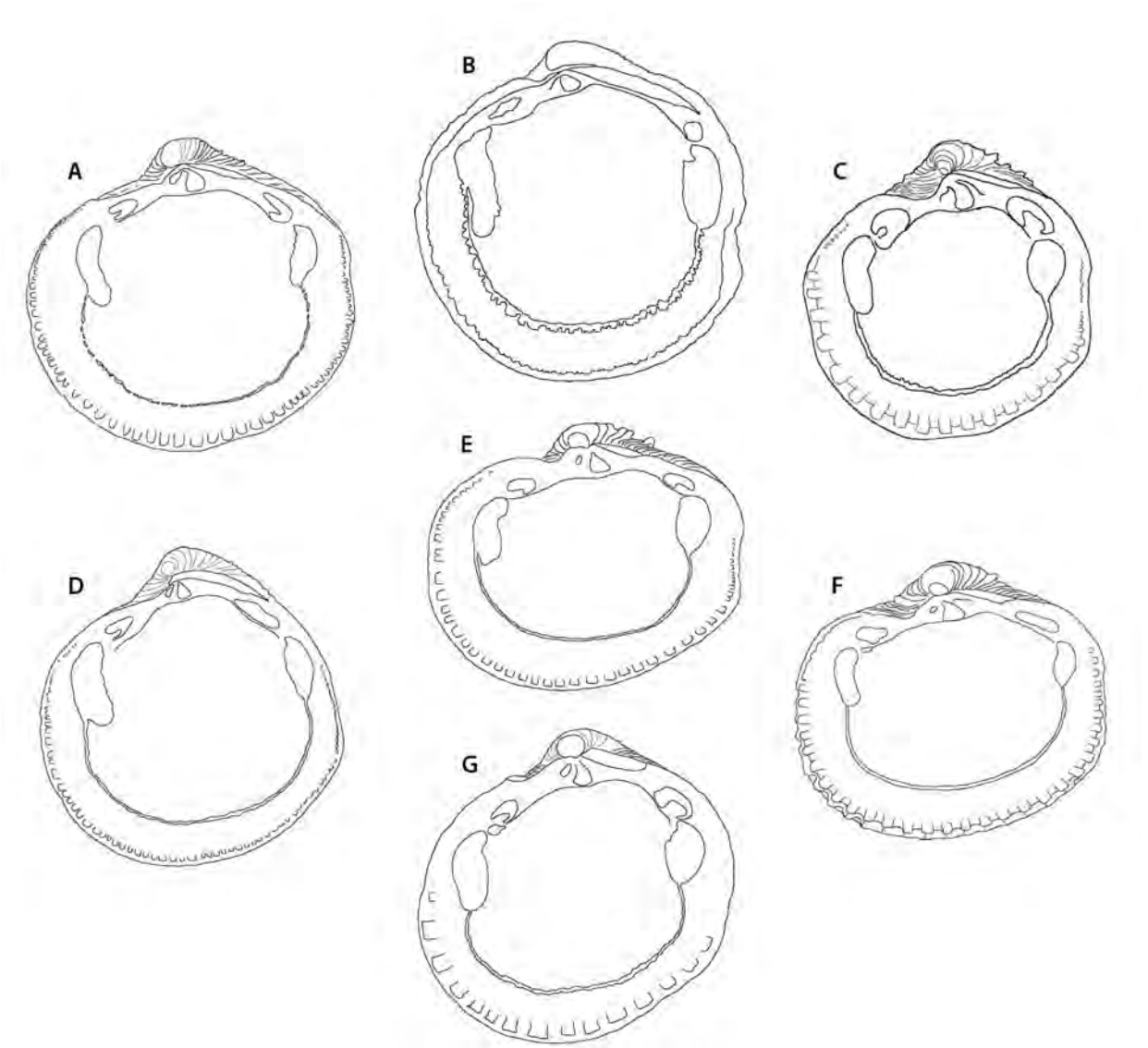


FIGURE 59

Cardiolucina species, outline drawings of shell interiors. Not to scale. **A**, *Cardiolucina civica*; **B**, *C. euglypta*; **C**, *C. macassari*; **D**, *C. quadrata*; **E**, *C. rugosa*; **F**, *C. serrata*; **G**, *C. siquijorensis*.

FIGURE 58

Cardiolucina civica (Yokoyama, 1927). (All figured specimens from PANGLAO 2004 stn CP2348) — **A**, **B**, exterior and interior of left valve. L 8.3 mm; **C**, exterior of left valve. L 7.8 mm; **D**, exterior of right valve. L 7.1 mm; **E**, exterior of left valve. L 5.2 mm; **F**, exterior of left valve. L 5.3 mm; **G**, interior of right valve. L 5.5 mm; **H**, juvenile, exterior of right valve. L 2.4 mm; **I**, juvenile, interior of left valve. L 2.3 mm; **J**, protoconch. Scale bar = 50 µm; **K**, **L**, details of hinge of right and left valves. Scale bar = 1.0 mm; **M**, microsculpture. Scale bar = 10 µm.

FIGURE 60

Cardiolucina euglypta (Smith, 1885) — **A**-**D**, exterior of left valve, interior of right and left valves and dorsal view of paired valves, PANGLAO 2004 stn R9. L 21.9 mm; **E**-**J**, *Lucina euglypta* Smith, 1915, syntypes NHMUK 1914.6.17.56-7, Puerto Galera, Mindoro, Philippines; **E**-**G**, exterior of right valve and interior right and left valves. L 11.3 mm; **H**-**J**, exterior of right valves and interior of right and left valves. L 16.4 mm.

DESCRIPTION — Shell medium size, L to 21.5, H to 22.6, subcircular H/L 1.05, inflated T/L 0.39, thick-shelled, white. Posterior sulcus prominent with marked posterior dorsal area. Umbones central. Sculpture of closely spaced, narrow commarginal lamellae, interspaces with low radial ribs with fluting where they cross commarginal lamellae, more prominent anteriorly. Radial sculpture absent in anterior and posterior dorsal areas. Lunule small, heart-shaped, tucked under umbones. Ligament long, lying in sunken, narrow groove. Hinge: LV with two single cardinal teeth that can be fused together in large specimens, anterior lateral tooth close to cardinal teeth, posterior lateral tooth; RV with two cardinal teeth fusing to one in larger specimens, anterior and posterior lateral teeth. Anterior adductor scar short, ventrally detached for 1/2 of length. Posterior adductor ovoid, pallial line entire, ventral shell margin roughly denticulate with some radial folds between margin and pallial line.

REMARKS — This is a large species from the Philippines, known from only a few specimens and here provisionally placed in *Cardiolucina*. The radial sculpture is indistinct although it shares many other *Cardiolucina* characters such as large hinge teeth and robust, inflated shells. The syntypes are immature specimens that are less inflated and thinner shelled. Compared to the other large species, *C. australopilula* Taylor & Glover, 1997 (H 13.8) from Western Australia, *C. euglypta* has finer commarginal sculpture, less prominent radials, a more defined posterior sulcus and a longer anterior adductor scar.

Cardiolucina macassari (Prashad, 1932) comb. nov.

Figures 59C; 61A-J

Dentilucina (Bellucina) macassari Prashad, 1932: 163, pl. 5, figs 13-16.
Lucina pisum Reeve, 1850 (part): pl. 11, fig. 66b (non *Lucina pisum* Sowerby, 1836 - a Cretaceous fossil species).
Cardiolucina semperiana Issel, 1869 – Taylor & Glover 1997: 107, fig. 21.

TYPE MATERIAL — *Dentilucina (B.) macassari*: holotype ZMA Moll. 135275, RMNH. — *Lucina pisum* (part): 4 paralectotypes NHMUK 1963552, Cuming Collection, Singapore, 6 fathoms [11 m], sandy mud.

TYPE LOCALITY — Indonesia, Sulawesi, Makassar, 5°06'S, 119°22'E, 32 m [*Siboga* Expedition: stn 71].

OTHER MATERIAL EXAMINED — Philippines. Corregidor, Manila Bay, intertidal, NHMUK. Thailand. Kung Kraben Bay, intertidal, NHMUK. Cambodia. Off Sihanukville, 20 m, mud NHMUK. Singapore. Johore Straits, NHMUK 1953.1.30.

DISTRIBUTION — Singapore, Thailand, Indonesia, Philippines, intertidal and shallow water.

DESCRIPTION — Shell white, very small L to 4.8, H to 5.0, highly inflated, sculpture of coarse, irregularly spaced commarginal lamellae that are prominent near the umbones, radial ribs in interspaces and intersecting with the commarginal lamellae giving a coarsely beaded appearance. Prominent posterior sulcus with commarginal lamellae only. Lunule short, heart-shaped, deep. Microsculpture of rows of shallow, fine pits (Figure 61J). Hinge robust with strong cardinal teeth in both valves, large anterior and posterior laterals in both valves. Anterior adductor scar short, barely detached from the pallial line. Pallial line entire, shell margin coarsely dentate.

REMARKS — In a previous paper we (Taylor & Glover 1997) considered *C. macassari* as an eastern form of *C. semperiana* Issel, 1869. Since then, study of more samples from the type locality shows that it is a distinct species. The syntypes of *Lucina pisum* Reeve, 1850 comprised two species, one from Singapore and the other Port Essington, Northern Territory, Australia and the selected lectotype from Port Essington has the distinctive, deeply excavated lunule as mentioned by Reeve (1850) in

the original description. As the name *L. pisum* Reeve was preoccupied by *L. pisum* J. de C. Sowerby, 1836 the replacement name *Phacoides* (*Parvilucina*) *eucosmia* Dall, 1901 is used for the northern Australian species. *Dentilucina (Bellucina) macassari* Prashad is the next oldest available name for Reeves's *Lucina pisum* from Singapore. No specimens were found amongst the PANGLAO 2004 and 2005 samples but there are specimens from Manila Bay in the NHMUK collections.

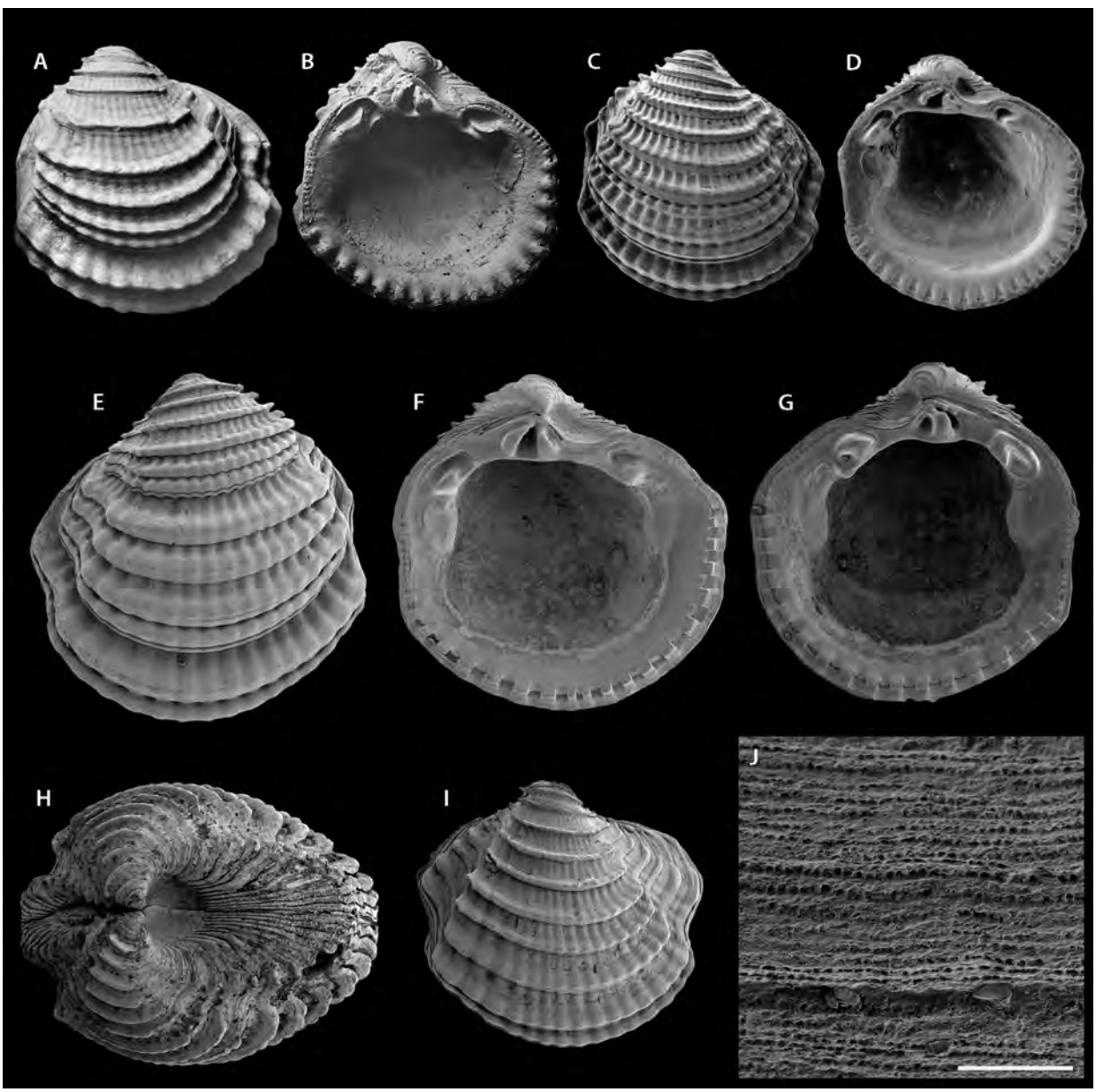


FIGURE 61

Cardiolucina macassari (Prashad, 1932) — **A**, **B**, *Dentilucina (Bellucina) macassari* Prashad, 1932, holotype ZMA Moll. 135275, exterior of right valve and interior of left valve. L 5.1 mm — **C**, **D**, *Lucina pisum* Reeve, 1850, paralectotype NHMUK 1963552, exterior of right valve and interior of left valve, Singapore. L 3.9 mm — **E**-**J**, *Cardiolucina macassari* (Prashad, 1932). **E**-**G**, exterior of right valve (L 4.8 mm), interior of left valve (L 4.6 mm) and right valve (L 4.8 mm), Indonesia, Batavia Bay (NHMUK); **H**, dorsal view of conjoined valves. L 4.5 mm; **I**, exterior of right valve. L 4.6 mm; **J**, microsculpture. Scale bar = 20 µm.

Cardiolucina quadrata (Prashad, 1932)

Figures 59D; 62A-I

Dentilucina hedleyi var. *quadrata* Prashad, 1932: 164, pl. 5, figs 19, 20.
Cardiolucina quadrata – Taylor & Glover 1997: 105, 107, figs 16, 17. — Cosel & Bouchet 2008: 125, figs 6A-K, 7. — Poppe & Tagaro 2011: 146, pl. 1068, figs 6a, b.

TYPE MATERIAL — Holotype ZMA Moll. 135315, 4 paratypes ZMA Moll. 135316, RMNH.

TYPE LOCALITY — Indonesia Sulawesi, west of Salayar, 5°54.5'S, 120°19.2'E, 462 m [*Siboga* Expedition: stn 212].

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2005: stn CP2333, 584-596 m, 1 pv, 1 v. – Stn CP2334, 606-631 m, 3 v. – Stn CP2335, 729-733 m, 20 pv, 25 v. – Stn CP2336, 757-760 m, 49 pv, 47 v. – Stn CP2341, 544-712 m, 5 v. – Stn CP2342, 1240-1258 m, 3 v. – Stn CP2350, 602-738 m, 1 pv, 2 v. – Stn CP2351, 810-812 m, 3 pv, 12 v. – Stn CP2352, 923-1260 m, 1 v. – Stn CP2362, 679-740 m, 99v. – Stn DW2364, 427 m, 1 v. – Stn CP2384, 624-647 m, 5 v. – Stn CP2388, 762-786 m, 323 pv, 87 v. – Stn CP2389, 784-786 m, 318 pv, 26 v. – Stn CP2390, 627-645 m, 4 pv, 12 v. – Stn CP2392, 242-400 m, 1v. – Stn CP2394, 470-566 m, 1 pv. – Stn CP2396, 609-673 m, 23 pv, 23 v. – Stn CP2397, 642-669 m, 24 pv, 24 v. – Stn CP2398, 713-731 m, 151 pv, 98 v. – Stn CP2399, 309-342 m, 2 v. – Stn CP2404, 481-505 m, 2 pv. – Stn CP2405, 387-453 m, 1 v. – AURORA 2007: stn CP2686, 996-1037 m, 1 v.

DISTRIBUTION — Central IWP, Philippines to Madagascar from depths between 300-1200 m in organic rich substrates.

DESCRIPTION — Shell solid, L to 12.4, H to 14.5, outline subcircular and extended anteriorly, highly inflated. Umbones prominent, deep posterior sulcus with commarginal lamellae only. Sculpture of closely spaced, rounded commarginal lamellae with radial ribs hidden in interspaces and crossing the lamellae giving a beaded appearance. Prominent growth halts. Microsculpture of rows of shallow pits (Figure 62I). Protoconch (Figure 62H): PI + PII 200 µm, PI 189 µm smooth, PII a narrow rim. Lunule small, shallow, lying almost entirely under the umbones. Hinge: solid, LV with two small cardinal teeth, very large anterior and posterior lateral teeth; RV with two cardinal teeth, anterior smaller and large anterior and posterior lateral teeth. Anterior adductor scar buttressed in older specimens, short, barely detached from pallial line; ventral margin denticulate. Inner shell within pallial line often eroded with conchiolin layers exposed.

REMARKS — This is by far the most abundant of all the deeper water lucinids around Panglao, particularly at depths between 500-1000 m. It is the deepest living of all the *Cardiolucina* species and easily distinguished by its posterior quadrate margin and beaded sculpture.

In molecular analysis, Taylor *et al.* (2011) sequenced a specimen from PANGLAO 2005 stn CP2388 that grouped in a clade of Lucininae with other *Cardiolucina* species, while Brissac *et al.* (2011) sequenced the bacterial symbiont and host from another specimen from the same station.

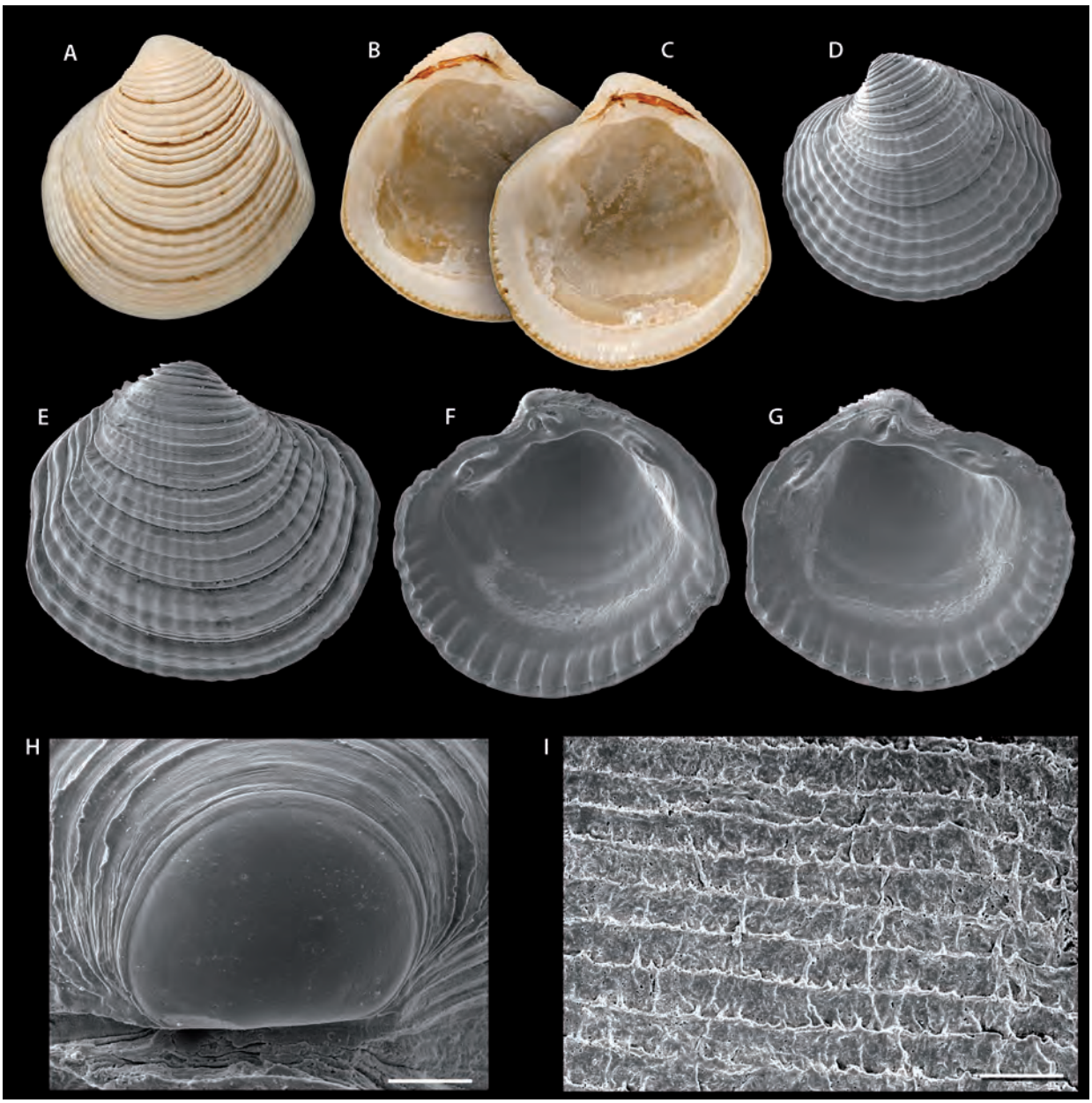


FIGURE 62

Cardiolucina quadrata (Prashad, 1932). (All figured specimens from PANGLAO 2005 stations) — **A**-**C**, exterior of left valve and interior of left and right valves, stn CP2388. L 11.9 mm; **D**, juvenile, exterior of left valve, stn CP2398. L 4.5 mm; **E**, juvenile, exterior of right valve, stn CP2398. L 4.3 mm; **F**, **G**, interior of right (L 4.4 mm) and left (L 4.2 mm) valves, stn CP2398; **H**, protoconch, stn CP2398. Scale bar = 50 µm; **I**, microsculpture, stn CP2398. Scale bar = 10 µm.

Cardiolucina rugosa (Hedley 1909)

Figures 59E; 63A-I

Lucina (Myrtea) seminula Gould, 1862: 174 (non *Lucina seminula* Deshayes, 1858).
Phacoides rugosus Hedley, 1909: 427 (replacement name for *L. seminula* Gould).
Lucina (Codakia) seminula (Gould) – Smith 1885: 180-181, pl. 13, figs 5, 5a.
Lucina seminula Gould – Johnson 1964: 148 pl. 28, fig. 3 (lectotype designation).
Cardiolucina rugosa – Taylor & Glover 1997: 107, figs 18-19.
Bellucina pisum (Reeve, 1850) – Poppe & Tagaro 2011: 146, pl. 1068, figs 2, 3 (non *Lucina pisum* J. de C. Sowerby, 1836).

TYPE MATERIAL — Lectotype USNM 553, designated by Johnson (1964).

TYPE LOCALITY — Hong Kong Harbour, 9-18 m.

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn T1, 83-100 m, 1 v. – Stn T3, 150 m, 1 pv. – Stn T4, 82 m, 4 v. – Stn T5, 84-87 m, 1 pv, 46 v. – Stn T6, 34-82 m, 8 pv, 56 v. – Stn T7 61-62 m, 1 v. – Stn T9, 97-120 m, 2 pv, 79 v. – Stn T10, 117-124 m, 8 v. – Stn T11, 78-95 m, 5 v. – Stn T14, 101-110 m, 9 v. – Stn T26 123-135 m, 2 pv, 1 v. – Stn T27 106-137 m, 1 pv, 50 v. – Stn T28, 80 m 1 pv, 113 v. – Stn T29, 77-84 m, 2 v. – Stn T30, 59-65 m, 1 v. – Stn T32, 60-62 m, 1 v. – Stn T33, 67-74 m, 1 v. – Stn T36, 95-128 m, 1 pv, 24 v. – Stn T39, 100-138 m, 2 v. – Stn T41, 110-112 m, 1 v. – Stn T44, 83-86 m, 2 pv, 13 v. – PANGLAO 2005: stn DW2370, 92-96 m, 8 v. – Stn DW2376, 189-219 m, 3 v. – Stn CP2408, 121-137 m, 9 v.

DISTRIBUTION — Central IWP from southern China to northern Australia, 10-200 m.

DESCRIPTION — Shell very small, L to 5.1, H to 4.8, longer than high, with deep posterior sulcus that lacks commarginal lamellae. Sculpture of prominent, irregularly spaced commarginal lamellae with low radial ribs in the interspaces and intersecting the commarginals; lamellae often very closely spaced in umbones. Microsculpture of close lines of irregular pits (Figure 63I). Protoconch (Figure 63H): 172 μm, all PI except for a narrow 2 μm rim. Hinge with two cardinal teeth and posterior and anterior laterals in both valves, anterior cardinal tooth small. Anterior adductor scar short detached for 1/5 length. Pallial line entire. Shell margin dentate.

REMARKS — *Cardiolucina rugosa* resembles *C. serrata* n. sp. from shallow water in the Philippines but can be distinguished by its more irregular commarginal lamellae that lack the crimped edges of *C. serrata*. It differs from *C. civica* (Yokoyama, 1927) in its more elongate shell, sharply defined posterior sulcus and the less regular commarginal lamellae. Huber (2015: 48) discusses the nomenclature of this species but we consider the position unresolved pending further molecular sampling and taxonomic study.

Cardiolucina serrata n. sp.

Figures 59F; 64A-P

Cardiolucina sp. – Taylor & Glover 1997: 115, figs 26a-c.
Bellucina semperiana (Issel, 1869) – Poppe & Tagaro 2011: 146, figs 4, 5.

TYPE MATERIAL — Holotype NHMUK 20120335/1, pv (L 4.4, H 4.6, T 2.0), 3 paratypes NHMUK 20120335/2: 1 pv (L 4.0, H 4.1, T 1.9; Figures 64D-F); 2 pv (L 3.4, H 3.5, T 1.6; L 2.6, H 2.4, T 0.8; unfigured). Cuming Collection.

TYPE LOCALITY — Philippines, Luzon, Province of Batangas, 9-10 fathoms [18 m].

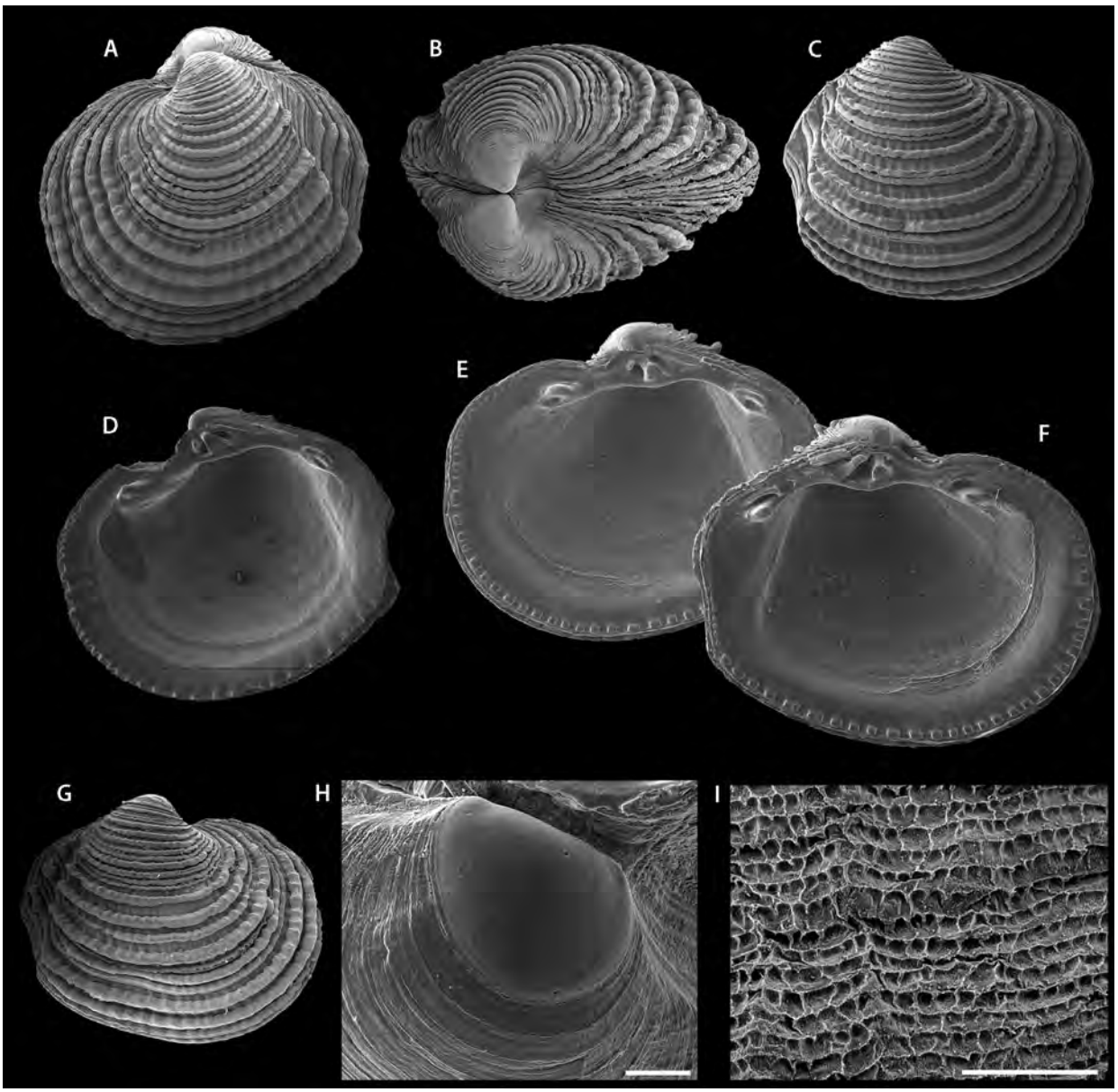
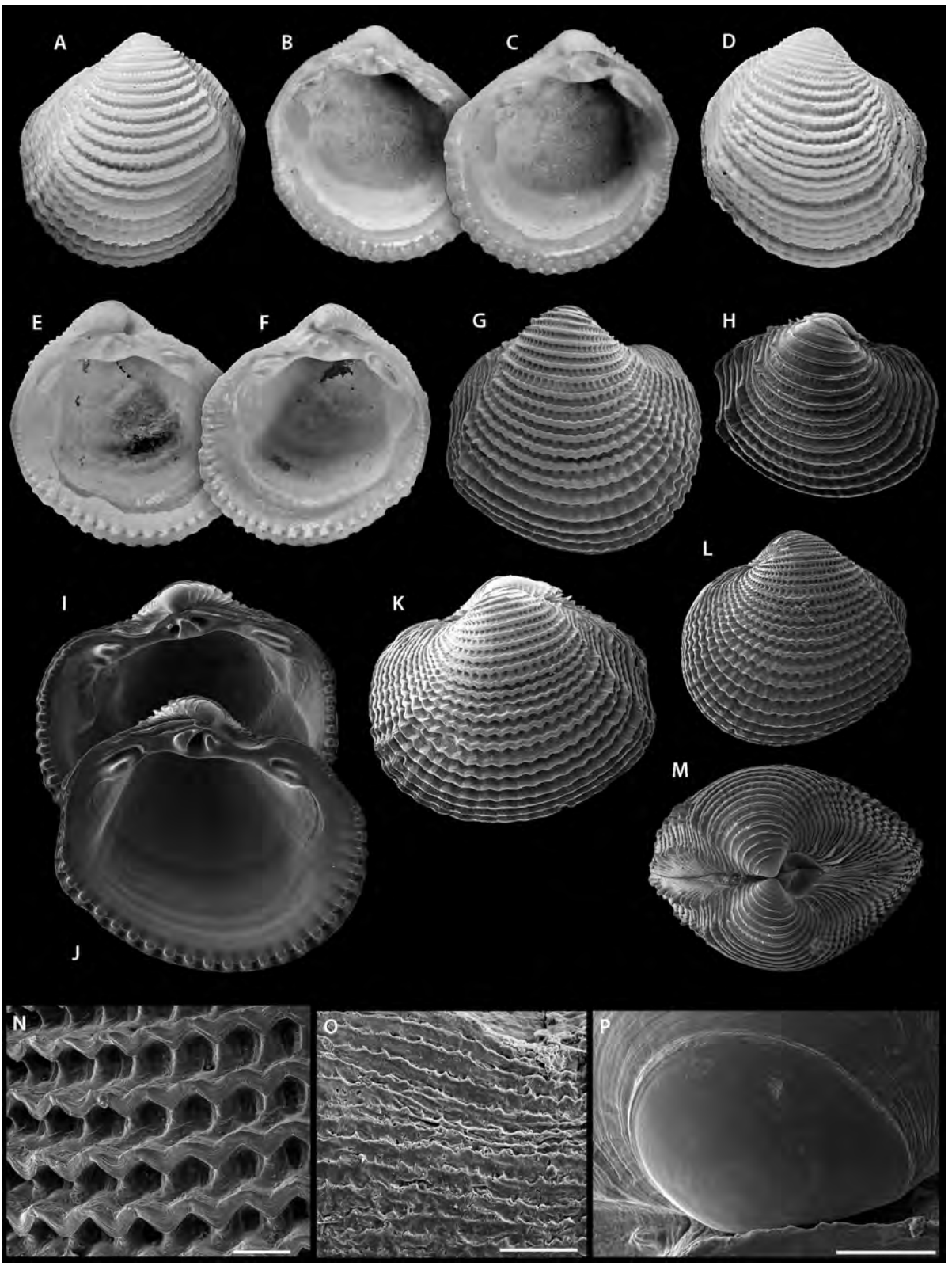


FIGURE 63

Cardiolucina rugosa (Hedley, 1909). (All figured specimens from PANGLO 2004 stations) — **A**, exterior of left valve, stn T6. L 3.3 mm; **B**, dorsal view of A. L 3.3 mm; **C**, exterior of right valve, stn T6. L 3.1 mm; **D**, juvenile, interior of right valve, stn T9. L 2.4 mm; **E**, **F**. interiors of right and left valves, stn T6. L 2.8 mm; **G**, exterior of right valve, stn T6. L 3.1 mm; **H**, protoconch, stn T9. Scale bar = 50 µm; **I**, microsculpture, stn T6. Scale bar = 20 µm.

FIGURE 64

Cardiolucina serrata n. sp. (All figured specimens except **A**-**F**, from PANGLAO 2004 stn S25) — **A**-**C**, holotype NHMUK 20120335/1, exterior of right valve, interior of left and right valves, Philippines, Luzon, Batangas. L 4.4 mm; **D**-**F**, paratype NHMUK 20120335/2, exterior of right valve and interior of left and right valves. L 3.9 mm; **G**, exterior of right valve. L 2.7 mm; **H**, juvenile shell. L 1.7 mm; **I**, **J**, juvenile, interior of right and left valves. L 2.6 mm; **K**, exterior of left valve of whole shell. L 2.7 mm; **L**, exterior of left valve. L 3.3 mm; **M**, dorsal view of K. L 2.7 mm; **N**, detail of sculpture. Scale bar = 200 µm; **O**, microsculpture. Scale bar = 10 µm; **P**, protoconch. Scale bar = 50 µm.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OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn B20, 2-8 m, 1 pv. – Stn D10, 15-22 m, 5 v. – Stn S1, 5 m, 1 v. – Stn S19, 3-4 m, 2v. – Stn S20, 10 m, 5 pv. – Stn S21, 4-12 m, 2 v. – Stn S25, 21 m, 17 pv, 24 v. – Stn S27, 12 m, 4 pv, 17 v. – Stn T14, 101-110 m, 1 v. – Stn T19, 10-26 m, 7 v. – Stn T23, 35-45 m, 3 v. – Stn T24, 35-57 m, 1 v. – Stn T26, 123-135 m, 10 v.

DISTRIBUTION — Known only from the central Philippines at depths from low intertidal to 100 m, with all living records at less than 30 m.

DESCRIPTION — Shell small, subcircular, inflated, white, L to 4.4, H to 4.6, T 2.0, posterior sulcus present, anterior dorsal area not well defined. Sculpture of closely spaced commarginal lamellae with radials deeply inset in the interspaces giving pitted appearance; where radials cross, the commarginal lamellae are fluted and crinkled. Radial sculpture absent in dorsal areas. Microsculpture of fine, *ca.* 5 µm growth increments with irregularly serrated upper margins (Figure 64O). Protoconch (Figure 64P): PI+PII 161 µm, PI 152 µm smooth, with PII a narrow rim. Lunule heart-shaped and impressed into the shell. Hinge: robust, LV with two cardinals the anterior smaller, anterior and posterior laterals; RV with two cardinals, anterior of these extremely small, anterior and posterior laterals present. Anterior adductor muscle scar short, very close to and barely detached from pallial line. Posterior adductor scar ovoid. Inner shell surface shiny. Pallial line entire. Ventral shell margin coarsely denticulate.

REMARKS — We previously recorded *C. serrata* n. sp. as *Cardiolucina* sp. in Taylor & Glover (2007) based on a few eroded specimens from other Philippine localities. In shell form, *C. serrata* can be separated from other shallow water Philippine species by the distinctive fluted commarginal lamellae, narrow radials and the prominent marginal denticles. In molecular analysis (as *Cardiolucina* new species), it groups in a subclade with the other shallow water species *C. siquijorensis* Taylor & Glover, 2007 from the Philippines and *C. pisiformis* (Thiele, 1930) from Western Australia (Taylor *et al.* 2011).

ETYMOLOGY — Derived from Latin *serra,* meaning saw, in reference to the finely fluted commarginal lamellae.

Cardiolucina siquijorensis Taylor & Glover, 1997

Figures 59G; 65A-I

Cardiolucina siquijorensis Taylor & Glover, 1997: 115, figs 25 a-d.

TYPE MATERIAL — Holotype pv USNM 812176, 2 paratypes USNM 812177, 812169.

TYPE LOCALITY — Philippines, Siquijor Island, Visayan Islands, 9°13.10'N, 123°27.30'E, 2-3 m.

OTHER MATERIAL EXAMINED — Philippines. PANGLAO 2004: stn B1, 8-14 m, 1 v. – Stn B3, 8 m, 1 v. – Stn B4, 24 m, 1 v. – Stn B11, 2-4 m, 1 v. – Stn B14, 2-4 m, 5 v. – Stn B18, 3-5 m, 13 v. – Stn B21, 20-21 m, 1 v. – Stn B31, 1-2 m, 4 v. – Stn B34, 1-2 m, 4 v. – Stn D1, 2 m, 1 pv, 12 v. – Stn D5, 0-3 m, 8 pv, 24 v. – Stn D12, 2-4 m, 2 v. – Stn M1, 0-1 m, 1 pv, 5 v. – Stn M7, 0-3 m, 3 v. – Stn M20, 0-2 m, 5 v. – Stn M26, 0-2 m, 2 pv, 1 v. – Stn M51, 0 m, 1 pv, 9 v. – Stn S2, 4-5 m, 1 v. – Stn S3, 6 m, 11 pv, 3 v. – Stn S6, 1-4 m, 1 v. – Stn S8, 28-32 m, 2 v. – Stn S11, 2 m, 7 v. – Stn S14, 5-12 m, 100 v. – Stn S20, 10 m, 9 v. – Stn S22, 15-20 m, 1 pv, 28 v. – Stn S24, 2-4 m, 115 v. – Stn S25, 21 m, 5 v. – Stn S32, 2-3 m, 9 v. – Stn S34, 2 m, 5 pv, 14 v. – Stn S38, 3-4 m, 2 v. – Stn S39, 3-4 m, 1 pv, 5 v. – Stn S43, 2-3 m, 1 pv, 1 v.

DISTRIBUTION — Central Philippines, intertidal to 20 m.

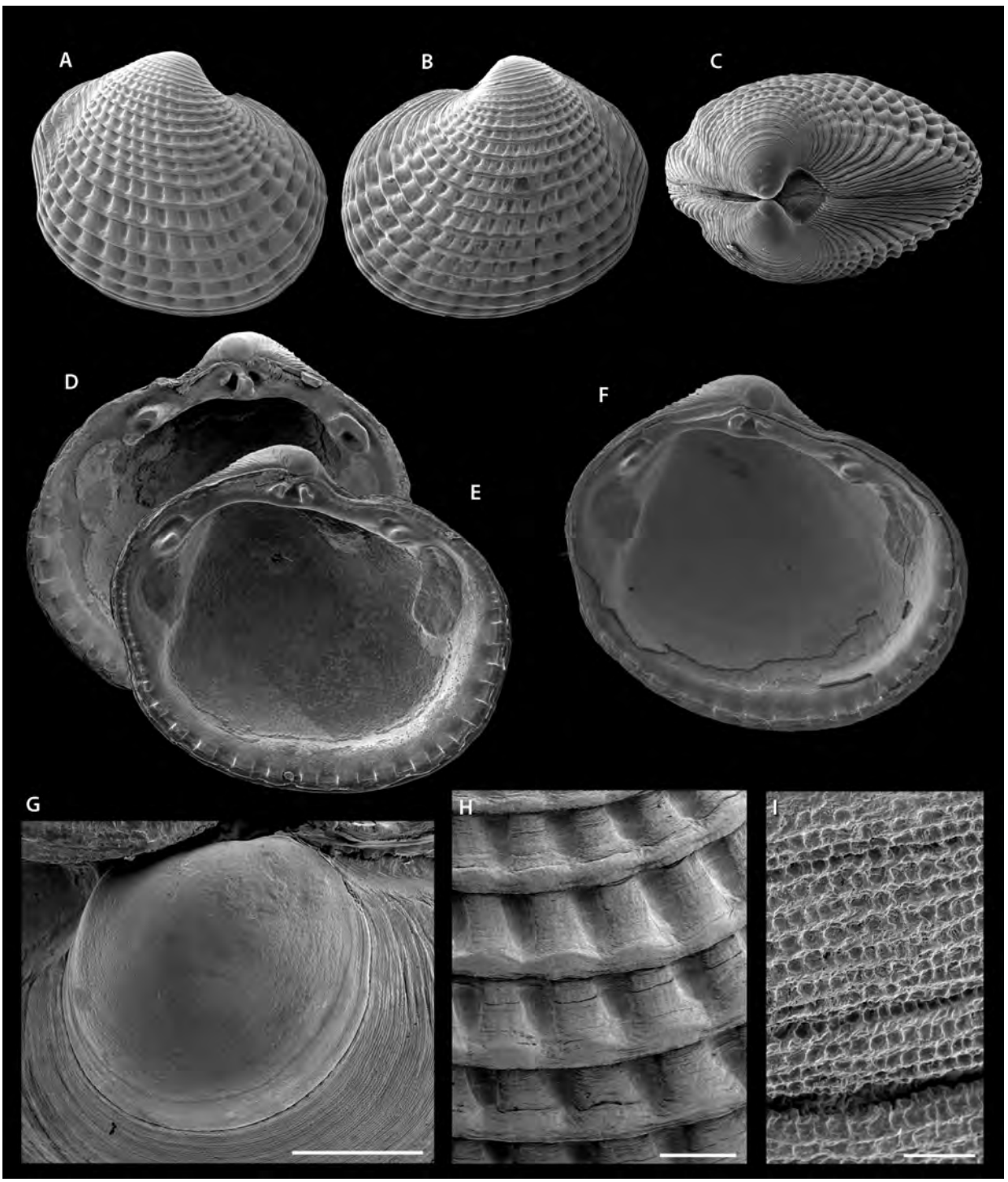


FIGURE 65

Cardiolucina siquijorensis Taylor & Glover, 1997. (All figured specimens from PANGLAO 2004 stn S3) — **A**, exterior of right valve. L 2.5 mm; **B**, exterior of left valve. L 3.0mm; **C**, dorsal view of B; **D**, **E**, interior of right and left valves. L 2.8 mm; **F**, interior of left valve. L 3.2 mm; **G**, protoconch. Scale bar = 100 µm; **H**, detail of sculpture. Scale bar = 200 µm; **I**, microsculpture. Scale bar = 10 µm.

DESCRIPTION — Shell small, subcircular, L to 3.9, H to 3.5, inflated, shallow posterior sulcus with commarginal lamellae only, anterodorsal area not well defined. Sculpture of *ca.* 16 broad radial ribs, wide interspaces, ribs slightly broader towards anterior, commarginal lamellae thin, regular and widely spaced. Microsculpture of rows of irregular pits (Figure 65I). Protoconch (Figure 65G): P1 + PII 272 µm, PI 235 µm, PII a broad rim with a few fine growth lines. Lunule shallow and heart-shaped, ligament in shallow groove, short. Hinge plate: robust, LV with two cardinals, anterior and posterior lateral teeth prominent; RV with two cardinal teeth, anterior very small to obscure, anterior and posterior laterals large. Anterior adductor short and barely detached from pallial line. Pallial line entire, ventral margin dentate.

REMARKS — *Cardiolucina siquijorensis* can be separated from other Philppine species by its broader, more prominent radial ribs. In molecular analysis *C. siquijorensis* (specimen MNHN IM-2009-10366 from PANGLAO 2004 stn M26) is a sister species to *C. pisiformis* (Thiele, 1930) from Western Australia (Taylor *et al.* 2011); they are similar in shell morphology but the latter has fewer, broader radial ribs and a more deeply impressed lunule.

RESULTS

PANGLAO

From the PANGLAO expeditions in 2004 and 2005, a total of 16,118 shell specimens were recovered with 60 species of lucinids identified (see Table 1). Forty-eight species were recognised from shallow water samples of 2004 and 31 from the deeper water dredge and trawl sampling in 2005 with some species occurring in both sampling programmes. Species range in size (height) from 1.5 to 87 mm, with 37 species less than 15 mm and 11 species less than 5 mm (Table 1; Figure 66).

For the purposes of this analysis we have combined the data from a variety of sampling methods from both the 2004 and 2005 expeditions and grouped it into depth zones across the whole sampled area; shallow water 0-20m, and subtidal samples 20-100 m, 100-200 m, 300-400 m, 400-600 m, 600-800 m and >800 m.

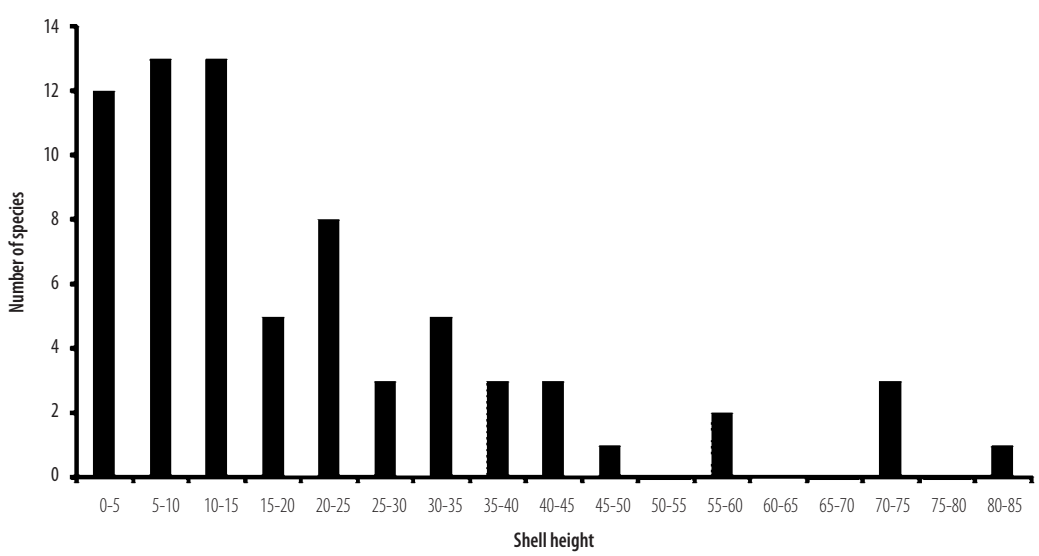


FIGURE 66
Size distribution (shell height) of lucinid species listed in Table 1.

TABLE 1

List of species recorded from PANGLAO 2004, 2005 and from other expeditions and elsewhere in the Philippines (excluding Panglao). New species described herein in bold. Adult shell height mm.

	shell height	PANGLAO 2004	PANGLAO 2005	MUSORSTOM 2, 3; AURORA 2007; ESTASE 2 cruises	other sources
Pegophyseminae					
Pegophysema philippiana	60.0	X			
Euanodontia ovum	36.0	X	X		
Euanodontia hawaiensis	23.0	X			
Cryptophysema vesicula	44.0	X			
Cryptophysema ovulum	30.0				X
Cryptophysema insulosa	30.0			X	
Cavatidens bullula	13.0	X			
Leucosphaerinae					
Leucosphaera philippinensis	11.5	X			
Alucinoma alis	21.0		X		
Dulcina musorstomi	34.0		X		
Dulcina guidoi	37.0			X	
Dulcina minor	23.0			X	
Gonimyrtea profunda	11.0		X		
Gonimyrtea celata	8.0	X			
Myrtina adamsiana	14.5	X	X		
Myrtina boholensis	5.0	X	X		
Myrtina galatea	9.3		X	X	
Myrtina spinosa	9.4			X	
Myrtina vicina	5.0			X	
Opalocina persica	3.0	X		X	
Opalocina majuscula	6.8	X			
Pseudolucinisca kantori	19.6	X	X		
Myrteinae					
Elliptiolucina magnifica	58.0			X	
Elliptiolucina labeyriei	31.0			X	
Elliptiolucina williamsae	37.2		X		
Gloverina rectangularis	29.0		X	X	
Notomyrtea catonii	11.0	X	X	X	
Notomyrtea fabula	7.5	X	X	X	
Notomyrtea flabelliformis	8.0		X	X	
Notomyrtea perfecta	3.0	X	X		
Notomyrtea scitulum	8.0				X
Notomyrtea tanimbarensis	18.5		X		
Notomyrtea triclotae	23.7			X	
Myrtea s.l. hyphalosa				X	
Rostrilucina anterostrata	42.0			X	
Taylorina alata	22.0		X		
Fimbriinae					
Fimbria fimbriata	87.0	X			
Fimbria soverbii	74.0				X
Monitilorinae					
Monitilora subtilis	22.0	X		X	

	shell height	PANGLAO 2004	PANGLAO 2005	MUSORSTOM 2, 3; AURORA 2007; ESTASE 2 cruises	other sources
Codakiinae					
Lucinoma estasia	5.5			X	
Lucinoma dulcinea	41.0		X		
Epicodakia izuensis	12.2			X	
Epicodakia sweeti	17.0	X			
Ctena bella	25.0	X			
Ctena delicatula	10.0	X			
Codakia interrupta	50.0	X			
Codakia punctata	70.0	X			
Codakia tigerina	85.0	X			
Lucininae					
Funafutia levukana	6.0	X	X		
Discolucina virginea	33.0	X			
Lepidolucina venusta	31.0			X	
Lamellolucina gemma	13.5			X	
Megaxinus quadrangularis	35.0	X	X		
Pillucina maestratii	3.7	X	X		
Pillucina pacifica	8.0	X			
Pillucina pusilla	2.0	X			
Pillucina profusa	6.0	X			
Wallucina fijiensis	15.0	X			
Chavania striata	9.2	X			
Troendleina suluensis	34.5		X	X	
Liralucina sperabilis	4.5	X			
Liralucina lathetikosa	6.6	X	X		
Ferrocina luzonensis	14.0	X	X		
Divaricella ornatissima	12.0	X	X	X	
Indoaustriella cf plicifera	9.0	x			
Austriella corrugata	71.0	X			
Parvidontia mutabilis	13.0	X	X		
Bretskya scapula	7.0	X		X	
Jallenia inanis	16.2	X	X	X	
Easmithia bractea	17.8	X	X	X	
Easmithia brevis	5.2	X		X	
Cardiolucina civica	11.5	X	X		
Cardiolucina macassari	5.0			X	
Cardiolucina quadrata	14.5		X		
Cardiolucina rugosa	4.8	X	X		
Cardiolucina serrata	3.8	X			
Cardiolucina siquijorensis	3.5	X	X		
Cardiolucina euglypta	22.6	X			
78		**48**	**31**	**17**	**3**

From shallow water stations of 0 to *ca.* 20 m, 26 lucinid species were identified from 7,495 shells (Table 2). A wide variety of substrate types were sampled. Most individuals were recovered by SCUBA suction pump and shallow dredging in soft substrates such as sand, sandy-mud and sea grass. Brushing stations from hard substrates (*e.g.*, rock platform and reef edge) yielded smaller numbers but a distinctive fauna. Intertidal hand collecting and SCUBA produced fewer individuals but some larger species not recorded by other methods. The highest species richness, up to ten lucinid species per station, was recovered from suction sampling of mud and silt substrates (see Appendix 1).

The shallow fauna was dominated by small lucinds of <10 mm, with the small (6 mm) *Pillucina profusa* by far the most abundant with over 90% of individuals, particularly from fine sand and sea grass at 0-5 m (Table 2). Other frequent species included *Cardiolucina siquijorenis, Ctena bella, Wallucina fijiensis* and *Funafutia levukana.* Intertidal collecting recovered some larger lucinids such as *Pegophysema philippiana*, *Euanodontia ovum* and *Codakia tigerina*. Brushing of hard substrates (Table 2) recovered *Funafutia levukana*, *Ctena bella*, *Pillucina profusa* and *Epicodakia sweeti*. Species from more muddy stations included the extremely small *Pillucina pusilla* and *Opalocina persica.* In contrast to the abundance of *Pillucina*, some species such as *Discolucina virginea*, *Cardiolucina euglypta, Divaricella ornatissima*, and *Ferrocina luzonensis* were rare, with only one or two individuals recovered. Surprisingly, in comparison with its abundance at some mainland SE Asian localities, only a single individual of the mangrove associated *Indoaustriella* was recovered in the *Nypa* habitat of the Abatan River.

Deeper water samples from >20 m down to 1200 m were collected by trawl and dredge with 89 stations containing lucinids (Table 3, 4; Appendix 1 & 2). A total of 43 species were recorded from 8,623 shell specimens. Some of the stations between 100-200 m were surprisingly rich with up to 11 species recorded per station (Appendix 1 & 2) and nine species per station between 650-700 m. The lucinid faunas recorded from stations below 50 m are quite distinct from those documented from shallower sites. Notable is the diversity and abundance of Leucosphaerinae and Myrteinae species that are largely absent from shallow water sites. By contrast, Codakiinae are represented just by *Lucinoma dulcinea* and the Lucininae largely by *Trondleina suluensis* and three *Cardiolucina* species, *C. rugosa*, *C. civica* and *C. quadrata*. Some species, such as *Euanodontia ovum* and *Ctena bella* have allochthonous distributions far deeper than their normal habitat range and we presume they were carried into deeper water by downslope transport.

The ranked relative abundance of species in the seven depth zones is shown in Table 4. The most diverse zones were between 100-200 m with 27 species from 2550 shells, and 22 species from 3058 specimens between 200-300 m. Below 300 m the faunas were less diverse with only six species recorded at depths greater than 800 m, although the samples were fewer. There are significant changes in the lucinid assemblages with depth; *Cardiolucina* species were common at all depths but different species dominated in different zones. For example, *Cardiolucina rugosa* comprised 51% of lucinid individuals at depths of less than 100 m, replaced by *C. civica* that dominated between 10-300 m, succeeded by *C. quadrata* that ranges between 400 to >800 m but was abundant between 600-800 m. Similar depth successions are seen with *Myrtina* and *Notomyrtea* species; *Myrtina adamsiana* and *M. boholensis* were present at 70-150 m while *M. galatea* was common at 400-600 m. At shallower sites < 100 m, *Notomyrtea perfecta* was more abundant but between 100-300 m *N. catonii* was common, succeeded by *N. tanimbarensis* at depths greater than 300 m and *N. flabelliformis* between 400-600 m. Larger species of Myrteinae, *Gloverina rectangularis* and *Elliptiolucina williamsae*, were more frequent below 400 m. Larger Leucosphaerinae include *Alucinoma alis* (150-600 m) and *Pseudolucinisca kantori* (70-400 m) and the deepest recorded lucinid species from the Panglao samples was *Taylorina alata* from 1258 m.

No lucinids were recovered from the eight other PANGLAO 2005 stations that spanned depths of 1260-2307 m.

A		
Brush stations 2-30m (B stations)	**n**	**%**
Funafutia levukana	137	34,9
Pillucina profusa	93	23,7
Ctena bella	69	17,6
Cardiolucina siquijorensis	31	7,9
Epicodakia sweeti	23	5,9
Wallucina fijiensis	21	5,4
Euanodontia ovum	6	1,5
Gonimyrtea celata	3	0,8
Ctena delicatula	3	0,8
Chavania striata	3	0,8
Codakia tigerina	1	0,3
Pillucina pacifica	1	0,3
Cardiolucina serrata	1	0,3
stns = 37		
N individuals = 392		
S species =13		

B		
Hand- collected intertidal stations 0-3m (M stations)	**n**	**%**
Pillucina profusa	136	29,4
Euanodontia ovum	126	27,3
Ctena bella	52	11,3
Pegophysema philippiana	45	9,7
Codakia tigerina	28	6,1
Cardiolucina siquijorensis	27	5,8
Wallucina fijiensis	23	5,0
Cryptophysema vesicula	12	2,6
Codakia interrupta	7	1,5
Euanodontia hawaiensis	2	0,4
Indoaustriella cf plicifera	2	0,4
Epicodakia sweeti	1	0,22
Austriella corrugata	1	0,22
stns = 26		
N = 462		
S = 13		

C		
Suction dredge stations, 2- 25m (S stations)	**n**	**%**
Pillucina profusa	3100	68,2
Cardiolucina siquijorensis	322	7,1
Wallucina fijiensis	304	6,7
Funafutia levukana	220	4,8
Ctena bella	161	3,5
Opalocina persica	118	2,6
Cardiolucina serrata	72	1,6
Epicodakia sweeti	62	1,4
Euanodontia ovum	54	1,2
Pillucina pacifica	45	1,0
Easmithia brevis	15	0,3
Ctena delicatula	14	0,3
Pillucina pusilla	11	0,2
Liralucina sperabilis	11	0,2
Codakia tigerina	6	0,1
Easmithia bractea	6	0,1
Gonimyrtea celata	5	0,1
Chavania striata	5	0,1
Notomyrtea fabula	4	0,1
Leucosphaera philippinensis	3	0,1
Euanodontia hawaiensis	2	0,0
Bretskya scapula	2	0,0
Cryptophysema vesicula	1	0,0
stns = 39		
N = 4543		
S =23		

D		
SCUBA stations 5-20m (R stations)	**n**	**%**
Codakia interrupta	9	20,5
Epicodakia sweeti	8	18,2
Fimbria fimbriata	6	13,6
Cryptophysema vesicula	4	9,1
Codakia tigerina	4	9,1
Pillucina profusa	4	9,1
Euanodontia ovum	3	6,8
Ctena bella	2	4,5
Codakia punctata	2	4,5
Pegophysema philippiana	1	2,3
Cardiolucina euglypta	1	2,3
stns = 23		
N = 44		
S = 11		

E		
Dredge stations 0-20m (D stations)	**n**	**%**
Pillucina profusa	1929	93,9
Cardiolucina siquijorensis	47	2,3
Wallucina fijiensis	23	1,1
Ctena bella	19	0,9
Euanodontia ovum	11	0,5
Cryptophysema vesicula	5	0,2
Cardiolucina serrata	5	0,2
Pegophysema philippiana	4	0,2
Codakia tigerina	3	0,1
Ferrocina luzonensis	2	0,1
Fimbria fimbriata	1	0,0
Codakia interrupta	1	0,0
Funafutia levukana	1	0,0
Discolucina virginea	1	0,0
Divaricella ornatissima	1	0,0
Easmithia brevis	1	0,0
stns = 11		
N = 2054		
S =16		

TABLE 2
Ranked abundance of Lucinidae from PANGLAO 2004 shallow stations grouped according to collection method.

TABLE 3

Unranked relative abundance of Lucinidae from trawl and dredge stations (PANGLAO 2004, 2005) tabulated in depth zones. Most abundant species in bold. *denotes likely allochthonous records.

	20 - 100m %	100 - 200m %	200 - 300 m %	300 - 400 m %	400 - 600 m %	600 - 800 m %	>800 m %
Pegophyseminae						0.37	
Euanodontia ovum *	--	--	0.16	0.76	0.64		--
Leucosphaerinae						--	
Leucosphaera philippinensis	4.09	1.57	--	--	--	0.80	--
Alucinoma alis	0.19	0.04	7.55	**67.42**	6.43	--	--
Dulcina musorstomi	--	--	0.75	--	--	--	--
Pseudolucinisca kantori	--	3.68	6.90	0.38	0.32	--	--
Myrtina adamsiana	1.36	2.12	0.03	--	--	--	--
Myrtina boholensis	0.78	2.55	0.07	--	--	5.89	--
Myrtina galatea	--	1.69	6.41	4.17	56.27	--	24.39
Opalocina persica	5.06	--	--	--	--	--	--
Opalocina majuscula	1.17	4.12	3.60	--	--	8.92	--
Gonimyrtea profunda	--	--	--	--	1.29		2.44
Myrteinae						0.21	
Notomyrtea catonii	4.28	11.92	23.97	3.03	1.93	--	--
Notomyrtea fabula	0.39	1.18	0.75	--	--	0.42	--
Notomyrtea flabelliformis	--	--	0.26	5.30	12.54	--	2.44
Notomyrtea perfecta	13.81	8.27	0.07	--	--	1.38	--
Notomyrtea tanimbarensis	--	0.27	11.25	8.33	1.29	5.04	4.88
Gloverina rectangularis	--	--	--	1.14	1.93	0.05	--
Taylorina alata	--	--	--	--	--	1.91	19.51
Elliptiolucina williamsae	--	--	0.13	0.76	4.50		--
Monitilorinae						--	
Monitilora subtilis	--	1.10	--	--	--		--
Codakiinae						1.22	
Lucinoma dulcinea	--	--	0.23	3.03	0.64	--	--
Epicodakia sweeti *	--	0.04	--	--	--	--	--
Ctena bella *	--	--	--	0.38	0.64		--
Lucininae						--	
Megaxinus quadrangularis	--	0.16	1.96	0.76	--	--	--
Pillucina maestratii	3.11	2.98	--	--	--	--	--
Pillucina profusa *	0.39	0.08	--	--	--		--
Chavania striata *		0.04				1.01	
Troendleina suluensis	--	0.12	0.10	--	7.40	--	--
Liralucina lathetikosa	--	5.96	2.19	1.52	0.32	--	--
Liralucina sperabilis	0.39	0.08	--	--	--	--	--
Ferrocina luzonensis	0.39	--	--	--	0.32	--	--
Divaricella ornatissima	0.19	--	--	--	--	--	--
Austriella corrugata *	--	--	--	--	0.32	--	--
Parvidontia mutabilis	2.53	1.22	0.07	--	--	--	--
Bretskya scapula	2.14	0.16	--	--	--	--	--
Jallenia inanis	0.39	0.24	0.03	--	--	--	--
Easmithia bractea	4.09	1.14	--	--	--	--	--
Easmithia brevis	2.14	0.27	--	--	--	0.11	--
Cardiolucina civica	--	**41.51**	**33.42**	1.89	0.96	--	--
Cardiolucina rugosa	**50.97**	7.13	0.10	--	--	**72.66**	--
Cardiolucina quadrata	--	--	--	1.14	2.25	--	**46.34**
Cardiolucina serrata	2.14	0.39	--	--	--		--
N individuals	514	2552	3058	264	311	1884	41
Number of species	21	28	22	15	18	14	6

The frequency of stations occupied by lucinids in the various depth zones, and as a total, is shown in Table 5. Some species were widely distributed among the stations; for example, *Myrtina galatea* occurred at 38% of the 89 stations, with *Notomyrtea catonii* and *Cardiolucina civica* at 30%, followed by *Notomyrtea tanimbarensis*, *Cardiolucina rugosa* and *C. quadrata* at 26%. Some species inhabited narrow depth zones with *Gloverina rectangularis* and *Cardiolucina quadrata* occurring at 85% and 94% of stations between 600-800 m, respectively. One of the rarer species is *Taylorina alata* that only occurred at three stations below 800 m.

A summary of the depth distribution of all the species recorded from PANGLAO 2004 & 2005, MUSORSTOM 2 & 3 and AURORA 2007, both dead and live-collected, is shown in Figure 67.

Other research cruises

In addition to the species recorded from Panglao, a number of species have been recorded from other expeditions including MUSORSTOM 2 & 3, AURORA 2007 and ESTASE 2 (see Appendix for details). The larger species from MUSORSTOM 2 & 3 were documented by Cosel & Bouchet (2008) who described 14 new species and five new genera from Philippine samples, but six of these, *Dulcina guidoi*, *D. minor*, *Elliptiolucina magnifica*, *E. labeyriei*, *Rostrilucina anterorostrata* and *Notomyrtea triclotae*, were not recorded in the Panglao samples. We describe here a further two species, *Myrtina spinosa* and *M. vicina* from MUSORSTOM 2 station DR140 that also included *Lamellolucina gemma* not present in the Panglao samples. Relatively few lucinids were recovered from the AURORA 2007 cruise, but included *Lepidolucina venusta* and well-preserved shells of *Jallenia inanis* and *Easmithia bractea*.

The ESTASE 2, 1984 cruise yielded three species of lucinids from a single station (CP6) in the southern Philippines at 2570 m; *Elliptiolucina labeyriei* Cosel & Bouchet was described in 2008 and two other new species are considered here: *Myrtea s.l. hyphalosa* and *Lucinoma estasia*. This cruise was largely geoscience-based and only a few biological samples were recovered.

Museum collections and literature records

In addition to the Panglao and other material from French expeditions, we have used existing museum collections and literature records to further document the lucinid fauna of the Philippines. Even in shallow water there are obscure species such as *Notomyrtea scitulum* (A. Adams, 1853), first described as *Gafrarium (Corbis)* and never previously figured. *Cardiolucina euglypta* (E. A. Smith, 1916) has rarely been mentioned since the first description; Lamy (1920: 181) wrongly considered it similar to *Lamellolucina gemma*. The type material of the rare *Ferrocina luzonensis* n. sp. comprises specimens collected in the Philippines by Hugh Cuming in the 1830s as were *Lamellolucina gemma* (Reeve, 1850) and figured specimens of *Lepidolucina venusta* (Philippi, 1850).

Other lucinids have been recorded from the Philippines but the records are spurious or doubtful. Two species described by Reeve with Philippine localities (and listed by Hidalgo in 1904-5) are from the western Atlantic: *Lucina bicornis* Reeve, 1850 (syntypes NHMUK 1963116-7) is *Phacoides pectinatus* (Gmelin, 1791) and, judging from the figure, *Lucina malum* Reeve, 1850 (type not located) is probably a shell of *Anodontia alba* Link, 1805 with a dark orange interior. Reeve (1850) also recorded the northeastern Atlantic species *Lucinoma borealis* from the Philippines but this again is a spurious locality. Another species, *Lucina sericata* Reeve, 1850 (syntypes NHMUK 1963131/1-3) belongs in the Ungulinidae.

Some other species recorded from the Philippines are unconfirmed. *Codakia paytenorum* Iredale, 1930 recorded by Poppe & Tagaro (2011: 140, pl. 1065, figs 1, 2) is the similar species *Codakia interrupta* (Lamarck, 1818) although the true *C. paytenorum* could also be present in the Philippines. Similarly, we are uncertain whether *Pegophysema bialata* (Pilsbry, 1895) [synonym *P. stearnsiana* (Oyama, 1954)] occurs in the Philippines although the name, as *Anodontia stearnsiana*, is used in publications (Poppe & Tagaro 2011, plate 1063, figs 4, 5) but neither of the two shells illustrated is that species. The

TABLE 4

Ranked relative abundance of Lucinidae in depth zones from trawl and dredged stations (PANGLAO 2004, 2005).

A			B			C		
2-100 m	**n**	**%**	**100-200 m**	**n**	**%**	**200 - 300 m**	**n**	**%**
Cardiolucina rugosa	262	51.0	*Cardiolucina civica*	1059	41.51	*Cardiolucina civica*	1022	33.42
Notomyrtea perfecta	71	13.8	*Notomyrtea catonii*	304	11.92	*Notomyrtea catonii*	733	23.97
Opalocina persica	26	5.1	*Notomyrtea perfecta*	211	8.27	*Notomyrtea tanimbarensis*	344	11.25
Notomyrtea catonii	22	4.3	*Cardiolucina rugosa*	182	7.13	*Alucinoma alis*	231	7.55
Leucosphaera philippinensis	21	4.1	*Liralucina lathetikosa*	152	5.96	*Pseudolucinisca kantori*	211	6.90
Easmithia bractea	21	4.1	*Opalocina majuscula*	105	4.12	*Myrtina galatea*	196	6.41
Pillucina maestratii	16	3.1	*Pseudolucinisca kantori*	94	3.68	*Opalocina majuscula*	110	3.60
Gonimyrtea celata	3	0.8	*Pillucina maestratii*	76	2.98	*Liralucina lathetikosa*	67	2.19
Parvidontia mutabilis	13	2.5	*Myrtina boholensis*	65	2.55	*Megaxinus quadrangularis*	60	1.96
Bretskya scapula	11	2.1	*Myrtina adamsiana*	54	2.12	*Dulcina musorstomi*	23	0.75
Easmithia brevis	11	2.1	*Myrtina galatea*	43	1.69	*Notomyrtea fabula*	23	0.75
Cardiolucina serrata	11	2.1	*Leucosphaera philippinensis*	40	1.57	*Notomyrtea flabelliformis*	8	0.26
Myrtina adamsiana	7	1.4	*Parvidontia mutabilis*	31	1.22	*Lucinoma dulcinea*	7	0.23
Opalocina majuscula	6	1.2	*Notomyrtea fabula*	30	1.18	*Euanodontia ovum*	5	0.16
Myrtina boholensis	4	0.8	*Easmithia bractea*	29	1.14	*Elliptiolucina williamsae*	4	0.13
Notomyrtea fabula	2	0.4	*Monitilora subtila*	28	1.10	*Troendleina suluensis*	3	0.10
Pillucina profusa	2	0.4	*Cardiolucina serrata*	10	0.39	*Cardiolucina rugosa*	3	0.10
Liralucina sperabilis	2	0.4	*Notomyrtea tanimbarensis*	7	0.27	*Myrtina boholensis*	2	0.07
Ferrocina luzonensis	2	0.4	*Easmithia brevis*	7	0.27	*Notomyrtea perfecta*	2	0.07
Jallenia inanis	2	0.4	*Jallenia inanis*	6	0.24	*Parvidontia mutabilis*	2	0.07
Alucinoma alis	1	0.2	*Megaxinus quadrangularis*	4	0.16	*Myrtina adamsiana*	1	0.03
Divaricella ornatissima	1	0.2	*Bretskya scapula*	4	0.16	*Jallenia inanis*	1	0.03
			Troendleina suluensis	3	0.12			
N individuals = 514			*Pillucina profusa*	2	0.08	N = 3058		
S species = 21			*Liralucina sperabilis*	2	0.08	S = 22		
			Alucinoma alis	1	0.04			
			Epicodakia sweeti	1	0.04			
			Chavania striata	1	0.04			
			N = 2551					
			S = 28					

D		
300-400 m	**n**	**%**
Alucinoma alis	178	67.4
Notomyrtea tanimbarensis	22	8.33
Notomyrtea flabelliformis	14	5.3
Myrtina galatea	11	4.17
Notomyrtea catonii	8	3.03
Lucinoma dulcinea	8	3.03
Cardiolucina civica	5	1.89
Liralucina lathetikosa	4	1.52
Gloverina rectangularis	3	1.14
Cardiolucina quadrata	3	1.14
Euanodontia ovum	2	0.76
Elliptiolucina williamsae	2	0.76
Megaxinus quadrangularis	2	0.76
Pseudolucinisca kantori	1	0.38
Ctena bella	1	0.38
N individuals = 264		
S species = 15		

E		
400-600 m	**n**	**%**
Myrtina galatea	175	56.27
Notomyrtea flabelliformis	39	12.54
Troendleina suluensis	23	7.40
Alucinoma alis	20	6.43
Elliptiolucina williamsi	14	4.50
Cardiolucina quadrata	7	2.25
Notomyrtea catonii	6	1.93
Gloverina rectangularis	6	1.93
Gonimyrtea profunda	4	1.29
Notomyrtea tanimbarensis	4	1.29
Cardiolucina civica	3	0.96
Euanodontia ovum	2	0.64
Lucinoma dulcinea	2	0.64
Ctena bella	2	0.64
Pseudolucinisca kantori	1	0.32
Liralucina lathetikosa	1	0.32
Ferrocina luzonensis	1	0.32
Austriella corrugata	1	0.32
N = 311		
S = 18		

F		
600-800 m	**n**	**%**
Cardiolucina quadrata	1369	72.66
Gonimyrtea profunda	168	8.92
Myrtina galatea	111	5.89
Gloverina rectangularis	95	5.04
Elliptiolucina williamsae	36	1.91
Notomyrtea tanimbarensis	26	1.38
Lucinoma dulcinea	23	1.22
Troendleina suluensis	19	1.01
Alucinoma alis	15	0.80
Notomyrtea flabelliformis	8	0.42
Euanodontia ovum	7	0.37
Notomyrtea catonii	4	0.21
Cardiolucina civica	2	0.11
Taylorina alata	1	0.05
N = 1884		
S = 14		

G		
>800 m	**n**	**%**
Cardiolucina quadrata	19	46.34
Myrtina galatea	10	24.39
Taylorina alata	8	19.51
Notomyrtea tanimbarensis	2	4.88
Gonimyrtea profunda	1	2.44
Notomyrtea flabelliformis	1	2.44
N = 41		
S = 6		

large edible species, *Pegophysema philippiana* (Reeve, 1850), is often cited as *Anodontia edentula* (Linnaeus, 1758) but see Taylor & Glover (2005) for a discussion of nomenclature of this species. *Anodontia semiasperatoides* (*sic*) (Nomura, 1932), recorded by Poppe & Tagaro (2011, pl. 1063, fig. 3) is an Ungulinidae, *Cycladicama semiasperoides* (Nomura, 1932). The specimen named *Myrtea minima* Okutani, 1964 in Poppe & Tagaro (2011:144, pl. 1067, fig 3) is *Easmithia bractea* n. sp. Furthermore, the shells figured by Poppe & Tagaro (2011: 144, pl. 1067, figs 6-8) as *Myrtea lamellosa* and *Myrtea tanimbarensis* are species of Semelidae. Misidentifications continue with Masagca *et al.* (2010) recording the northeastern Pacific *Lucinoma annulata* (Reeve, 1850) and the Western Atlantic *Anodontia alba* Link, 1807 from Philippine mangroves.

In summary, Table 1 lists the Lucinidae we recognise from the Philippines. This list combines records from Panglao, other research expeditions and existing museum collections. The lucinid fauna of Philippines, from depths of 0-2750 m, totals 78 species, 42 genera from 7 subfamilies. Undoubtedly, further sampling, especially at bathyal depths, will yield more new lucinids and new records.

MORPHOLOGY OF LARVAL SHELLS

Measurements and descriptions of protoconch characters were obtained for 53 lucinid species, and summarized in Table 6. These species represent six different subfamilies sampled from a range of water depths and habitats. All observed PIs are D-shaped, with smooth profiles. Protoconch size (PI+ PII) ranged from 134-272 µm, with lengths of PI from 63-240 µm. Ten species have protoconchs larger than 200 µm, the largest being *Lucinoma estasia* 275 µm and *Cardiolucina siquijorensis* at 272 µm, but the majority ranged between 150-200 µm. The smallest protoconchs of 134-150 µm were *Liralucina lathetikosa*, *Pillucina* spp. and *Wallucina fijiensis*. In general, smaller protoconchs have more growth in PII.

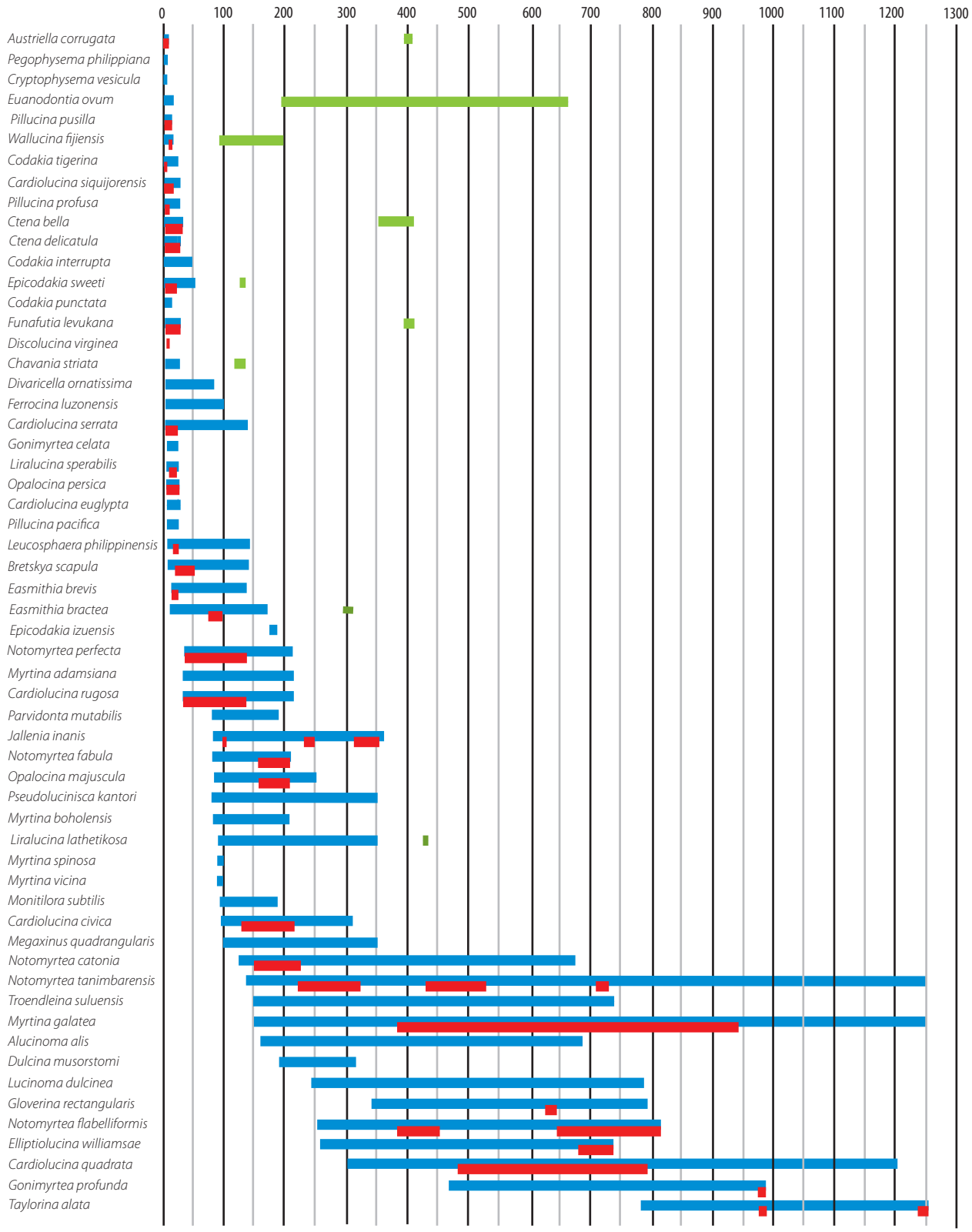
There is a strong phylogenetic signal in protoconch characters and Figure 68 illustrates four major types. Most Leucosphaerinae, particularly *Alucinoma* and *Myrtina* species have protoconchs from 166-265 µm with PII generally a rim of 8-15 µm. Exceptions are *Leucosphaera philippinensis* and *Opalocina* spp. that have PII stages with many growth increments. All Myrteinae, *Notomyrtea* spp., *Gloverina*, *Elliptiolucina* have protoconchs from 164-210 µm with PII consisting of a narrow rim of less than 8 µm. *Monitilora subtilis* (Monitilorinae) is similar. Amongst the Codakiinae, *Lucinoma estasia* has a large protoconch of 275 µm with a rim of 30 µm and in *L. dulcinea* the protoconch is 230 µm with an 8-15 µm rim. For *Epicodakia sweeti*, *Ctena bella, C. delicatula* and *Codakia tigerina* the protoconchs were 160-190 µm with numerous growth increments in PII, while *Codakia interrupta* has a protoconch of 190 µm with very few growth increments in PII; similarly *E. izuensis* has a protoconch of 180 µm with a narrow PII. Amongst the Lucininae, protoconch size varies between 134-265 µm. The majority of species have significant growth increments in PII, excepting the five *Cardiolucina* species, which have the largest protoconchs but with PII present only as a narrow rim. Two other species, *Parvidontia mutabilis* and *Megaxinus quadrangularis*, also have PII as narrow rims.

In general, deeper water species (below 100 m) have a larger PI with PII as narrow rims indicating a lack of, or very short period of, planktonic feeding. By contrast, most of the shallow water species have PIIs with multiple growth increments indicating a significant period of planktonic feeding. Except for *Codakia interrupta*, most intertidal species have significant growth in PII. Additionally, amongst the *Cardiolucina* species, even the very shallow water *C. siquijorensis* and *C. serrata* have narrow rims and no growth in PII, a state more typical of deeper water taxa, including *C. quadrata* that ranges down to 1000 m.

TABLE 5

Occurrence of deeper water lucinid species at dredge and trawl stations, number and % of stations occupied.

	20-100 m	100-200 m	200-300 m	300-400 m	400-600 m	600-800 m	>800 m	total	%
Euanodontia ovum	0	0	4	2	1	3	0	10	11.2
Leucosphaera philippinensis	6	7	0	0	0	0	0	13	14.6
Alucinoma alis	1	1	7	6	3	2	0	20	22.5
Dulcina musorstomi	0	0	6	0	0	0	0	6	6.7
Pseudolucinisca kantori	0	9	6	1	1	0	0	17	19.1
Myrtina adamsiana	3	7	1	0	0	0	0	11	12.4
Myrtina boholensis	2	10	0	0	0	0	0	12	13.5
Myrtina galatea	0	1	8	3	9	9	4	34	38.2
Opalocina persica	2	0	0	0	0	0	0	2	2.2
Opalocina majuscula	1	4	4	0	0	0	0	9	10.1
Gonimyrtea profunda	0	0	0	0	3	2	1	6	6.7
Notomyrtea catonii	2	10	6	3	4	2	0	27	30.3
Notomyrtea fabula	1	6	1	0	0	0	0	8	9.0
Notomyrtea flabelliformis	0	0	4	2	7	5	1	19	21.3
Notomyrtea perfecta	5	9	0	0	0	0	0	14	15.7
Notomyrtea tanimbarensis	0	2	7	4	2	6	2	23	25.8
Gloverina rectangularis	0	0	0	2	3	11	0	16	18.0
Taylorina alata	0	0	0	0	0	1	2	3	3.4
Elliptiolucina williamsae	0	0	1	2	3	1	0	7	7.9
Monitilora subtilis	0	9	0	0	0	0	0	9	10.1
Lucinoma dulcinea	0	0	2	3	1	7	0	13	14.6
Epicodakia sweeti	0	1	0	0	0	0	0	1	1.1
Ctena bella	0	0	0	1	1	0	0	2	2.2
Megaxinus quadrangularis	0	4	3	1	0	0	0	8	9.0
Pillucina maestratii	4	5	0	0	0	0	0	9	10.1
Pillucina profusa	2	2	0	0	0	0	0	4	4.5
Chavania striata	0	1	0	0	0	0	0	1	1.1
Troendleina suluensis	0	2	2	0	2	1	0	7	7.9
Liralucina lathetikosa	0	10	3	1	1	0	0	15	16.9
Liralucina sperabilis	2	1	0	0	0	0	0	3	3.4
Ferrocina luzonensis	1	0	0	0	1	0	0	2	2.2
Divaricella ornatissima	1	0	0	0	0	0	0	1	1.1
Austriella corrugata	0	0	0	0	1	0	0	1	1.1
Parvidontia mutabilis	5	8	0	0	0	0	0	13	14.6
Bretskya scapula	6	2	0	0	0	0	0	8	9.0
Jallenia inanis	1	3	0	0	0	0	0	4	4.5
Easmithia bractea	4	3	0	0	0	0	0	7	7.9
Easmithia brevis	4	4	0	0	0	0	0	8	9.0
Cardiolucina civica	0	14	8	2	2	1	0	27	30.3
Cardiolucina rugosa	13	9	1	0	0	0	0	23	25.8
Cardiolucina quadrata	0	0	0	2	5	13	3	23	25.8
Cardiolucina serrata	3	1	0	0	0	0	0	4	4.5
number of stations	20	21	10	9	12	13	4	89	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1100
1200
1300
Austriella corrugata
Pegophysema philippiana
Cryptophysema vesicula
Euanodontia ovum
Pillucina pusilla
Wallucina fijiensis
Codakia tigerina
Cardiolucina siquijorensis
Pillucina profusa
Ctena bella
Ctena delicatula
Codakia interrupta
Epicodakia sweeti
Codakia punctata
Funafutia levukana
Discolucina virginea
Chavania striata
Divaricella ornatissima
Ferrocina luzonensis
Cardiolucina serrata
Gonimyrtea celata
Liralucina sperabilis
Opalocina persica
Cardiolucina euglypta
Pillucina pacifica
Leucosphaera philippinensis
Bretskya scapula
Easmithia brevis
Easmithia bractea
Epicodakia izuensis
Notomyrtea perfecta
Myrtina adamsiana
Cardiolucina rugosa
Parvidonta mutabilis
Jallenia inanis
Notomyrtea fabula
Opalocina majuscula
Pseudolucinisca kantori
Myrtina boholensis
Liralucina lathetikosa
Myrtina spinosa
Myrtina vicina
Monitilora subtilis
Cardiolucina civica
Megaxinus quadrangularis
Notomyrtea catonia
Notomyrtea tanimbarensis
Troendleina suluensis
Myrtina galatea
Alucinoma alis
Dulcina musorstomi
Lucinoma dulcinea
Gloverina rectangularis
Notomyrtea flabelliformis
Elliptiolucina williamsae
Cardiolucina quadrata
Gonimyrtea profunda
Taylorina alata

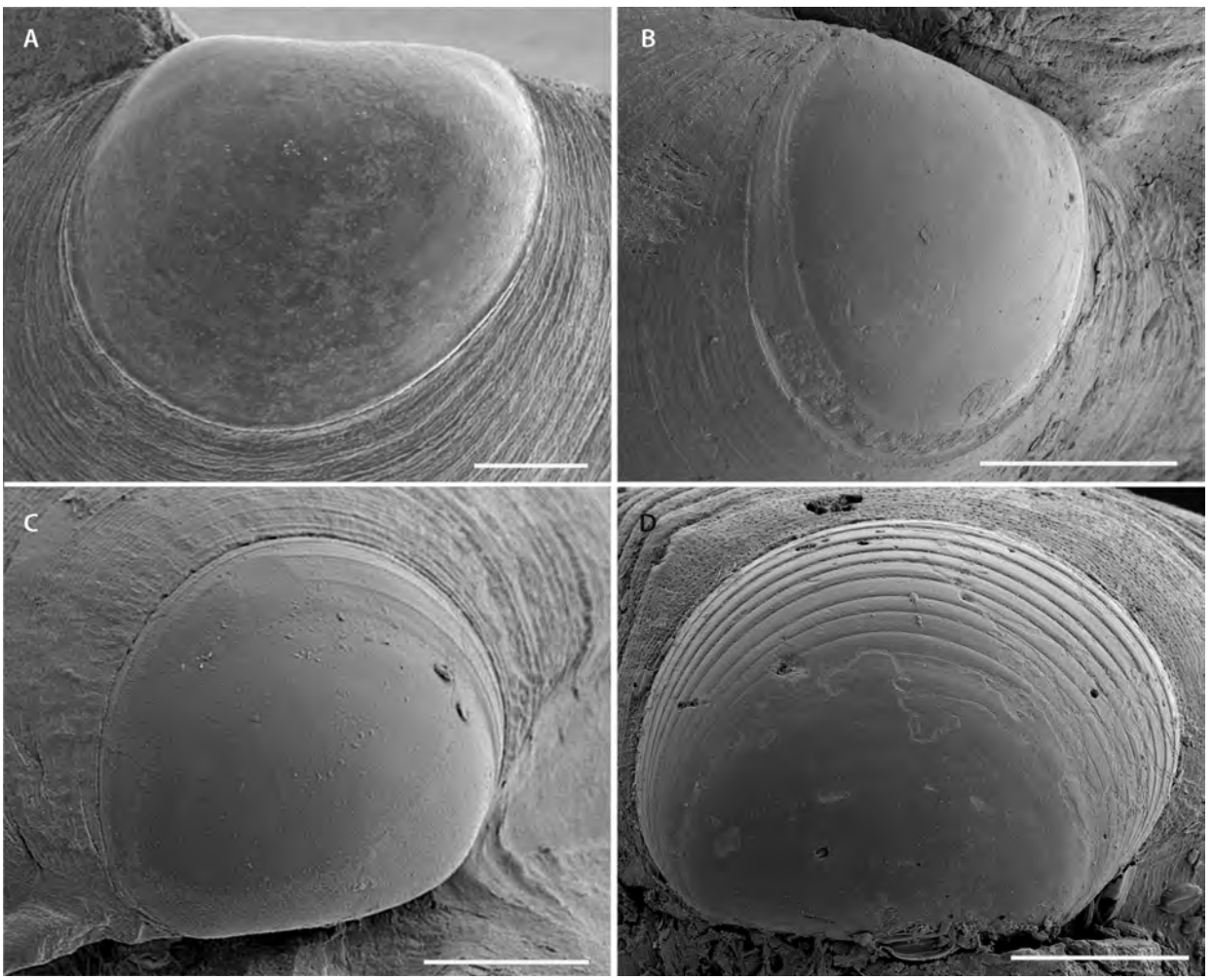

FIGURE 68

Types of protoconchs as classified in Table 6. **A**, large PI, PII a very narrow rim, *Monitilora subtilis*. Scale bar = 50 µm; **B**, large PI, PII with a broad rim, *Dulcina musorstomi*. Scale bar = 100 µm; **C**, PII with few growth increments, *Pillucina profusa*. Scale bar = 50 µm; **D**, PII with many growth increments, *Epicodakia sweeti*. Scale bar = 50 µm.

FIGURE 67

Depth ranges of Philippine Lucinidae from PANGLAO 2004, PANGLAO 2005, MUSORSTOM 2 and 3. Dead shells in blue, live-collected specimens in red, likely allochthonous specimens in green.

SHELL SURFACE MICROSCULPTURE

Alhough we did not examine all species in detail, microsculptural characters (visible at magnifications of 1000-2000x) formed in the periostracum and part of outer shell layer were observed, with striking differences between subfamilies and some genera. The most conspicuous feature is the micropitting (2-5 µm diameter) and mesh-like structures seen in some species. The Leucosphaerinae have fine lines without pitting. For Codakiinae, the four genera (Figure 35) are different but all have pitted or punctate microsculpture either linear or in a mesh-like pattern. All observed Myrteinae have varied pitted morphology differing between species (eg Figures 25L, M) in lines or in an irregular mesh pattern. *Monitilora* has rows of microspines. In the Lucininae, pitted microsculpture was noted in a number of genera; *Funafutia* has rows of closely spaced pits, *Troendleina* has linear gooves and *Easmithia* has granules. *Liralucina* species have microgrowth lines with dorsally serrate edges. *Bretskya* has a finely microlamellate surface. Some *Cardiolucina* species, *C. civica* and *C. quadrata* have microgrowth lines with serrate dorsal edges but others (*C. rugosa* and *C. siquijorenis*) are densely pitted. *Pillucina* species have irregular growth lines and lack pits or serrations.

DISCUSSION

SPECIES RICHNESS

In all, 78 species of Lucinidae are now confirmed for the Philippines. Some 80% of these were recovered from the PANGLAO 2004/2005 sampling and 96% from all French expeditions to the area. Only three additional species were noted from our search of museum collections. Remarkably 33% of these species are new (26 out of 78) with three new genera, *Opalocina*, *Easmithia* and *Jallenia*, proposed. Many of the new species were collected from depths greater than 100 m. This high diversity results from the intensive sampling of a wide variety of habitats from the intertidal to 1000 m using a range of techniques and attention to fine sieving that recovered many small species down to 1.5 mm in height. It should be emphasized that the bulk of specimens were empty shells from non-quantitative samples and the samples do not necessarily reflect the living community of lucinids at any single point of time.

The Philippine lucinid fauna is the highest diversity of chemosymbiotic molluscs yet recorded from an area and highlights the continuing discoveries of animals with this nutritional life habit. Chemosymbiotic bivalves are usually thought to be associated with the specialized environments of hydrocarbon seeps and vents (Taylor & Glover 2010) but, in contrast, Lucinidae are found in a broad range of habitats and depths and have the ability to adapt to variable edaphic conditions with respect to sulphide availability. The diversity of Lucinidae around the Philippines and central IWP reflects the tectonic complexity and wide range of habitats available ranging from highly eutrophic to more oligotrophic environments and encompassing mangroves, mud flats, seagrass beds, reef platforms, reef slopes, basinal organic accumulations of sunken vegetation and possible hydrocarbon seeps. Species distribution seems to reflect different sulphide levels; some such as *Austriella corrugata* are associated with organic-rich mangrove habitats, *Codakia* species and *Pillucina profusa* with seagrass beds and *Funafutia levukana* and *Epicodakia sweeti* with reef slope rubble. Less is known about habitats of deeper water species although some are found in organic-rich mud, for example *Dulcina musorstomi*, *Notoymyrtea* spp, and *Easmithia bractea*, while others such as *Bretskya scapula*, occur with sunken vegetation including wood and coconut fibres. Three of the deepest-recorded species at 2570 m (ESTASE 2 stn CP6) *Elliptiolucina labeyriei*, *Lucinoma estasia* and *Myrtea s.l. hyphalosa*, co-occur with three species of Vesicomyidae (MNHN, E. Krylova pers. comm.) and this assemblage of six species of chemosymbiotic bivalves indicates an active hydrocarbon seep.

TABLE 6

Protoconch measurements (in µm) and characters for Philippine Lucinidae classified in subfamilies. See individual species figures for details.

SPECIES		PI +PII (L)	PI (L)	P II characters				
				narrow rim <8µm	broad rim 8 - 15µm	few increments < 5	many increments >5	P1/PII
Euanodontia ovum	Pegophyseminae	188	108				×	0.57
Leucosphaera philippinensis	Leucosphaerinae	184	94				×	0.51
Alucinoma alis	Leucosphaerinae	265	240		×			0.91
Dulcina musorstomi	Leucosphaerinae	173	146		×			0.84
Gonimyrtea profunda	Leucosphaerinae	252	234		×			0.93
Gonimyrtea celata	Leucosphaerinae	183	153		×			0.89
Myrtina adamsiana	Leucosphaerinae	196	181		×			0.92
Myrtina boholae	Leucosphaerinae	196	183		×			0.93
Myrtina galatea	Leucosphaerinae	202	197		×			0.975
Myrtina spinosa	Leucosphaerinae	211	198		×			0.938
Myrtina vicina	Leucosphaerinae	190	177		×			0.932
Opalocina persica	Leucosphaerinae	165	87				×	0.527
Opalocina majuscula	Leucosphaerinae	168	91				×	0.542
Pseudolucinisca kantori	Leucosphaerinae	166	155		×			0.934
Elliptiolucina williamsae	Myrteinae	210	205	×				0.976
Gloverina rectangularis	Myrteinae	193	188	×				0.974
Notomyrtea catonii	Myrteinae	175	168	×				0.960
Notomyrtea fabula	Myrteinae	170	162	×				0.953
Notomyrtea flabelliformis	Myrteinae	183	172	×				0.940
Notomyrtea perfecta	Myrteinae	164	158	×				0.963
Notomyrtea tanimbarensis	Myrteinae	160	154	×				0.963
Myrtea s.l. hyphalosa	Myrteinae	246	221		×			0.900
Monitilora subtilis	Monitilorinae	193	190	×				0.984
Lucinoma dulcinea	Codakiinae	230	220		×			0.957
Lucinoma estasia	Codakiinae	275	245			×		0.891
Epicodakia izuensis	Codakiinae	180	167		×			0.928
Epicodakia sweeti	Codakiinae	159	120				×	0.755
Ctena bella	Codakiinae	170	133				×	0.782
Ctena delicatula	Codakiinae	140	98				×	0.700
Codakia tigerina	Codakiinae	189	155				×	0.820
Codakia interrupta	Codakiinae	190	180			×		0.947
Funafutia levukana	Lucininae	162	98				×	0.605
Megaxinus quadrangularis	Lucininae	193	190	×				0.984
Pillucina profusa	Lucininae	140	125			×		0.893
Pillucina maestratii	Lucininae	157	93				×	0.592
Pillucina pacifica	Lucininae	163	79				×	0.485
Pillucina pusilla	Lucininae	134	worn				×	
Wallucina fijiensis	Lucininae	135	107				×	0.793
Troendleina suluensis	Lucininae	163	80				×	0.491
Easmithia brevis	Lucininae	158	142			×		0.899
Easmithia bractea	Lucininae	189	170			×		0.899
Liralucina lathitikosa	Lucininae	162	96				×	0.593
Liralucina sperabilis	Lucininae	150	100				×	0.667
Ferrocina luzonensis	Lucininae	165	worn				×	
Parvidontia mutabilis	Lucininae	173	160		×			0.925
Bretskya scapula	Lucininae	193	87				×	0.451
Jallenia inanis	Lucininae	161	63				×	0.391
Cardiolucina civica	Lucininae	182	174	×				0.956
Cardiolucina quadrata	Lucininae	200	189	×				0.945
Cardiolucina rugosa	Lucininae	172	170	×				0.988
Cardiolucina serrata	Lucininae	161	152	×				0.944
Cardiolucina siquijorensis	Lucininae	272	235		×			0.875

The main focus of research on Lucinidae has been on shallow water ecosystems such as seagrass beds (*e.g.*, Dando *et al.* 1986; Gros *et al.* 1997, 2003; Heide *et al.* 2012) and to some extent on *Lucinoma* species at hydrocarbon seeps and oxygen minimum zones (Cary *et al.* 1989; Salas & Woodside 2002; Duperron *et al.* 2007; Oliver *et al.* 2011). Ideas on lucinid diversity and distribution were challenged when Cosel & Bouchet (2008) described a rich, new deep-water fauna of previously unknown large lucinids living around the islands of Philippines and Indonesia. This discovery is extended by the present study that highlights the remarkable diversity of lucinids in deeper water in the central Philippines with many species recorded from the subfamilies Leucosphaerinae and Myrteinae. The former subfamily was recently defined from molecular evidence and the composition of the latter much revised (Taylor *et al.* 2011, 2014) and it seems that many deeper water lucinids may be grouped within these phylogenetically older clades. *Lucinoma* species are allied to *Codakia* and *Ctena* in the Codakiinae. Fewer deep-water species fall within the Lucininae, including *Troendleina suluensis*, *Cardiolucina quadrata* and *C. civica*. In contrast to temperate latitudes, Bouchet (2008) and Bouchet *et al.* (2008) argued that in the tropics the turnover from shallow to deep-water faunas is reached at depths as shallow as 100 m and there are several zones of deep-sea faunas present between 200-1500 m compared with a single zone in the North Atlantic. Our plot of depth distributions (Figure 67) supports this idea with major changes of lucinid assemblages at *ca.* 100 m, at 300 m and yet again below 600 m. This turnover is exemplified in the depth succession of the multiple species of *Myrtina*, *Notomyrtea* and *Cardiolucina*. Moreover, collections from more recent expeditions around the Solomon Islands and Papua New Guinea (MNHN collections, unpubl. data) indicate that diversity of deeper water lucinids in the central IWP has been grossly undersampled.

Prior to the PANGLAO sampling programme, the highest diversity of Lucinidae recorded was the 34 species identified from depths less than 200 m around New Caledonia and these were mostly collected using similar intensive sampling methods (Glover & Taylor 2007). By comparison, from PANGLAO samples taken at depths less than 200 m, 48 species were recorded, indicating that the Philippine fauna is about 30% richer. It is likely that similar high species numbers might be recorded from elsewhere in the central IWP such as northeastern Australia, New Guinea and Indonesia but these areas are not as well sampled or documented. From other parts of the IWP, 29 species are recognised from all depths around Japan (Matsukuma 2000; Okutani 2011), 23 from China (Xu 2012), while 24 species are recorded from the Red Sea (Oliver 1992; Zuschin & Oliver 2003 and additions) and only ten species from French Polynesia (Tröndlé & Boutet 2009). More distantly, in the tropical Eastern Pacific, from southern California to Peru, 34 species are recognised from the intertidal to depths of 1800 m (Coan & Valentich Scott 2012). From the western Atlantic, 22 species are known from southern Florida (Mikkelsen & Bieler 2008) with 42 for the whole Caribbean area (unpubl. data) and 34 species from tropical West Africa, ranging from Mauritania to southern Angola (Cosel 2006).

Although the Philippine Islands have long been recognised as supporting high molluscan diversities, there have been few comprehensive studies of species-rich bivalve families comparable to the Lucinidae. The recently published detailed account of the Cardiidae from the PANGLAO 2004/2005 samples recorded 63 species (4 new) and a total of 85 species for all of the Philippines (ter Poorten 2009), a diversity similar to that for the Lucinidae. Most cardiids inhabit shallow water with only three species living below 200 m, compared with 29 species of lucinids recorded deeper than 200 m and 3 species from 2570 m. Amongst other diverse heterodont bivalve families, 87 species of shallow water Veneridae from the Philippines were illustrated by Poppe (2011).

BIOGEOGRAPHY

Many of the shallow water lucinids known from the Philippines are also widely distributed across the IWP as far to the west as East Africa and the Red Sea, for example *Codakia* species, *Euanodontia ovum*, *Cryptophysema vesicula*, *Pegophysema philippiana*, and some to islands in the south west Pacific including *Funafutia levukana*, *Ctena bella*, *Epicodakia sweeti, Wallucina fijiensis*, *Euanodontia hawaiensis* and *E. ovum* (Tröndlé & Boutet 2009). At the extreme limit of the IWP at Easter Island, only two species *Ctena bella* and *Funafutia levukana* are recorded (Raines & Huber

2012). Other shallow water species including *Pillucina profusa* and *P. pusilla* are members of a complex of species that are distributed across the IWP but the ranges of each species are uncertain (Glover & Taylor 2001). *Opalocina persica* and *O. majuscula* belong to a newly described genus (see above) that is known from around Panglao but also from the Mozambique Channel in the western Indian Ocean represented by *O. fosteri* (Hartmnan & Boss, 1965). The new species, *Gonimyrtea celata*, is very similar to the species from the northern Red Sea illustrated as "*Lucina*' unidentified species' by Zuschin & Oliver (2003). Some of the deeper water taxa are known only from the Philippines, for example *Notomyrtea catonii*, *N. perfecta*, *Gloverina rectangularis*, *Myrtina galatea* and *Taylorina alata,* but the sampling effort has been patchy and the true distributions and possible endemism are uncertain. An interesting case is *Pseudolucinisca,* a genus with two species and thought, until now, to be a shallow water endemic of south Western Australia (Glover & Taylor 2008) but the discovery of *P. kantori* extends the known distribution to the Philippines and into much deeper water (100-430 m). Moreover, we regard *Lucinoma japonica* Habe, 1958 from 100-150 m off Japan as another species of *Pseudolucinisca*. Three other previously known lucinids described from Japan have been reassigned to other genera; *Myrtina adamsiana* (previously *Lucinoma*), *Epicodakia izuensis* (previously *Wallucina*) and *Jallenia imajimai* (previously Cavatidens).

Pillucina profusa was by far the most abundant of the shallow water lucinids reaching extremely high numbers in seagrass habitats and similar abundances of *Pillucina* species have been recorded in southern Japan (Uede & Takahashi 2008) and Thailand (Nakaoka *et al.* 2002; Meyer *et al.* 2008) and northern Queensland (pers. obs.). *Cardiolucina quadrata* was abundant in deeper water making up 73% of the individuals at every station between 600-800 m with *C. rugosa* and *C. civica* numerically dominant at depths between 100-300 m.

MORPHOLOGICAL DIVERSITY

Large size is often thought to be a corollary of chemosymbiosis but the majority of the species from the Philippines are less than 15 mm in height, many less than 5 mm, with *Pillucina pusilla* the smallest known lucinid at 1.9 mm. This compares with the largest living lucinids with shell lengths of 150 mm for *Meganodontia acetabulum* Bouchet & Cosel, 2004 and *Codakia distinguenda* (Tryon, 1872) (Coan & Valentich Scott 2012).

The range of shell morphologies present amongst Lucinidae continues to be extended. For example, the irregular shell and extreme anterior extension of *Bretskya scapula* is likely linked to its nestling habitat amongst decomposing wood and vegetation. The unusually coloured, red-brown genus *Ferrocina* (type species *F. multiradiata* Glover & Taylor, 2007) was originally described from Fiji and a another highly coloured species, *F. luzonensis*, is described from the Philippines. The highly unusual divided posterior lateral tooth in *Pillucina pusilla* has been only previously recorded in *P. denticula* from South Africa.

We observed fine external microsculptural textures in more than half of lucinid species examined. There is a strong taxonomic signal present, for example all Myrteinae and Codakinae have pitted and mesh-like microsculpture that is absent in the studied Leucosphaerinae and Pegophyseminae that have fine growth increments only. Amongst the Lucininae, pitted and mesh-like textures are seen in *Funafutia, Liralucina* and *Cardiolucina* species, with linear structures noted in *Troendlein*a and *Bretskya*. Shallow pits formed in the periostracum have recently been described (Salas *et al.* 2012) in *Digitaria* (Astartidae) but we have no details on the formation of the superficially similar structures in the Lucinidae. The functional significance of these structures is presently unknown but may concern the interaction of the bivalve shell surface with fine particles of the substrate. Over the last few years, micro-ornamentation in the form of spines, needles, pins and pits has been observed in a number of other bivalve families (Checa & Harper 2010; Glover & Taylor 2010; Salas *et al.* 2012) but never systematically studied across the Bivalvia.

PROTOCONCHS AND LARVAL DEVELOPMENT

There is very little data on larval development in Lucinidae, with the most detailed study that of Gros *et al.* (1997) for *Codakia orbicularis*. This has a protoconch of 190 µm, with a D-shaped and smooth PI of 170 µm, while PII is a narrow rim representing the veliger, pedi-veliger and plantigrade stages and indicating little planktonic feeding and growth. Similarly, Collin & Giribet (2010) have described a gelatinous mass of egg capsules produced by *Phacoides pectinatus* with swimming veligers hatching at 198 µm as a PI with PII a narrow rim but not feeding before settlement. Protoconchs of some lucinids from New Caledonia illustrated by Glover & Taylor (2007) suggested different development patterns including some species where PII was large with marked growth increments. By comparison with other bivalves, this indicated significant planktonic feeding before settlement, a strategy different from the published accounts.

Allen & Pernet (2007) highlighted the range of intermediate modes of larval development between planktotrophy and lecithotrophy. Our survey of protoconchs of the Philippine lucinids indicates several developmental strategies (Figure 68). There are species with relatively large PIs and very narrow PII rims indicating rapid settlement without planktonic feeding; other species with broader PII rims probably have longer veliger and pediveliger stages but without significant growth. Other species have larger PII stages with regular growth increments indicating feeding in a planktonic stage, with some species having just a few increments while others have many. In general, the intertidal and shallow water lucinids have large PII stages with many growth increments while the deeper water species mainly have narrow PII rims. Many of the shallow water lucinids, such as *Ctena bella*, *Codakia tigerina*, *Funafutia levukana* and *Wallucina fijiensis*, have broad distributional ranges across the IWP, probably facilitated by extended planktonic feeding at the veliger stage. The distributional ranges of the deeper water species that lack a planktonic feeding stage and have a larger PI are poorly known but seem to be narrower (Cosel & Bouchet 2008). In contrast *Bretskya scapula* and probably *Jallenia inanis* that are associated with sunken wood and coconuts have extensive growth in PII as might be expected for species reliant on patchy, ephemeral habitats.

FINAL REMARKS

Although the Philippine lucinid fauna presented here is by far the most diverse yet described, there will undoubtedly be more species discovered in the area. Outside of the Philippines we also are aware of many undescribed lucinids recovered from deep-water sampling around the Solomon Islands, Papua New Guinea and Madagascar held in the collections of the MNHN. Moreover, detailed study of larger samples of shallow water lucinids is revealing 'cryptic' species amongst taxa previously thought as wide ranging, as exemplified by the '*Anodontia*'species (Taylor & Glover 2005) and the *Pillucina* and *Cardiolucina* groups.

The great diversity, broad habitat and bathymetric distribution of lucinids, exemplified by this study from the Philippines, demonstrates that chemosymbiosis, sometimes thought of as a highly specialised strategy for seep and vent molluscs, is in fact a commonplace and readily adaptive feeding mode. Around Panglao, seagrass-dominated habitats contained up to 12 species per sample, deep water muds up to ten species, and even reef slopes supported up to eight species. Although none of the samples were quantitative, the predominance of some species such as *Pillucina profusa* and *Cardiolucina quadrata* indicates that they are abundant in the habitats sampled.

Analyses of the diversity and distribution of bivalves have contributed greatly to our understanding of global and regional scale biodiversity patterns in the marine realm with the data used to investigate gradients in latitudinal and longitudinal diversity (*e.g.*, Crame 2000; Jablonski, Roy & Valentine 2006). In common with many other animal groups, such as corals and fish (review by Bellwood *et al.* 2012), all studies of bivalves recognise the South East Asian or Indo-Australian Archipelago as supporting the highest diversities. Crame (2000) estimated from compilations of published data that the marine bivalve fauna of the 'Coral Triangle' was 1211 species but only 24 species in his compilation were 'lucinoids' (including Ungulinidae and Thyasiridae, now excluded from the Lucinoidea), a figure 70% less than our

records for Philippines Lucinidae alone; although 60 Cardiidae were recorded, this is 30% less than ter Poorten's (2009) total of 85 species from the area. More recently, Huber (2010) suggested a conservative 1100 species for the same area. It is certain that bivalve numbers will far exceed these estimates; Bouchet (2008, 2009) has emphasised, with results from intensive sampling programmes in New Caledonia and Philippines, that published data grossly underestimate the levels of molluscan diversity by failing to consider the hordes of small species and neglected families as exemplified by the Galeommatoidea and Lucinidae.

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APPENDIX 1

PANGLAO 2004 - data for stations at which Lucinidae were recovered.

Station	Latitude	Longitude	Depth range		Locality	Habitat	Species
B1	9°33.0'N	123°46.5'E	8	14	Panglao Island, Alona Reef	slope between reef patches	*Epicodakia sweeti, Ctena bella, Funafutia levukana, Pillucina profusa, Cardiolucina siquijorensis*
B2	9°33.0'N	123°46.5'E		5	Panglao Island, Alona reef	reef slope	*Euanodontia ovum, Gonimyrtea celata, Ctena bella, Funafutia levukana*
B3	9°33.5'N	123°48.6'E		8	Panglao Island, Arco Point	base of reef slope	*Euanodontia ovum, Epicodakia sweeti, Funafutia levukana, Pillucina profusa, Cardiolucina siquijorensis*
B4	9°33.2'N	123°48.3'E		24	Panglao Island, BBC Point	reef slope with overhangs	*Gonimyrtea celata, Funafutia levukana, Chavania striata, Cardiolucina siquijorensis*
B5	9°35.2'N	123°50.4'E		4	Panglao Island, Biking	reef slope with overhangs	*Ctena bella, Funafutia levukana, Pillucina profusa*
B6	9°31.1'N	123°41.3'E	12	14	Balicasag Island: Black Forest	coral patches	*Ctena bella, Funafutia levukana, Pillucina pacifica*
B7	9°35.9'N	123°51.8'E	4	30	Panglao Island, Catarman	reef slope with caves	*Ctena bella, Funafutia levukana, Pillucina profusa, Chavania striata*
B8	9°37.1'N	123°46.1'E		3	Panglao Island, Napaling	subtidal reef platform	*Funafutia levukana, Pillucina profusa*
B9	9°33.1'N	123°44.0'E	8	10	Panglao Island, Napaling	caves in the reef wall	*Euanodontia ovum, Funafutia levukana*
B10	9°36.5'N	123°45.6'E	3	14	Panglao Island, Momo Beach	reef wall with small caves	*Funafutia levukana*
B11	9°29.4'N	123°56.0'E	2	4	Pamilacan Island	coral rubble	*Epicodakia sweeti, Ctena bella, Pillucina profusa, Cardiolucina siquijorensis*
B12	9°35.6'N	123°43.2'E	24	27	Panglao Island, Doljo point	reef slope	*Funafutia levukana*
B13	9°37.1'N	123°52.6'E	3	5	Bohol Island, Baclayon Takot	coral rubble	*Ctena bella, Funafutia levukana*
B14	9°38.5'N	123°49.2'E	2	4	Panglao Island, Sungcolan Bay	coral rubble	*Ctena bella, Pillucina profusa, Wallucina fijiensis, Cardiolucina siquijorensis*
B15	9°38.8'N	123°49.2'E	2	4	Panglao Island, Sungcolan Bay	reef wall with dead corals	*Funafutia levukana*
B16	9°37.6'N	123°47.3'E		20	Panglao Island, Bingag	coral rubble on sand and gravel	*Funafutia levukana*
B17	9°37.5'N	123°46.9'E	3	21	Panglao Island, Bingag	reef wall with small caves	*Funafutia levukana*
B18	9°38.5'N	123°49.7'E	3	5	Panglao Island, Sungcolan Bay	blocks dispersed among seagrass	*Ctena bella, Pillucina profusa, Wallucina fijiensis Cardiolucina siquijorensis*
B19	9°29.4'N	123°56.0'E		17	Pamilacan Island	reef slope with caves	*Ctena bella, Funafutia levukana*
B20	9°41.5'N	123°51.0'E	2	8	Bohol Island, Ubajan	rocks and corals with sand and mud	*Ctena bella, Funafutia levukana, Pillucina profusa, Cardiolucina serrata*
B21	9°37.2'N	123°46.4'E	20	21	Panglao Island, Napaling	reef wall with small caves	*Funafutia levukana, Cardiolucina siquijorensis*
B23	9°31.1'N	123°41.3'E	20	25	Balicasag, Black Forest	rubble on sand	*Ctena bella, Funafutia levukana*
B24	9°29.4'N	123°56.0'E		38	Pamilacan Island	floor of cave	*Epicodakia sweeti, Ctena bella*
B26	9°29.4'N	123°56.0'E		35	Pamilacan Island	ceiling of small cavern	*Ctena delicatula*
B28	9°29.4'N	123°56.1'E		25	Pamilacan Island	sediment from deep part of cave	*Epicodakia sweeti, Ctena bella, Codakia tigerina, Funafutia levukana*
B29	9°29.4'N	123°56.1'E		26	Pamilacan Island	sediment from cave entrance	*Epicodakia sweeti, Ctena bella, Funafutia levukana*
B30	9°29.4'N	123°56.1'E		25	Pamilacan Island	ceiling and wall of cave	*Epicodakia sweeti, Ctena bella, Funafutia levukana*
B31	9°38.7'N	123°50.4'E	1	2	Panglao Island, Dauis		*Pillucina profusa, Cardiolucina siquijorensis*
B34	9°38.3'N	123°50.3'E	1	2	Panglao Island, Sungcolan Bay	channel between inlet and the open sea	*Pillucina profusa, Cardiolucina siquijorensis*
B36	9°35.9'N	123°44.5'E		24	Panglao Island, North of Doljo	reef wall	*Funafutia levukana*
B37	9°30.9'N	123°40.8'E	19	20	Balicasag Island	floor of cave A, corals, sponges	*Ctena bella*
B38	9°30.9'N	123°40.8'E	17	18	Panglao Island, Balicasag Island	bioclastic sand at entrance of cave C	*Euanodontia ovum, Gonimyrtea celata, Epicodakia sweeti, Ctena bella, Funafutia levukana*
B39	9°32.8'N	123°42.1'E	17	25	Panglao Island, Pontod Lagoon 1	reef wall with small caves	*Funafutia levukana*
B40	9°34.6'N	123°49.9'E		22	Panglao Island, San Isidro	inside cave: bioclastic sand and brushing of cave wall	*Epicodakia sweeti, Ctena bella, Chavania striata*
B41	9°30.9'N	123°40.8'E	17	19	Balicasag Island	floor of large cave	*Epicodakia sweeti, Funafutia levukana, Pillucina profusa*
D1	9°37.2'N	123°52.2'E		2	Panglao Island, SE of Dauis	muddy coarse sand with rubble	*Euanodontia ovum, Cryptophysema vesicula, Ctena bella, Codakia tigerina, Funafutia levukana, Pillucina profusa, Wallucina fijiensis, Ferrocina luzonensis, Cardiolucina siqujorensis*
D4	9°33.1'N	123°44.0'E		2	Panglao Island, Pontod Islet	soft bottom with seagrass	*Euanodontia ovum, Ctena bella, Pillucina profusa*
D5	9°33.6'N	123°43.5'E		3	Panglao Island, Pontod Islet	soft bottom with seagrass	*Ctena bella, Pillucina profusa, Wallucina fijiensis,Cardiolucina siqujorensis*
D6	9°33.4'N	123°48.4'E		3	Panglao Island, Bolod	mixed bottom	*Codakia tigerina*
D7	9°33.1'N	123°44.0'E	2	3	Panglao Island, Pontod Islet	soft bottom with seagrass	*Euanodontia ovum, Ctena bella, Pillucina profusa*
D8	9°34.0'N	123°48.9'E	1	4	Panglao Island, Dao	sandy bottom, seagrass, rubble, coral slabs	*Pegophysema philippiana, Pillucina profusa*
D9	9°30.0'N	123°55.3'E	2	4	Pamilacan Island	coral and white sand	*Ctena bella, Codakia interrupta*
D10	9°42.4'N	123°50.6'E	15	22	Bohol Island, Cortes	mud	*Easmithia brevis, Cardiolucina serrata*
D12	9°38.5'N	123°51.0'E	2	4	Tagbilaran - Panglao channel	mud	*Euanodontia ovum, Pillucina profusa,Cardiolucina siqujorensis*

D13	9°38.0'N	123°51.4'E	2	3	Panglao Island, Tagbilaran channel	sand	*Euanodontia ovum, Discolucina virginiae, Pillucina profusa, Wallucina fijiensis, Divaricella ornatissima*
D14	9°38.8'N	123°50.6'E	2	4	Panglao Island, West Tutoland	coral sand on hard bottom	*Euanodontia ovum, Fimbria fimbriata, Wallucina fijiensis*
D15	9°32.7'N-9°32.9'N	123°47.9/48.4'E	53	63	Panglao Island, Bolod		*Cardiolucina rugosa*
D16	9°33'N	123°50'E	141	147	between Panglao and Pamilacan islands	sandy mud	*Alucinoma alis, Opalocina majuscula, Notomyrtea catonii, Liralucina lathetikosa*
G1	9°41.9'N	123°49.5'E		100	Bohol Island, Cortes	fine muddy sand	*Fimbria fimbriata, Easmithia bractea, Jallenia inanis, Bretskya scapula, Leucosphaera philppinensis, Opalocina majuscula, Notomyrtea perfecta, Cardiolucina rugosa, Pillucina maestratii*
P1	9 36N	123 45 E	90	200			*Myrtina boholensis*
P3	9 31 N	123 41 E	100				*Jallenia inanis*
P4	?						*Liralucina lathetikosa, Pseudolucinisca kantori*
L41	9°31.3'N	123°41.2'E	90	100	Panglao Island, Front of PTA Compound		*Funafutia levukana*
L46	9°31'N	123°41'E	90	110	Balicasag Island		*Leucosphaera phillpinensis*
L48	9°42.3'N	123°49.9'E		100	Bohol Island, Manga		*Funafutia levukana*
L51-60	9°37.7'N	123°47.9/48.1'E		62	Panglao Island, Bingag/Tabalong		*Leucosphaera phillpinensis*
L74-75	9°31'N	123°41'E	120	139	Balicasag Island		*Funafutia levukana*
M1	9°32.9'N	123°46.6'E		1	Panglao Island, Alona Beach	intertidal to shallow subtidal	*Codakia interrupta, Codakia tigerina, Cardiolucina siquijorensis*
M2	9°32.8'N	123°45.9'E		2	Panglao Island, W end of Alona Beach	reef flat with seagrass bed	*Euanodontia ovum, Euanodontia hawaiensis, Cryptophysema vesicula, Codakia interrupta, Codakia tigerina*
M3	9°32.5'N-9°33.1'N	123°44.7'-123°45.5'E			Panglao Island, Danao	intertidal to shallow subtidal reef	*Pegophysema philippiana, Euanodontia ovum, Euanodontia hawaiensis, Cryptophysema vesicula, Ctena bella, Codakia tigerina, Pillucina profusa, Wallucina fijiensis*
M5	9°35.5'N	123°43.3'-123°44.3'E		2	Panglao Island, Doljo Point	mixed intertidal platform, fringe mangove, seagrass	*Pegophysema philippiana, Codakia interrupta, Codakia tigerina*
M6	9°36.2'N	123°57.9'E			Bohol Island	mangrove and intertidal seagrass bed	*Euanodontia ovum, Codakia tigerina*
M7	9°36.1'N	123°45.2'E		3	Panglao Island, Momo Beach	reef platform with seagrass	*Euanodontia ovum, Cryptophysema vesicula, Codakia interrupta, Codakia tigerina, Wallucina fijiensis, Cardiolucina siquijorensis*
M9	9°35.1'N	123°43.6'E			Panglao Island, inside lagoon near Doljo Pt	muddy sand flat with seagrass, fringe mangrove	*Pegophysema philippiana,Euanodontia ovum, Ctena bella, Codakia tigerina, Pillucina profusa, Wallucina fijiensis*
M10	9°37.8'N	123°48.4'E		3	Panglao Island, Bingag/Tabalong	rocky intertidal with seagrass	*Euanodontia ovum, Pillucina profusa*
M11	9°38.3'N	123°49.6'E		3	Panglao Island, Sungcolan Bay	rocky intertidal, fringe mangrove and seagrass	*Pegophysema philippiana, Euanodontia ovum*
M13	9°32.9'N	123°47.5'E		3	Panglao Island, Bolod	coral platform with seagrass	*Cryptophysema vesicula*
M15	9°37.2'N	123°55.4'E		1	Bohol Island, Baclayon	intertidal platform with seagrass	*Ctena bella*
M18	9°33.0'N	123°43.5'E		1	Panglao Island, Gak-Ang Islet	sandy bottom and seagrass	*Ctena bella, Codakia tigerina, Wallucina fijiensis*
M19	9°30.0'N	123°55.3'E		2	Pamilacan Island	sand beach, seagrass and rocks	*Euanodontia ovum, Cryptophysema vesicula, Ctena bella, Codakia interrupta, Codakia tigerina*
M20	9°29.3'N	123°55.1'E		2	Pamilacan Island	gently sloping platform protected by rock bar	*Cryptophysema vesicula, Epicodakia sweeti, Cardiolucina siquijorensis*
M23	9°37.8'N	123°48.4'E		1	Panglao Island, Bingag/Tabalong	white sand and seagrass	*Euanodontia ovum*
M24	9°42.1'N	123°51.3'E		1	Bohol Island, Manga Point	mangrove and mixed intertidal	*Pegophysema philippiana, Euanodontia ovum, Ctena bella*
M26	9°40.9'N	123°51.1'E		2	Bohol Island, Taloto	mixed intertidal with fringe mangrove	*Pegophysema philippiana, Ctena bella, Pillucina profusa, Cardiolucina siquijorensis*
M27	9°43.6'N	123°51.2'E		1	Bohol Island, North of Abatan River	mangrove; salinity 35	*Austriella corrugata*
M40	9°35.7'N	123°44.7'E		3	Panglao Island, Looc (lagoon inside)	fringe mangrove, subtidal with seagrass and hard bottom	*Euanodontia ovum*
M44	9°33.1'N	123°44.9'E			Panglao Island, inner part of Danao embayment	fringe mangrove	*Pegophysema philippiana, Eunanodontia ovum*
M47	9°33.6'N	123°45.1'E			Panglao Island, middle part of Danao embayment	fringe mangrove	*Euanodontia ovum, Ctena bella, Pillucina profusa*
M50	9°43.2'N	123°52.3'E			Bohol Island, Abatan River	nipa palms; salinity 14	*Austriella corrugata, Indoaustriella cf plicifera*
M51	9°36.8'N	123°52.2'E			Panglao Island, Mayacabac	sand and seagrass	*Euanodontia ovum, Cryptophysema vesicula, Codakia tigerina, Pillucina profusa, Cardiolucina siquijorensis*
M52	9°34.2'N	123°44.9'E		1	Panglao Island, mouth of Danao embayment	fringe mangrove, seagrass on sand	*Cryptophysema vesicula, Pillucina profusa*
M58	9°31.3'N	123°41.0'E			Balicasag Island	intertidal	*Codakia interrupta*
M61	9°32.9'N	123°46.6'E		1	Panglao Island, Alona Beach	intertidal	*Pegophysema philippiana*
R1	9°31.2'N	123°41.3'E	5	7	Balicasag Island	sand with degraded coral patches	*Codakia interrupta, Codakia punctata*
R3	9°33.0'N	123°46.5'E	5	24	Panglao Island, Alona reef	base of reef slope	*Codakia tigerina*

R5	9°36.6'N	123°52.4'E	5	16	Panglao Island, Catarman	coral heads	*Fimbria fimbriata*
R9	9°33.2'N	123°48.3'E	5	22	Panglao Island, BBC Point	reef slope with soft/hard corals, small caves	*Cardiolucina euglypta*
R10	9°35.3'N	123°50.5'E	2	10	Panglao Island, Biking	reef platform with seagrass bed	*Codakia interrupta*
R14	9°37.4'N	123°54.5'E	6	8	Bohol Island, Baclayon	sand and coral patches	*Euanodontia ovum*
R16	9°31.1'N	123°41.3'E	6	22	Balicasag Island: Black Forest	edge of reef platform and slope	*Codakia interrupta*
R20	9°31.1'N	123°41.5'E	7	48	Balicasag Island: Cathedral	sand ledge with coral patches, reef wall	*Codakia interrupta*
R23	9°33.5'N-9°34.8'N	123°42.7/43.6'E	1	5	Panglao Island, lagoon off Poblacion	sand with extensive seagrass, few coral heads	*Cryptophysema vesicula, Fimbria fimbriata, Codakia punctata, Codakia tigerina, Pillucina profusa*
R31	9 29.4'N,	123 56.0"E	10	41	Pamilacan Island	reef slope with caves	*Epicodakia sweeti*
R34	9 35.9'N	123 44.7"E	1	12	Panglao Island, Looc	coral platform	*Codakia interrupta, Codakia tigerina*
R36	9°30.2'N	123°55.3'E	3	32	Pamilacan Island		*Codakia interrupta*
R37	9°36.5'N	123°45.6'E	28	32	Panglao Island, Momo Beach	caves in the reef wall	*Epicodakia sweeti, Codakia interrupta*
R38	9°29.4'N	123°56.0'E	6	37	Pamilacan Island	reef slope	*Epicodakia sweeti*
R45	9°29.3'N	123°55.1'E	3	7	Pamilacan Island	fringing reef with patches of sand	*Euanodontia ovum*
R50	9°35.7'N	123°44.4'E	3	7	Panglao Island, Looc	sand and seagrass with coral patches	*Codakia interrupta, Codakia tigerina*
R51	9°35.5'N-9°35.9'N	123°43.2/44.5'E	2	52	Panglao Island, Doljo point	reef platform and wall; giant seafans in 40-60 m	*Epicodakia sweeti*
R59	9°36.1'N	123°44.9'E	2	20	Panglao Island, Momo Beach	coral patches, platform with thin layer of sand	*Epicodakia sweeti*
R66	9°38.3'N	123°50.3'E	1	3	Panglao Island, Sungcolan Bay	channel between lagoon and the sea	*Ctena bella*
R67	9°38.1'N	123°51.4'E		3	Panglao Island, Tagbilaran - Panglao channel	sand with little mud	*Pillucina profusa*
R69							*Fimbria fimbriata*
R75	9°32.8'N	123°42.1'E	3	35	Panglao Island, West of Pontod	reef slope and wall	*Fimbria fimbriata*
R78	9°42.7'N	123°51.7'E	2	4	Bohol Island, Manga-Taloto	subtidal mudflat	*Pegophysema philippiana*
S1	9°35.3'N	123°50.5'E		5	Panglao Island, Biking	reef slope with overhangs	*Gonimyrtea celata, Epicodakia sweeti, Ctena bella, Funafutia levukana, Pillucina profusa, Easmithia bractea, Liralucina sperabilis, Cardiolucina serrata*
S2	9°37.4'N	123°54.5'E	4	5	Bohol Island, Baclayon	hard bottom with small pockets of sediment	*Epicodakia sweeti, Ctena bella, Ctena delicatula, Funafutia levukana, Cardiolucina siquijorensis*
S3	9°31.1'N	123°41.3'E		6	Balicasag Island: Black Forest	edge of reef platform	*Euanodontia ovum, Epicodakia sweeti, Ctena bella, Funafutia levukana, Pillucina pacifica, Wallucina fijiensis, Cardiolucina siquijorensis*
S4	9°35.9'N	123°51.8'E	4	30	Panglao Island, Catarman	reef slope with caves	*Epicodakia sweeti, Ctena bella, Ctena delicatula, Funafutia levukana, Pillucina profusa*
S5	9°37.1'N	123°46.1'E	2	4	Panglao Island, Napaling	rock and coral patches, brown algae	*Epicodakia sweeti, Ctena bella, Funafutia levukana*
S6	9°38.5'N	123°49.2'E	1	4	Panglao Island, Sungcolan Bay	sand with seagrass	*Euanodontia ovum, Cryptophysema vesicula, Pillucina profusa, Wallucina fijiensis, Cardiolucina siquijorensis*
S7	9°38.5'N	123°49.2'E	1	4	Panglao Island, Sungcolan Bay	sand with seagrass	*Epicodakia sweeti, Ctena bella, Funafutia levukana, Pillucina profusa, Wallucina fijiensis*
S8	9°36.5'N	123°45.6'E	28	32	Panglao Island, Momo Beach	caves in the reef wall	*Epicodakia sweeti, Ctena bella, Pillucina profusa, Wallucina fijiensis, Chavania striata, Cardiolucina siquijorensis*
S9	9°33.8'N	123°43.6'E		3	Panglao Island, lagoon off Poblacion	fine sand and seagrass	*Ctena bella, Pillucina profusa, Wallucina fijiensis*
S10	9°29.4'N	123°56.0'E	6	14	Pamilacan Island	coral plateau with fine sand covering rocks	*Epicodakia sweeti, Ctena bella, Ctena delicatula, Funafutia levukana*
S11	9°33.6'N	123°43.6'E		2	Panglao Island, lagoon off Poblacion	fine sand and seagrass	*Ctena bella, Pillucina profusa, Cardiolucina siquijorensis*
S12	9°29.4'N	123°56.0'E	6	8	Pamilacan Island	coral plateau with fine sand	*Epicodakia sweeti, Ctena bella, Ctena delicatula, Funafutia levukana*
S13	9°37.1'N	123°52.6'E	8	15	Bohol Island, Baclayon Takot	reef wall with dead coral sand and mud	*Euanodontia hawaiensis, Epicodakia sweeti, Ctena bella, Funafutia levukana, Pillucina profusa, Easmithia bractea, Liralucina sperabilis*
S14	9°29.3'N	123°55.1'E	5	12	Pamilacan Island	fringing reef	*Euanodontia ovum, Epicodakia sweeti, Ctena bella, Codakia tigerina, Funafutia levukana, Pillucina pacifica, Wallucina fijiensis, Chavania striata, Easmithia bractea, Cardiolucina siquijorensis*
S15	9°41.3'N	123°49.5'E	4	6	Bohol Island, Cortes Takot	coral plateau	*Euanodontia hawaiensis, Ctena bella*
S16	9°37.6'N	123°47.3'E	15	18	Panglao Island, Bingag	reef wall with small caves	*Euanodontia ovum, Epicodakia sweeti, Ctena bella, Pillucina pacifica*
S17	9°34.6'N	123°49.9'E		6	Panglao Island, San Isidro	reef flat, mixed bottoms	*Euanodontia ovum, Ctena bella, Codakia tigerina, Funafutia levukana, Pillucina pacifica*
S18	9°35.7'N	123°44.4'E	0	2	Panglao Island, Looc		*Ctena bella, Wallucina fijiensis*
S19	9°42.1'N	123°51.4'E	3	4	Bohol Island, Manga	mud	*Opalocina persica, Pillucina profusa, Pillucina pusilla, Cardiolucina serrata*

S20	9°41.8'N	123°51.1'E		10	Bohol Island, Manga	mud	*Leucosphaera phillpinensis, Opalocina persica, Pillucina pusilla, Cardiolucina serrata, Cardiolucina siquijorensis*
S21	9°41.7'N	123°50.9'E	4	12	Bohol Island, Manga	reef slope with silt	*Gonimyrtea celata, Notomyrtea fabula, Opalocina persica, Ctena bella, Epicodakia sweeti, Funafutia levukana, Liralucina sperabilis, Easmithia bractea, Pillucina pacifica, Cardiolucina serrata*
S22	9°29.4'N	123°56.0'E	15	20	Pamilacan Island	hard ground covered with sand	*Euanodontia ovum, Epicodakia sweeti, Ctena bella, Codakia tigerina, Pillucina profusa, Wallucina fijiensis, Easmithia brevis, Liralucina sperabilis, Cardiolucina siquijorensis*
S23	9°35.7'N	123°44.7'E		2	Panglao Island, Looc	sand and seagrass	*Ctena bella, Codakia tigerina, Pillucina profusa, Wallucina fijiensis, Chavania striata*
S24	9°36.1'N	123°45.0'E	2	4	Panglao Island, Momo Beach	subtidal platform	*Ctena bella, Funafutia levukana, Wallucina fijiensis, Cardiolucina siquijorensis*
S25	9°41.5'N	123°51.0'E		21	Bohol Island, Ubajan	mud	*Euanodontia ovum, Epicodakia sweeti, Funafutia levukana, Pillucina pacifica, Pillucina profusa, Easmithia brevis, Liralucina sperabilis, Cardiolucina serrata , Cardiolucina siquijorensis*
S27	9°41.5'N	123°51.0'E		12	Bohol Island, Ubajan	mud	*Leucosphaera philppinensis, Opalocina persica, Ctena bella, Funafutia levukana, Easmithia brevis, Liralucina sperabilis, Bretskya scapula, Cardiolucina serrata*
S28	9°37.2'N	123°46.4'E	28	32	Panglao Island, Napaling	reef wall with small caves	*Epicodakia sweeti, Ctena bella, Funafutia levukana, Pillucina profusa, Wallucina fijiensis*
S29	9°29.4'N	123°56.0'E		32	Pamilacan Island	wall and floor of small cavern	*Ctena bella, Funafutia levukana*
S30	9°29.4'N	123°56.1'E		25	Pamilacan Island	floor of cave (same cave as S31)	*Epicodakia sweeti*
S31	9°29.4'N	123°56.1'E		24	Pamilacan Island	wall of cave (same cave as S30)	*Epicodakia sweeti, Ctena bella*
S32	9°35.8'N	123°44.6'E	2	3	Panglao Island, Looc	hard plateau with sand covering rocks	*Epicodakia sweeti, Ctena bella, Funafutia levukana, Wallucina fijiensis, Cardiolucina siquijorensis*
S34	9°38.3'N	123°50.3'E		2	Panglao Island, Sungcolan Bay	mixed bottom	*Pillucina profusa, Cardiolucina siquijorensis*
S38	9°38.1'N	123°51.4'E	3	4	Panglao Island, Tagbilaran - Panglao channel	grey sand with a little mud	*Pillucina profusa, Cardiolucina siquijorensis*
S39	9°38.1'N	123°51.4'E	3	4	Panglao Island, Tagbilaran - Panglao channel	muddy sand, beds of Modiolus	*Pillucina profusa, Cardiolucina siquijorensis*
S40	9°38.4'N	123°49.4'E	2	4	Panglao Island, Sungcolan Bay	very fine sand	*Epicodakia sweeti, Ctena bella, Wallucina fijiensis*
S41	9°38.4'N	123°49.4'E	2	4	Panglao Island, Sungcolan Bay	coarse Amphioxus sand	*Wallucina fijiensis*
S42	9°30.1'N	123°55.5'E	15	20	Pamilacan Island	sand on hardground	*Euanodontia ovum, Ctena bella*
S43	9°30.1'N	123°55.5'E	2	3	Pamilacan Island	sand and coral debris	*Euanodontia ovum, Ctena bella, Cardiolucina siquijorensis*
S46	9°30.9'N	123°40.8'E		14	Balicasag Island	wall and floor of cave B	*Funafutia levukana*
S51	9°42.9'N	123°51.6'E		2	Bohol Island, off Abatan River mouth	mud	*Pillucina profusa*
S53	9°42.7'N	123°51.1'E		2	Bohol Island, off Abatan River mouth	muddy sand	*Pillucina profusa*
T1	9°32'N	123°47'E	83	102	Panglao Island, Bolod	mud and many sponges	*Myrtina boholensis, Notomyrtea perfecta, Cardiolucina rugosa*
T2	9°32'N	123°48'E		152	Panglao Island, Bolod	coarse sand	*Leucosphaera philippinensis, Myrtina adamsiana, Myrtina boholensis, Pseudolucinisca kantori, Notomyrtea catonii, Notomyrtea perfecta, Pillucina maestratii, Parvidontia mutabilis, Cardiolucina civica*
T3	9°32'N	123°47'E		150	Panglao Island, Bolod	fine and muddy sand	*Pseudolucinisca kantori, Megaxinus quadrangularis, Cardiolucina civica, Cardiolucina rugosa*
T4	9°33.0'N	123°48.5'E		82	Panglao Island, Bolod	many large sponges	*Alucinoma alis, Pillucina profusa, Cardiolucina rugosa*
T5	9°35.3'N	123°52.2'E	84	87	Bohol Island, W of Baclayon	coarse muddy sand	*Leucosphaera philippensis, Myrtina adamsiana, Notomyrtea perfecta, Pillucina profusa, Easmithia brevis, Easmithia bractea, Liralucina sperabilis, Parvidontia mutabilis, Cardiolucina rugosa*
T6	9°35.1'N	123°51.2'E	34	82	Bohol Island, W of Baclayon	coarse muddy sand with large sponges	*Leucosphaera philippensis, Myrtina adamsiana, Notomyrtea perfecta, Pillucina maestratii, Divaricella ornatissima, Parvidontia mutabilis, Bretskya scapula, Cardiolucina rugosa*
T7	9°36.1'N	123°53.3'E	61	62	Bohol Island, W of Baclayon	muddy fine sand	*Cardiolucina rugosa*
T9	9°33.5'N-9°33.9'N	123°49.5'-123°50.5'E	97	120	Panglao Island, off San Isidro	fine sand with seagrass	*Leucosphaera philippinensis, Myrtina adamsiana, Notomyrtea perfecta, Monitilora subtilis, Pillucina maestratii, Easmithia brevis, Easmithia bractea, Liralucina lathetikosa, Parvidontia mutabilis, Bretskya scapula, Cardiolucina rugosa*
T10	9°33.4'N-9°33.8'N	123°49.6'-123°51.5'E	117	124	Panglao Island, off San Isidro	mud and fine sand	*Leucosphaera philippinensis, Myrtina adamsiana, Myrtina boholensis, Notomyrtea fabula, Notomyrtea perfecta, Monitilora subtilis, Pillucina profusa, Easmithia brevis, Easmithia bractea, Liralucina lathetikosa, Parvidontia mutabilis, Cardiolucina civica, Cardiolucina rugosa*
T11	9°40.9'N	123°50.0'E	78	95	Bohol Island, Maribohoc Bay	sponges and muddy sand	*Leucosphaera philippinensis, Pillucina maestratii, Easmithia bractea, Cardiolucina rugosa*
T13	9°40.5'N	123°49.5'E	90	100	Bohol Island, Maribohoc Bay	sponges	*Myrtina boholensis, Parvidontia mutabilis, Bretskya scapula*
T14	9°42'N	123°49'E	101	110	Bohol Island, Maribohoc Bay	mud with shells	*Leucosphaera philippinensis, Pillucina maestratii, Easmithia brevis, Easmithia bractea, Cardiolucina rugosa, Cardiolucina serrata*
T17	9°42'N	123°49'E	132	137	Bohol Island, Cortes	muddy bottom with sponges	*Epicodakia sweeti*
T18	9°41.8'N	123°49.9'E	80	100	Bohol Island, Cortes	muddy bottom with sponges	*Leucosphaera philippinensis, Notomyrtea fabula, Notomyrtea perfecta, Pillucina maestratii, Easmithia brevis, Ferrocina luzonensis, Bretskya scapula, Jallenia inanis*

T19	9°42.2'N	123°50.8'E	10	26	Bohol Island, Cortes	mud	*Opalocina persica, Easmithia brevis, Liralucina sperabilis, Bretskya scapula, Cardiolucina serrata*
T22	9°42.5'N	123°50.7'E	11	20	Bohol Island, Cortes	mud	*Opalocina persica*
T23	9°42.2'N	123°50.6'E	35	45	Bohol Island, Cortes		*Easmithia brevis, Bretskya scapula, Cardiolucina serrata*
T24	9°42.3'N	123°50.3'E	35	57	Bohol Island, Cortes	mud and wood	*Cardiolucina serrata*
T25	9°41'N	123°49'E	160	210	Bohol Island, Cortes	fine sand and mud	*Alucinoma alis, Myrtina boholensis, Opalocina majuscula, Pseudolucinisca kantori, Notomyrtea catonii, Notomyrtea fabula, Notomyrtea perfecta, Liralucina lathetikosa, Jallenia inanis, Cardiolucina civica*
T26	9°43'N	123°49'E	123	135	Bohol Island, Cortes	mud	*Leucosphaera philippinensis, Myrtina boholensis, Opalocina majuscula, Notomyrtea fabula, Pillucina maestratii, Chavania striata, Bretskya scapula, Jallenia inanis, Cardiolucina civica, Cardiolucina rugosa, Cardiolucina serrata*
T27	9°33'N	123°51'E	106	137	between Panglao and Pamilacan islands	fine sand and mud with echinoderms	*Leucosphaera philippinensis, Myrtina adamsiana, Myrtina boholensis, Pseudolucinisca kantori, Notomyrtea fabula, Notomyrtea perfecta, Monitilora subtilis, Easmithia brevis, Easmithia bractea, Liralucina lathetikosa, Parvidontia mutabilis, Cardiolucina rugosa*
T28	9°35.0'N	123°51.4'E		80	Panglao Island, Biking - Catarman	muddy sand	*Myrtina adamsiana, Notomyrtea catonii, Pillucina maestratii, Parvidontia mutabilis, Cardiolucina rugosa*
T29	9°34.5'N	123°50.6'E	77	84	Panglao Island, Biking	mud	*Cardiolucina rugosa*
T30	9°36.3'N	123°53.5'E	59	65	Bohol Island, Baclayon	muddy sand	*Cardiolucina rugosa*
T31	9°33'N	123°42'E	100	140	between Panglao and Balicasag islands	sand and hard bottom	*Pseudolucinisca kantori, Notomyrtea catonii, Monitilora subtilis, Megaxinus quadrangularis, Liralucina sperabilis, Cardiolucina civica*
T32	9°36.4'N	123°53.8'E	60	62	Bohol Island, Baclayon	muddy sand	*Leucosphaera philippinensis, Notomyrtea perfecta, Bretskya scapula, Cardiolucina rugosa*
T33	9°36.0'N	123°53.7'E	67	74	Bohol Island, Baclayon	sand with sponges	*Cardiolucina rugosa*
T34	9°31'N	123°51'E	145	163	between Libaong and Pamilacan	sand with echinoderms	*Leucosphaera philippinensis, Myrtina boholensis, Pseudolucinisca kantori, Notomyrtea catonii, Monitilora subtilis, Pillucina profusa, Liralucina lathetikosa, Parvidontia mutabilis, Cardiolucina civica*
T35	9°32'N	123°50'E	172	182	between Libaong and Pamilacan		*Notomyrtea catonii, Cardiolucina civica*
T36	9°29'N	123°52'E	95	128	West Pamilacan island, Cervera shoal	sand on echinoderms bed	*Leucosphaera philippinensis, Myrtina adamsiana, Myrtina boholensis, Notomyrtea catonii, Notomyrtea perfecta, Monitilora subtilis, Pillucina maestratii, Liralucina lathetikosa, Parvidontia mutabilis, Cardiolucina civica, Cardiolucina rugosa*
T37	9°28'N	123°51'E	134	190	West Pamilacan Island, Cervera shoal	sand on echinoderms bed	*Myrtina adamsiana, Myrtina boholensis, Pseudolucinisca kantori, Notomyrtea perfecta, Liralucina lathetikosa, Parvidontia mutabilis, Cardiolucina civica*
T39	9°30'N	123°50'E	100	138	West Pamilacan Island, Cervera shoal	muddy sand	*Myrtina boholensis, Notomyrtea catonii, Monitilora subtilis, Easmithia brevis, Cardiolucina rugosa*
T41	9°30'N	123°50'E	110	112	West Pamilacan Island, Cervera shoal		*Notomyrtea perfecta, Cardiolucina rugosa*
T43	9°42.0'N-9°42.5'N	123°49.7/50.1'E	70	96	Bohol Island, Cortes	muddy sand	*Easmithia bractea*
T44	9°34.4'N	123°48.9'E	83	86	Panglao Island, off Bolod	sand, coral, sponges	*Notomyrtea catonii, Parvidontia mutabilis, Cardiolucina rugosa*

APPENDIX 2

PANGLAO 2005, ESTASE 2, MUSORSTOM 2 & 3 and AURORA 2007 data for stations at which Lucinidae were recovered.

Station	latitude	longitude	Depth range		Locality	Species
CP2331	9°39'N	123°48'E	255	268	Bohol Sea, Maribojoc Bay	*Alucinoma alis, Dulcina musorstomi, Myrtina galatea, Opalocina masjuscula, Notomyrtea catonii, Notomyrtea tanimbarensis, Cardiolucina civica*
CP2332	9°39'N	123°46'E	396	418	Bohol Sea, Maribojoc Bay	*Alucinoma alis, Myrtina galatea, Notomyrtea flabelliformis*
CP2333	9°38'N	123°44'E	584	596	Bohol Sea, Maribojoc Bay	*Myrtina galatea, Notomyrtea flabelliformis, Cardiolucina quadrata*
CP2334	9°38'N	123°40'E	606	631	Bohol Sea, Maribojoc Bay	*Myrtina galatea, Gloverina rectangularis, Megaxinus quadrangularis, Cardiolucina quadrata*
CP2335	9°34'N	123°38'E	729	733	Bohol Sea	*Gloverina rectangularis, Cardiolucina quadrata*
CP2336	9°32'N	123°39'E	757	760	Bohol Sea, off Balicasag Island	*Gloverina rectangularis, Lucinoma dulcinea, Cardiolucina quadrata*
DW2339	9°32'N	123°44'E	164	176	Bohol Sea, off Balicasag Island	*Opalocina majuscula, Pseudolucinisca kantori, Notomyrtea catonii, Notomyrtea fabula, Megaxinus quadrangularis, Troendleina suluensis, Liralucina lathetikosa, Parvidontia mutablis, Cardiolucina civica*
CP2340	9°29'N	123°44'E	271	318	Bohol Sea, off Balicasag Island	*Alucinoma alis, Dulcina musorstomi, Myrtina galatea, Pseudolucinisca kantori, Notomyrtea catonii, Notomyrtea flabelliformis, Notomyrtea tanimbarensis, Lucinoma dulcinea, Cardiolucina civica*
CP2341	9°24'N	123°50'E	544	712	Bohol Sea, off Pamilacan Island	*Alucinoma alis, Myrtina galatea, Gloverina rectangularis, Notomyrtea tanimbarensis, Cardiolucina quadrata*
CP2342	9°24'N	123°53'E	1240	1258	Bohol Sea, off Pamilacan Island	*Myrtina galatea, Notomyrtea tanimbarensis, Taylorina alata, Cardiolucina quadrata*
CP2343	9°27'N	123°49'E	273	356	Bohol Sea, off Pamilacan Island	*Pseudolucinisca kantori, Notomyrtea catonii,Notomyrtea tanimbarensi, Megaxinus quadrangularis, Liralucina lathetikosa*
CP2344	9°28'N	123°50'E	128	142	Bohol Sea, off Pamilacan Island	*Leucosphaera philippinensis, Pseudolucinisca kantori, Notomyrtea catonii, Liralucina lathetikosa, Cardiolucina civica*
DW2347	9°29'N	123°54'E	198	233	Bohol Sea, off Pamilacan Island	*Myrtina galatea, Pseudolucinisca kantori, Notomyrtea tanimbarensis, Cardiolucina civica*
CP2348	9°30'N	123°52'E	196	216	Bohol Sea, off Pamilacan Island	*Alucinoma alis, Dulcinea musorstomi, Myrtina galatea, Opalocina masjuscula, Pseudolucinisca kantori, Notomyrtea catonii, Notomyrtea fabula, Notomyrtea tanimbarensis, Megaxinus quadrangularis, Liralucina lathetikosa, Cardiolucina civica*
CP2349	9°32'N	123°56'E	219	240	Bohol Sea, off Pamilacan Island	*Alucinoma alis, Dulcina musorstomi, Myrtina galatea, Opalocina masjuscula, Pseudolucinisca kantori, Notomyrtea catonii, Notomyrtea tanimbarensis, Megaxinus quadrangularis, Troendleina suluensis, Liralucina lathetikosa, Cardiolucina civica*
CP2350	9°31'N	124°01'E	602	738	Bohol Sea	*Myrtina galatea, Gloverina rectangularis, Notomyrtea flabelliformis, Notomyrtea tanimbarensis, Cardiolucina civica, Cardiolucina quadrata*
CP2351	9°31'N	124°03'E	810	812	Bohol Sea	*Myrtina galatea, Notomyrtea flabelliformis, Notomyrtea tanimbarensis, Cardiolucina quadrata*
CP2352	9°27'N	124°03'E	923	1260	Bohol Sea	*Myrtina galatea, Cardiolucina quadrata*
CP2358	8°52'N	123°37'E	569	583	Bohol/Sulu Sea sill	*Alucinoma alis, Gonimyrtea profunda, Myrtina galatea, Elliptiolucina williamsae, Notomyrtea tanimbarensis, Lucinoma dulcinea*
CP2359	8°50'N	123°35'E	437	476	Bohol/Sulu Sea sill	*Elliptiolucina williamsae, Troendleina suluensis*
CP2360	8°49'N	123°38'E	357	372	Bohol/Sulu Sea sill	*Alucinoma alis*
CP2361	8°53'N	123°34'E	516	543	Bohol/Sulu Sea sill	*Gonimyrtea profunda, Elliptiolucina williamsae, Troendleina suluensis*
CP2362	8°56'N	123°33'E	679	740	Bohol/Sulu Sea sill	*Alucinoma alis, Gonimyrtea profunda, Myrtina galatea,Gloverina rectangularis, Elliptiolucina williamsae, Notomyrtea tanimbarensis, Lucinoma dulcinea, Troendleina suluensis, Cardiolucina quadrata*
DW2364	9°01'N	123°26'E		427	Bohol/Sulu Sea sill	*Myrtina galatea, Pseudolucinisca kantori, Notomyrtea catonii, Notomyrtea flabelliformis, Liralucina lathetikosa, Cardiolucina civica, Cardiolucina quadrata*
DW2370	8°33.7'N	123°08.6'E	92	96	Bohol/Sulu Sea sill, Dipolog Bay	*Easmithia bractea, Cardiolucina rugosa*
DW2371	8°35'N	123°16'E	172	175	Bohol/Sulu Sea sill, Dipolog Bay	*Notomyrtea fabula, Cardiolucina civica*
CP2372	8°39'N	123°16'E	255	301	Bohol/Sulu Sea sill, Dipolog Bay	*Alucinoma alis, Myrtina galatea, Notomyrtea flabelliformis, Lucinoma dulcinea*
DW2376	8°41'N	123°16'E	189	219	Bohol/Sulu Sea sill, off Aligbay Island	*Myrtina adamsiana, Cardiolucina civica, Cardiolucina rugosa*
CP2380	8°41'N	123°18'E	150	163	Bohol/Sulu Sea sill, Dipolog Bay	*Myrtina adamsiana, Myrtina galatea, Opalocina masjuscula, Pseudolucinisca kantori, Notomyrtea catonii, Notomyrtea fabula, Notomyrtea tanimbarensis, Monitilora subtilis, Troendleina suluensis, Liralucina lathetikosa, Jallenia inanis, Cardiolucina civica*
CP2381	8°43'N	123°19'E	259	280	Bohol/Sulu Sea sill, Dipolog Bay	*Alucinoma alis, Dulcina musorstomi, Myrtina galatea, Pseudolucinisca kantori, Notomyrtea catonii, Notomyrtea flabelliformis, Notomyrtea tanimbarensis, Liralucina lathetikosa, Cardiolucina civica*
CP2383	8°45'N	123°18'E	338	351	Bohol/Sulu Sea sill, off Aligbay Island	*Alucinoma alis, Gloverina rectangularis*
CP2384	8°46'N	123°16'E	624	647	Bohol/Sulu Sea sill, off Aligbay Island	*Gonimyrtea profunda, Myrtina galatea, Notomyrtea catonii, Cardiolucina quadrata*

CP2385	8°51'N	123°10'E	982	989	Bohol/Sulu Sea sill	*Gonimyrtea profunda, Myrtina galatea, Taylorina alata*
CP2388	9°27'N	123°34'E	762	786	Bohol Sea	*Gloverina rectangularis, Notomyrtea flabelliformis, Lucinoma dulcinea, Cardiolucina quadrata*
CP2389	9°28'N	123°38'E	784	786	Bohol Sea	*Gloverina rectangularis, Taylorina alata, Lucinoma dulcinea, Cardiolucina quadrata*
CP2390	9°27'N	123°43'E	627	645	Bohol Sea	*Myrtina galatea, Gloverina rectangularis, Notomyrtea flabelliformis, Notomyrtea tanimbarensis, Cardiolucina quadrata*
DW2391	9°30'N	123°43'E	323	336	Bohol Sea, off Balicasag Island	*Alucinoma alis*
CP2392	9°29'N	123°41'E	242	400	Bohol Sea, off Balicasag Island	*Alucinoma alis, Gloverina rectangularis, Notomyrtea tanimbarensis, Lucinoma dulcinea, Cardiolucina quadrata*
CP2393	9°30'N	123°42'E	356	396	Bohol Sea, off Balicasag Island	*Alucinoma alis, Myrtina galatea, Elliptiolucina williamsae, Notomyrtea catonii, Notomyrtea flabelliformis, Notomyrtea tanimbarensis, Lucinoma dulcinea, Cardiolucina civica*
CP2394	9°29'N	123°40'E	470	566	Bohol Sea, off Balicasag Island	*Gonimyrtea profunda, Myrtina galatea, Notomyrtea catonii, Notomyrtea flabelliformis, Cardiolucina quadrata*
CP2395	9°36'N	123°44'E	382	434	Bohol Sea, Maribojoc Bay	*Alucinoma alis, Myrtina galatea, Notomyrtea catonii, Notomyrtea flabelliformis, Notomyrtea tanimbarensis*
CP2396	9°36'N	123°42'E	609	673	Bohol Sea, Maribojoc Bay	*Myrtina galatea, Notomyrtea catonii, Lucinoma dulcinea, Cardiolucina quadrata*
CP2397	9°35'N	123°42'E	642	669	Bohol Sea, Maribojoc Bay	*Myrtina galatea, Gloverina rectangularis, Notomyrtea flabelliformis, Notomyrtea tanimbarensis, Lucinoma dulcinea, Cardiolucina quadrata*
CP2398	9°33'N	123°40'E	713	731	Bohol Sea, off Balicasag Island	*Myrtina galatea, Gloverina rectangularis, Notomyrtea flabelliformis, Notomyrtea tanimbarensis, Lucinoma dulcinea, Cardiolucina quadrata*
CP2399	9°32'N	123°42'E	309	342	Bohol Sea, off Balicasag Island	*Myrtina galatea, Notomyrtea tanimbarensis, Lucinoma dulcinea, Cardiolucina civica, Cardiolucina quadrata*
DW2400	9°32'N	123°42'E	111	115	Bohol Sea, off Balicasag Island	*Myrtina boholensis, Pillucina maestratii*
DW2401	9°31'N	123°40'E	397	410	Bohol Sea, off Balicasag Island	*Myrtina galatea, Gloverina rectangularis, Notomyrtea catonii, Notomyrtea flabelliformis, Cardiolucina civica*
CP2404	9°39'N	123°43'E	481	505	Bohol Sea, Maribojoc Bay	*Myrtina galatea, Gloverina rectangularis, Cardiolucina quadrata*
CP2405	9°39'N	123°46'E	387	453	Bohol Sea, Maribojoc Bay	*Alucinoma alis, Myrtina galatea, Gloverina rectangularis, Notomyrtea flabelliformis, Cardiolucina quadrata*
CP2406	9°41'N	123°47'E	334	387	Bohol Sea, Maribojoc Bay	*Alucinoma alis, Myrtina galatea, Notomyrtea catonii, Notomyrtea flabelliformis*
CP2407	9°41'N	123°48'E	256	268	Bohol Sea, Maribojoc Bay	*Alucinoma alis, Opalocina majuscula, Notomyrtea catonii, Notomyrtea flabelliformis, Notomyrtea tanimbarensis*
CP2408	9°44'N	123°47'E	121	137	Bohol Sea, Maribojoc Bay	*Notomyrtea perfecta, Notomyrtea tanimbarensis, Cardiolucina rugosa*
CP2409	9°45'N	123°45'E	220	257	Bohol Sea, Maribojoc Bay	*Dulcina musorstomi, Myrtina galatea, Pseudolucinisca kantori, Megaxinus quadrangulari, Troendleina suluensis, Cardiolucina civica*
ESTASE						
CP6	4°38N	119°49'E	2570		southern Philippines	*Elliptiolucina labeyriei, 'Myrtea' hyphalosa, Lucinoma estasia*
MUSORSTOM 2						
CP 25	13°39'N	120°43'E	520	550	N of Mindoro	*Dulcina guidoi, Elliptolucina magnifica, Rostrilucina anterorostrata*
CP 40	13°8'N	122°40'E	280	440		*Gloverina rectangularis*
CP 64	14°01'N	120°19'E	191	195	off Luzon, nr Lubang Is.	*Dulcina minor*
MUSORSTOM 3						
CP 87			191	197		*Notomyrtea catonii*
CP 100			189	199		*Notomyrtea catonii*
CP 101			194	196		*Myrtina galatea, Notomyrtea catonii*
CP 102			192	192		*Notomyrtea catonii*
CP 106			640	668		*Alucinoma alis,*
CP 109	14°00'N	120°18'E	190	198		*Megaxinus quadrangularis*
CP 122	12°20'N	121°42'E	673	675		*Taylorina alata*
CP 139			240	267		*Notomyrtea catonii, Jallenia inanis*
DR 140	11°43'N	122°34'E	93	99	N coast of Panay Island	*Myrtina spinosa, Myrtina vicina, Opalocina majuscula, Notomyrtea catonii, Notomyrtea fabula, Lamellolucina gemma, Divaricella ornatissima, Easmithia brevis, Easmithia bractea, Bretskya scapula, Jallenia inanis*
CP 141	11°45'N	122°45'E	40	44		*Cryptophysema insulosa*
CP 143	11°29'N	124°11'E	205	214	NW of Samar	*Dulcina musorstomi,*
CP 144	11°12'N	124°15'E	379	384	NW of San Isidro, Leyte	*Notomyrtea triclotae, Lucinoma dulcinea*
AURORA 2007						
CP 2653	16°06 N	121°59'E	83	83		*Cryptophysema insulosa*
CP 2654	16°04 N	121°57'E	98	107		*Notomyrtea fabula, Easmithia bractea*
CP 2665	15°53 N	121°42'E	125	198		*Cryptophysema insulosa, Notomyrtea fabula, Jallenia inanis*
DW 2670	14°52 N	121°49'E	180	187		*Notomyrtea catonii, Epicodakia izuensis, Troendleina suluensis, Jallenia inanis*
CP 2671	14°52'N	121°46'E	269	277		*Troendleina suluensis*
CP 2672	14°57'N	121°44'E	276	346		*Myrtina galatea*

CP2677	14°45 N	123°11	499	499		*Gonimyrtea profunda*
CP2686	15°56 N	123°09′E	996	1037		*Cardiolucina quadrata*
CP2692	14°40N	123°40′E	261	272		*Notomyrtea catonii*
CP 2695	14°46 N	123°39′E	367	357		*Myrtina galatea, Gonimyrtea profunda*
CP2706	15°04 N	121°42′E	478	480		*Alucinoma alis, Gonimyrtea profunda*
CP 2709	15°11 N	121°35′E	296	244		*Myrtina galatea*
CP 2711	15°19 N	121°32′E	184	200		*Myrtina galatea, Lepidolucina venusta, Divaricella ornatissima*
CP 2712	15°21 N	121°30′E	140	139		*Monitilora subtilis*
CP 2715	14°32 N	121°42′E	233	249		*Jallenia inanis*
CP 2716	14°31 N	121°60′E	335	356		*Jallenia inanis*
CP 2720	14°26 N	121°47′E	300	301		*Easmithia bractea*
CP 2721	14°24 N	121°47′E	360	367		*Jallenia inanis*
CP 2722	14°25 N	121°47′E	313	338		*Jallenia inanis*
CP 2723	14°25 N	121°49′E	147	156		*Jallenia inanis*
DW 2726	15°20 N	121°34′E	327	339		*Monitilora subtilis, Lepidolucina venusta*
DW 2738	16°04 N	121°55′E	111	113		*Easmithia bractea, Jallenia inanis*
DW 2739	16°05 N	121°57′E	96	96		*Myrtina boholensis, Easmithia bractea, Bretskya scapula, Jallenia inanis*
CP 2741	16°03 N	121°55′E	194	203		*Lepidolucina venusta*
CP2749	15°56 N	121°49′E	473	473		*Gonimyreta profunda, Myrtina boholensis, Liralucina lathetikosa*
DW 2758	15°55 N	121°50′E	151	173		*Monitilora subtilis, Easmithia bractea, Jallenia inanis*
CP 2762	15°52 N	121°37′E	66	66		*Jallenia inanis*