Museum Victoria Science Reports 26: 1–24 (2024)
ISSN 1833-0290
https://museumsvictoria.com.au/collections-research/journals/museum-victoria-science-reports/
DOI https://doi.org/10.24199/j.mvsr.2024.26

Catalogue of the Echinoidea (sea urchins, phylum Echinodermata) collected by the IN2021_V04 and IN2022_V08 expeditions to the Australian Christmas Island and Cocos (Keeling) Islands Territories

Ashley Miskelly

Sea Urchin Science Centre and Gallery, Kurrajong NSW 2758, Australia [seaurchins1@optusnet.com.au]

Abstract In this catalogue, the 17 species of echinoids collected by the IN2021_V04 and IN2022_V08 expeditions to the Australian Christmas Island and Cocos (Keeling) Islands Territories are described and illustrated.

Ashley Miskelly. 2024. Catalogue of the Echinoidea (sea urchins, phylum Echinodermata) collected by the IN2021_V04 and IN2022_V08 expeditions to the Australian Christmas Island and Cocos (Keeling) Islands Territories. *Museum Victoria Science Reports* 26: 1–24 https://doi.org/10.24199/j.mvsr.2024.26

Keywords echinoids, echinoderms, Indian Ocean Territories, illustrated catalogue, biodiversity, species discovery, deep-sea

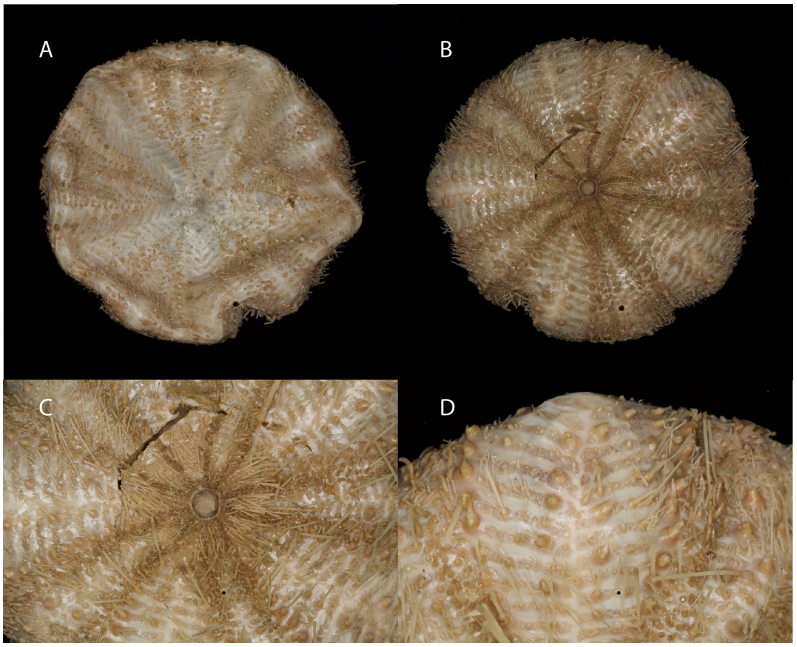

Figure 1. *Araeosoma tesselatum*.

Contents

Introduction

The collection of benthic sea urchin species sampled from Cocos-Keeling Island territory holds significant scientific importance due to several reasons. Firstly, the Cocos-Keeling Islands are located in the Indian Ocean which is known for its rich biodiversity. By studying the range of species of sea urchins and other marine invertebrates from such deep water environments, scientists can gain insights into the ecological dynamics and distribution patterns of these marine organisms. This data is crucial for understanding how various factors such as ocean currents, depth and habitat influence the diversity and abundance of sea urchins contributing to broader efforts in marine conservation and management.

Moreover, deep water environments such as those around the Cocos-Keeling Islands remain relatively understudied compared to shallow water ecosystems. The collection and identification of species provides valuable information about these mysterious, poorly known habitats. Understanding the biodiversity of of deep water sea urchins is beneficial for assessing the overall health and resilience of marine ecosystems, particularly in the face of ongoing environmental changes and anthropogenic pressures. Thus, the research conducted in this area not only advances our knowledge of benthic marine biodiversity, but also informs conservation strategies aimed at protecting these critical underwater ecosystems, and better understanding of Australia's Indian Ocean Territories (IOT).

Methods

Station details and collection methods are described in O'Hara (2024).

Taxonomy follows David *et al.* (2005); Rowe & Gates (1996); Schultz (2009, 2011); Shigei (1986); Smith & Kroh (2011).

Systematic account

Order Salenioida

Family Saleniidae

***Salenocidaris hastigera* (A. Agassiz, 1869)**

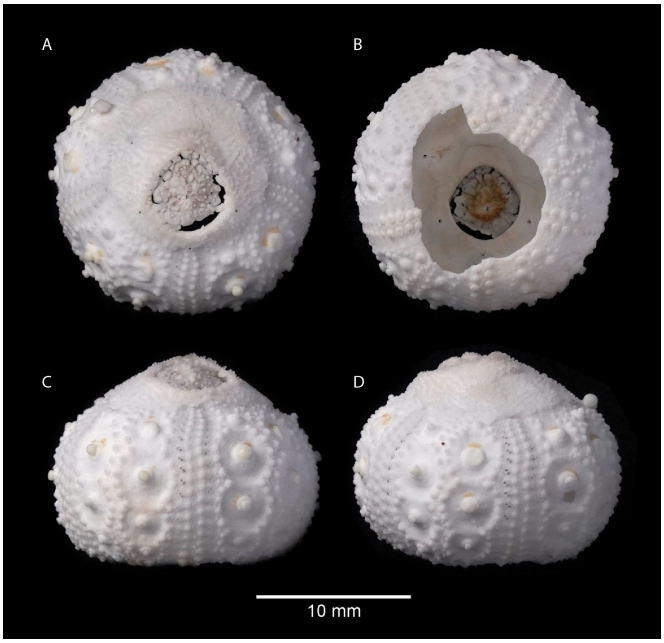

Figure 2. *Salenocidaris hastigera*. (A-D) AM J30941 (Op 103) Denuded test. (A) Aboral, (B) Oral, (C) Ambital. (D) Ambital, alternate view.

Diagnosis Test diameter up to 17.5 mm, denuded test white, fawn/pale lavender coloured when preserved in ethanol. Apical system covering approximately 50% of aboral surface. Peristome smaller in diameter than periproct. Plates of the apical system ornamented. Poriferous zones of the ambulacra uniserial. One single tubercle per ambulacral plate. Periproct offset to ocular plate 1. Primary spines white, serrated with tiny thorns, more so on the upper length of the spine. Primary spines slightly curved downward distally, and 3.5 times as long as the test diameter. (Based on specimens AM J30941 and AM J30942).

Distribution Indian Ocean, Norfolk Island, Tasman Sea, Indo-Malay Archipelago, North Cape, New Zealand, Great Australian Bight (South of Yalata). depth range 370–2565 m (IOT records: 3611–3510 m).

Order Arbacioida

Family Arbaciidae

Pygmaeocidaris prionigera **(A. Agassiz, 1879)**

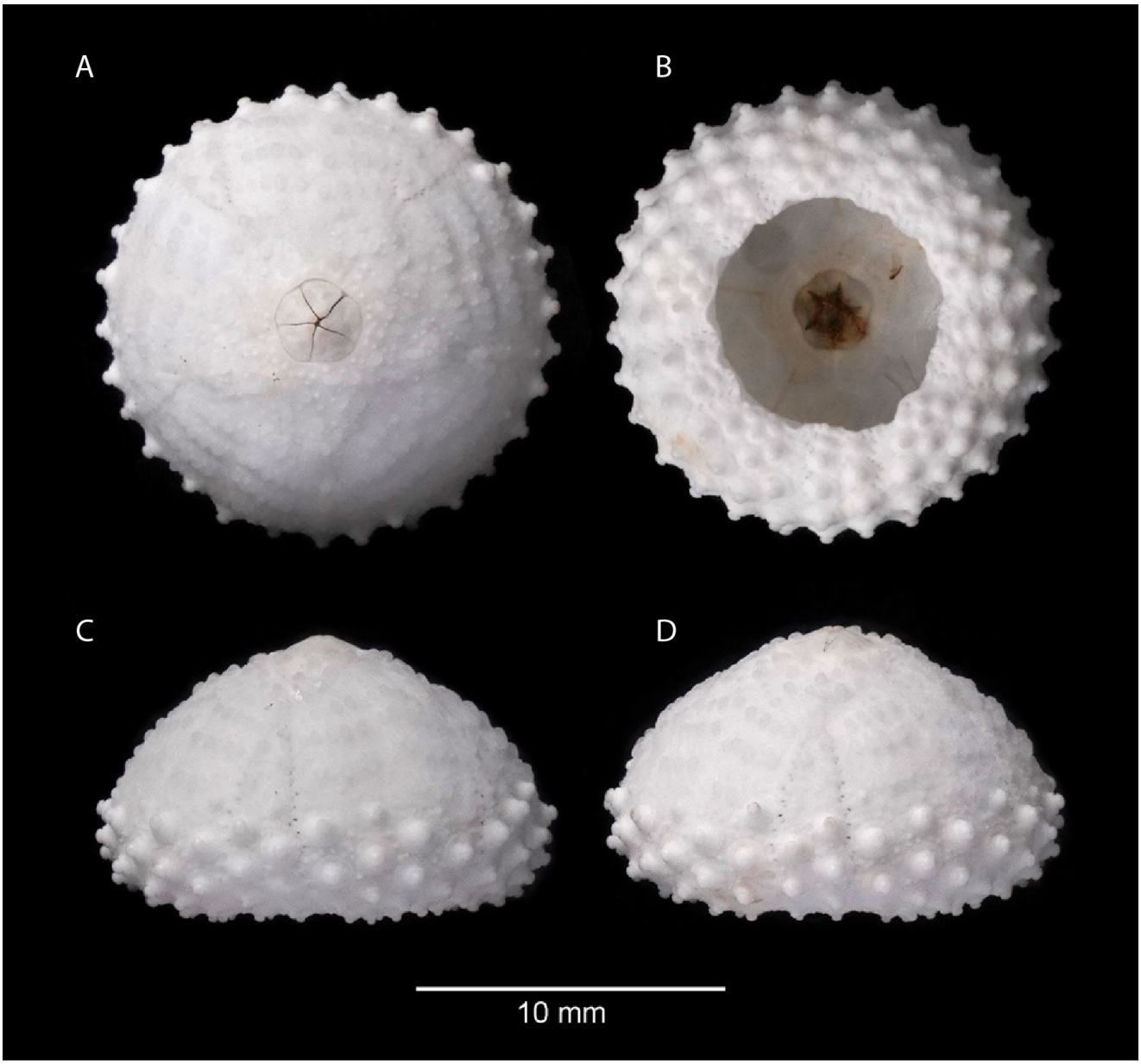

Figure 3. *Pygmaeocidaris prionigera*. (A-D) AM J30907 (Op 103) Denuded test. (A) Aboral, (B) Oral, (C) Ambital. (D) Ambital, alternate area.

Diagnosis Test subconical, diameter up to 15.9 mm, denuded test white, fawn coloured when preserved in ethanol. Apical system covering approximately 50% of aboral surface. Peristome slightly larger in diameter than periproct. Five distinct suranal plates of equal size within the apical system. Plates of the apical system coarsely tuberculated with granules. Gonopores absent. Poriferous zones of the ambulacra uniserial. Oral primary tubercles large, continuing to the ambitus. Above the ambitus, primary tubercle size much reduced. Primary spines very pale greenish to white, short, distally flattened. (Based on specimens AM J30907).

Distribution North of New Guinea, Bay of Bengal, Mouth of Heping River, Taiwan. New Australian record for species occurring off Balthazar Seamount. Depth range 660–2860 m (IOT records: 3611–3510 m).

Order Echinolampadacea

Family Fibulariidae

***Echinocyamus* cf. *apicatus* Mortensen, 1948**

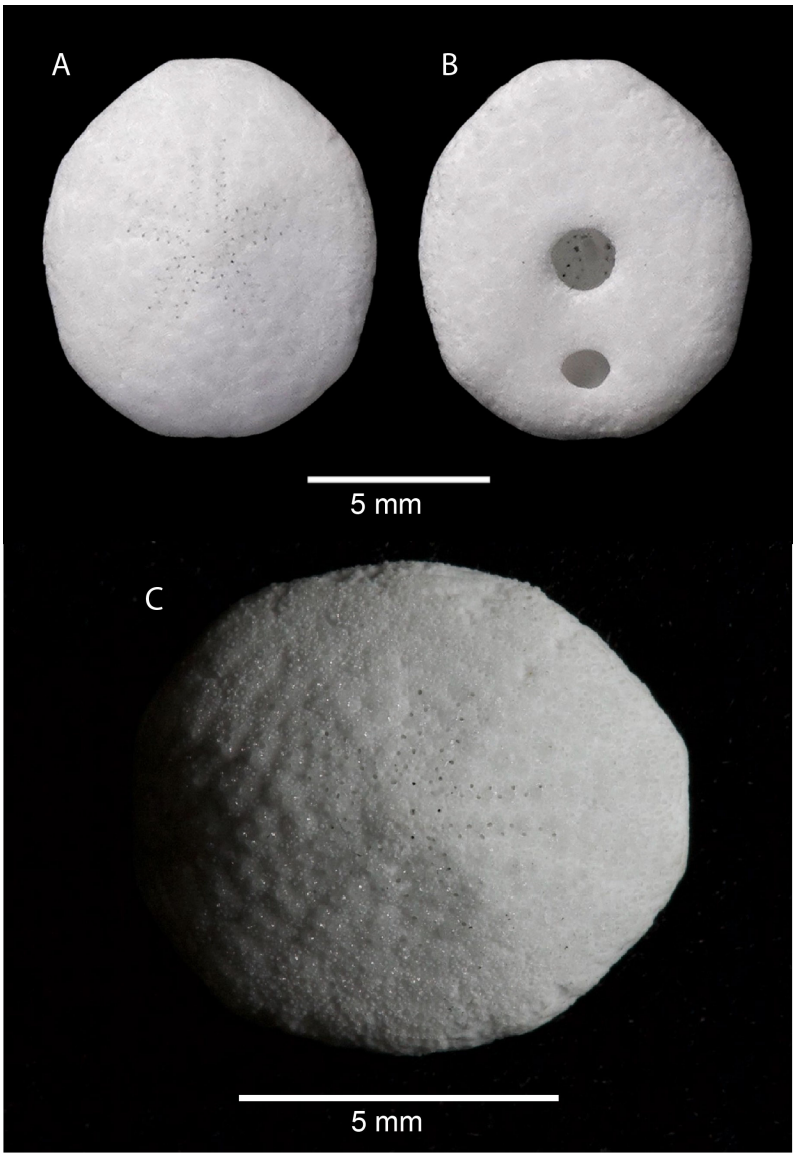

Figure 4. *Echinocyamus* cf. *apicatus*. (A-C) AM J30945 (Op 159) Denuded test. (A) Aboral, (B) Oral, (C) Side lighting to highlight glassy tubercles.

Diagnosis Test low, conical, length up to 10 mm, corresponding width 8.7 mm. Denuded test white, slightly ovate. 4 gonopores. Petals faint, open distally not well developed, yet distinct with five pore-pairs in each side of the petal. Petals covering approximately 50% of aboral surface. Peristome slightly transverse oval, positioned not quite mid-way between peristome and test margin, closer to posterior. Test longer than wide. There are glassy tubercles distributed both on the oral surface and the oral surface in moderate concentration. (Based on specimens AM J30945).
Distribution Indeterminate at present. depth range (IOT records, 603–675 m).

Order Clypeasteroida

Family Clypeasteroidae

Clypeaster virescens **Doderlein, 1885**

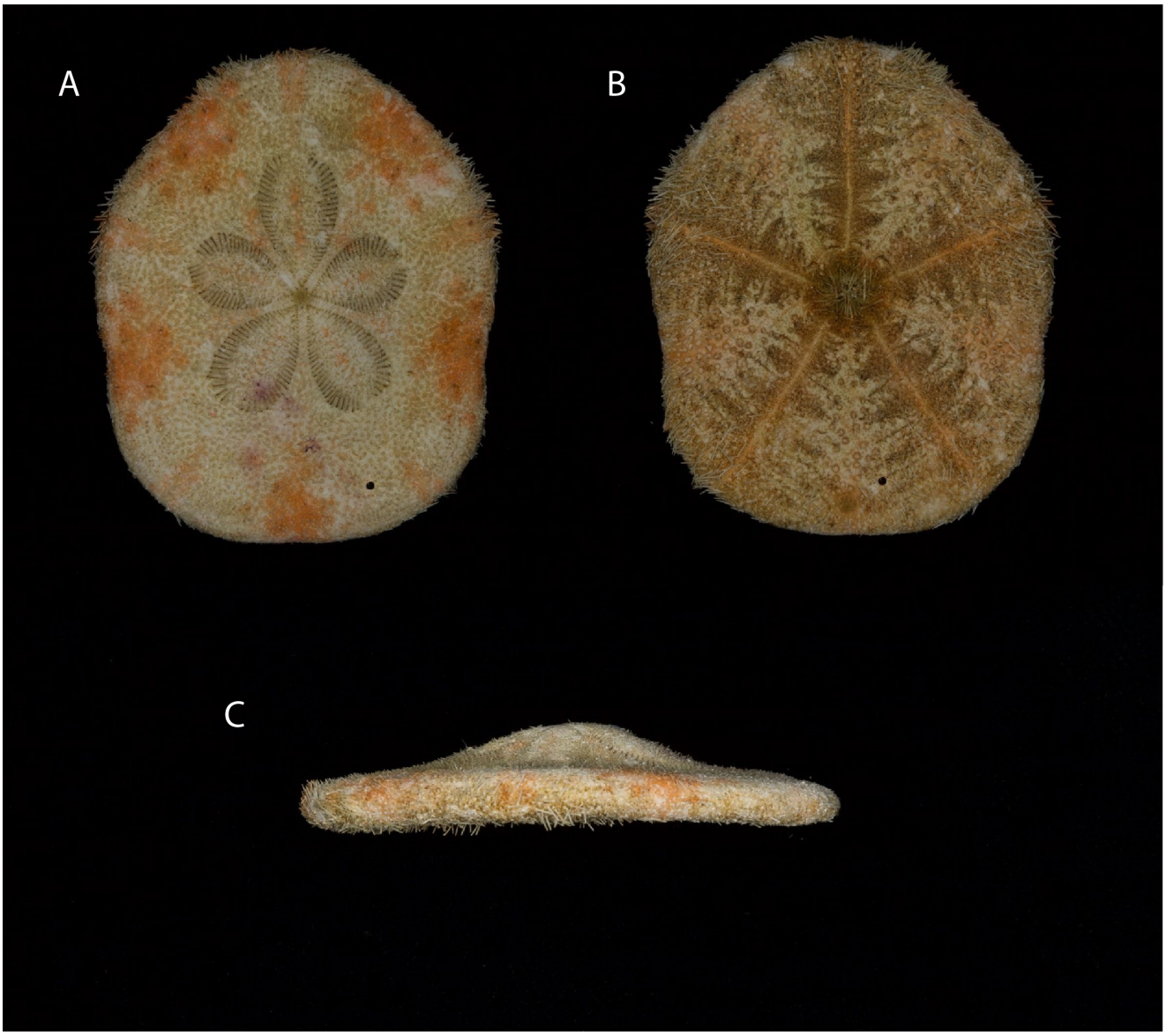

Figure 5. *Clypeaster virescens*. (A-C) AM J30895 (Op 179). Dried specimen. (A) Aboral, (B) Oral, (C) Ambital.

Diagnosis Test flattened, raised slightly apically. Length up to 48 mm with corresponding width 38 mm. May grow to 135 mm. Colour may be orange, often of the interambulacra (aborally) in dry preserved specimens with pale green/yellow ambulacra. Denuded test white. Petals well developed and closed distally, covering approximately 50% of aboral surface. Ridges between pore pairs having 3-4 primary tubercles. Periproct in close proximity to test margin. (Based on specimens AM J30895).

Taxonomic remarks Known to occur in previously unrecorded shallower waters within Port Jackson, Sydney Harbour. Shallowest depth, 6 m.

Distribution Japan, Malayan Archipelago. Cocos Keeling Islands, Moreton Bay, Queensland to Green Cape, New South Wales. Depth range 6-630 m (Miskelly unpublished data) (IOT records: 111–121 m).

Order Temnopleuroidea

Family Trigonocidaridae

***Trigonocidaris monolini* A. Agassiz, 1879**

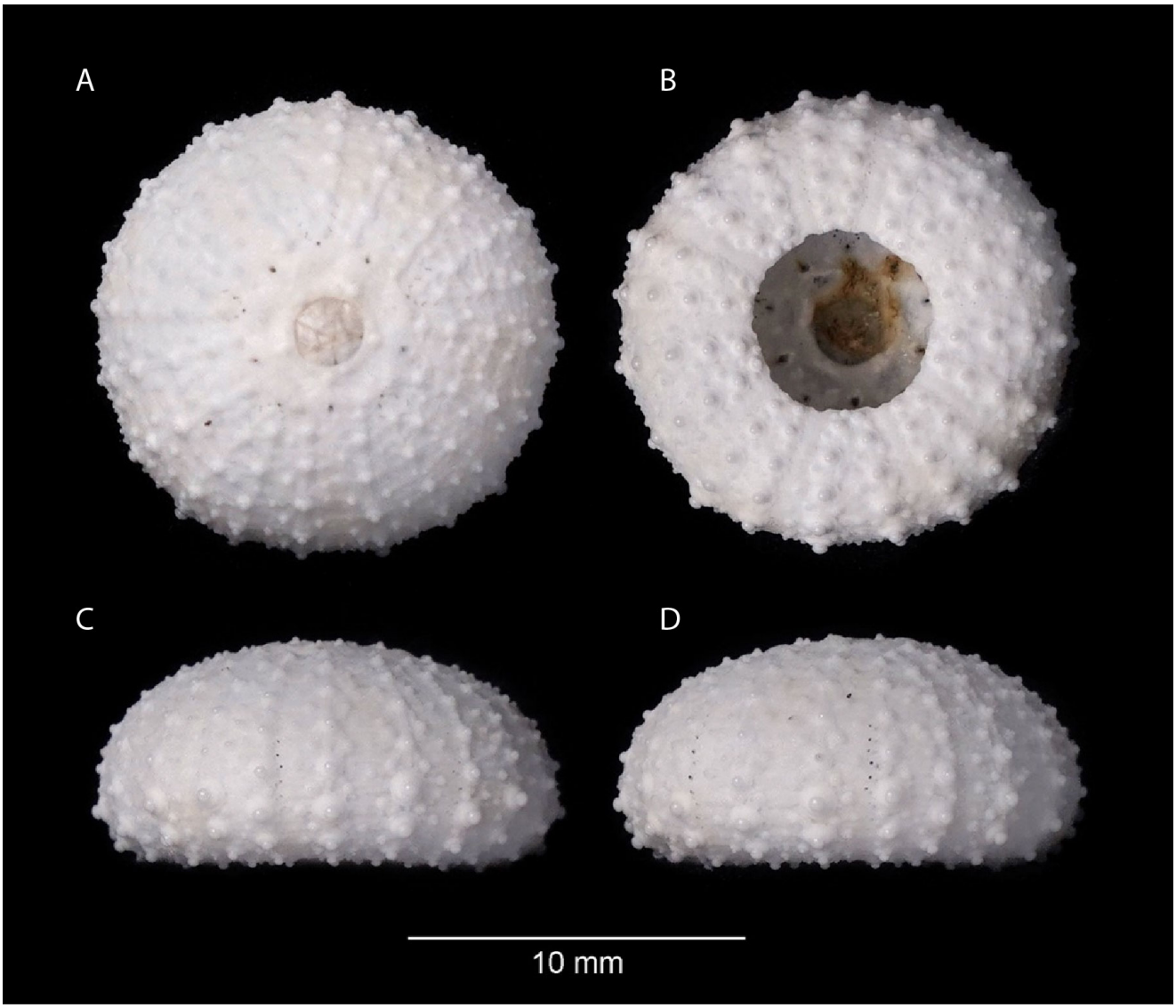

Figure 6. *Trigonocidaris monolini*. (A-C) AM J28252 (Op 009). Denuded test. (A) Aboral, (B) Oral, (C) Ambital. (D) AM J30904 Dried specimen with spines.

Diagnosis Test diameter up to 14 mm, denuded test white. Apical system covering approximately one third of the aboral surface area. A single primary tubercle is present on inner edge of each genital plate. Primary tubercles imperforate and weakly crenulate. Uniserial pore pair arrangement, pore-pairs well-spaced but becoming more compact closer to the peristome. Interambulacral plates with a central primary tubercle an a few smaller projecting secondary tubercles on either side; suture pits small but well developed, the secondaries projecting strongly from test surface giving a sculpted appearance. Peristome moderately large with faint buccal notches. Spines short and white in colour. (Based on specimens AM J28252, AM J28273 and AM J30904).

Taxonomic remarks *Orechinus monolini* is a subjective junior synonym.

Distribution Indian Ocean, Indonesia, Hawaii, Malayan Region, Tasman Sea, Wanganella Bank, Kermadec Islands. Depth range 318-2300 m. (IOT records, 1640–1850 m).

***Prionechinus agassizii* Wood-Mason & Alcock, 1891**

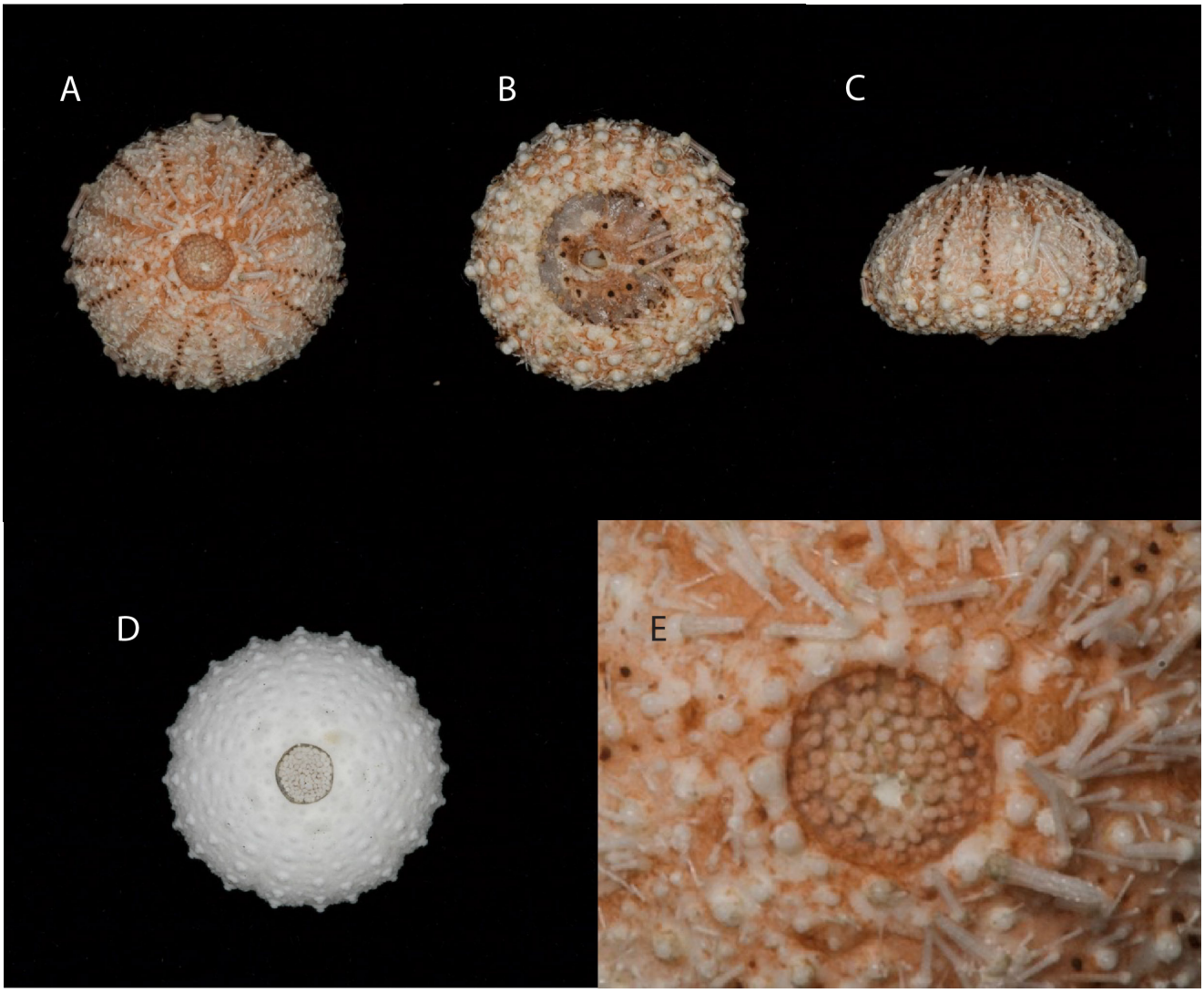

Figure 7. *Prionechinus agassizii*. Prionechinus agassizii (A-C, E) AM J30850 (Op 105) Dry preserved specimen. (A) Aboral, (B) Oral, (C) Ambital, (D) AM J30964 (Op 147) Denuded test, aboral without natural pigmentation, (E) Apical system.

Diagnosis Test diameter up to 16 mm, denuded test white. Apical system small, occupying approximately one twelfth of the aboral surface area. The madreporite is very small. Periproctal plates small and numerous, with minimal variance in size. Gonopores in males small, slit-like and very hard to distinguish. The pore pairs are arranged in arcs of three, but this is not particularly evident until the ambitus. Above the ambitus, the formation appears more uniserial and slightly irregular. On the peristome, the pore pair arcs are the most distinct. The inter-radial sutured are distinctly depressed from the apical system to the peristome. Each interambulacral plates has a central primary tubercle and smaller, scattered secondary tubercles around it. The primary tubercles become noticeably larger and crowded at the ambitus towards the peristome. Peristome larger than the apical system. Primary pines short, no more than 6 mm and whitish cream in colour. (Based on specimens AM J30964 and AM J30964.)

Taxonomic remarks Distinguished from *Prionechinus sagittiger* (which shows similar colouration) by the following two characteristics:

- The lack of a suranal plate within the periproct
- A distinctly depressed inter-radial suture occurring from the apical system to the peristome.

Another species, *Prionechinus forbesianus* has pale orange/whitish colouration of the spines and test.

Distribution Indian Ocean from the Pemba Strait and Tanzania to Sumatra, Indonesia, Cocos-Keeling Islands. Depth range (IOT records, 2617–2721 m).

Order Spatangoida

Family Maretiidae

***Gymnopatagus magnus* A. Agassiz & H.L. Clark, 1907**

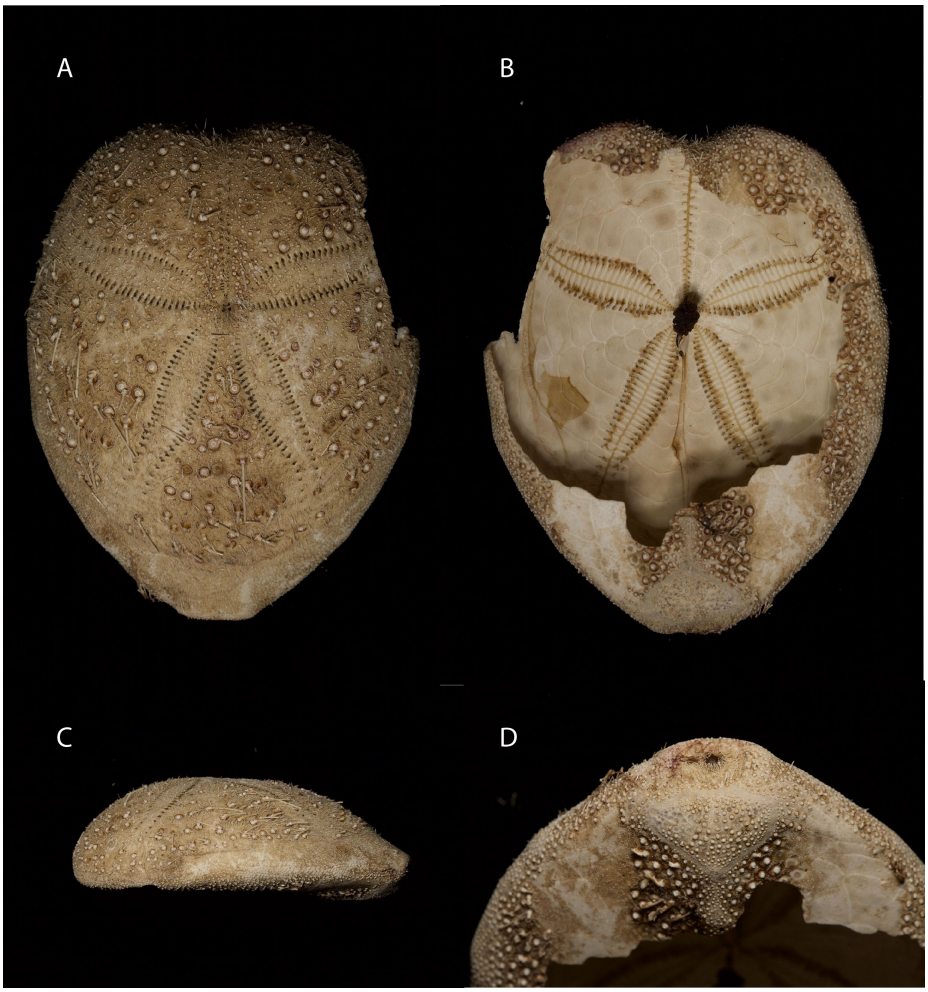

Figure 8. *Gymnopatagus magnus*. (A-D) AM J30871 (Op 113) Partial test, dried specimen. (A) Aboral, (B) Oral, (C) Ambital, (D) Subanal fasciole

Diagnosis Test fragile, length up to 108 mm, with a corresponding width of 84 mm. Heart shaped in outline, The petals are of equal length and not sunken. The anterior ambulacrum is distinctly notched, but not deeply. The anterior petals are flexed slightly downward. The peripetalous fasciole does not closely outline the petals and runs close to the ambitus anteriorly. Within the peripetalous fasciole the primary tubercles are large, slightly sunken, supporting long, defensive spines. The subanal fasciole is shield shaped and there are two pore pairs in each side. Apical system slightly anterior with four gonopores. The test slopes gently from the apical system to the periproct. Preserved specimen uniformly pale fawn. (Based on specimen AM J30871).

Taxonomic remarks *Gymnopatagus parvipetalus* is a similar species known from Japan, East China Sea and New Zealand. It is readily distinguishable by the smaller petal size, fewer primary tubercles, and deeper anterior notch.

Distribution Indian Ocean, Japan. Depth range 780-2350 m. (IOT records, 1936–1968 m).

Order Aspidodiadematoida

Family Aspidodiadematidae

***Aspidodiadema tonsum* A. Agassiz, 1879**

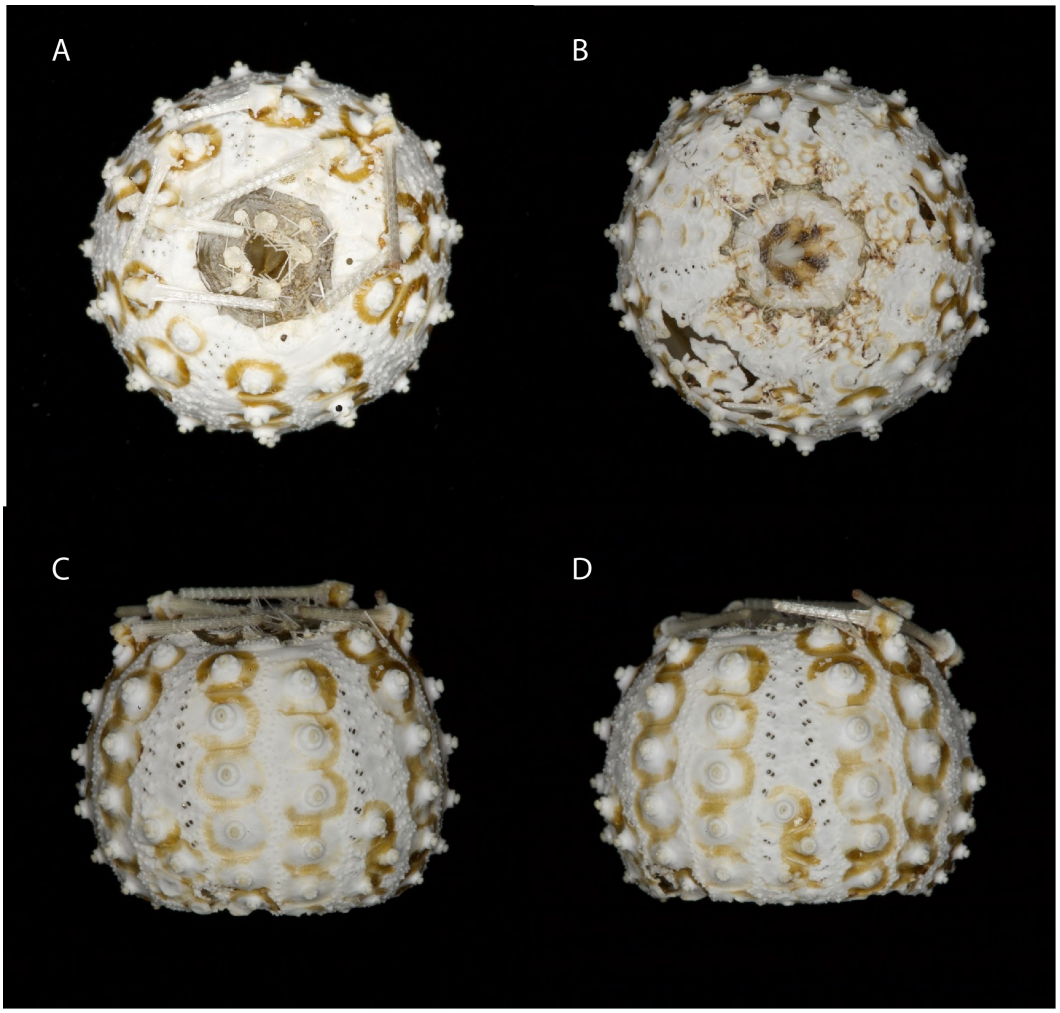

Figure 9. *Aspidodiadema tonsum*. (A-D) AM J30949 (Op 165) Denuded test. (A) Aboral, (B) Oral, (C) Ambital, showing interambulacral tubercle arrangement. (D) Ambital, showing the poriferous zones of the ambulacra.

Diagnosis Test diameter up to 20 mm, very fragile. The denuded test is white and barrel-shaped. Apical system large, occupying approximately 80% of the aboral surface area. The periproctal plates are centrally positioned within a fleshy membrane are densely covered with small spines. The pore pair arrangement consists of a uniserial vertical series. There is one very large perforate, crenulate primary tubercle on each interambulacral plate forming regular straight series. Surrounding the primary tubercles are comparatively few small tubercles for fine secondary spines confined to the plate margins. This is due to the large surface area of the primary tubercle. Four primary tubercles exist from the ambitus to the edge of the peristome. Buccal plates of the peristome large and close-fitting together, each with a large buccal tube foot. Primary spines strongly verticillate and purplish. (Based on specimens AM J30949).

Taxonomic remarks Species of *Aspidodiadema* are easily damaged due to the extremely fragile nature of the plates. Spines are easily broken and consequently are often detached after sampling.

Distribution Japan, Philippines, Indo-Malayan region, Kermadec Islands, Norfolk Island, Tasman Sea. Depth range 180–1135 m. (IOT records, 932–965 m).

Order Echinothurioida

Family Echinothuriidae

Hygrosoma hoplacantha **(W. Thomson, 1877)**

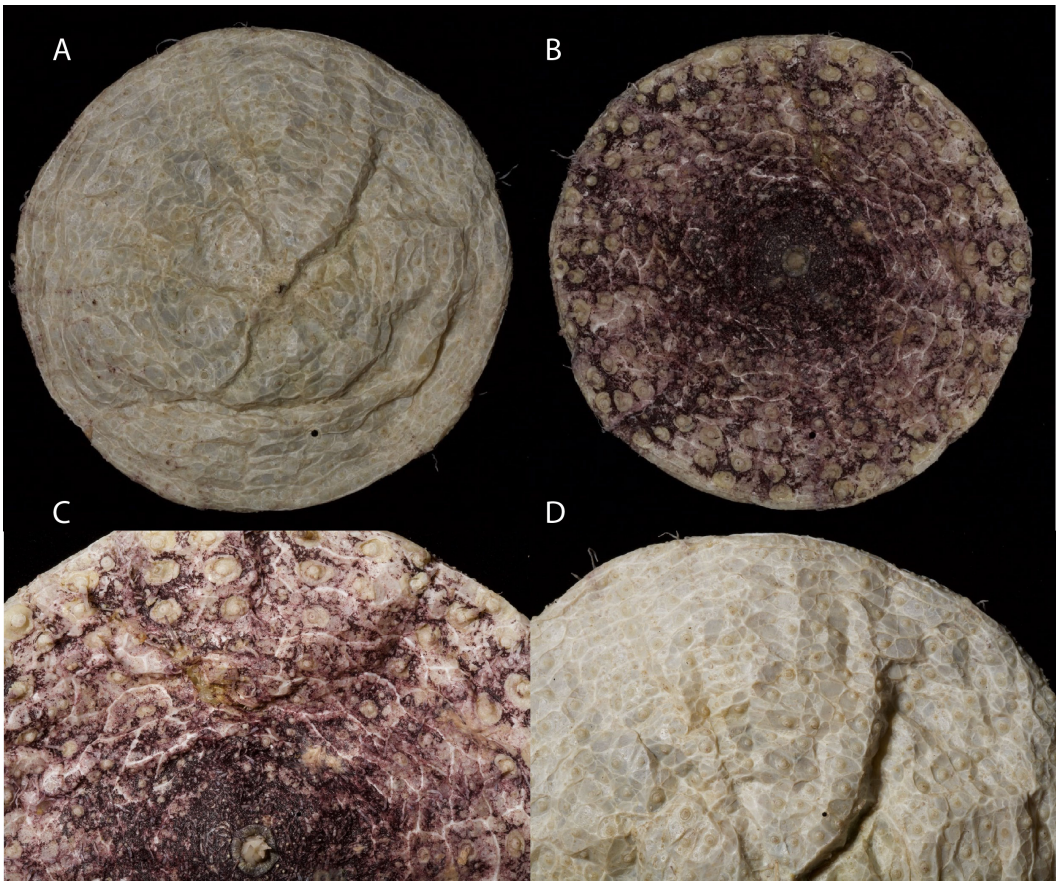

Figure 10. *Hygrosoma hoplacantha*. (A-D) AM J30885 (Op 108) Test preserved in 70% ethanol (A) Aboral, (B) Oral, (C) Oral plate detail and peristome. (D) Aboral plate detail.

Diagnosis Test diameter up to 280 mm, very thin and fragile, non-rigid and flexible, deflated, compacted appearance on preservation where plates become undulating due to prominent membranous gaps between plates. Apical system occupying no more than around 10% of the aboral surface area. The periproctal plates are interspersed with skin tissue and are of irregular arrangement. The ambulacral and interambulacral plates show little, if any sign of a regular ordered arrangement in their size, shape, and tubercle distribution. The size of the interambulacral plates becomes larger on the oral surface. The ambulacral plates extend over the peristome all the way to the Aristotle's Lantern. The aboral pore pair arrangement of the primary plate opens more at the side of the demi-plates, forming three distinct series, but variations do occur. Oral spines up to 32 mm length, with terminal "hoof." Preserved specimens dark purple or purplish brown. (Based on specimens AM J30885, AM J30892 and AM J30872).

Taxonomic remarks The morphology of the spines and pedicellariae of Hygrosoma, and indeed many other Echinothuriids are important in distinguishing species. However, as is usually the case with deep water sampled specimens, both are frequently lost in the process. For example, for specimen AM J30892 only two single unbroken spines showing the characteristic hoofed tip were present. Other spines were either completely absent or damaged.

Distribution Indo-Malayan archipelago, North of Port Hedland, Western Australia. Depth range 360–2068 m. (IOT records, 1355–2721 m).

***Araeosoma tessellatum* (A. Agassiz, 1879)**

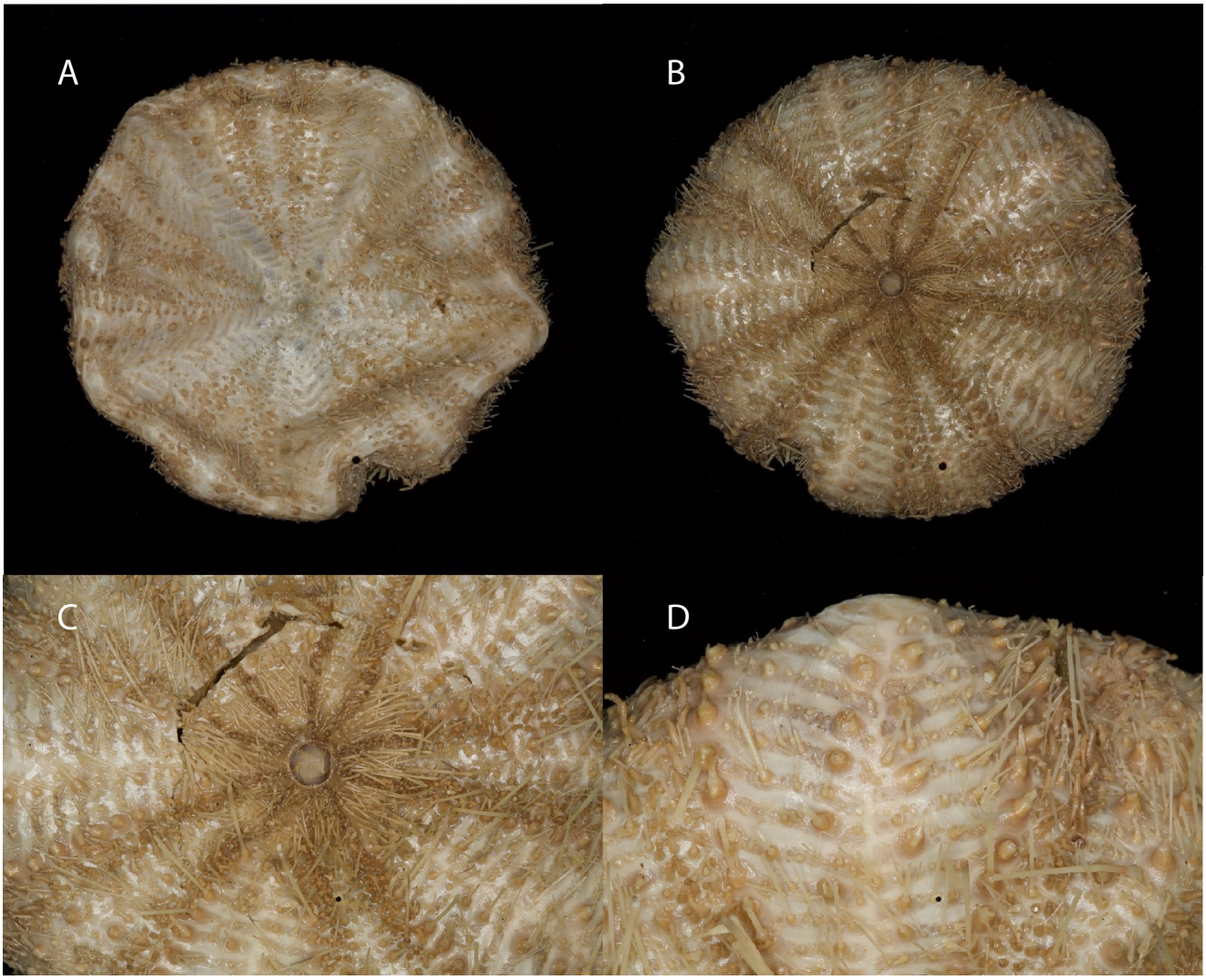

Figure 11. *Araeosoma tessellatum*. (A-D) AM J30878 (Op 157) Test preserved in 70% ethanol (A) Aboral, (B) Oral, (C) Peristome and spines. (D) Interambulacral plates.

Diagnosis Test diameter up to 155 mm, comparatively rigid when compared to other echinothuriids, yet flexible. Compacted, crumpled, appearance on preservation. The interambulacral plates appear as a chevron-shaped arrangement, pointing outwards. The boundaries of the plates composing the apical system appear indistinct, and the gonopores are conspicuously elongated and fleshy. The plates composing the apical system are sparsely endowed with spines. From the ambitus to the peristome, the primary interambulacral tubercles form an ordered arrangement not seen on the aboral surface, close to the outer margins of the ambulacra. The pore pair arrangement consists of three vertical rows; the two innermost rows situated closer together than the outermost row. The oral spines are curved and may attain a length of 20 mm. They have a terminal "hoof" which is whiter in colour compared to the rest of the spine. Preserved specimens pale fawn. (Based on specimens AM J28243 and AM J30878).

Taxonomic remarks Differentiated from the other species of *Araeosoma* by the combination of the following:

- Ordered arrangement of primary tubercles on the oral surface.
- Chevron-shaped interambulacral plates.
- Distinctly elongated genital plates.

The terminal hooves of the oral primary spines are often not intact, so specimens may give the impression of having fewer hoofed spines due to their broken tips.

Distribution Indo-Malayan archipelago, China Sea. Depth range 180–900 m. (IOT records, 643–1023 m). New faunal record for Australia.

Family Phormosomatidae

***Phormosoma bursarium* A. Agassiz, 1881**

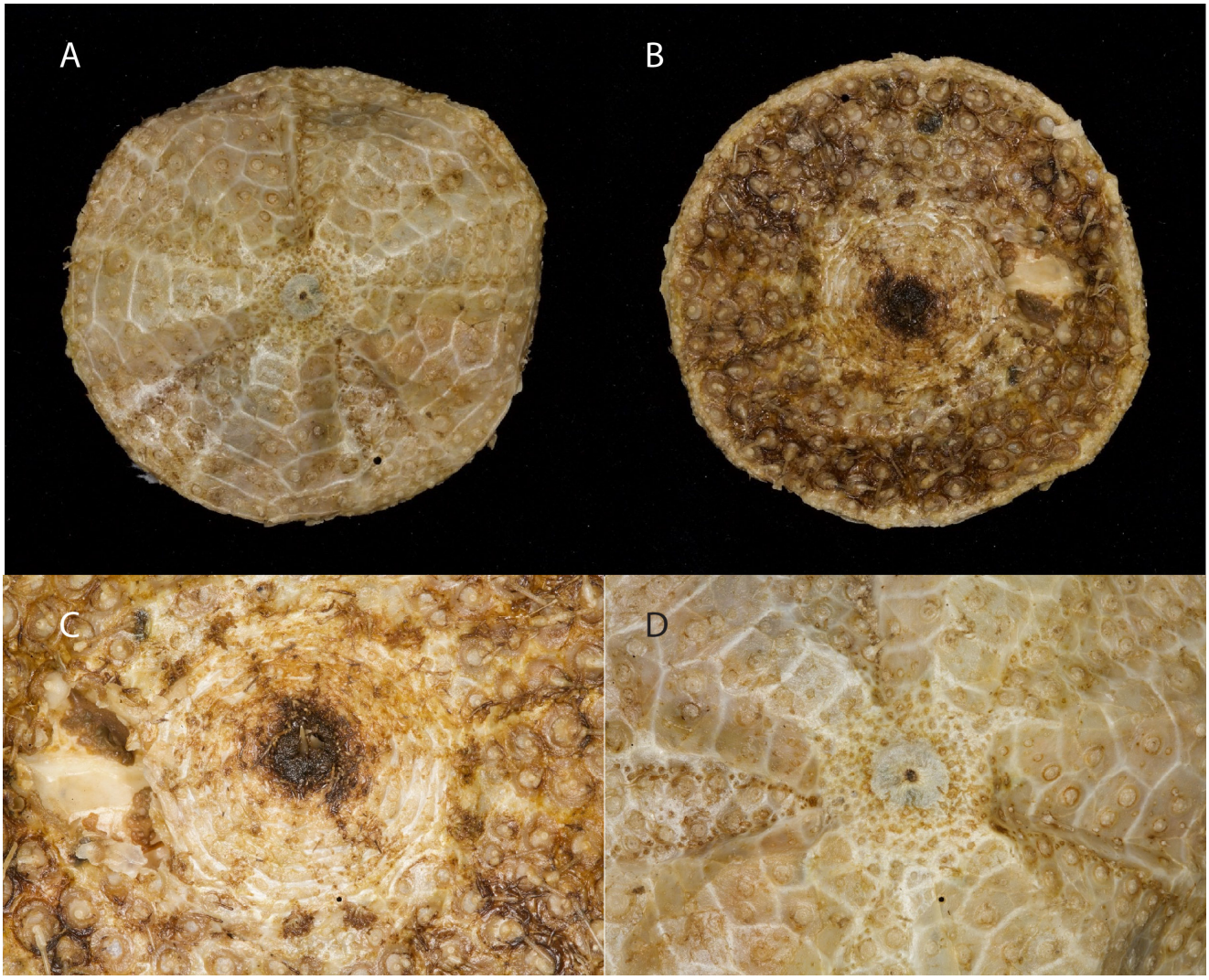

Figure 12. *Phormosoma bursarium*. (A-D) AM J30891 (Op 117) Test preserved in 70% ethanol (A) Aboral, (B) Oral, (C) Peristome. (D) Apical system.

Diagnosis Test very thin and fragile with a diameter up to 130 mm. Preserved specimens are flat. Apical system smaller than peristome. The periproctal plates are numerous and variable in their size and shape. On the oral surface, the ambulacral and interambulacral plates show a regular arrangement of primary tubercles with large areoles. They occur in regular series of 5 or 6, stopping well short of the peristome. Individual oral interambulacral plates have up to three primary tubercles per plate. The ambulacra are about half the width of the interambulacral at the ambitus. The plates extend over the peristome all the way to the Aristotle's Lantern. The aboral pore pair arrangement consists of three distinct series, transforming to a uniserial arrangement on the oral surface. The aboral tubercles are irregularly arranged. Oral spines up to 15 mm length, somewhat curved, and hollow. (Based on specimens AM J30891).

Taxonomic remarks Distinguished from other echinothurioids by the large, sunken areoles of its oral interambulacral tubercles.

Distribution Indo-West Pacific region from Natal and the Arabian Sea to Japan, Hawaii, New Zealand, Philippines, and Australia. Depth range 170–2340 m. (IOT records, 1164–1175 m).

Order Pedinoida

Family Pedinidae

***Caenopedina mirabilis* (Doderlein, 1885)**

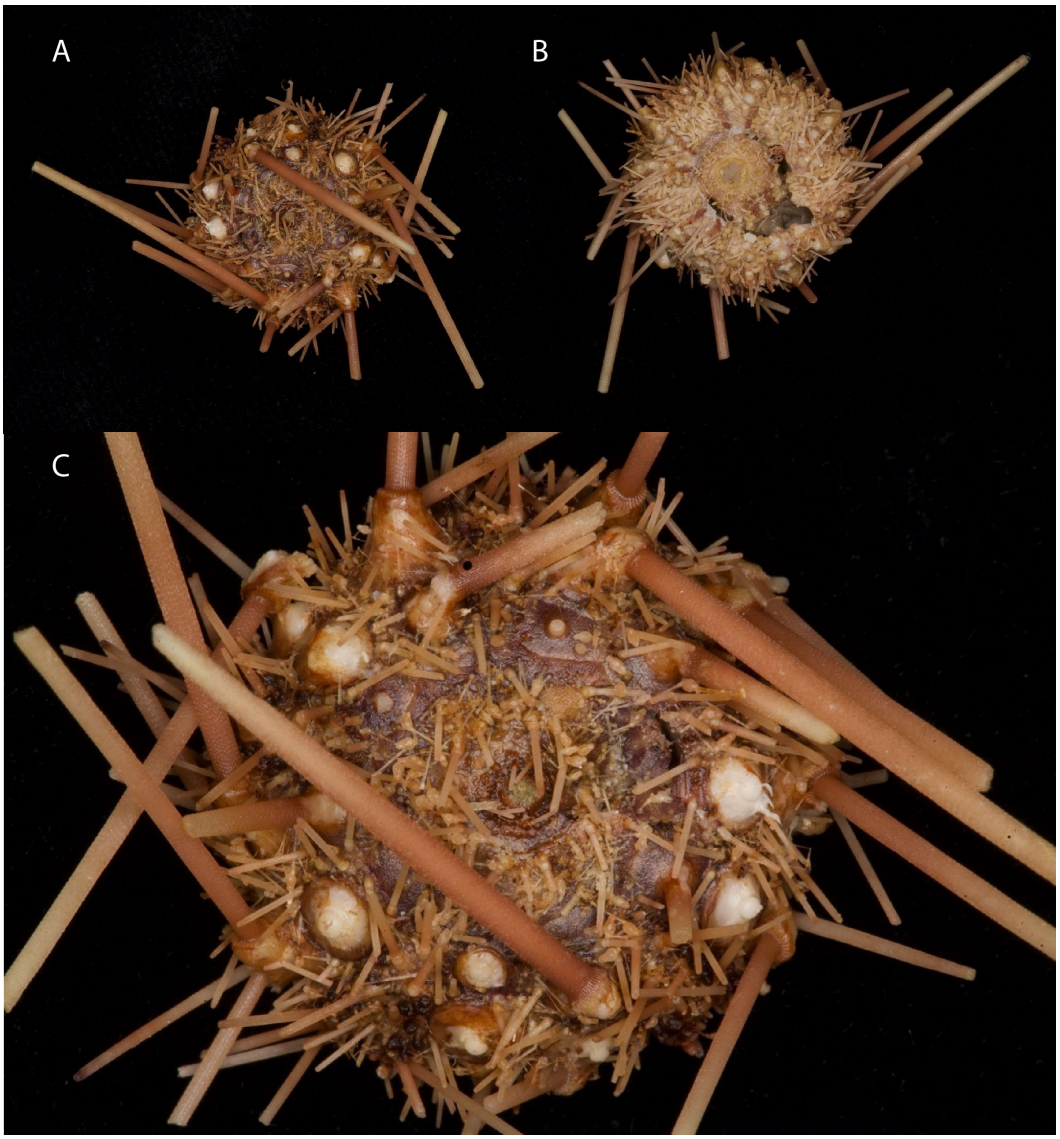

Figure 13. *Caenopedina mirabilis*. (A-C) AM J28245 (Op 005) Preserved in 70% ethanol (A) Aboral, (B) Oral, (C) Apical System.

Diagnosis Test low, somewhat flattened, diameter up to 20 mm, denuded test whitish coloured, but overall colour brown when preserved in ethanol. Apical system approximately the same diameter as the peristome. A regular series of compact tubercles occurs on each genital plate very close to thin membrane of the periproct. Pore pairs arranged in oblique arcs of three. Interambulacral primary tubercles large, occupying nearly the whole plate. Primary spines with solid core, finely thorny but not verticillate. Secondary spines with hollow core, much thinner and shorter than primary spines. Buccal plates with spines and pedicellariae. (Based on specimens AM J28245 and AM J28259).

Taxonomic remarks Schultz (2011) states that "the primary spines are banded with broad, not sharply defined bands in reddish-brown and white; the secondary spines are whitish. The bands may be so faint as to appear uniformly red-brown." Based on the feature of these faint bands that are uniformly red-brown, it eliminated the other two possible species known to occur in the Indo-Malayan region - *Caenopedina indica* and *Caenopedina annulata* - both of which have very distinct banding and colour.

Distribution Japan, Indo-Malay Archipelago, Eastern Australia (Raine Is, Queensland to off Ulladulla, New

South Wales). Depth range 80–540 m (IOT records, 442–997 m).

Order Salenioida

Family Saleniidae

***Bathysalenia cincta* (A. Agassiz & H.L. Clark, 1907)**

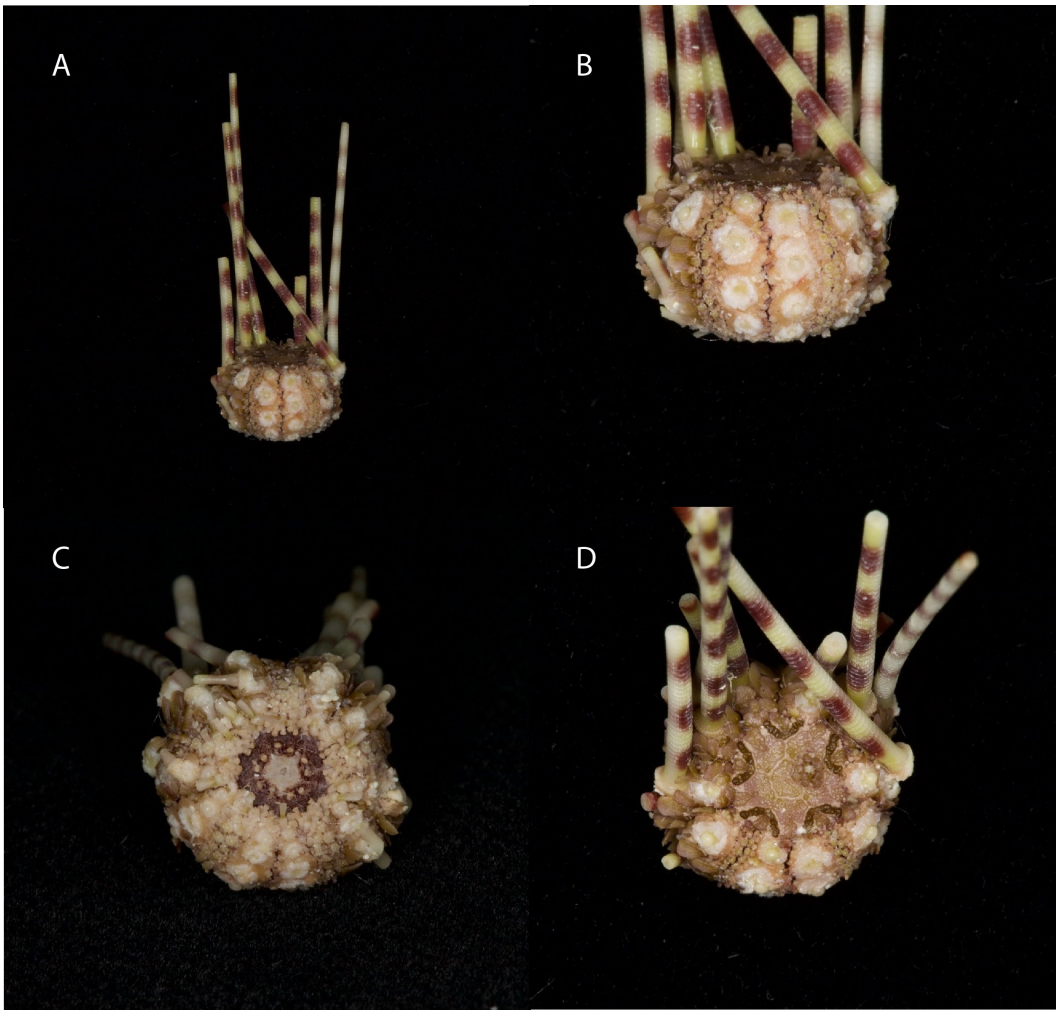

Figure 14. *Bathysalenia cincta*. (A-D) AM J30847 (Op 172) Preserved specimen. (A) Specimen with spines showing entirety, (B) Ambital, (C) Oral. (D) Aboral showing apical system.

Diagnosis Test diameter up to 11 mm, denuded test various shades of green and white; the ambulacral tubercles are pale lime green and arranged in two straight regular series. The primary tubercles are crenulate and imperforate. The tubercles of the ambulacra are non-crenulate. The poriferous zones are narrow and uniserial in arrangement. The apical system covers approximately 80% of aboral surface and the periproct is in an excentric position. There are very prominent chevron-shaped ridges bordering each ocular plate. The genital plates and the suranal plate are covered with low, irregularly shaped granules. The gonopores are concealed under the enlarged papilla on the distal end of the genital plates. The aboral primary spines are long and slender, ridged, and slightly curved downwards. They are alternately banded with whitish or whitish-green and dark brown bands. The secondary spines are short, flat and broad and widened at the end where they appear truncated. (Based on specimen AM J30847).

Distribution Sagami Bay, Japan, East China Sea, Philippines, Malayan Archipelago. Depth range 170–520 m (IOT records, 169–176 m).

Order Cidaroida

Family Cidaridae

***Stereocidaris sceptriferoides* (Döderlein, 1887)**

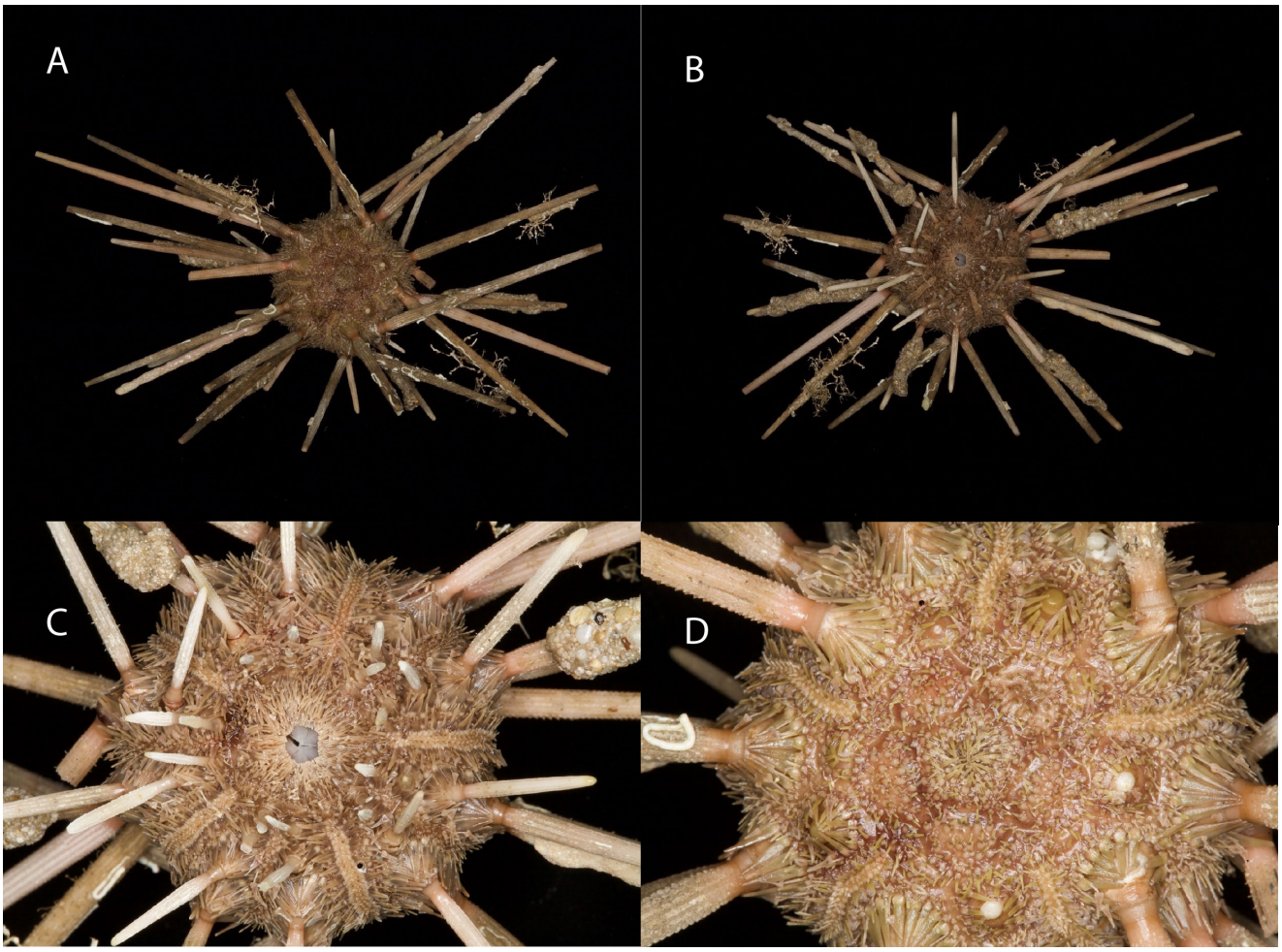

Figure 15. *Stereocidaris sceptriferoides*. (A-D) AM J30875 (Op 163) (A) Aboral, (B) Oral, (C) Ambital. (D) Apical System.

Diagnosis Test slightly inflated, diameter up to 35 mm, denuded test white, fawn to brown coloured when preserved in ethanol. The primary tubercles are recessed, particularly on the ambitus. The apical system is covered with many tubercles corresponding with densely crowded miliary spines. The scrobicular spines surrounding the primary spines are tapered. The primary spines may reach a length of 70 mm, and have12-15 longitudinal series of low spinules which form a conspicuous ridge. The oral spines are lighter fawn in colour and slightly curved and flattened, the edge being serrate. The marginal ambulacral spines are flat and scarcely tapering. The peristome diameter is nearly as large as the apical system. (Based on specimen AM J30875).

Distribution Japan, New Zealand, New South Wales, Australia. Depth range 360–1040 m (IOT records, 527–528 m).

***Stereocidaris microtuberculata* (Yoshiwara, 1898)**

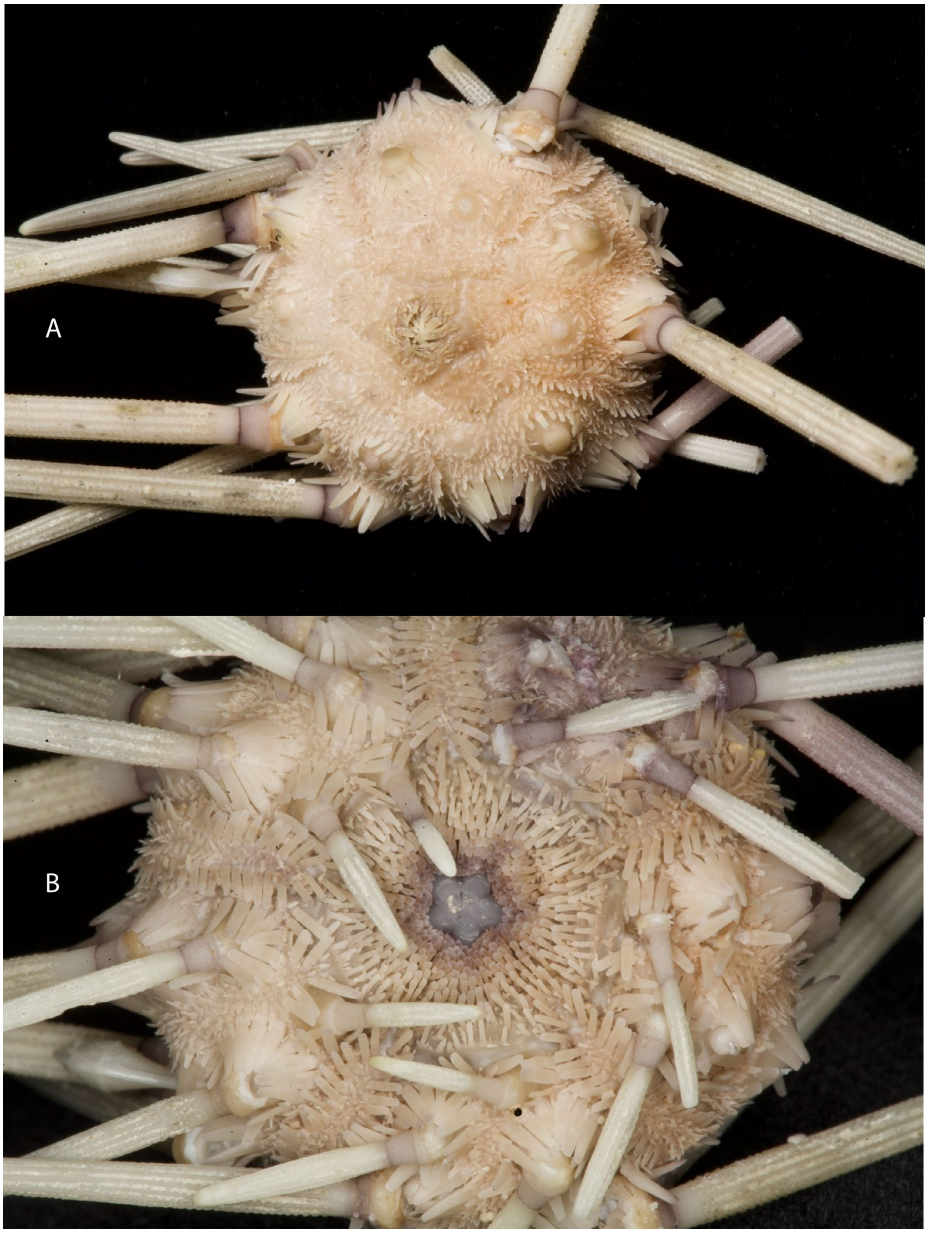

Figure 16. *Stereocidaris microtuberculata*. (A-B) AM J30897 (Op 163) Wet specimen (A) Aboral, (B) Oral.

Diagnosis Test inflated, somewhat globose, diameter up to 79 mm, denuded test white, pale cream coloured when preserved in ethanol. The primary tubercles are recessed, particularly on the ambitus. Newly emerging tubercles rudimentary. The apical system is covered with many tubercles corresponding with densely crowded miliary spines. The scrobicular spines surrounding the primary spines are tapered, truncated at the distal ends. The primary spines may reach a length of 70 mm, and have 12-14 longitudinal series of low spinules which form a conspicuous ridge. The oral spines are light cream in colour and the ridging is more deeply pronounced than the longer aboral spines. The marginal ambulacral spines are flat and rounded distally. The peristome diameter is nearly as large as the apical system. (Based on specimens AM J30876 and AM J30897).

Taxonomic remarks A similar species, *Stereocidaris reducta* also occurs in the same region, but has primary spines with 18-20 rows of low spinules, more than the 12-15 series for *S. microtuberculata*. Shigei (1986) regards *Stereocidaris microtuberculata* as synonymous to *Stereocidaris grandis*.

Distribution Japan, New Zealand, New South Wales, Australia. Depth range 140–700 m (IOT records, 328–528 m).

Family Histocidaridae

***Histocidaris* cf *recurvata* Mortensen, 1928**

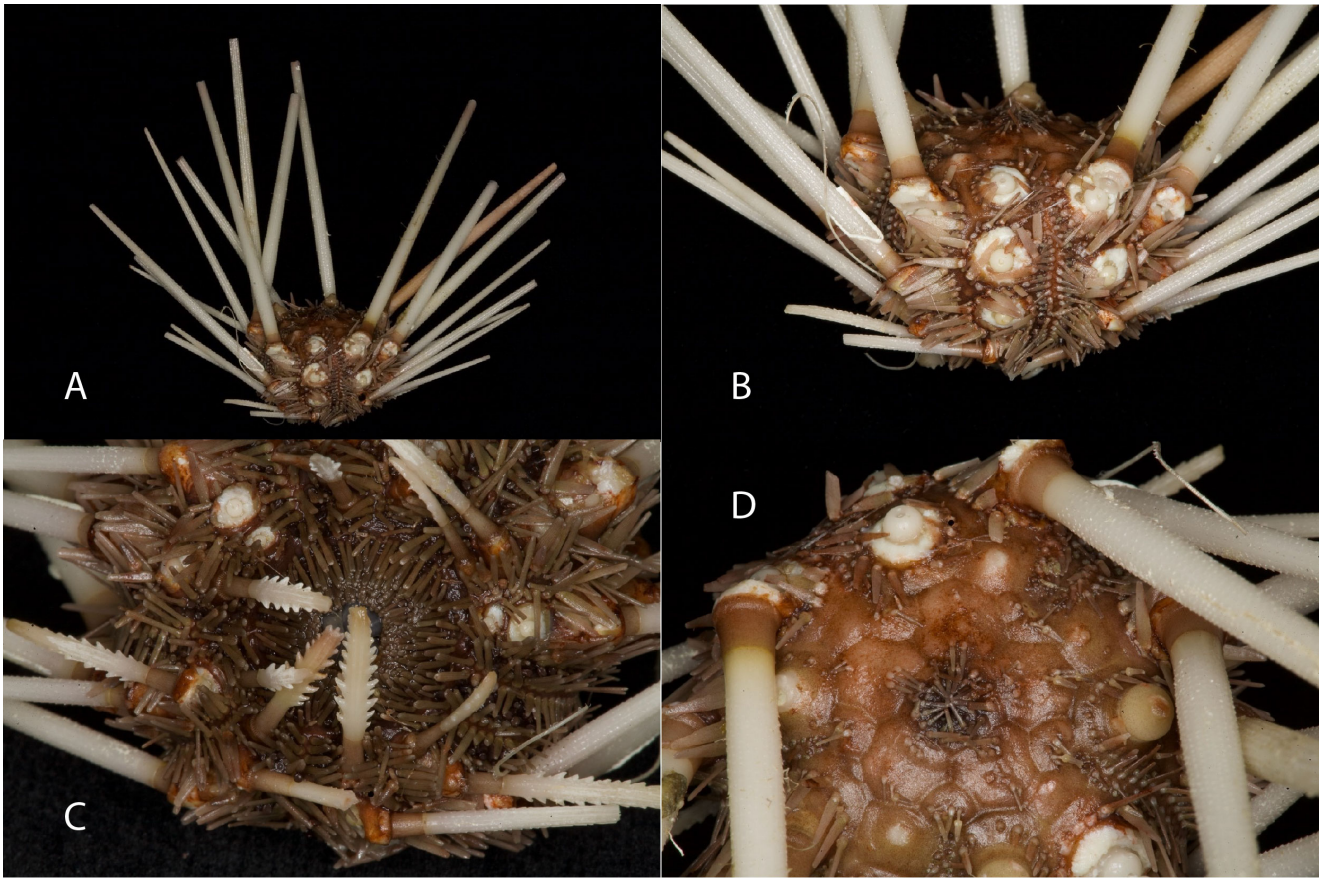

Figure 17. *Histocidaris* cf *recurvata*. (A-D) AM J30879 (Op 126) wet specimen (A) Aboral, (B) Oral, (C) Ambital. (D) Oral Spines.

Diagnosis Test slightly flattened above, diameter up to 48 mm, denuded test white, primary spines pale cream to brownish cream, attaining a length of 72 mm. Scrobicular and miliary spines are fawn and the ground colour is darker brown on the surface. Oral primary spines short, strongly serrated and curved. Primary tubercles crenulate and perforate. Apical system possessing comparatively few spines. (Based on specimens AM J30879 and AM J30877).

Taxonomic remarks The holotype of *Histocidaris recurvata* is from the Kei Islands, Indonesia at a depth of 984m. It is highly likely that the species is *H. recurvata*, given the close characteristics of this species and the proximity to the type locality.

Distribution Holotype recorded from the Kei Islands, Indonesia. Depth range 984 m (IOT records, 820–822 m).

Order Holasteroida

Family Plexechinidae

***Plexechinus parvus* (Mironov, 1978)**

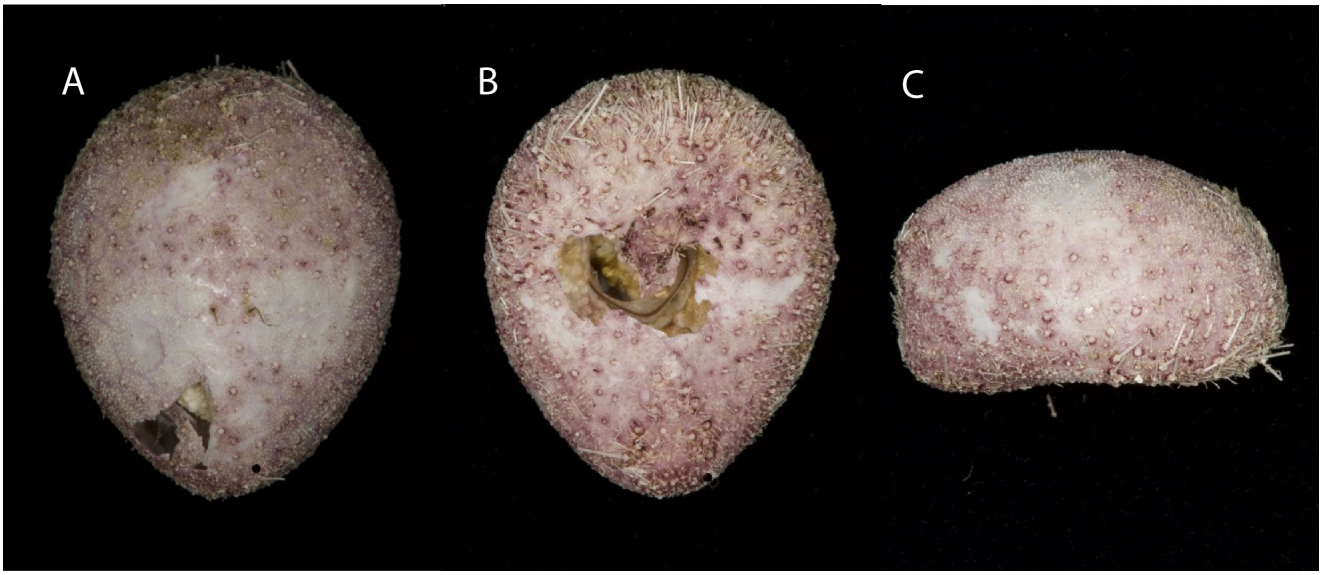

Figure 18. *Plexechinus parvus*. (A-C) AM J30921 (Op 153), dried specimen. (A) Aboral, (B) Oral, (C) Ambital.

Diagnosis Test fragile, somewhat shiny when denuded of spines, length up to 18 mm, with a corresponding width of 14 mm. The anterior is rounded and the posterior is tapered. The slope of the posterior is vertical and there is no anterior notch. The ambulacra do not form petals and are uniporous outside of the phyllodes. There are three gonopores. The colour when preserved in ethanol is pale purple. There is a distinct subanal fasciole. (Based on specimen AM J30921).

Taxonomic remarks *Plexechinus aoteanus*, *P. parvus*, and *P. planus* may be synonymous, differing only in their geographical range. Their mode of life is largely speculative. They are soft bottom dwellers that feed on sediment and are likely epifaunal.

Distribution Western Australia (as *P. parvus*), Tasmania (as *P. planus*), New Zealand (as *P. aoteanus*). Depth range 2320–2350 m. (IOT records, 1736–1747 m).

Acknowledgements

This research was supported by a grant of sea time on RV Investigator from the CSIRO Marine National Facility (MNF, https://ror.org/01mae9353); and operational support and funding from Australia's Department of Climate Change, Energy, the Environment and Water through their Parks Australia and Bushblitz programs. The author acknowledges The Nippon Foundation-Nekton Ocean Census Programme (https://oceancensus.org/) for supporting the discovery and description of these species. The voyages form part of the Second International Indian Ocean Expedition's endorsed project IIOE2-EP40.

I would like to thank Dr Claire Rowe, Acting Collection Manager, Marine Invertebrates, Australian Museum Research Institute, Sydney for her professional assistance in making the necessary equipment and specimens available for identification and facilitating loan of the material.

I would also like to thank Dr Anders Hallan, research associate, Australian Museum Sydney, for the photography of four of the smaller species that made it possible to study minute, taxonomically important characteristics.

Thanks are also due to Maggie Haines at Museums Victoria who efficiently undertook the LaTeX markup and other editing duties for this manuscript at short notice.

References

David, B., Choné, T., Mooi, R. & Ridder, C. (2005). Antarctic echinoidea. *Synopses of the Antarctic Benthos*, 10.

O'Hara, T.D. (2024). The IN2021_V04 and IN2022_V08

expeditions to the Australian Christmas Island and Cocos (Keeling) Islands Territories. *Museum Victoria Science Reports*, 23, 1–5. https://doi.org/10.24199/j.mvsr.2024.23.

Rowe, F. & Gates, J. (1996). *Zoological Catalogue of Australia. Echinodermata*. CSIRO, Melbourne.

Schultz, H. (2009). *Sea Urchins II, Worldwide Irregular Deep Water Species*. 1st edn. Heinke and Peter Schultz Partner Scientific Publications.

Schultz, H. (2011). *Sea Urchins III, Worldwide Irregular Deep Water Species*. 1st edn. Heinke and Peter Schultz Partner Scientific Publications.

Shigei, M. (1986). *The Sea Urchins of Sagami Bay. Collected by His Majesty the Emperor of Japan. Biological Laboratory Imperial Household*. Maruzen Co Ltd., Toyko.

Smith, A. & Kroh, A. (2011). The echinoid directory. http://www.nhm.ac.uk/research-curation/projects/echinoid-directory.

Family index

Species index

Appendix - Echinoidea from voyages IN2021_V04 and IN2022_V08 to the Australian Christmas Island and Cocos (Keeling) Islands Territories

Order	Family	Species	Operation	Acc. no	Num	Reg. no.*
Arabcioida	Arbaciidae	*Pygmaeocidaris prionigera*	IN2022_V08 103	116	8	AM J.30907
Asabdodiadematoida	Aspidodiadematidae	*Aspidodiadema tonsum*	IN2022_V08 165	113	10	AM J.30949
Ciabroida	Cidaridae	*Stereocidaris microtuberculata*	IN2022_V08 128	126	1	AM J.30876
Ciabroida	Cidaridae	*Stereocidaris microtuberculata*	IN2022_V08 163	118	1	AM J.30897
Ciabroida	Cidaridae	*Stereocidaris sceptriferoides*	IN2022_V08 163	115	1	AM J.30875
Hiabroida	Histocidaridae	*Histocidaris* sp.	IN2022_V08 126	104	1	AM J.30877
Hiabroida	Histocidaridae	*Histocidaris* sp.	IN2022_V08 126	103	1	AM J.30879
Clabeasteroida	Clypeasteridae	*Clypeaster virescens*	IN2022_V08 179	106	4	AM J.30895
Fiabnolampadacea	Fibulariidae	*Echinocyamus* cf. *apicatus*	IN2022_V08 159	122	17	AM J.30945
Ecabnothurioida	Echinothuriidae	*Araeosoma tesselatum*	IN2021_V04 005	102	1	AM J.28243
Ecabnothurioida	Echinothuriidae	*Araeosoma tesselatum*	IN2022_V08 157	103	1	AM J.30878
Ecabnothurioida	Echinothuriidae	*Hygrosoma hoplacantha*	IN2022_V08 105	101	1	AM J.30872
Ecabnothurioida	Echinothuriidae	*Hygrosoma hoplacantha*	IN2022_V08 108	116	3	AM J.30885
Ecabnothurioida	Echinothuriidae	*Hygrosoma hoplacantha*	IN2022_V08 147	103	1	AM J.30892
Phabnothurioida	Phormosomatidae	*Phormosoma bursarium*	IN2022_V08 117	109	16	AM J.30891
Plabsteroida	Plexechinidae	*Plexechinus parvus*	IN2022_V08 153	114	1	AM J.30921
Peabnoida	Pedinidae	*Caenopedina indica*	IN2021_V04 005	114	1	AM J.28245
Peabnoida	Pedinidae	*Caenopedina indica*	IN2021_V04 018	111	1	AM J.28259
Saabnioida	Saleniidae	*Bathysalenia cincta*	IN2022_V08 172	118	1	AM J.30847
Saabnioida	Saleniidae	*Salenocidaris hastigera*	IN2022_V08 103	116	9	AM J.30941
Saabnioida	Saleniidae	*Salenocidaris hastigera*	IN2022_V08 187	106	3	AM J.30942
Maabangoida	Maretiidae	*Gymnopatagus magnus*	IN2022_V08 113	108	1 (Partial)	AM J.30871
Trabopleuroidea	Trigonocidaridae	*Prionechinus agassizii*	IN2022_V08 147	113	3	AM J.30964
Trabopleuroidea	Trigonocidaridae	*Trigonocidaris monolini*	IN2021_V04 009	111	5 of 7	AM J.28252
Trabopleuroidea	Trigonocidaridae	*Trigonocidaris monolini*	IN2021_V04 037	113	1	AM J.28273
Trabopleuroidea	Trigonocidaridae	*Trigonocidaris monolini*	IN2022_V08 153	116	15	AM J.30904

*Australian Museum, Sydney