

Plio–Pleistocene *Peronella* (Echinoidea: Clypeasteroidea) from Western Australia

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Abstract – Three species of the laganid clypeasteroid *Peronella* are described from sediments of Pliocene and Pleistocene age in the Carnarvon, Perth and Eucla Basins in Western Australia. The oldest is *Peronella ova* sp. nov. from the Pliocene Roe Calcarene of the Eucla Basin. *Laganum decagonale rictum* Gregory, 1892, is redescribed, elevated to specific status and placed in the genus *Peronella*. *Peronella ricta* appears to be restricted to the basal part of the Carbla Oolite, a Middle Pleistocene formation in the Carnarvon Basin outcropping around Shark Bay. Late Pleistocene sediments in the Shark Bay region contain the still extant species *P. orbicularis*. The living species *P. lesueuri* is recorded from Holocene sediments in the Perth Basin. A key to fossil *Peronella* in Western Australia permits differentiation of the four known species by reference to test length, test thickness and petal length. The genus is of only limited biostratigraphical utility in the late Cenozoic of this region.

INTRODUCTION

In 1892 the first fossil echinoid was described and figured from the western half of Australia by J.W. Gregory of the British Museum (Natural History) in London. The specimen, described by Gregory (1892: 433–435) as "*Laganum decagonale*, Lesson. Var. *rictum*, n.var." had been sent by the Western Australian Government Geologist from 1888–1895, Harry Page Woodward (McNamara and Dodds 1986), to Gregory in London, where it was deposited in the British Museum (Natural History) and given the catalogue number E3770. According to Gregory the specimen was from the "Cainozoic of Shark's [sic] Bay, West Australia". Another specimen from the same locality was retained by Woodward and placed in his collection (No.81; WAM 96.208), now housed in the palaeontology collections in the Western Australian Museum.

Since being described, this form has variously been either raised to specific status (e.g., Clark 1946) or synonymised with other living species, notably a living species, *Peronella lesueuri* (e.g., Mortensen 1948: 271; Logan *et al.* 1970: 56). Clark (1946) recognised that this form belonged in *Peronella* rather than *Laganum*, on the basis of the presence of four, not five, gonopores. However, he observed that "*ricta* . . . must be considered [a] *Peronella* whose specific limits and geographical distribution are not satisfactorily known". Mortensen (1948), on the contrary, considered the Shark Bay form to be very closely related to *Peronella lesueuri*, and "possibly identical with it".

In their study of the history of carbonate sedimentation in Shark Bay, Logan *et al.* (1970) identified it unequivocally as *Peronella lesueuri* [sic]. These actions were all taken on the basis of Gregory's description and line drawing of the specimen, not on the basis of extra material.

Fieldwork in the Shark Bay region in the 1980s by the author has resulted in the collection of 103 specimens of this echinoid, enabling its specific status to be firmly established. Furthermore, another species, *Peronella orbicularis*, also occurs in the extensive Pleistocene deposits that outcrop in this region (see Kendrick *et al.* 1991). These two species from different Pleistocene units are described herein in detail for the first time.

Pliocene occurrences of *Peronella* in Western Australia are restricted to the Roe Calcarene, which outcrops on the Roe Plains in the Eucla Basin (Figure 1). Foster and Philip (1980) placed this species in the extant *Peronella orbicularis*. However, the Pliocene species has a number of characteristics that clearly distinguish it from the living species. It is herein described as a new species. These Plio–Pleistocene species, including true *P. orbicularis*, are described and their stratigraphic distribution, and that of a Holocene species of *Peronella*, discussed.

BIOSTRATIGRAPHY

All of the material of Gregory's "*Laganum decagonale*, Lesson. Var. *rictum*, n.var." was collected from the Gladstone Embayment, on the

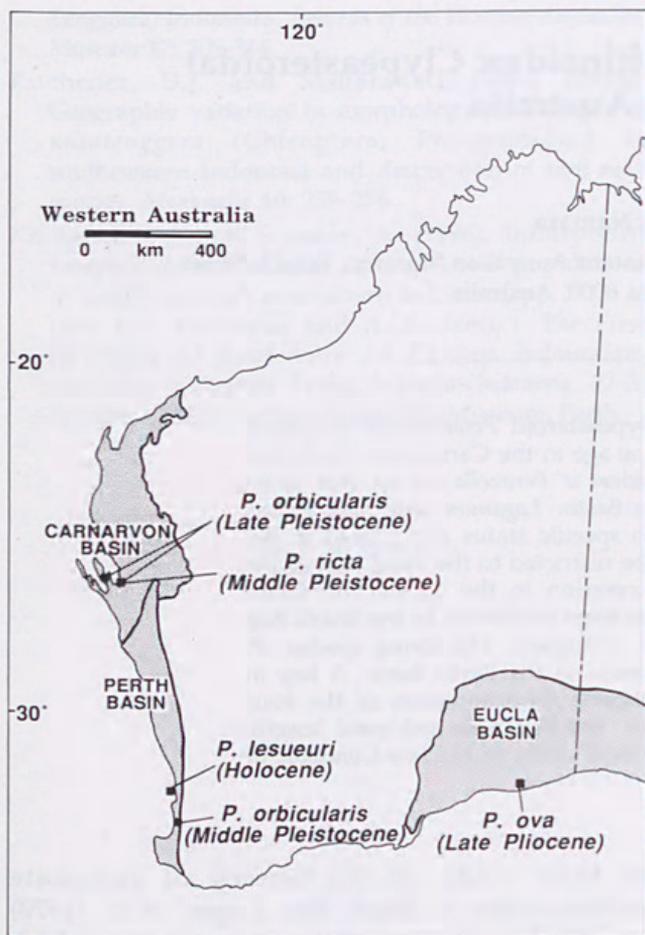


Figure 1 Map showing the locations of fossil *Peronella* in the Carnarvon, Perth and Eucla Basins, Western Australia.

southeastern arm of Shark Bay, immediately north of Hamelin Pool and the Faure Sill (Figure 1). The bed containing the echinoids is a fossiliferous limestone, less than one metre in thickness, that outcrops at Wooramel Cliff, Gladstone Bluff, Gladstone Jetty and in gullies along the Toolonga Scarp (Logan *et al.* 1970). The specimens used in this study were collected from approximately 2 km south of Gladstone Jetty to about 100 m north of the Jetty, from outcrops of limestone that occur in the intertidal zone, 200–300 m seaward of high water mark.

This limestone was termed the "Gladstone unit" by Davies (1970), and was regarded by Logan *et al.* (1970) as being laterally equivalent to the basal beds of the Carbla Oolite. Playford *et al.* (1975) called this unit the Gladstone Member of the Carbla Oolite. This classification is followed herein. The Carbla Oolite was provisionally considered by Kendrick *et al.* (1991) as being correlated with Oxygen Isotope Stage 7 (220,000 – 235,000 BP) of the Middle Pleistocene.

In addition to the presence of the species of *Peronella*, this unit has yielded the spatangoid echinoid *Breyntia desorii* (Gray), a species which is still living in Shark Bay today (McNamara 1982). In

addition, there is a molluscan fauna that includes *Pecten modestus* Reeve, *Dendostrea folium* (Linnaeus), *Fragum* (*Lunulicardia*) sp., *Circe* sp., *Tagelus* sp., *Clementia papyracea* (Gray), *Dosinia* (*Pectunculus*) cf. *sculpta* (Hanley), and *Strombus* (*Doxander*) *campbelli* Griffith and Pidgeon (specimens WAM 87.528 to 87.535, identified by G.W. Kendrick). The foraminifer *Marginopora vertebralis* Blainville is also a common element, indicating, as Logan *et al.* (1970) suggested, that this "Peronella assemblage" occupied open sandy patches in seagrass meadows.

Overlying the Gladstone Member in the eastern part of Shark Bay is a unit of shelly calcarenite, containing well-preserved aragonitic shell, which is probably equivalent to the Dampier Formation. A small species of *Peronella*, attributable to the living species *P. orbicularis*, occurs in this unit. The same species has been recovered from the Dampier Formation on the Peron Peninsula. Rarely more than 1 m in thickness, the Dampier Formation is a bivalve-rich limestone and lithoclast grainstone. While this formation was considered by Logan *et al.* (1970) to be of Middle Pleistocene age, Uranium-series dates from the coral *Goniastrea* (Kendrick *et al.* 1991) indicate a Late Pleistocene, Last Interglacial, age for this formation.

The oldest species of *Peronella* to occur in Western Australia is found in the Eucla Basin in the Roe Calcarenite. While Foster and Philip (1980) followed Ludbrook (1978) in ascribing a Pleistocene age to this richly fossiliferous unit, Kendrick *et al.* (1991) favoured a Late Pliocene age, on the basis of the nature of the molluscan fauna. Unfortunately, the echinoid fauna, as described by Foster and Philip (1980), provides no corroborating evidence one way or the other. In addition to *Peronella*, Foster and Philip (1980) recorded *Microcyphus annulatus* Mortensen, *Amblyneustes formosus* Valenciennes and *Amblyneustes* sp. nov.

Specimens referred to in this study are housed in the invertebrate palaeontology collections of the Western Australian Museum (WAM) and the Natural History Museum, London (BMNH). Measurements were made with an electronic calliper to an accuracy of 0.01 mm. A number of parameters are expressed as percentages of test length (%TL).

SYSTEMATIC PALAEOLOGY

Order Clypeasteroida A. Agassiz, 1872

Family Laganidae A. Agassiz, 1872

Genus *Peronella* Gray, 1855

Type species

Laganum peronii L. Agassiz, 1841: 123; by original designation

Key to fossil species of *Peronella* from Western Australia

1. Test large, reaching more than 50 mm in length 2
 Test small, reaching less than 50 mm in length 3
2. Test thin, with petals open distally .. *P. lesueuri*
 Test thick, with petals closed distally *P. ricta*
3. Petals extending about two-thirds of the distance to ambitus *P. ova*
 Petals extending about one-half of the distance to ambitus *P. orbicularis*

Peronella ova sp. nov.

Figure 2

Peronella orbicularis (Leske, 1778): Foster and Philip 1980: 156.

Peronella platymodes (Tate, 1893): Kendrick 1985: figure 3C.

Peronella sp.: McNamara 1988: 158, figure 12.5

Material Examined

Holotype

WAM 94.854 from the Late Pliocene Roe

Calcarenites, Roe Plains, Madura district, Western Australia; pit 0.5 km north of Hampton Microwave Repeater Tower. Collected by V.A. Ryland and G.W. Kendrick, 1980.

Paratypes

All from the Roe Calcarenites: WAM 82.2103–82.2121, 82.2255, 82.2273–2283, 94.853, 94.855, 94.856 from same locality and horizon as the holotype; WAM 82.2095–6, spoil heaps at base of Hampton Microwave Repeater Station; WAM 82.2135–2143, 82.2241–2248, 94.850, 94.848, 94.849, 94.851, 94.852, 94.854, pit 1.5 km north of Hampton Microwave Repeater Station; WAM 85.2025, 89.754, pit 2.5 km north of Hampton Microwave Repeater Station; WAM 82.2151 (4 specimens) from doline of Nurina Cave N.46, about 5.5 km southwest of Madura Cave; 85.1876 (3 specimens) from Main Roads Department quarry, 16 km south of Madura Roadhouse.

Etymology

From the Latin *ovum*, egg, alluding to the occurrence of the species in the Roe Calcarenites, and to the ovate outline of the test.

Diagnosis

Test low, thick; petals relatively long, extending about two-thirds of the way to ambitus. Peristome

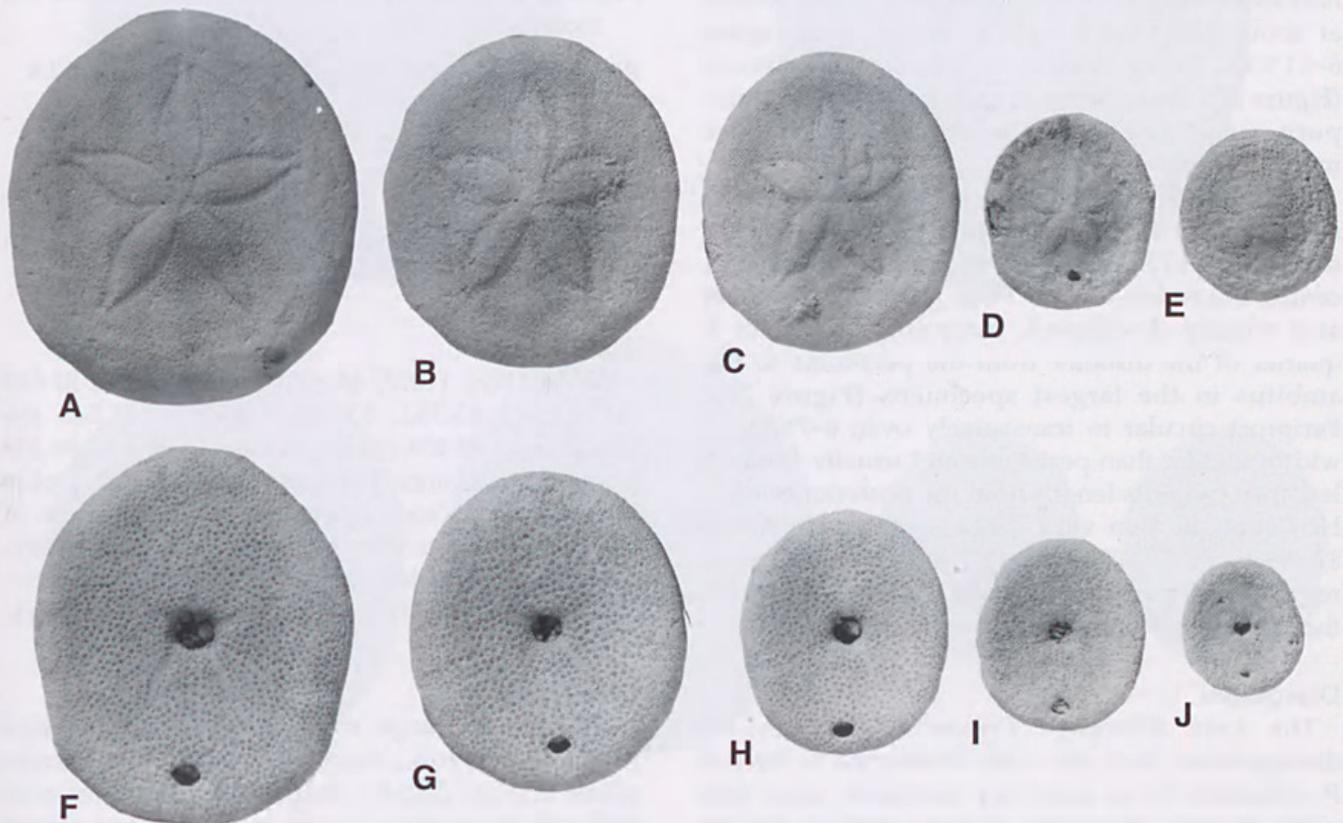


Figure 2 *Peronella ova* sp. nov. from the Late Pliocene Roe Calcarenites, Roe Plains, Western Australia; A, WAM 82.2096; B, WAM 82.2105; C, WAM 82.2113; D, WAM 82.2280; E, WAM 94.853; F, WAM 94.854, holotype; G, WAM 82.2118; H, WAM 82.2163; I, WAM 82.2120; J, WAM 94.849; all x1.5, except E, which is x4.

large; food grooves short and weakly developed, extending less than a quarter the distance from the peristome to the ambitus. Periproct situated less than twice its diameter from posterior margin, except in very large specimens.

Description

Test small, reaching up to 44 mm test length (TL); ovate, with a thick, broadly rounded ambitus; posterior margin (interambularum 5) transverse; margins of ambulacra I and II and interambulacra 1 and 4 also straight, intersecting each other with sharp angle; margin anterior of interambulacra 1 and 4 broadly rounded. Test low, being highest at mid-test length at apical system; height 13–22%TL; rarely, in large specimens, as narrow as 77%TL; juveniles almost flat with relatively thinner margin; at margin test height varies between 10–20%; test longer than wide, width ranging between 84–92%TL; wider in small individuals, narrowing with increase in test size. Aboral surface rises slightly from lateral margin. Apical system slightly anterior of centre; tuberculate, with four gonopores. Petals closed or almost closed distally (Figure 2A). Decrease in relative width during ontogeny. Paired petals of equal length (17–26%TL), but slightly shorter than anterior petal in ambulacrum III (23–32%TL); extend about two-thirds of the way to the ambitus; maximum width varying between 10–17%TL; relatively broad in juveniles (Figure 2E), narrowing slightly during ontogeny; petals widest at about mid-petal length. Interporiferous region 6–11%TL, being widest in smallest specimens (Figure 2E). Inner pores of each pair circular; outer pore elongate; connected by shallow interporiferous furrow.

Adoral surface concave, sloping at low angle to sunken peristome. Peristome circular, large, diameter 8–13%TL; central or slightly anterior of centre; bourrelets absent. Food grooves very short and weakly developed, extending less than a quarter of the distance from the peristome to the ambitus in the largest specimens (Figure 2F). Periproct circular to transversely oval; 4–7%TL in width; smaller than peristome and usually situated less than twice its length from the posterior border. However, in two very large specimens (WAM 82.2095 and 85.2025, TL 43.2 mm and 44.7 mm, respectively) periproct situated greater than twice the periproct diameter from posterior ambitus.

Discussion

The Late Pliocene *Peronella ova* can be distinguished from the Late Pleistocene to Recent *P. orbicularis* by its relatively narrower, lower test with thicker margins; longer petals; larger peristome; weaker, shorter food grooves; and periproct situated closer to the posterior ambitus (except in very large specimens). It differs from

another living Western Australian species, *P. tuberculata* Mortensen, 1918, from northwestern Australia, in possessing a relatively narrower test; periproct situated closer to the posterior margin; shorter food grooves; and flatter adoral surface. *P. ova* differs from the Middle Pleistocene *P. ricta* in possessing a lower test with thicker margins; relatively broader, longer petals; more concave adoral surface with slightly larger peristome and weaker, shorter food grooves.

The other Australian Pliocene species of *Peronella* is *P. platymodes* (Tate, 1893) from the Late Pliocene Hallett Cove Sandstone. This species has a much thinner, narrower test than *P. ova*, combined with appreciably shorter petals. Of the four Pliocene species of *Peronella* described from Okinawa by Cooke (1954), *P. ova* most closely resembles *P. kamimura* Cooke, 1954. However, the Australian species can be distinguished by its longer petals that are closed distally and periproct situated closer to the posterior margin.

Peronella ricta (Gregory, 1892)

Figures 3, 4

Laganum decagonale rictum Gregory 1892: 435–437, Pl.12, figures 1a–c; Mortensen 1948: 271.

Peronella ricta: Clark 1946: 34.

Peronella lesueri (sic.): Logan *et al.* 1970: 56, 62, 73, figures 10–5, 16–7.

Peronella rictum: McNamara 1988: 158, figure 12.5.

Material Examined

Holotype

BMNH E3770 (Gregory 1892, figures 1a–c) from the "Cainozoic. Shark's Bay, West Australia".

Other material

WAM 1808; 11027; 66.805; 78.352–78.354; 81.610 (3); 83.771–83.782, 83.799 – 83.815; 87.545 (66 specimens); 89.409 (five specimens); 96.208; 96.209 from the Gladstone Member of the Carbla Oolite (Middle Pleistocene), approximately 2 km south of Gladstone Jetty to about 100 m north of the Jetty, from outcrops of limestone that occur in the intertidal zone, 200–300 m seaward of high water mark.

Diagnosis

Moderately large species of *Peronella* with relatively narrow, thick test; relatively narrow petals that are distally closed and extend just over half way to ambitus. Adoral surface of test almost flat. Food grooves short but moderately sunken proximally. Periproct less than twice its diameter from posterior margin.

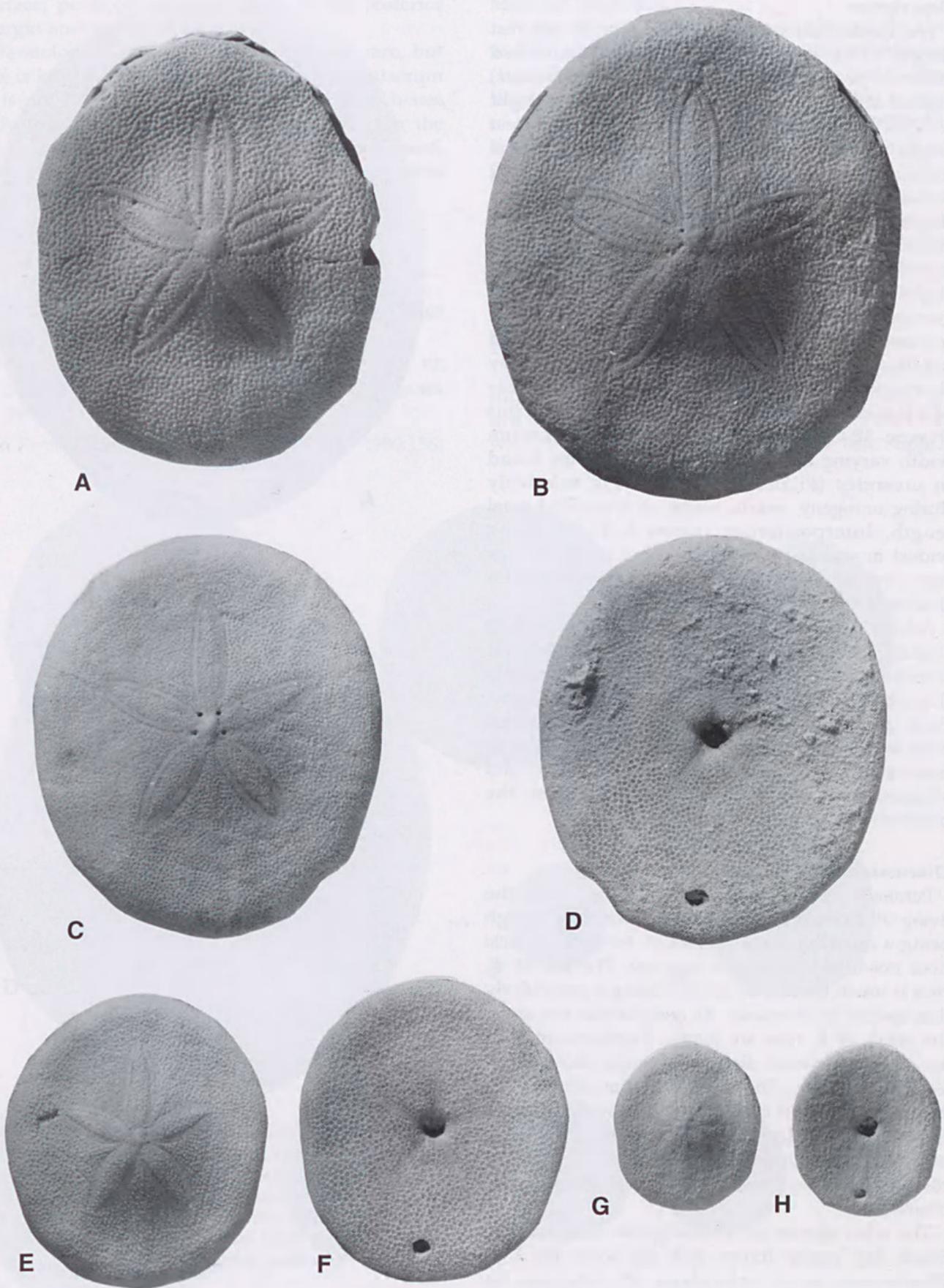


Figure 3 *Peronella ricta* (Gregory, 1892) from the Middle Pleistocene Gladstone Member of the Carbla Oolite, near Gladstone Jetty, Shark Bay, Western Australia: A, WAM 96.208; B, WAM 1808; C, D, WAM 83.806; E, F, WAM 83.788; G, H, WAM 96.209; all x1.5.

Description

Test moderately large, reaching up to 86 mm test length (TL); ovate, with a broadly rounded ambitus; posterior sometimes broadly acuminate; highest at mid test length at apical system; height 15–23%TL; juveniles almost flat; at margin test height varies between 8–20%, being higher in small individuals; test longer than wide, width ranging between 78–94%TL; widest in small individuals (Figure 3G,H), narrowing with increase in test size. Aboral surface rises gently from lateral margin, increasing angle of slope up to apex. Apical system slightly anterior of centre; tuberculate, with four gonopores. Petals closed or almost closed distally. Increase in relative length during ontogeny. Paired petals of equal length (18–28%TL), but slightly shorter than anterior petal in ambulacrum III (23–34%TL); extend just over half way to the ambitus (Figure 3B,C,E); petals narrow, with maximum width varying between 7–15%TL; relatively broad in juveniles (Figure 3G), narrowing relatively during ontogeny; petals widest at about mid-petal length. Interporiferous region 4–8%TL, being widest in smallest specimens. Inner pores of each pair circular; outer pore elongate; connected by shallow interporiferous furrow.

Adoral surface flat, sloping at very low angle to slightly sunken peristome. Peristome circular and surrounded by weakly developed bourrelets (Figure 3D); central or slightly anterior of centre. Food grooves short, but relatively deeply sunken close to peristome (Figure 4B). Periproct circular to transversely oval; similar in size to peristome and situated less than twice its diameter from the posterior border (4–11%TL).

Discussion

Peronella ricta can be distinguished from the living *P. lesueuri* in a number of ways. Although being a relatively large species of *Peronella*, *P. ricta* does not attain as large a test size. The test of *P. ricta* is much thicker, *P. lesueuri* being a particularly thin species of *Peronella*. At comparable test sizes, the petals of *P. ricta* are longer. Furthermore, they are virtually closed distally, whereas those of *P. lesueuri* are open. The interporiferous zone of the petals in *P. lesueuri* is slightly more swollen than in *P. ricta*. On the adoral surface, the food grooves are much deeper close to the peristome in *P. ricta*, resulting in the presence of more pronounced bourrelets.

The other species of *Peronella* that occurs in the Shark Bay region today, and did so in the Late Pleistocene, is *P. orbicularis*. *P. ricta* can be distinguished by its larger size; relatively narrower test that is more rounded posteriorly; more evenly sloping aboral surface; relatively longer, narrower petals; flatter adoral surface; periproct set closer to the posterior ambitus, less than two periproct

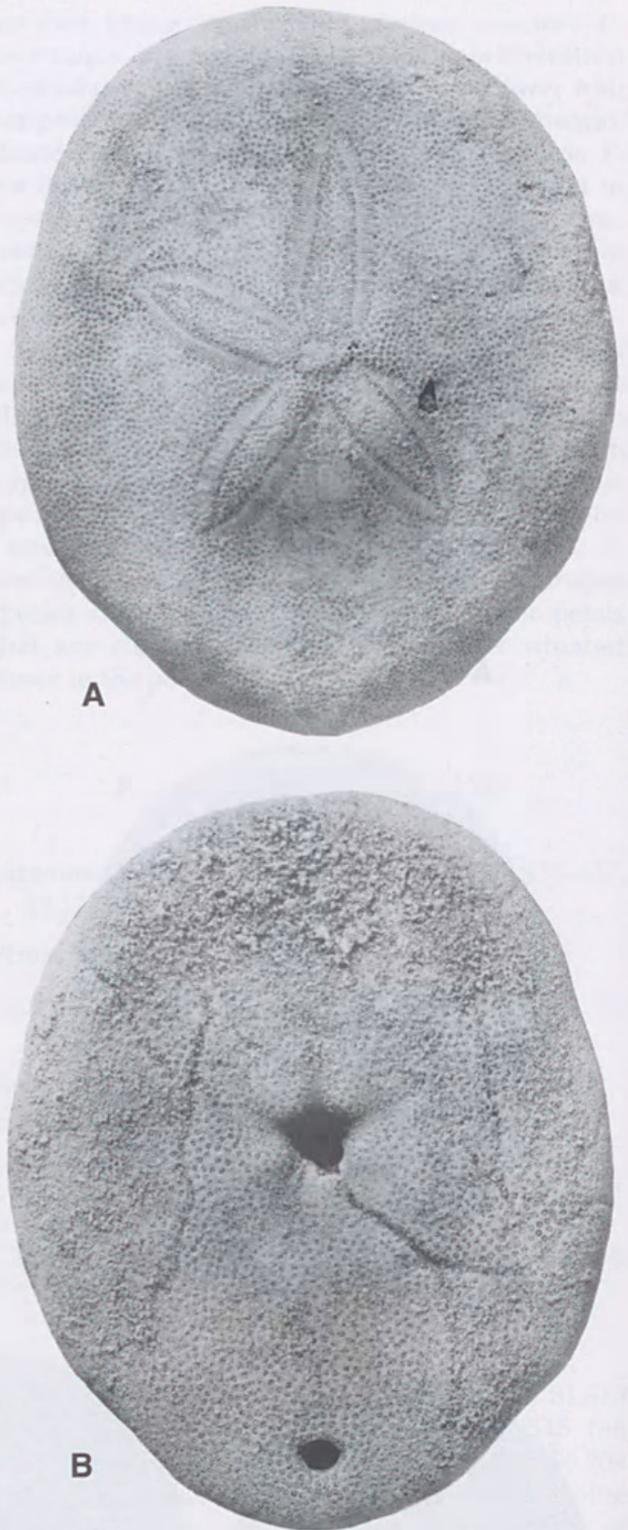


Figure 4 *Peronella ricta* (Gregory, 1892) from the Middle Pleistocene Gladstone Member of the Carbla Oolite, near Gladstone Jetty, Shark Bay, Western Australia: WAM 83.782, A, aboral view of teratological specimen with only four petals; B, aboral view of same specimen; both $\times 1.5$.

diameter widths away, whereas in *P. orbicularis* it is at least two periproct widths away. The test of *P. ricta* is relatively narrower than that of the third living Western Australian species, *P. tuberculata*. Furthermore, it has narrower petals; flatter adoral

surface; periproct situated closer to the posterior margin and shorter food grooves.

Teratological specimens of *P. ricta* are rare, but one is known (WAM 83.782) in which ambulacrum II is not developed on the aboral surface, hence only four petals are present (Figure 4A). On the adoral surface, however, ambulacrum II is present, the specimen possessing the normal complement of five food grooves (Figure 4B).

Peronella orbicularis (Leske, 1778)

Figure 5

Echinodiscus orbicularis Leske, 1778: 208, Pl.45, figs 6,7.

Peronella orbicularis: Mortensen 1948: 286–291; Pl. 51, figs 1–18 (with full synonymy); McNamara 1988: 158, figure 12.5.

non *Peronella orbicularis*: Foster and Philip 1980:156.

Material Examined

WAM 87.610 (157 specimens); WAM 96.210–96.218 (nine specimens) from the Bibra Formation (Late Pleistocene), Yaringa Station, Shark Bay, Western Australia, from large claypan 400 m west of northwest coastal highway; WAM 93.252 (six specimens) from the Dampier Formation (Late Pleistocene), Peron Peninsula, Shark Bay, from southern end of "Big Lagoon", on east side, 1 m thick shell bed that is 1 m above high water mark; four specimens (WAM 94.266) from a Middle Pleistocene unit at Dumbarton, near Busselton in the Perth Basin.

Emended Diagnosis

Small species of *Peronella* with circular test with thickened rim; relatively broad petals that are distally closed and rarely extend more than half way to ambitus. Adoral surface of test slightly

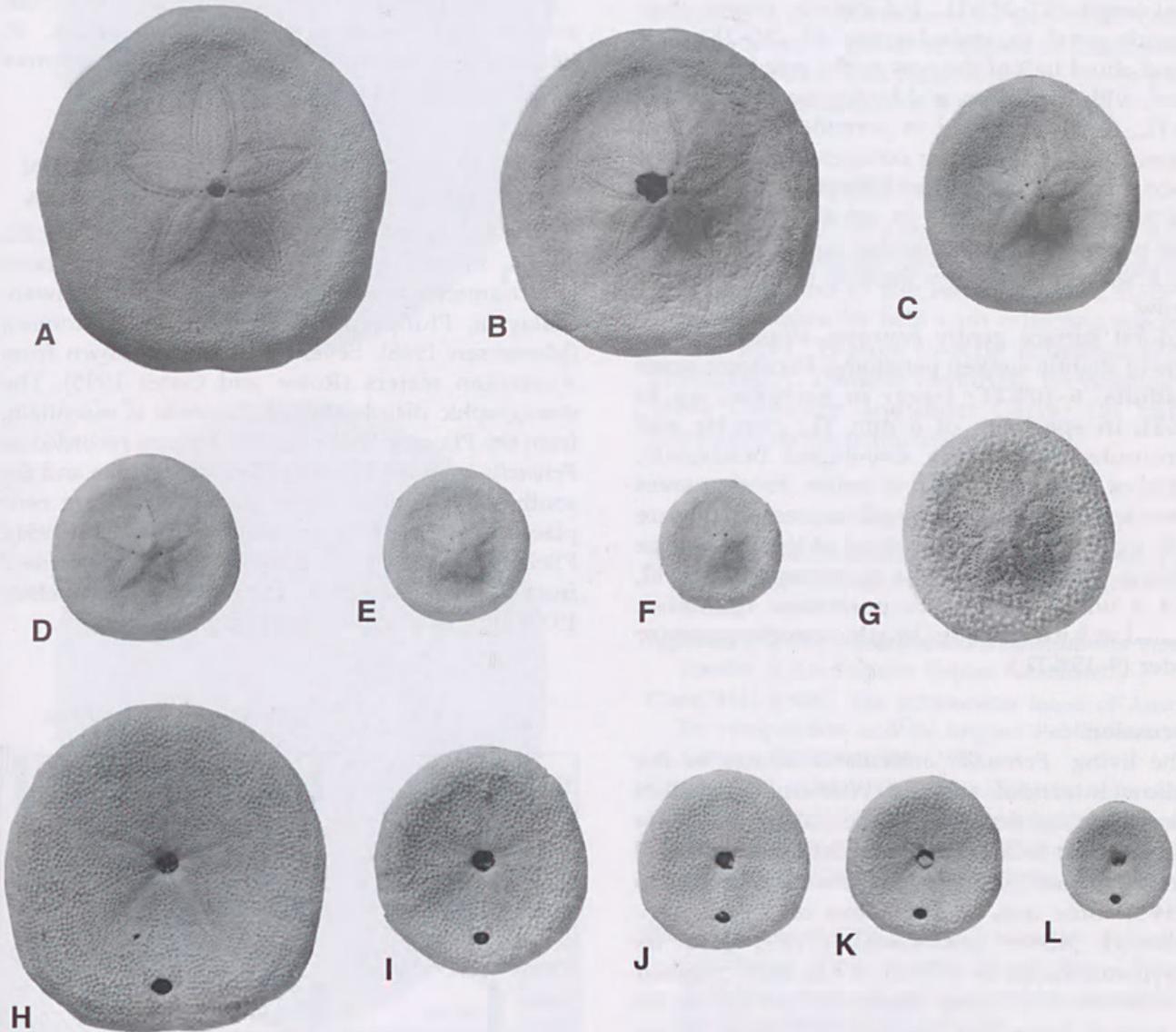


Figure 5 *Peronella orbicularis* (Leske, 1778) from the Late Pleistocene Dampier Formation, Shark Bay, Western Australia: A, H, WAM 93.252c; B, WAM 93.252d; C, WAM 96.211; D, WAM 96.213; E, WAM 96.212; F, WAM 96.214; G, WAM 96.210; I, WAM 96.215; J, WAM 96.216; K, WAM 96.217; L, WAM 96.218; all x1.5, except G which is x4.

concave; peristome a little sunken. Food grooves relatively long, extending about one-third of the way to the ambitus in larger specimens. Peristome and periproct small. Periproct situated at least two periproct diameters from posterior margin.

Description

Test small, reaching up to 35 mm test length (TL); subcircular, with a broadly rounded ambitus; posterior generally truncate (Figure 5A,B,H); highest at mid-test length at apical system; height 19–26%TL; large adults relatively lower than smaller adults; at margin test height varies between 12–20%, being higher in small individuals; test slightly longer than wide, width ranging between 91–99%TL. Aboral surface rises gently and evenly from broadly rounded lateral margin up to apex. Apical system slightly anterior of centre; tuberculate, with four gonopores. Petals almost closed or slightly open distally. Paired petals of equal length (17–24%TL, but slightly shorter than anterior petal in ambulacrum III (20–28%TL); extend about half of the way to the ambitus; petals broad, with maximum width varying between 10–16%TL; relatively broad in juveniles (Figure 5G), narrowing slightly during ontogeny; petals widest at about mid-petal length. Interporiferous region 6–10%TL, being widest in smallest specimens. Inner pores of each pair circular; outer pore slightly elongate; connected by shallow interporiferous furrow.

Adoral surface gently concave, sloping at low angle to slightly sunken peristome. Peristome small in adults, 6–10%TL; larger in juveniles, up to 18%TL in specimen of 8 mm TL; circular and surrounded by weakly developed bourrelets; central or slightly anterior of centre. Food grooves of moderate length and well-impressed (Figure 5H,I), extending about one-third of the way to the ambitus. Periproct circular to transversely oval, with a width similar to peristome diameter; situated at least twice its length from the posterior border (9–15%TL).

Discussion

The living *Peronella orbicularis* occurs in the shallow intertidal zone in Western Australian waters from the far north of the state at a latitude of 14°S, south to Shark Bay at a latitude of 26°S. It extends further south only offshore, reaching to 31°34'S, some tens of kilometres off Guilderton. Although Rowe and Gates (1995) give its bathymetric range as 0–70 m, it has been collected off Guilderton in water depths of 106–110 m, 40 km west of Jurien Bay (latitude 30°21'S) at 165 m, and off Green Head (latitude 30°S) from between 190 and 238 m. Its presence offshore this far south, but absence inshore, can be attributed to southerly dispersal in the offshore Leeuwin Current (see

McNamara 1992 for a discussion of the effect of this current on the southerly dispersal of echinoids). It occurs in Late Pleistocene deposits in the Shark Bay region, but is absent from coeval deposits in the Perth Basin. However, four specimens from a Middle Pleistocene unit at Dumbarton, near Busselton in the Perth Basin (WAM 94.266), although poorly preserved, probably belong to this species, having, like *P. orbicularis*, a relatively broad test, relatively short petals and periproct that is not less than two diameters from the posterior ambitus.

The living species occupies a range of habitats, specimens in the collections of the Western Australian Museum recording its presence from intertidal reef flats to at least 200 m. It inhabits a variety of substrates, from coarse gravel to sand, muddy sand to silt. In shallow water it is found in association with mangroves or seagrass, but with coralline algae nodules and bryozoa in deeper water off the coast.

Peronella orbicularis can be distinguished from another living northwest Australian species, *P. tuberculata*, in having shorter petals and periproct situated closer to the posterior margin.

PLIOCENE TO HOLOCENE DISTRIBUTION OF PERONELLA IN WESTERN AUSTRALIA

Peronella is today a Tropical Indo-West Pacific genus, having been recorded from near-shore environments around Australia, Japan, Taiwan, Malaysia, Philippines, Polynesia and Indonesia (Mortensen 1948). Seven species are known from Australian waters (Rowe and Gates 1995). The stratigraphic distribution of *Peronella* is essentially from the Pliocene to the Recent. Species recorded as *Peronella* from the Eocene of Trinidad, Cuba and the southeastern United States (Cooke 1942) are now placed in *Weisbordella*, a neolaganid (Durham 1954). Pliocene species have previously been described from Japan (Cooke 1954), the Philippines (Israelsky 1933) and South Australia (Tate 1893).

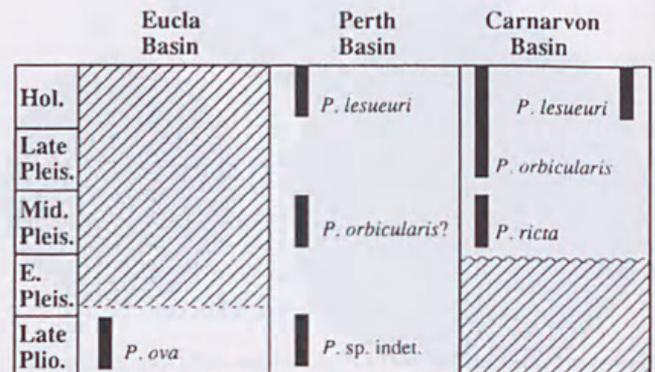


Figure 6 Biostratigraphical distribution of fossil species of *Peronella* in the Eucla, Perth and Carnarvon Basins in Western Australia.

Species of *Peronella* are of limited biostratigraphical value in the western part of the continent (Figure 6). The Middle Pleistocene *P. ricta* has only been recognised with certainty from a very restricted area of Shark Bay. Four poorly preserved specimens of *Peronella* from the Middle Pleistocene of the Perth Basin near Busselton, appear much closer to *P. orbicularis* than they do to *P. ricta*. In the Carnarvon Basin *P. orbicularis* is restricted to the Late Pleistocene and Holocene. As

such, species of *Peronella* have some biostratigraphical utility in the Carnarvon Basin, allowing Middle and Late Pleistocene units to be characterised. The well-known living *P. lesueuri* appears to be restricted to the Holocene in the Perth and Carnarvon Basins. This species is morphologically quite distinct from the other species described herein, attaining a much larger size, having a much thinner, flatter test and petals that distally are open (Figure 7). It is a common element in Holocene deposits in the Swan Estuary (Yassini and Kendrick 1988) and occurs in the Herschel Limestone, a unit of the same age, on Rottnest Island.

While Pliocene sediments occur extensively subsurface in the Perth Basin (Kendrick *et al.* 1991) only rare, indeterminate fragments of *Peronella* are known, unlike coeval sediments in the Eucla Basin, where *P. ova* is common. The dominant clypeasteroid that occurs within the subsurface Pliocene Ascot Formation in the Perth Basin is *Ammotrochus*, a genus restricted to southwestern Australia today. This form, however, is not present in the Roe Calcarene in the Eucla Basin.

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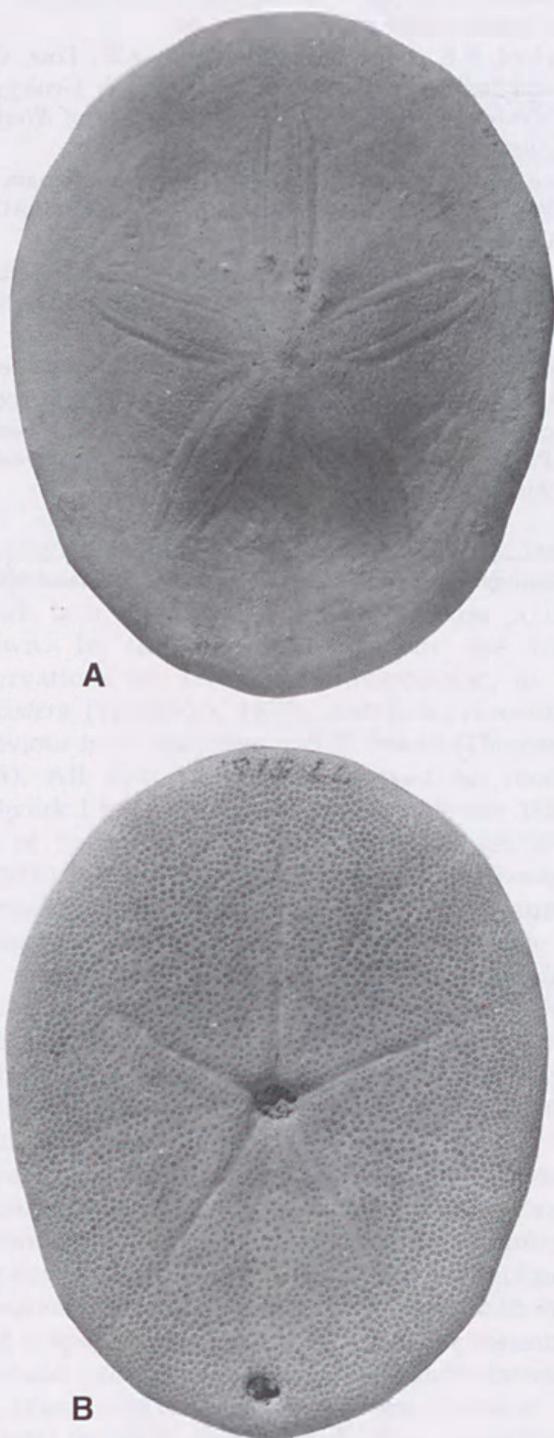


Figure 7 *Peronella lesueuri* (Valenciennes, 1841) from the Middle Holocene Herschel Limestone, Lake Baghdad, Rottnest Island, Western Australia: A, B, WAM 77.516; x1.

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