

# Further Mollusca from the late Eocene Pallinup Formation, Eucla Basin, Western Australia

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**ABSTRACT** – The molluscan fauna of the late Eocene Pallinup Formation from the southern coast of Western Australia consists of 30 species of bivalves, 125 gastropods, 1 scaphopod and 1 cephalopod. Of the gastropods, 29 are newly described, 13 have been previously described from the formation, 32 have been previously described from other localities and are here newly recorded from the formation and the rest are recorded in open nomenclature. The majority of the gastropods are carnivores that preyed on or were associated with sponges, cnidarians and tunicates. *Tenagodus occlusus* Tenison Woods is a very common gastropod, often found preserved within silicious sponges. The composition of the fauna shows that the Eucla Basin in the late Eocene was within the Southern Australian Province (70% of the genera present characteristic of the Province). The following are newly described: *Clavocerithium kendricki*, *Pseudovertagus? longbottomi*, *Mastoniaeformis pagodiformis*, *Inella moniliferata*, *Inella dauciformis*, *Costatophora? pulcherrima*, *Seila stenopyrgisca*, *Cerithiopsis pustuloclathrata*, *Ataxocerithium otopleuroides*, *Ataxocerithium venustulum*, *Ataxocerithium multicostulatum*, *Ataxocerithium biaulax*, *Trituba (Granulotriforis) umboseriata*, *Cerithiella limula*, *Tasmeuthria? arenicola*, *Dermomurex silicatus*, *Attiliosa arenaria*, *Eratoidea fusoides*, *Cryptospira hordeastra*, *Ovaginella mumiformis*, *Ovaginella arenula*, *Lyria craticulata*, *Conomitra strombodiformis*, *Belloliva canaliculata*, *Cordieria fuscoamnica*, *Cordieria torquata*, *Conorbis notialis*, *Neoguraleus filiferus*, *Comitas silicicola*. *Seraphs* is recorded for the first time from the Australian Tertiary.

**KEYWORDS:** Gastropoda, Scaphopoda, Cephalopoda, taxonomy, new species, siliceous fossils, Southern Australian Province, biogeography, paleoecology

urn:lsid:zoobank.org:pub:A757ED55-17B2-42AF-BEB4-1C822D496665

## INTRODUCTION

Late Eocene molluscan faunas in Western Australia have been described from an unnamed sandstone near Kalbarri (Darragh and Kendrick 2008) and from the Merlinleigh Sandstone (Darragh and Kendrick 2010), both in the Carnarvon Basin, as well from the Pallinup Formation, Eucla Basin (formerly Bremer Basin) on the southern coast (Darragh and Kendrick 1980, 2000). In the latter case only the bivalves and 23 of the gastropods were described. This third paper concluding the work on the molluscan fauna of the Pallinup Formation describes and records the remaining gastropods, a scaphopod and a cephalopod.

The majority of the specimens dealt with in this paper, as in the two earlier papers, are siliceous replacements of carbonate shells, but a few are external moulds from which latex casts were made for study. Details of the preservation of the material and the

localities from which specimens were collected have been given in the two previous papers and need not be repeated. Most of the material dealt with here has come from the locality beside the Thompson Road at North Walpole with a few specimens from Lucky Bay, east of Esperance, and from Ocumup no 1 deep well, near Bremer Bay. The specimens from the Thompson Road were collected by sieving the fossiliferous matrix, so the relative abundance of the specimens of each taxon is probably representative of the occurrence of the taxon at that locality. Since the two previous papers on the molluscs were published, there has been some revision of the stratigraphy and basin nomenclature of the area by Clarke et al. (2003). The Pallinup Siltstone was redefined as the Pallinup Formation and the term Bremer Basin was abandoned for the Eocene succession in favour of the Eucla Basin for the Eocene sediments that extend from west of Albany into South Australia.

Because the environment of the Pallinup Formation was one unusually rich in sponges (Gammon et al. 2000b), many of the molluscan taxa were probably spongivores or were associated with sponges in some way and represent genera and species hitherto not recorded either from the Australian Eocene or the Australian Tertiary in general. As a result generic assignments for many of the species are tentative, especially as preservation of critical details may be poor. A number of taxa are known from only very few specimens, often poorly preserved.

A complete list of the molluscan taxa recorded, including those in the two previous papers (Darragh and Kendrick 1980, 2000), is given in Table 1, which also records the occurrences of the species at other localities in the Australian Tertiary.

### OTHER FAUNAL ELEMENTS

As well as molluscs, sponges, cnidarians, echinoderms, brachiopods, bryozoans, serpulids and other annelids, fish otoliths also occur in the formation but, with the exception of the sponges, these groups have not been studied. The sponge fauna has only been partly recorded. Pisera (2004) stated that in the Pallinup Formation at least 20 species of sponges representing the families Theonellidae (dominating), Phymatellidae, Phymaraphinidae, Pleromidae and Corallistidae and rhizomorine lithistids await description, and these 20 species were listed by Gammon et al. (2000, Table 1). Pisera and Bitner (2007) described a pachastrellid demosponge from the formation and Łukowiak (2015) described and illustrated over 43 taxa of sponges based on loose siliceous spicules from the Pallinup Formation including its Princess Royal Member and from the Blanche Point Formation of South Australia. Pickett (1982) described the calcareous demosponge *Vaceletia progenitor*, the only sponge as yet recorded from the North Walpole site. The specimens of *V. progenitor* are silicified, and Pickett reported that many lithistid sponges at the locality are also silicified to the extent that details of spiculation are obscured.

### CORRELATION AND AGE

The Pallinup Formation was dated as late Eocene, Priabonian, by McGowran (2009), and is coeval with the Blanche Point Formation of South Australia and the Browns Creek Formation of Victoria.

Comparison and correlation with other Australian Eocene faunas using molluscs is hampered by factors that include geographical isolation from other localities of possibly similar age and, more importantly, facies differences. The depositional environment of the Pallinup Formation was particularly rich in sponges, which seems to have been unique, at least as far as the known outcrops of Eocene sediments in southern Australia is concerned. Nothing quite like this environment has been discovered in the Eocene

formations of eastern Australia, although sponge spicules occur in the Blanche Point Formation (Łukowiak 2015). Nevertheless, similarities between the faunas of the east and west of the continent do exist and provide useful evidence for correlation (see Table 1).

Of the 30 bivalves recorded from the Pallinup Formation, 8 or 27% of the species are endemic and so of no value in correlation. Of these only one species, *Plicatula emaciata*, is represented by a large number of specimens. The other taxa are represented by only one to four specimens. Seven species (23% of the bivalve fauna) are closely related or identical to species occurring in the unnamed sandstone at Kalbarri (Darragh and Kendrick, 2008), whereas only one species, *Spondylus* cf. *S. gaderopoides* McCoy, 1876, occurs in the Merlinleigh Sandstone (Darragh and Kendrick, 2010). The differences in the faunas probably result from facies rather than stratigraphical differences. In comparing the bivalve fauna of the Pallinup Formation with those of the late Eocene faunas of eastern Australia, 67% of the bivalves are in common with those of the Blanche Point Formation of the St Vincent Basin, 33% are in common with those of the lower part of the Browns Creek Formation and 46% with those of the upper part of the Browns Creek Formation.

Of the 125 gastropods of the Pallinup Formation, 87 species (71% of the fauna) are endemic. Of the remainder, 31 (24%) also occur in the Blanche Point Formation, 32 (26%) in the lower Browns Creek Formation and 25 (20%) in the upper. With respect to the overall fauna, 32% of species occur in the Blanche Point Formation, 28% in the lower Browns Creek Formation and 26% in the upper. Allowing for the unique nature of the environment of the Pallinup Formation, the foregoing occurrences suggest a strong correlation with both the Blanche Point and Browns Creek formations. The lower percentages of the Browns Creek occurrences might be explained by the greater distance of Browns Creek, Victoria, from the Walpole area compared with that of Blanche Point, Aldinga, in South Australia.

### PALEOECOLOGY

The Pallinup Formation is a heterogeneous unit of spiculite, spongolite, terrigenous sandstone and mudstone that outcrops along the southern coast of Western Australia from Northcliffe in the west to Mount Arid in the east. Sponges increasingly dominate the fossil fauna stratigraphically upward in the formation (Gammon et al. 2000b). Deposition is considered to have taken place under tropical to warm temperate conditions in shallow water embayments in a sheltered environment owing to the sheltering effects of shoals and islands. This protected environment mitigated the influence of storms and reproduced the relatively calm conditions that modern day deep water lithistid and hexactinellid sponges inhabit (Gammon et al. 2000a, b; Gammon and James 2001, 2003).







	A	B		C		D	E					F		G	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
120. <i>Ocenebra prionotus</i> (Tate)	?		x		x		x	x	x						
121. <i>Coralliophila</i> (s.l.) sp.			x												
122. <i>Laevityphis ludbrookae</i> Keen & Campbell			x		x		x	x	x						
123. <i>Eratoidea fusoides</i> sp. nov.			x												
124. <i>Cryptospira hordeastrae</i> sp. nov.			x												
125. <i>Ovaginella mumiformis</i> sp. nov.			x												
126. <i>Ovaginella arenula</i> sp. nov.			x												
127. <i>Serrata</i> cf. <i>S. mala</i> (Cotton)			x		x		x	x							
128. <i>Lyria craticulata</i> sp. nov.			x												
129. <i>Mitreola salapatium</i> Darragh			x												
130. <i>Notopeplum</i> cf. <i>N. protorhysum</i> (Tate)	x		x		x		x	x							
131. <i>Conomitra strombodiformis</i> sp. nov.			x												
132. <i>Microvoluta</i> cf. <i>M. subcrenularis</i> (Tate)			x		x		x	x							
133. <i>Microvoluta</i> cf. <i>M. complanata</i> (Tate)			x		x		x	x							
134. <i>Amalda</i> ( <i>Gracilispira</i> ) <i>ligata</i> (Tate)	cf		x		x		x	x							
135. <i>Belloлива canaliculata</i> sp. nov.			x												
136. <i>Conus</i> sp.			x												
137. <i>Cordieria fuscoamnica</i> sp. nov.			x					x							
138. <i>Cordieria torquata</i> sp. nov.			x												
139. <i>Apiotoma</i> sp.			x					x							
140. <i>Conorbis notialis</i> sp. nov.			x												
141. <i>Splendrillia?</i> sp.			x												
142. <i>Neoguraleus filiferus</i> sp. nov.			x												
143. <i>Comitas silicicola</i> sp. nov.			x												
144. <i>Comitas aldingensis</i> Powell			x		x		x	x							
145. <i>Comitas?</i> sp.			x												
146. <i>Asperdaphne</i> sp.			x												
147. <i>Turehua</i> sp.			x												
148. <i>Semitriton</i> sp.			x												
149. <i>Unitas</i> sp.			x												
150. <i>Heliacus</i> ( <i>Torinista</i> ) <i>darraghi</i> Garrard			x						x	x					
151. <i>Tuba</i> sp.			x												
152. <i>Turbonilla</i> sp.			x												
153. <i>Pyrgiscus</i> sp.			x												
154. <i>Syrnola</i> sp.			x												
154. <i>Cylichna</i> cf. <i>angustata</i> (Tate & Cossmann)			x		x		x								
<b>Total gastropods</b>	<b>10</b>	<b>9</b>	<b>125</b>	<b>1</b>	<b>31</b>	<b>5</b>	<b>32</b>	<b>25</b>	<b>10</b>	<b>3</b>	<b>6</b>	<b>5</b>	<b>3</b>	<b>4</b>	
<b>Scaphopods</b>															
155. <i>Fissidentalium mawsoni</i> (Ludbrook)	x		x		x	x	x	x	x	x	x	x	x	x	x
<b>Cephalopods</b>															
156. <i>Eutrephoceras?</i> sp.			x												
<b>Total all molluscs</b>	<b>18</b>	<b>14</b>	<b>157</b>	<b>3</b>	<b>52</b>	<b>7</b>	<b>43</b>	<b>40</b>	<b>19</b>	<b>5</b>	<b>8</b>	<b>8</b>	<b>4</b>	<b>7</b>	



Table 2 shows the number of specimens of each species of gastropod that were collected during the project. It is the relative abundance of each species that is important rather than absolute numbers as the latter is very much an artefact of collecting. The feeding habit of each species was estimated by analogy with living representatives, if such could be found. Not surprisingly, given the sponge rich environment in which the molluscs were living, the fauna is dominated by carnivores that prey on sponges and by other molluscs, such as *Tenagodus*, that are associated with them. Other carnivores that preyed on tunicates also dominate the fauna, suggesting that tunicates were also a significant faunal element. Most tunicates have no hard parts and leave no fossil record, though some species possess spicules that may be fossilised. As yet no such spicules have been recorded from the Pallinup Formation, but Łukowiak (2012) recorded a number of tunicate taxa based on spicules from the Blanche Point Formation. Other significant elements of the molluscan fauna seem to have preyed on cnidarians.

Many shells show signs of hermit crab predation. In the case of *Clavocerithium kendricki* sp. nov. every one of the 469 shells shows damage consistent with crab predation. All specimens of *Pseudovertagus? longbottomi* sp. nov., *Ataxocerithium otopleuroides* sp. nov. and *Lyria craticulata* sp. nov. show similar damage. As these species are amongst the most common taxa present in the fauna, hermit crabs must have been an exceedingly common element in the fauna, though few remains of crabs have been found.

## TROPHIC COMPOSITION

The reservations about the validity of a trophic analysis expressed in my work on the Pebble Point Formation molluscan fauna (Darragh 1994) apply here; nevertheless, some general remarks are probably valid, particularly since collections were made by sieving matrix. The analysis of the bivalves is based on collections made to 1981, whereas that of the gastropods includes specimens collected subsequently.

TABLE 2 Numbers of specimens of Gastropoda, Scaphopoda and Cephalopoda and feeding type.

Species	Number	Feeding type
<i>Cordieria torquata</i> sp. nov.	1225	Carnivore
<i>Tenagodus oculus?</i> Tenison Woods	>1000	Suspension feeder
<i>Triviella pompholugota</i> (Tate)	502	Carnivore on tunicates
<i>Clavocerithium kendricki</i> sp. nov.	469	Detritivore
<i>Trituba (Granulotriforis) umboseriata</i> sp. nov.	366	Carnivore on sponges
<i>Ocenebra prionotus</i> (Tate)	361	Carnivore
<i>Tricolia psilia</i> Darragh & Kendrick	357	Grazer on microbial films on algae & sea grasses
<i>Ataxocerithium multicostulatum</i> sp. nov.	300	Carnivore on sponges
<i>Tanea hamiltonensis</i> (Tenison Woods)	286	Carnivore on molluscs
<i>Eutinophilus otwayensis</i> (Pritchard)	277	?
<i>Willungia ovulatella</i> (Tate)	232	Carnivore on sponges?
<i>Lyria craticulata</i> sp. nov.	231	Carnivore on molluscs
<i>Pseudovertagus? longbottomi</i> sp. nov.	208	Detritivore
<i>Hexaplex? tridentatus</i> (Tate)	194	Carnivore
<i>Seila stenopyrgisca</i> sp. nov.	191	Carnivore on sponges
<i>Ataxocerithium otopleuroides</i> sp. nov.	182	Carnivore on sponges
<i>Archierato pyrulata</i> (Tate)	179	Carnivore on tunicates
<i>Homalopoma (H.) limnaios</i> Darragh & Kendrick	177	? Grazer on microbial films
<i>Leucorhynchia rotulina</i> Darragh & Kendrick	175	? Grazer on microbial films
<i>Liotina lamellosa</i> (Tenison Woods)	167	? Grazer on microbial films
<i>Inella moniliferata</i> sp. nov.	142	Carnivore on sponges
<i>Ovaginella mumiformis</i> sp. nov.	140	Carnivore
<i>Calliostoma (Fautor) numapum</i> Darragh & Kendrick	135	Carnivore on cnidarians or sponges & tunicates
<i>Tasmeuthria? arenicola</i> sp. nov.	134	Carnivore
<i>Cryptospira hordeastra</i> sp. nov.	116	Carnivore
<i>Timbellus calvus</i> (Tate)	102	Carnivore
<i>Cantharidus armulatus</i> Darragh & Kendrick	79	Grazer on algal films

Species	Number	Feeding type
<i>Ataxocerithium venustum</i> sp. nov.	76	Carnivore on sponges
<i>Dennantia aldingensis</i> (Tate)	71	Carnivore on other molluscs
<i>Sassia tortirostris</i> (Tate)	69	Carnivore on ascidians
<i>Neoguraleus filiferus</i> sp. nov.	69	Carnivore
<i>Attiliosa arenaria</i> sp. nov.	57	Carnivore
<i>Notopeplum</i> cf. <i>N. protorhysum</i> (Tate)	55	Carnivore
<i>Dermomurex silicatus</i> sp. nov.	53	Carnivore
<i>Conomitra strombodiformis</i> sp. nov.	50	Carnivore
<i>Eulima danae</i> Tenison Woods	49	Parasitic on echinoderms
<i>Ataxocerithium biaulax</i> sp. nov.	47	Carnivore on sponges
<i>Ovaginella arenula</i> sp. nov.	41	Carnivore
<i>Bolma</i> (B.) <i>flindersi darraghi</i> Beu and Ponder	36	Herbivore or grazer on microbial films
<i>Belloliva canaliculata</i> sp. nov.	33	Carnivore
<i>Cirsotrema pleiophylla</i> Tate	31	Carnivore on cnidarians
<i>Cerithiopsis pustuloclathrata</i> sp. nov.	31	Carnivore on sponges
<i>Cerithiella limula</i> sp. nov.	31	Carnivore on sponges
<i>Coralliophila</i> (s.l.) sp.	30	Carnivore on cnidaria
<i>Conus</i> sp.	29	Carnivore
<i>Eratoidea fusoides</i> sp. nov.	28	Carnivore
<i>Trochaclis?</i> <i>stillata</i> Darragh & Kendrick	28	Carnivore on hexactinellid sponges
<i>Cordieria fuscoamnica</i> sp. nov.	26	Carnivore
<i>Comitas silicicola</i> sp. nov.	25	Carnivore
<i>Costatophora?</i> <i>pulcherrima</i> sp. nov.	24	Carnivore on sponges
<i>Conorbis notialis</i> sp. nov.	24	Carnivore
<i>Eocolina</i> sp.	23	Carnivore on sponges
<i>Retizafra</i> sp.	23	Carnivore?
Cerithiid genus and species indeterminate 3	22	Detritivore?
<i>Mastoniaeformis pagodiformis</i> sp. nov.	22	Carnivore on sponges
<i>Mitreola salaputium</i> Darragh	22	Carnivore
<i>Jetwoodsia nullarborica</i> (Chapman & Crespin)	19	Detritivore?
<i>Danilia vialis</i> Darragh & Kendrick	19	Carnivore on sponges or sponge microbes
<i>Leucorhynchia ventricosa</i> Darragh & Kendrick	19	? Grazer on microbial films
<i>Inella dauciformis</i> sp. nov.	16	Carnivore on sponges
<i>Amalda</i> ( <i>Gracilispira</i> ) <i>ligata</i> (Tate)	15	Carnivore
<i>Fissidentalium mawsoni</i> (Ludbrook)	15	Carnivore on micro-organisms
<i>Zoila viathomsoni</i> Darragh	14	Carnivore on sponges
<i>Melanella?</i> sp.	14	Parasitic on echinoderms
<i>Cerithiella</i> sp.	14	Carnivore on sponges
<i>Dermomurex</i> sp.	12	Carnivore
<i>Microvoluta</i> cf. <i>M. subcrenularis</i> (Tate)	12	Carnivore
<i>Zeacolpus bartoni</i> Darragh & Kendrick	11	Suspension and/or deposit feeder
<i>Pugilina?</i> sp.	11	Carnivore on bivalves?
<i>Microvoluta</i> cf. <i>M. complanata</i> (Tate)	11	Carnivore
<i>Orthochetus pagoda</i> (Chapman & Crespin)	10	Deposit feeder?
<i>Eumetula</i> sp.	9	Carnivore on sponges
<i>Emarginula?</i> sp.	9	Carnivore on sponges?
<i>Glyptozaria</i> sp.	8	Suspension and/or deposit feeder
<i>Seraphs</i> sp.	8	Deposit feeder?
<i>Mitrella</i> sp.	8	Carnivore on polychaetes & ascidians
<i>Comitas aldingensis</i> Powell	8	Carnivore
<i>Comitas?</i> sp.	8	Carnivore



Species	Number	Feeding type
<i>Splendrillia?</i> sp.	7	Carnivore
<i>Asperdaphne</i> sp.	7	Carnivore
<i>Viriola?</i> sp.	6	Carnivore on sponges
<i>Clanculus</i> (s.l.) sp.	6	Herbivore
Cerithiid genus and species indeterminate 2	5	Detritus feeder?
<i>Curveulima?</i> sp.	5	Parasitic on echinoderms
<i>Angaria</i> ( <i>Pseudoninella</i> )? sp.	5	Herbivore?
<i>Calliostoma</i> (s.l.) sp.	5	Carnivore on cnidarian, sponges & tunicates
<i>Euspirocrommium?</i> sp.	4	Grazer on macroalgae?
<i>Cerithiopsis?</i> sp.	4	Carnivore on sponges
<i>Turehua</i> sp.	4	Carnivore?
<i>Semitriton</i> sp.	4	Carnivore?
<i>Turbonilla</i> sp.	4	Parasite on polychaetes or molluscs
<i>Pseudovertagus?</i> sp.	3	Deposit feeder?
<i>Pyrgiscus</i> sp.	3	Parasite on polychaetes or molluscs
<i>Cylichna</i> cf. <i>angustata</i> (Tate & Cossmann)	3	Carnivore feeding on foraminifera
<i>Turbo</i> ( <i>Euninella</i> ) sp. cf. <i>T. (E.) hamiltonensis</i> Harris	3	Herbivore?
Trochid, genus undetermined Species B	3	?
<i>Circulus</i> sp.	3	Grazer on algal and bacterial films
Cerithiid genus and species indeterminate 1	2	?
<i>Cerithioderma tabulata</i> (Tate)	2	Filter feeder
<i>Notacirsa lampra</i> (Tate)	2	Carnivore on cnidarians
<i>Niso kimberi</i> Pritchard	2	Parasite on echinoderms
<i>Trituba</i> sp.	2	Carnivore on sponges
<i>Serrata</i> cf. <i>S. mala</i> (Cotton)	2	Carnivore
<i>Syrnola</i> sp.	2	Parasite on polychaetes or molluscs
<i>Nacella?</i> <i>jutsoni</i> (Chapman and Crespin)	2	Grazer on microalgae and diatoms on hard surfaces?
<i>Sirius</i> sp.	1	Filter feeder
<i>Phenacovolva</i> sp.	1	Carnivore on cnidarians
Rissoid genus and species indeterminate	1	?
<i>Thylacodes actinotus</i> Tate	1	Filter feeder
<i>Xenophora</i> sp.	1	Herbivore
Epitoniid sp.	1	Carnivore on cnidarians
Cerithiopsid sp. 1	1	Carnivore on sponges
Cerithiopsid sp. 2	1	Carnivore on sponges
<i>Fusinus sculptilis</i> (Tate)	1	Carnivore
<i>Austrolithes</i> cf. <i>A. incompositus</i> (Tate)	1	Carnivore?
<i>Tectifusus aldingensis</i> (Tate)	1	Carnivore?
<i>Laevityphis ludbrookae</i> Keen & Campbell	1	Carnivore
<i>Apiotoma</i> sp.	1	Carnivore
<i>Unitas</i> sp.	1	Carnivore
<i>Heliacus</i> ( <i>Torinista</i> ) <i>darraghi</i> Garrard	1	Carnivore on cnidarians
<i>Tuba</i> sp.	1	Carnivore on cnidarians
<i>Eutrephoceras?</i> sp.	1	Pelagic carnivore
<i>Astralium?</i> sp.	1	?
<i>Agathodonta?</i> sp.	1	? Grazer on microbial films on hard substrates
<i>Carinastele?</i> sp.	1	Carnivore?
<i>Crosseola princeps</i> (Tate)	1	?
Trochid, genus undetermined Species A	1	?
<b>Total</b>	<b>9,440</b>	

## BIVALVES

Of the 30 bivalve species in the fauna, represented by 772 specimens, five (*Limopsis chapmani*, *Saccula chapmani*, *Arcopsis dissimilis*, *Plicatula emaciata* and *Venericardia (Rotundicardia) latissima*) dominate the assemblage in terms of numbers of specimens collected (621) and relative abundance (80% of the total number). Of these species, 44% are infaunal, suspension feeding bivalves, 36% are epifaunal, suspension feeding bivalves and 20% are infaunal deposit feeding bivalves. Overall there are 470 specimens of infaunal bivalves and 290 epifaunal bivalves (ignoring some specimens of indeterminate affinity).

### *Generalised grouping of species according to feeding type and habitat*

#### **Infaunal deposit feeding**

*Saccula chapmani*, *Nucula tatei*, *Sarepta planiuscula*.

#### **Infaunal suspension feeding**

*Limopsis chapmani*, *Limopsis multiradiata*, *Tucetona lenticularis*, *Epicodakia* sp., *Venericardia (Rotundicardia) latissima*, *Salaputium communis*, *Glossus (Miocardiosis) sp.*, *Dosina multilamellata*, *Corbula (Caryocorbula) pixidata*.

#### **Epifaunal, byssate, suspension feeding**

*Arcopsis dissimilis*, *Barbatia (B.) limatella*, *Arca pseudonavicularis*, *Barbatia (Acar) gunsoni*, *Septifer* sp.

#### **Epifaunal, attached, suspension feeding**

*Plicatula (P.) emaciata*, *Dimya sigillata*, *Vulsella laevigata*, *Spondylus gaderopoides*.

#### **Infaunal carnivore**

*Verticordia* sp. A, *Verticordia* sp. B.

## OTHER MOLLUSCS (SEE TABLE 2)

There are 105 genera of gastropods, one scaphopod and one cephalopod for which feeding habits can be estimated with reasonable certainty and which are represented by about 9160 specimens. Seventy genera (67%) are carnivores, 15 genera (13%) are grazers, 9 genera (9%) are detritivores, 7 genera (7%) are parasites and 5 genera (4%) are suspension feeders. In terms of percentages of total number of specimens collected 69% are carnivores, 11% are grazers, 8% are detritivores, 0.9% are parasites and 11% are suspension feeders. The latter percentage may be slightly inaccurate as it is not possible to give precise numbers of specimens of *Tenagodus* of which there are slightly in excess of 1000 as many are broken, but still this suspension feeder amounts to the second most common species collected. Overall the fauna is dominated by carnivores both in terms of number of taxa and number of specimens.

Of the carnivores, 19 genera (18% of all genera) are associated with sponges, which is 27% of the carnivore

genera. In terms of numbers of specimens of these taxa, there are 1825 specimens amounting to 20% of all specimens collected and 29% of the total carnivore specimens. Large and small specimens of siliceous sponges are a very common element of the fauna in the Pallinup Formation and many specimens of *Tenagodus* are found within sponges. The sponges are yet to be studied in detail.

Carnivores on tunicates and cnidarians are also present in high proportions (Table 2), which suggests that tunicates and cnidarians were significant elements of the fauna. Some fragmentary silicified skeletal remains of cnidarians occur in the fauna, but they have not yet been studied.

The parasitic molluscs comprise two groups: eulimids which parasitise echinoderms and pyramidellids which parasitise polychaetes or molluscs. Echinoderms are not common in the Pallinup Formation at Walpole and are represented mostly by regular echinoid spines belonging to *Stylocidaris*, *Eucidaris*, and possibly *Stereocidaris* (personal communication K. McNamara). However, a number of irregular echinoids have also been recorded, namely species of *Linthia*, *Schizaster*, *Prenaster*, *Giraliaster* and ?*Pericosmus* (McNamara 1985).

## GENERALISED GROUPINGS (BASED ON TABLE 2).

Genera are arranged according to species abundance.

### **Grazers**

*Tricolia*, *Homalopoma*, *Leucorhynchia*, *Liotina*, *Cantharidus*, *Bolma*, *Clanculus*, *Angaria*, *Circulus*, *Euspirocromium*, *Turbo*, *Nacella*, *Xenophora*.

### **Suspension feeders**

*Tenagodus*, *Seraphs*, *Cerithioderma*, *Sirius*, *Thylacodes*.

### **Detritivores**

*Clavocerithium*, *Pseudovertagus*, *Jetwoodsia*, *Zeacolpus*, *Orthochetus*, *Glyptozaria*.

### **Parasites**

*Eulima*, *Melanella*, *Curveulima*, *Turbonilla*, *Pyrgiscus*, *Niso*, *Syrnola*.

### **Pelagic carnivores**

*Eutrephoceras*.

### **Carnivores**

*Cordieria*, *Triviella*, *Granulotriforis*, *Ocenebra*, *Ataxocerithium*, *Tanea*, *Willungia*, *Lyria*, *Hexaplex*, *Seila*, *Archierato*, *Inella*, *Ovaginella*, *Calliostoma*, *Tasmeuthria*, *Cryptospira*, *Timbellus*, *Denanntia*, *Sassia*, *Neoguraleus*, *Attiliosa*, *Notopeplum*, *Dermomurex*, *Conomitra*, *Belloliva*, *Cirsotrema*, *Cerithiopsis*, *Cerithiella*, *Coralliophila*, *Conus*, *Eratoidea*, *Trochaclis*, *Comitas*, *Conorbis*, *Eocolina*, *Retizafra*, *Mastonaeforis*, *Mitreola*, *Danilia*, *Gracilispira*, *Fissidentalium*, *Zoila*, *Microvoluta*, *Pugilina*, *Eumetula*, *Emarginula*,

*Mitrella*, *Comitas*, *Splendrillia*, *Asperdaphne*, *Viriola*, *Calliostoma*, *Turehua*, *Semitriton*, *Cylichna*, *Notocirsa*, *Trituba*, *Phenacovolva*, *Fusinus*, *Austrolithes*, *Tectifusus*, *Laevityphys*, *Apiotoma*, *Unitas*, *Heliacus*, *Tuba*, *Carinastele*.

### BIOGEOGRAPHY

Valid biogeographic conclusions rely on correct generic assignments of the taxa in the fauna as well as on accurate geographical records of the genera. Many of the species in the Walpole fauna are assigned to genera with a query, so it could be argued that it is not possible to come to any biogeographic conclusions. However, most of the taxa with these questionable assignments are very similar to other species in the genus or to other genera in the family, so an assignment to a particular biogeographic element is probably correct in most cases. Given the number of genera involved (about 130), broad conclusions can be drawn which have some validity. Another factor which may affect conclusions is the high number of taxa that seem to be endemic to the fauna. About 33 genera (25.5%) present in the fauna are not known from Eocene or later faunas in eastern Australia. There are two possible reasons for this: faunas from environments rich in sponges do not seem to be represented elsewhere; and many of the taxa, particularly those small in size, belong to groups of molluscs not yet studied from other Australian formations but possibly present in them. Of the other genera, 64 (49%) are known from other Eocene formations in eastern Australia and 33 (25.5%) are known from younger formations in eastern Australia. Overall about 74% of the genera are found in the Southern Australian Province (Darragh and Kendrick 2008), so it is concluded that the Eucla Basin during the late Eocene was within that province which at that time extended from the southern Carnarvon Basin to the Gippsland Basin.

In terms of biogeographic origins of the Walpole fauna using criteria outlined by Darragh (1985), 11.5% of the genera are of the Australia-New Zealand element, 57% are of the Tethyan Indo-Pacific element, 13% are of the Southern Australian Endemic element and 18.5% are cosmopolitan. These percentages can be compared with the proportions of the biogeographic elements for the eastern Australian Eocene cited by Darragh (1985), 26%, 25%, 24% and 25% respectively, where each element comprised about a quarter of the fauna. It will be seen that the Tethyan Indo-Pacific element in the Walpole fauna comprises over half the fauna, which is probably explained by the high proportion of the endemic taxa having a Tethyan Indo-Pacific origin.

McGowran et al. (1997) argued that the Leeuwin Current that moves south along the western coast of Western Australia and sweeps east around the southern

coast originated in the late middle Eocene, bringing warm water faunas from the north to the southern coast. Of significance to this argument is the presence of *Seraphs* in the Pallinup Formation, whereas it is not present in eastern Australia. Other genera that are found in the Pallinup Formation but only occurred in eastern Australia later in the mid-Tertiary thermal maximum include *Plicatula*, *Glyptozaria*, *Xenophora*, *Zoila*, *Phenacovolva*, *Lyria* and *Conus*. An explanation for the high proportion of the Tethyan Indo-Pacific element at Walpole but not in the eastern Australian faunas might be provided by the influence of the Leeuwin Current that weakens to the east and so has less influence on the faunas there.

### SIMILAR FOSSIL FAUNAS

Molluscan faunas associated with sponges such as that of the Pallinup Formation seem to be exceedingly rare in the Tertiary sequence. A fauna with somewhat similar molluscan taxa occurs in the Danian Faxe Formation of Denmark (Lauridsen and Schnetler 2014). However, the Faxe Formation is a cool water carbonate deposit with coral and bryozoan mounds, said to be deposited at depths of 200–400 metres, and thus represents a fundamentally different environment from that of the Pallinup Formation. Nevertheless, the occurrence in the Faxe Formation of similar genera of molluscs, particularly representatives of the Triphoridae, Cerithiopsidae and Newtoniellidae, is surprising and perhaps reflects the presence of cnidarians and sponges in both formations.

### SYSTEMATIC PALAEOLOGY

The arrangement of families follows Bouchet and Rocroi (2005) with the exception of the former Family Turridae where the arrangement is according to Bouchet et al. (2011). The authors of all generic and higher taxa are based on information from the World Register of Marine Species (WoRMS) [<http://www.marinespecies.org/index.php>], which provides full bibliographic references for each taxon as well as type species of genera and such details are not repeated here.

Australian Map Grid references are cited from Western Australian 1:100,000 maps, Deep River for the North Walpole locality and Merivale for Cape Le Grand National Park localities.

Institutional abbreviations are as follows:

NMV P Museum Victoria Palaeontological Collection.

SAM T South Australian Museum Tate Collection.

WAM Western Australian Museum.

**Class Gastropoda Cuvier, 1797****Vetigastropoda****Family Crosseolidae Hickman, 2013****Genus *Crosseola* Iredale, 1924*****Crosseola princeps* (Tate, 1890)**

Figure 1.36

*Crossea princeps* Tate, 1890: 220; Tate, 1891, plate 8, figures 6a–b.

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Australian Map Grid, Deep River 743 486. 1 specimen (WAM 69.165).

**DESCRIPTION**

Shell small (3 mm), turbinate, of four regularly convex whorls. Protoconch of one smooth whorl coiled in axis of shell. Sculpture of very fine, close-set lirae present over entire whorl, interspaces pitted. Aperture subcircular with outer lip thickened into a prominent rounded varix; aperture notched anteriorly forming a short shallow canal. Pseudumbilicus present bounded by a strongly developed umbilical keel sculptured like the whorls.

**DIMENSIONS**

	Height	Width	No. of whorls
WAM 69.165	3.0	2.6	4

**REMARKS**

Although somewhat damaged the single specimen is sufficiently well preserved to enable determination.

This species is very similar to *Crosseola concinna*, Recent, south-eastern Australia, but differs in having more numerous and finer lirae, a more prominent pseudumbilicus and the early whorls do not possess a keel.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Murray Basin:** Cadell Marl. **Otway Basin:** Muddy Creek Formation.

**Caenogastropoda****Family Cerithiidae Fleming, 1822****Genus *Clavocerithium* Cossmann, 1920*****Clavocerithium kendricki* sp. nov.**

Figures 1.1–3, 1.19

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**MATERIAL EXAMINED*****Holotype***

**Australia: Western Australia:** WAM 69.135 from Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486.

***Paratypes***

WAM 72.252, NMV P329330 from type locality.

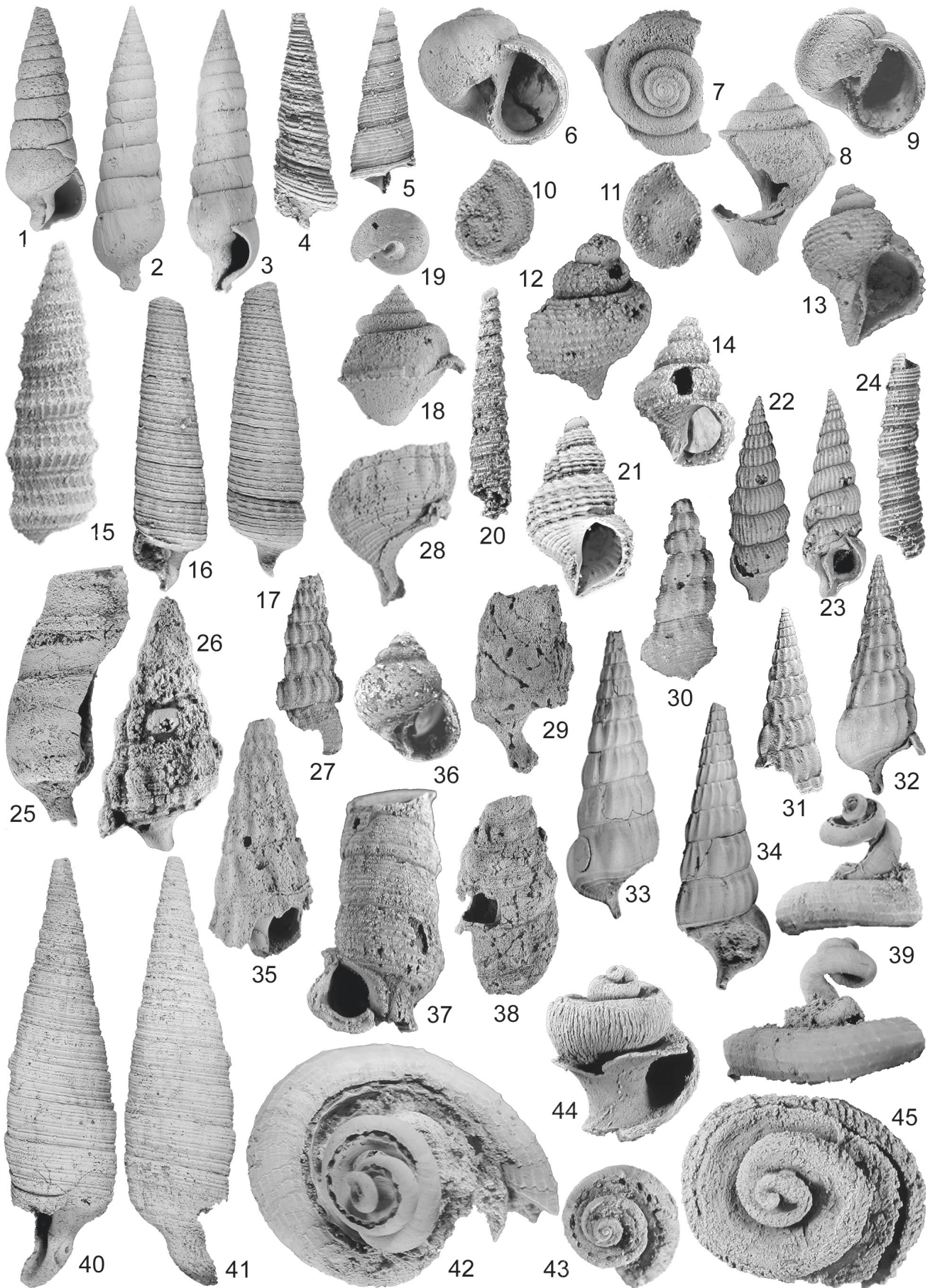
***Other material***

From type locality: 466 specimens (WAM 67.117, 67.174, 69.196, 72.240, 72.258, 72.320–1, 79.1015, 82.1482, 99.164, 99.222, 04.145a, 10.12; NMV P302225, P302226–8, P317172).

**FIGURE 1**

1, 2, 3, 19, *Clavocerithium kendricki* sp. nov.: 1, 19, WAM 72.252 (x 2) paratype; 2, 3, WAM 69.125 (x2) holotype; 4, 16, 17, 40, 41, *Pseudovertagus longbottomi* sp. nov.: 4, WAM 67.109 (x 2) paratype; 16, 17, WAM 67.171 (x2) paratype; 40, 41, WAM 79.1014 (x2) holotype; 5, *Zeacolpus bartoni* Darragh & Kendrick, 2008: 5, WAM 07.190a (x3) Lucky Bay; 6, 9, *Tanea hamiltonensis* (Tenison Woods, 1879): 6, WAM 12.02 (x 5); 9, WAM 12.01 (x 5); 7, 8, 18, *Euspirocrommium?* sp.: 7, 18, WAM 99.208 (x3); 8, WAM 12.06 (x 1.5); 10, 11, *Naticid operculum*: 10 (internal), 11 (external), WAM 12.04 (x7); 12, 13, *Sirius* sp.: 12, 13, WAM 99.221 (x 8); 14, 21, *Cerithioderma tabulata* (Tate, 1890): 14, WAM 69.171 (x 5); 21, SAM T766 (x 5) holotype, Adelaide bore; 15, *Orthochetus pagoda* (Chapman & Crespin, 1934): 15, WAM 05.34 (x 4) Lucky Bay; 20, 24, *Glyptozaria* sp.: 20, WAM 15.51 (x 5); 24, WAM 15.52 (x 5); 22, 23, 27, 28, 30, 31, 32, 33, 34, 35, *Jetwoodsia nullarborica* (Chapman & Crespin, 1934): 22, 23, WAM 12.71 (x 1.5); 27, 30 NMV P14631 (x 3) paratype, Cape Riche; 28, WAM 99.226c (x 2); 31, NMV P13675 (x 3) paratype, Blanche Point; 33, 34, NMV P13674 (x 1.25) holotype, Blanche Point; 35, WAM 99.226b (x 2); 25, *Cerithiid* sp. 1: 25, WAM 99.225 (x 1.5); 26, 29, 38, *Cerithiid* sp. 2: 26, WAM 99.163 (x 1.5); 29, WAM 99.224b (x 1); 38, WAM 99.224a (x 1); 36, *Crosseola princeps* (Tate, 1890): 36, WAM 69.165 (x 8); 37, *Pseudovertagus* sp.: 37, WAM 80.1340 (x 3) Cape Le Grand; 39, 42, 43, 44, 45, *Tenagodus oclusus?* Tenison Woods, 1877: 39, 42, WAM 09.05a, 38, 39 (x 2), 42 (3); 43, WAM 09.01 (x 4); 44, 45, WAM 09.05b (x 3).





Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak, near road to Lucky Bay, 2 specimens. (WAM 80.1336, 85.1451). Total 469 specimens.

#### DIAGNOSIS

Shell cyrtoconoid with three weakly beaded lirae on abapical spire whorls, remainder of shell smooth. Siphonal fasciole prominent.

#### DESCRIPTION

Shell elongate, cyrtoconoid, whorls very slightly convex, 10 to 15 teleoconch whorls. Sutures impressed. Protoconch of 2½ smooth, convex whorls, first whorl deviated slightly from axis of shell, second whorl with slight peripheral keel on some specimens, merging rapidly into first teleoconch whorl. First three to five teleoconch whorls sculptured with three very weakly beaded, thick lirae, interspaces about as wide as lirae, remainder of teleoconch whorls smooth. Aperture lenticular, produced anteriorly into a short right twisted canal. Outer lip sinuous, opisthocline. Columella covered with callus, developed into thick plate on some specimens. Right raised edge of canal angulation forming a prominent ridge extending up the spire. Siphonal fasciole prominent.

#### DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 69.135, holotype	26.0	6.5	6.5	16
WAM 72.252, paratype	21.0	7.5	3.8	11 spire broken
NMV P329330, paratype	17.2	5.0	3.0	12

#### ETYMOLOGY

This species is named in memory of my late friend and colleague George Kendrick, formerly of the Palaeontology Department of the Western Australian Museum, who first discovered the silicified mollusc fauna at North Walpole and with whom I enjoyed several field seasons collecting fossils there and at other places in Western Australia.

#### REMARKS

This is one of the most common species of gastropod in the fauna, yet not one specimen has a complete aperture. All specimens with the last whorl preserved have damage consistent with crab attack. Many specimens also have evidence of earlier mended fractures on the spire. A few specimens have gastropod boreholes.

The morphology of the teleoconch is very similar to the type species of the genus, *Clavocerithium lacazei* (Vasseuer, 1881), Eocene, France, but that species has a uniformly tapering spire and a weak siphonal fasciole.

There is nothing like this species present in any of the other Australian Tertiary formations.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

#### Genus *Orthochetus* Cossmann, 1889

#### *Orthochetus pagoda* (Chapman and Crespin, 1934)

Figure 1.15

*Mathilda pagoda* Chapman and Crespin, 1934:122, plate 11, figures 29–30.

*Orthochetus pagoda* (Chapman and Crespin): Darragh, 2011a: 39, Figures 3A–R.

#### MATERIAL EXAMINED

**Australia: Western Australia:** Pallinup Formation. Gardner River, 1 specimen, external mould (WAM 75.142); nine miles east of Northcliffe, west side of Egging Rd., quartz gravel excavation, 1 specimen (WAM 69.266); Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486, 4 specimens (WAM 10.02, 10.11; NMV P317171); Albany, 1 paratype; Lucky Bay, via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay 1 specimen (WAM 05.34); Cape Le Grand National Park, Merivale 428 219, 2 specimens (WAM 07.191, 80.1339). Total 10 specimens.

#### DESCRIPTION

Shell turreted, pagodiform, of average size for genus (30–40 mm high), with imbricate whorls bearing prominent keel and fenestrate sculpture; spire angle about 20°. Protoconch of 1–1.5 whorls, first whorl smooth, swollen and deviated at right angles to axis of shell; second whorl with thin, close-set axial lamellae extending across whole whorl. Spiral sculpture begins on first teleoconch whorl. Teleoconch whorls with prominent keel situated at anterior ¾ of whorl, which bears one prominent cord. Spiral sculpture of three fine lirae posterior to keel and one fine lira anterior to keel and adjacent to anterior suture. Axial sculpture of fine, regularly spaced costae, tuberculate at intersections with spiral lirae, forming a fenestrate pattern on posterior half of spire. Towards aperture, costae become crowded together and less distinct. Last whorl abruptly contracted anterior to keel, bearing one prominent cord and simple thin lirae; low somewhat coarse lirae on canal. Aperture subrectangular with



prominent columella plate, produced into short narrow anterior canal, weak posterior notch. Single plait present at beginning of canal.

#### REMARKS

This species has been dealt with in detail by Darragh (2011a). Some additional occurrences are recorded here. The species is rare in Western Australia and all specimens are fragmentary and usually crushed.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation. **Saint Vincent Basin:** Blanche Point Marl (type). **Otway Basin:** Browns Creek Formation.

#### Genus *Jetwoodsia* Ludbrook, 1971

##### *Jetwoodsia nullarborica* (Chapman and Crespin, 1934)

Figures 1.22–23, 1.27–28, 1.30–35

*Potamides nullarboricum* Chapman and Crespin, 1934:123, plate 11, figures 31–3.

*Jetwoodsia nullarborica* (Chapman and Crespin): Ludbrook, 1971: 39, plate 6, figures 4–5.

#### MATERIAL EXAMINED

##### *Holotype*

**Australia: South Australia:** NMV P13674 from Blanche Point Marl, Aldinga.

##### *Paratypes*

NMV P13675 from type locality. NMV P14631 **Western Australia:** Pallinup Formation. Cape Riche.

##### *Other material*

**Australia: Western Australia:** Pallinup Formation. Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486, 9 specimens (WAM 67.115, 72.286, 99.226b–c, 12.71; NMV P323140–1); Lucky Bay, via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, 1 specimen (WAM 05.35); Cape Le Grand National Park, Merivale 428 219, 4 specimens (WAM 06.159, 07.189). Mt Barker, Plantagenet Location 6128, west side Barrow Rd, 2 specimens (WAM 84.1033 a–b)? Little Wharton Bay near Mt Belches, Duke of Orleans Bay, Lat. 33° 56' 55"S, Long 122° 34' 28" E, 1 specimen (WAM 05.173a). Cape Riche, 1 specimen (NMV P14631)? Total 18 specimens.

#### DESCRIPTION

Shell of small size for genus, turreted with 11–12 slightly convex whorls. Protoconch of 2½ smooth whorls, coiled in axis of shell, merging abruptly with teleoconch whorls. Axial sculpture of about 16–18 low,

thin costae, much narrower than interspaces, extending from suture to suture and becoming obsolete on last whorl. Occasional broad varices present on whorls. Last whorl with two varices about 120° apart; one varix behind outer lip. Spiral sculpture of very fine, weak threads. Aperture with deep posterior notch, outer lip reflected dorsally, columella covered with thick glaze. Siphonal canal short, reflexed dorsally.

#### DIMENSIONS

	Height	Width	No. of whorls
NMV P13674, holotype	33.9	11.5	10+ spire broken
NMV P13675, paratype	11.3	4.1	10+ spire broken
NMV P14631, paratype	c. 14.4		
WAM 07.189A	29.1	10.6	12+ spire broken and shell slightly crushed
WAM 12.71	25.4	7.6	11+ spire broken and shell slightly crushed
WAM 99.226b	21.8	10.0	8+ specimen broken
WAM 99.226c	15.0	12.6	broken last whorl

#### REMARKS

Specimens from Walpole, Lucky Bay and Cape Le Grand have slightly more convex whorls than those from the type locality, but otherwise match the type material closely. The specimens from Cape Riche and Mt Barrow are external moulds and seem to have more prominent spiral sculpture than the other Eucla Basin material, but the preservation of this material leaves some doubt about the identifications. Browns Creek specimens have very weak axial plicae, more or less restricted to the area below the posterior suture.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation. **Saint Vincent Basin:** Blanche Point Marl (type). **Otway Basin:** Browns Creek Formation.

#### Genus *Glyptozaria* Iredale, 1924

##### *Glyptozaria* sp.

Figures 1.20, 1.24

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 6 specimens (WAM 69.132, 15.51–3, NMV P329280, P329282). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak. 1 specimen (WAM 80.1334). Total 8 specimens.

## DESCRIPTION

Shell turriculate, whorls rounded with impressed sutures. Spiral sculpture of four widely spaced lirae. Axial sculpture of very thin, widely spaced threads. Aperture subcircular.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.51	8.4	1.5	11+ specimen broken
WAM 15.52	7.5	1.4	8+ specimen broken

## REMARKS

All the specimens are very poorly preserved and broken. This species differs from *Glyptozaria transenna* (Tenison Woods, 1879), Middle Miocene, Otway Basin, Victoria, by having much narrower and more regularly rounded whorls. From *G. opulenta* (Hedley, 1907), Recent, eastern Australia, it differs by having finer and less cancellate sculpture.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Cerithiid genus and species indeterminate 1**

Figure 1.25

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 99.225; NMV P317174. Total 2 specimens.

## DESCRIPTION

Shell turriculate, whorls flat to very slightly concave, smooth. Whorls very slightly stepped.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 99.225	31.8	13	3+ specimen broken

## REMARKS

The available material is too poor for precise description and determination. Both specimens lack posterior whorls. The preserved anterior portion of the last whorl present on the figured specimen suggests the possible presence of a canal. There is nothing like this species present in Eocene formations of south-eastern Australia.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Cerithiid genus and species indeterminate 2**

Figures 1.26, 1.29, 1.38

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. (WAM 99.163, 99.224; NMV P317187). Total 5 specimens.

## DESCRIPTION

Fragmentary specimens of at least five whorls with weak shoulder. Sculpture of fine lirae, interspaces equal in width to lirae. Axial sculpture of prominent elongate nodules running from shoulder to anterior suture, about nine per whorl.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 99.163	30.7	15	5+ specimen broken
WAM 99.224a	36.4	19	4+
WAM 99.224b	34.4	18.5	3+

## REMARKS

The available material is too poor for precise description and determination.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Cerithiid genus and species indeterminate 3**

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 99.173, 99.226a; NMV P302234. Total 22 specimens.

## DESCRIPTION

Fragmentary specimens. Spire turriculate with slightly rounded whorls. Protoconch of one axially plicate whorl merging imperceptibly into teleoconch whorls, coiled in axis of shell. First teleoconch whorls axially plicate. Plicae developing into broad costae by second teleoconch whorl; about 12 costae per whorl on mid spire. Spiral sculpture of fine lirae, much narrower than interspaces, becoming wider and more irregular in width on last whorl.

## REMARKS

The available material is too poor for precise description and determination. The specimens consist of several small juvenile specimens, some of which may not belong to this species, but poor preservation prevents certainty.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Pseudovertagus* Vignal, 1904*****Pseudovertagus? longbottomi* sp. nov.**

Figures 1.4, 1.16–17, 1.40–41

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**MATERIAL EXAMINED*****Holotype***

**Australia: Western Australia:** WAM 79.1014 from Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486.

***Paratypes***

WAM 67.109; 67.171, NMV P329331 from type locality.

***Other material***

196 specimens from type locality (WAM 67.112, 67.116, 69.154, 72.288, 72.290?, 99.162, 99.223–4, 10.13; NMV P302229, P302230, P302231, P302232, P317173). Cape Le Grand National Park, via Esperance, old track surface 3.7 km south-east from Frenchman Peak, 5 specimens (WAM 80.1325, 80.1338); Lucky Bay, via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386, 4 specimens (WAM 05.38). Total 208 specimens.

**DIAGNOSIS**

Shell sinistral with 6–10 flat, ribbon-like lirae with irregular low axial folds.

**DESCRIPTION**

Shell sinistral, elongate turriteliform. Protoconch of about two smooth whorls, first whorl globose, deviated about 90° to axis of shell, second whorl convex and merging rapidly into first teleoconch whorl. First teleoconch whorl with three thick lirae, which continue and flatten by fourth or fifth whorl. Whorls flat 14–16+. Spiral sculpture of 6–10 flat, ribbon-like lirae of varying width, separated by shallow grooves. Lirae bearing irregular, low axial folds which give spiral sculpture an undulatory appearance. Aperture, subcircular, produced into an almost closed posterior notch, anteriorly produced into medium length canal, almost closed and dorsally reflexed. Columella covered with thick callus forming a plate.

**DIMENSIONS**

	Height	Width	Aperture height	No. of whorls
WAM 79.1014, holotype	39	10.2		14+ juvenile whorls broken off
WAM 67.171, paratype	26.5	7.1	3.6	9+ specimen crushed
WAM 67.109, paratype	9.8	2.8		10+ protoconch
NMV P329331, paratype	41.7	9.5	c.4.0	16+ specimen crushed

**ETYMOLOGY**

This species is named for Alan F. Longbottom of Grass Patch, Western Australia, in recognition of his assistance in collecting at North Walpole and who collected many specimens for the project at Lucky Bay and Cape Le Grand.

**REMARKS**

Most of the specimens are fragmentary and many specimens are crushed. All specimens with the last whorl preserved have damage consistent with crab attack. Only one specimen has a reasonably well preserved aperture. Assignment to the genus *Pseudovertagus* is tentative, because of the sinistral nature of the shell, however, it bears some resemblance to the dextrally coiled Indo-Pacific species *P. nobilis* (Reeve, 1855). Sinistral marine shells are very rare and none are known in the Cerithioidea. Only species in the family Triphoridae are consistently sinistral. The members of this family are small and it is most unlikely that this large species would belong in the family. The species probably represents a new genus, but given the quality of preservation and lack of a complete aperture on any specimen, it seems unwise to erect a new genus for the species. There is no other similar species recorded from the Tertiary of Australia.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.

***Pseudovertagus? sp.***

Figure 1.37

**MATERIAL EXAMINED**

**Australia: Western Australia:** Cape Le Grand National Park, via Esperance, old track surface 3.7 km south-east from Frenchman Peak, 1 specimen (WAM 80.1340); Lucky Bay, via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386, 1 specimen (WAM 04.186); Little Wharton Bay, near Mt Belches, Duke of Orleans Bay, 1 specimen (WAM 05.174). Total 3 specimens.

**DESCRIPTION**

Shell sinistral, with slightly convex whorls. Axial sculpture of close-set lirae of somewhat irregular width, about eight on penultimate whorl and 10–11 on last whorl. Aperture somewhat D shaped, posterior notch closed and forming a short tube, anterior canal short and narrow (poorly preserved).

**DIMENSIONS**

	Height	Width	Aperture height	No. of whorls
WAM 80.1340	14.8	7.5	3.5	3½ whorls preserved

## REMARKS

All specimens are broken, so it is not known how many whorls an adult shell possessed nor the morphology of the protoconch and early whorls. This species bears a close resemblance to *Pseudovertagus? longbottomi* sp. nov., but the whorls are more rounded and there is no trace of axial sculpture.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Family Siliquariidae Anton, 1838****Genus *Tenagodus* Guettard, 1770*****Tenagodus oclusus?* Tenison Woods, 1877**

Figures 1.39, 1.42–45, 2

?*Tenagodus oclusus* Tenison Woods, 1877: 100.

*Tenagodus* sp. Darragh and Kendrick, 2008: 233, Figures 2.11, 2.15.

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 1000+ specimens (WAM 67.110, 69.134, 72.239, 72.256, 72.282–3, 99.175–6, 99.219–20, 99.227, 99.229–234, 04.157, 09.04–5, 15.266–7, plus numerous unregistered specimens. NMV P302219–4, P329334–7). Lucky Bay, via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386, 1 specimen (WAM 05.56 cast); 19 km south of Jerramongup near the Eucla River. WAM 71.1032 1 specimen; 14.5 km east of Northcliffe, gravel pit west side of Egging Rd., Pemberton 428724. 2 specimens (WAM 69.267, 69.273). Total 1000+ specimens.

## DESCRIPTION

Shell irregular, early whorls loosely coiled, later whorls, loosely to irregularly coiled. Protoconch of 1¼ whorls merging abruptly with teleoconch. Sculpture of beaded, longitudinal ribs or threads. On some specimens very faint, on others coarse, becoming stronger adapically, widely spaced or crowded. Slit consisting of a series of holes, sealed on the early whorls.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 09.05a	18.2	18.8	5½+ specimen broken
WAM 09.05b	10.8	10.2	3½+ specimen broken
WAM 15.266	5.5	6.4	3 specimen broken
WAM 71.1032	85		

## REMARKS

This is by far the most common mollusc found at the Thomson Road locality. Specimens range from

small specimens to large fragments up to 8 mm whorl diameter. Some specimens are found still embedded within lithistid sponges, but the majority of the material consists of loose broken specimens of varying lengths, which may or may not have the early whorls preserved. It was first thought there were two species present in the material, one species having a simple open slit with smooth sides and the other having a slit formed from a series of holes, however, on close examination it is not always possible to prove that the slit consistently has smooth sides so probably only one species is present. Specimen number WAM 71.1032 (Figure 2) is a cast of a sponge that was inhabited by two large specimens of *Tenagodus*, probably of this species.

Large Walpole specimens closely resemble specimens from Fossil Bluff, Tasmania, the type locality of *Tenagodus oclusus* Tenison Woods, 1877. The latter specimens also seem to vary in the development of the slit, so the Walpole species has been included in that taxon, but with a query. Somewhat similar but much rarer material of this species is found in the late Eocene unnamed sandstone near Kalbarri, Blanche Point Formation and in the Browns Creek Formation. The species also occurs in Miocene formations in South Australia, Tasmania and Victoria, but nowhere as common as at the Thomson Road locality.

Based on a sample sent to him, Dr Andrzej Pisera (personal communication, August 2016) stated that: 'Unfortunately, the silicification is very gross thus it is not possible to tell the genus of the lithistid as details of the desmas are not well preserved (also because ectosomal spicules are absent). It can be both theonellid as well as corallistid — looking at gross morphology of desmas. Today, such gastropods are associated mostly with theonellids, and I have never heard of corallistids in such association. Taking into account that such gastropods are rather shallow, deep water association with corallistids is less probable'.

## OCCURRENCE

**Southern Carnarvon Basin:** unnamed sandstone. **Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation. **Murray Basin:** Cadell Marl; **Bass Basin:** Freestone Sandstone (type). **Otway Basin:** Browns Creek Formation; Fyansford Formation.



FIGURE 2 *Tenagodus oclusus?* Tenison Woods, 1877: WAM 71.1032 (x 0.9) 19 km S of Jerramongup.



**Family Turritellidae Lovén, 1847****Genus *Zeacolpus* Finlay, 1926*****Zeacolpus bartoni* Darragh & Kendrick, 2008**

Figure 1.5

*Zeacolpus bartoni* Darragh and Kendrick, 2008: 232, Figures 3.8, 3.9, 3.10, 3.32.

**MATERIAL EXAMINED**

**Australia: Western Australia:** Cape Le Grand National Park, via Esperance, old track surface 3.7 km south-east from Frenchman Peak, 5 specimens (WAM 80.1333, 85.634); 0.8 km north-east of turn-off to Lucky Bay, Merivale 428219, 3 specimens (WAM 07.190); Lucky Bay, via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386, 1 specimen (WAM 05.33); Ocumup No. 1 deep well, 68.6 m., Eucla Bay district. 2 specimens (WAM 95.406). Total 11 specimens.

**DIMENSIONS**

	Height	Width	No. of whorls
WAM 07.190a	11.5	4.1	7+ specimen broken

**REMARKS**

This species is very common in the late Eocene unnamed sandstone near Kalbarri, Western Australia. The specimens recorded here are all fragmentary and some somewhat worn, but nevertheless match closely the material from Kalbarri. No specimens have been found at the Thomson Road locality north of Walpole.

**OCCURRENCE**

**Southern Carnarvon Basin:** unnamed sandstone;  
**Eucla Basin:** Pallinup Formation.

**Family Capulidae Fleming, 1822****Genus *Sirius* Hedley, 1900*****Sirius* sp.**

Figures 1.12–13

**MATERIAL EXAMINED**

Australia: Western Australia: Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 1 specimen (WAM 99.221). Total 1 specimen.

**DESCRIPTION**

Shell ovately fusiform of three or more tumid whorls. Protoconch broken, Teleoconch whorls rapidly increasing, last whorl ventricose, suture deeply incised. Sculpture of prominent beaded lirae, about 20 on last whorl, about nine on penultimate whorl. No obvious transverse sculpture

(preservation poor?). Aperture subcircular, produced anteriorly into short canal. Inner lip with thin plate over columella, slightly reflexed over narrow umbilicus. Prominent fasciole separated from canal and aperture by deep furrow running into umbilicus.

**DIMENSIONS**

	Height	Width	Aperture height	No. of whorls
WAM 99.221	3.7	2.7	2.9	3+

**REMARKS**

The genus is known from species present in the late Eocene, Miocene and Recent of Australia, but this species doesn't resemble any of the fossil species. It is somewhat similar to the type species of the genus, *Sirius badius* (Tenison Woods, 1878), Recent, eastern and southern Australia but has more lirae.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.

**Genus *Cerithioderma* Conrad, 1860*****Cerithioderma tabulata* (Tate, 1890)**

Figures 1.14, 1.21

*Trichotropis tabulata* Tate, 1890: 187; Tate, 1892, plate 13, figure 4.

**MATERIAL EXAMINED*****Holotype***

**Australia: South Australia:** SAM T766, Adelaide bore, Kent Town, South Australia.

***Other material***

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 2 specimens (WAM 69.171; NMV P329278). Total 2 specimens.

**DESCRIPTION**

Shell small, turbiniform, whorls four, convex with impressed sutures. Last whorl contracting abruptly to short canal. Axial sculpture of low, broad costae. Spiral sculpture of about six prominent lirae, beaded where crossed by costae. Base of shell sculptured with fine, close-set lirae. Aperture pyriform with short canal, outer lip internally lirate. Small umbilical chink.

**DIMENSIONS**

	Height	Width	Aperture height	No. of whorls
SAM T766, holotype	6.5	3.8		3+
WAM 69.171	5.5	3.6	2.2	4+

## REMARKS

Of the Walpole material, one specimen is broken and worn, and the other is a worn juvenile (3 whorls) but sufficient morphology is preserved to show that they are identical with Tate's species from the Kent Town Bore (Figure 1.21).

## OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

## Family Cypraeidae Rafinesque, 1815

Genus *Zoila* Jousseume, 1884*Zoila viathomsoni* Darragh, 2011

Figures 3.33, 3.38–39

*Zoila viathomsoni* Darragh, 2011b: 5, Figures 1D, 2C, 5B–C, H, L.

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** WAM 72.296. Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486.

*Paratypes*

From type locality WAM 72.2539; NMV P310193–4.

*Other material*

WAM 82.1484, 15.277–8 from type locality. Total 14 specimens.

## DESCRIPTION

Shell of average size for genus (19–28 mm in length), pyriform. Spire not visible on most specimens,

projecting on one specimen. Posterior canal very short, slightly bent to left. Posterior canal very short, slightly deflected to right. Aperture slightly sinuous. Outer lip with about 23 to 25 teeth present along entire lip. Columella with about 23 to 26 teeth present along entire lip. Fossula well developed, deep, elongate, bounded anteriorly by thickened ridge; very weak notch present in inner edge just posterior to anterior ridge; weak terminal ridge joining edge of fossula. First columella tooth adjacent to terminal ridge, almost blocking shallow sulcus that descends into the fossula parallel to terminal ridge.

## REMARKS

This is the oldest true cowry recorded from Australia. It has been discussed in detail by Darragh (2011b).

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

## Family Eocypraeidae Schilder, 1924

Genus *Willungia* Powell, 1938*Willungia ovulatella* (Tate, 1890)

Figures 3. 19, 3.31–32, 3.35–37

*Cypraea ovulatella* Tate, 1890: 208; Tate 1892, plate 16, figures 7, 7a.

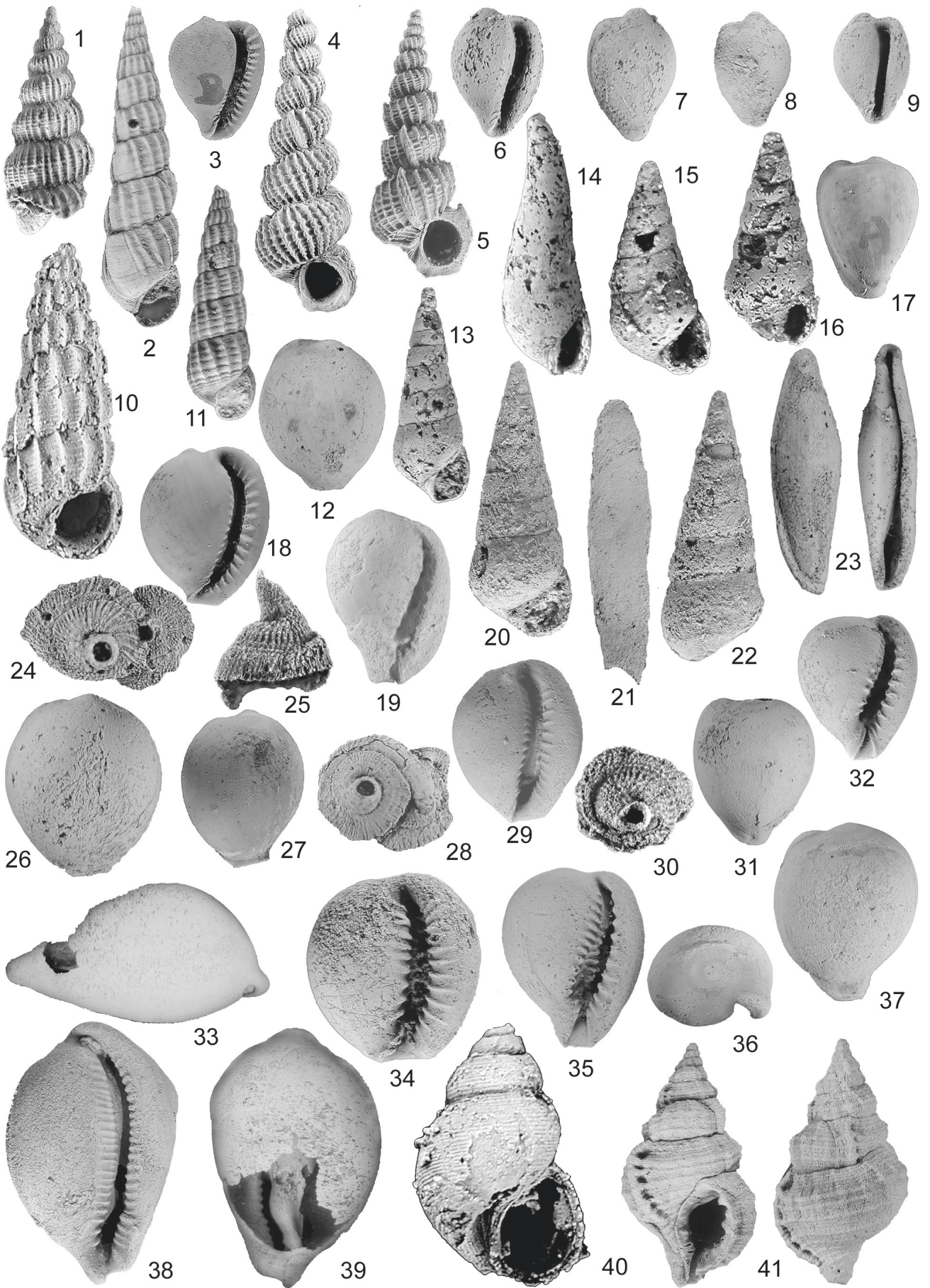
*Austrocypraea ovulatella*: Schilder, 1935: 339, Figure 18, non Tate, 1890.

*Willungia ovulatella* (Tate): Powell, 1938, plate 39, figure 5; Fehse, 2013: 150, Text-figure 4.

## FIGURE 3

- 1, *Epitoniid* sp.: 1, WAM 10.04 (x 7);
- 2, 10, 11, *Notacirsa lampra* (Tate, 1890): 2, SAM T781B (x 5) holotype, Aldinga; 10, WAM 99.215 (x 10); 11, NMV P307865 (x 5), Blanche Point;
- 3, 6, 7, 8, 9, 17, *Archierato pyrulata* (Tate, 1890): 3, SAM T774B (x 4) lectotype, Adelaide bore; 6, 7, WAM 09.02b (x 5); 8, 9, WAM 09.02a (x 5); 17, SAM T774A (x 4) paralectotype, Adelaide bore;
- 4, 5, *Cirsotrema pleiophylla* Tate, 1890: 4, SAM 789K (x 4) lectotype, Torquay; 5, WAM 10.03 (x 4);
- 12, 18, 26, 27, 29, 34, *Triviella pompholugota* (Tate, 1890): 12, 29, WAM 07.09a (x 4); 18, 27, SAM T803 (x 4) holotype, Adelaide bore; 26, WAM 76.2542a (x 5); 34, WAM 76.2542b (x 5);
- 13, 20, 22, *Eulima danae* Tension Woods, 1879: 13, WAM 99.178b (x 4); 20, 22 WAM 99.178a (x 4);
- 14, *Melanella?* sp.: 14, WAM 15.70 (x 7);
- 15, *Curveulima?* sp.: 15, WAM 15.72 (x 10);
- 16, *Niso kimberli* Pritchard, 1906: 16, WAM 10.05 (x 7);
- 19, 31, 32, 35, 36, 37, *Willungia ovulatella* (Tate, 1890): 19, WAM 80.1342 (x 3) Cape Le Grand; 31, 32, WAM 09.06 (x 3); 35, 36, 37, WAM 76.2543a (x 3);
- 21, *Seraphs* sp.: WAM 84.1036 (x 1.5) Mount Barker;
- 23, *Phenacovolva* sp.: 22, 23, WAM 12.70 (x 3);
- 24, 25, 28, 30, *Thylacodes actinotus* Tate, 1893: 24, SAM T1521A (x 3) lectotype, Adelaide bore; 25, 30, WAM 15.299 (x 2); 28, SAM T 1521E (x 3) paralectotype, Adelaide bore.
- 33, 38, 39, *Zoila viathomsoni* Darragh, 2011: WAM 72.296 (x 3) holotype;
- 40, *Rissoid* sp.: 37, 99.216 (x 20);
- 41, *Sassia tortirostris* (Tate, 1888): 38, 39, WAM 72.299 (x 2).





## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 227 specimens (WAM 67.135, 69.157, 72.242, 72.294, 76.2543, 82.1485, 99.179, 09.06, 10.15, 10.16; NMV P317176–80). Cape le Grand National Park, 0.8 km NE of turnoff to Lucky Bay, west side of road, Merivale 428219: 2 specimens (WAM 07.192). Cape Le Grand National Park, via Esperance, old track surface 3.7 km south-east from Frenchman Peak, 1 specimen (WAM 80.1342). Lucky Bay, via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386, 2 specimens (WAM 04.185, 05.41). Total 232 specimens.

## DESCRIPTION

Shell of small size for genus, globose, smooth, abruptly truncated anteriorly to anterior canal. Spire barely, if at all, projecting. Aperture arcuate, narrow posteriorly, widening anteriorly and then abruptly narrowing to anterior canal. Posterior canal indistinct, barely notched. Anterior canal short, prominent, bounded by ridges on columella and labial sides, almost closed. Terminal ridge bifid. Labial lip with 10–12 teeth. Inner lip with 10–12 elongate ridges extending well into aperture. Shallow subcircular fossula, crossed by very weak ribs that become stronger after crossing fossula. Wide shallow groove between terminal ridge and first columella rib.

## DIMENSIONS

	Height	Width
WAM 09.06	9.4	7.6
WAM 76.2543a	11.3	8.8
WAM 80.1342	10.7	7.6

## REMARKS

Walpole specimens are identical in shape to those from Browns Creek but they are consistently smaller. Both have similar teeth and outer lip. Browns Creek specimens are generally much bigger than those from Blanche Point and Blanche Point specimens are generally slightly bigger than Walpole specimens. Most of the Blanche Point specimens are crushed. This species has a paucispiral protoconch suggesting that the species had direct developing larvae. The genus ranges late Eocene-early Miocene in Australia and late Oligocene-middle Miocene in New Zealand. The large number of specimens present suggests this species might have been a spongophore.

## OCCURRENCE

**Eucla Basin**, Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

## Family Ovulidae Fleming, 1822

Genus *Phenacovolva* Iredale, 1930*Phenacovolva* sp.

Figures 3.23

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.70. Total 1 specimen.

## DESCRIPTION

Shell of average size for genus, elongate fusiform, smooth. Aperture very narrow, slightly wider anteriorly. Four weak denticles present at anterior end of columella.

## DIMENSIONS

	Height	Width
WAM 12.70	15.0	4.4

## REMARKS

The single specimen is slightly crushed dorso-ventrally. This is the earliest record of the genus in Australia and the only record for the genus in the Australian Eocene. The only other species of the genus known in the Australian fossil record is *Phenacovolva exigua* (Tate, 1890) from the middle Miocene of Victoria.

## OCCURRENCE

**Eucla Basin**, Pallinup Formation.

## Family Naticidae Guilding, 1834

Genus *Tanea* Marwick, 1931*Tanea hamiltonensis* (Tenison Woods, 1879)

Figures 1.6, 1.9, 1.10–11

*Natica wintlei* var. *hamiltonensis* Tenison Woods, 1879a: 229, plate 21, figure 8.

*Natica hamiltonensis* Tenison Woods: Tate, 1893: 319, plate 10, figure 6.

*Tanea hamiltonensis* (Tenison Woods): Ludbrook, 1958: 48, plate. 1, figures 9–10.

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 285 specimens (WAM 67.133, 69.156, 72.244, 72.297, 82.1486, 99.181, 04.158, 10.27–29, 12.01–03; NMV P317493–6). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386: 1 specimen (WAM 05.39?). Total 286 specimens.



## DESCRIPTION

Shell smooth, solid, globose, of small size (3.8–6 mm) with low spire. Protoconch smooth, of about one whorl coiled in axis of shell and merging imperceptibly with teleoconch whorls. No spiral sculpture. Axial sculpture of fine growth striae only. Aperture D shaped. Umbilicus open, deep, narrow with a very fine funicle running up umbilicus.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 12.01	4.8	5.2	3
WAM 12.02	5.0	5.7	3
WAM 12.04	2.8	2.1	

## REMARKS

This is one of the most common species in the Pallinup Formation. It has a long time range (late Eocene to middle Miocene) and a wide distribution. The Eocene specimens from the Pallinup Formation, Blanche Point Formation and Browns Creek Formation are much smaller than the average size of the Miocene specimens and the funicle is generally much less prominent. It is possible that many of the specimens are juveniles.

This seems to be the only naticid species present in the Pallinup Formation, so the two opercula found at Walpole (Figures 1.10–11) probably belong to this species. It is probably responsible for the naticid boreholes present in other molluscs in the formation.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation **Otway Basin:** Browns Creek Formation; Jan Juc Formation, Muddy Creek Formation, Gellibrand Formation, Fyansford Formation.

**Family Ampullinidae Cossmann, 1918****Genus *Euspirocrommium* Sacco, 1890*****Euspirocrommium?* sp.**

Figures 1.7–8, 1.18

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Grid reference Deep River 743 486: WAM 99.208, 12.05, NMV P317498–9. Total 4 specimens.

## DESCRIPTION

Shell solid, globose, of average size for genus (23 mm). Protoconch worn and indistinct. Spire somewhat gradate with about five regularly rounded whorls; sutures impressed. Aperture not preserved. Small umbilicus present.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 99.208	8.5		5+
WAM 12.05	23.4	14	5

## REMARKS

All specimens are incomplete. Specimen WAM 12.05 shows indications of tearing by a crab. *Euspirocrommium effusum* (Tate, 1893) has a narrower and more gradate spire. The specimen of *Euspirocrommium* recorded from the late Eocene of Kalbarri by Darragh and Kendrick (2008) has a much more gradate spire than this species.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Family Rissoidae Gray, 1847****Genus and species indeterminate**

Figure 3.40

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Grid reference Deep River 743 486: 1 specimen (WAM 99.216).

## DESCRIPTION

Shell turbiniform, of very small size. Protoconch broken. About 3½ regularly convex whorls. No axial sculpture. Spiral sculpture of fine, closely spaced threads over whole whorl. Aperture lenticular with weak posterior notch. Narrow umbilicus present.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 99.216	2.5	1.6	0.9	3½

## REMARKS

The single specimen is poorly preserved. Not only is the protoconch missing, but the dorsal side of the teleoconch has large holes in each whorl and the aperture is damaged, so assignment to genus or family is not possible. It bears some resemblance to species of the rissoid genera *Onoba* H. & A. Adams, 1852 or *Lucidestea* Laseron, 1956.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Family Seraphsidae Gray, 1853****Genus *Seraphs* Montfort, 1810*****Seraphs* sp.**

Figure 3.21

**MATERIAL EXAMINED**

**Australia: Western Australia:** Mt Barker, Plantagenet Location 6129, Mount Barker Rd. 8 specimens (WAM 84.1021–2, 84.1034–9).

**DIMENSIONS**

Height

WAM 84.1036 34.5

**REMARKS**

The eight specimens are casts and moulds but sufficiently well preserved to enable generic assignment but too poorly preserved to formally name. The genus ranges from Paleocene to Oligocene and has a Tethyan distribution. It has not been recorded from Australia previously. The nearest occurrence is in the Eocene of Java.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.

**Family Ranellidae Gray, 1853****Genus *Sassia* Bellardi, 1872*****Sassia tortirostris* (Tate, 1888)**

Figures 3.41

*Triton tortirostris* Tate, 1888: 123, plate 5, figure 7.

*Triton oligostirus* Tate, 1888: 126, plate 6, figure 7.

*Cymatiella oligostirus* (Tate): Ludbrook, 1973: plate 25, figure 29.

*Sassia tortirostris* (Tate): Beu and Maxwell, 1990: 223 (with synonymy).

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Grid reference Deep River 743 486: WAM 67.137, 69.160, 69.170, 99.182, 72.299, 04.160, 09.29, 10.08, 10.09; NMV P316328, P316329, P316330, P317781, P332655. Total 69 specimens.

**DESCRIPTION**

Shell of small size for genus, up to 23 mm. Protoconch dome-shaped, of 2½ smooth whorls, coiled with axis of shell. Teleoconch of 5–7 convex whorls with impressed sutures. Spiral sculpture of six irregularly

spaced prominent lirae with one to three finer lirae in interspaces, total of 24 lirae on last whorl extending onto siphonal canal. Axial sculpture of 12 costae forming prominent tubercles where crossed by spiral lirae; varices at every ⅓ of a whorl. Last whorl contracting evenly to siphonal canal. Aperture ovate, outer lip with six prominent internal denticles; columella with one prominent posterior denticle and two to three prominent anterior denticles; siphonal canal short.

**DIMENSIONS**

Height Width No. of whorls

WAM 72.299 22.8 13.0 7 protoconch broken

**REMARKS**

Walpole specimens closely resemble specimens from Eocene formations of the St Vincent and Otway basins, which were previously identified as *Sassia oligostira*. Most of the Walpole specimens are small juveniles. Specimens from the Eocene formations are smaller than specimens from Oligocene and Miocene formations. Miocene specimens of *S. tortirostris* can exceed 60 mm in length.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation; Glen Aire Clay; Jan Juc Formation; Gellibrand Formation, Fyansford Formation. Late Eocene-Middle Miocene.

**Family Triviidae Troschel, 1863****Genus *Triviella* Jousseume, 1884*****Triviella pompholugota* (Tate, 1890)**

Figures 3.12, 3.18, 3.26–27, 3.29, 3.34

*Trivia pompholugota* Tate, 1890: 214.

*Triviella pompholugota* (Tate). Fehse and Grego, 2004: 7, plate 27, figure 110.

**MATERIAL EXAMINED*****Holotype***

**Australia: South Australia:** SAM T803, Adelaide (= Kent Town) Bore.

***Other material***

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 501 specimens (WAM 67.136, 69.158, 72.243, 72.295, 76.2542, 76.2544, 76.2545, 79.1020, 99.180, 09.07, 10.20–22; NMV P316001–5, P317186). Cape Le Grand National Park, via Esperance, old track surface 3.7 km south-east from Frenchman Peak, 1 specimen (WAM 80.1343). Total 502 specimens.

## DESCRIPTION

Shell globular, smooth, of medium to small size for genus (5.5–8 mm). Spire scarcely projecting. Aperture narrow, uniformly curved; outer lip thickened, with short, thick-sided anal notch, labial teeth 13–16, columella teeth 11–13. Anterior canal very short, notched with thickened sides. Fossula broad, concave, bisected by sharp ridge, extremely fine terminal ridge; in some specimens columella teeth extend as ridges across fossula.

## DIMENSIONS

	Height	Width	Labial teeth	Columella teeth
SAM T803, holotype	7.3	5.6		
WAM 09.07a	6.9	5.9	12	15
WAM 76.2542a	7.1	6.0	13	11
WAM 76.2542b	7.2	6.8	12	12

## REMARKS

Most Walpole specimens are about half the size of most Browns Creek specimens, but small specimens from Browns Creek are very similar to the Walpole specimens. One specimen from Aldinga is the same as the largest Walpole specimens. The holotype of the species from Kent Town Bore (Figures 3.18, 3.27) is about the same size as Walpole specimens. This species differs from most others in the genus by the complete lack of any ribbing on the lateral and dorsal surfaces.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type) **Otway Basin:** Browns Creek Formation.

**Genus *Archierato* Schilder, 1933*****Archierato pyrulata* (Tate, 1890)**

Figures 3.3, 3.6–9, 3.17

*Erato pyrulata* Tate, 1890: p. 216. Tate, 1892: plate 13, figures 12, 12a.

*Archierato pyrulata* Tate. Schilder, 1933: 253, 257, 270, Figure 8. Schilder, 1935: 328, Figure 1.

## MATERIAL EXAMINED

*Types*

**Australia: South Australia:** SAM T774A–F from Blanche Point Marl, Adelaide (= Kent Town) Bore. Tate's figured specimen (T774B) is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species.

*Paralectotypes*

SAM T774B–F from the same locality.

*Other material*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 177 specimens (WAM 67.164, 69.183, 72.249, 72.316, 99.177, 04.159, 04.173, 09.02, 10.23–5; NMV P317189, P317490–2). Cape Le Grand National Park, via Esperance, old track surface 3.7 km south-east from Frenchman Peak, 1 specimen (WAM 80.1353). Lucky Bay, via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386, 1 specimen (WAM, 05.40). Total 179 specimens.

## DESCRIPTION

Shell small, of average size for genus (4–5.4 mm), smooth, pyriform, with slightly projecting spire. Protoconch of about 1 to 1½ smooth whorls passing imperceptibly into teleoconch whorls. Teleoconch of about three whorls. Aperture long and narrow, slightly sinuous; outer lip prominently thickened with traces of up to 13 weak teeth. Columella with two to six teeth. Terminal ridge prominent, bounding shallow subrectangular fossula with sharp internal edge.

## DIMENSIONS

	Height	Width
WAM 09.02a	4.1	2.9
WAM 09.02b	4.9	3.4

## REMARKS

Walpole specimens are very similar in morphology to the specimens from the Blanche Point Formation in South Australia, but the apertural teeth tend to be much weaker like specimens from the Browns Creek Formation in Victoria.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

**Family Vermetidae Rafinesque, 1815****Genus *Thylacodes* Guettard, 1770*****Thylacodes actinotus* Tate, 1893**

Figures 3.24–25, 3.28, 3.30

*Thylacodes actinotus* Tate, 1893: 342, plate 9, figure 1.

## MATERIAL EXAMINED

*Types*

**Australia: South Australia:** SAM T1521A–E from Blanche Point Marl, Adelaide (= Kent Town) Bore. Tate's figured specimen (T1521A) is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species.

*Paralectotypes*

SAM T1521B–E from the same locality.

*Other material*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 1 specimen (WAM 15.299). Total 1 specimen.

## DESCRIPTION

Shell small, irregularly conical, early whorls somewhat flattened, embracing except for last whorl which is extended into a short erect circular tube. Sculptured with axial costae crossed by weak longitudinal threads.

## DIMENSIONS

	Height	Width
WAM 15.299	12.6	10.9

## REMARKS

Dr R. Bieler (personal communication), having examined images of the Thomson Road specimen and Tate's types, confirmed that the species was a vermetid as was assumed in Bieler and Petit (2011). The attachment surface of the Thomson Road specimen is dimpled indicating possible attachment to a sponge.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type).

**Family Xenophoridae Troschel, 1852 (1840)****Genus *Xenophora* Fischer von Waldheim, 1807*****Xenophora* sp.**

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Grid reference Deep River 743 486: (WAM 67.180).

## REMARKS

Ponder (1983, p. 29) regarded the single broken specimen as a typical member of the *Xenophora conchliophora* group. Since his examination of it, the specimen has been lost. A similar if not identical species from the late Eocene, unnamed sandstone near Kalbarri was recorded by Darragh and Kendrick (2008, p. 233, Figures 2.12–13) as *Xenophora* sp, cf. *X. tatei* Harris, 1897. These two records are the only records of the genus known from the Australian Eocene as no species have been found from the late Eocene of eastern Australia. The earliest record in eastern Australia is from the late Oligocene of the Otway Basin.

**Family Epitoniidae Berry, 1910 (1812)****Genus *Notacirsa* Finlay, 1926*****Notacirsa lampra* (Tate, 1890)**

Figures 3.2, 3.10–11

*Scalaria (Hemiacirsa) lampra* Tate, 1890: 234; Tate 1892: plate 11, figure 8.

## MATERIAL EXAMINED

*Types*

**Australia: South Australia:** Aldinga. (SAM T781 A–G). Tate's figured specimen (T781B) is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species.

*Other material*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: (WAM 67.131, 99.215). Total 2 specimens.

**South Australia:** Aldinga, lower part of cliff, Blanche Point. (P307865). 2 specimens.

## DESCRIPTION

Spire elongate turritiform; teleoconch whorls flat with sharp axial costae running from suture to suture, almost aligned from whorl to whorl, 14 present on penultimate whorl; spiral sculpture of fine, evenly spaced lirae, 11 on penultimate whorl. Last whorl with about 15 weak spiral lirae, axial costae not sharp and slightly weaker, with low broad varix at aperture. Aperture oval. Columella concave. No callus.

## DIMENSIONS

	Height	Width	No. of whorls
SAM T781B, lectotype	11.7	3.0	10
WAM 99.215	5.8	2.1	7+ juvenile whorls missing
NMV P307865	9.5	2.7	8+ juvenile whorls missing

## REMARKS

The two Walpole specimens are similar to specimens of *Notacirsa lampra* Tate from the St Vincent and Otway Basins, but the costae are slightly sharper than most of the latter specimens, but fall within the range of variation. Mature specimens of the species can reach up to 14 mm in length.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation; Glen Aire Clay.



**Genus *Cirsotrema* Mörch 1852*****Cirsotrema pleiophylla* Tate, 1890**

Figures 3.4–5

*Scalaria (Cirsotrema) pleiophylla* Tate, 1890: 231; 1892: plate 12, figure 1.

**MATERIAL EXAMINED****Types**

**Australia: Victoria:** Spring Creek (= Torquay). (SAM T789 A–K). Tate's figured specimen (T789K) is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species.

**Other material**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 67.130, 69.155, 04.155–6, 10.02–3; 15.272–4; NMV P316319–21. Total 31 fragmentary specimens

**DESCRIPTION**

Shell of average size for genus, turrated of 7–8 strongly convex teleoconch whorls (apical whorls missing on all specimens). Sutures impressed. Axial sculpture of 17–24 equidistant, frilled lamellae, slightly produced into a point posteriorly, thick foliaceous varices present at about 180° on some specimens, at irregular intervals on others; varices produced into a point posteriorly. Spiral sculpture of 11–12 lirae about as wide as interspaces, weakly developed against posterior suture. Prominent peripheral rib present on last whorl coinciding with posterior suture. Aperture subcircular, apertural lip entire.

**DIMENSIONS**

	Height	Width	No. of whorls
SAM T789K, lectotype	14.0	4.7	7+ broken
WAM 10.03	12.2	4.5	8

**REMARKS**

This species has the same basic form as the southern Australian Eocene species *Cirsotrema mariae* (Tate, 1885) but is much smaller and more delicate, having finer axial and spiral sculpture. A somewhat similar species occurs in Eocene sandstones at Kalbarri National Park (Darragh and Kendrick, 2008).

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation. **Otway Basin:** Browns Creek Formation, Jan Juc Formation (type).

***Epitoniid* sp.**

Figure 3.1

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, west side, Deep River 743 486: WAM 10.04. Total specimens 1.

**DESCRIPTION**

Shell of small size; with protoconch of about two whorls, the first whorl deviated at about a right angle to shell axis; spire elongate turriteliform; sutures moderately incised; teleoconch whorls convex with sharp, regularly spaced axial costae running from suture to suture, about 26 present on last preserved whorl, much narrower than interspaces; spiral sculpture of fine, evenly spaced lirae, thinner than interspaces, about 12 on last preserved whorl. Aperture not preserved.

**DIMENSIONS**

	Height	Width	No. of whorls
WAM 10.04	6.9	3.0 (max)	9+ broken and squashed laterally

**REMARKS**

There is nothing in the St Vincents and Otway Basins matching this taxon, but preservation may be deceiving.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.

**Family Eulimidae Philippi, 1853**

Eulimid species are parasitic on a variety of echinoderms. McNamara (1985) recorded *Linthia*, *Schizaster*, *Prenaster*, *Giraliaster* and ?*Pericosmus* in the Pallinup Formation at Walpole and spines of regular echinoids have been found at Walpole, but given that there are four generic taxa recorded here, it may be that other yet unrecognised echinodermata such as holothurians, whose remains, if preserved, would be difficult to recover, were also present in the formation.

**Genus *Eulima* Risso, 1826*****Eulima danae* Tenison Woods, 1879**

Figures 3.13, 3.20, 3.22

*Eulima danae* Tenison Woods, 1879b:2, plate 1, figure 1.

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 43 specimens (WAM 67.123,

99.178; 04.178, 15.269–271; NMV P316323, P316324–7). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 3 specimens (WAM 04.184, 05.44). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak. (WAM 80.1341, 85.636). Total 49 specimens.

#### DESCRIPTION

Shell of average size for genus; elongate, slender; teleoconch whorls 9–11, smooth except for very fine growth striae and incremental scars. Early whorls flat, then tending to slightly convex on last whorls of large specimens. Protoconch of about 1½ smooth, shining whorls, the first whorl slightly deviated from shell axis. Aperture elliptical with opisthocline outer lip.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 99.178a	12.4	4.5	9+ juvenile whorls broken off
WAM 99.178b	9.8	3.3	9

#### REMARKS

The Walpole and Cape Le Grand specimens are very similar in morphology to specimens of the same size from Muddy Creek. Browns Creek specimens of this species can reach up to 25 mm in length and consist of 15 whorls and are much the same size as large specimens from Muddy Creek (type locality).

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation. **Otway Basin:** Browns Creek Formation, Glen Aire Clay, Jan Juc Formation; Gellibrand Formation, Muddy Creek Marl (type), Fyansford Formation. Late Eocene–Middle Miocene.

### Genus *Niso* Risso, 1826

#### *Niso kimberi* Pritchard, 1906

Figure 3.16

*Niso kimberi* Pritchard, 1906:119.

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 10.05; NMV P316322. Total 2 specimens.

#### DESCRIPTION

Shell of average size for genus; spire elongate with flat, shining, smooth teleoconch whorls. Last whorl contracting abruptly to base. Aperture narrow,

lenticular. Umbilicus prominent, coniform with sharp margin.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 10.05	5.7	2.5	8+ juvenile whorls broken off

#### REMARKS

The two specimens are similar to specimens of *Niso kimberi* from the Otway Basin, but no specimens from the Blanche Point Formation, St Vincent Basin, are available for comparison, as it seems to be very rare in it. The species is very close in morphology to the Victorian Miocene species *Niso psila* Tenison Woods, 1879, but differs, as Pritchard correctly noted, by its flatter whorls, narrower spire and narrower umbilicus.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

### Genus *Curveulima* Laseron, 1955

#### *Curveulima?* sp.

Figure 3.15

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 15.72–3, NMV P329300. Total 5 specimens.

#### DESCRIPTION

Shell of average size for genus; spire somewhat conical, slightly curved, with 6–7 flat, shining, slightly convex smooth whorls. Protoconch of about one smooth, rounded whorl, deviated from axis of shell. Subsutural band present on all whorls. No incremental scars present. Aperture broadly elliptical; outer lip with broad, shallow sinus.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 15.72	3.9	1.6	6

#### REMARKS

Apart from the next taxon, nothing similar has yet been recorded from the Tertiary of Australia, though there are many living species of the genus and similar genera known from Australia.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Melanella* Bowdich, 1822*****Melanella?* sp.**

Figure 3.14

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 69.195, 15.69–71; NMV P329297–9. Total 14 specimens.

## DESCRIPTION

Shell of average size for genus; spire very elongate, slightly sinuous, with 7–8 flat, shining, smooth whorls. Subsutural band present on all whorls. No incremental scars present. Aperture narrow, lenticular; outer lip sinuous with sinus against posterior suture, protruding slightly at middle of lip.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.70	6.8	2.1	7

## REMARKS

Owing to the lack of preservation of the protoconch, the generic assignment of this species is doubtful. Apart from the previous taxon, nothing similar has yet been recorded from the Tertiary of Australia, though there are many living species of the genus and similar genera known from Australia.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Family Triphoridae Gray, 1847****Genus *Viriola* Jousseume, 1884*****Viriola?* sp.**

Figure 4.34

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 15.85–6, NMV P329310. Total 6 specimens.

## DESCRIPTION

Shell sinistral, turriculate, of average size for genus (11–15 mm); whorls convex with impressed sutures. Protoconch poorly preserved (multipiral?). Spiral sculpture of strong lirae slightly narrower than interspaces, 7–8 lirae on penultimate whorl, 10–11 lirae on last whorl from suture to canal. No axial sculpture except for growth striae. Aperture oval with very short, twisted canal. No siphonal fasciole.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.85	11.7	2.7	10+ specimen broken

## REMARKS

All specimens are not well preserved. The generic assignment is tentative. This species differs from most species of *Viriola* in having slightly convex rather than flat whorls.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Mastoniaeforis* Jousseume, 1884*****Mastoniaeforis pagodiformis* sp. nov.**

Figures 4.14–18

urn:lsid:zoobank.org:act:066D928D-A111-4A5C-991E-3B0290482F4F

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 69.153a.

*Paratypes*

WAM 15.25 from type locality. NMV P327573 from type locality.

*Other material*

From type locality: 18 specimens (15.24, 15.26; NMV P327572, P327574). Ocumup No. 1 deep well, 53.4 m., Eucla Bay district. 1 specimen (WAM 95.433). Total 22 specimens.

## DIAGNOSIS

Shell with four nodulate lirae, anterior lira developed into prominent keel.

## DESCRIPTION

Shell very slender, elongate-conical, of about 8–10 keeled whorls with impressed sutures. Protoconch of about two whorls merging gradually with teleoconch, first whorl smooth, last whorl with prominent keel. Spiral sculpture of four lirae, narrower than interspaces, one against anterior suture, another against posterior suture, central two slighter thicker, the anterior of which is larger and forms prominent keel. Axial sculpture of low costae produced into prominent elongate nodes on crossing lirae to form a cancellate sculptural pattern. Aperture subcircular, entire, produced into short tube. Posterior canal produced into a short tube, projecting on dorsal side 180° from aperture. Anterior canal enclosed, produced into a short tube directed dorsally.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 69.153a, holotype	4.7	1.1	8+
WAM 15.25, paratype	4.9	1.1	9
NMV P327573, paratype	5.4	1.6	6+

## ETYMOLOGY

Latin adjective. Shaped like a pagoda.

## REMARKS

This species resembles *Mastoniaeforis insulana* (Laseron, 1958) from Christmas Island, but has a much more prominent keel. The protoconch seems to lack any axial sculpture unlike the protoconch of *Mastoniaeforis* illustrated by Marshall (1983, Fig 20E–F). Nothing like this species has yet been recorded from the Tertiary formations elsewhere in Australia.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Inella* Bayle, 1879*****Inella moniliferata* sp. nov.**

Figures 4.1–3

urn:lsid:zoobank.org:act:68C91E29-AF80-4BF9-9E73-3CE1CD908110

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.29.

*Paratypes*

WAM 99.169a from type locality. NMV P327577 from type locality.

*Other material*

From type locality: 137 specimens (WAM 67.113–4, 67.128–9, 69.151a, 72.289, 99. 168, 04.152a, 04. 154, 15.27–8, 15.30; NMV P302233, P327575–6, P327578). Ocumup No. 1 deep well, 53.4 m, Eucla Bay district. 2 specimens (WAM 95.385, 95.434). Total 142 specimens.

## DIAGNOSIS

Shell with three prominent nodulate lirae and one thin smooth lira against anterior suture of whorls.

## DESCRIPTION

Shell sinistral, narrowly conical, of average size for genus (7–19 mm) with about 10–12 flat whorls. Protoconch of about 4½ whorls bearing three sharp lirae about as wide as interspaces merging imperceptibly into teleoconch whorls. Spiral sculpture of three lirae about as wide as interspaces with prominent nodules where crossed by axial sculpture. Thinner, smooth anterior lira against anterior suture. Axial sculpture of very weak oblique costae, only visible on crossing lirae. Base of shell smooth or with two or three smooth lirae. Aperture subrectangular. Columella covered with thick layer of callus. Very short twisted anterior canal.

## DIMENSIONS

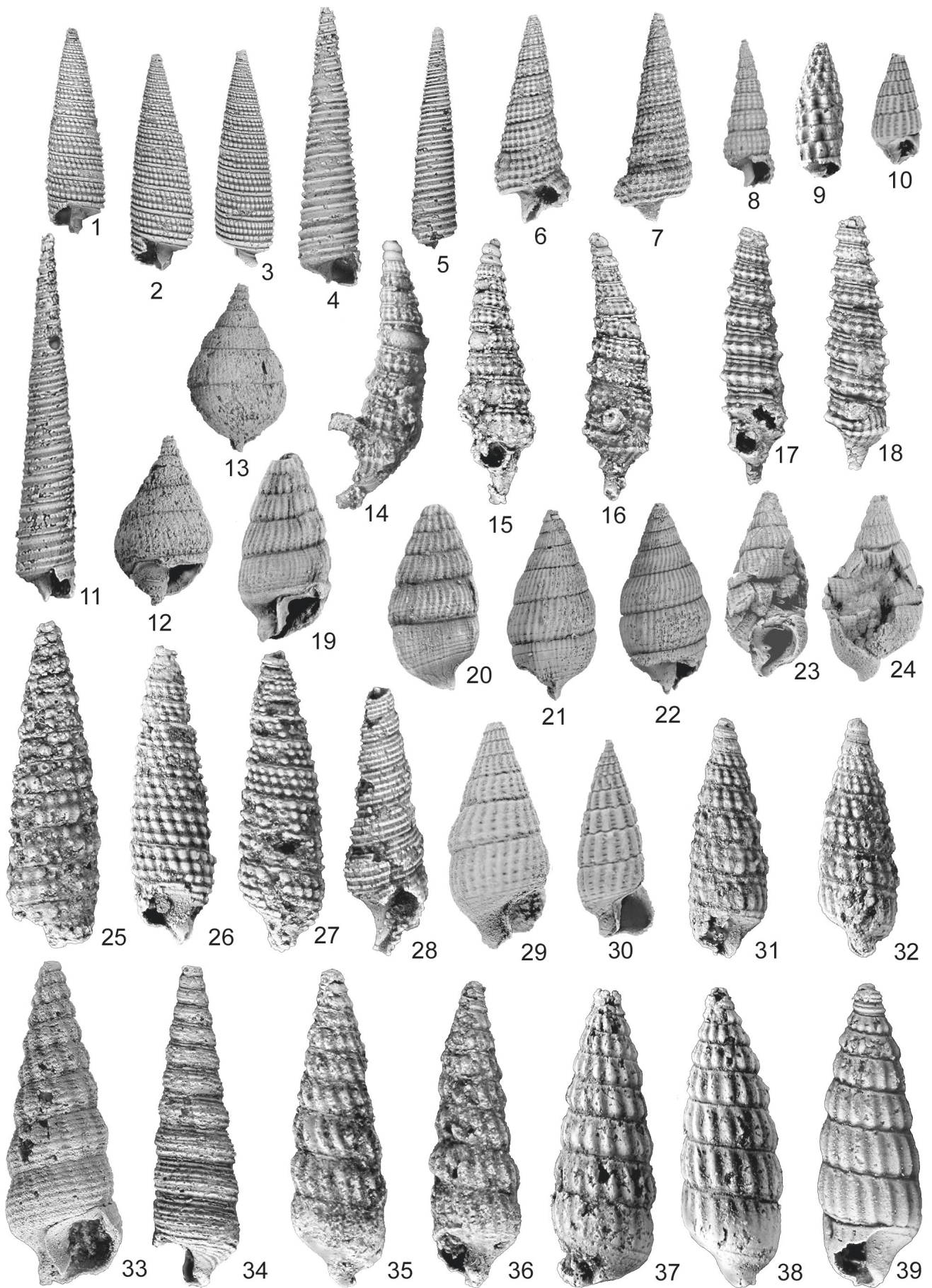
	Height	Width	No. of whorls
WAM 15.29, holotype	10.0	2.8	11
WAM 99.169a, paratype	9.3	2.6	11
NMV P327577, paratype	8.4	2.4	10

## ETYMOLOGY

Latin adjective. Monile a necklace; -ferata having.

- FIGURE 4 1, 2, 3, *Inella moniliferata* sp. nov.: WAM 99.169a (x 4) paratype; 2, 3, WAM 15.29 (x 4) holotype; 4, 5, 11, *Seila stenopyrgisca* sp. nov.: 4, WAM 15.21 (x 5) paratype; 5, WAM 15.20 (x 5) paratype; 11 WAM 15.19 (x 5) holotype; 6, 7, 8, *Cerithiopsis pustuloclathrata* sp. nov.: 6, 7, WAM 69.136 (x 3) holotype; 8, WAM 72.291a (x 3) paratype; 9, *Cerithiopsis* sp.: 9, WAM 15.268 (x 5); 10, 29, 30 *Ataxocerithium concatenatum* Tate, 1893: 10, SAM T241F (x 5), lectoparatype, Adelaide bore; 29, SAM T241A (x 4) lectotype, Adelaide bore; 30, SAM T241E (x 5) lectoparatype, Adelaide bore; 12, 13, 19, 20, 21, 22, 23, 24, *Ataxocerithium otopleuroides* sp. nov.: 12, 13, WAM 12.60 (x 3) holotype; 19, 20, WAM 80.1335a (x 3) paratype; 21, 22, WAM 05.57a (x 3) paratype; 23, 24, WAM 05.52 (x 2) paratype; 14, 15, 16, 17, 18, *Mastoniaeforis pagodiformis* sp. nov.: 14, 15, 16, WAM 15.25 (x 10) paratype; 17, 18, WAM 69.153a (x 10) holotype; 25, 26, 27, 31, 32, *Inella dauciformis* sp. nov.: 25, WAM 15.57 (x 10) paratype; 26, 27, WAM 15.58 (x 10) holotype; 31, 32, WAM 15.59 (x 10) paratype; 28, *Cerithiopsis* sp.: 28, WAM 15.287 (x 10); 33, *Eocolina* sp.: 33, WAM 82.1483 (x 4); 34, *Viriola* sp.: 34, WAM 15.85 (x 5); 35, 36, 37, 38, 39, *Costatophora? pulcherrima* sp. nov.: 35, 36, WAM 15.66 (x 10) paratype; 37, WAM 15.64 (x 10) paratype; 38, 39 WAM 15.62 (x 10) holotype.





## REMARKS

This species has some resemblance to *Inella aoteaensis* (Marshall and Murdoch, 1920) from the middle Eocene of New Zealand, but has an extra beaded lira. Its sculpture resembles *I. carinata* Marsall, 1983, Recent, South Australia, but it has a prominent smooth anterior lira not present on the latter.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

***Inella dauciformis* sp. nov.**

Figures 4.25–27, 4.31–32

urn:lsid:zoobank.org:act:C10963C9-CE53-4FFD-AF15-3328FF7485BA

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.58.

*Paratypes*

WAM 15.57, 15.59 from type locality. NMV P329290 from type locality.

*Other material*

From type locality: 15 specimens (WAM 15.60–61; 04.152b?, NMV P329291–2). Ocumup No. 1 deep well, 53.4 m, Eucla Bay district. 1 specimen (WAM 95.384). Total specimens 16.

## DIAGNOSIS

Shell with three broad, coarsely nodulate lirae, crossed by prosocline grooves.

## DESCRIPTION

Shell sinistral, narrowly cyrtococonical of small size for genus (4.5–6.2 mm). Protoconch of 2½ whorls, with three sharp lirae, merging abruptly into teleoconch whorls. Spiral sculpture of three broad lirae, much wider than interspaces and broken into prominent nodules by prosocline grooves; posterior lira weaker than anterior pair on some specimens. Aperture ovate, weakly notched posteriorly and produced into a very short, twisted anterior canal.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.58, holotype	5.5	1.5	9
WAM 15.57, paratype	6.0	1.7	10+ specimen broken
WAM 15.59, paratype	4.4	1.5	7
NMV P329290, paratype	4.4	1.4	8

## ETYMOLOGY

Latin adjective. *Dauciformis* shaped like a carrot.

## REMARKS

Compared with *Inella moniliferata* sp. nov. this species is smaller, relatively narrower and has consistently coarser sculpture with more prominent nodules on the lirae. It also lacks the smooth anterior lira present on that species. The protoconch is similarly sculptured but has one whorl less than that of *I. moniliferata*.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Costatophora* B. A. Marshall, 1994*****Costatophora pulcherrima* sp. nov.**

Figures 4.35–39

urn:lsid:zoobank.org:act:D8B52DA8-D7F8-4492-BE13-7F5478FBA6B7

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.62.

*Paratypes*

WAM 15.64, 15.66 from type locality. NMV P329294 from type locality.

*Other material*

From type locality: WAM 67.134, 15.63, 69.151b, 15.65; NMV P329293, P329295. Total specimens 24.

## DIAGNOSIS

Shell cyrtococonical with broad costae extending from suture to suture and with one thin lira adjacent to anterior suture.

## DESCRIPTION

Shell sinistral, narrowly cyrtococonical, of average size for genus, of 6–8 slightly convex whorls, last whorl roundly truncated to anterior canal. Protoconch of three whorls bearing three spiral lirae merging abruptly into teleoconch, posterior lira beaded. Axial sculpture of broad costae extending from suture to suture, slightly narrower than interspaces, about 19 on penultimate whorl, 19–21 on last whorl becoming weaker aperturally, slightly nodulate on first two whorls. Spiral sculpture of one thin lira adjacent to anterior suture. On last whorl two spiral grooves against the posterior suture. Aperture elongate lenticular with short anterior canal.



## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.62, holotype	5.5	1.7	6
WAM 15.64, paratype	5.4	1.9	7
WAM 15.66, paratype	5.6	1.6	8
NMV P329294, paratype	5.3	1.7	6

## ETYMOLOGY

Latin adjective. Pulcherrima most beautiful.

## REMARKS

No specimen has a complete aperture, so apertural details are not known. This species is unusual in that it lacks almost all spiral sculpture. The lirate protoconch is similar to the species of *Inella* recorded from here and to species illustrated by Marshall (1983), whereas it has some resemblance to *Costatophora serana* (P.J. Fischer, 1927), Pliocene and Recent, Indonesia, but the protoconch of that species has prominent axial sculpture quite unlike that of this species and the costae are not so prominent. It may represent a new genus, but given the quality of preservation, it seems unwise to erect a new taxon.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Family Cerithiopsidae H. & A. Adams, 1853**

**Genus *Seila* A. Adams, 1861**

***Seila stenopyrgisca* sp. nov.**

Figures 4.4–5, 4.11

urn:lsid:zoobank.org:act:12D85112-9840-45ED-BB44-578C0E9A074D

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.19.

*Paratypes*

WAM 15.20–1 from type locality. NMV P332349 from type locality.

*Other material*

From type locality: 186 specimens (WAM 67.125, 69.133, 69.140, 69.150, 99.170, 99.172, 04.151, 15.15–18;

NMV P302247-8, P302250, P302299, P327567). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak 2 specimens (WAM 85.635, 85.1450). Total 191.

## DIAGNOSIS

Shell aciculate with three prominent rounded cords, weakly beaded where crossed by fine axial threads.

## DESCRIPTION

Shell narrowly conical, very elongate, of about 15–17 flat whorls, of average size for genus (10–13.6 mm), contracting abruptly to base. Protoconch of 2–3½ whorls, axially costate and merging abruptly with teleoconch. Axial sculpture of very fine, close-set threads. Spiral sculpture of three prominent rounded cords narrower than interspaces with a fourth partly covered by the anterior suture, cords intermittently weakly beaded where crossed by axial threads. Aperture subquadrate; outer lip simple; columella smooth. Anterior canal short, well developed. No siphonal fasciole.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 15.19, holotype	13.5	2.2	1.2	19
WAM 15.20, paratype	8.2	1.7		13+
WAM 15.21, paratype	10.3	2.2		14+
NMV P332349, paratype	11.6	2.0		14+

## ETYMOLOGY

Latin adjective derived from Greek. Stenos narrow; pyrgiskos a little tower.

## REMARKS

*Seila* species are spongophores, which probably accounts for the relative abundance of this species in the Walpole fauna. Despite this abundance no specimen is complete. This species has some resemblance to the southern Australian living species *Seila albosutura* (Tenison Woods, 1876), but is much narrower and more elongate. The narrow spire distinguishes the species from most Australian living species. In degree of narrowness, it resembles *Seila gagei* Maxwell from the middle Eocene of New Zealand, but the whorls are flatter and the spiral sculpture is not as coarse.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Cerithiopsis* Forbes & Hanley, 1850**

***Cerithiopsis pustuloclathrata* sp. nov.**

Figures 4.6–8

urn:lsid:zoobank.org:act:094C9DEC-1A5C-4FBB-B39E-5208A3FD099F

**MATERIAL EXAMINED**

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 69.136.

*Paratypes*

WAM 72.291a from type locality. NMV P302244 from type locality.

*Other material*

From type locality: 27 specimens (WAM 67.119, 72.291, 15.22–3; NMV P302244, P327568–70). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 2 specimens (WAM 04.182, 05.36). Total 31 specimens.

**DIAGNOSIS**

Shell with four thick lirae crossed by thick costae producing prominent nodules over whole whorl.

**DESCRIPTION**

Shell narrowly conical, very elongate, of small size for genus (5–13 mm), sutures slightly impressed, of about 6–9 very slightly convex whorls; last whorl contracting abruptly to anterior canal. Protoconch of 2½ whorls, first whorl slightly tilted, axially ribbed, second whorl with more prominent axial costae, abruptly merging with teleoconch. Spiral sculpture of four thick lirae. Axial sculpture of moderately thick costae, slightly narrower than interspaces with prominent nodules where crossed by spiral sculpture, about 28 costae on last and penultimate whorls. Last whorl with one thick, non-nodulose anterior lira corresponding to suture and completely covered by previous whorls. Last whorl smooth anterior to fifth lira. Aperture subrectangular, slight trace of posterior notch. Anterior canal short and slightly twisted. No siphonal fasciole.

**DIMENSIONS**

	Height	Width	Aperture height	No. of whorls
WAM 69.136, holotype	12.7	4.7	1.2	9+ slightly crushed
WAM 72.291a, paratype	9.1	2.7	1.1	
NMV P302244, paratype	10.6	3.5	1.7	9+

**ETYMOLOGY**

Latin adjective. Pustula a blister; clathrate latticed.

**REMARKS**

This species has some resemblance to *Cerithiopsis maresi* (Deshayes, 1864), Lutetian, Paris Basin, but has relatively flat-sided whorls when compared with that species.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.

***Cerithiopsis?* sp.**

Figure 5.5

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 15.67–8; NMV P329296. Total specimens 4.

**DESCRIPTION**

Shell very narrow, elongate, whorls slightly convex with impressed sutures. Sculpture cancellate. Axial sculpture of 12–13 wide low costae, slightly narrower than interspaces. Spiral sculpture of four thin, erect lirae, much narrower than interspaces, developed into nodules at intersections with axial sculpture; anterior third lira slightly more prominent producing a very weak keel. Aperture subquadrate, produced anteriorly into short anterior canal.

**DIMENSIONS**

	Height	Width	No. of whorls
WAM 15.67	5.2	1.3	6+ specimen broken

**REMARKS**

The shell is extremely long and narrow and all specimens are broken. No protoconchs or complete apertures are preserved so generic placement is uncertain.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.

***Cerithiopsis* sp. 1**

Figure 4.9

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 1 specimen (WAM 15.268). Total specimens 1.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.268	5.5	1.9	9+ specimen broken.

## REMARKS

This unique specimen is figured as there is nothing else quite like it in the fauna. Because the specimen lacks a protoconch and the aperture is broken it is not possible to assign it to a genus. It has some resemblance to species assigned to *Joculator* and *Horologia*.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Cerithiopsid sp. 2**

Figure 4.28

## MATERIAL EXAMINED

Australia: Western Australia: Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 15.287. Total 1 specimen.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.287	4.9	1.4	6+ specimen broken

## REMARKS

This unique specimen is figured as there is nothing else quite like it in the fauna. Because the specimen lacks a protoconch and the aperture is broken it is not possible to assign it to a genus.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Family Newtoniellidae Korobkov, 1955****Genus *Eocolina* Chavan, 1952*****Eocolina* sp.**

Figure 4.33

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 69.138?, 82.1483, 04.146, 04.149?, 10.14, 15.264–5, NMV P317175, P329332–3. Total 23 specimens.

## DESCRIPTION

Spire turreted of average size for genus (12–17 mm), of 9–10 rounded whorls. Protoconch of one axially plicate whorl merging imperceptibly into teleoconch whorls,

coiled in axis of shell. First teleoconch whorl axially plicate. Plicae developing into broad costae by second teleoconch whorl; about 12–16 costae per whorl on mid spire. Spiral sculpture of about 6 to 8 lirae, wider than interspaces. Last whorl with low, broad varix situated just behind aperture. Spiral sculpture on anterior of last whorl very weak. Aperture ovate with slight posterior notch and short left directed anterior canal. Columella covered by a prominent plate.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 82.1483	14.7	5.1	2.9	9 + spire broken

## REMARKS

This species has some resemblance to *Eocolina difficilis* (Deshayes, 1864) and *E. fayellensis* (Deshayes, 1864) both Eocene, France, but the sculpture is not cancellate as in those species. Most of the specimens are juveniles and some may not be conspecific with the others. No similar taxa are known from eastern Australia.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Ataxocerithium* Tate, 1894*****Ataxocerithium concatenatum* Tate, 1894**

Figures 4.10, 4.29–30

*Ataxocerithium concatenatum* Tate, 1894: 179, plate 11, figure 6.

## MATERIAL EXAMINED

*Types*

**Australia: South Australia:** SAM T241A–G from Adelaide and Aldinga. Tate's figured specimen (T241A) is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species. The matrix suggests it came from the Adelaide (= Kent Town) Bore.

*Paralectotypes*

SAM T774B–G from Adelaide and Aldinga.

## DIMENSIONS

	Height	Width	No. of whorls
SAM T241A, lectotype	10.4	4.6	7 spire broken
SAM T241E, lectoparatype	7.3	2.7	9
SAM T241F, lectoparatype	5.9	2.8	6 spire broken

## REMARKS

Three of Tate's types are figured for comparison with the species from Thomson Rd, North Walpole. In his description of the species Tate did not mention that there are one or two plaits present on the columella and denticles within the outer lip on some specimens.

***Ataxocerithium otopleuroides* sp. nov.**

Figures 4.12–13, 4.19–24

urn:lsid:zoobank.org:act:E56A86BA-B81B-4ED9-AFD1-C8EC03BC691C

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.60.

*Paratypes*

WAM 05.52, 05.57a from Lucky Bay; 80.1335a from Cape Le Grand National Park. NMV P323139 from type locality.

*Other material*

From type locality. 161 specimens (WAM 67.97, 67.132, 69.192, 72.241, 72.287, 99.167, 04.150, 12.59, 12.61, NMV P323134–8). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 8 specimens (WAM 04.183, 05.57b). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak. 11 specimens (WAM 80.1335b, 80.1455, 85.641, 85.1459.). Total 182 specimens.

## DIAGNOSIS

Shell tumid, somewhat convolute with numerous prominent axial costae crossed by weak close-set lirae.

## DESCRIPTION

Shell of medium size for genus (13–17 mm), elongate, subconical with tumid last whorls and tapering spire. Protoconch damaged or missing on most specimens; seemingly of 2–3 smooth turbinid whorls, coiled in axis of shell. Spiral sculpture of 7–10 fine, weak, close-set lirae, as wide as interspaces. Axial sculpture of 35–50 costae, slightly wider than interspaces, weakly nodulate where crossed by spiral sculpture. Aperture subcircular; outer lip thickened with an internal rib; columella covered with thick callus forming a plate, two strong denticles present at base of anterior canal, which extend into aperture as plaits; one denticle bounding a slight posterior notch in aperture. Siphonal canal very short, twisted. No siphonal fasciole.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 12.60, holotype	10.3	5.7	5+
WAM 05.52, paratype	17.0		6+ specimen broken and crushed
WAM 05.57a, paratype	11.6	5.5	7+
WAM 80.1335a, paratype	11.5		5+ specimen broken and crushed
NMV P323139, paratype	12.6	6	8 specimen slightly crushed

## ETYMOLOGY

In reference to its similarity in shape to species of the genus *Otopleura*.

## REMARKS

Despite the apertural thickening, nearly every specimen has the outer lip peeled away, probably caused by crabs. This species has a close resemblance to *Ataxocerithium pellati* (Cossmann and Lambert, 1884) from the Oligocene of Pierrefitte, France, but doesn't have the cancellate appearance of that species as the axial costae are much stronger than the lirae. It also doesn't have the cancellate appearance of *A. concatenatum* Tate from the Blanche Point Formation.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

***Ataxocerithium venustulum* sp. nov.**

Figures 5.24–25, 5.36–37

urn:lsid:zoobank.org:act:CD9BE218-4F5F-4C16-A243-2CED73875569

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.65.

*Paratypes*

WAM 12.66 from type locality. NMV P319917 from type locality.

*Other material*

From type locality. 70 specimens (WAM 67.120, 99.166, 99.174, 04.147–8, 12.67, 12.68, 12.69, NMV P302237–9, P319916–7). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 1 specimen (WAM 05.37). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak. 3 specimens (WAM 80.1337, 85.1449, 85.1452.). Total 76 specimens.



## DIAGNOSIS

Shell with five prominent spiral cords, cut into elongate beads by axial grooves.

## DESCRIPTION

Shell of average size for genus (10–12 mm), turriculate of 8–9 somewhat flat whorls. Protoconch turbinate, of about 2½ finely ribbed whorls, coiled in axis of shell, ribs sharp, narrower than interspaces, merging imperceptibly with teleoconch. Spiral sculpture dominant of five prominent cords. Axial sculpture of 13–14 low, coarse costae, about as wide as interspaces, becoming weaker on last whorl, weakly tuberculate where crossed by spiral sculpture. Aperture subrectangular, with posterior denticle bounding posterior notch in aperture. Columella with prominent plate and two plaits at posterior canal. Siphonal canal short and twisted. Outer lip of aperture swollen forming a low varix. Weak siphonal fasciole.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 12.65, holotype	11.5	3.9	8
WAM 12.66, paratype	12.6	4.1	8
NMV P319917, paratype	10.3	3.8	8

## ETYMOLOGY

Latin adjective. Diminutive of *venustus* beautiful.

## REMARKS

This species is characterised by the dominant spiral sculpture, which separates it from the other similar sized cerithiopsids in the Walpole fauna. Nothing like this taxon is known from South Australia or Victoria. It bears some resemblance to the New Zealand late Eocene *Ataxocerithium scitulium* Maxwell, 1992, but the lirae are more prominent and the costae less prominent. The whorls are also flatter than the latter.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

***Ataxocerithium multicosculatum* sp. nov.**

Figures 5.26–27, 5.34–35

urn:lsid:zoobank.org:act:2FA5FA82-C1DF-45CE-B6D3-694F053D57EC

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.75.

*Paratypes*

WAM 12.76 from type locality. NMV P319918 from type locality.

*Other material*

From type locality: WAM 65.118a, 67.121, 69.137?, 9.139, 69.175b, 69.193, 72.284, 72.285, 72.293, 99.165, 04.169, 12.72, 12.73, 12.74, 12.76; NMV 302235, P302240, P302242–3, P319915, P319918. Total specimens 300.

## DIAGNOSIS

Shell with somewhat convex whorls bearing broad axial ribs and fine lirae in rib interspaces.

## DESCRIPTION

Shell subconical, turreted of medium size for genus (5–9 mm) of about 6 whorls, last whorl contracting abruptly to siphonal canal; sutures impressed. Protoconch of 2½ whorls bearing fine ribs narrower than interspaces and merging imperceptibly into teleoconch whorls. Axial sculpture of broad ribs, about 17–19 per whorl, wider than interspaces, extending from suture to suture on spire, absent on anterior half of last whorl, or becoming obsolete on some specimens. Spiral sculpture of eight fine lirae on spire whorls, 20+ on last whorl extending onto siphonal canal, slightly narrower than interspaces. Aperture with outer lip slightly reflexed dorsally and thickened on some specimens, lenticular, notched posteriorly, with prominent columella plate bearing two tubercles, absent on some specimens. Siphonal canal very short, reflexed dorsally.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 12.75, holotype	8.0	3.5	6
WAM 12.76, paratype	5.2	2.5	5+
NMV P319918, paratype	8.1	3.2	6

## ETYMOLOGY

Latin adjective. Multus many; costulatum small ribbed.

## REMARKS

The preservation of many of the above listed specimens is very poor, so that some of the specimens included in this taxon may not be correctly identified. It seems that well developed apertures with columella plate and tubercles are only present on mature specimens. Many small specimens in the samples lack these. This species has some resemblance to the Australian living species *Ataxocerithium serotinum* (A. Adams, 1855) but is not as narrow and elongate and the spiral sculpture is not so prominent.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

***Ataxocerithium biaulax* sp. nov.**

Figures 5.28–31

urn:lsid:zoobank.org:act:EA9FFD60-03C0-459A-9B76-AA936A6E2194

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.51.

*Paratypes*

WAM 12.52 from type locality. NMV P319913 from type locality.

*Other material*

From type locality: WAM 67.121 in part, 67.126, 99.206, 04.145b, 12.53, 12.62, 12.63, 12.64: NMV P302241, 319912–4. Total 47 specimens.

## DIAGNOSIS

Shell cyrtoconoid with impressed sutures and convex whorls, smooth except for two prominent grooves adjacent to anterior and posterior sutures.

## DESCRIPTION

Shell of small size (7–10 mm), cyrtoconoid, of about 7–8 whorls. Protoconch of 2½ finely costate whorls, costal interspaces wider than costae, merging abruptly into teleoconch whorls. Whorls slightly convex, sutures impressed. Spiral sculpture consisting of prominent groove immediately anterior to posterior suture and one slightly less prominent groove immediately posterior to anterior suture, otherwise smooth. Aperture subcircular with prominent smooth columella plate; prominent

siphonal notch. Siphonal canal short, slightly twisted. Weak siphonal fasciole.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 12.51, holotype	9.0	3.9	8
WAM 12.52, paratype	7.5	3.1	6
NMV P319913, paratype	8.8	3.5	7

## ETYMOLOGY

Latin noun in apposition. Biaulax two furrows.

## REMARKS

This species is characterised by the relative smooth whorls, having merely two spiral grooves, which separates it from the other species of *Ataxocerithium* which have prominent axial costae and usually some lirae.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Eumetula* Thiele, 1912*****Eumetula* sp.**

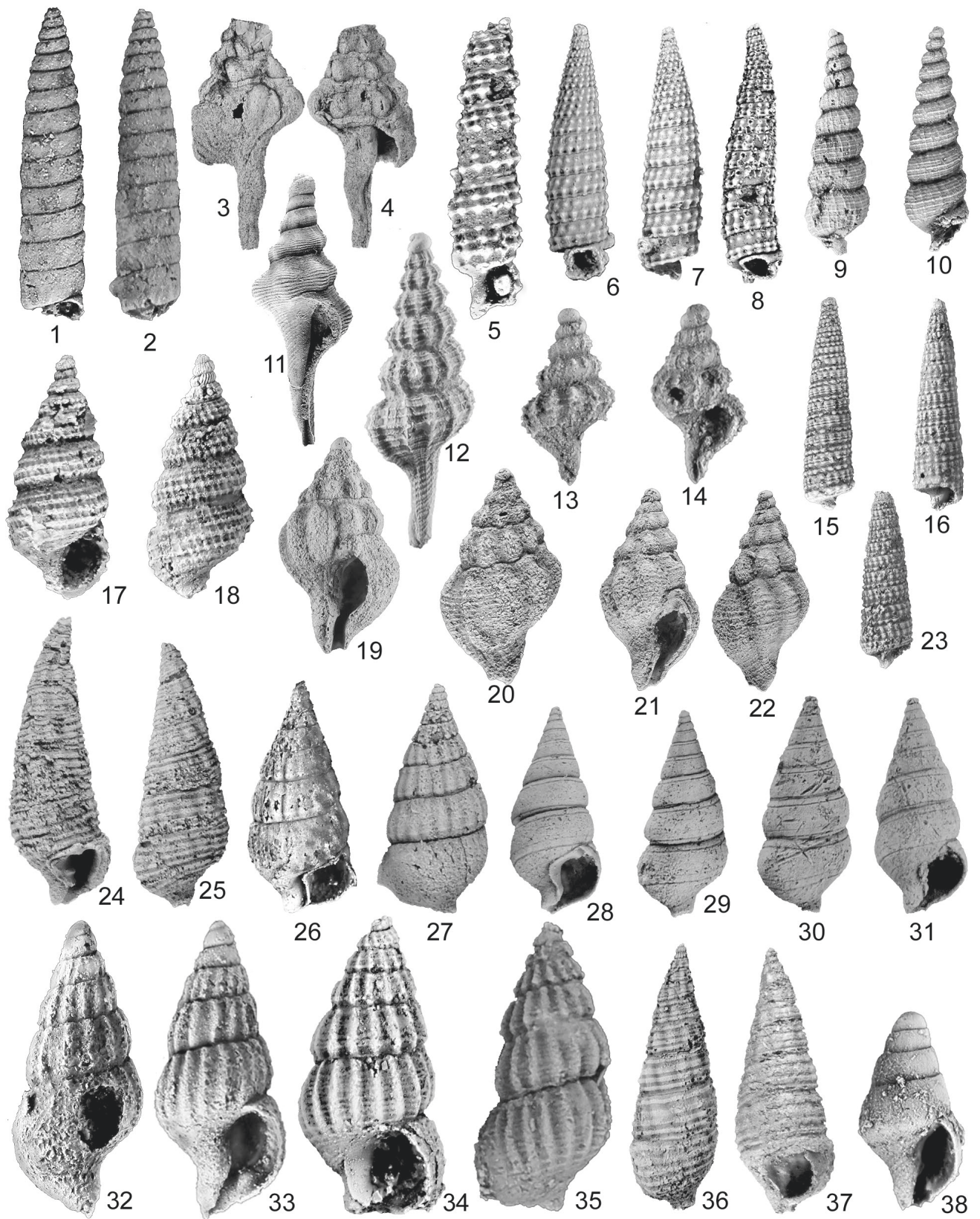
Figures 5.17–18

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 9 specimens (WAM 67.187, 15.81–2; NMV P329306–7). Total 9 specimens.

## FIGURE 5

- 1, 2, *Trituba* sp.: 1, 2, WAM 15.293 (x 10);  
 3, 4, *Austrolithes* c.f. *A. incompositus* (Tate, 1888): 3, 4, WAM 12.32 (x 1);  
 5, *Cerithiopsis?* sp.: 5, WAM 15.293 (x 10);  
 6, 7, 8, *Trituba (Granulotriforis) umboseriata* sp. nov.: 6, 7, WAM 12.78 (x 5) holotype; 8, WAM 12.80 (x 5) paratype;  
 9, 10, *Cerithiella* sp.: 9, 10, WAM 15.78 (x 5);  
 11, *Austrolithes incompositus* (Tate, 1888): 11, SAM T492A (x 1.5) lectotype, Blanche Point;  
 12, 13, 14, *Fusinus sculptilis* (Tate, 1888): 12, SAM T478F (x3) syntype, Adelaide bore; 13, 14, WAM 12.07 (x 7);  
 15, 16, 23, *Cerithiella limula* sp. nov.: 15, 16, WAM 15.74 (x 5) holotype; 23, WAM 15.75 (x 5) paratype;  
 17, 18, *Eumetula* sp.: 17, 18, WAM 15.81 (x 10);  
 19, 20, 21, 22, *Tasmeuthria? arenicola* sp. nov.: 19, 20, WAM 12.20 (x 4) holotype; 21, 22, WAM 12.21 (x 4) paratype;  
 24, 25, 36, 37, *Ataxocerithium venustum* sp. nov.: 24, 25, WAM 12.66 (x 4) paratype; 36, 37, WAM 12.65 (x 4) holotype;  
 26, 27, 34, 35, *Ataxocerithium multicostulatum* sp. nov.: 26, 27, WAM 12.75 (x 5) holotype; 34, 35, WAM 12.76 (x 10) paratype;  
 28, 29, 30, 31, *Ataxocerithium biaulax* sp. nov.: 28, 29, WAM 12.51 (x 4) holotype; 30, 31, WAM 12.52 (x 5) paratype;  
 32, 33, *Retizafra* sp.: 32, 33, WAM 15.90 (x 10);  
 38, *Mitrella* sp.: 38, WAM 67.149 (x 7).





## DESCRIPTION

Shell elongate, turbiniform of about five cancellate whorls with impressed sutures. Protoconch of three whorls, first whorl slightly deviated from shell axis, all whorls sculptured with fine axial costulae, much narrower than interspaces, merging abruptly into teleoconch. Axial sculpture of low, thin costulae, much narrower than interspaces, about 34 on penultimate whorl and about 32 on last whorl. Spiral sculpture of prominent lirae, wider than the axial costulae, weakly beaded where crossed by axial sculpture, five lirae on penultimate whorl and eight lirae on last whorl. Aperture subcircular with short anterior canal.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.81	4.3	1.6	5

## REMARKS

This species has some resemblance to the Antarctic living species *Eumetula strebeli* (Thiele, 1912), but has narrower and more numerous lirae.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Trituba* Jousseume, 1884*****Trituba* sp.**

Figures 5.1–2

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.293. NMV P332364. Total 2 specimens.

## DESCRIPTION

Shell cyrtoconoid, whorls flat, sutures slightly grooved. Protoconch not preserved. No spiral or axial sculpture. Aperture tubular (broken). Posterior canal produced into tube on dorsal side of last whorl. Anterior canal broken. Base of shell concave.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.293	5.4	1.0	14+

## REMARKS

The last whorl of this species is similar to species of *Trituba*, but the shell is quite smooth. Nothing in the Australian fossil or Recent fauna is similar to it.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Subgenus *Trituba* (*Granulotriforis*) Kosuge, 1967*****Trituba* (*Granulotriforis*) *umboseiata* sp. nov.**

Figures 5.6–8

urn:lsid:zoobank.org:act:5B2BA421-D6AC-4F29-A9EB-836427619317

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.78.

*Paratypes*

WAM 12.80 from type locality. NMV P319922 from type locality.

*Other material*

From type locality: WAM 67.122, 67.124, 67.127, 69.142–3, 69.148–9, 69.151c, 72.292(part), 99.171, 04.153, 12.77, 12.79, 12.81; NMV P302236, P302245–6, P319919–21. Total 366 specimens.

## DIAGNOSIS

Shell slender with impressed sutures and two rows of prominent tubercles aligned from whorl to whorl.

## DESCRIPTION

Shell very slender, elongate-conical, only tapering slightly posteriorly, of about 13–15 flat whorls. Sutures impressed. Protoconch of about 2½ whorls, sculptured with fine axial ribs narrower than interspaces. Spiral sculpture of two rows of very prominent tubercles; tubercles aligned from whorl to whorl and about as wide as interspaces. About 16 pairs of tubercles per whorl. Penultimate whorl with a third anterior row of tubercles developing against anterior suture. Last whorl very abruptly contracted to form a smooth, very slightly concave base. Aperture rectangular, entire, produced slightly into a rectangular tube. Posterior canal enclosed produced into a short tube, projecting dorsally. Anterior canal enclosed, produced into a short tube.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 12.78, holotype	8.9	2.3	13
WAM 12.80, paratype	9.0	2.2	15
NMV P319922, paratype	7.6	2.1	13

## ETYMOLOGY

Latin adjective. Umbo knob; seriata arranged in rows.



## REMARKS

Species of this subgenus are known ranging in age from Miocene to Recent in Europe, Japan, Australia and New Zealand. *Trituba (Granulotriforis) umboeriata* is very similar to *T. (G.) dujardini* (Mayer, 1862) from the Miocene of France. The protoconch, though present on very few specimens and not well preserved, seems to match that of *T. (G.) blacki* Marshall, 1977, Recent, New Zealand. The axially aligned rows of tubercles distinguishes this species from its congeners.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Cerithiella* Verrill, 1882*****Cerithiella limula* sp. nov.**

Figures 5.15–16, 5.23

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## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.74.

*Paratypes*

WAM 15.75 from type locality. NMV P329302 from type locality.

*Other material*

From type locality: 27 specimens (WAM 67.189?, 15.76–7; NMV P329301, P329303). Ocumup No. 1 deep well, 59.5 m., Eucla Bay district. 2 fragments (WAM 95.372). Total 32 specimens

## DIAGNOSIS

Shell acicular with flat whorls sculpted by broad flat costae and one narrow prominent beaded lira against anterior suture and two broad posterior lirae.

## DESCRIPTION

Shell acicular of 10–12 flat whorls, last whorl abruptly contracting to anterior canal. Protoconch of about two whorls, the first whorl smooth and slightly deviated from axis of shell, second whorl with numerous thin axial costae, much narrower than interspaces, merging imperceptibly into teleoconch. Axial sculpture of broad, rather flat costae wider than interspaces. Spiral sculpture of one narrow but prominent beaded lira against the anterior suture and posteriorly two broad lirae, on some specimens almost merging together to form a single band with a shallow groove in the middle, lirae beaded where crossed by axial costae. Last whorl with two thin lirae bounding base of whorl. Aperture subrectangular, produced into short twisted canal; columella with one thin plait close to canal.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.74, holotype	7.4	1.7	12
WAM 15.75, paratype	6.1	1.8	10+ specimen broken
NMV P329302, paratype	5.3	1.6	10

## ETYMOLOGY

Latin noun in apposition. *Limula* a little file.

## REMARKS

The aperture is broken on all specimens. This species has some resemblance to the living New Zealand species *Cerithiella stiria* (Webster, 1906), but has more prominent axial costae.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

***Cerithiella* sp.**

Figures 5.9–10

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 14 specimens (WAM 69.146–7, 15.78–80; NMV P329304–5). Total 14 specimens.

## DESCRIPTION

Shell elongate with 7–10 convex, cancellate whorls with impressed sutures. Axial sculpture of thin costulae, much narrower than interspaces, very weak or absent on some specimens. Spiral sculpture of thin, well defined lirae, about seven on penultimate whorl and 6–10 on last whorl, somewhat irregularly spaced and slightly beaded where crossed by axial sculpture. Aperture seemingly subcircular with short anterior canal, slightly reflexed dorsally.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.78	7.8	2.2	9+ specimen broken

## REMARKS

The material available is not well preserved enough for formal description. The apertures are broken on all specimens and no protoconchs are preserved except possibly on one specimen, which shows part of two whorls sculptured with thin costae much narrower than the interspaces. On some specimens the sculpture is relatively strongly cancellate and on others the spiral sculpture is weak to absent so the sculpture is either weakly cancellate or not at all cancellate.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

## Neogastropoda

### Family Buccinidae Rafinesque, 1815

#### Genus *Tasmeuthria* Iredale, 1925

##### *Tasmeuthria? arenicola* sp. nov.

Figures 5.19–22

#### MATERIAL EXAMINED

##### *Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.20.

##### *Paratypes*

WAM 12.21 from type locality. NMV P327597 from type locality.

##### *Other material*

From type locality: Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 133 specimens (WAM 67.139 part, 69.164, 72.303, 12.22–23, 15.38, 15.92–3, 15.38; NMV P317507, P327586–7, P329316–8). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 1 specimen (WAM 05.47). Total 134 specimens.

#### DIAGNOSIS

Shell with weak shoulder and very thick costae extending from shoulder to anterior suture crossed by very weak irregular lirae.

#### DESCRIPTION

Shell fusiform, tumid, with weak shoulder, of small size for genus (8–10 mm). Protoconch prominent of 1½ smooth whorls, the first deviated from axis of shell, merging abruptly into teleoconch. Spiral sculpture of very weak, low, irregularly sized lirae about as wide as interspaces, about 9–10 on penultimate whorl, 15–20 on last whorl and extending onto anterior canal. Axial sculpture of very thick costae as wide as interspaces, 8–9 on penultimate and last whorls, extending from shoulder to anterior suture on spire whorls. Aperture lenticular, produced into a short, slightly twisted canal. Interior of outer lip lirate on some specimens; columella with 3–5 weak elongate nodules on some specimens. Siphonal fasciole very weak.

#### DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.20, holotype	9.3	5.0	2.1	4½
WAM 12.21, paratype	8.7	4.4	1.9	4½
NMV P327597, paratype	9.0	4.5	2.3	4½

#### ETYMOLOGY

Latin adjective. Arenicola sand dwelling.

#### REMARKS

Most specimens are slightly worn, so the lirae are scarcely visible. This species resembles *Tasmeuthria clarkei* (Tenison Woods, 1876), Recent, south-east Australia, but is significantly smaller and the shoulder is much weaker.

#### OCCURRENCE

**Eucla Basin**, Pallinup Formation.

### Family Columbellidae Swainson, 1840

#### Genus *Retizafra* Hedley, 1913

##### *Retizafra* sp.

Figures 5.32–33

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 67.170, 69.174, 69.175a, 69.191, 15.90–1; 15.285. NMV P329314–5, P332354. Total 23 specimens.

#### DESCRIPTION

Shell fusiform, of small size for genus (5–6.6 mm) with 4–5 slightly convex whorls. Protoconch smooth, two whorls, first whorl slightly deviated, merging imperceptibly into teleoconch. Axial sculpture of broad costae, slightly narrower than interspaces, 10–12 on last whorl. No obvious spiral sculpture. Aperture oval, produced into short anterior canal; interior of outer lip with 9–10 fine lirae on some specimens.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 15.90	5.2	2.2	4

#### REMARKS

This species has some resemblance to *Retizafra multicostata* (May), Recent, New South Wales and Tasmania, but has a more ovate rather than elongate aperture.

#### OCCURRENCE

**Eucla Basin**, Pallinup Formation.

#### Genus *Mitrella* Risso, 1826

##### *Mitrella* sp.

Figure 5.38

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road,

Deep River 743 486: WAM 67.149, 72.322, 15.284; NMV P332356. Total 8 specimens.

#### DESCRIPTION

Shell fusiform, of small size for genus (5 mm), with about three flat whorls with impressed sutures abruptly contracting to canal. Smooth except for very weak, fine lirae on anterior of last whorl and extending onto canal. Aperture elliptical, extending anteriorly into short canal; inner lip with about eight elongate denticles; columella smooth.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 67.149	5.0	2.6	3

#### REMARKS

This species has some resemblance to *Mitrella leucostoma* (Gaskoin, 1852), Recent, southern Australia, but the spire is not as conical as in that species and the whorls are flatter.

#### OCCURRENCE

**Eucla Basin**, Pallinup Formation.

#### Family Fascioliariidae Gray, 1853

#### Genus *Fusinus* Rafinesque, 1815

#### *Fusinus sculptilis* (Tate, 1888)

Figures 5.12–14

*Fusinus sculptilis* Tate, 1888: 137, plate 10, figure 13.

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 1 specimen (WAM 12.07).

#### DESCRIPTION

Shell fusiform, elongate of three whorls, of small size for genus. Protoconch of 1½ smooth whorls merging abruptly with teleoconch whorls, first whorl deviated 45° to axis of shell. Spiral sculpture of about five fine lirae, much narrower than interspaces. Axial sculpture of fine costae forming sharp tubercles at intersection with spiral sculpture, 13 costae on last whorl. Aperture D-shaped, broken, produced anteriorly into a prominent canal.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 12.07	4.5	2.4	3 specimen broken

#### REMARKS

This specimen closely matches specimens from the Blanche Point Formation and Browns Creek Formation. This species belongs to a group of Eocene species of *Fusinus* characterised by the European *F. porrectus*

(Solander in Brander, 1766). One of Tate's syntypes of this species is figured for comparison (Figure 5.12). A lectotype has not been chosen because further work needs to be done to ascertain which specimens were figured and measured by Tate.

#### OCCURRENCE

**Eucla Basin**, Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

#### Genus *Austrolithes* Finlay, 1931

#### *Austrolithes* cf. *A. incompositus* (Tate, 1888)

Figures 5.3–4

cf. *Fusus incompositus* Tate, 1888: 137, plate 3, figure 9.

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 12.32. Total 1 specimen.

#### DIMENSIONS

	Height	Width
WAM 12.32	40.04	19.9 spire broken and crushed

#### REMARKS

This crushed specimen bears a close resemblance to specimens of *Austrolithes incompositus* from the Browns Creek Formation. Another specimen (WAM 12.31) from the Thomson Road locality consists of a broken anterior canal with part of the columella plate and without the rest of the teleoconch. It probably belongs to this species. Two small juvenile specimens from Cape Le Grand track (WAM 80.1347) with similar sculpture may belong to this species. There are two specimens of this species from the Blanche Point Formation in Tate's collection. Specimen number T492A from Blanche Point, Aldinga, is the figured specimen (Figure 5.11). The other smaller, incomplete specimen, T492B, comes from the Kent Town (Adelaide) Bore. Tate's figured specimen (T492A) is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species.

#### OCCURRENCE

**Eucla Basin**, Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

#### Genus *Dennantia* Tate, 1888

*Fractolatirus* Iredale, 1936, Recent, New South Wales, is probably a synonym of *Dennantia*. The following fossil species are included in the genus. *Peristernia aldingensis* Tate, 1888; *Latirus tatei* Harris, 1897; *Dennantia cingulata* Tate, 1888; *Trophon* (*Enatimene*)

*crassiliratus* Chapple, 1941(?); *Peristernia lintea* Tate, 1888; *Leucozonia staminea* Tate, 1888; *Fusus ino* Tenison Woods, 1879; *Leucozonia tumida* Tate, 1888; *Sipho crebrigranosa* Tate, 1888; *Peristernia subundulosa* Tate, 1888; *Peristernia interlineata* Tate, 1888; *Pisania rostrata* Tate, 1888; *Pisania semicostata* Tate, 1888; *Trophon succinctus* Tenison Woods, 1879.

### ***Dennantia aldingensis* (Tate, 1888)**

Figures 6.21–22, 6.28–31

*Peristernia aldingensis* Tate, 1888: 156, plate 8, figure 8a–b.

*Broccchitas aldingensis* (Tate): Ludbrook, 1973: plate 25, figure 33.

#### MATERIAL EXAMINED

##### *Types*

**Australia: South Australia.** Blanche Point, Aldinga Bay. SAM T570A–L. Tate's figured specimen T570B is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species.

##### *Other material*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 67.161, 72.307, 79.1024, 99.183, 99.187, 99.192, 99.203(?), 04.164 (part), 04.167, 15.01–3, 15.275; NMV P327561–5. Total 71 specimens.

#### DESCRIPTION

Shell fusiform, of average size for genus (18–24 mm), elongate of 5–6 convex whorls. Last whorl contracted abruptly to siphonal canal. Protoconch of about 1.5 smooth, somewhat tumid whorls, merging abruptly with teleoconch, coiled at a slight angle to spire axis. First teleoconch whorl sculptured with fine, widely spaced costae. Axial sculpture of broad costae, 5–9 on penultimate whorl, tending to weaken and disappear on last whorl. Spiral sculpture of fine lirae, much narrower than interspaces, 12–14 lirae on penultimate whorl. Aperture subcircular with small posterior notch; outer lip internally lirate. Columella with small denticle at beginning of anterior canal, four weak plaits extending into aperture, each beginning with a small denticle. Anterior canal long, slightly twisted, about ¼ length of shell.

#### DIMENSIONS

	Height	Width	Aperture height	No. of whorls
SAM T570B, lectotype	25.4	14.4		5
SAM T570H, lectoparatype	23.4	12.1		6
WAM 79.1024	21.6	8.8	6.0	6
WAM 99.187a	18.2	17	6.2	5

#### REMARKS

Large specimens from the Pallinup Formation are crushed, but the overall shell shape and sculpture match specimens of the species from the Blanche Point Formation. It is possible that some of the poorly preserved juvenile specimens do not belong to this species. Specimens from all formations of its range are exceedingly variable in morphology. None of the specimens mounted on Tate's tablet can be matched with the figures, though Tate has written 'figd' in red ink under specimens T570B from Blanche Point and T570H from Adelaide bore. Both these specimens are figured here (Figures 6.30 and 6.31 respectively).

#### OCCURRENCE

**Eucla Basin**, Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

### **Genus *Tectifusus* Tate, 1893**

#### ***Tectifusus aldingensis* (Tate, 1888)**

Figures 6.9–13

*Fusus aldingensis* Tate, 1888: 172, plate 3, figure 10.

*Fusus tholoides* Tate, 1888: 172, plate 3, figure 11; Cossmann, 1901: 13, Figure 4, plate 1, figure 11.

*Tectifusus tholoides* (Tate): Ludbrook, 1973: plate 25, figure 54.

#### MATERIAL EXAMINED

##### *Types*

**Australia: South Australia.** Blanche Point, Aldinga Bay. SAM T482A–D. Tate's figured specimen T482C (Figures 6.12–13) is chosen as lectotype of *Fusus aldingensis* to fix the status of the specimen as the sole name-bearing type of the species.

*Fusus tholoides:* Kent Town (Adelaide) Bore. SAM T493A–B. Tate's figured specimen T493A (Figure 6.11) is chosen as lectotype of *Fusus tholoides* to fix the status of the specimen as the sole name-bearing type of the species.

##### *Other material*

**Australia: Western Australia:** Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. WAM 07.183. Total 1 specimen.

#### DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 07.183	15.9	11.4	8.4	2 spire broken



## REMARKS

Tate described two species from material which in fact represents a somewhat variable single species. I select *Fusus aldingensis* to have priority over *Fusus tholoides*, because it has plate priority and specimens are readily collectable at Blanche Point. Though *F. tholoides* has page priority, the type locality is Adelaide (Kent Town) bore and specimens cannot be recollected. The species is common at Blanche Point and Browns Creek. The single specimen from Lucky Bay closely matches specimens from Blanche Point and Browns Creek.

## OCCURRENCE

**Eucla Basin**, Pallinup Formation. **St Vincent Basin**: Blanche Point Formation (type). **Otway Basin**: Browns Creek Formation.

**Family Melongenidae Gill, 1871****Genus *Pugilina* Schumacher, 1817*****Pugilina?* sp.**

Figures 6.23–24

## MATERIAL EXAMINED

**Australia: Western Australia**: Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 67.146, 12.24, 12.25, 12.26; NMV P317504–6. Total 11 specimens.

## DESCRIPTION

Shell elongate, fusiform, of small size for genus, of about six teleoconch whorls, with gradate spire and prominent shoulder bounded by sharp keel. Protoconch of 1½ smooth whorls, the first whorl deviated at about 45° to axis of shell. Axial sculpture of prominent, rather broad, short costae extending anteriorly from keel, sharply produced on keel and at every 120° costae more prominent having a varix-like appearance; very weakly developed on posterior whorl slope. Spiral sculpture of prominent cords narrower than interspaces, three on anterior whorl slope and 10 lirae on last whorl and another 10 on canal. Aperture very long, narrow, extending into a long canal. Internal surface of outer lip smooth. Columella internally lirated, with lirae corresponding to lirae of previous whorl.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 12.25	20.9	10.4	6

## REMARKS

The assignment of this species to *Pugilina* is tentative as most of the species included in that genus are much larger than this and have a tropical distribution. This species bears a superficial resemblance to the southern

Australian Eocene species *Tectifusus aldingensis* (Tate), but the latter does not have varix-like costae at every third of a whorl, which give the shell a triangular appearance when viewed posteriorly and the protoconch is quite different. *T. aldingensis* does not have internal lirae on the columella. There is nothing like this species known from the Tertiary formations of eastern Australia.

## OCCURRENCE

**Eucla Basin**, Pallinup Formation.

**Family Muricidae Rafinesque, 1815****Genus *Timbellus* de Gregorio, 1885*****Timbellus calvus* (Tate, 1888)**

Figures 6.14, 6.19–20

*Murex calvus* Tate, 1888: 96, plate 1, figure 11.

*Pterynotus (Pterynotus) calvus* (Tate). Ludbrook, 1973: plate 25, figure 50.

*Timbellus calvus* (Tate): Merle, Garrigues and Pointier, 2011: 434, plate 95, figures 1–3.

## MATERIAL EXAMINED

*Types*

**Australia: South Australia**: Aldinga and Adelaide. SAM T427A–C. Tate's figured specimen (T427B, Blanche Point, Aldinga) is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species (Figure 6.14).

*Other material*

**Australia: Western Australia**: Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 101 specimens (WAM 67.142, 72.301, 99.184, 04.162, 10.17–19; NMV P317181–5). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 1 specimen (WAM 05.43). Total 102 specimens.

## DESCRIPTION

Shell fusiform of average size for genus (15–20 mm), about five teleoconch whorls, with three prominent foliaceous varices, continuous from whorl to whorl, situated 120° from one another. Varices with incipient spine at shoulder. Protoconch of 1½ smooth whorls, the first deviated from axis of shell. Spiral sculpture of fine lirae, much narrower than interspaces and continuing onto varices; four to five on penultimate whorl, up to 16 on last whorl and extending onto canal. One prominent tubercle at midpoint between varices. Aperture large, ovate, produced anteriorly into short, open canal, notched posteriorly; inner lip smooth, outer lip with six to seven denticles.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 67.142a	15.1	6.4	5.3	5

## REMARKS

The Western Australian specimens closely match those from Browns Creek. Walpole specimens have a slight suggestion of a posterior labral spine but this is not well developed and they also show signs of an incipient groove in the varix at the shoulder.

## OCCURRENCE

**Eucla Basin**, Pallinup Formation. **St Vincent Basin**: Blanche Point Formation (type). **Otway Basin**: Browns Creek Formation; Glen Aire Clay.

**Genus *Dermomurex* Monterosato, 1890*****Dermomurex silicatus* sp. nov.**

Figures 6.25–27

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## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. 14 specimens. WAM 15.42.

*Paratypes*

From type locality WAM 15.46; NMV P327593.

*Other material*

From type locality: WAM 69.161, 72.300, 99.186, 15.41–46; NMV P327592–6. Total 53 specimens.

## DIAGNOSIS

Shell with very narrow, widely spaced lirae and five prominent foliaceous aligned varices.

## DESCRIPTION

Shell narrowly fusiform, of average size for genus (15–29 mm), about five teleoconch whorls. Protoconch of 1½ smooth whorls, abruptly (?poorly preserved) merging with teleoconch. Spiral sculpture of thin lirae, much narrower than interspaces, 13–15 on last whorl and 4–5 on penultimate whorl (posterior lira very faint). Axial sculpture of five prominent, foliaceous varices aligned from whorl to whorl. Aperture elongate oval, produced into short canal; columella with denticle on some specimens but smooth in others, inner side of outer lip with three or more denticles on some specimens. Siphonal fasciole present on some specimens.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 15.42, holotype	24.0	9.9	7.9	5
WAM 15.46, paratype	29.0	14.6	8.0	5
NMV P327593, paratype	25.3	11.2	7.2	5

## ETYMOLOGY

Latin adjective. *Silicatus* silicified.

## REMARKS

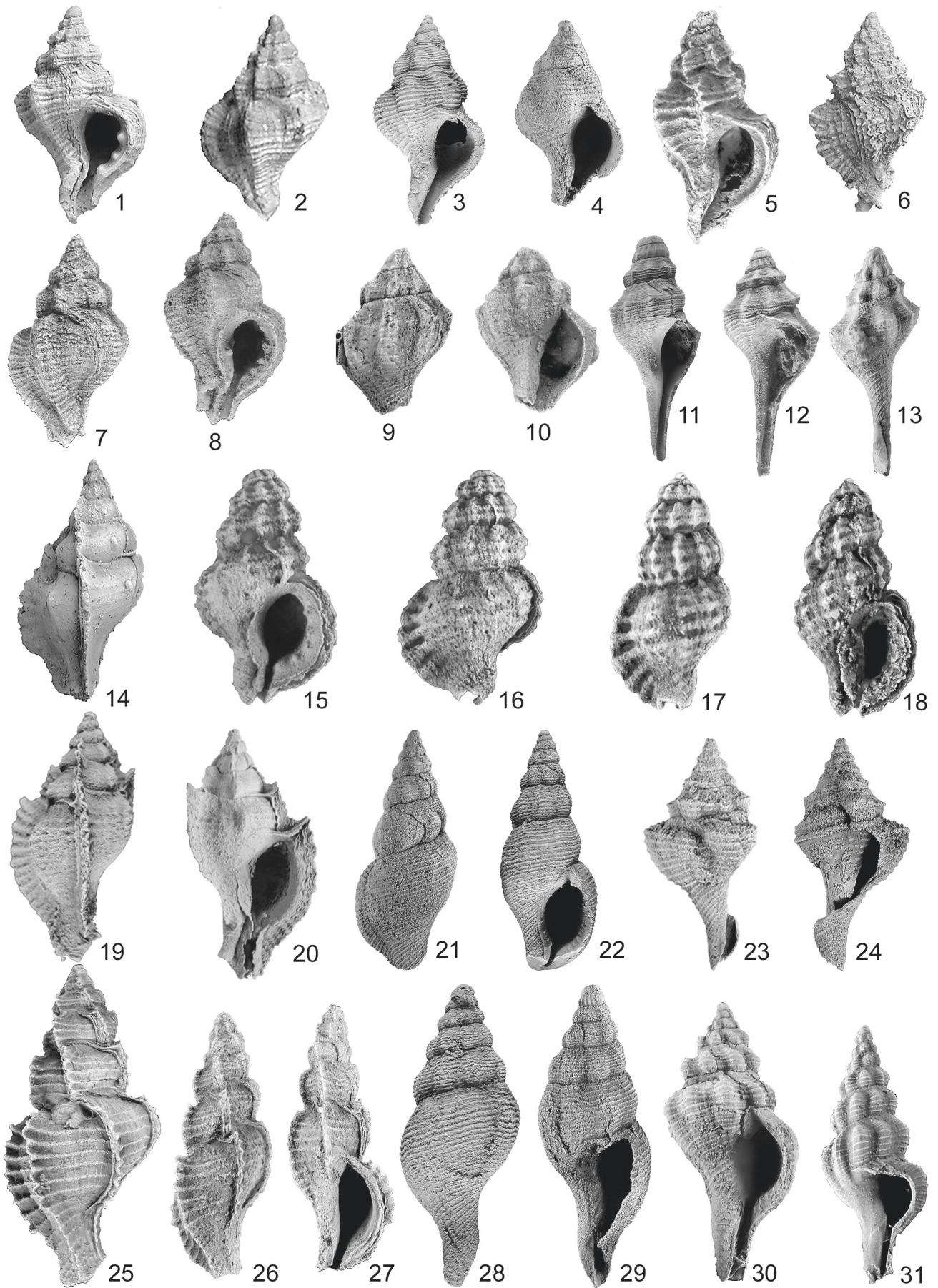
All specimens are somewhat worn and some of the worn juvenile specimens may not be this species. This species bears a close resemblance to *Dermomurex garrardi* Vokes, 1985, Miocene, Victoria, but differs in having very prominent thin lirae. Of other described species of the genus, this taxon has some resemblance to *Dermomurex bathyrhaphé* Lozouet, 1999 from the late Oligocene of France, but differs in having well developed thin lirae rather than broad low lirae.

## OCCURRENCE

**Eucla Basin**, Pallinup Formation.

## FIGURE 6

1, 2, 7, 8, *Hexaplex? tridentatus* (Tate, 1888): 1, 2, SAM T433 (x 4) holotype, Aldinga Bay; 7, 8, WAM 15.31 (x 3);  
3, 4, *Attiliosa arenaria* sp. nov.: 3, WAM 12.10 (x 3) holotype; 4, WAM 12.11 (x 3) paratype;  
5, 6, *Ocenebra prionotus* (Tate, 1888): 5, WAM 15.89 (x 5); 6, SAM T411C (x 2) lectotype, Adelaide bore;  
9, 10, 11, 12, 13, *Tectifusus aldingensis* (Tate, 1888): 9, 10, WAM 07.183 (x 2); 11, SAM T493A (x 1.5), syntype of *Fusus tholoides* Tate, 1888, Adelaide bore; 12, 13, SAM T482C (x 1.5) lectotype, Aldinga;  
14, 19, 20, *Timbellus calvus* (Tate, 1888): 14, SAM T427B (x 2) lectotype, Blanche Point; 19, 20, WAM 67.142a (x 3);  
15, 16, 17, 18, *Dermomurex* sp.: 15, 16, WAM 67.141 (x 7); 17, 18, WAM 15.100 (x 7);  
21, 22, 28, 29, 30, 31, *Dennantia aldingensis* (Tate, 1888): 21, 22, WAM 79.1024 (x 2); 28, 29, WAM 99.187a (x 3); 30, SAM T570B (x 2) lectotype, Blanche Point; 31, SAM T570H (x 2) paralectotype, Adelaide bore;  
23, 24, *Pugilina?* sp.: 23, 24, WAM 12.25 (x 2);  
25, 26, 27, *Dermomurex silicatus* sp. nov.: 25, WAM 15.46 (x 2) paratype; 26, 27, WAM 15.42 (x 2) holotype.





***Dermomurex* sp.**

Figures 6.15–18

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 67.138, 69.141, 15.100, 15.261-2; NMV P329324-5, P332359. Total 12 specimens.

**DESCRIPTION**

Shell somewhat tumid, fusiform, of small size for genus (6–7.5 mm), of about four convex whorls with impressed sutures. Protoconch of 1½ smooth whorls, first whorl deviated at about 45° from axis of shell, merging abruptly with teleoconch. Axial sculpture of broad, somewhat scabrose costae slightly narrower than interspaces, nodulose where crossed by spiral sculpture, five on penultimate whorl and 10 on last whorl and diminishing in strength apically. Spiral sculpture of thick cords slightly narrower than interspaces, five on penultimate whorl and 6–8 on last whorl extending onto canal. Traces of apertural varices present on spire whorls. Aperture ovate, thickened externally into a frilled varix, internal lip with 4–5 denticles, columella covered with thin plate. Siphonal canal short narrow, twisted dorsally. Siphonal fasciole prominent.

**MEASUREMENTS**

	Height	Width	No. of whorls
WAM 15.100	7.2	3.5	4
WAM 67.141	6.1	4.6	4

**REMARKS**

The specimens are probably all juveniles and poorly preserved, so the generic assignment is tentative. Nothing similar is known from eastern Australia. This species has some resemblance to the Eastern Pacific species *Dermomurex obeliscus* (A. Adams, 1853) and *D. alabastrum* (A. Adams, 1864).

**OCCURRENCE**

**Eucla Basin**, Pallinup Formation.

**Genus *Hexaplex* Perry, 1810*****Hexaplex? tridentatus* (Tate, 1888)**

Figures 6.1–2, 6.7–8

*Murex tridentatus* Tate, 1888: 108, plate 2, figure 2.

**MATERIAL EXAMINED****Holotype**

**Australia: South Australia:** Aldinga Bay: SAM T433.

**Other material**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 191 specimens (WAM 67.137a, 67.141, 67.144a, 69.145; 69.159?, 69.162, 69.168, 72.304–5, 69.172?, 72.305, 79.1022, 04.161, 04.163, 15.31–6; NMV P317508–9, P327579–81, P329326). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 2 specimens (WAM 04.190, 05.42). Cape le Grand National Park, 0.8 km NE of turnoff to Lucky Bay, west side of road, Merivale 428219: 1 specimen (WAM 07.195?) Total 194 specimens.

**DESCRIPTION**

Shell fusiform of average size for genus (7–14 mm), with about five to six somewhat tumid whorls. Protoconch of 1½ smooth whorls, the first slightly deviated from axis of shell. Spiral sculpture of thin lirae slightly narrower than interspaces, five to six on penultimate whorl, about 20 on last whorl extending onto canal. Axial sculpture of prominent, thick, foliaceous varices, somewhat irregularly spaced, five to six on last whorl. Aperture ovate, inner lip with three and rarely up to five prominent denticles. Columella with one and rarely another prominent denticle near canal. Canal short and slightly twisted. Siphonal fasciole prominent.

**DIMENSIONS**

	Height	Width	Aperture height	No. of whorls
WAM 15.31	12.8	7.1	4.1	5

**REMARKS**

Many specimens from Walpole are not very well preserved but sufficient numbers are present to show that they resemble the holotype (Figures 6.1–2) and also specimens from Browns Creek Formation. Only the holotype is known from the Blanche Point Formation. It has three denticles on the inner lip of the aperture and does not have a denticle on the columella. However, specimens from Walpole and Browns Creek show that these features vary in number. This species bears some resemblance to *Pterynotus* (*Pteryomarchia*) *denudatus* (Deshayes, 1835), Middle–Late Eocene, Europe.

**OCCURRENCE**

**Eucla Basin**, Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.



**Genus *Attiliosa* Emerson, 1958*****Attiliosa arenaria* sp. nov.**

Figures 6.3–4

urn:lsid:zoobank.org:act:078DC9E9-5518-4177-BADD-288E10C3A2BF

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.10.

*Paratypes*

WAM 12.11, from type locality. NMV P327584 from type locality.

*Other material*

From type locality: 56 specimens (WAM 67.162, 69.167, 72.254, 72.302?, 99. 188, 12.12, 15.37; NMV P327582–3, P327585, P327588, P329327, P332353, P332355). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 1 specimen (WAM 04.188). Total 57 specimens.

## DIAGNOSIS

Shell with impressed sutures and thin, raised, widely spaced lirae and six prominent swollen costae per whorl.

## DESCRIPTION

Shell tumid, fusiform of 4–6 whorls with impressed sutures. Spire subconical. Protoconch of 1¼ smooth whorls, first whorl slightly deviated from axis of shell, merging abruptly into teleoconch. Spiral sculpture of thin, raised lirae, very much narrower than interspaces, 11 on penultimate whorl and 28 on last whorl extending over whole whorl and down anterior canal, on some specimens lirae somewhat scabrous. Axial sculpture of prominent, swollen costae, six per whorl. Aperture lenticular produced anteriorly into a long, slightly twisted canal; outer lip internally lirate on some specimens. Siphonal fasciole prominent.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.10, holotype	25.3	13.5	7.2	6
WAM 12.11, paratype	11.2	7.0	3.7	4
NMV P327584, paratype	20.0	10.2	8.0	4+

## ETYMOLOGY

Latin adjective. Arenaria pertaining to sand.

## REMARKS

This species has some resemblance to *Ocenebra asperula* (Tate, 1888), Miocene, Otway and Port Phillip Basins. It differs by having a more conical spire, less scabrose lirae and having six rather than 8–9 costae per whorl.

## OCCURRENCE

**Eucla Basin**, Pallinup Formation.

**Genus *Ocenebra* Gray, 1847*****Ocenebra prionotus* (Tate, 1888)**

Figures 6.5–6

*Murex prionotus* Tate, 1888: 107, plate 1, figure 5.

*Murexsul prionotus* (Tate): Ludbrook, 1973: plate 25, figure 45.

## MATERIAL EXAMINED

*Types*

**Australia: South Australia:** Kent Town Bore, Adelaide, South Australia, T411A–G. Tate's figured specimen T411C is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species (Figure 6.6).

*Other material*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 15.83–4, 15.89; NMV P329308–9. Total 361 specimens.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.89	8.5	4.7	4

## REMARKS

Specimens from Thomson Road are all juveniles and relatively smaller in size than specimens from South Australia and Victoria, but otherwise seem to match specimens from Blanche Point and Browns Creek Formations as well as small specimens on Tate's tablet of syntypes from the Kent Town Bore.

## OCCURRENCE

**Eucla Basin**, Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

**Genus *Coralliophila* H. & A. Adams, 1853*****Coralliophila* (s.l.) sp.**

Figures 7.20–22, 7.26–27

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 67.148, 69.163, 72.246, 72.308a, 99.185, 15.39–40, 15.276; NMV P327589–91. Total 30 specimens.

**DESCRIPTION**

Shell of average size for genus (16–32 mm), fusiform, whorls somewhat tumid with impressed sutures. Protoconch of two smooth whorls merging imperceptibly into teleoconch, first whorl deviated from shell axis. Spiral sculpture of thin, erect lirae, narrower than interspaces, scabrose where crossed by axial sculpture, 13 on penultimate whorl, about 28 lirae on last whorl. Axial sculpture of very broad costae, 7–9 on posterior whorls decreasing in size and fading on last whorl, plus numerous thin, raised lamellae forming delicate scales on crossing lirae. Prominent raised cord on last whorl emerging from posterior suture and continuing to outer lip where it forms a small labral tooth. Growth lines form a v shape over cord. Aperture ovate, produced into short straight canal. Columella and inside surface of outer lip smooth. No siphonal fasciole. Prominent umbilicus present.

**DIMENSIONS**

	Height	Width	No. of whorls
WAM 67.148	32	21	5 shell distorted and canal broken
WAM 99.185a	22.8		5 shell distorted and canal broken
WAM 72.308a	13.0	8.8	4
WAM 72.246	15.9	7.4	4

**FIGURE 7**

- 1, 5, 6, 10, 11, *Ovaginella arenula* sp. nov.: 1, WAM 15.281 (x 10) paratype; 5, 6, WAM 15.12 (x 10), paratype; 10, 11, WAM 15.11 (x 10) holotype;  
 2, 8, *Serrata mala* (Cotton, 1949): 2, 8, SAM P4016 (x 4) holotype, Aldinga (Photo: Alexis Tindall, South Australian Museum).  
 3, 4, 15, 16, *Cryptospira hordeastrae* sp. nov.: 3, 4, WAM 12.87 (x 5) holotype; 15, 16, WAM 15.88 (x 5) paratype;  
 7, *Serrata* cf. *S. mala* (Cotton, 1949): 7, WAM 82.1488 (x 5);  
 9, 12, 13, 14, *Cordieria torquata* sp. nov.: 9, 14, WAM 12.58 (x 5) paratype; 13, 14, WAM 12.57 (x 5) holotype;  
 17, 18, 19, *Laevityphus ludbrookae* Keen & Campbell, 1964: 17, SAM T453A (x 3) paralectotype, Adelaide bore; 18, SAM T453B (x 4) lectotype, Adelaide bore; 19, WAM 12.06 (x 3);  
 20, 21, 22, 26, 27, *Coralliophila* sp.: 20, 21, WAM 72.246 (x 3); 22, WAM 99.185 (x 1.5); 26, WAM 67.148 (x 1.5); 27, WAM 72.308a (x 3);  
 23, 24, 25, 32, *Eratoidea fusoides* sp. nov.: 23, 32, WAM 12.84 (x 5) holotype; 24, 25, WAM 12.85 (x 5) paratype;  
 28, 29, 30, 31, *Ovaginella mumiformis* sp. nov.: 28, 29, WAM 15.10 (x 10) paratype; 30, 31, WAM 15.09 (x 10) holotype.

**REMARKS**

This species is somewhat similar to *Attiliosa arenaria* sp. nov. but is distinguished by the presence of an umbilicus and the scabrose sculpture. It resembles somewhat the Indo-Pacific *Coralliophila abnormis* (Smith, 1878), but the protoconch of the Walpole species doesn't seem to be pustulate as in that species, however, the Walpole specimens are worn and broken and such delicate sculpture may have been abraded off. It also has some resemblance to *C. mira* (Cotton and Godfrey, 1932) from southern Australia, but has much more inflated whorls.

**OCCURRENCE**

**Eucla Basin**, Pallinup Formation.

**Genus *Laevityphus* Cossmann, 1903*****Laevityphus ludbrookae* Keen & Campbell, 1964**

Figures 7.17–19

*Typhis tripterus* Tate, 1888: 93, plate 3, figure 14 (non Grateloup, 1833).

*Laevityphus (Laevityphus) ludbrookae* Keen and Campbell, 1964: 52, plate 10, figures 33, 34, 36 (nom. nov. for *Typhis tripterus* Tate, 1888 non Grateloup, 1833).

*Laevityphus (Laevityphus) ludbrookae* Keen & Campbell: Ludbrook, 1973: plate 25, figure 46.

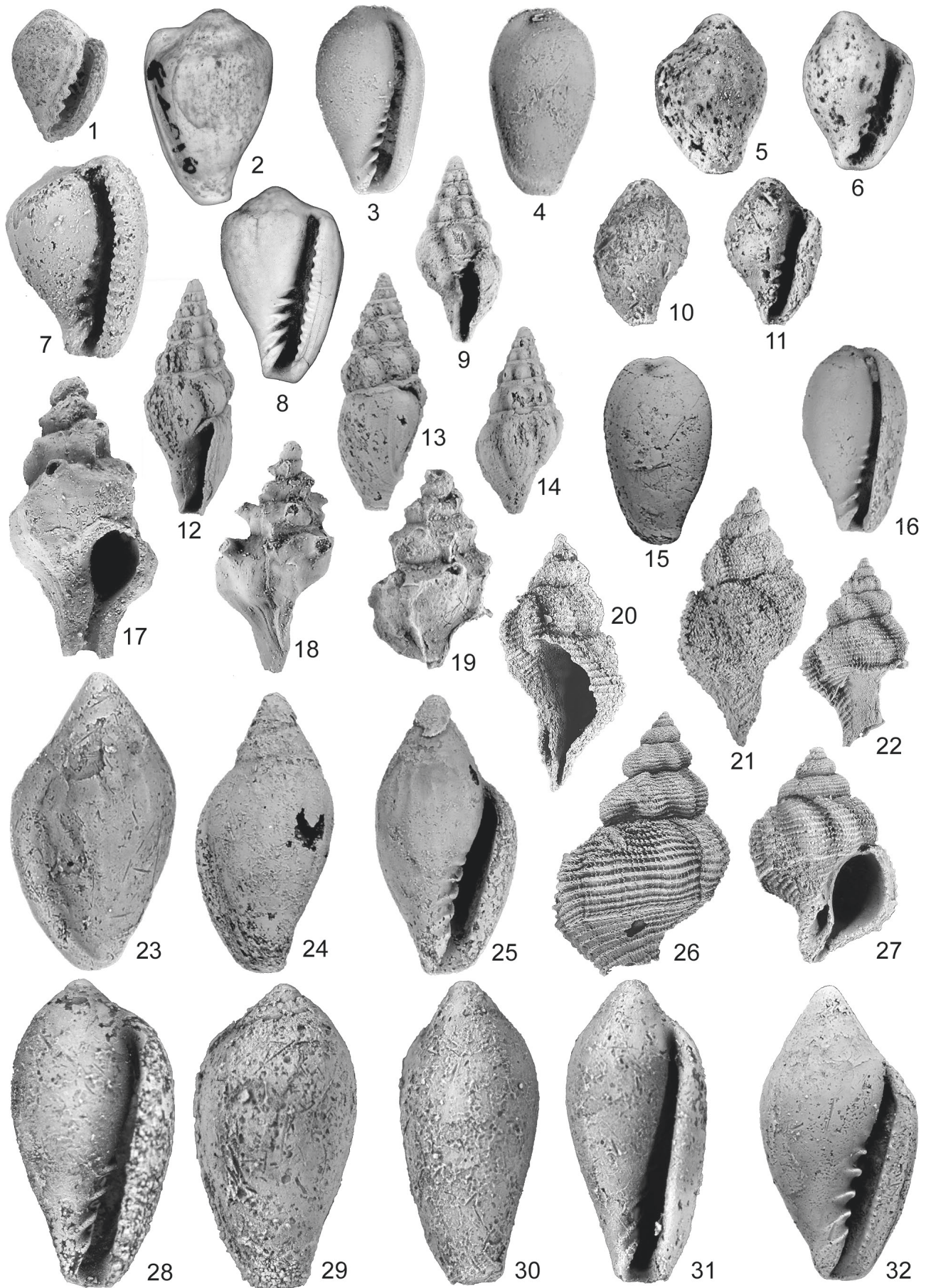
**MATERIAL EXAMINED*****Syntypes***

**Australia: South Australia:** Adelaide (Kent Town) Bore: SAM T453A–B.

***Other material***

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 1 specimen (WAM 12.06).





## DESCRIPTION

Protoconch missing, four teleoconch whorls remaining. Shell elongate of average size for genus. Spire gradate with impressed sutures and prominent shoulder bearing short tubes, broken in this specimen. Last whorl abruptly contracted to anterior canal (broken). Sculpture of thin varices extending from shoulder anteriorly, about four varices per whorl, not present on posterior whorl slope of shoulder.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 12.06	6.5	4.0	4 specimen broken

## REMARKS

The unique Walpole specimen, though broken, is sufficiently well preserved to enable it to be identified. Keen and Campbell (1964) stated that the holotype of the species was T453B, but Tate, who mentioned he had two specimens, did not chose a holotype. In terms of Article 73.1 of the International Code of Zoological Nomenclature this specimen is not the holotype and Tate's specimens are syntypes. It is not clear which of the two specimens mentioned by Tate was figured, however, specimen T453B is the better preserved of the two and most likely the figured specimen. This specimen T453B is chosen as the lectotype to fix the specimen as the sole name-bearing type of the species. Both of Tate's specimens are figured here (Figures 7.17 paralectotype, 7.18 lectotype).

## OCCURRENCE

**Eucla Basin**, Pallinup Formation. **St Vincent Basin**: Blanche Point Formation (type). **Otway Basin**: Browns Creek Formation; Glen Aire Clay.

**Family Marginellidae Fleming, 1828****Genus Eratoidea Weinkauff, 1879*****Eratoidea fusoides* sp. nov.**

Figures 7.23–25, 7.32

urn:lsid:zoobank.org:act:4561EC40-BED7-4709-9BF4-8A737767BFD4

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia**: Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.84.

*Paratypes*

WAM 12.85 from type locality. NMV P323143 from type locality.

*Other material*

From type locality: 22 specimens (WAM 72.313, 72.317, 99.195, 99.197, 04.171a, 12.82–3, 12.86 NMV P323142, P323144–6). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 1 specimen (WAM 05.51). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak 2 specimens (WAM 80.1326, 80.1352). Total 28 specimens.

## DIAGNOSIS

Shell almost biconical, spire conical. Outer lip of aperture finely denticulate. Columella with five equal plaits.

## DESCRIPTION

Shell smooth, broadly fusiform, almost biconic, of large size for the genus (9–11 mm), with conical spire about one third height of shell. Protoconch dome-shaped, smooth. Aperture moderately wide; columella with five equal plaits; outer lip with very weak denticulations along entire length of inner surface, thickened into prominent varix on some specimens. Siphonal notch barely visible.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.84, holotype	10.7	5.5	6.7	4
WAM 12.85, paratype	10.2	5.1	6.6	4
NMV P323143, paratype	9.1	5.4	6.5	4

## ETYMOLOGY

Latin adjective. Fusoides resembling a spindle.

## REMARKS

This species is unlike any other Australian taxon. It is distinguished by the conical spire, denticulate outer lip and the presence of five equal plaits on the columella. Specimens of a marginellid from the Late Eocene near Kalbarri, Western Australia (Darragh and Kendrick, 2008) are somewhat similar in size and general shape, though somewhat more elongated, but are too poorly preserved for precise comparison.

## OCCURRENCE

**Eucla Basin**: Pallinup Formation.



**Genus *Cryptospira* Hinds, 1844*****Cryptospira hordeastra* sp. nov.**

Figures 7.3–4, 7.15–16

urn:lsid:zoobank.org:act:978F7FB3-98E1-4A2B-AF67-A84D47F197CC

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.87.

*Paratypes*

WAM 12.88 from type locality. NMV P323148 from type locality.

*Other material*

From type locality: WAM 67.169, 69.185a, 72.314, 82.1489, 99.194, 04.170, 12.89–90, 15.04–5; NMV P323147, P323149, P327189–91. Total 116 specimens.

## DIAGNOSIS

Shell pyriform, last whorl almost enveloping earlier whorls. Outer lip of aperture smooth internally and with prominent varix.

## DESCRIPTION

Shell of average size for genus (6.5–8.3 mm), elongate, pyriform, spire very low, last whorl almost enveloping earlier whorls. Protoconch smooth, of about one whorl coiled in axis of teleoconch, merging imperceptibly with teleoconch whorls. Aperture narrow, elongate, posteriorly extended and overlapping onto spire whorls; outer lip smooth internally, thickened externally into prominent varix. Columella with four equal plaits and one or two weak plications posteriorly that do not extend into the aperture. No siphonal notch.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.87, holotype	6.9	3.9	6.4	3
WAM 12.88, paratype	6.8	4.0	6.2	3
NMV P323148, paratype	7.0	4.0	6.5	3

## ETYMOLOGY

Latin adjective. *Hordeastra* like a barley seed.

## REMARKS

This species has some resemblance to *Marginella doma* Cotton, 1949 from the Dry Creek Sands, South Australia, but differs in not having a denticulated outer apertural lip. There is nothing like it in the Eocene formations of the St Vincents and Otway Basins.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Ovaginella* Laseron, 1957*****Ovaginella mumiformis* sp. nov.**

Figures 7.28–31

urn:lsid:zoobank.org:act:5E3D965D-BFAB-4F04-8AFB-39ABC1054F19

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.09.

*Paratypes*

WAM 15.10 from type locality. NMV P327195 from type locality.

*Other material*

From type locality: 135 specimens (WAM 67.163, 67.165, 69.182, 69.185b, 72.315, 99.193, 99.196, 04.171b, 04.172, 15.06-8; NMV P327192–4, P327571). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 1 specimen (WAM 05.50). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak 1 specimen (WAM 85.640). Total 140 specimens.

## DIAGNOSIS

Shell elongate with conical spire and outer lip smooth internally. Columella with four strong plaits.

## DESCRIPTION

Shell of average size for genus (5–6 mm), smooth, elongate pyriform; spire low, conical, barely projecting. Protoconch of one smooth whorl, coiled in axis of shell, merging imperceptibly with teleoconch whorls. Aperture narrow, elongate; outer lip internally smooth, externally thickened into prominent varix. Columella with four strong, equal-sized plaits. No siphonal notch.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 15.09, holotype	5.5	2.5	4.0	3
WAM 15.10, paratype	5.6	3.0	4.4	3
NMV P327195, paratype	6.5	3.1	4.8	3

## ETYMOLOGY

Latin adjective. Mumiformis having the shape of a mummy.

## REMARKS

This species is similar in shape to the Victorian Miocene species *Marginella propinqua* Tate, 1878 and *M. woodsi* Tate, 1878, but lacks the denticles present on the inside of the outer lip of those species.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

***Ovaginella arenula* sp. nov.**

Figures 7.1, 7.5–6, 7.10–11

urn:lsid:zoobank.org:act:7D85829D-9E11-4559-997C-B6D90A91188C

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.11.

*Paratypes*

WAM 15.12, 15.281 from type locality. NMV P327196 from type locality.

*Other material*

From type locality: WAM 69.184, 15.11-13; NMV P327197–8. Total 41 specimens.

## DIAGNOSIS

Shell small, biconical with outer lip smooth internally. Columella with four plaits.

## DESCRIPTION

Shell of small size for genus (2.5–3.5 mm), smooth, tumid, biconical. Protoconch of one smooth whorl, coiled in axis of shell, merging imperceptibly with teleoconch whorls. Aperture relatively wide, elongate; with prominent posterior notch; outer lip internally smooth, externally thickened into prominent varix. Columella with four strong, equal-sized plaits. No siphonal notch.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 15.11, holotype	2.7	1.8	2.0	3
WAM 15.12, paratype	2.9	2.0	2.3	3
WAM 15.281, paratype	2.5	1.8		3
NMV P327196, paratype	3.3	2.1	2.6	3

## ETYMOLOGY

Latin noun in apposition. Arenula a grain of sand.

## REMARKS

This species is very small like *Marginella aldingae* Tate, 1878, but the spire is much more conical and there are no costae on the whorls as in the latter.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Serrata* Jousseume, 1875*****Serrata* cf. *S. mala* (Cotton, 1949)**

Figure 7.7

*Marginella mala* Cotton, 1949: 215, plate 18.

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 82.1488. NMV P329279. Total 2 specimens.

## DIMENSIONS

	Height	Width	Aperture height
WAM 82.1488	7.5	5.4	6.0

## REMARKS

The better preserved specimen has a more rounded last whorl rather than having the very slight shoulder present on specimens of *Serrata mala* (Cotton) from South Australia, but otherwise closely resembles it. This is the only marginellid in the fauna that seems to be identical to a species from the Eocene of South Australia and Victoria. The holotype of *Marginella malla* Cotton, SAM P4016 from Blanche Point Formation, Aldinga, is figured for comparison (Figures 7.2, 7.8).

## OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Marl (type). **Otway Basin:** Browns Creek Formation.

**Family Volutidae Rafinesque, 1815****Genus *Lyria* Gray, 1847*****Lyria craticulata* sp. nov.**

Figures 8.35–39

rn:lsid:zoobank.org:act:15F82D58-44A9-4F9A-9232-B74C5081027D

**MATERIAL EXAMINED***Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 09.03a.

*Paratypes*

WAM 09.03b, 12.37 from type locality. NMV P332352 from type locality.

*Other material*

From type locality: 213 specimens (WAM 67.153–5, 67.157, 67.159, 67.176, 69.179, 69.180, 69.186, 72.247, 72.257, 72.310, 72.311, 72.312?, 99.198, 04.174, 12.33, 12.34, 12.36. NMV P317770–73). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 7 specimens (04.189, 04.193, 05.53, 05.54, 05.55b). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak 15 specimens (WAM 80.1348–51, 85.638, 85.1456). Cape le Grand National Park, 0.8 km NE of turnoff to Lucky Bay, west side of road, Merivale 428219: 3 specimens (WAM 07.194). Little Wharton Bay, near Mt Belcher, Duke of Orleans Bay: 1 specimen (WAM 05.176a). Total 231 specimens.

**DIAGNOSIS**

Shell, fusiform with weak shoulder. Sculpture cancellate of fine lirae crossed by coarse or fine costae.

**DESCRIPTION**

Shell elongate, fusiform of small size for genus (20–43 mm) with subturbinate spire, weak shoulder and impressed sutures. Whorls five to six with subsutural groove and row of nodules corresponding to axial sculpture between it and suture. Protoconch of 1½ smooth whorls, first whorl slightly deviated from axis of shell. Spiral sculpture of lirae about as wide as interspaces, seven to 10 lirae on spire whorls, tuberculate where crossed by axial sculpture, 16 lirae on last whorl and extending onto canal. Axial sculpture highly variable, on some specimens consisting of stout costae about 10 on last whorl and 16 on spire whorls becoming coarser and indistinct towards aperture; on other specimens consisting of up to 45 very narrow costae producing a cancellate appearance where crossed by spiral sculpture. Aperture, where preserved, lenticular, outer lip with prominent interior tubercle

situated about ¾ the distance along lip posteriorly. Columella with four prominent plaits, becoming stronger posteriorly and with one or two narrow spiral ridges posterior to plaits. Canal short with weak siphonal notch and weak siphonal fasciole.

**DIMENSIONS**

	Height	Width	Aperture height	No. of whorls
WAM 09.03a, holotype	25.7	12.6	11.1	5+
WAM 09.03b, paratype	28.2	12.9		6
WAM 12.37, paratype	33.7	14	17	6
NMV P332352, paratype	30.6	13.5	15.6	5

**ETYMOLOGY**

Latin adjective. Craticulata latticed.

**REMARKS**

This is one of the most common species in the Pallinup Formation at Thomson Road. All specimens are distorted to some extent and most seem to have suffered attacks by crabs. Only one specimen has the aperture preserved. This species shows a high degree of morphological variability. It does not resemble any species previously recorded from Australia. This is the second species of *Lyria* recorded from the Eocene of Western Australia. *Lyria lamellatoplicata* Darragh and Kendrick, 2008 from Kalbarri has a prominent shoulder and no subsutural groove.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.

**Genus *Mitreola* Swainson, 1833*****Mitreola salaputium* Darragh, 1989**

Figures 8.1–2

*Mitreola salaputium* Darragh, 1989: 215, plate 1, figures 10, 11, 15, 16.

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 20 specimens (WAM 79.386 holotype, 89.976, 99.199a, 12.34, 12.36; NMV P50005–6, P50007 paratype, P317774–6, P329328). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak: 2 specimens (WAM 80.1346, 85.1454). Total 22 specimens.

## DESCRIPTION

Shell of small size for genus (9.5–12.9 mm), ovately fusiform. Protoconch of 1½ smooth whorls, first of which slightly deviated from axis of shell. Axial sculpture of thick, low costae as wide as interspaces present on spire whorls, but absent from last whorl. No spiral sculpture. Aperture narrowly lenticular; outer lip thickened with small internal denticle; inner lip covered with thick callus; columella with four prominent plaits and posterior denticle. Siphonal notch and siphonal fasciole weakly developed.

## DIMENSIONS

	Height	Width	Aperture height
WAM 12.34	9.5	4.3	4.3

## REMARKS

As Darragh (1989) noted this is the only record of the genus known from Australia. The range of the species has been extended from the occurrence on Thomson Road to Cape Le Grand National Park.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Notopeplum* Finlay, 1927*****Notopeplum* cf. *N. prorhysum* (Tate, 1889)**

Figures 8.29–30

*Voluta prorhysa* Tate, 1889:126, plate 2, figures 6a–b.

*Notopeplum prorhysum* (Tate). Darragh 1989: 256, 257, plate 25, figures 7, 10, 11, figure 31 (with synonymy). Darragh and Kendrick, 2008: 239, Figures 3.16–17.

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 50 specimens (WAM 67.160,

69.181, 72.248, 12.38, 12.39, 12.40, 12.41, 12.42. NMV P317777–80). Cape le Grand National Park, 0.8 km NE of turnoff to Lucky Bay, west side of road, Merivale 428219: 2 specimens (WAM 06.161, 07.197?). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak, 2 specimens (WAM 85.1456). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386: 1 specimen (WAM 05.55a). Total 55 specimens.

## DESCRIPTION

Shell elongate fusiform, of average size for genus (30–48 mm). Protoconch of 1½ whorls, first somewhat irregular, smooth, next whorl plicate, plicae enlarging to form costae on teleoconch whorls. Teleoconch sculpture of stout costae, narrower than interspaces present on first two or three teleoconch whorls then becoming weaker and fading adaperturally. Aperture elongate, lenticular with slightly thickened out lip Columella with four strong and one to three weaker posterior plaits. Siphonal notch and fasciole weak.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorl
WAM 12.38	37.8	14.5	17.4	5

## DISCUSSION

The overall shape of the specimens, particularly those from Lucky Bay and Cape Le Grande, is very similar to Tate's figured specimen from the Kent Town Bore, Adelaide, though Walpole specimens tend to be not so prominently shouldered. This may be due to variation typical of many volute taxa, or less likely an artefact of preservation.

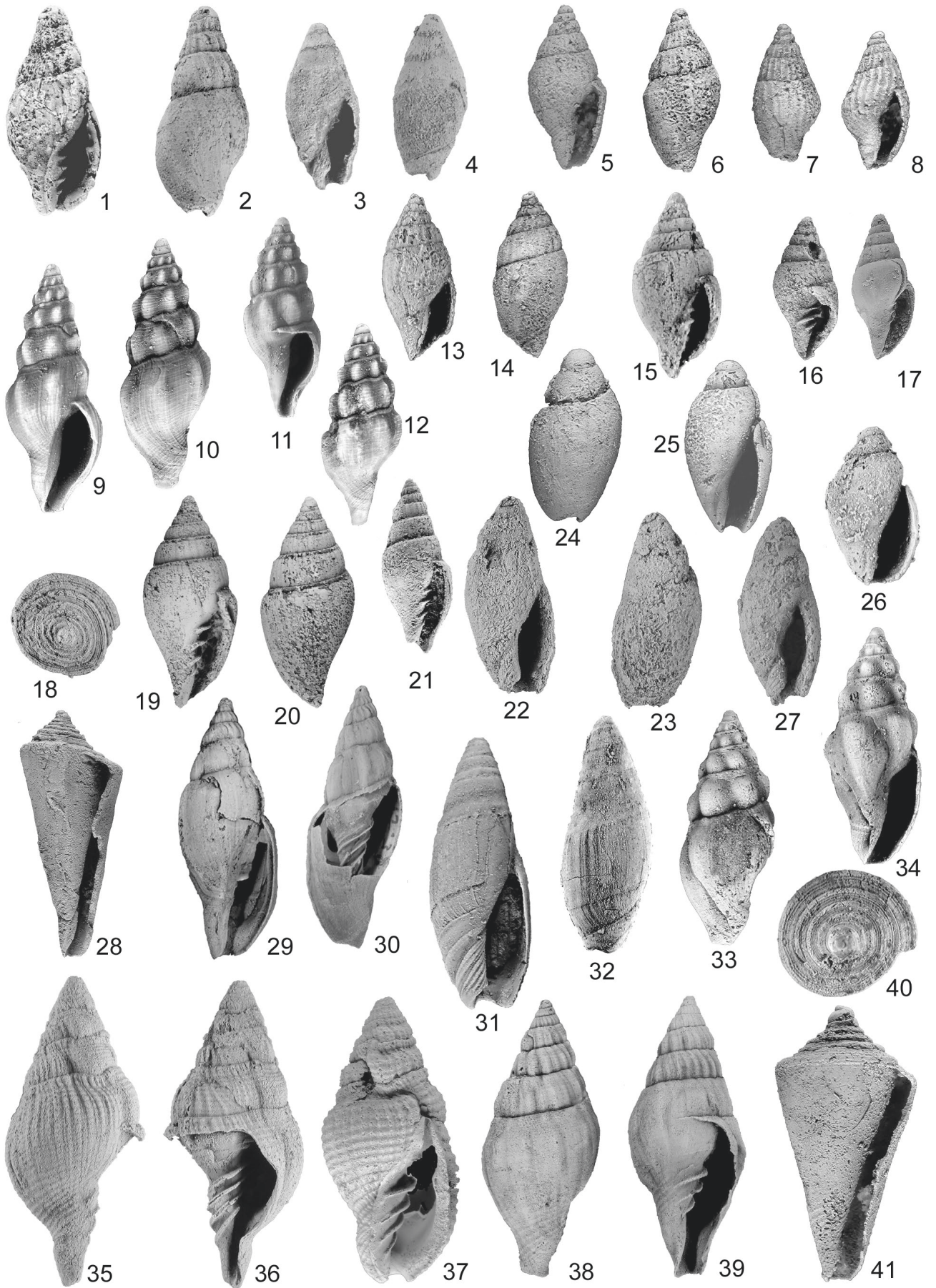
## OCCURRENCE

**Southern Carnarvon Basin:** unnamed sandstone. Middle–Late Eocene. **Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

## FIGURE 8

- 1, 2, *Mitreola salaputium* Darragh, 1989: 1, 2, WAM 12.34 (x 4);  
 3, 4, 22, 23, 27, 31, 32, *Amalda (Gracilispira) ligata* (Tate, 1889): 3, 4, WAM 12.28 (x 5); 22, 23, WAM 12.30 (x 5); 27, WAM 12.27 (x 5); 31, SAM T700C (x 2) lectotype, Adelaide bore; 32, SAM 700H (x 2) paralectotype, Adelaide bore?;  
 5, 6, 7, 8, 13, 14, *Conomitra strombodiformis* sp. nov.: 5, 6, WAM 12.13 (x 6) holotype; 7, 8, WAM 12.15 (x 7) paratype; 13, 14, WAM 12.14 (x 6) paratype;  
 9, 10, 11, 12, 33, 34, *Cordieria fuscoamnica* sp. nov.: 9, 10, NMV P33348 (x 5) holotype, Browns Creek; 11, 12 NMV P329287 (x 5) paratype; 33, 34, WAM 99.202 (x 2) paratype;  
 15, 16, *Microvoluta* cf. *M. complanata* (Tate, 1889): 15, WAM 99.191b (x 5); 16, WAM 12.09 (x 4);  
 17, *Microvoluta complanata* (Tate, 1889): 17, SAM T643 (x 2) holotype, Adelaide bore;  
 18, 28, 40, 41, *Conus* sp.: 18, 28, WAM 10.06 (x 2); 40, 41, WAM 10.07 (x 4);  
 19, 20, *Microvoluta* cf. *M. subcrenularis* (Tate, 1889): 19, 20, WAM 99.191a (x 3);  
 21, *Microvoluta subcrenularis* (Tate, 1889): 21, SAM T647B (x 2) syntype, Adelaide bore;  
 24, 25, 26, *Belloлива canaliculata* sp. nov.: 24, 25, WAM 12.18 (x 8) holotype; 26, WAM 12.19 (x 7) paratype;  
 29, 30, *Notopeplum* cf. *N. prorhysum* (Tate, 1889): 29, 30, WAM 12.38 (x 1.25);  
 35, 36, 37, 38, 39, *Lyria craticulata* sp. nov.: 35, 36, WAM 09.03b (x 2) paratype; 37, WAM 09.03a (x 2) holotype; 38, 39, 12.37 (x 1.5) paratype.





**Family Volutomitridae Gray, 1854****Genus *Conomitra* Conrad, 1865*****Conomitra strombodiformis* sp. nov.**

Figures 8.5–8, 8.13–14

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## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** WAM 12.13 from Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486.

*Paratypes*

WAM 12.14–5, NMV P317786 from type locality.

*Other material*

From type locality: WAM 67.158, 69.178, 12.16, 12.50, 15.279; NMV P317785, P317787, P332351. Total 50 specimens.

## DIAGNOSIS

Shell tumid, fusiform with coarse costae on some or all whorls and fine lirae on anterior whorl slope of last whorl.

## DESCRIPTION

Shell small for genus (4–5 mm), tumid, fusiform of about four to five whorls, with subconical spire. Protoconch of about 1½ smooth whorls; first whorl slightly tilted. Four to five teleoconch whorls. Axial sculpture of 20–26 coarse costae about as wide as interspaces, usually present on some or all whorls, rarely absent. Spiral sculpture of about 10 lirae on anterior whorl slope of last whorl. Aperture elliptical, produced into short canal; columella with two plaits, interior of outer lip with three to seven irregular plicae.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.13, holotype	4.9	2.4	2.4	4
WAM 12.14, paratype	5.0	2.2	2.2	4
WAM 12.15, paratype	3.6	1.7	2.1	4
NVP P317786, paratype	5.0	2.0	2.0	4

## ETYMOLOGY

Latin adjective from Greek. Strombodiformis in the shape of a top.

## REMARKS

This species bears a close resemblance to *Conomitra fusoides* (Lea, 1833), Eocene, USA, type species of the genus, but is not as tumid. It is not very similar to other Australian species of the genus.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Microvoluta* Angas, 1877*****Microvoluta* cf. *M. subcrenularis* (Tate, 1889)**

Figures 8.19–20

*Mitra subcrenularis* Tate, 1889: 142, pl. 5, figure 6.

*Waimatea subcrenularis* (Tate). Ludbrook, 1973: plate 25, figure 25.

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 10 specimens (WAM 99.191a, 99.201(?), 15.94, 15.288?; NMV P319910, P329319, P332358?). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386: 2 specimens (WAM 05.45). Total 12 specimens.

## DESCRIPTION

Shell fusiform, somewhat tumid, of average size for genus (12 mm), with imbricated sutures. Protoconch of two smooth whorls. Teleoconch of six whorls. Spiral sculpture of a single groove just anterior to posterior suture and a few obscure grooves on anterior whorl slope of last whorl. Axial sculpture of low, close-set costae, about 40 on penultimate whorl, cut by spiral groove and produced into row of small tubercles against posterior suture. Aperture narrow, slightly elliptical, produced anteriorly into short anterior canal. Columella with four plaits, three posterior the strongest.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 99.191a	12.7	5.6	6.7	6

## REMARKS

The specimens are more tumid than specimens of *Microvoluta subcrenularis* from the Blanche Point Formation and the axial sculpture is much finer than on the latter. Some specimens are much worn and

assignment to the species is somewhat uncertain. A syntype of *M. subcrenularis*, SAM T647B, Adelaide bore, possibly Tate's figured specimen is figured for comparison (Figure 8.21).

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

#### *Microvoluta* cf. *M. complanata* (Tate, 1889)

Figures 8.15–16

*Mitra complanata* Tate, 1889: 138, pl. 5, figure 12.

*Waimatea complanata* (Tate). Ludbrook, 1973: plate 25, figure 24

#### MATERIAL

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 9 specimens (WAM 99.191b, 12.09, 15.99; NMV P319911). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386: 2 specimens (WAM 05.46, 05.68). Total 11 specimens.

#### DESCRIPTION

Shell fusiform, smooth, tumid, of average size for genus (12 mm), with imbricated sutures and somewhat turreted spire. Protoconch poorly preserved of about two smooth whorls. Teleoconch of five whorls. No visible sculpture. Aperture narrow, slightly elliptical, produced anteriorly into short anterior canal. Columella with three to four plaits, three posterior the strongest

#### DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.09	6.5	3.0	3.5	5
WAM 99.191b	6.8	3.4	3.3	4+ specimen broken

#### REMARKS

The specimens are too poorly preserved for precise determination, but bear a very close resemblance in overall morphology to specimens of *Microvoluta complanata* from the Browns Creek Formation and the holotype from the Kent Town Bore (Figure 8.17), though the Walpole specimens are much smaller than those from Browns Creek.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

#### Family Olividae Latreille, 1789

#### Genus *Amalda* H. & A. Adams, 1853

#### Subgenus *Gracilispira* Olson, 1956

#### *Amalda* (*Gracilispira*) *ligata* (Tate, 1889)

Figures 8.3–4, 8.22–23, 8.27, 8.31–32

*Ancillaria ligata* Tate, 1889: 147, plate 7, figure 6.

*Baryspira* (*Gracilispira*) *ligata* (Tate): Ludbrook: 1973, plate 25, figures 55–56.

#### MATERIAL EXAMINED

##### Types

**Australia: South Australia:** Blanche Point, Aldinga; Adelaide (Kent Town) Bore, Adelaide, (SAM T700A–R). Tate's figured specimen (T700C, Adelaide (Kent Town) bore) is chosen as lectotype to fix the status of the specimen as the sole name-bearing type of the species (Figure 8.31, paralectotype Figure 8.32).

##### Paralectotypes

SAM T700A–B, D–R.

##### Other material

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: (WAM 72.309, 12.27–30; NMV P317500-1, P317788). Total 15 specimens.

#### DESCRIPTION

Shell narrowly fusiform, with tall, narrow spire, small for the species. Protoconch smooth, of about 1½ whorls. Spire callus scarcely visible. Columella with three plaits.

#### DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.27	6.4	2.8	3.1	3
WAM 12.28	10.1	4.5	5.2	3
WAM 12.30	7.1	3.1	3.0	3

#### REMARKS

All Walpole specimens are small and not very well preserved, but seem identical to small and middle sized specimens of this species from the Blanche Point Formation and the Browns Creek Formation, in both of which small specimens are common. The specimen recorded by Darragh and Kendrick (2008) as *Gracilispira* sp. cf. *G. ligata* (Tate) from the unnamed Eocene Sandstone near Kalbarri, WA, looks somewhat more tumid than specimens from Walpole, but this could be an artefact of preservation as many specimens from Walpole are slightly distorted.



## OCCURRENCE

**Eucla Basin**, Pallinup Formation. **St Vincent Basin**: Blanche Point Formation (type). **Otway Basin**: Browns Creek Formation.

## Family Olivellidae Troschel, 1869

Genus *Belloлива* Peile, 1922*Belloлива canaliculata* sp. nov.

Figures 8.24–26

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## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia**: WAM 12.18 from Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486.

*Paratypes*

WAM 12.19, NMV P317503 from type locality.

*Other material*

From type locality: WAM 67.151, 69.177, 12.17; NMV P317502. Total 33 specimens.

## DIAGNOSIS

Shell small, smooth, fusiform with channelled suture. No plaits on columella.

## DESCRIPTION

Shell smooth, glossy, ovately fusiform, with channelled sutures. Small for genus (3–4.5mm). Protoconch of about 1½ smooth whorls merging imperceptibly with teleoconch. Whorls two to three. Aperture lenticular, moderately wide, with prominent siphonal notch. Columella with no visible plaits.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.18, holotype	3.9	2.0	1.9	2
WAM 12.19, paratype	4.1	2.1	2.2	2
NMV P317503, paratype	4.0	2.2	2.1	2½

## ETYMOLOGY

Latin adjective. Canaliculata channelled.

## REMARKS

This species is somewhat similar in morphology to *Belloлива adelaidae* (Tate, 1889), Blanche

Point Formation, South Australia. It has the same canaliculated suture, but is much smaller, lacks prominent plaits, is not as elongate, and the protoconch is much smaller. Similar differences separate it from the species recorded by Darragh and Kendrick (2008) as *Gemmoliva* sp. cf. *G. adelaidae* from the unnamed Eocene Sandstone near Kalbarri, WA.

## OCCURRENCE

**Eucla Basin**: Pallinup Formation.

## Family Conidae Fleming, 1822

Genus *Conus* Linnaeus, 1758*Conus* sp.

Figures 8.18, 8.28, 8.40–41

## MATERIAL EXAMINED

**Australia: Western Australia**: Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 28 specimens (WAM 67.179, 69.187, 99.204, 04.175, 10.06–7, 15.282–3; NMV P316331–3). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak: 1 specimen (WAM 80.1354). Total 29 specimens.

## DESCRIPTION

Shell of medium size for genus, up to 27 mm high. Protoconch of 2½ smooth, turbiniform whorls, coiled in axis of shell and protruding above teleoconch whorls. Teleoconch of five to six whorls, biconic with very low spire. Sculpture present on whorl shoulder of about five thin, equally spaced spiral threads, much narrower than interspaces. Last whorl anterior to shoulder smooth, except for 5–10 weak lirae at the anterior of the whorl.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 10.06	22.3	10.0 (max)	17.2	9 slightly squashed laterally
WAM 10.07	12.5	6.3	10.1	4

## REMARKS

An internal mould of a possible species of *Conus* was recorded by Darragh and Kendrick (2008) from the late Eocene sandstone at Kalbarri, Western Australia. No species of *Conus* are known from the Eocene formations of the St Vincent or Otway basins. The earliest occurrence of the genus in eastern Australia is in the Late Oligocene Jan Juc Formation. The preservation of the specimens varies somewhat and the better preserved material is slightly distorted. Most of the specimens are fragments. This species bears some resemblance to the



Victorian Miocene species *Conus pullulescens* Tenison Woods, 1879 in respect to the protoconch, but lacks the spiral sculpture covering the last whorl in that species. It has a general resemblance to the low-spired forms of *C. sauridens* Conrad, 1833, Eocene, United States of America. A laterally compressed internal mould (WAM 84.1027) from the Pallinup Formation at Mt Barker, Plantaganet loc 6129, west side Barrow Rd, may possibly be this species. It has four lirae on the shoulder. Indeterminate internal moulds of *Conus* have been found in the Nannarup Limestone quarry (WAM 69.250) and at Bremer Bay (G6053) (but possibly actually from Balladonia). Both the latter specimens do not bear any resemblance to the Walpole material.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

#### Family Borsoniidae Bellardi, 1875

#### Genus *Cordieria* Rouault, 1848

#### *Cordieria fuscoamnica* sp. nov.

Figures 8.9–12, 8.33–34

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?*Cordieria* sp. a. Long, 1981: 33, plate 5, figure 11.

#### MATERIAL EXAMINED

##### *Holotype*

**Australia: Victoria:** NMV P33348, from locality PL3011, Browns Creek Formation, dark gritty clay, below greensand, washout nearest Brown Creek, Johanna, Victoria, Glenaire 079 058.

##### *Paratypes*

P329287 from type locality. WAM 99.202 from **Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486.

##### *Other material*

From type locality 9 specimens (NMV P33373, P42908, P329286, 329288–9). From Walpole

25 specimens (WAM 72.318, 15.54–6; NMV P329283–5). Total 37 specimens.

#### DIAGNOSIS

Shell narrowly fusiform with prominent coarse costae and fine lirae. Columella with two weak plaits on most specimens.

#### DESCRIPTION

Shell of average size for genus (7–10 mm), narrowly fusiform, of about five whorls with narrow concave

shoulder. Protoconch of 1½ smooth whorls, the first whorl slightly deviated from axis of shell, abruptly merging into teleoconch. Axial sculpture of prominent coarse costae extending from shoulder to anterior suture, narrower than interspaces, becoming weaker on last quarter of last whorl, seven costae on penultimate whorl. Spiral sculpture of fine lirae about as wide as interspaces, about 11 on penultimate whorl and about 37 on last whorl extending onto anterior canal. Aperture narrowly elliptical with very short anterior canal and shallow anal sinus. Siphonal fasciole weakly developed. Columella with two weak plaits present on some specimens.

#### DIMENSIONS

	Height	Width	Aperture height	No. of whorls
NMV P33348, holotype	9.0	3.3	3.2	5
NMV P329287, paratype	7.3	2.8	2.0	5
WAM 99.202, paratype	8.8	3.4	3.7	5

#### ETYMOLOGY

Latin adjective. Fuscus brown; amnica pertaining to a stream.

#### REMARKS

Specimens from Walpole are slightly wider than those from Browns Creek. The plaits are very weak and not present on all specimens which caused Long (1981) to record this taxon as doubtfully *Cordieria*. However, the shape, sculpture and presence of two plaits on some specimens indicate that it does belong in the genus. As Long pointed out the species has a close resemblance to *C. rudis* (Hutton, 1885) from the Eocene of New Zealand. The Australian species is more slender, with much finer and more numerous lirae and more prominent costae.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation. **Otway Basin:** Browns Creek Formation (type).

#### *Cordieria torquata* sp. nov.

Figures 7.9, 7.12–14

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#### MATERIAL EXAMINED

##### *Holotype*

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 12.57.

*Paratypes*

WAM 12.58 from type locality. NMV P323133 from type locality.

*Other material*

From type locality: 1218 specimens (WAM 67.143, 69.169, 69.188, 72.245, 72.306, 82.1487, 99.189, 99.190, 04.165, 04.166, 12.54, 12.55, 12.56, 12.57. NMV P317789, P323130–3). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386: 3 specimens (04.191, 05.49). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak: 6 specimens (WAM 80.1344). Little Wharton Bay, near Mt Belcher, Duke of Orleans Bay: 1 specimen (WAM 05.175). Total 1225 specimens.

## DIAGNOSIS

Shell narrow with prominent subsutural cord and broad close-set costae. Columella with two prominent plaits.

## DESCRIPTION

Shell narrow, fusiform of average size for genus (6–14 mm). Teleoconch of 4–4½ whorls. Protoconch of 1½ smooth whorls coiled in axis of shell, merging abruptly into teleoconch whorls. Spiral sculpture consisting of a thin subsutural cord. Axial sculpture of prominent thick, rounded costae, slightly wider than interspaces, extending on spire whorls from subsutural cord to anterior suture, six costae on last whorl. Last whorl contracting abruptly to short anterior canal. Siphonal fasciole scarcely visible. Aperture elongate, D shaped; outer lip prosocyrty with a very shallow posterior sinus against suture; inner lip with two plaits, the posterior the strongest.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.57, holotype	8.6	3.0	3.6	5
WAM 12.58, paratype	6.8	3.2	3.2	4½
NMV P323133, paratype	8.4	3.2	4.0	4½

## ETYMOLOGY

Latin adjective. Torquata collared.

## REMARKS

This is the second most common gastropod at Walpole. This species is very similar to *Cordieria fuscoamnica* sp. nov. but is distinguished by the presence of the subsutural cord and the plaits are

quite prominent just within the aperture whereas in the former they are hidden. It has a close resemblance to *C. brevicula* (Deshayes, 1834) Eocene, France, but has a subsutural cord lacking in that species and is more elongate.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Family Cochlespiridae Powell, 1942****Genus *Apiotoma* Cossmann, 1889*****Apiotoma* sp.**

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 67.175. 1 specimen.

## REMARKS

The single specimen is a fragment consisting of the protoconch and five teleoconch whorls. It seems to be the same species as that figured by Long (1981, plate 4, figure 14) from the Browns Creek Formation.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation. **Otway Basin:** Browns Creek Formation.

**Family Conorbidae de Gregorio, 1880****Genus *Conorbis* Swainson, 1840*****Conorbis notialis* sp. nov.**

Figures 9.26–29

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## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** WAM 67.167 from Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486.

*Paratypes*

WAM 12.43, NMV P317782 from type locality.

*Other material*

From type locality: 16 specimens (WAM 72.319, 99.200; 12.44–5; NMV P316338–40, P317783). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386. 1 specimen (WAM 04.192).

Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak, 1 specimen (WAM 85.1453). Cape Le Grand National Park, 0.8 km NE of turnoff to Lucky Bay, Merivale 428219. 3 specimens (WAM 07.193). Total 24 specimens.

#### DIAGNOSIS

Shell biconic, tumid, with fine lirae on anterior half of last whorl and thin groove adjacent to posterior suture of whorls.

#### DESCRIPTION

Shell of small size for genus, up to 11.8 mm high, fusiform, somewhat tumid, biconic, spire slightly gradate, about  $\frac{1}{3}$  height of shell. Protoconch of  $1\frac{1}{2}$  smooth, dome-shaped whorls, axis slightly deviated from axis of shell. Four to five slightly convex teleoconch whorls. Sculpture of about 10–13 faint lirae on anterior half of last whorl, extending onto siphonal canal. Thin groove present immediately anterior to posterior suture. Last whorl convex posteriorly, anteriorly attenuating to a short canal. Aperture narrow, elongate, outer lip sinuous with wide, shallow posterior sinus. Siphonal canal short.

#### DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 67.167, holotype	9.2	3.7	4.7	5
WAM 12.43, paratype	8.6	4.0	4.6	5
NMV P317782, paratype	8.5	3.6	4.2	5

#### ETYMOLOGY

Latin adjective. Notialis southern.

#### REMARKS

Specimens from Cape Le Grand are somewhat distorted and larger than the specimens from Walpole, but otherwise seem similar in morphology to the latter. This taxon is much smaller, has more convex whorls and fewer and fainter spiral lirae when compared to *Conorbis attractoides* (Tate, 1890) from the St Vincent and Otway Basins. The single specimen of *Conorbis* sp. from the late Eocene unnamed sandstone near Kalbarri figured by Darragh and Kendrick (2008, Figures 21–22) is much larger and relatively more slender than *C. notialis* sp. nov.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

#### Family Drillidae Olsson, 1964

#### Genus *Splendrillia* Hedley, 1922

#### *Splendrillia?* sp.

Figures 9.19–20

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 6 specimens (WAM 15.294–5; NMV P332365). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak, 1 specimen (WAM 80.1345). Total 7 specimens.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 15.294	10.5	4.4	5

#### REMARKS

This species has some resemblance to *Splendrillia persica* (E.A. Smith, 1888), Indian Ocean, but the shoulder is not as prominent. It differs in the same way from *?Splendrillia* illustrated by Long (1981, plate 6, figure 4).

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

#### Family Mangiliidae P. Fischer, 1883

#### Genus *Neoguraleus* Powell, 1939

#### *Neoguraleus filiferus* sp. nov.

Figures 9.5–7

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#### MATERIAL EXAMINED

##### *Holotype*

**Australia: Western Australia:** WAM 12.46 from Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486.

##### *Paratypes*

WAM 12.47, NMV P316336 from type locality.

##### *Other material*

From type locality: WAM 67.145, 67.186, 69.189, 72.298, 04.176–7, 12.48–49; NMV P316334–5, P316337, P317784. Total 69 specimens.

#### DIAGNOSIS

Shell small with prominent shoulder and strong, sharp costae running from suture to suture, crossed by very fine spiral threads over whole whorl surface.

## DESCRIPTION

Shell of small size for genus (up to 7 mm), elongate fusiform, with gradate spire of about four whorls, shoulder prominent. Protoconch of 1½ smooth whorls, the first whorl deviated slightly from axis of shell, merging gradually with teleoconch whorls. Axial sculpture of strong, sharp costae slightly narrower than interspaces, running from suture to suture, 10 per whorl. Spiral sculpture of close-set, very fine threads covering whole of whorl surface, about 20 on spire whorls and 40 plus on last whorl, extending onto canal. Aperture narrow, elongate, subelliptical, extending to short canal; very shallow posterior sinus scarcely visible.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 12.46, holotype	5.4	2.4	2.3	4
WAM 12.47, paratype	5.3	2.0	2.4	4
NMV P316336, paratype	4.7	2.2	2.1	4

## ETYMOLOGY

Latin adjective. Filiferus bearing threads.

## REMARKS

This species bears some resemblance to the type species, *Neoguraleus sinclairi* Gillies, Recent, New Zealand, but the whorls on *N. filiferus* sp. nov. are much more angular. It is very similar to specimens recorded from the Late Eocene Browns Creek Formation by Long (1981) as *?Antiguraleus* sp. c. but has fewer and broader costae and a sharp rather than rounded shoulder. It is also much narrower. The genus is known from the Oligocene to Recent in New Zealand.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

## Family Pseudomelatomidae Morrison, 1966

Genus *Comitas* Finlay, 1926*Comitas silicicola* sp. nov.

Figures 9.12–14

urn:lsid:zoobank.org:act:8D82A435-7C29-4406-8BB4-31217D53D8D0

## MATERIAL EXAMINED

*Holotype*

**Australia: Western Australia:** WAM 15.96 from Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486.

*Paratypes*

WAM 15.97, NMV P329321 from type locality.

*Other material*

From type locality: 22 specimens (WAM 15.95, 15.98; NMV P329320-23). Total 25 specimens.

## DIAGNOSIS

Shell small with prominent concave shoulder and broad costae running from shoulder to anterior suture, crossed by very fine spiral threads over the whole whorl surface.

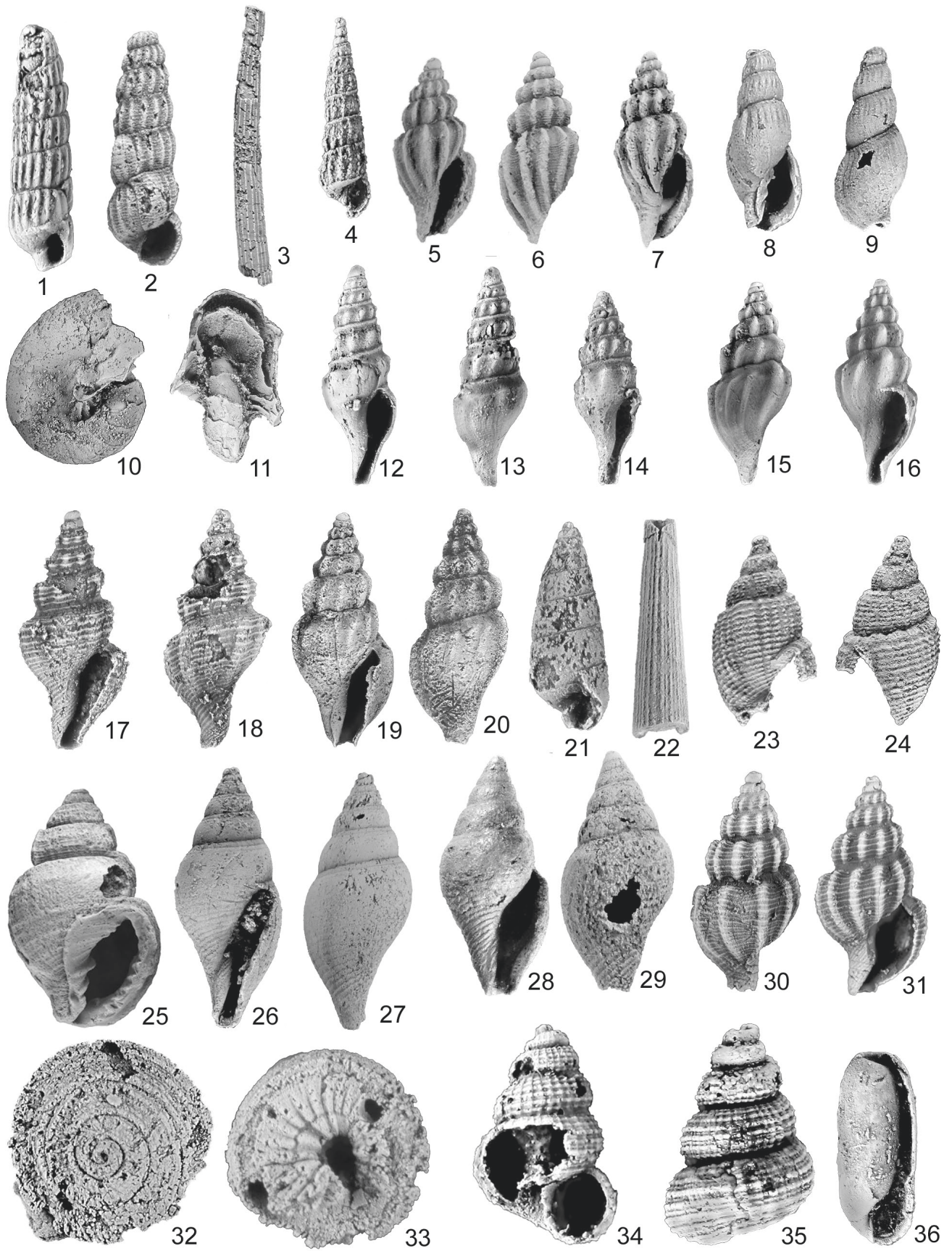
## DESCRIPTION

Shell of small size for genus (6–7 mm), elongate fusiform, spire of about five whorls, shoulder prominent. Protoconch of 1½ smooth whorls, the first whorl deviated slightly from axis of shell, merging abruptly with teleoconch whorls. Axial sculpture of strong, broad costae slightly narrower than interspaces running from shoulder to suture, six on last whorl, 9–11 on penultimate whorl, slightly weaker on last whorl and extending from shoulder to about mid whorl. Spiral sculpture of close-set, very fine threads covering whole

## FIGURE 9

- 1, *Pyrgiscus* sp.: 1, WAM 69.194 (x 10);
- 2, 4, *Turbonilla* sp.: 2, WAM 15.87 (x 7); 4, WAM 15.88 (x 5);
- 3, 22, *Fissidentalium mawsoni* Ludbrook, 1956: 3, WAM 10.10 (x 3); 22, WAM 80.1357a (x 4);
- 5, 6, 7, *Neoguraleus filiferus* sp. nov.: 5, 6, WAM 12.46 (x 7) holotype; 7, WAM 12.47 (x 7) paratype;
- 8, 9, *Turehua* sp.: 8, 9, WAM 99.207 (x 5);
- 10, 11, *Eutrophoceras?* sp.: 10, 11, WAM 15.48 (x 2);
- 12, 13, 14, *Comitas silicicola* sp. nov.: 12, 13, WAM 15.96 (x 5) holotype; 14, WAM 15.97 (x 5) paratype;
- 15, 16, *Comitas?* sp.: 15, 16, WAM 15.296 (x 4);
- 17, 18, *Comitas aldingensis* Powell, 1944: 17, 18, WAM 67.166 (x 5);
- 19, 20, *Splendrillia?* sp.: 19, 20, WAM 15.294 (x 4);
- 21, *Syrnola* sp.: WAM 15.286 (x 7);
- 23, 24, *Semitriton* sp.: 23, 24, WAM 12.08 (x 4);
- 25, *Unitas* sp.: 25, WAM 05.176b (x 3);
- 26, 27, 28, 29, *Conorbis notialis* sp. nov.: 26, 27, WAM 67.167 (x 5) holotype; 28, 29, WAM 12.43 (x 5) paratype;
- 30, 31, *Asperdaphne* sp.: 30, 31, WAM 15.289 (x 7);
- 32, 33, *Heliacus (Torinista) darraghi* Garrard, 1977: 32, 33, WAM 99.218 (x 10);
- 34, 35, *Tuba* sp.: 34, 35, WAM 15.49 (x 15);
- 36, *Cyllichna* cf. *C. angusta* (Tate & Cossmann, 1897): WAM 12.47 (x 7).





of whorl surface, except shoulder, extending onto canal. Aperture narrow, elongate, subelliptical, extending into moderately short canal; very shallow posterior sinus scarcely visible on shoulder.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 15.96, holotype	7.8	2.5	5
WAM 15.97, paratype	6.9	2.4	5
NMV P329321, paratype	6.9	2.4	4

#### ETYMOLOGY

Latin noun in apposition. Silicicola inhabitant of sand.

#### REMARKS

This species bears some resemblance to *Comitas wynyardensis cudmorei* Long, 1918, Early Oligocene, Victoria, but has broader costae and a more concave shoulder. It differs from *Comitas aldingensis* Powell, 1944, Late Eocene, Blanche Point Formation, in having finer lirae and a more prominent shoulder.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

#### ***Comitas aldingensis* Powell, 1944**

Figures 9.17–18

*Comitas (Carinocomitas) aldingensis* Powell, 1944: 18, plate 1, figure 7.

*Comitas aldingensis* Powell. Long, 1981: 22, plate 4, figures 2, 3.

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 67.166, 15.291–2; NMV P332361–3. Total 8 specimens.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 67.166	8.5	3.7	5

#### REMARKS

The carinae on the second protoconch whorl are very weak on Thomson Road specimens otherwise they closely match topotypes from Aldinga. Browns Creek specimens are somewhat midway between specimens from the previous localities, so the degree of development of the carinae seems to be rather variable.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

#### ***Comitas?* sp**

Figures 9.15–16

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.296–8; NMV P332366. Total 8 specimens.

#### DIMENSIONS

	Height	Width	No. of whorls
WAM 15.296	8.6	3.2	5

#### REMARKS

All specimens are either broken or poorly preserved. This taxon does not seem to resemble any other from the Tertiary formations of Australia.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

#### **Family Raphitomidae Bellardi, 1875**

#### **Genus *Asperdaphne* Hedley, 1922**

#### ***Asperdaphne* sp.**

Figures 9.30–31

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486. WAM 15.289–290; P332360. Total 7 specimens.

#### DESCRIPTION

Shell fusiform of about 4 convex whorls and impressed sutures, last whorl contracting abruptly to anterior canal; small for genus (5.4–6 mm). Protoconch of about two whorls, sculptured with very fine, close-set lirae, merging abruptly into teleoconch whorls. Axial sculpture of well developed, erect costae, much narrower than interspaces, 11 on penultimate whorl, 10 on last whorl. Spiral sculpture of very thin lirae, much narrower than interspaces, nine on penultimate whorl, about 19 on last whorl extending onto canal. Aperture elongate oval with short anterior canal. Posterior sulcus against posterior suture, trace of sulcus forming band against suture sculptured with fine, close-set arcuate threads.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 15.289	5.6	2.8	4

## REMARKS

This species is very similar to *Asperdaphne* sp. illustrated by Long (1981, plate 7, figure 8) from the late Eocene, Browns Creek Formation, but has more well defined costae.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Family Cancellariidae Forbes & Hanley, 1851****Genus *Turehua* Marwick, 1943*****Turehua* sp.**

Figures 9.8–9

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 99.207, 15.14; P327566. Total 4 specimens.

## DESCRIPTION

Shell small for genus (6.5–7.7 mm), narrow with convex whorls with impressed sutures. Spiral sculpture, worn, scarcely visible. Axial sculpture of thin, slightly opisthocline, non-collabral costae, slightly wider than interspaces, 28 on penultimate whorl. Whorls with a narrow posterior subsutural collar, weakly beaded where crossed by costae. Aperture elliptical; outer lip somewhat flared anteriorly, thickened externally into a weak varix. Columella overlaid with thick callus bearing three very prominent plaits; prominent anterior notch. Siphonal fasciole well developed.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 99.207	6.6	2.5	2.5	3+ specimen broken

## REMARKS

All specimens are very worn and broken. There are no taxa in the fossil record in the Australian Tertiary that resemble this species. Species of the genus are known from the Eocene and Oligocene of Europe and from Eocene to Pliocene in New Zealand.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Semitriton* Cossmann, 1903*****Semitriton* sp.**

Figures 9.23–24

## MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 12.08, 15.263; P329329. Total 4 specimens.

## DIMENSIONS

	Height	Width	No. of whorls
WAM 12.08	8.5	4.5	4 shell distorted

## REMARKS

This species is somewhat similar to *Semitriton varicosus* (Tate, 1888) from the Blanche Point Formation, but it is much narrower, has a caniculate suture and lacks the regular varices. In the latter respect it resembles the Victorian Oligocene species *S. dennanti* (Tate, 1898), but has a caniculate suture and is narrower. The species is much smaller than both the former species, but that may be because the four specimens are not mature individuals.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Genus *Unitas* Palmer, 1947*****Unitas* sp.**

Figure 9.25

## MATERIAL EXAMINED

**Australia: Western Australia:** Little Wharton Bay, near Mt Belcher, Duke of Orleans Bay: WAM 05.176b. Total 1 specimen.

## DIMENSIONS

	Height	Width	Aperture height	No. of whorls
WAM 05.176b	14.4	9.2	6.0	4+

## REMARKS

The single specimen is worn and broken. There is nothing like this taxon in the Eocene formations of eastern Australia.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation.



**Family Architectonicidae Gray, 1850****Genus *Heliacus* d'Orbigny, 1842****Subgenus *Torinista* Iredale, 1936*****Heliacus (Torinista) darraghi* Garrard, 1977?**

Figures 9.32–33

?*Heliacus (Torinista) darraghi* Garrard, 1978: 550, Figure 10 (4–6).

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: (WAM 99.218). Total 1 specimen.

**DIMENSIONS**

	Width	Height	No. of whorls
WAM 99.218	3.76	1.8	3

**REMARKS**

The material consists of one tiny, juvenile specimen, the ventral side of which compares reasonably well with the smallest specimens of topotypes, though they are nearly twice its size. The dorsal surface is so poorly preserved that comparison is not possible. The ventral surface has a wide band around the umbilicus with coarse elongate nodules then a deep narrow groove, then a wide band of folds which fade about midway to periphery. It has a small subperipheral keel or rib and a rib right on periphery. In these respects it agrees closely with topotypes.

The species is rare in the Browns Creek Formation, but is more common at the type locality, Point Flinders.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation. **Otway Basin:** Browns Creek Formation; Glenaire Clay (type).

**Family Mathildidae Dall, 1889****Genus *Tuba* Lea, 1833*****Tuba* sp.**

Figures 9.34–35

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 15.49. Total 1 specimen.

**DIMENSIONS**

	Height	Width	No. of whorls
WAM 15.49	2.5	1.6	4+

**REMARKS**

The material consists of a single, small, broken specimen. The hypostrophic protoconch of this species strongly resembles that of *Tuba valkyrie* (Powell, 1971), Recent, New Zealand. The sculpture is more coarsely cancellate than the latter species. There is a species of *Tuba* in the Paleocene Pebble Point Formation, but this species has finer lirae and no obvious siphonal fasciole. *Tuba olsoni* (Maxwell, 1969), middle Eocene to early Miocene, New Zealand, has much stronger spiral lirae that are closer together than in this species.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.

**Family Pyramidellidae Gray, 1840****Genus *Turbonilla* Risso, 1826*****Turbonilla* sp.**

Figures 9.2, 9.4

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 4 specimens (WAM 15.87–8; NMV P329312–3). Total 4 specimens.

**DESCRIPTION**

Shell elongate, of average size for genus (7.2 mm), whorls eight, convex, very weakly concave at posterior suture. Axial sculpture of sharp costae, much narrower than interspaces, 14–15 on last whorl. Spiral sculpture of very fine, close-set threads, about 20–22 on last whorl. Base with spiral sculpture only. Aperture oval.

**DIMENSIONS**

	Height	Width	No. of whorls
WAM 15.87	6.0	1.8	6+ specimen broken
WAM 15.88	7.1	1.7	8

**REMARKS**

All specimens are poorly preserved. The only complete specimen has eight whorls and a very poorly preserved heterostrophic protoconch.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.



**Genus *Pyrgiscus* Philippi, 1841*****Pyrgiscus* sp.**

Figure 9.1

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 69.194, 99.205; NMV P329311. Total 3 specimens.

**DESCRIPTION**

Shell attenuate, of at least seven whorls. Protoconch not preserved. Axial sculpture of broad costae about as wide as interspaces; last whorl with 17 costae. No trace of spiral sculpture preserved. Aperture ovate; columella with one weak plait at about midpoint.

**DIMENSIONS**

	Height	Width	No. of whorls
WAM 69.194	2.5	1.6	4+

**REMARKS**

All three specimens are poorly preserved and only one has the aperture present. This taxon bears some resemblance to *Pyrgiscus waihaoica* (Maxwell, 1992) from the Eocene of New Zealand.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation.

**Genus *Symola* A. Adams, 1860*****Symola* sp.**

Figure 9.21

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: WAM 15.286; NMV P332357. Total 2 specimens.

**DIMENSIONS**

	Height	Width	No. of whorls
WAM 15.286	5.3	2.0	6

**REMARKS**

Both specimens are poorly preserved. Specimen P332357 consists only of the anterior two whorls of the teleoconch.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation

**Family Cylichnidae H. & A. Adams, 1854****Genus *Cylichna* Lovén, 1846*****Cylichna* cf. *C. angustata* (Tate & Cossmann, 1897)**

Figure 9.36

c.f. *Bullinella angustata* Tate and Cossman, 1897: 11, pl. 1, figs 1–2.

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 3 specimens WAM 15.47; NMV P329277, P329281. Total 3 specimens.

**DIMENSIONS**

	Height	Width
WAM 15.47	5.0	1.9

**REMARKS**

There are only three specimens in the entire collection, one well preserved and one consisting of about the top third of a complete specimen and the other broken and crushed. What little there is seems similar to Tate and Cossmann's specimens from the Kent Town Bore. No other opisthobranchs were found at the Thomson Road locality or elsewhere in the Pallinup Formation.

**OCCURRENCE**

**Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation (type). **Otway Basin:** Browns Creek Formation.

**Class Scaphopoda Bronn, 1862****Family Dentaliidae Children, 1834****Genus *Fissidentalium* Fischer, 1885*****Fissidentalium mawsoni* (Ludbrook, 1956)**

Figures 9.3, 9.22

*Dentalium (Fissidentalium) mawsoni* Ludbrook, 1956: 2, plate 1, figures. 5, 6; Darragh and Kendrick, 2008, 228, Figures 3.1–2.

**MATERIAL EXAMINED**

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: 8 specimens (WAM 10.10; 10.26, NMV P317170, P317188). Lucky Bay via Esperance, track surface 4.3 km south-east from Frenchman Peak, 0.1 km from road to Lucky Bay, Merivale 264386: 1 specimen (WAM 05.58). Cape Le Grand National Park, old track surface, 3.7 km south-east of Frenchman Peak: 4

specimens (WAM 80.1357. Cape Le Grand National Park, 0.8 km north-east of turn-off to Lucky Bay, Merivale 428219: 2 specimens (WAM 07.198). Total 15 specimens.

#### DESCRIPTION

Medium sized, robust, circular to slightly oval in cross-section, almost straight, curvature slight, where visible, tending toward apex. Ribs fine to very fine, of irregular size and spacing, numbering ca. 15–17 (apex) to ca 21–34 (aperture), increasing by intercalation. One specimen with apical slit preserved.

#### DIMENSIONS

	Length	Maximum diameter
WAM 80.1357a	9.8	2.4
WAM 10.10	16.0	1.9

#### REMARKS

This is a widely distributed and long-ranging dentaliid species from the Tertiary of southern and north-western Australia. Walpole specimens have been compared with topotypes from the middle Miocene Cadell Marl (Murray Basin) and with late Eocene material from the Browns Creek Formation (Otway Basin) and are closely comparable. Specimens are not as common in the Pallinup, Blanche Point and Browns Creek formations as they are in the unnamed sandstone of the Southern Carnarvon Basin and in younger formations of the Otway, Bass and Murray basins.

Specimens WAM 89.324 (Mt Barker) and WAM 66.1230 (SE of Kendenup) are similar to the large specimens of *Fissidentalium mawsoni* from Browns Creek.

#### OCCURRENCE

Southern Carnarvon Basin: unnamed sandstone. **Eucla Basin:** Pallinup Formation. **St Vincent Basin:** Blanche Point Formation; Dry Creek Sands. **Murray Basin:** Cadell Marl Member, Morgan Limestone (type). **Otway Basin:** Browns Creek Formation; Glen Aire Clay; Jan Juc Formation; Puebla Formation; Muddy Creek Formation; Fyansford Formation. **Bass Basin:** Freestone Cove Sandstone.

**Class Cephalopoda Cuvier, 1795**

**Family Nautilidae Blainville, 1825**

**Genus *Eutrephoceras* Hyatt, 1894**

***Eutrephoceras?* sp.**

Figures 9.10–11

#### MATERIAL EXAMINED

**Australia: Western Australia:** Walpole, 24 km north of Walpole townsite on west side of Thomson Road, Deep River 743 486: (WAM 15.48) 1 specimen.

#### DIMENSIONS

	Maximum diameter	Maximum width
WAM 15.48	15.5	9.1

#### REMARKS

The unique specimen is a slightly crushed and broken juvenile. There are no saddles or lobes visible on the exposed septum, so a simple suture. The siphuncle is situated very close to the ventral margin. The cross section of the shell is somewhat narrow for typical species of *Eutrephoceras*, however, the other genera of nautiloids known from the Pallinup Formation include *Cimomia*, *Aturia* and *Teichertia*, all of which have a much more complicated suture than that present in this specimen. Darragh and Kendrick (2008) record juvenile specimens of a species of *Eutrephoceras* from the Late Eocene unnamed formation near Kalbarri in the Southern Carnarvon Basin, similar sized specimens of which seem much broader than the Thomson Road specimen, even allowing for the slight crushing of the latter, however, as there is only one poorly preserved specimen to compare, such a difference may not be real.

#### OCCURRENCE

**Eucla Basin:** Pallinup Formation.

**Class Bivalvia Linnaeus 1758**

**Family Cardiidae Lamarck, 1809**

**Genus *Hedecardium* Marwick, 1944**

***Hedecardium monilectum* (Tate, 1887)**

Figure 10

*Cardium monilectum* Tate, 1887: 151, plate 14, figure 3a–b.

#### MATERIAL EXAMINED

**Australia: Western Australia:** Green Range, Plantagenet location 6475. WAM 76.06 1 specimen.



**FIGURE 10** *Hedecardium monilectum* (Tate, 1887): WAM 76.06 (x 2) Green Range, Plantagenet location 6475.

## DIMENSIONS

	Length	Height
WAM 76.06	26.0	23.0

## REMARKS

This specimen, a slightly distorted external mould, agrees fairly well with a specimen of this species from South Australia and matches Tate's figure.

## OCCURRENCE

**Eucla Basin:** Pallinup Formation. **St Vincents Basin:** Blanche Point Formation (type).

## ACKNOWLEDGEMENTS

I thank Alan Beu, Rudiger Bieler, Roland Houart, Bruce Marshall and Marco Oliverio for advice on generic assignments; Mary-Ann Binnie for facilitating access to the Tate collection at the South Australian Museum; John Pickett and Andrzej Pisera for advice on the sponge fauna; Paul Gammon, Alan Monger and Brian McGowran for providing necessary literature; Carole Hickman and Bruce Marshall for information on gastropod feeding, Helen Ryan and Cassia Piper for assisting with loans from the Western Australian Museum and Alan Longbottom for assistance in the field. David Holloway gave helpful comments on a draft of the introduction and advice on photography. I am grateful to Alan Beu, Bruce Marshall and Ken McNamara who provided useful comments on the final manuscript.

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MANUSCRIPT RECEIVED 26 OCTOBER 2016; ACCEPTED 27 MARCH 2017.

## ADDENDUM

Whilst this paper was in final stages a further paper has been published on the sponge fauna of the Pallinup Formation:

- Lukowiak, M. and Pisera, A. (2017). Bodily preserved Eocene non-lithistid demosponge fauna from southern Australia: taxonomy and affinities. *Journal of Systematic Palaeontology* **15**: 473–497.