

HEFT 54 (1-2) / July 2023

CONCHYLIA

ISSN 1869-5302

NEUBESCHREIBUNGEN

**Angariidae, Bothriembryontidae,
Costellariidae, Mitridae, Volutidae**

REGIONEN

Australia (New South Wales, Queensland,
South Australia, Western Australia), Ecuador, Panama



Description of three new species of *Bothriembryon* (Gastropoda: Stylommatophora: Bothriembryontidae) from Dundas Shire in the south east of Western Australia

BY HUGH M. MORRISON & BEN SCHNEIDER, AUS–Perth

With 1 Map, 7 Text-Figures and 50 Figures on Plates 1-4

Keywords

Gastropoda, Stylommatophora, Bothriembryontidae, *Bothriembryon bicinctus* n. sp., *Bothriembryon rusticus* n. sp., Kalbarri, *Bothriembryon corylus* n. sp., Dundas Shire, Western Australia.

Abstract

Three new species of *Bothriembryon* PILSBRY, 1894 discovered along the isolated Fraser Range Road are described. *Bothriembryon bicinctus* n. sp. is described from the area adjacent to the junction of Fraser Range Road and the Norseman to Balladonia Overland Telegraph Track, within the Dundas Nature Reserve, south east of Norseman. It is compared with *Bothriembryon angasianus* (PFEIFFER, 1864) and *B. balteolus* IREDALE, 1939. It differs from all other species within the genus *Bothriembryon* by its large but thin shell, busy, finely reticulated sculpture and distinct colour pattern of a prominent pre sutural zone of yellow becoming two parallel spiral bands on the body whorl.

Bothriembryon rusticus n. sp. is described from the junction of Fraser Range Road and the Eyre Highway, to at least 60 km south towards the type locality of *B. bicinctus* n. sp. and appears to be sympatric with that species over at least part of its range. It is compared with *Bothriembryon corylus* n. sp., *B. fragilis* MORRISON, SCHNEIDER & WHISSON, 2019 and *B. nanambinia* MORRISON, 2021. It differs from all other species within the genus by its diminutive size, very thin, fragile shell, prominent protoconch with distinct honeycomb sculpture and lattice like sculpture over the body whorl.

Bothriembryon corylus n. sp. is described from the southern section of Fraser Range Road, east south east of Salmon Gums. It currently does not appear to be sympatric with the above two newly discovered species. It is compared with *Bothriembryon rusticus* n. sp. and *B. grohi* MORRISON & SCHNEIDER, 2022. It differs from all other species within the genus by its relatively small size, thin, globose, fragile shell, a distinctive snowflake pattern over the body whorl and two-tone colour palette of pale spire and dark brown body whorl and aperture.

Zusammenfassung

Drei neue Arten von *Bothriembryon* PILSBRY, 1894 werden beschrieben, die entlang der abgelegenen Fraser Range Road entdeckt wurden. *Bothriembryon bicinctus*

n. sp. wird aus dem an der Kreuzung von Fraser Range Road und des Norseman to Balladonia Overland Telegraph Track gelegenen Gebiets innerhalb der Dundas Nature Reserve, südöstlich von Norseman beschrieben. Sie wird mit *Bothriembryon angasianus* (PFEIFFER, 1864) und *B. balteolus* IREDALE, 1939 verglichen und unterscheidet sich von allen anderen Arten innerhalb der Gattung *Bothriembryon* durch ihr großes, aber dünnes Gehäuse, die lebhaft, fein netzartige Skulptur und ein deutliches gelbes Farbmuster einer markanten Stelle unterhalb der Naht, die sich bis hin zu zwei parallelen Spiralbändern auf dem Körperwirbel erstreckt.

Bothriembryon rusticus n. sp. wird von der Kreuzung der Fraser Range Road und des Eyre Highway bis mindestens 60 km südlich in Richtung der Typuslokalität von *B. bicinctus* n. sp. beschrieben und scheint mit dieser Art zumindest teilweise sympatrisch zu leben. Sie wird mit *Bothriembryon corylus* n. sp., *B. fragilis* MORRISON, SCHNEIDER & WHISSON, 2019, sowie *B. nanambinia* MORRISON, 2021 verglichen. Sie unterscheidet sich von allen anderen Arten innerhalb der Gattung durch ihre sehr geringe Größe, die sehr dünne, zerbrechliche Schale, den markanten Protoconch mit ausgeprägter wabenartiger Skulptur und eine gitterförmige Ornamentierung auf dem letzten Umgang.

Bothriembryon corylus n. sp. wird vom südlichen Abschnitt der Fraser Range Road, ost-südöstlich von Salmon Gums, beschrieben. Diese Art scheint nicht sympatrisch mit den beiden oben genannten, neu entdeckten Arten aufzutreten. Sie wird mit *Bothriembryon rusticus* n. sp. und *B. grohi* MORRISON & SCHNEIDER, 2022 verglichen. Sie unterscheidet sich von allen anderen Arten innerhalb der Gattung durch ihre relativ geringe Größe, das dünnchalige, kugelige Gehäuse, ein markantes Schneeflockenmuster oberhalb der Körperwindung und den zweifarbigen Kontrast zwischen blassem Gewinde und dunkelbrauner Körperwindung und Mündung.

Introduction

Settlers first arrived in Western Australia (WA) at Albany on the south coast in 1826, however its official status as the “Swan River Colony” did not occur until May 1829 (APPLEYARD & MANFORD 1979: 33). All communication with both Britain and the eastern states of Australia was by ship. In 1840 EDWARD JOHN EYRE traversed the coast line of the Great

Australian Bight and Nullarbor Plain from Adelaide, South Australia (SA) to Albany in WA. This route formed the basis for an overland telegraph line and basic track, completed in 1877, which finally linked WA with the eastern Australian colonies (WILLIAM 1954). Pastoral leases slowly spread along the telegraph line route (MORRISON & SCHNEIDER 2021), which remained in use until the 1940's. A new road, the "Eyre Highway" was eventually constructed north of the telegraph line track and opened for traffic in 1942. These two land links formed the basis for access tracks to the various homesteads and telegraph stations across the south east of WA. The telegraph stations remained in use well into the 20th century but by the 1940's had fallen into disrepair with many of the access tracks becoming unpassable. During the 1980's and 90's a new phase of exploration began in the Shire of Dundas (population: 677, LGA 2021), primarily searching for minerals. Various tracks used by geologists quickly disappeared again unless deposits of useful minerals were found. Many small exploratory excavations were undertaken, but to date no significant deposits have been found. The Dundas Nature Reserve now covers approximately 780,000 hectares of the area, with sole access via the few remaining tracks which are maintained by local station owners.

It is along one of these near impassable tracks, the Fraser Range Road, that three new *Bothriembryon* species have been discovered and are herein described.

Abbreviations & Acronyms

AC	ANDREW CUMMINGS collection, Perth, Western Australia
BS	BEN SCHNEIDER collection, Perth, Western Australia
DMH	DEREK MEAD HUNTER collection, Perth, Western Australia
ENE	east north east
GE	Google Earth
GPS	Global Positioning System
HM	HUGH MORRISON collection, Perth, Western Australia
KG	KLAUS GROH collection, Bad Dürkheim, Germany
km	kilometre(s)
LGA	Local government area (Australian Bureau of Statistics)
NTM	Museum & Art Gallery of the Northern Territory, Darwin, Australia
SA	South Australia
WA	Western Australia
WM	WAYNE MARSHALL collection, Augusta, Western Australia

WAM Western Australian Museum,
Perth, Western Australia

h: height
mm: millimetres
n: sample size
w: width

Materials and Methods

Microscope Leica M205C and associated camera Leica DFC7000T were used for extreme closeup sculpture and protoconch photography.

Systematics

Family Bothriembryontidae IREDALE, 1937

Subfamily Bothriembryontinae IREDALE, 1937

Genus *Bothriembryon* PILSBRY, 1894

Type species *Helix melo* QUOY & GAIMARD, 1832
by original designation.

Bothriembryon bicinctus n. sp.

(Pl. 1, Figs 1-10, Pl. 4, Figs 38, 39 and 48)

Type Material

Holotype: WAM S_112363, Type Locality: Western Australia, Dundas Shire, 25 km in a southerly direction along Fraser Range Road from the Old Telegraph Line Track junction, 32° 33' 04.0" S, 122° 26' 57.6" E. (GE). Taken live under leaf litter, September 2022. h: 26.5 mm, w: 18.1 mm. (Pl. 1, Figs 1-6, Pl. 4, Figs 38, 39 & 48).

Paratype 1: NTM P.64607, location as for holotype. h: 25.8 mm, w: 17.2 mm (Pl. 1, Fig. 7-8).

Paratype 2: BS BOTH-L0182a, Western Australia, Dundas Shire, 14 km west of the crossing of the Old Telegraph Line with Fraser Range Road, on the Old Telegraph Line, 32° 24' 06.7" S, 122° 19' 31.0" E. (GE). h: 27.4 mm, w: 15.4 mm (Pl. 1, Fig. 9-10).

Paratype 3: KG, location as for holotype. h: 23.3 mm, w: 16.3 mm.

Paratype 4: HM, location as for holotype. h: 26.0 mm, w: 16.3 mm.

Paratype 5: WAM S 112364, location as for holotype. h: 25.3 mm, w: 16.2 mm.

Paratype 6: WAM S 112365, location as for holotype. h: 26.0 mm, w: 16.4 mm.

Paratype 7: BS, location as for holotype. h: 22.6 mm, w: 15.6 mm.

Paratype 8: DMH, location as for holotype. h: 23.6 mm, w: 15.9 mm.

Paratype 9: BS, location as for Paratype 2. h: 23.1 mm, w: 14.9 mm.

Paratype 10: AC, location as for holotype, h: 24.1 mm, w: 17.0 mm.

Paratype 11: AC, location as for holotype, h: 23.0 mm, w: 15.9 mm.

Paratype 12: HM, subadult, location as for holotype, h: 21.8 mm, w: 15.7 mm

Paratype 13: HM, location as for holotype, h: 24.4 mm, w: 16.3 mm

Paratype 14: HM, location as for holotype, h: 25.8 mm, w: 17.4 mm

Paratype 15: BS, subadult, location as for holotype, h: 20.9 mm, w: 15.5 mm

Paratype 16: WAM S 79988, (wet), location as for paratype 2, coll. 4th of June 2017. h: 20.78 mm, w: 14.37 mm.

Paratype 17: WAM S 79989, (wet), location as for paratype 2, coll. 4th of June 2017. h: 23.09 mm, w: 15.44 mm.

Paratype 18: WAM S 79990, (wet), location as for paratype 2, coll. 4th of June 2017. h: 21.08 mm, w: 14.63 mm.

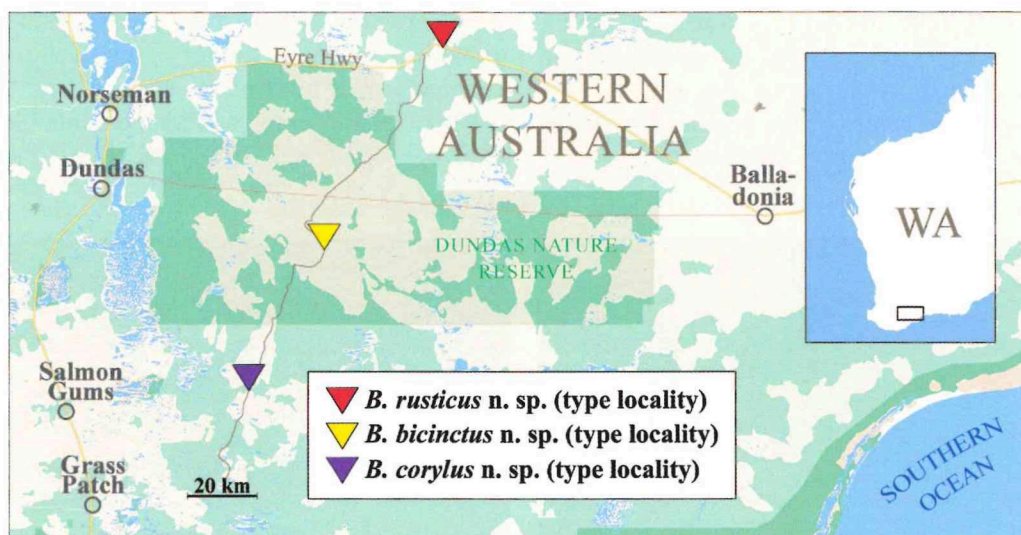
Comparative Material

Bothriembryon angasianus (PFEIFFER, 1864), 2 lots from HM.

Bothriembryon balteolus IREDALE, 1939, 15 lots from AC, 10 lots from BS, 16 lots from HM.

Type Locality

Australia, Western Australia, Dundas Shire, 25 km in a southerly direction along Fraser Range Road from the Old Telegraph Line Track junction. 32° 33' 04.0" S, 122° 26' 57.6" E (GE). This location lies approximately 15 km due south of the junction (see Map 1).



Map 1: Regional map of Dundas Shire area with Telegraph Line Track (red line), Fraser Range Road (brown line) and type localities of *Bothriembryon bicinctus* n. sp., *B. rusticus* n. sp. and *B. corylus* n. sp.

Distribution and Habitat

The currently confirmed distribution of *B. bicinctus* n. sp. is approximately 25 km in a southerly direction along Fraser Range Road from the Old Telegraph Line Track junction, and approx. 14 km due west along the Old Telegraph Line Track (paratype 2). Extensive searches to the north and east have so far failed to find any further evidence of this distinctive snail. The area is relatively flat at an altitude of approximately 300 metres above sea level and is covered with dense thickets of Mallee woodland, Acacia bush and thick low level scrub. The road (track) becomes overgrown with grasses during periods of rainfall and almost impassable to all but four-wheel drive vehicles. *B. bicinctus* n. sp. is found under leaf litter mats below Mallee trees and as dead snails adjacent to the track.



Text-Fig. 1: Habitat for *Bothriembryon bicinctus* n. sp.

Description

Shell: medium to medium large size for genus (average height (h): 24.3 mm, n = 16), ovate (h / w ratio: 0.67, n = 16), lightweight, thin to very thin, spire low (spire h / total h ratio: ~ 0.19) with 5.5 rapidly expanding whorls. Protoconch of 1 ½ to 2

whorls (diameter: ~1.85 mm) prominent, pitted centrally, with fine axial striae giving a wavy appearance which becomes obsolete towards the poorly defined protoconch / teleoconch junction, teleoconch of 2 ½ rapidly expanding convex whorls sculptured with very fine spiral grooves that are crossed by equally fine axial ridges, giving an almost beaded appearance, becoming more pronounced towards the body whorl, where the bead-like sculpture continues onwards to the lip over the upper portion to approximately the centre of the whorl, where the spiral grooves cease with only axial cords continuing towards the umbilicus; aperture large (total h / aperture h ratio: ~ 0.59), swollen centrally, lip simple, thin, becoming slightly thickened towards the columella, which is thin, partly covering the deep umbilicus, parietal callus absent. Colour overall brown to dark brown with a wide cream / yellow band developing on the central teleoconch whorl above the suture, then moving toward the centre of the penultimate whorl and crossing the body whorl adjacent to a second

pale band emanating from the aperture to create a pair of parallel yellow bands over the central part of the body whorl, aperture brown with the parallel banding of the outer shell clearly showing through, columella dark brown.

Variation of shell characters: There is little variation in shape or size of adults in the type series, however paratype 2 is a more elongate shell (h / w ratio: 0.56), as opposed to the average for the series (0.67). The colour intensity of the parallel spiral line pattern varies and rarely shells exhibit only one band (paratype 11), while paratype 12 has 3 spiral bands. In all cases, the yellow spiral pattern becomes more prominent as the shells fade, with dead shells having very pronounced banding.

Animal: The animal of *B. bicinctus* n. sp. is predominantly dark grey with distinct black venation creating lighter grey cells arranged randomly over most of the surface. The eye stalks are tipped darker grey and an indistinct black stripe is present on the head of the snail (Text-Figs 2 & 3).



Text-Figs 2 & 3: *Bothriembryon bicinctus* n. sp. holotype, live animal.

Discussion

Bothriembryon bicinctus n. sp. is unusual for the genus in being large and very distinct in an area surrounded by small, fragile species, such as *B. rusticus* n. sp. (sympatric), *B. corylus* n. sp. to the south and *B. fragilis* MORRISON, SCHNEIDER & WHISSON, 2019, *B. nanambinia* MORRISON, 2021 and *B. cummingsi* MORRISON & SCHNEIDER, 2021 to the east and south east. The closest snails of equivalent size are the *Bothriembryon balteolus* (IREDALE, 1939) complex found 100 km to the west along the Norseman – Esperance Road. It is here compared with *B. angasianus* (PFEIFFER, 1864) from SA only as it has a somewhat similar colour pattern.

Comparison

Bothriembryon bicinctus n. sp. is distinguished by its large, globose shell (Pl. 1, Figs 1-2 & 7-10), very

fine reticulated or beaded sculpture of the teleoconch and upper body whorl (Pl. 4, Fig. 48), a distinct single yellow band on the teleoconch, which becomes a pair of parallel bands over the body whorl (Pl. 1, Figs 1-2, 7-8, 9-10, Pl. 4, Figs 38-39). There is no *Bothriembryon* species which can be confused with *B. bicinctus* n. sp., however *B. balteolus* IREDALE, 1939 is part of a complex of snails of similar size situated 100 km to the west. This group of species includes at least 2 and up to 5 undescribed species and also includes shells with a single body band. *B. balteolus* is readily separated by its smaller size (average h: 22.4 mm, n = 28) compared with the average size of 24.3 mm for the type series of *B. bicinctus* n. sp. as well as the predominantly cream / white shell with a single dark central band (IREDALE, 1939) (Pl. 1, Figs 11-12). STANISIC et al (2017) illustrate a shell (species 76, page 109) which is clearly not *B. balteolus*, but does

appear to be one of the as yet undescribed species from the *B. balteolus* complex.

Bothriembryon angasianus (PFEIFFER, 1864) is well illustrated by STANISIC et al. (2017) and shows a small shell (20 mm), patterned with a pale band bordered by dark spiral lines. The small size, distinct colour pattern and 1,200 km of geographical distance between the two species readily separate *B. angasianus* from *B. bicinctus* n. sp.

Etymology

This species is named to highlight the distinctive colour pattern of twin parallel spiral lines on the body whorl.

Bothriembryon rusticus n. sp.

(Pl. 2, Figs 13-24, Pl. 4, Figs 40, 41 & 49)

Type Material

Holotype: WAM S_112366, Type Locality: Western Australia, Dundas Shire, 101 km east of Norseman along Eyre Highway, 32° 00' 56.9" S, 122° 49' 23.6" E (GE). Taken live under moist leaf litter and fallen Mallee tree branches, June 2013. h: 13.1 mm, w: 9.8 mm (Pl. 2, Figs 13-18, Pl. 4, Figs 40, 41 & 49).

Paratype 1: AC, Western Australia, Dundas Shire, 14 km west of the crossing of the Old Telegraph Line with Fraser Range Road, on the Old Telegraph Line, 32° 24' 06.7" S, 122° 19' 31.0" E. (GE). h: 14.5 mm, w: 9.4 mm (Pl. 2, Fig. 19-20).

Paratype 2: NTM P.64608, location as for paratype 1. h: 13.5 mm, w: 9.3 mm (Pl. 2, Fig. 21-22).

Paratype 3: WAM S_112367, location as for holotype. h: 13.2 mm, w: 8.9 mm (Pl. 2, Fig. 23-24).

Paratype 4: KG, location as for paratype 1. h: 13.7 mm, w: 9.5 mm.

Paratype 5: DMH, location as for paratype 1. h: 13.5 mm, w: 9.1 mm.

Paratype 6: BS, BOTH-L0122, location as for holotype. h: 12.3 mm, w: 9.0 mm.

Paratype 7: BS, BOTH-L0122, location as for holotype. h: 12.0 mm, w: 8.1 mm.

Paratype 8: HM, location as for paratype 1. h: 14.8 mm, w: 10.0 mm.

Paratype 9: HM, location as for paratype 1. h: 13.5 mm, w: 10.1 mm.

Paratype 10: HM, location as for paratype 1. h: 13.8 mm, w: 9.7 mm.

Paratype 11: HM, location as for paratype 1. h: 11.9 mm, w: 8.7 mm.

Comparative Material

Bothriembryon corylus n. sp., type series.

Bothriembryon fragilis MORRISON, SCHNEIDER & WHISSON, 2019, original type series.

Bothriembryon nanambinia MORRISON, 2021, original type series.

Type Locality

Australia, Western Australia, Dundas Shire, Eyre Highway, 101 km east of Norseman along Eyre Highway, 32° 00' 56.9" S, 122° 49' 23.6" E (GE). This location lies within 50 metres of the highway. (see Map 1).

Distribution and Habitat

Living specimens of *B. rusticus* n. sp. have been found along the Fraser Range Road from the Eyre Highway in the north (32° 00' 56.9" S, 122° 49' 23.6" E) (holotype) to at least 63 km south, partially encompassing the *B. bicinctus* n. sp. range. The northern limit at the Eyre Highway seems to suggest that *B. rusticus* n. sp. may be sympatric with several other as yet unnamed species (see discussion below). The habitat appears to be the same as for *B. bicinctus* n. sp., i.e. Mallee woodland with thick understory, with both species inhabiting the dense leaf litter mats below the trees (see Text Fig. 1).

Description

Shell: small size for genus (average height (h): 13.3 mm, n = 12), ovate, elongate (h / w ratio: 0.69, n = 12), very lightweight, thin to very thin, spire slightly elevated (spire h / total h ratio: ~ 0.15) with 5 to 5 ½ rapidly expanding whorls. Dome-like protoconch of 2 whorls (diameter: ~ 1.65 mm) prominent, pitted centrally, with hexagonal texture giving a honeycomb appearance which becomes obsolete towards the ill-defined protoconch – teleoconch junction, teleoconch of 2 ½ whorls consisting of rapidly expanding convex whorls sculptured initially with 3-5 fine spiral grooves expanding to 10 or more over the penultimate whorl, crossed by very fine axial ribs, becoming more prominent on the body whorl giving a distinct lattice-like sculpture; aperture large (total h / aperture h ratio: ~ 0.62, n = 12), swollen abapically, extending significantly below umbilicus, lip simple, thin, becoming slightly broader towards the columella, which partially covers a narrow, deep umbilicus, parietal callus absent. Colour predominantly translucent straw / tan to slightly rusty red over most of the shell with lighter vertical bands following growth lines on the body whorl, aperture translucent, straw coloured as is columella.

Variation of shell characters: There is little variation within the type series, with height within 2 mm of each other. There is a slightly larger range of width, i.e. 8.1 mm (paratype 7) to 10.1 mm

(paratype 9), giving an impression of a slightly broader shape in some specimens. Colour is generally consistent throughout except some specimens have a more intense pink / red protoconch (paratype 2) (Pl. 2, Fig. 21-22).

Animal: To date, photography of living animals has been unsuccessful. Although the species has been found alive, all specimens perished during transport.

Discussion

For many years, small dead specimens of *Bothriembryon* have been found along the Eyre Highway near the Fraser Range, westward towards Norseman (32.1978° S, 121.7789° E) and over 130 km northward along the Coolgardie to Esperance Highway to at least Kambalda (31.2016° S, 121.6625° E). The material available is unfortunately almost always either dead and in poor condition or extremely juvenile (pers. comm. COREY WHISSON). This lack of quality material has made a distinct delineation of species over this large area to date very difficult. With the discovery of the *B. rusticus* n. sp. population south of the Eyre Highway it became possible to clearly define these snails as a homogenous species and to compare them with *B. corylus* n. sp. further to the south. The snails to the north of the Eyre Highway possibly represent at least two if not more as yet undescribed species.

Comparison

Bothriembryon rusticus n. sp. is distinguished from all other members of the genus by its very small size (2nd smallest *Bothriembryon* species to date, average height 13.3 mm, n = 12), taller shape with translucent shell and uniform straw / tan colour (Pl. 2, Figs 13-14 & 19-24, Pl. 4, Figs 40-41) and distinct lattice sculpture over the penultimate and body whorls (Pl. 2, Figs 17-18, Pl. 4, Fig. 49). The closest congener species is *B. fragilis* MORRISON, SCHNEIDER & WHISSON, 2019, which is readily separated by its larger size (average height 15.9 mm, n = 11) compared with *B. rusticus* n. sp. (average height 13.3 mm, n = 12), much taller spire with 6 whorls compared with *B. rusticus* n. sp., differently sculptured protoconch and distinctly different sculpture on the body whorl (Pl. 4, Figs 42-43). The much larger sized *B. nanambinia* MORRISON, 2021 (average height 18.0 mm, n = 15) is also more heavily sculptured and has distinct vertical cream lines over much of the shell (Pl. 4, Figs 44-45).

Bothriembryon corylus n. sp. has a globose shape, a very clear two-tone colour palette and dark brown aperture (Pl. 3, Figs 25-26 & Figs 30-35, Pl. 4, Figs 46-47). Its larger size (average height 17.6 mm, n = 14) and more robust shell also help to set this geographically separate (47 km) species apart.

Etymology

The name *rusticus* implies an isolated and rural environment and also alludes to the rusty / tan colour of the shell.

Bothriembryon corylus n. sp.

(Pl. 3, Figs 25-35, Pl. 4, Figs 46, 47 & 50)

Type Material

Holotype: WAM S_112368, Type Locality: Western Australia, Fraser Range Road, at T junction of unnamed track connecting to Davies Road, which lies 26 km to the west of Fraser Range Road, 32° 55' 21.5" S, 122° 12' 47.8" E. (GE). Taken live, aestivating at the base of a Mallee tree, in humus rich sand, August 2021 (wet collection, DNA extraction). h: 16.8 mm, w: 12.1 mm (Pl. 3, Figs 25-29, Pl. 4, Figs 46, 47 & 50).

Paratype 1: WM, location as for holotype. h: 17.4 mm, w: 12.6 mm (Pl. 3, Figs 30-31).

Paratype 2: HM, location as for holotype. h: 17.5 mm, w: 11.9 mm (Pl. 3, Figs 32-33).

Paratype 3: BS, subadult, location as for holotype. h: 14.2 mm, w: 10.3 mm (Pl. 3, Figs 34-35).

Paratype 4: NTM P.64609, location as for holotype. h: 15.5 mm, w: 11.2 mm.

Paratype 5: KG, location as for holotype. h: 18.3 mm, w: 12.2 mm.

Paratype 6: DMH, location as for holotype. h: 17.9 mm, w: 12.5 mm.

Paratype 7: AJC, location as for holotype. h: 17.9 mm, w: 13.9 mm.

Paratype 8: BS, location as for holotype. h: 18.8 mm, w: 12.5 mm.

Paratype 9: HM, location as for holotype. h: 17.9 mm, w: 12.7 mm.

Paratype 10: BS, location as for holotype. h: 18.4 mm, w: 12.7 mm.

Paratype 11: HM, location as for holotype. h: 18.5 mm, w: 12.5 mm.

Paratype 12: BS, location as for holotype. h: 17.3 mm, w: 12.2 mm.

Paratype 13: HM, location as for holotype. h: 20.0 mm, w: 12.9 mm.

Comparative Material

Bothriembryon rusticus n. sp., type series.

Bothriembryon grohi MORRISON & SCHNEIDER, 2022, type series.

Type Locality

Australia, Western Australia, Dundas Shire, Fraser Range Road at T junction of unnamed track connecting to Davies Road, which lies 26 km to the west of Fraser Range Road, 32° 55' 21.5" S, 122° 12' 47.8" E (GE). This location is approximately 47 km south of the *B. bicinctus* n. sp. type locality and 54 km east north east of Salmon Gums (see Map 1).

Distribution and Habitat



Text-Fig. 4: Habitat for *Bothriembryon corylus* n. sp.

Bothriembryon corylus n. sp. is only known from the type locality. Due to the lack of access east or west of the Fraser Range Road, the only area searched is north and south of the type locality. To date, the only live specimens are the holotype and paratypes 1 to 3, with the remainder of the type series found dead. The area is characterised by open woodland of low Mallee trees scattered among small bushes and shrubs with large areas of open reddish clay soil. The vegetation is diverse and differs considerably from the habitat surrounding the two previously discussed species. The holotype and paratype 3 were located together buried in sand at the base of a small Mallee tree (see Text-Fig. 4).

Description

Shell: Small size for genus (average h: 17.6 mm, n = 14), ovate, globose (h / w ratio: 0.70, n = 14), relatively lightweight but not thin, spire very low (spire h / total h ratio: ~ 0.13) with 5 rapidly expanding whorls. Protoconch of 2 whorls (diameter: 2.1 mm) prominent, large for this small species, pitted centrally with very fine wavy sculpture, becoming obsolete towards protoconch / teleoconch junction, teleoconch of 2 rapidly expanding, convex whorls sculptured with 12-15 shallow spiral grooves interrupted by obscure growth lines giving a slightly cross-hatched appearance, becoming confined to the subsutural zone of the body whorl with the remainder of the whorl crossed by pale axial growth lines; aperture large (total h / aperture h ratio: ~ 0.68), swollen abapically, lip simple, thin, becoming broad towards the columella, which partly covers a shallow umbilicus, parietal callus absent. Colour predominantly straw / tan over teleoconch whorls, becoming darker brown on the body whorl, cream / tan striae of varying width highlighting axial growth lines, interspersed with discrete snowflake like patches between vertical lines, aperture and columella dark brown.

Variation of shell characters: There is little variation in size or shape within the type series. The majority of specimens within the type series were collected dead and therefore lack the intense colour of the holotype and paratypes 1 to 3. These four specimens are uniform in both external and aperture colouration.

Animal: The animal of *B. corylus* n. sp. is plain brown coloured along the body, flank and tail, darkening towards grey on the back and head, which are otherwise without distinguishing markings (Text-Figs 5 & 6).



Text-Figs 5 & 6: *Bothriembryon corylus* n. sp., live animal

Discussion

Over the past 10 years, significant efforts have been made in searching for the “small brown Both species”, which occur along the Coolgardie to Esperance Highway and toward Balladonia. To date at least five separate species have been discovered, of which *B. rusticus* n. sp. and *B. corylus* n. sp. are but two. *B. corylus* n. sp. is the most southerly occurring and most distinct species of this group of small snails due to its thick, globose shell, which separates it from the closest congener (*B. rusticus* n. sp.) as well as the other four species. The habitat in this southern area is more diverse with a higher average rain fall allowing limited wheat and sheep agriculture 22 km to the south west. It is perhaps this less hostile environment which allowed *B. corylus* n. sp. to develop a thicker shell (Pl. 3, Figs 25-29, 30-35, Pl. 4, Figs 46-47). This same more benign habitat is also where *Bothriembryon dux* (PFEIFFER, 1861) is found in large numbers. *B. dux* is the largest and heaviest *Bothriembryon* species in WA and provides an important food source for Grey Currawong birds, *Strepera versicolor plumbea* (A. LONGBOTTOM, B. SCHNEIDER, D. MEAD-HUNTER, pers. comm.). This predation is obvious as the birds use rocks or logs as anvils on which to shatter shells to consume the animals (see Text-Fig. 7).



Text-Fig. 7: Broken *B. dux* shells surrounding a rock used as anvil by birds.

Comparison

Bothriembryon corylus n. sp. is distinguished by its small size, globose shell and distinct two-tone brown colour palette of pale teleoconch and darker body whorl ornamented with axial white lines and snowflake pattern (Pl. 3, Figs 25-29, 30-35, Pl. 4, Figs 46-47). There is no close congener species other than *B. rusticus* n. sp., which is the geographically closest small brown species, however its taller thin fragile shell and greenish brown colour readily separate it from *B. corylus* n. sp. The globose thicker shell and dark brown aperture of

B. corylus n. sp. is evident even with dead and faded shells.

The only *Bothriembryon* species which is vaguely similar to *B. corylus* n. sp. is *B. grohi* MORRISON & SCHNEIDER, 2022 with its near equally small size (average h: 13.8 mm, n = 21), globose shape and dark brown aperture (Pl. 3, Figs 36-37). The prominent white lip (Pl. 3, Fig. 37), distinctly pustulose sculpture (Pl. 3, Fig. 36) and geographical separation of approximately 950 km set *B. grohi* apart from any of the small snails of the south east of WA.

Etymology

This species is named to highlight the similarity to a hazelnut with the pale transverse lines on brown and dark interior of the husk it shares with these rare and fragile snails.

Acknowledgements

We wish to thank ANDREW CUMMINGS and WAYNE MARSHALL for collecting material for this study and for information regarding the habitat and general environment in which the snails are found. We would also like to thank COREY WHISSON of the WAM for the use of specimens within the collection and for valuable information regarding the remaining undescribed species within the study area. We would especially like to acknowledge the assistance of AMANDA CHARLES and DANIELLE HALLIDAY of the Department of Water & Environmental Regulation for providing access and assistance in the use of the Leica microscope for protoconch imaging. KLAUS GROH helped with final preparation and SIMONE PFUETZNER assisted with research and editing of plates and manuscript.

References

- APPLEYARD, R. T & MANFORD, T. (1979): The beginning. European discovery and early settlement of Swan River, Western Australia. – 239 pp., Nedlands, W.A. (University of Western Australia Press).
- Australian Bureau of Statistics (2023): <https://www.abs.gov.au/census/find-census-data/quickstats/2021/LGA53080>, accessed 15/01/2023.
- IREDALE T. (1939): A review of the land Mollusca of Western Australia. – Records of the Western Australian Museum and Art Gallery, 2 (1): 1-88. [Published 1.viii.1939; same text re-published 21.viii.1939 in Journal of the Royal Society of Western Australia, 25: 1-88 (read before the Society on 13.ix.1938, but publication delayed)].

MORRISON, H. M. (2021): Description of two new species of *Bothriembryon* (Gastropoda: Stylommatophora, Bothriembryontidae) from the Semi-Arid Zone of the Southeast Corner of Western Australia. – *Conchylia*, **52** (1-2): 3-18.

MORRISON, H. M. & SCHNEIDER, B. (2022): Description of two New Species of *Bothriembryon* (Gastropoda, Stylommatophora: Bothriembryontidae) from near Kalbarri in the Mid West Region of Western Australia. – *Conchylia*, **52** (3-4): 15-29.

MORRISON, H. M., SCHNEIDER, B. & WHISSON, C. S. (2019): A New Species of the Genus *Bothriembryon* (Gastropoda: Bothriembryontidae) from the Shire of Esperance, Western Australia. – *Conchylia*, **50** (1-4): 15-24.

STANISIC, J., SHEA, M., POTTER, D. & GRIFFITHS, O. (2017): Australian Land Snails, Volume 2. A field guide to southern, central and western species. – 594 pp., Sydney (Bioculture Press for Australian Museum).

WILLIAM, D. (1954): Governor WELD Pushed The Telegraph. – *The West Australian* (Perth, WA: 1879-1954), 04 December 1954: p. 24.

Addresses of the authors:

HUGH MORRISON
5 Ealing Mews, Kingsley WA 6026, Perth
Western Australia
E-mail: hugh@seashells.net.au

BEN SCHNEIDER
47 Aldersea Circle, Clarkson WA 6030, Perth
Western Australia
E-mail: besc@iinet.net.au

Received: 29. April 2023

Accepted: 1. May 2023

Plate 1 (on page 80)

Figs 1-12: Holotype and paratypes 1-2 of *Bothriembryon bicinctus* n. sp., compared with *Bothriembryon balteolus* (IREDALE, 1939).

Figs 1-6: Holotype of *Bothriembryon bicinctus* n. sp., WAM S_112363, Western Australia, Dundas Shire, along Fraser Range Road. h: 26.5 mm, w: 18.1 mm; **Fig. 1:** Dorsal view; **Fig. 2:** Ventral view; **Fig. 3:** Detail of protoconch (view from top); **Fig. 4:** Detail of protoconch (side view); **Fig. 5:** Detail of penultimate whorl sculpture; **Fig. 6:** Detail of suture.

Figs 7-8: Paratype 1 of *Bothriembryon bicinctus* n. sp., NTM P.64607, location as for holotype. h: 25.8 mm, w: 17.2 mm; **Fig. 7:** Dorsal view; **Fig. 8:** Ventral view.

Figs 9-10: Paratype 2 of *Bothriembryon bicinctus* n. sp., BS BOTH-L0182a, Western Australia, Dundas Shire, 14 km west of Fraser Range Road along Old Telegraph Line. h: 27.4 mm, w: 15.4 mm; **Fig. 9:** Dorsal view; **Fig. 10:** Ventral view.

Figs 11-12: *Bothriembryon balteolus* (IREDALE, 1939), Western Australia, near Grass Patch. h: 21.6 mm, w: 13.3 mm; **Fig. 11:** Dorsal view; **Fig. 10:** Ventral view.

Plate 2 (on page 81)

Figs 13-24: Holotype and paratypes 1-3 of *Bothriembryon rusticus* n. sp.

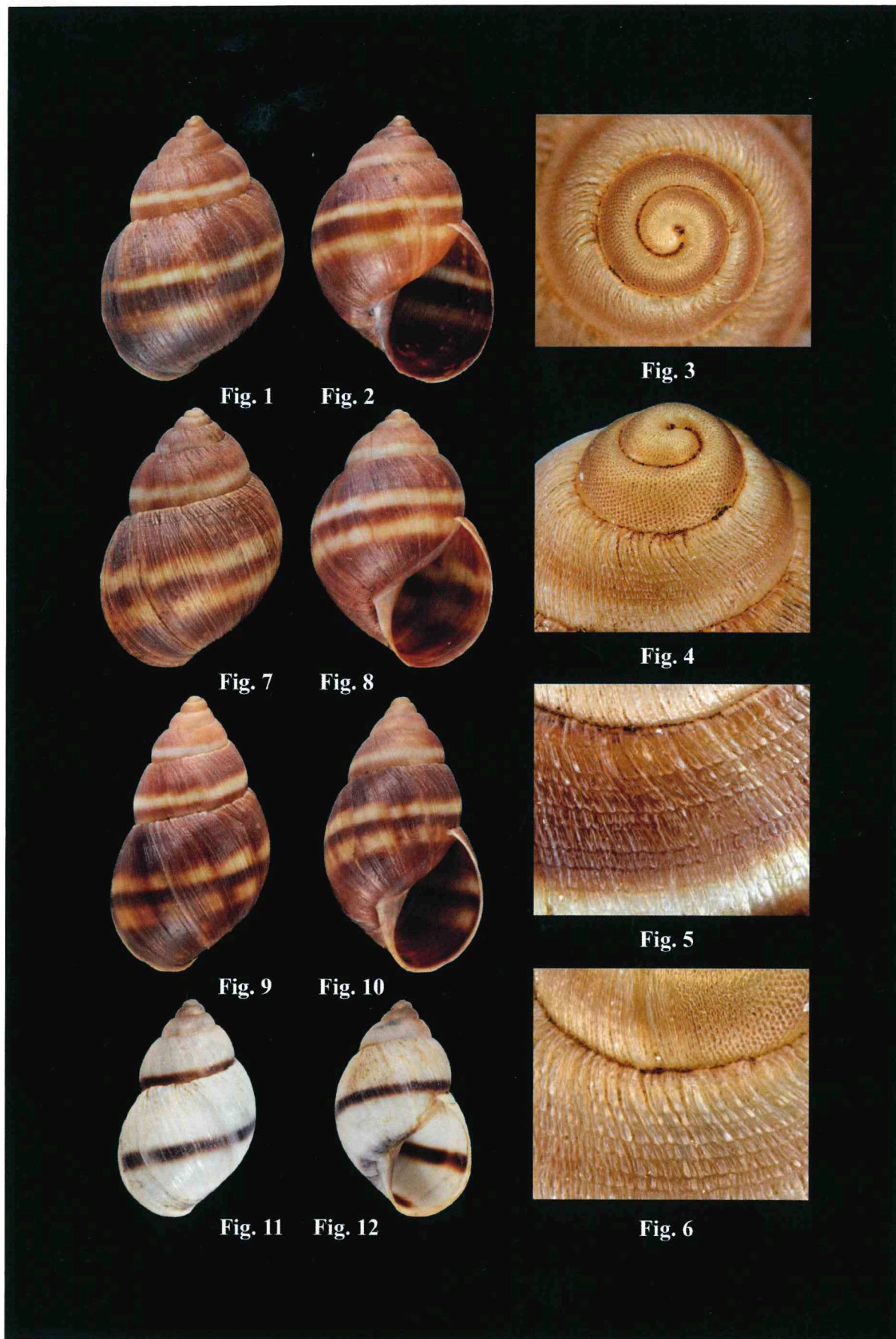
Figs 13-18: Holotype of *Bothriembryon rusticus* n. sp., WAM S_112366, Western Australia, Dundas Shire, 101 km east of Norseman along Eyre Highway. h: 13.1 mm, w: 9.8 mm; **Fig. 13:** Dorsal view; **Fig. 14:** Ventral view; **Fig. 15:** Detail of protoconch (view from top); **Fig. 16:** Detail of protoconch (side view); **Fig. 17:** Detail of penultimate whorl sculpture; **Fig. 18:** Detail of suture.

Figs 19-20: Paratype 1 of *Bothriembryon rusticus* n. sp., AC, Western Australia, Dundas Shire, 14 km west of Fraser Range Road along Old Telegraph Line. h: 14.5 mm, w: 9.4 mm; **Fig. 19:** Dorsal view; **Fig. 20:** Ventral view.

Figs 21-22: Paratype 2 of *Bothriembryon rusticus* n. sp., NTM P.64608, location as for paratype 1; h: 13.5 mm, w: 9.3 mm; **Fig. 21:** Dorsal view; **Fig. 22:** Ventral view.

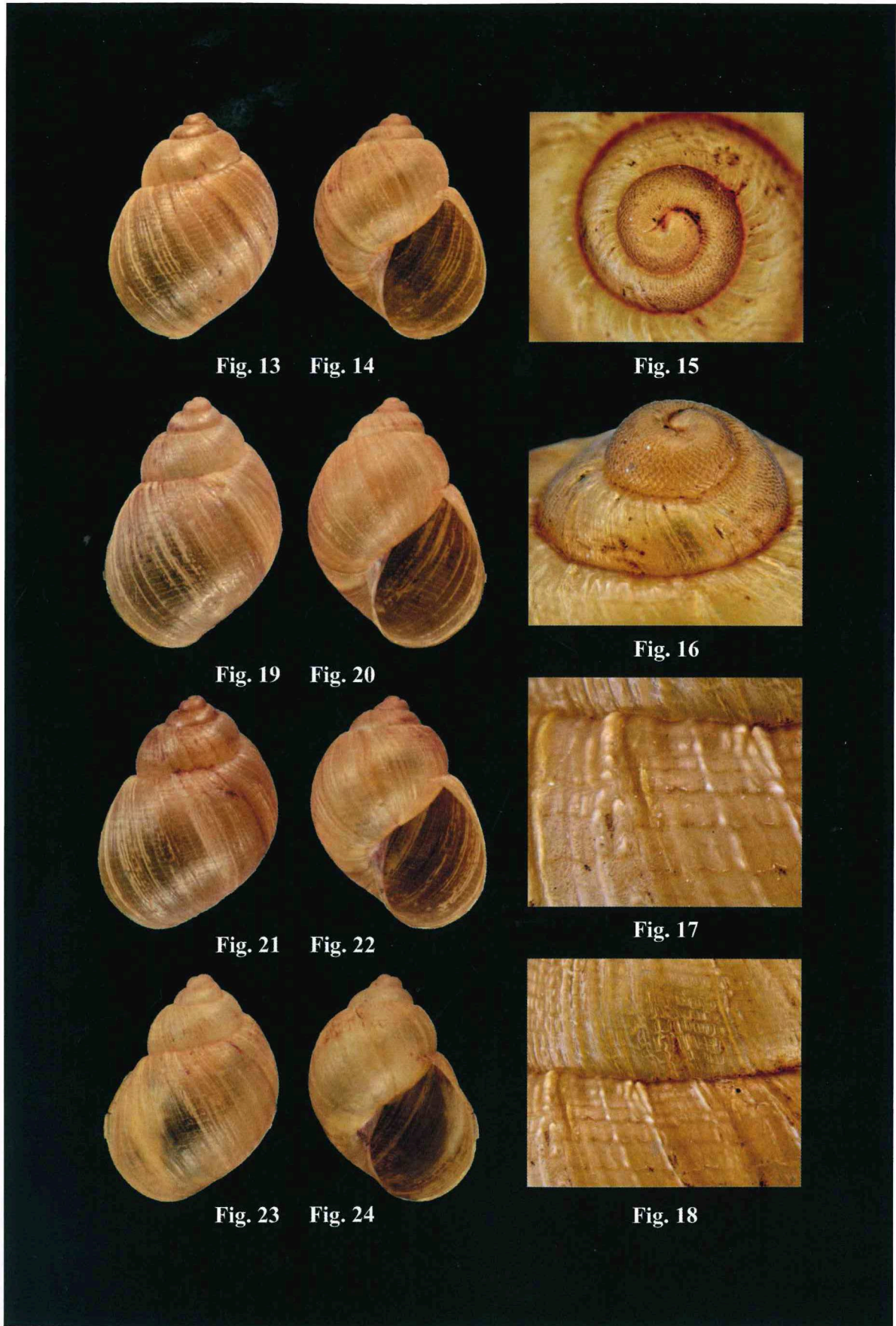
Figs 23-24: Paratype 3 of *Bothriembryon rusticus* n. sp., WAM S_112367, location as for holotype; h: 13.2 mm, w: 8.9 mm; **Fig. 23:** Dorsal view; **Fig. 24:** Ventral view.

Plate 1



Explanation on page 79

Plate 2



Explanation on page 79

Plate 3 (on opposite page)

Figs 25-37: Holotype and paratypes 1-3 of *Bothriembryon corylus* n. sp., compared with *Bothriembryon grohi* MORRISON & SCHNEIDER, 2022.

Figs 25-29: Holotype of *Bothriembryon corylus* n. sp., WAM S_112368, Western Australia, Fraser Range Road, at junction of track connecting to Davies Road. h: 16.8 mm, w: 12.1 mm; **Fig. 25:** Dorsal view; **Fig. 26:** Ventral view; **Fig. 27:** Detail of protoconch (side view); **Fig. 28:** Detail of whorl sculpture; **Fig. 29:** Detail of suture.

Figs 30-31: Paratype 1 of *Bothriembryon corylus* n. sp., WM, location as for holotype. h: 17.4 mm, w: 12.6 mm; **Fig. 30:** Dorsal view; **Fig. 31:** Ventral view.

Figs 32-33: Paratype 2 of *Bothriembryon corylus* n. sp., HM, location as for holotype. h: 17.5 mm, w: 11.9 mm; **Fig. 32:** Dorsal view; **Fig. 33:** Ventral view.

Figs 34-35: Paratype 3 of *Bothriembryon corylus* n. sp., BS, subadult, location as for holotype. h: 14.2 mm, w: 10.3 mm; **Fig. 34:** Dorsal view; **Fig. 35:** Ventral view.

Figs 36-37: Holotype of *Bothriembryon grohi* MORRISON & SCHNEIDER, 2022, WAM S_73585, Western Australia, 13 km south of Kalbarri, along George Grey Road between Kalbarri and Port Gregory, h: 13.5 mm, w: 9.6 mm; **Fig. 36:** Dorsal view; **Fig. 37:** Ventral view.

Plate 4 (on page 84)

Figs 38-50: Comparison of *Bothriembryon bicinctus* n. sp., *B. rusticus* n. sp. and *B. corylus* n. sp. with congener species *B. fragilis* MORRISON, SCHNEIDER & WHISSON, 2019 and *B. nanambinia* MORRISON, 2021.

Figs 38-39: Holotype of *Bothriembryon bicinctus* n. sp., WAM S_112363, h: 26.5 mm, w: 18.1 mm; **Fig. 38:** Dorsal view; **Fig. 39:** Ventral view.

Figs 40-41: Holotype of *Bothriembryon rusticus* n. sp., WAM S_112366, h: 13.1 mm, w: 9.8 mm; **Fig. 40:** Dorsal view; **Fig. 41:** Ventral view.

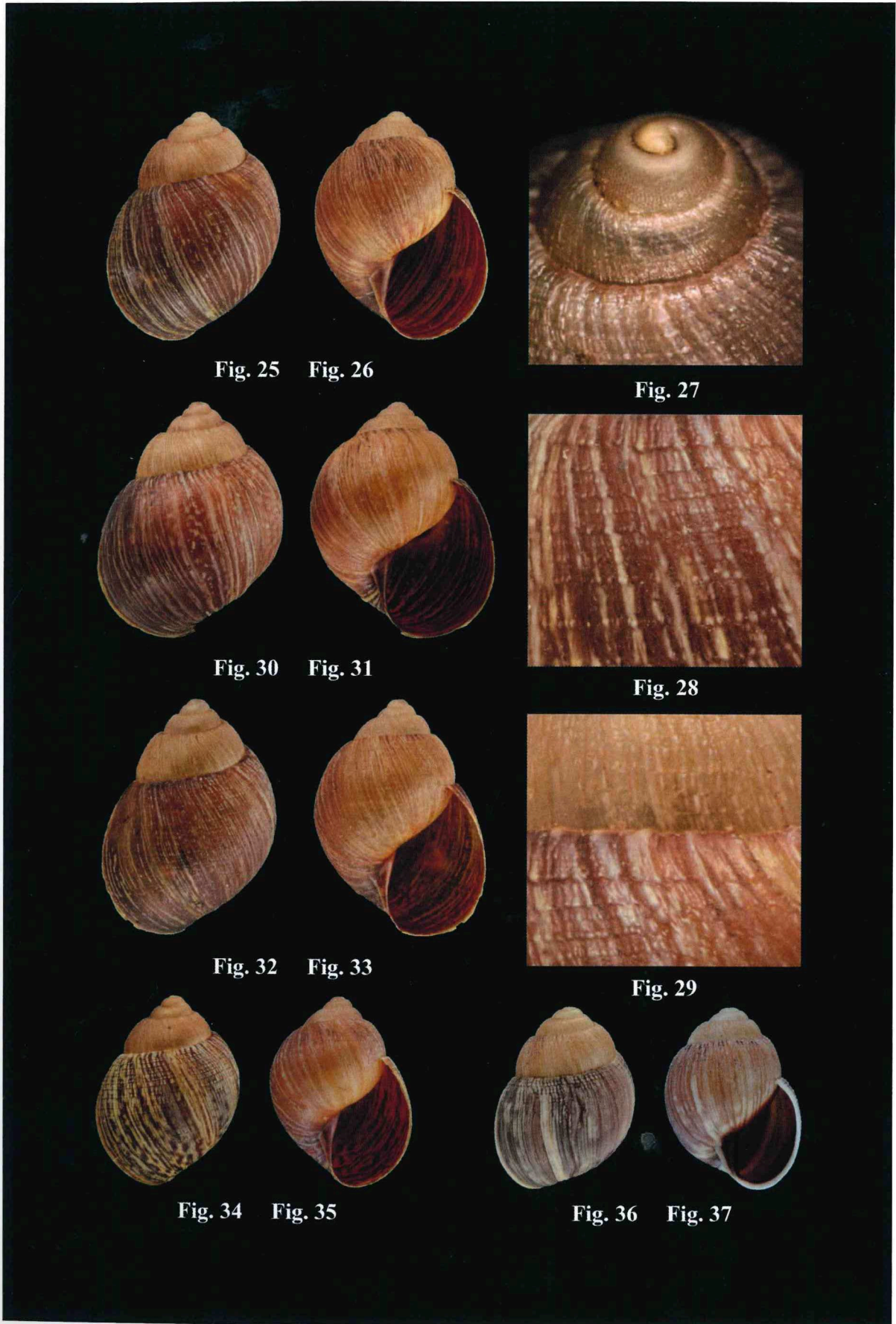
Figs 42-43: Holotype of *Bothriembryon fragilis* MORRISON, SCHNEIDER & WHISSON, 2019, WAM S_69353, Western Australia, Esperance, Beaumont, Muntz Nature Reserve, h: 15.9 mm, w: 8.1 mm; **Fig. 42:** Dorsal view; **Fig. 43:** Ventral view.

Figs 44-45: Holotype of *Bothriembryon nanambinia* MORRISON, 2021, WAM S_29963, Western Australia, Eyre Highway, 12 km east of Balladonia Homestead, h: 19.4 mm, w: 10.4 mm; **Fig. 44:** Dorsal view; **Fig. 45:** Ventral view.

Figs 46-47: Holotype of *Bothriembryon corylus* n. sp., WAM S_112368, h: 16.8 mm, w: 12.1 mm; **Fig. 46:** Dorsal view; **Fig. 47:** Ventral view.

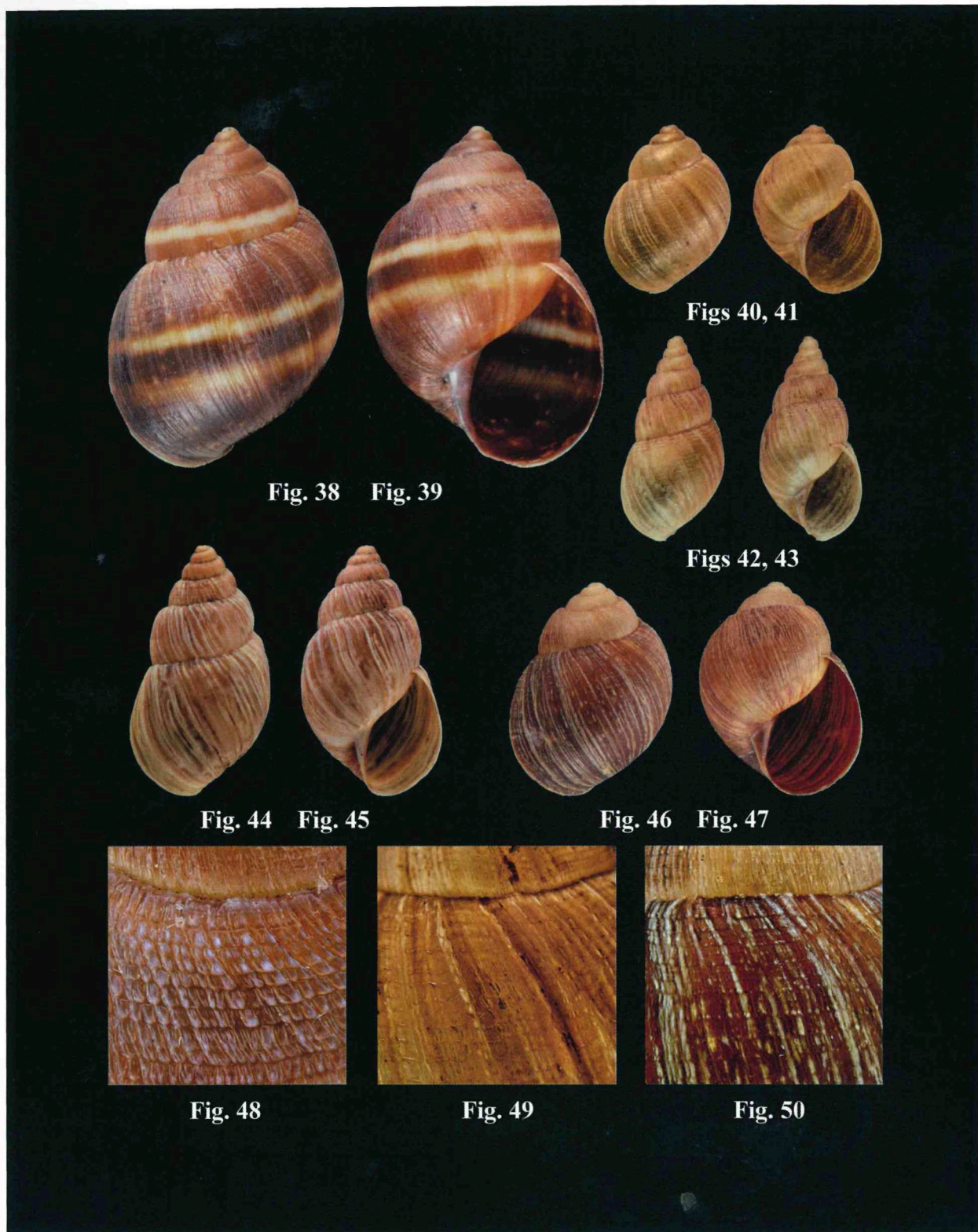
Figs 48-50: Comparison of sculpture (view of detail); **Fig. 48:** *Bothriembryon bicinctus* n. sp.; **Fig. 49:** *Bothriembryon rusticus* n. sp.; **Fig. 50:** *Bothriembryon corylus* n. sp.

Plate 3



Explanation on opposite page

Plate 4



Explanation on page 82



Isara bobreedi n. sp.



Paramoria leeuwinensis n. sp.



Panamitra gigantea



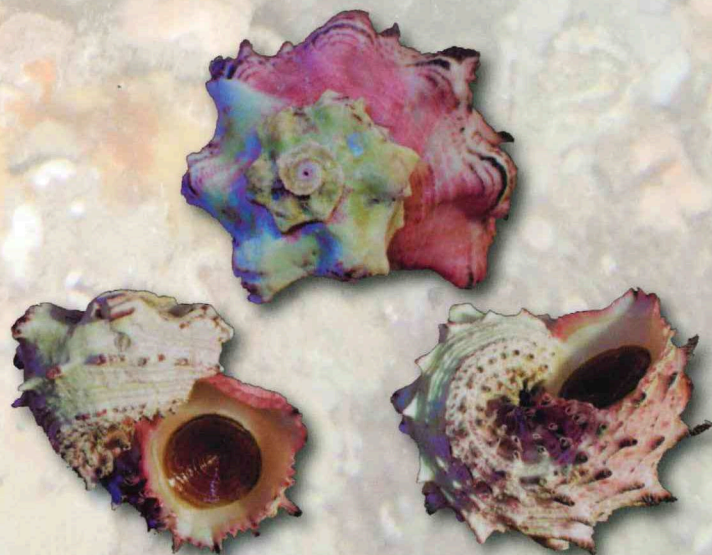
Austromitra diamantina n. sp.



Austromitra doningtonensis n. sp.



Bothriembryon bicinctus n. sp.



Angaria queenslandica n. sp.