# Wudjari Country Bush Blitz

# *Terrestrial Molluscs*

***27 March – 4 April 2023***

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Nomenclature and taxonomy used in this report is consistent with:

World Register of Marine Species

Australian Faunal Directory (AFD)

# Contents

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# Abstract

A total of 39 sites were sampled during this survey, 37 on the mainland and two on Middle Island, Recherche Archipelago. Of these, 29 yielded terrestrial molluscs. A total of 77 records of terrestrial molluscs were documented across nine families. Twenty-six taxa were found comprising the families Bothriembryontidae; Camaenidae; Charopidae; Gastrocoptidae; Geomitridae; Helicidae; Limacidae; Punctidae and Succineidae. Six taxa are considered exotic. Eleven of the taxa across the families Bothriembryontidae; Punctidae and Charopidae are considered un-named. The survey was relatively short and conducted in hot, dry conditions which is not ideal as land snails are buried and aestivating. However, given the limited sampling of the survey coupled with unfavourable conditions indicates the region may contain a significant number of unnamed native taxa.

Of the terrestrial molluscs collected, 70 specimen lots, comprising 287 specimens have been registered and deposited in the Western Australian Museum Mollusc collection. Data associated with these specimens will be uploaded to the Atlas of Living Australia (ALA).

# 1. Introduction

Bush Blitz is an Australian-wide biodiversity discovery partnership program, co-funded through the Department of Climate Change, Energy, the Environment and Water, Parks Australia, BHP and Earthwatch Australia (https://bushblitz.org.au/). Since the program began in 2010, more than 1,800 species of plants, animals and fungi have been identified as having been previously unknown to science. The program has also enhanced critical knowledge gaps in documenting Australia's biodiversity assets in often remote, regionally, and culturally significant regions. Bush Blitz engages expert scientists to undertake field expeditions in partnership and collaboration with Indigenous people (Traditional Owners), land managers and governments and disseminates much of this knowledge through Earthwatch Australia educational programs (https://earthwatch.org.au/), social media, technical reporting and peer-reviewed literature (e.g., Preece et al. 2014).

A Bush Blitz Expedition was undertaken from 27 March to 04 April 2023, in partnership with the Esperance Tjaltjraak Native Title Aboriginal Corporation (https://etntac.com.au/), the Western Australian Department of Biodiversity, Conservation & Attractions Parks & Wildlife Service, the Western Australian Museum, the Western Australian Herbarium and additional scientists from the Australian Museum (Sydney, NSW), the Australian Rivers Institute (Griffith University, Nathan, QLD), the Museum & Art Gallery of the Northern Territory (Darwin, NT), the Queensland Museum (Brisbane, QLD) and the University of New South Wales (School of Biological, Earth & Environmental Sciences, Sydney, NSW). The survey area for the expedition focussed on Mandoowernup (Cape Le Grand National Park) and Recherche Archipelago but included additional surveys in Wudjari Country, including Kepa Kurl (Esperance), Marbleerup (Mt Ridley) and Gauroojeninya (Cape Arid National Park).

This report summarises the results of a two-week targeted survey of terrestrial molluscs for the 2023 Wudjari Country Bush Blitz Expedition.

# 2. Methods

## 2.1 Site selection

Sampling sites were located within terrestrial habitats in an area bounded by 33.543505° S and 34.389322° S and 121.352556° E and 123.936705° E which consisted of urban, peri-urban, rural and conservation land between Kepa Kurl (Esperance), Mandoowernup (Cape Le Grand National Park) and Gauroojeninya (Cape Arid National Park).

Sites were based on prominent topographic features (outcrops, mountains and hills) and associated gullies or streams. Secondarily, sites across a range of healthy, remnant vegetation were selected. These were chosen primarily using Google Earth satellite imagery. Final site selection was made in conjunction with sites where likely un-named taxa had been previously collected (WA Museum Collection). Some sites were chosen in the field where suitable habitat or topography was encountered.

Local knowledge of site accessibility was provided through consultation with the WA Department of Biodiversity & Attractions Parks & Wildlife Service, Tjaltjraak Native Title Aboriginal Corporation and Doc Reynolds.

In addition to the terrestrial mollusc sites above, the marine ship-based team, led by Dr. Lisa Kirkendale briefly visited some of the Recherche Archipelago Islands to sample land snails. These sites and results are included here.

## 2.2 Survey techniques

Terrestrial molluscs were sampled by two main methods.

For macro-molluscs (>10mm), a minimum of 30 mins was spent hand-searching under rocks, litter or fallen vegetation (logs, bark and branches), usually with the assistance of small hand rakes. If shells were encountered, time and effort was given to digging using small spade in the vicinity of fresh-dead shells (e.g. under shrubs, roots or rock piles).

For micro-molluscs, a minimum of 30 mins was spent taking leaf litter/soil samples at various micro-habitats. Samples were then sifted through 2mm and 0.5mm sieves. Both fractions were examined on-site using a hand-lens, and if land snails were encountered, a minimum of half-litre of soil/leaf litter was taken back to the laboratory for further study using a dissecting microscope.

In addition to the mainland collections, some opportunistic terrestrial mollusc collecting was undertaken in the Recherche Archipelago by the marine mollusc team.

Images were taken of every site where molluscs were encountered using a Canon 6D, Olympus Tough TG-5 or iPhone 13 camera. For crawling snails, images were taken using an iPhone 13 in the field laboratory.

Prior to preservation, some live specimens had foot tissue taken and placed in 100% ethanol to facilitate molecular research. All specimens were stored in 100% ethanol, which is appropriate for molecular research.

All specimens were registered and deposited with the WA Museum.

### 2.2.1 Methods used at standard survey sites

The methods used at the standard survey sites were the same as 2.2 above.


Images of survey techniques and equipment used during the Wudjari Country Bush Blitz surveys **A)** Rock-turning and raking of soil/litter **B)** Laboratory setup to process terrestrial molluscs **C)** Frank Köhler (background) actively sieving and searching for terrestrial micro-molluscs in dense bushland near Mount Ridley.

## 2.3 Identifying the collections

Identification of specimens were made primarily by the senior author, initially in the field and then in the WA Museum laboratory using stereo microscopes. Specimens were identified to species level using available literature, primarily Stanisic et al. (2017) and Shea (2007). Taxonomy is consistent with the World Register of Marine Species.

# 3. Results and Discussion

A total of 39 sites were sampled during this survey, 37 on the mainland and two on Middle Island, Recherche Archipelago. Of these, 29 yielded terrestrial molluscs, including two sites on Middle Island. Four sites on the mainland were sampled by non-mollusc participants.

A total of 77 records of terrestrial molluscs were documented during this survey across nine families. Twenty-six taxa were found comprising the families Bothriembryontidae; Camaenidae; Charopidae; Gastrocoptidae; Geomitridae; Helicidae; Limacidae; Punctidae and Succineidae. Six taxa are considered exotic. Eleven of the taxa across the families Bothriembryontidae; Punctidae and Charopidae are considered un-named.

Of the terrestrial molluscs collected, 70 specimen lots, comprising 287 specimens have been registered and deposited in the Western Australian Museum Mollusc collection. Data associated with these specimens will be uploaded the Atlas of Living Australian (ALA).


Some of the snails collected during the Wudjari Country Bush Blitz surveys and selected habitat **A)** Crawling *Basedowena elfina* (Gastropoda: Camaenidae) from Mount Diamond, Cape Arid NP, S112429 **B)** Crawling *Succinea* cf. *australis* (Gastropoda: Succineidae) from Boyatup Hill, Cape Arid NP, S112436-37 **C)** Site WK023, granite sheet near Boyatup Hill, Cape Arid NP, *Succinea* cf. *australis* (Gastropoda: Succineidae) was found in the adjacent vegetation.

## 3.1 Un-named or not formalised taxa

The survey revealed the presence of many *Bothriembryon* that could not be assigned to described species. This was also the case for several taxa in the micro-mollusc families Punctidae and Charopidae. The taxa listed below were present in existing WAM collections, but material collected during this Bush Blitz will now allow genetic and/or morphological analysis to confirm they are new to science. They can then be formally described through the peer review process. Providing scientific names to formalise the species descriptions will be done in consultation with project partners, namely Traditional Owners.

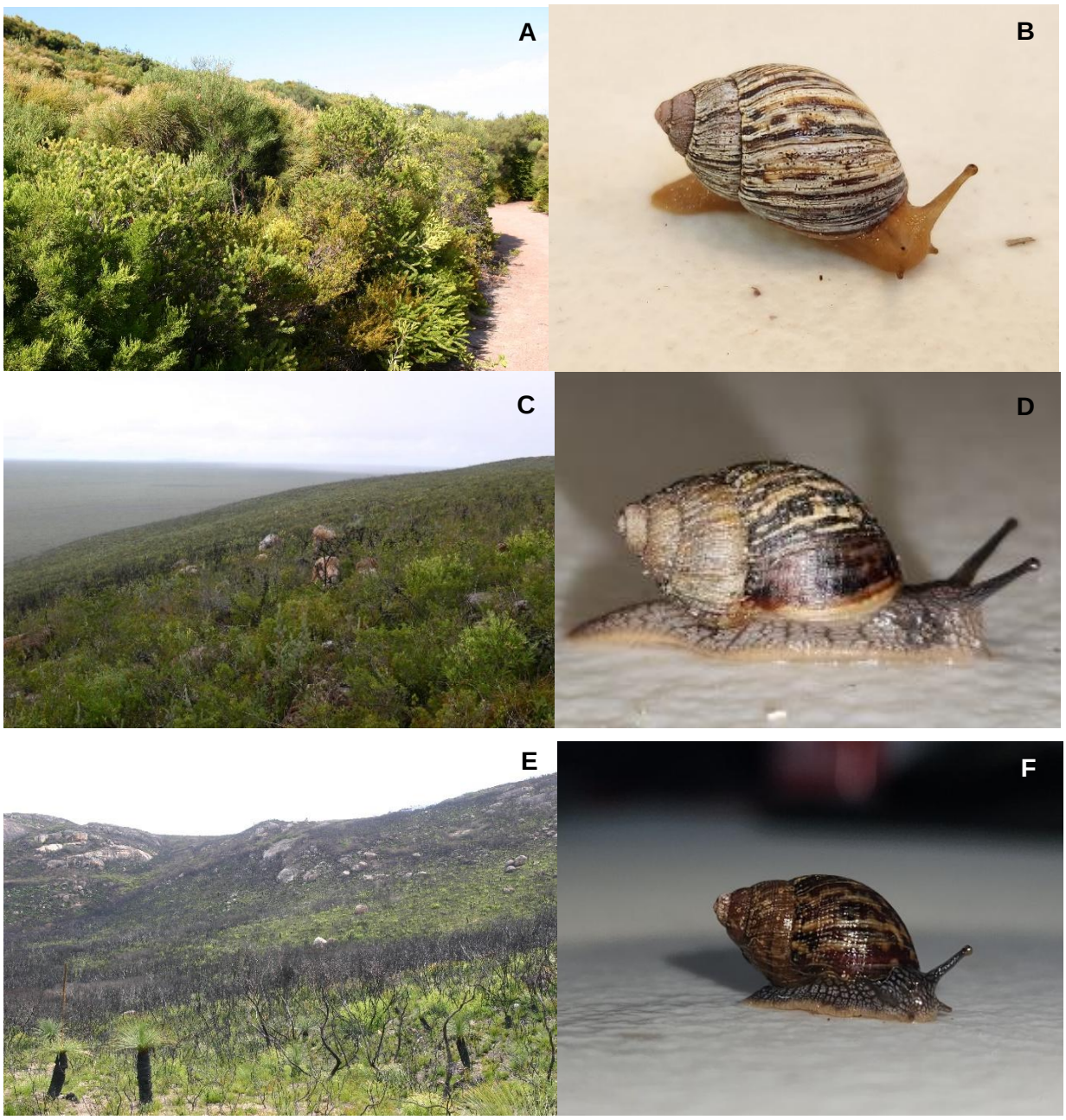
| Table 1. Putatively un-named or not formalised taxa | |
|---|---|
| **Taxon** | **Comment** |
| *Bothriembryon* `Cape Le Grande` n.sp. | Being published mid-2024 |
| *Bothriembryon* `Mount Howick` n.sp. | Dry specimens only (shells) |
| *Bothriembryon* `Mount Diamond` n.sp. | Requires genetic sequencing |
| *Bothriembryon* `inland esperantia` n.sp. | Requires taxonomic revision, genetic sequencing |
| *Bothriembryon* `Mount Arid` n.sp. | Requires genetic sequencing |
| *Luinodiscus* sp. | Requires genetic sequencing |
| Charopidae sp. 1 | Requires genetic sequencing |
| *Westralaoma* sp. 1 | Dry specimens only (shells) |
| *Westralaoma* sp. 2 | Dry specimens only (shells) |

## 3.2 Putative new species (new to science)

In this report, 'putative new species' means an un-named species that, as far as can be ascertained, was identified as a new species as a direct result of this Bush Blitz.

| Table 2. Putative new species (new to science) | |
|---|---|
| **Species** | **Comment** |
| *Bothriembryon* `Cape Arid Coastal` n.sp. | Dry specimens only (shells). Will require live specimens and genetic sequencing |
| *Bothriembryon* `Lake Boolenup` n.sp. | Dry specimens only (shells). Will require live specimens and genetic sequencing |


An un-named terrestrial *Bothriembryon* snail discovered during the Wudjari Country Bush Blitz surveys, with select habitat shot. **A)** Site WK009A, looking westward from headland of Cape Arid NP, near Belinup picnic area, where shells of *Bothriembryon* `Cape Arid Coastal` n.sp. were collected **B)** Broken shell of *Bothriembryon* `Cape Arid Coastal` n.sp. (Gastropoda: Bothriembryontidae), S112422.



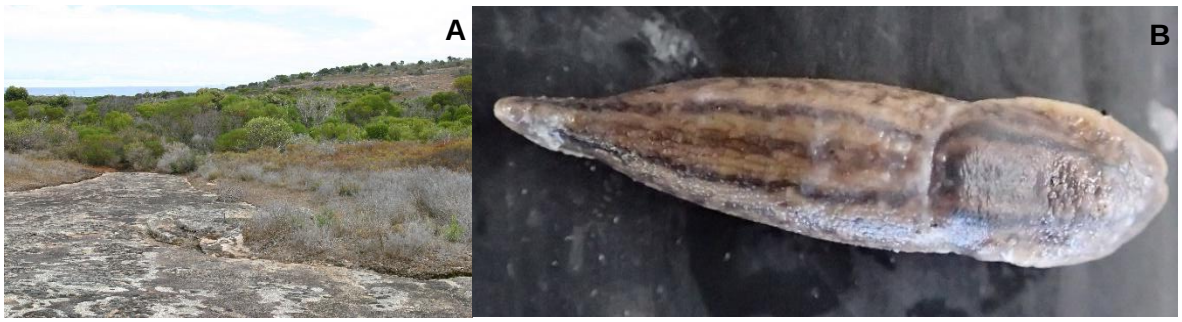

Some of the previously known, un-named terrestrial *Bothriembryon* snails collected during the Wudjari Country Bush Blitz surveys, with select habitat shots. **A)** Site WK029A (SS2), looking south-east, trail to Little Hellfire Bay, Cape Le Grande NP, where live *Bothriembryon* `Cape Le Grande` n.sp. was collected **B)** Crawling *Bothriembryon* `Cape Le Grande` n.sp. (Gastropoda: Bothriembryontidae), S112445 **C)** Site WK019, looking westward from near summit of Mount Diamond, Cape Arid NP, where *Bothriembryon* `Mount Diamond` n.sp. was collected, **D)** Crawling *Bothriembryon* `Mount Diamond` n.sp. (Gastropoda: Bothriembryontidae), S112431 **E) )** Site WK027A, looking westward toward Mount Arid, Cape Arid NP, where live *Bothriembryon* `Mt Arid` n.sp. was collected **F)** Crawling *Bothriembryon* `Mt Arid` n.sp. (Gastropoda: Bothriembryontidae), S112440.

## 3.3 Exotic and pest species

Six exotic species of terrestrial gastropod were collected during this survey.

**Table 3. Exotic and pest species recorded**

| Exotic/pest species | Location sighted/observed | Indication of abundance | Comments |
|---|---|---|---|
| *Cochlicella acuta (O. F. Müller, 1774)* | Cape Arid NP in the Belinup Rock area; Cape Arid NP, Thomas River at Merivale Rd | Locally abundant | This species is native to the Mediterranean Region but has successfully invaded Australia where it is common from southern Western Australia east to western Victoria, particularly in coastal limestone areas (Shea 2007). |
| *Cochlicella barbara (Linnaeus, 1758)* | Cape Arid NP, Thomas River at Merivale Rd | Locally abundant | Originated from the Mediterranean Region but has successfully invaded Australia where it is now fairly common in southern areas (Shea 2007). In Western Australia, it occurs in the south-western parts where it seems to prefer the slightly more inland areas. |
| *Cornu aspersum (O. F. Müller, 1774)* | Cape Le Grande NP, near Cape Le Grande beach campground carpark | Uncommon | Introduced to Australia where it is now common throughout most of southern and eastern Australia. Common garden and agricultural pest (Shea 2007). |
| *Theba pisana (O. F. Müller, 1774)* | Cape Arid NP in the Belinup Rock area; Cape Le Grande NP, near Cape Le Grande beach campground carpark | Locally abundant | Native to the Mediterranean region. It is now common across the drier coastal areas of southern Australia, from Western Australia east to New South Wales (Shea 2007). |
| *Ambigolimax sp.* | Mt Howick; Coolingup NR; Cape Arid NP in the Belinup Rock area. | Locally abundant | Introduced from Europe, there has been little study on species present in Australia. Many have previously been identified as *Letourneuxia nyctelia* (Bourguignat, 1861) but this species is not in Australia.The survey species could be *A. waterstoni*, *A. valentiana* or even *A. parvipenis*. |
| *Paralaoma servilis* (Shuttleworth, 1852) | Cape Le Grande NP at S end of Rossiter Bay; Recherche Archipelago, Middle Island near Pink Lake | Locally abundant | Widespread in Australia (Smith 1992) |




Exotic species of terrestrial snails collect during the Wudjari Country Bush Blitz surveys, with select habitat shot. **A)** Site 009, looking south from Belinup Rock area, Cape Arid NP, *Ambigoliax* sp. was collected under rocks and among vegetation in background **B)** Preserved specimen of *Ambigoliax* sp. (Gastropoda: Limacidae) from Belinup Rock, Cape Arid NP, S112421.

## 3.4 Threatened species

Although no threatened species were collected during this survey, many putative new species of *Bothriembryon* were found. In Western Australia, *Bothriembryon* are known to contain short-range endemic (SRE) species (Solem 1998, EPA 2016). SRE taxa are defined as species that have naturally small distributions of less than 10,000 km$^2$ because they are poor dispersers, have relatively low reproductive rates and are conservative in their ecological requirements (Harvey 2002). Additionally, eight species of *Bothriembryon* are currently listed as threatened at state and international level (DBCA 2023, IUCN 2023). Further taxonomic work is required on these taxa, including geographical distributions, so conservation management can be applied as required.

## 3.5 Range extensions

| Table 4. Range extensions or significant infill in distribution records for species | | | |
|---|---|---|---|
| **Species** | **Location sighted/observed** | **Distance from nearest known record (km)** | **Comments** |
| *Gastrocopta bannertonensis* (Gabriel, 1930) | N of Mt Ridley | 96 | Range Extension. Nearest museum record (WAMS59544) is 96km westward |
| *Gastrocopta margaretae* (J. C. Cox, 1868) | Recherche Archipelago, Middle Island, near Pink Lake | 98 | Range Extension. Nearest museum record (SAMD23538) is 98km northward; this is first record for Island in Recherche Archipelago |
| *Theba pisana* (O. F. Müller, 1774) | Cape Arid NP, W of Belinup Picnic area | 82 | Significant Infill. First record for Cape Arid NP |
| *Cochlicella acuta* (O. F. Müller, 1774) | Cape Arid NP, W of Belinup Picnic area; Cape Arid NP, Thomas River at Merivale Rd | 82 | Significant Infill. First record for Cape Arid NP |
| *Cochlicella barbara* (Linnaeus, 1758) | Cape Arid NP, Thomas River at Merivale Rd | 212 | Significant Infill. First record for Cape Arid NP |
| *Cornu aspersum* (O. F. Müller, 1774) | Cape Le Grande NP, near Cape Le Grande beach campground carpark | 363 | Significant Infill. First record for Cape Le Grande NP |
| *Succinea* cf. *australis* (A. Férussac, 1821) | Recherche Archipelago, Middle Island, Lake Hillier; Cape Arid NP, SE of Boyatup Hill | 285 | Range Extension. Nearest museum record (F106304) is 285km westward; this is first record for Cape Arid NP and Recherche Archipelago |

## 3.6 Genetic information

All live-taken specimens were subsampled and/or preserved in 100% ethanol, making them suitable for genetic work in the future. A total of 38 lots are available, comprising 105 specimens.

# 4. Information on species lists

The terrestrial molluscs collected during this survey comprise a mix of native and exotic species. Many of the native *Bothriembryon* taxa will require genetic sequencing to confirm if they are indeed new to science. The micro terrestrial snail families Charopidae and Punctidae are, in general, poorly studied and will form part of a current taxonomic revision at the Australian Museum. The diversity of *Bothriembryon* is significant, but not unexpected.

# 5. Information for land managers

The results from this survey indicate the region contains a significant number of unnamed native taxa, particularly *Bothriembryon*. Many localities were not examined during this survey because of time or access limitations. Undoubtedly, further unnamed taxa will be discovered. As mentioned previously*, Bothriembryon* are considered to contain SRE species. This is important because such taxa already with restricted ranges are facing even greater pressure from climate change, with trending towards reductions in annual rainfall and increasing temperature. The presence of exotic terrestrial molluscs found during this may also add pressures to native snails through competition or predation. Habitat disturbance is also a factor that could negatively impact on native land snails, given exotic weeds and past bushfire activity was noted at several sites where native snails were found.

# 6. Conclusions

An important aspect of this survey was that, in-spite of unfavourable conditions and a short duration, twenty-six taxa from nine families of terrestrial snails were found, with roughly 42% (eleven taxa) unnamed and potentially new to science. Some of these un-named taxa are likely SREs that require immediate taxonomic attention. The collection of potentially undescribed species achieved the “species discovery” objective of the Bush Blitz program and follow-up work through the WA Museum will aim to formally describe the species in consultation with project partners. The presence of six exotic species is important to document for management considerations including follow up monitoring for impacts to native species.

Results from this survey has significantly enhanced the biodiversity knowledge of Wudjari Country. However, the collection of many terrestrial molluscs which could not be formally identified shows that information gaps still exist for this remote southern region of Australia. Whilst many areas still need surveying for terrestrial molluscs, it is recommended that future collecting concentrate on Cape Arid NP and the Recherche Archipelago Islands. This is advisable to take place during the cooler, wetter months when land snails are most active.

Overall, this work in the understudied biodiversity hotspot of southwestern Western Australia, documented existing species, focussed attention on potentially new species and established and strengthened collaborative networks that together has enhanced biodiversity knowledge and exchange. It has also highlighted the importance of conservation management for the region.

# Acknowledgements

We are particularly grateful to the Bush Blitz Team, especially Jo Harding, Kate Grarock and Helen Cross and to the Reynolds family for hosting us on their property in Merivale, providing access to and culturally specific knowledge about survey sites around Wudjari Country. We thank the Tjaltjraak Native Title Aboriginal Corporation for partnering with us and guiding us through difficult to access areas and participating in survey work. It was a great pleasure to work with our Wudjari hosts and hope the findings are mutually beneficial. We appreciate sponsorship from BHP and enjoyed working with teachers from around southwestern Australia and the Esperance community coordinated by Sabrina Troccini and Anna McCallum from Earth Watch during outreach activities. We thank Stephen Butler, Tasman Douglass, Dylan Isles, Mick Sawyer and John Lizamore from the WA Department of Biodiversity, Conservation and Attractions Parks & Wildlife Service for free access and site information in national parks and conservation reserves. We thank Nicole Middleton from the Marine Parks Directorate of the Department of Climate Change, Energy, the Environment and Water for accompanying us during surveys and for her keen eye for nature observation and photography. We thank all WA Museum staff involved in the hard work put in to coordinate collection permits and delivery of field gear and curation and laboratory supplies.

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# Appendices

## Appendix 1. List of Terrestrial Molluscs recorded during the Wudjari Country Bush Blitz

| Family | Species | Common name | Putative new species | Threatened (EPBC Act) | Threatened (State /Territory Act) | Exotic /pest |
|---|---|---|---|---|---|---|
| BOTHRIEMBRYONTIDAE | *Bothriembryon* `Cape Arid Coastal` n.sp | Tapered Snail | Yes | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon* `Cape Le Grande` n.sp | Tapered Snail | No | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon* `Inland esperantia` n.sp | Tapered Snail | No | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon* `Lake Boolenup` n.sp | Tapered Snail | Yes | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon* `Mount Arid` n.sp | Tapered Snail | No | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon* `Mount Diamond` n.sp | Tapered Snail | No | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon* `Mount Howick` n.sp | Tapered Snail | No | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon* cf. *balteolus* Iredale, 1939 | Salmon Gums Tapered Snail | No | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon* cf. *rhodostomus* (J. E. Gray, 1834) | Recherche Islands Tapered Snail | No | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon esperantia* Iredale, 1939 | Esperance Tapered Snail | No | No | No | No |
| BOTHRIEMBRYONTIDAE | *Bothriembryon dux* (L. Pfeiffer, 1861) | Balladonia Tapered Snail | No | No | No | No |
| CAMAENIDAE | *Basedowena elfina (*Iredale, 1939) | Elfin Sculptured Snail | No | No | No | No |
| CHAROPIDAE | *Luinodiscus* sp. | Pinwheel Snail | No | No | No | No |
| CHAROPIDAE | sp. 1 | Pinwheel Snail | No | No | No | No |
| GASTROCOPTIDAE | *Gastrocopta bannertonensis* (Gabriel, 1930) | Bannerton Pupasnail | No | No | No | No |
| GASTROCOPTIDAE | *Gastrocopta margaretae* (J. C. Cox, 1868) | Margaret's Pupasnail | No | No | No | No |
| GEOMITRIDAE | *Cochlicella acuta* (O. F. Müller, 1774) | Pointed Snail | No | No | No | Yes |
| GEOMITRIDAE | *Cochlicella barbara* (Linnaeus, 1758) | Small Pointed Snail | No | No | No | Yes |
| HELICIDAE | *Cornu aspersum* (O. F. Müller, 1774) | European Garden Snail | No | No | No | Yes |
| HELICIDAE | *Theba pisana* (O. F. Müller, 1774) | White Italian Snail | No | No | No | Yes |
| LIMACIDAE | *Ambigolimax* sp. | Striped Field Slug | No | No | No | Yes |

| | | | | | | |
|---|---|---|---|---|---|---|
| PUNCTIDAE | *Paralaoma servilis* (Shuttleworth, 1852) | Bronze Pinhead Snail | No | No | No | Yes |
| PUNCTIDAE | *Westralaoma* sp. 1 | Pinhead Snail | No | No | No | No |
| PUNCTIDAE | *Westralaoma* sp. 2 | Pinhead Snail | No | No | No | No |
| PUNCTIDAE | *Westralaoma* sp. 3 | Pinhead Snail | No | No | No | No |
| SUCCINEIDAE | *Succinea* cf. *australis* (A. Férussac, 1821) | Southern Ambersnail | No | No | No | No |