Wudjari Country Bush Blitz

Inland Aquatic Molluscs

27 March – 4 April 2023

Submitted: 18 July 2023

Michael Klunzinger

Ana Hara

Frank Köhler

Corey Whisson

Lisa Kirkendale

Nomenclature and taxonomy used in this report is consistent with:
Australian Faunal Directory (AFD)

Australian Freshwater Molluscs: The snails and bivalves of Australian inland waters

MolluscaBase

Contents

List of contributors

List of contributors to this report.			
Name	**Institution/affiliation**	**Qualifications/area of expertise**	**Level/form of contribution**
Dr. Michael W. Klunzinger	***Australian Rivers Institute, Griffith University & WA Museum***	***Inland Aquatic Molluscs***	***Survey participant, identifications, Principal author***
Mrs. Ana Hara	***WA Museum***	***Crustaceans***	***Survey participant***
Dr. Frank Köhler	***Australian Museum***	***Molluscs***	***Survey participant, identifications***
Mr. Corey Whisson	***WA Museum***	***Molluscs***	***Survey participant, identifications***
Dr. Lisa Kirkendale	***WA Museum***	***Molluscs***	***Principal author***

Preferred citation for this report:

Klunzinger MW, Hara A, Köhler F, Whisson C & Kirkendale L (2023). *Wudjari Country Bush Blitz Inland Aquatic Molluscs*. Final Report for the Department of Climate Change, Energy, the Environment and Water and Parks Australia by Australian Rivers Institute (Griffith University) in conjunction with the Australian Museum, and the Western Australian Museum, July 2023.

Abstract

Sixty-three lots of inland aquatic molluscs were collected from 2 classes (Gastropoda and Bivalvia) comprised of seven families and 11 identified species, one of which may be new to science. Of the 19 sites surveyed in ponds, wetlands, lakes, rivers, and streams on Wudjari County, including regions around Kepa Kurl (Esperance), Madoowernup (Cape Le Grand National Park) and Gauroojeninya (Cape Arid National Park)), nine supported aquatic molluscs. An important aspect of this survey was to confirm whether the threatened freshwater mussel, *Westralunio carteri* Iredale, 1934 (listed as vulnerable on the Western Australian *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth of Australia *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)). One Western Australian Museum record indicated that the species was found from catchments draining to Esperance Town Beach in the 1970s. However, surveys of the Bandy Creek catchment failed to locate the species. Two exotic/pest species of freshwater snail were confirmed to be inhabiting modified wetland sites within and near the town of Esperance. The study also resulted in seven new records/range extensions for six species of inland aquatic mollusc. Additionally, the collection of a potentially undescribed species of what appears to be *Coxiella* from standing water on a sheet of granite near the base of Boyatup Hill is an unexpected outcome given this genus of aquatic snails typically occurs in inland salt lakes and seldom found in freshwater habitats. The revelation of at least one putatively undescribed species of mollusc during the survey 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.

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).

Much of the Esperance Coast Basin (as defined by AWRC 1976) was cleared of its native vegetation for conversion to agricultural cropping since the 1950s. The loss of deeper-rooted native vegetation has led to a rising of naturally saline groundwater and coupled with low annual rainfall, flat topography and relatively impermeable Tertiary sediments, rivers and wetlands of the region have become unnaturally salinised (Mayer et al. 2005). Salinisation of formerly freshwater habitats, coupled with reductions in mean annual rainfall due to climate change, has led to a significant conservation threat to freshwater fauna and has been the primary driver in widespread die-off of the region's freshwater mussel, *Westralunio carteri*

Iredale, 1934 which was listed as threatened (vulnerable) under the EPBC Act (DCCEEW 2022) and the WA BC Act (DBCA 2022) (Klunzinger et al. 2015, 2022; Klunzinger 2023, and references therein). Never-the-less, there are pockets of relatively fresh water remaining in the survey region (Mayer et al. 2005) which could potentially support freshwater molluscs (Pinder et al. 2004; Stewart 2009). Additionally, south-western Australia is a hotspot for native species of inland salt lake snails, including potentially undescribed species (Lawrie et al. 2023), as well as other aquatic inland molluscs (Ponder et al. 2022). This report summarises the results of a two-week targeted survey of aquatic inland molluscs for the 2023 Wudjari Country Bush Blitz Expedition.

2. Methods

2.1 Site selection

Sampling sites were located within terrestrial aquatic 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 chosen to represent as wide a range of inland aquatic habitat types as possible, including ponds, wetlands, lakes, streams, and rivers. Site locations were partly determined by a pre-expedition desktop study of WA Museum, Atlas of Living Australia (https://www.ala.org.au/) and published survey records from Pinder et al. (2004). During the time of the surveys, some target survey sites were not sampled either due to the likelihood that additional taxa would not have already been sampled or whether sites were inaccessible via 4WD vehicle. 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. Between desktop surveys, local knowledge of additional sites and previous taxa records, a total of 40 sites were identified to survey and of these, 13 were not surveyed due to site access or time constraints, leaving 27 sites which were able to be surveyed for target taxa.

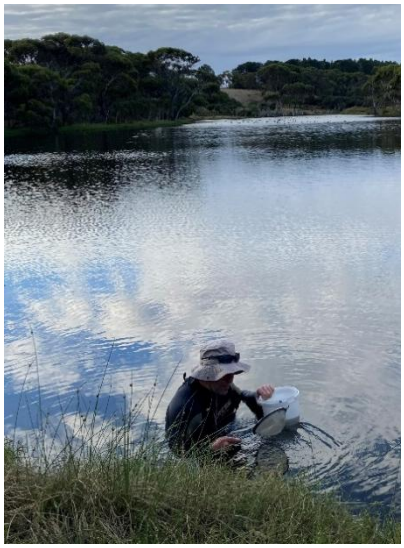
2.2 Survey techniques

Molluscs were sampled by several methods. The first method of sampling was targeted visual detection and hand collection through tactile searches of sediments and surfaces of aquatic vegetation, woody debris and rocks. Samples were captured live and placed in small white plastic buckets containing water from the sites where they were collected from and transported live to the Bush Blitz Base Camp laboratory for later identification. This allowed collection of small cryptic species as well as larger mobile species.

The second method involved scooping aquatic vegetation or scraping a hand-held kitchen sieve along surfaced of submerged vegetation, rocks, and woody debris to collect molluscs which were then emptied into plastic buckets containing water from each collection site as above. The third method allowed direct or indirect procurement of sediment for capture of smaller molluscs. Sediment was sampled directly by scooping a fraction (~0.5 L) into buckets containing water from each survey site. Sediment was later sieved using a series of geological survey sieves with varying sized mesh screens and molluscs were hand picked using forceps with the aid of a compound dissecting microscope in the laboratory. Live molluscs were observed under microscope and photographed with a Dinolite Premier 1.3 MP digital microscope and associated software (Aunet Pty Ltd, 20 Pomelaa Way, Clarkson, WA, 6030). Shells of larger molluscs were also gleaned as bycatch from seine nets collected by the fish team and provided to the mollusc team for identification and vouchering.

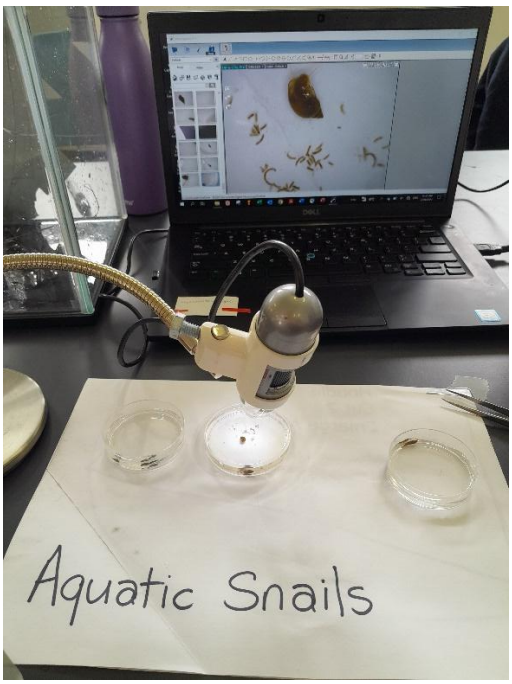
In addition to fauna sampling, electrical conductivity of water was tested using a calibrated KL-1371 Pen-type EC meter at each sampling site. This was performed to characterise each sampling site as either freshwater (0 – 1,500 µS/cm), brackish (>1,500 - <55,000 µS/cm) or saline (>55,000 µS/cm).

Left: Frank Köhler (foreground) and Michael Klunzinger (background) hand picking *Coxiella* salt lake snails near Woody Lake Nature Reserve. Photo by Nicole Middleton. **Right:** example of brackish bivalve *Fluviolanatus subtortus* attached to fallen branch of *Melaleuca* tree at the same site.



Examples of hand nets (left and middle) and hand-held kitchen sieve (middle) used for collecting aquatic vegetation and observing for aquatic molluscs in the field. **Left:** Ana Hara at a perched freshwater dune lake at Thistle Cove, Mandoowernup (Cape Le Grand National Park) where the native South-western pouched snail (*Glyptophysa (Glyptophysa) georgiana*) was found. Photo by Nicole Middleton. **Right:** Michael Klunzinger using hand-held kitchen sieve to scrape sediments and aquatic vegetation in search of aquatic molluscs at a farm dam upstream from Doombup Lake, near Bush Blitz Base Camp in Merivale.

Tjaltjraak rangers, Elders, research scientists and teachers working together on Wudjari Country.



Example of laboratory set-up used to identify live inland aquatic molluscs. White buckets contain molluscs collected from two separate collection sites and individual molluscs were placed on plastic petri dishes with site water and observed by live microscope digital camera connected to a laptop which allowed for photography and video capture. These photos were taken from the display set up by survey participants during the Bush Blitz Community Day in Esperance on 02 April 2023.

Base Camp Laboratory setup where molluscs and crustacea team identified and curated species collected during surveys.

2.2.1 Methods used at standard survey sites

Standard survey sites were selected by terrestrial teams. As standard survey sites did not contain aquatic habitats, surveys for inland aquatic molluscs were not applicable.

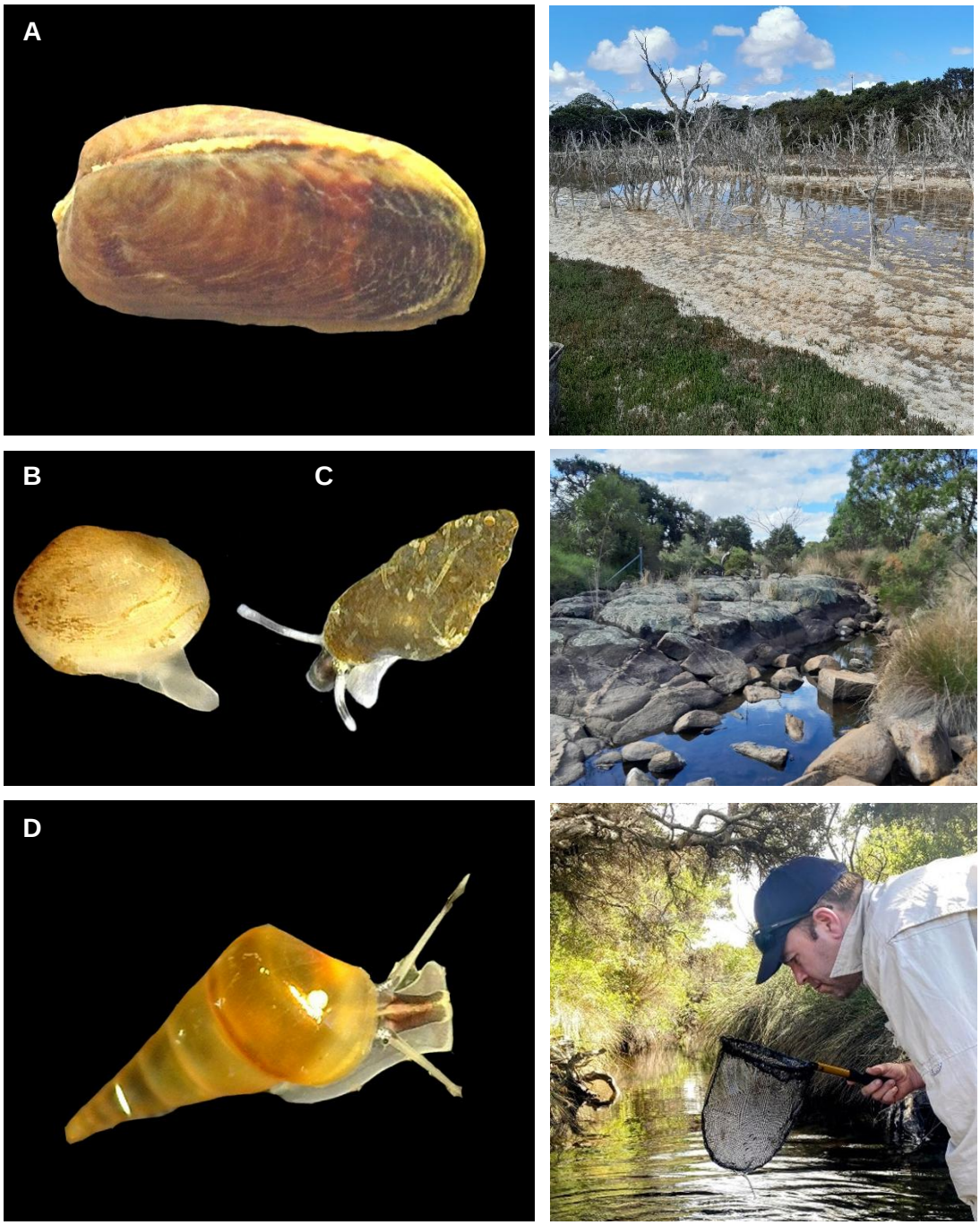
2.3 Identifying the collections

Identification of live specimens was made by the authors, initially in the field and then in the laboratory, using microscopes. Specimens were identified to species level using available literature including Smith (1996), Stanisic et al. (2017), Ponder (2022) and Ponder et al. (2022). Dr. Winston Ponder (Australian Museum) confirmed identifications of aquatic gastropods through email correspondence. Specimens of salt lake gastropods (*Coxiella* spp.) were confirmed by Angus Lawrie (Murdoch University) also by email correspondence. Taxonomy is consistent with the Australian Faunal Directory, Stanisic et al. (2017), Ponder et al. (2022) and MolluscaBase.

3. Results and Discussion

Appendix 1 lists all inland aquatic molluscs recorded during the Bush Blitz. Appendix 2 provides a summary of water conductivity for each of the sites in which inland aquatic molluscs were found and their resulting aquatic habitat classification. Collections made during this Bush Blitz will result in 63 lots of specimens being added to public collections and an equivalent number of records being added to publicly accessible databases, specifically Atlas of Living Australian (ALA). Species provided in Appendix 1 and their associated habitats are illustrated below.

The native Southwestern pouched snail, *Glyptophysa (Glyptophysa) georgiana*, and associated habitat collected from a perched freshwater dune lake draining to Thistle Cove at Mandoowernup (Cape Le Grand National Park).



Brackish bivalves and snails collected during the Wudjari Country Bush Blitz surveys. **A)** *Fluviolanatus subtorus* (Bivalvia: Trapezidae) and associated habitat from a creek near Woody Lake, an inland salt lake near Esperance. **B)** *Arthritica semen* (Bivalvia: Lasaeidae) and **C)** *Ascorhis occidua* (Gastropoda: Tateidae) and associated habitat in Bandy Creek, a brackish creek east of Esperance. **D)** *Tatea rufilabris* (Gastropoda: Tateidae) and associated habitat in Duke Creek, a brackish creek east of Mandoowernup (Cape Le Grand National Park). Photo by Nicole Middleton.

Salt lake snails collected during the Wudjari Country Bush Blitz surveys. **A)** *Coxiella minima* (Gastropoda: Tomichiidae) and associated habitat in Mullet Lake, an inland salt lake near Esperance. **B)** *Coxiella striatula* (Gastropoda: Tomichiidae) and associated habitat in Boolenup Lake, an inland brackish lake in Gauroojeninya (Cape Arid National Park).

3.1 Un-named or not formalised taxa

The survey revealed the presence of at least one aquatic gastropod species which could not be identified to species level (Table 1). Well-worn shells of a species of what appears to be *Coxiella* (Gastropoda: Tomichiidae) were found in the Thomas River.

Table 1. Putatively un-named or not formalised taxa	
Taxon	**Comment**
Coxiella sp.	Could not be identified to species level

3.2 Putative new species (new to science)

In this report, ‘putative new species’ means an unnamed 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**
Coxiella sp. Boyatup Hill	Likely the first example of the genus in freshwater and likely to be a species new to science

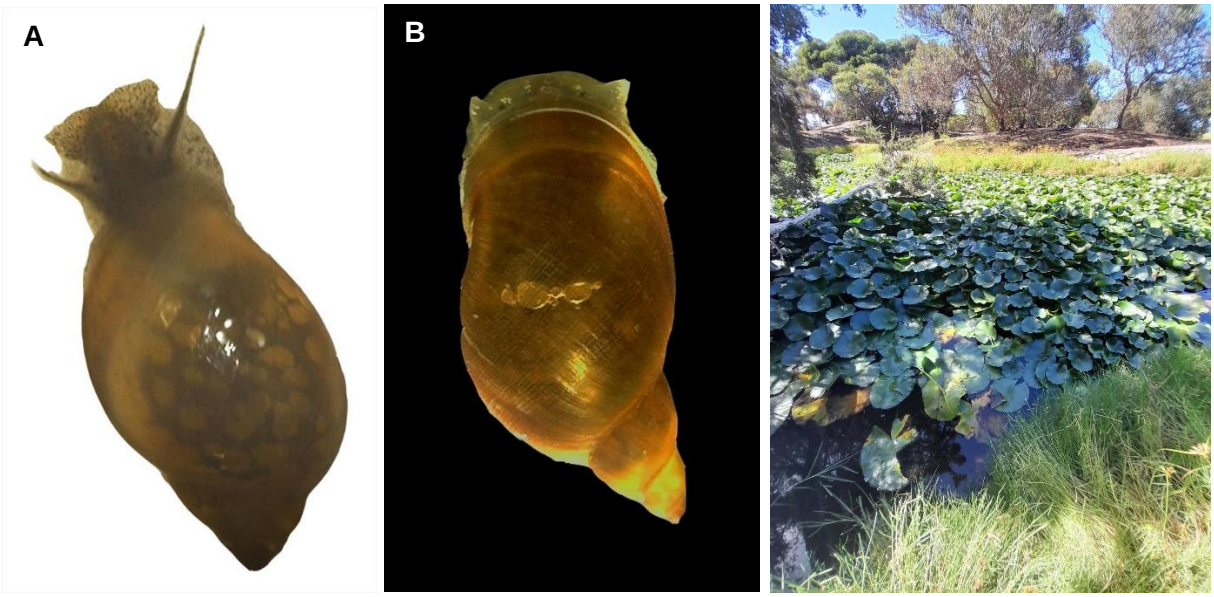
Potentially undescribed species of aquatic *Coxiella* snail (Gastropoda: Tomichiidae) collected from standing water on a granite sheet near the base of Boyatup Hill.

3.3 Exotic and pest species

Two exotic species of aquatic gastropod were collected. See comments below.

Table 3. Exotic and pest species recorded

Exotic/pest species	Location sighted/observed	Indication of abundance	Comments
Physa acuta Draparnaud, 1805	Ornamental pond near Esperance town Municipal Museum	Locally abundant	The species is native to the north-eastern United States of America and Canada but has been spread throughout the world and is a very successful invader. It is found throughout Australia and tends to favour disturbed freshwater habitats particularly in agricultural and urban areas. Where it is found, it usually occurs in large numbers.
Pseudosuccinea columella (Say, 1817)	Ornamental pond near Esperance town Municipal Museum	Locally abundant	Introduced from North America to southern Western Australia, New South Wales, Tasmania and Victoria; found primarily in coastal freshwater drainages associated with agricultural and urban areas. This species is a host for Liver Fluke (*Fasciola hepatica*), a parasite which infects livestock and occasionally humans.



The two exotic species of freshwater snail collect during the Wudjari Country Bush Blitz surveys. **A)** *Physa acuta* (Gastropoda: Physidae) and **B)** *Pseudosuccinea columella* (Gastropoda: Lymnaeidae), from an ornamental pond near Esperance town municipal museum, shown in image on the right.

3.4 Threatened species

Although no threatened species were collected during this survey, the survey confirms that the endemic threatened freshwater mussel, *Westralunio carteri* appears to have been extirpated from the survey region if indeed it was once found here as WA Museum records suggest. The 'freshest' reaches of the catchments draining to Esperance Town Beach, where the species was previously recorded from, include Bandy Creek and Coramup Creek. Conductivities at these sites were 17,500 µS/cm and 3,700 µS/cm, respectively, and considered brackish. Although the Coramup Creek site is within the salinity tolerance range of *W. carteri* (see Klunzinger et al. 2015), the failure to locate any despite a rigorous search, suggests that: 1) salinity may increase beyond the tolerance range of the species at other times of the year, 2) the species has been extirpated from the catchment by some other limiting factor or, 3) the species never existed within the region in the first place and perhaps the individual shell in the WA Museum collection may have originated from elsewhere (e.g. as fishing bait brought in from elsewhere within the species' range). The species' existence within the region, however, can not be completely ruled out, particularly if Coramup Creek might support the species, as the measured conductivity suggests. Future survey work could potentially employ more extensive surveys within Coramup Creek where habitat and water quality are suitable and/or utilising eDNA techniques to detect whether the species might be in the region. A similar approach was proven useful for the detection of rare, threatened freshwater mussels in southern Victoria, for example (Raadik et al. 2022).

The threatened (vulnerable) freshwater mussel, *Westralunio carteri* (not found during the Wudjari Country Bush Blitz surveys. Photo: Mandy Reid (Australian Museum).

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
Arthritica semen (Menke, 1843)	Bandy Creek at Fisheries Road crossing, east of Esperance	118	Nearest museum record is Oldfield River, 118 km to the west; this appears to be a new record of species occurrence
Arthritica semen (Menke, 1843)	Duke Creek crossing at southern end of Orleans Bay Road	175	Nearest museum record is Oldfield River, 175 km to the west; this appears to be a new record of species occurrence
Ascorhis occidua Ponder & Clark, 1988	Bandy Creek at Fisheries Road crossing, east of Esperance	7.5	Nearest record from Pinder et al. 2004 is Mullet Lake, 7.5 km to the southwest; although this is a new record for the species, although it is within the same catchment as previously surveyed by Pinder et al. 2004
Coxiella striatula (Menke, 1843)	Lake Boolenup	96	Nearest museum record is Mullet Lake, 96 km to the west; this appears to be a new record of species occurrence
Fluviolanatus subtortus (Dunker, 1857)	salt creek directly east of Lake Warden in Woody Lake Nature Reserve along Coolgardie-Esperance Highway	138	Nearest record from Pinder et al. 2004 is a museum record from an inland salt lake off Mason Bay Road, 138 km to the west; this appears to be a new record of species occurrence
Glyptophysa (Glyptophysa) georgiana (Quoy & Gaimard, 1832)	perched freshwater dune lake draining to Thistle Cove at Mandoowernup (Cape Le Grand National Park)	33	Nearest museum record is in Woody Lake Nature Reserve complex, 33 km to the northwest; this appears to be a new record of species occurrence
Tatea rufilabris (A. Adams, 1862)	Duke Creek crossing at southern end of Orleans Bay Road	65	Nearest museum record is from Esperance Bay, near Esperance, 65 km to the west; this appears to be a new record of species occurrence

3.6 Genetic information

Most specimens were preserved in 100% ethanol to facilitate genetic work in the future.

4. Information on species lists

Additional species of inland aquatic molluscs have been recorded previously from the region but were not found in the sites surveyed during this Bush Blitz expedition. These are available from the Western Australian Museum and Atlas of Living Australia databases, as well as an inventory available from Pinder et al. (2004). Identifying species of aquatic molluscs can be difficult for the non-expert taxonomist, especially in cases where specialised skills are required for formal diagnoses, such as microscopic dissection of anatomy. However, using the online keys provided by Ponder et al. (2022), aided in part by the ability to photograph live specimens in the laboratory at Bush Blitz Base Camp, was particularly helpful.

5. Information for land managers

Undisturbed strictly freshwater habitats have become increasingly rare in the region (Pinder et al. 2004; Mayer et al. 2005). The population of the native freshwater snail, *Glyptophysa (Glyptophysa) georgiana* within the perched freshwater dune lake in Mandoowernup (Cape Le Grand) appears to be unique to the region and an important indicator species. Maintaining careful conservation management of the lake within the reserved land and waters of the area to avoid introductions of competing exotic snails such as *Physa acuta* and *Pseudosuccinea columella* which are well-established in disturbed habitats near and in Esperance and maintaining adequate water quality will facilitate their persistence and uniqueness for the region.

With climate change trending towards reductions in annual rainfall and increasing temperatures, regionally significant fauna inhabiting salt lakes, including native *Coxiella* snails may face growing conservation pressure now, and into the future (Lawrie et al. 2023). Regional planning could consider managing and monitoring water quality, supply, and temperatures to benefit this unique fauna.

Museum records and previous studies of the region suggest that additional aquatic molluscs may occur in areas that could not be accessed during the Bush Blitz Expedition. Follow-up surveys in partnership with land managers including Tjaltjraak stakeholders and WA Government would be beneficial for filling biodiversity information gaps and enhancing conservation management.

Although the threatened freshwater mussel, *Westralunio carteri*, was not recorded despite intensive targeted survey efforts to locate it, the fact that a voucher of the species exists from Esperance suggests that it may have once occurred in the region. Given the rivers of the Esperance Coast Basin have been impacted by salinity, it is likely that the species may indeed have been extirpated from the region which will affect further refinement of the conservation status of *Westralunio* species, as suggested by Klunzinger et al. (2022 and references therein).

Finally, monitoring other inland aquatic molluscs found during the Wudjari Country Bush Blitz Expedition and formally describing *Coxiella* snails from Boyatup Hill will benefit biodiversity conservation. The unexpected finding of previously unrecorded inland aquatic mollusc species in the region enhances biodiversity knowledge and locating molluscs which could not be formally identified shows that information gaps still exist for this remote region of Australia.

6. Other significant findings

Shells of the invasive land snail *Cochlicella acuta* were found near the edges of Thomas River and shells of *Bothriembryon esperantia* and an un-named species of *Bothriembryon* were found near the shores of Mullet Lake and Lake Boolanup, respectively. Land snails were undoubtedly washed into the water from land near the waters' edge during flooding, but this was nevertheless an interesting find.

7. Conclusions

This Bush Blitz expedition to Wudjari Country recovered a relatively diverse collection of 63 lots of inland aquatic molluscs from two bivalve and five gastropod families which included a total of 11 species, one likely to be new to science. The apparent absence of the threatened freshwater mussel *Westralunio carteri* from the region suggests either that the previous record of the species from Esperance Town Beach was either erroneous or that the species may have died out from the region, a likely scenario given the effect of salinisation of formerly freshwater habitats has been an issue throughout the wheat belt of southwestern Australia, including the Esperance Coast drainage division. Two species of exotic freshwater snails were recovered from urban and peri-urban wetlands near the town of Esperance. Yet, in the relatively undisturbed freshwater perched dune lake draining to Thistle Cove in Mandoowernup (Cape Le Grand National Park), only native freshwater snails (*Glyptophysa (Glyptophysa) georgiana*) were found. The presence of exotic and absence of native freshwater snails in disturbed habitats highlights the importance of conservation reserves for the region. Inaccessibility to some sites and the relatively short time available to conduct thorough surveys of the region likely resulted in an incomplete inventory of the full suite of aquatic molluscs known to inhabit the region and follow-up surveys are recommended to locate and monitor populations of other inland aquatic molluscs of the region. The serendipitous finding of a putatively undescribed species of *Coxiella* in a stand of rainwater across a sheet of granite in a remote area by the land snail team highlights the benefit of conducting Bush Blitz surveys.

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. We thank the Australian Rivers Institute, Griffith University, particularly Professors Fran Sheldon and David Hamilton, Nadine Painter, David Wiseman, Jennifer Finigan and Ana Veamatahau for providing approvals, assistance with contracts and travel coordination to allow Dr. Michael Klunzinger to participate. We thank Dr. Winston F. Ponder (Australian Museum) for confirming identification of tateid snails collected from streams during the surveys. We also thank Angus Lawrie (Murdoch University) for

confirming the identities of *Coxiella* snail species collected from salt lakes and brackish habitats during surveys. We hope we haven't forgotten anyone, but certainly thank everyone who was involved during this awesome Bush Blitz opportunity!

References

AWRC. 1976. *Review of Australia's Water Resources 1975*. (Australian Water Resources Council (AWRC), Department of Natural Resources: Canberra.)

DBCA (Department of Biodiversity, Conservation and Attractions), Parks and Wildlife Service. 2022. Threatened and Priority Fauna List. Government of Western Australia.

DCCEEW (Department of Climate Change, Energy, the Environment and Water). 2022. EPBC Act List of Threatened Fauna. Australian Government.

Klunzinger, M.W. 2023. Conservation status of freshwater mussels in Australia – New species, new listings and work to come. *The Tentacle* 31: 3-5. https://www.hawaii.edu/cowielab/Tentacle/Tentacle_31.pdf

Klunzinger, M.W., Beatty, S.J., Morgan, D.L., Pinder, A.M. & Lymbery, A.J. 2015. Range decline and conservation status of *Westralunio carteri* Iredale, 1934 (Bivalvia: Hyriidae) from south-western Australia. *Australian Journal of Zoology* 63: 127-135.

Klunzinger, M.W., Whisson, C., Zieritz, A., Benson, J.A., Stewart, B.A. & Kirkendale, L. 2022. Integrated taxonomy reveals new threatened freshwater mussels (Bivalvia: Hyriidae: *Westralunio*) from southwestern Australia. *Scientific Reports* 12: 20385.

Lawrie, A., Chaplin, J., Kirkendale, L., Whisson, C., Pinder, A. & Mlambo, M.C. 2023. Phylogenetic assessment of the halophilic Australian gastropod *Coxiella* and South African *Tomichia* resolves taxonomic uncertainties, uncovers new species and supports a Gondwanan link. *Molecular Phylogenetics and Evolution* 184: 107810.

Mayer, X., Ruprecht, J. & Bari, M. 2005. *Stream salinity status and trends in southwest Western Australia*. Salinity and Land Use Impacts. SLUI 38. Department of Environment, Perth.

Pinder, A.M., Halse, S.A., McRae, J.M. & Shiel, R.J. 2004. Aquatic invertebrate assemblages of wetlands and rivers in the wheat belt region of Western Australia. *Records of the Western Australian Museum* Supplement No. 67: 7-37.

Ponder, W.F. 2022. The first galeommatoidean from inland waters: a new species of *Arthritica* (Bivalvia, Lasaeidae) from artesian springs in South Australia, with comments on other Australian members of the genus. *Molluscan Research* 43: 22-33.

Ponder, W.F., Hallan, A., Shea, M.E., Clark, S.A., Richards, K. & Kessner, V. 2022. *Australian Freshwater Molluscs: The land snails and bivalves of Australian inland waters.* Available at: https://keys.lucidcentral.org/keys/v3/freshwater_molluscs/ [Accessed 27 March – 04 April, 2023].

Preece, M., Harding, J. & West, J.G. 2014. Bush Blitz: journeys of discovery in the Australian outback. *Australian Systematic Botany* 27: 325-332.

Raadik, T.A., Stoessel, D.J., Ryan, S. & Murphy, N. 2022. *Locating the threatened Glenelg Freshwater Mussel in the lower Glenelg River system: Remote sensing and physical sampling.* Arthur Rylah Institute for Environmental Research Technical Report Series No. 345. Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Smith, B.J. 1996. *Identification Keys to the Families and Genera of Bivalve and Gastropod Molluscs Found in Australian Inland Waters.* Co-operative Research Centre for Freshwater Ecology Identification Guide No. 6, Albury, NSW, Australia.

Stanisic, J., Shea, M., Potter, D. & Griffiths, O. 2017. *Australian Land Snails. Volume 2. A Field Guide to Southern, Central and Western Species.* Bioculture Press for the Australian Museum, Sydney.

Stewart, B.A. 2009. Two aquatic bioregions proposed for the South Coast Region, Western Australia. *Journal of the Royal Society of Western Australia* 92: 277-287.

Appendices

Appendix 1. List of Inland Aquatic Molluscs recorded during the Wudjari Country Bush Blitz

Family	Species	Common name	Putative new species	Threatened (EPBC Act)	Threatened (State/Territory Act)	Exotic/ pest
LYMNAEIDAE	*Pseudosuccinea columella* (Say,1817)	Striated pond snail	No	No	No	Yes
PHYSIDAE	*Physa acuta* Draparnaud, 1805	Acute bladder snail/ Fountain snail	No	No	No	Yes
PLANORBIDAE	*Glyptophysa (Glyptophysa) georgiana* (Quoy & Gaimard, 1832)	South-western pouched snail	No	No	No	No
TOMICHIIDAE	*Coxiella* sp. 'Boyatup Hill'	Undescribed aquatic snail	Yes	No	No	No
TOMICHIIDAE	*Coxiella* sp. (Thomas River)	Unidentified salt lake snail	No	No	No	No
TOMICHIIDAE	*Coxiella minima* (Macpherson, 1957)	Salt lake snail	No	No	No	No
TOMICHIIDAE	*Coxiella striatula* (Menke, 1843)	Salt lake snail	No	No	No	No
TATEIDAE	*Ascorhis occidua* Ponder & Clark, 1988	brackish aquatic snail	No	No	No	No
TATEIDAE	*Tatea rufilabris* (A. Adams, 1862)	brackish aquatic snail	No	No	No	No
LASAEIDAE	*Arthritica semen* (Menke, 1843)	brackish bivalve	No	No	No	No
TRAPEZIDAE	*Fluviolanatus subtortus* (Dunker, 1857)	brackish bivalve	No	No	No	No

Appendix 2. Water conductivity values and resulting habitat classification for each site from which Inland Aquatic Molluscs were recorded during the Wudjari Country Bush Blitz.

Waterbody	Locality	Electrical Conductivity (µS/cm)	Habitat type
unnamed	ornamental pond near Esperance Municipal Museum	5 µs/cm	freshwater pond
unnamed	perched dune lake draining to Thistle Cove at Mandoowernup (Cape Le Grand National Park)	1,100 µs/cm	freshwater lake
unnamed	granite sheet in standing water near base of Boyatup Hill	1,600 µs/cm	freshwater puddle
Lake Boolenup	South-western Gauroojeninya (Cape Arid National Park)	2,475 µs/cm	brackish lake
Shark Lake	Shark Lake Nature Reserve	4,200 µs/cm	brackish lake
Duke Creek	crossing at southern end of Orleans Bay Road	10,800 µs/cm	brackish stream
Bandy Creek	Fisheries Road crossing	17,500 µs/cm	brackish stream
Mullet Lake	Mullet Lake Nature Reserve	>50,000 µs/cm	salt lake
Woody Lake Inlet	creek directly east of Lake Warden in Woody Lake Nature Reserve along Coolgardie-Esperance Highway	>50,000 µs/cm	salt lake