



Westralunio Iredale, 1934

Diagnostic features

Westralunio is distinguished from other hyriid genera in having a pseudocardinal tooth in right valve that is usually coarsely serrated, thick, and erect, fitting into deeply grooved socket in the left valve.

Anatomy: the gills (ctenidia) are of the eulamellibranch type, and the foot is compressed, tongue-shaped, and lacks a byssal groove. Larvae (glochidia) are brooded in a marsupium that occupies about two thirds of the inner pair of demibranchs of ctenidia. A supra-anal opening is absent. Inhalant and exhalant siphons are not prominent but protrude slightly beyond the shell margin and are formed by the mantle edge, which is open ventrally, separated from each other by a mantle bridge. The exhalant (branchial) 'siphon' is about 1.5 times larger than the inhalant (anal) 'siphon', with two to three rows of papillae. Siphons are heavily pigmented with orange and dark brown to black blotches. Labial palps are relatively small and semi-lunar in shape.

Westralunio is more distantly related to other hyriids than any other hyriid genus (Graf et al. 2015; Klunzinger et al. 2022).

The Australian taxa of *Westralunio* can be separated as follows:

W. carteri: From Klunzinger et al. (2022): "Specimens of *W. carteri* are distinguished from other Australian *Westralunio* taxa by having shell series that are significantly larger and more elongated than *W. inbisi inbisi*, but not different from *W. inbisi meridiemus*. The species has 10 diagnostic nucleotides at COI (57 G, 117 T, 210 G, 249 T, 255 C, 345 G, 423 T, 447 T, 465 A, 499 T) and 13 at 16S (137 T, 155 C, 228 C, 229 T, 60 G, 290 A, 305 G, 307 T, 310 A, 311 C, 321 T, 330 A, 460 A), which differentiate it from its sister taxa, *W. inbisi inbisi* and *W. inbisi meridiemus* using ASAP and TCS species delimitation models." Maximum shell length rarely exceeds 100 mm. The distributional range of this species extends from the Moore-Hill Catchment in the north to the Margaret River catchment in the south, found primarily in westerly flowing streams, rivers and lakes flowing into the Indian Ocean within 150 km of the coast of south-western Australia.

W. inbisi inbisi: From Klunzinger et al. (2022): "Specimens of *W. inbisi inbisi* are distinguished from other Australian *Westralunio* taxa by having shell series that are significantly smaller and less elongated than *W. carteri*, but not *W. inbisi meridiemus*. The subspecies has three diagnostic nucleotides at COI (75 A, 87 T, 318

T) and none at 16S, which differentiate it from its sister taxa, *W. carteri* and *W. inbisi meridiemus* using ASAP and TCS species delimitation models.” Maximum shell length rarely exceeds 90 mm. The distributional range of this subspecies extends from Margaret and Blackwood Rivers in the west to Waychinicup River in the east, found primarily in southerly flowing streams, rivers and lakes flowing into the Southern Ocean within 100 km of the coast of south-western Australia.

W. inbisi meridiemus: From Klunzinger et al. (2022): “Specimens of *W. inbisi meridiemus* have five diagnostic nucleotides at COI (69 C, 123 C, 126 T, 483 A, 526 A) and none at 16S, which differentiate it from its sister taxa, *W. carteri* and *W. inbisi inbisi* using ASAP and TCS species delimitation models.” Maximum shell length rarely exceeds 90 mm. This subspecies is restricted to Margaret and Blackwood Rivers of south-western Australia.

Classification

Class Bivalvia

Infraclass Heteroconchia

Cohort Palaeoheterodonta

Order Unionida

Superfamily Unionoidea

Family Hyriidae

Subfamily Velesunioninae

Genus *Westralunio* Iredale, 1934

Type species: *Westralunio ambiguus carteri* Iredale, 1934

Original reference: Iredale, T. (1934). The freshwater mussels of Australia. *Australian Zoologist* 8: 57-78 pls 3-6.

Type locality: Victoria Reservoir, Darling Range, 12 miles east of Perth, Western Australia.

State of taxonomy

The last major taxonomic revision of Australian freshwater mussels was by McMichael and Hiscock (1958).

Based on the available molecular results, Walker et al. (2014) pointed out that a reassessment of Australian hyriids is needed.

In addition to *W. carteri*, Klunzinger et al. (2022) described two additional subspecies of *Westralunio* from Australia. Under the taxonomic framework of McMichael and Hiscock (1958), two species of *Westralunio* (*W. albertisi* and *W. flyensis*) are found in Papua New Guinea, but unpublished preliminary genetic analysis suggests they may not belong in the same genus as their Australian sister taxa.

Biology and ecology

This genus favours slower flowing areas of freshwater rivers and streams and occurs in water supply reservoirs, farm dams, lakes and some wetlands. Infaunal, living two thirds to almost fully buried in sand and mud sediment. They are suspension feeders. Sexes are separate; females brood young in marsupia in the inner pair of demibranchs of ctenidia. Larvae (glochidia) are parasitic, using fish as hosts and dispersal agents.

Distribution

Coastal rivers of south-western Australia. The genus also occurs in Papua New Guinea.

Notes

The Australian genera of freshwater mussels are distinguished by the following shell characters (note that all are subject to erosion with age, depending on the local environment):-

Hyridella. Beak and umbo of at least young specimens sculptured with V-shaped ridges; shell quadrate to elongate (ratio of maximum height of shell to its length >50%), not markedly winged. Hinge strong with grooved pseudocardinal teeth and simple 'lateral' teeth. Shell surface (other than beaks) more-or-less smooth except for concentric growth lines, but sculpturing extends over shell surface in *H. genelgensis*.

Velesunio. Beaks smooth, shell can be rather thick, rounded in outline (ratio of maximum height of shell to its length >50%), often inflated, hinge lamellar, usually simple (rarely serrated). Shell surface with concentric growth lines only.

Alathyria. Shell typically large, elongate-ovate (ratio of maximum height of shell to its length >50%), often distinctly winged, thick, hinge usually with heavy, pseudocardinal teeth grooved, 'lateral' teeth smooth. Shell surface more-or-less smooth, with concentric growth lines only.

Cucumerunio. Shell very elongate (ratio of maximum height of shell to its length <40%), beaks sculptured with V-shaped ridges; rest of shell surface with conspicuous nodules or ridges. Hinge strong, pseudocardinal teeth grooved.

Lortiella. Shell elongate (ratio of maximum height of shell to its length <45%), usually winged posteriorly, hinge simple, not well developed. Beaks smooth and shell surface with concentric growth lines only. Found in NW Australia.

Westralunio. Shell more or less oblong (ratio of maximum height of shell to its length >50%). Pseudocardinal teeth erect, strongly serrated, shell medium-sized (usually less than 70-80 mm in length, up to 90-100 mm). Beaks sculptured in un-eroded juveniles with v- or w-shaped ridges, shell rather thick, with collabral growth lines. Three taxa in SW Australia and two species in Papua New Guinea.

Further reading

Beesley, P. L., Ross, G. J. B. & Wells, A., Eds. (1998). *Mollusca: The Southern Synthesis. Parts A & B*. Melbourne, CSIRO Publishing.

Benson, J. A., Close, P. G. Stewart, B. A. & Lymbery, A. J. (2017). Upstream recolonization by freshwater mussels (Unionoida: Hyriidae) following installation of a fishway. *Aquatic Conservation: Marine and Freshwater Ecosystems* 28: 512–517.

Benson, J. A., Close, P. G. Stewart, B. A. & Lymbery, A. J. (2019). Freshwater tributaries provide refuge and recolonization opportunities for mussels following salinity reversal. *Science of the Total Environment* 683: 231–239.

Benson, J., Stewart, B., Close, P. & Lymbery, A. (2022). Evidence for multiple refugia and hotspots of genetic diversity for *Westralunio carteri*, a threatened freshwater mussel in south-western Australia. *Aquatic Conservation: Marine & Freshwater Ecosystems* <https://onlinelibrary.wiley.com/doi/abs/10.1002/aqc.3780>

Graf, D. L. & Cummings, K. S. (2019). Hyriidae Swainson, 1840. Pp. 214-217 in C. Lydeard & Cummings, K. S. *Freshwater Mollusks of the World: a Distribution Atlas*. Baltimore, John Hopkins University Press.

Graf, D. L., Jones, H. A., Geneva, A. J., Pfeiffer, J. M. III & Klunzinger, M. W. (2015). Molecular phylogenetic analysis supports a Gondwanan origin of the Hyriidae (Mollusca: Bivalvia: Unionida) and the paraphyly of Australasian taxa. *Molecular Phylogenetics and Evolution* 85: 1-9.

Haas, F. (1969) Superfamilia Unionacea (in) Das Terreich, Lieferung 88, de Gruyter and Co. Berlin.

Iredale, T. (1934). The freshwater mussels of Australia. *Australian Zoologist* 8: 57-78.

Iredale, T. (1943). A basic list of the fresh water Mollusca of Australia. *Australian Zoologist* 10: 188-230.

Jones, H. A. & Byrne, M. (2014). Changes in the distributions of freshwater mussels (Unionoida: Hyriidae) in coastal southeastern Australia and implications for their conservation status. *Aquatic Conservation: Marine and Freshwater Ecosystems* 24: 203-217. *Tropical Natural History Supplement* 3: 112.

- Klunzinger, M. W. (2011). Freshwater shrimp (*Palaemonetes australis*) may be involved in glochidia release from the freshwater mussel *Westralunio carteri*. *The Western Australian Naturalist* 28: 61-65.
- Klunzinger, M. W. (2023). Conservation status of freshwater mussels in Australia – New species, new listings and work to come. *The Tentacle* 31: 3-5.
- Klunzinger, M. W. (2023). Description of the glochidia of *Westralunio albertisi* Clench, 1957 (Bivalvia: Unionida: Hyriidae) from the Fly River system, Papua New Guinea. *Molluscan Research* doi: 10.1080/13235818.2023.2203075.
- Klunzinger, M., Beatty, S. & Lymbery, A. (2010). Acute salinity tolerance of the freshwater mussel *Westralunio carteri* Iredale, 1934 of south-west Western Australia. 17th International Congress of Unitas Malacologica, 18-24 July 2010. Phuket, Thailand (Conference abstract).
- Klunzinger, M. W., Beatty, S. J., Morgan, D. L., Lymbery, R., Thomson, G. & Lymbery, A. (2011). Discovery of a host fish species for glochidia of *Westralunio carteri* Iredale, 1934 (Bivalvia: Unionoidea: Hyriidae). *Journal of the Royal Society of Western Australia* 94: 19-23.
- Klunzinger, M. W., Beatty, S. J., Morgan, D. L., Thomson, G. J. & Lymbery, A. J. (2012). Glochidia ecology in wild fish populations and laboratory determination of competent host fishes for an endemic freshwater mussel of south-western Australia. *Australian Journal of Zoology* 60: 26-36.
- Klunzinger, M. W., Beatty, S. J., Morgan, D. L., & Lymbery, A. J. (2012). Distribution of *Westralunio carteri* Iredale, 1934 (Bivalvia: Unionoidea: Hyriidae) on the south coast of south-western Australia, including new records of the species. *Journal of the Royal Society of Western Australia* 95: 77-81.
- Klunzinger, M. W., Beatty, S. J., Morgan, D. L., Lymbery, A. J. & Haag, W. R. (2014). Age and growth in the Australian freshwater mussel, *Westralunio carteri*, with an evaluation of the fluorochrome calcein for validating the assumption of annulus formation. *Freshwater Science* 33: 1127-1135.
- 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., Thomson, G. J., Beatty, S. J., Morgan, D. L., & Lymbery, A. J. (2013). Morphological and morphometrical description of the glochidia of *Westralunio carteri* Iredale, 1934 (Bivalvia: Unionoidea: Hyriidae). *Molluscan Research* 33: 104-109.
- 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., Lopes-Lima, M., Gomes-dos-Santos, A., Froufe, E., Lymbery, A. J. & Kirkendale, L. (2020). Phylogeographic study of the West Australian freshwater mussel, *Westralunio carteri*, uncovers evolutionarily significant units that raise new conservation concerns. *Hydrobiologia* 848: 2951-2964.
- Klunzinger, M. & Walker, K. F. (2014). *Westralunio carteri*. The IUCN Red List of Threatened Species 2014: e.T23073A58526341. <http://dx.doi.org/10.2305/IUCN.UK.2014-3.RLTS.T23073A58526341.en>
- 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.
- Lamprell, K. & Healy, J. (1998). *Bivalves of Australia, volume 2*. Leiden, Backhuys Publishers.
- Lymbery, A. J., Ma, L., Lymbery, S. J., Klunzinger, M. W., Beatty, S. J. & Morgan, D. L. (2021). Burrowing behavior protects a threatened freshwater mussel in drying rivers. *Hydrobiologia* 848: 3141-3152.
- McMichael, D. F. & Hiscock, I. D. (1958). A monograph of the freshwater mussels (Mollusca: Pelecypoda) of the Australian region. *Australian Journal of Marine and Freshwater Research* 9: 372-508.
- Smith, B. J. (1992). Non-marine Mollusca. Pp. i-xii, 1-408 in W. W. K. Houston. *Zoological Catalogue of Australia*, 8. Canberra, Australian Government Publishing Service.
- Sousa, R., Halabowski, D., Labecka, A.M., Douda, K., Aksenova, O., Bepalaya, Y., Bolotov, I., Geist, J., Jones, H.A., Konopleva, E. and Klunzinger, M.W. (2021). The role of anthropogenic habitats in freshwater mussel conservation. *Global Change Biology* 27: 2298-2314.
- Storey, A. W. & Edward, H. D. (1989). The freshwater mussel, *Westralunio carteri* Iredale, as a biological monitor of organochlorine pesticides. *Australian Journal of Marine and Freshwater Research* 40: 587-593.
- Stream Environment and Water (2021). Byford Railway Extension Targeted Fauna Survey for *Westralunio carteri* Carter's Freshwater Mussel. Prepared for GHD Pty Ltd. https://www.epa.wa.gov.au/sites/default/files/PER_documentation2/Appendix%20H%20-%20Carter's%20Mussel%20Stream%20Environment%20and%20Water%2020200405%20BRE%20Targeted%20Fauna%20Survey_Rev0_Final%20-%202018%20January%202021.pdf
- Thorburn, D. (2020). Vasse Diversion Drain Upgrade Project *Westralunio carteri* Management Plan. Prepared for Water Corporation by Indo-Pacific Environmental, Duncraig East, WA. <https://yoursay.watercorporation.com.au/50705/widgets/276465/documents/185207>

Threatened Species Scientific Committee (2018). Conservation Advice *Westralunio carteri* Carter's freshwater mussel. Canberra: Department of the Environment and Energy. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/86266-conservation-advice-15022018.pdf>.

Walker, K. F. (2004). *A guide to the provisional identification of the freshwater mussels (Unionoida) of Australasia*. Albury, Murray Darling Freshwater Research Centre.

Walker, K. F., Byrne, M., Hickey, C. W. & Roper, D. S. (2001). Freshwater Mussels (Hyriidae) of Australasia. Pp. 5-31 in G. Bauer & Wächtler, K. *Ecology and Evolution of the Freshwater Mussels Unionoida*. *Ecological Studies*. Berlin, Springer-Verlag.

Walker, K. F., Jones, H. A. & Klunzinger, M. W. (2014). Bivalves in a bottleneck: taxonomy, phylogeography and conservation of freshwater mussels (Bivalvia: Unionoida) in Australasia. *Hydrobiologia* 735: 61-79.

Zeritz, A., Sartori, A. F. & Klunzinger, M. W. (2013). Morphological evidence shows that not all Velesunioninae have smooth umbos. *Journal of Molluscan Studies* 79: 277–282.

To cite this resource: **Ponder, W. F., Hallan, A., Shea, M. E., Clark, S. A., Richards, K., Klunzinger, M. W., and Kessner, V. 2023. Australian Freshwater Molluscs. Revision 2.**

https://keys.lucidcentral.org/keys/v3/freshwater_molluscs/

To contact the authors for comment or suggestions, please email: fwmollusc@gmail.com

Copyright © 2023. All rights reserved. The Australian Museum.

