Rec. West. Aust. Mus. 1983, 11 (1): 49-57

A New Species of the Prosobranch Gastropod *Glacidorbis* and its Implications for the Biogeography of South-Western Australia

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Abstract

Minute snails found in streams of the Darling Range, Western Australia, are described here as a new species, *Glacidorbis occidentalis*. *Glacidorbis* has a southern distribution, occurring in south-eastern Australia, Tasmania, and southern Chile. Its presence in south-western Australia is consistent with theories proposing a common Gondwanic origin for much of this region's freshwater fauna and that of south-eastern Australia.

Introduction

As faunal and floral surveys become increasingly intensive, a better understanding of biogeographic patterns is achieved. This is especially true for groups of minute or cryptic organisms. Here, the discovery of a particularly small gastropod during an ecological study of the invertebrate fauna of streams in the Darling Range, Western Australia, provides an important link between the freshwater faunas of south-western and south-eastern Australia.

This paper describes the snail as a new species of the genus *Glacidorbis* Iredale, 1943. Occurrences of other members of this genus have been used recently to demonstrate zoogeographic relationships between south-eastern Australia, Tasmania and South America (Meier-Brook and Smith 1975; Smith 1979). The significance of its occurrence in south-western Australia is discussed in context with past and present views on the biogeography of this region.

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[1] Order randomly determined.

Systematics

Family ?Hydrobiidae[2]

Genus *Glacidorbis* Iredale, 1943

***Glacidorbis occidentalis* sp. nov.**

Figures 1-7

Holotype

WAM 778.82 from Wungong Brook, Jarrahdale, at the Chandler Bridge (32°17'S, 116°08'E) Western Australia. Collected by S. Bunn, 21 July 1982.

Paratypes

WAM 779.82 from Dillon Brook, North Dandalup, Western Australia (32°30'S, 116°04'E). Collected by S. Bunn, 23 July 1982, 3 specimens. WAM 780.82 from Seldom Seen Brook, Jarrahdale, Western Australia (32°16'S, 116°06'E). Collected by S. Bunn, 2 July 1982, 2 specimens.

Diagnosis

A small species of *Glacidorbis* with a shell not more than 1.20 mm diameter at 2.5 whorls; radula of 19-20 rows of teeth, each with a single short mesocone bearing 2-5 denticles on either side.

Description

Shell minute, planispiral, flattened dorsally, concave ventrally, smooth, with fine growth lines (Figure 1). Maximum diameter 1.20 mm; apertural diameter 0.5 mm at 2.6 whorls. Periostracum fine, brown, often fringing the aperture lip. Operculum thin, corneous, paucispiral with a number of whorls equivalent to that of the shell (Figure 2).

Radula with 19-20 rows of teeth (Figure 3), each row consisting of a single triangular mesocone. Mesocones bear 2-5 pointed cusps on either side (Figures 4-5); cusps may be broken off or worn and are absent on older teeth (Figure 6); marginals absent.

Live animals vary in colour from cream to dark grey as amounts of pigment vary between sites. The foot is bifurcated posteriorly and palps on the anterior head produce a similar bilobed appearance (Figure 7). Developing embryos, seen through the shell of some specimens, appear to be distributed from the rear of the mantle posteriorly into the region of the digestive gland. No gills were seen. The small size of the snail prevented a more detailed dissection.

The species is named *occidentalis* as it is the most western *Glacidorbis* recorded.

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[2] The familial placement of the genus is uncertain and is under review by Dr B.J. Smith of the National Museum of Victoria.

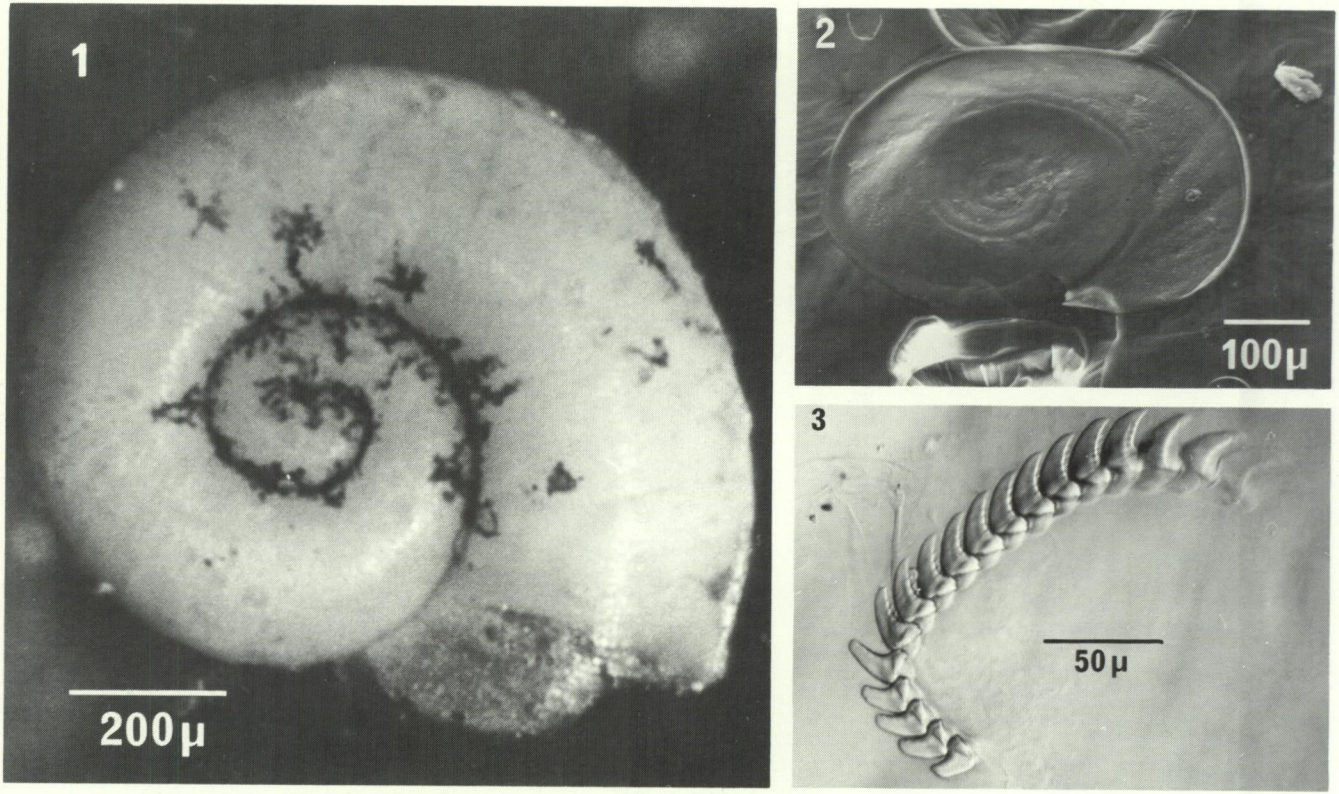
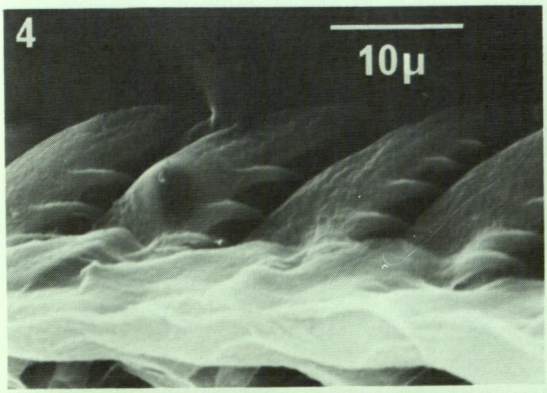
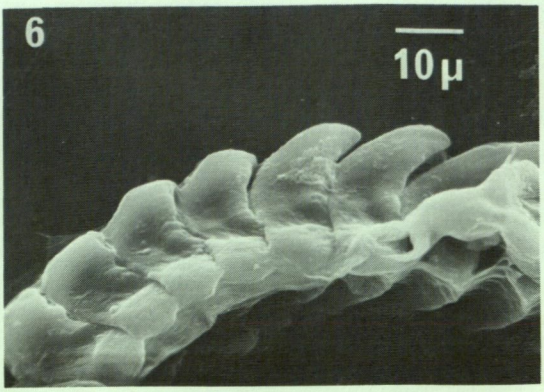
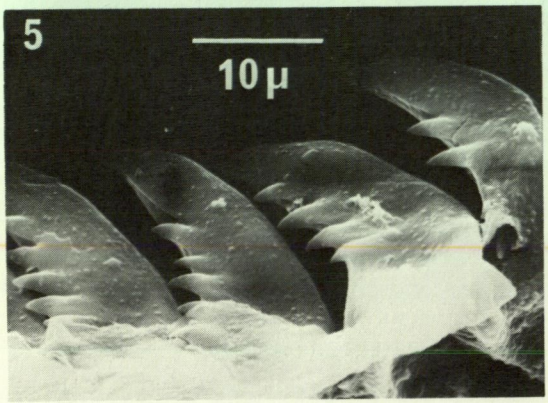


Figure 1 Shell of *G. occidentalis* from Wungong Brook, dorsal aspect.
Figure 2 Exterior surface of operculum of specimen from Wungong Brook.
Figure 3 Radula of specimen from Dillon Brook.



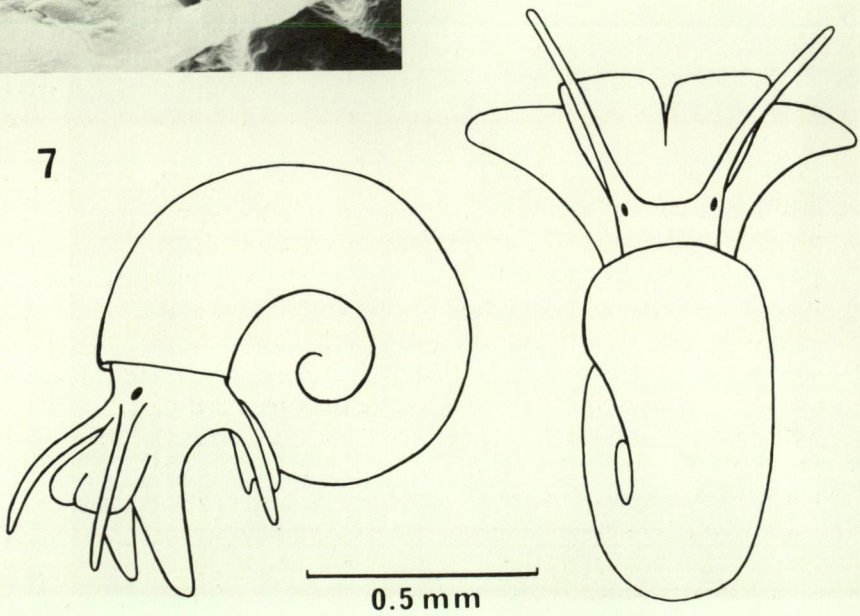




Figures 4, 5 Radula of specimen from Wungong Brook showing teeth and cusps.

Figure 6 Radula of specimen from Wungong Brook showing worn teeth.

Figure 7 Drawing showing head and foot of live specimen from Wungong Brook.



Dimensions

Specimen	Maximum diameter (mm)	Aperture diameter (mm)	Whorls
Holotype WAM 778.82	0.96	0.44	2.3
Paratypes WAM 779.82	0.84	0.36	2.1
"	1.08	0.40	2.2
"	0.68	0.32	1.6
WAM 780.82	1.20	0.48	2.6

Other Material Examined

Western Australia:

Wungong Brook, Jarrahdale, 14 specimens, S. Bunn, 17/ix/1981; Dillon Brook, North Dandalup, 10 specimens, S. Bunn, 19/ix/1981; Wungong Brook, Jarrahdale, 2 specimens, S. Bunn, 2/xii/1981; Dillon Brook, North Dandalup, 6 specimens, S. Bunn, 4/xii/1981; Wungong Brook, Jarrahdale 2 specimens, S. Bunn, 20/i/1982; Seldom Seen Brook, Jarrahdale, 1 specimen, S. Bunn, 20/i/1982; Wungong Brook, Jarrahdale, 6 specimens, S. Bunn 4/iii/1982; Wungong Brook, Jarrahdale, 19 specimens, S. Bunn, 2/vi/1982; Seldom Seen Brook, Jarrahdale, 4 specimens, S. Bunn, 2/vi/1982; Wungong Brook, Jarrahdale, 2 specimens, S. Bunn 21/viii/1982; Dillon Brook, North Dandalup, 2 specimens, S. Bunn, 23/vii/1982. This material is currently held in the Department of Zoology, University of Western Australia.

Description of Habitat

The snails were found in three of six streams sampled in jarrah forest on the western edge of the Darling Range, south of Perth, Western Australia. This is a dry sclerophyll forest dominated by jarrah *(Eucalyptus marginata)* and to a lesser extent marri *(E. calophylla)* (Gardner 1942). The climate is typically Mediterranean with a yearly rainfall of approximately 1250 mm, of which approximately 85% falls between May and October (Seddon 1972).

Although many rivers and streams in this region flow intermittently, some headwater streams arising from spring-fed swamps flow all year. The southern branch of the Wungong Brook, and Seldom Seen Brook near Jarrahdale are perennial streams in a catchment currently strip-mined for bauxite. Dillon Brook is a small intermittent stream in the North Dandalup catchment approximately 20 km south of Jarrahdale. All three streams are in the highest rainfall area of the Darling Range (1200-1400 mm). Similar streams are present to the south of these but were not sampled in the present study and it may be that the distribution of *G. occidentalis* is more extensive than recorded here.

Snails were taken from gravel riffle sections of the streams with a Surber sampler (0.10m^2; 475 μm mesh net). Specimens for dissection were narcotized with menthol crystals and preserved in 70% ethyl alcohol. All other material was fixed in 4% formalin and preserved in 70% ethyl alcohol. Streams were sampled at approximately six-weekly intervals beginning in September 1981, with the exception of Dillon Brook which was dry from December 1981 until May 1982. Table 1 summarizes some of the chemical and physical characteristics of these streams.

Table 1 Some chemical and physical features of the three streams where *G. occidentalis* have been found. The mean, range and number of measurements made from September 1981 to August 1982 are presented.

		Temp. °C	pH	Depth cm	D.O. mg/1	Na^+ mg/1	K^+ mg/1	Mg^{2+} mg/1	Ca^{2+} mg/1
Wungong Brook	$\bar{x}$	14.5	6.3	17	8.2	39.9	1.2	2.6	5.2
(permanent)	range	9.5-19.0	6.15-6.50	6-31	6.0-10.8	29.0-46.6	0.7-1.5	1.8-3.5	3.7-6.4
	(n)	8	6	8	5	7	7	7	7
Seldom Seen Brook	$\bar{x}$	16.5	6.3	15	9.0	34.4	1.1	2.1	4.8
(permanent)	range	11.0-21.5	6.20-6.45	8-24	8.1-10.2	27.6-38.0	0.7-1.4	1.8-2.7	3.8-5.7
	(n)	8	6	8	5	7	7	7	7
Dillon Brook	$\bar{x}$	15.0	6.4	6	10.4	33.8	1.2	1.6	3.9
(intermittent)	range	11.0-19.0	6.30-6.50	0-15	–	29.4-36.9	0.8-1.5	1.1-2.1	3.4-4.3
	(n)	5	3	8	1	4	4	4	4

Table 2 Shell and radular characters of the five described species of *Glacidorbis*, derived from the text and figures of Smith (1973, 1979) and Meier-Brook and Smith (1975). '1' denotes presence of the character, '0' absence.

Species	Max. diameter (mm)	Av. teeth rows	Av. cusps per side	Marginal teeth	Tooth height / Depth at base	Keel
pawpela	3.5	24.0	18.0	0	4.4	0
hedleyi	3.0	25.0	7.0	0	3.0	0
magallanicus	2.8	28.0	4.5	1	1.1	0
pedderi	1.7	19.0	7.0	0	2.5	1
occidentalis	1.2	19.5	3.5	0	1.6	0

Relationships with Other Species

Comparison of characters obtained from descriptions of other species of *Glacidorbis* with those of *G. occidentalis* (Table 2) shows that although this species is the smallest of the genus, most of its character states are shared. Application of the parsimony assumption through Wagner analysis (Farris 1973) to our rather limited data set (Figure 8) suggests *G. occidentalis* to be most closely related to *G. pedderi*. Although this character set is too meagre to provide a robust basis for testing hypotheses, it is inconsistent with any idea of *G. occidentalis* either having a separate origin from the other species of *Glacidorbis* or representing a western outgroup.

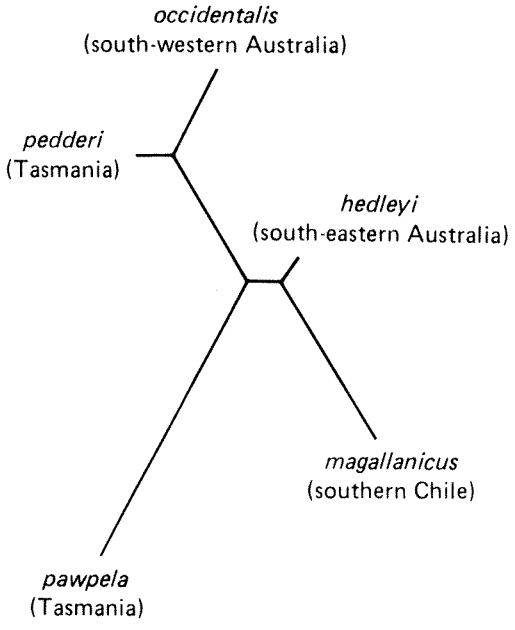


Figure 8 Wagner network for *Glacidorbis* species. Internode distances are proportional to patristic distances.

Discussion

Early workers on Australian biogeography considered the south-west of Western Australia to have such a distinctive flora and fauna that they postulated a separate origin of the south-western and south-eastern biotas (Tate 1887; Hedley 1893; Harrison 1928). Nicholls (1933) recognized a closer relationship between the faunas of south-western and south-eastern Australia but still considered the south-west to be sufficiently distinctive to be regarded as a separate faunal region. A number of terms were proposed by these workers to delineate faunal regions but many of these are now obsolete (see in Jenkins 1982). The south-west is currently considered as the western part of the Bassian Province of temperate

southern Australia (MacKerras 1970). Although the fauna of the south-west is distinctive it is predominantly Bassian in relationships.

According to MacKerras (1970) most groups of terrestrial and freshwater invertebrates of the Bassian Province are composed predominantly of southern elements. Such elements, usually apparent at generic level or above, are characterized by their evolutionarily primitive forms and Gondwanic distributions. Many of these elements are shared principally between southern Australia and South America. Further data, collected over the past decade, have supported such an hypothesis (see Keast 1981). The presence of a species of *Glacidorbis* in south-western Australia is consistent with both the common origins of the south-western and south-eastern Bassian faunas and the presence of Gondwanic elements in these origins. A fossil species of *Glacidorbis* has recently been reported from Middle Miocene deposits in the Strzelecki Desert of Central Australia (Buonaiuto 1982) suggesting that the past distribution of *Glacidorbis* was much more extensive than the present. Subsequent contraction of this distribution, perhaps due to climatic effects, has resulted in the present day occurrence of *Glacidorbis* species in often discrete and widely separated pockets.

Reliable zoogeographic indicators should have limited powers of dispersal and/or limited ecological tolerances (MacKerras 1970). Species of *Glacidorbis* appear to meet both of these criteria. Previous collections of *Glacidorbis* species have come from permanent, fresh, slightly acidic waters which remain cold for most of the year and are often subjected to winter snow (Smith 1979). Although the habitat of *G. occidentalis* is substantially different from this, the association of the genus with slightly acidic waters draining peaty swamps still holds. Such areas are not prone to the massive flooding which may act as a dispersal mechanism for some snails; nor is it likely that aerial dispersion by birds, suggested for some pulmonates (Rees 1965), could transfer these tiny prosobranchs to a suitable habitat. The presence of *G. occidentalis* in two separate catchment areas distant from centres of population suggests it has not been introduced by man. Thus, the distribution of the genus *Glacidorbis* is primarily relictual, an indicator of past events.

The distinctiveness of the freshwater fauna of south-western Australia is not the result of a unique origin. Rather, it is probably the result of a combination of factors including, isolation from the northern elements which have subsequently invaded south-eastern Australia, the evolutionary consequences of the episodic nature of much of its freshwater, the lack of certain habitat types, and the separation of its gene pools from those of conspecifics in south-eastern Australia.

Acknowledgements

We wish to thank B.J. Smith of the National Museum of Victoria, for the loan of specimens of *Glacidorbis hedleyi* and *G. pedderi;* D.H. Edward, G.W. Kendrick and A.R. Main for comments on the manuscript; M.F. Buonaiuto for access to his unpublished data; S. Hopwood for the photographs; and J. Kuo for the electron microscopy.

This project was funded by a University of Western Australia Research Grant and a grant from Alcoa of Australia Ltd.

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Received 19 October 1982 Accepted 10 February 1983 Published 14 November 1983