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A new species of *Lortiella* (Mollusca : Bivalvia : Unionoidea : Hyriidae) from northern Australia

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Abstract

A new species of *Lortiella*, *L. opertanea* n. sp., is described from the Katherine, Daly and Douglas Rivers, Northern Territory, and disjunctly in the Carson and King Edward Rivers of Western Australia. It appears to be the sister taxon to the allopatric *Lortiella rugata* (Sowerby, 1868), the type species of the genus, which occurs in drainages between the two sets of disjunct populations. Some notes on the anatomy of the genus are provided and the subfamily Lortiellinae Iredale, 1934 is synonymised with Velesunioninae.

Introduction

The Australian freshwater mussels (Hyriidae) were last revised by McMichael and Hiscock (1958) (as Mutelidae) and almost no changes to the systematics of the group have occurred since that time. They recognised *Lortiella* as a distinct genus within its own subfamily (Lortiellinae), which contained two species. *Lortiella* is the least known Australian hyriid genus, with little known of its anatomy or larvae, the only basis for the subfamily being the unusual elongate shell. McMichael and Hiscock (1958) suggest this genus has its closest relationships outside Australia, namely with the Asian genus *Solenaia* Conrad, 1869. Although this hypothesis has not yet been tested properly, *Solenaia* has a pallial sinus (which *Lortiella* lacks) and is included in the Unionidae (Unioninae) by Haas (1969*a*, 1969*b*). Hiscock in McMichael (1967) stated ‘Preserved *Lortiella* recently studied by Dr I. D. Hiscock appear to be very similar in gross anatomy to the Velesunioninae’ and Bonetto *et al*. (1987) also discussed this genus briefly. Walker *et al*. (2001) figured the glochidial larva of *Lortiella froggatti* and repeated McMichael and Hiscock’s (1958) suggestion that the subfamilies Lortiellinae and Hyridellinae were derived from the Velesunioninae.

Considerable collecting of freshwater molluscs has occurred in northern Australia in the last 30 years and this additional material has resulted in more collections of *Lortiella* being available. Two specimens from the Katherine River were considered to be *L. rugata* by McMichael and Hiscock (1958) but the availability of more material shows specimens from this area represent a third species of *Lortiella.* In addition to describing this taxon, we add some observations on the gross anatomy of the genus and additional morphometric, locality and habitat data.

Materials and methods

Shell measurements

Shells were measured to the nearest 0.05 mm using manual calipers. The following dimensions are the same as those used by McMichael and Hiscock (1958: fig. 2): TL, total (i.e. maximum) length as measured from anterior margin to posterior margin; MH, maximum height measured from dorsal margin to ventral margin; BH, height at beak measured from beak to ventral margin at 180º from beak; W, inflation (width) measured

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by a single valve held against calipers at ventral and dorsal margin and at greatest width created by posterior ridge (in specimens with two joined valves, the greatest width at the posterior ridge was measured and then divided by two); BL, length of beak measured from umbo to anterior end of shell along dorsal margin (differs from McMichael and Hiscock measurement that was at right angles to the vertical axis of the shell). All dimensions given are in mm. Ratios: MH/TL (= MHI of McMichael and Hiscock); BH/MH (= BHI of McMichael and Hiscock); W/TL; BL/TL (= BLI of McMichael and Hiscock); BH/ML.

For dry material, all available valves (both right and left) were measured separately and no attempt was made to match up single valves. With complete shells, beak length was measured from the outside of the shell from the umbone to the anterior margin, rather than from inside, the method used for single valves. Inflation for complete specimens was measured across both valves then recorded as half that measurement for each valve.

Statistical analyses (discriminant function analysis and ANOVA) of the measurements were conducted using SYSTAT, version 7.0.1 (SPSS, Chicago, IL, USA).

Wet material of each species was examined, and comparative preserved material of *Velesunio angasi* (Sowerby, 1867) (AMS C.420524) and *Alathyria jacksoni* Iredale, 1934 (AMS C.420521) was also examined. Except where noted otherwise, material examined is held in the Australian Museum, Sydney (AMS).

Abbreviations used in material examined

Institutions:

AMS	Australian Museum, Sydney
NTM	Northern Territory Museum and Art Gallery, Darwin
WAM	Western Australian Museum, Perth

Other abbreviations:

Hwy	Highway
HS	Homestead
nr	near
pr	pair (of valves)
R	River
Rd	Road
v	valve(s) (of shell)

Locality records

Material examined from the AMS and WAM is listed under ‘Material examined’ for each species. Two records from the NTM have not been checked by the authors and are listed under ‘Additional records’.

Results

A summary of the samples measured is given in Table 1. These data were analysed to test the hypothesis that three species-group taxa could be recognised morphometrically. The third species is described below as *L. opertanea* n. sp. A discriminant function analysis accurately separated 88% of all three species using the measurement data ($P < 0.0001$): 88% of *L. froggatti* (20 out of 177 were misclassified as *L. opertanea* n. sp. and one as *L. rugata*), 83% of *L. rugata* (12 out of 70 misidentified as *L. opertanea* n. sp.) and 94% of *L. opertanea* n. sp. (three out of 100 misclassified as *L. rugata* and three as *L. froggatti*). A further analysis was carried out to test the distinctiveness of Western Australian (vicinity of Kalumburu, Kimberley) specimens, which are morphologically similar to the Northern Territory specimens attributed to *L. opertanea* yet markedly disjunct. The results are presented in Table 2 and in Fig. 1 (see also ‘Remarks’ under *L. opertanea* n. sp.) The disjunct Western Australian and Northern Territory samples attributed here to *L. opertanea* are not considered to be sufficiently distinct for formal recognition using morphological data alone and, accordingly, only three taxa are recognised formally below.

Table 1. Summary of the samples measured
See 'Material examined' under each taxon for further details about each lot. The numbers following the registration numbers are the numbers of measured valves.

Species	Material
Lortiella rugata	Ord River, WA (C427600, 10; C427109, 6; C424069, 19; WAM S13756, 10); Victoria River, NT (C371676, 13; C313605, 3; C113749, 12; C424068, 4).
Lortiella froggatti	Lennard River, WA (holotype and paratypes, 31; WAM S13760, 2; WAM S13762, 3; WAM S13764, 3; WAM S13761, 13); Fitzroy River, WA (C202368, 88; C371699, 20; C414981, 12; C367894, 10).
Lortiella opertanea n. sp.	Katherine River, NT (holotype and paratypes, 6; C155936, 8; C113750, 6; C126339, 37); Douglas River, NT (C314474, 11); Daly River, NT (C386619, 2); King Edward River, WA (WAM S13755, 2; WAM S13772, 16; WAM S13753, 14).

NT, Northern Territory; WA, Western Australia.

Table 2. Classification matrix resulting from a discriminant function analysis in which the Western Australian specimens of *Lortiella opertanea* n. sp. have been separated from the 'typical' eastern (NT) samples of that species
The material originally classified as each species is distributed along the rows.

	L. frogatti	*L. rugata*	*L. opertanea* NT	*L. opertanea* WA	Correct (%)
L. frogatti	151	0	21	5	85
L. opertanea NT	1	1	53	13	78
L. opertanea WA	1	0	7	24	75
L. rugata	0	57	7	6	81
Total	153	58	88	48	82

Table 3 summarises the measurements and ratios for each species, with the Northern Territory and Western Australian material of *L. opertanea* separated. ANOVA analyses were carried out on all measurements and followed with a Bonferroni adjusted *post hoc* test. The results, with *L. opertanea* separated graphically, are summarised in Tables 3 and 4.

Taxonomy

Subfamily **VELESUNIONINAE** Iredale, 1934

Velesunioninae Iredale, 1934: 58 (as Velesunionae).
Lortiellinae Iredale, 1934: 58.

The gross anatomy of specimens of all three species of *Lortiella* was examined. They are all very similar to one another and characteristic of the Hyriidae in having a marsupium formed from the inner demibranch, an anterior attachment of the inner demibranchs near the labial palps and a small posterior perforation separating the supra and infrabranchial chambers. *Lortiella* also has all the important diagnostic anatomical features of Velesunioninae listed by McMichael and Hiscock (1958). These include: the smooth umbos; lamellar hinge; lack of a supraanal opening (this also seems to be a characteristic of the family); siphons not prominent or protruding; marsupium occupying at least two-thirds of the inner demibranch with the interlamellar junctions discontinuous; palps of medium to large size; glochidium subtriangular and hooked. The palps differ from those of

Table 3. Summary of measurement (mm) and ratio data: number of specimens measured, minimum to maximum (± standard deviation) and mean

The significance value (*P*), degrees of freedom (df) and *F*-ratio (*F*) were obtained from ANOVA. The Western Australian specimens of *Lortiella opertanea* n. sp. have been separated from the 'typical' eastern (NT) samples of that species.

Variable		*L. rugata*			*L. froggatti*			*L. opertanea* NT			*L. opertanea* WA		df	*F*	*P*
	n	Min–max ± SD	Mean	*n*	Min–max ± SD	Mean	*n*	Min–max ± SD	Mean	*n*	Min–max ± SD	Mean			
TL	74	22.55–116.05 ± 20.96	64.43	180	29.90–94.87 ± 10.66	58.00	70	35.35–71.65 ± 7.91	58.41	32	41.45–95.10 ± 11.99	60.25	352	4.41	0.005
MH	78	9.05–38.40 ± 6.22	21.55	181	14.95–38.70 ± 5.01	26.28	70	14.30–31.15 ± 3.15	23.21	32	18.00–40.35 ± 4.94	23.67	357	18.53	<0.001
BH	78	7.35–27.70 ± 4.74	16.99	182	13.35–34.80 ± 4.15	23.47	70	12.50 – 23.20 ± 2.25	19.21	32	12.90–31.05 ± 4.06	17.96	358	60.03	<0.001
W	74	2.53–13.40 ± 2.48	7.64	182	5.10–13.55 ± 1.66	9.13	68	4.70–11.45 ± 1.31	7.61	32	6.41–13.05 ± 1.53	8.35	352	18.50	<0.001
BL	76	6.25–29.50 ± 5.20	18.46	182	11.40–29.40 ± 3.61	19.99	70	10.90–22.60 ± 2.12	17.72	32	11.50–31.45 ± 4.33	17.22	356	9.35	<0.001
MH/TL	74	0.29–0.41 ± 0.02	0.34	178	0.35–0.55 ± 0.04	0.45	70	0.36–0.44 ± 0.02	0.40	32	0.36–0.49 ± 0.04	0.40	350	240.89	<0.001
BH/MH	78	0.60–0.90 ± 0.05	0.79	180	0.77–1.03 ± 0.05	0.90	70	0.73–1.03 ± 0.05	0.83	32	0.64–0.86 ± 0.05	0.76	356	131.68	<0.001
W/TL	70	0.10–0.15 ± 0.01	0.12	179	0.11–0.19 ± 0.01	0.16	70	0.09–0.16 ± 0.01	0.13	32	0.12–0.21 ± .02	0.14	345	204.03	<0.001
BH/TL	74	0.24–0.35 ± 0.03	0.29	179	0.27–0.41 ± 0.02	0.35	70	0.25–0.36 ± 0.03	0.31	32	0.22–0.44 ± 0.04	0.29	351	103.36	<0.001
BL/TL	74	0.22–0.33 ± 0.02	0.27	179	0.30–0.48 ± 0.04	0.41	70	0.29–0.38 ± 0.02	0.33	32	0.24–0.44 ± 0.04	0.30	351	379.95	<0.001

BH, height at beak measured from beak to ventral margin at 180º from beak; BL, length of beak measured from umbo to anterior end of shell along dorsal margin; MH, maximum height measured from dorsal margin to ventral margin; TL, total length as measured from anterior margin to posterior margin; W, width of a single valve.

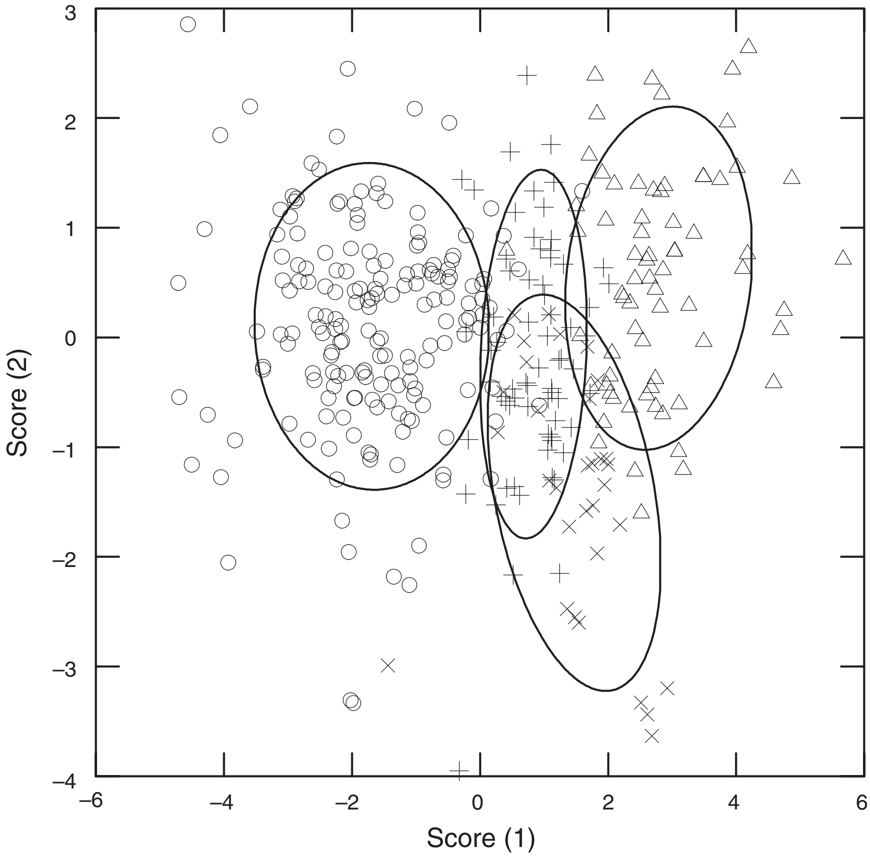

Fig. 1. Plot of discriminant function scores obtained from the non-ratio measurement data for all three species. △, *Lortiella rugata*; ○, *Lortiella froggatti*; +, Northern Territory populations of *Lortiella opertanea*; ×, Western Australian populations of *Lortiella opertanea*. The ellipses show signficance of $P = 0.7$.

Table 4. Summary of measurements and ratios of *Lortiella* taxa that are significantly different ($P < 0.001$ or $P = 0.001$–0.005, the latter in parentheses) using a Bonferroni adjusted *post hoc* test
The Western Australian specimens of *L. opertanea* n. sp. have been separated from the 'typical' eastern (NT) samples of that species.

	L. rugata	*L. froggatti*	*L. opertanea* NT
L. froggatti	(TL), BH, W, MH/TL, BH/MH, W/TL, BH/TL, BL/TL		
L. opertanea NT	MH, (BH), MH/TL, BH/MH, W/TL, BL/TL	MH, BH, W, BL, MH/TL, BH/MH, W/TL, BH/TL, BL/TL	
L. opertanea WA	(BH), MH/TL, (BH/MH), W/TL, BL/TL	BH, (BL), MH/TL, BH/MH, W/TL, BH/TL, BL/TL	BH/MH, BL/TL

Abbreviations as in Table 3.

Alathyria and *Velesunio* in being more truncated posteriorly, giving them an elongated triangular appearance. In contrast, *Alathyria* and *Velesunio* have 'semilunar' palps. McMichael and Hiscock (1958: 387) stated that the palps of *Velesunio* are triangular to subtriangular, but in their description of *V. wilsonii* (Lea) they state that the palps of that species are 'subtriangular to semilunar' (p.400). Given that there are no significant differences between Velesunioninae and Lortiellinae, we treat these taxa as synonyms. Because both family-group names were erected by Iredale (1934) on the same page we, as first revisers, give Velesunioninae precedence.

The nomenclatural details of the generic and specific taxa included in *Lortiella* were given in detail by McMichael and Hiscock (1958) and most of these data are not repeated here.

Genus ***Lortiella*** Iredale, 1934

Genus *Lortiella* Iredale, 1934: 70.
Type species: *Mycetopus rugatus* Sowerby, 1868.

Remarks

The type designation was cited as 'original designation' by McMichael and Hiscock (1958: 432) but Iredale (1934: 70) did not clearly designate *Mycetopus rugatus* as the type species and introduced *L. froggatti* as a new species on the next page. Similarly, Iredale (1943) did not designate a type species. The first subsequent designation appears to be that of McMichael and Hiscock (1958: 432).

McMichael and Hiscock's (1958) description of the genus included only the shell morphology and distribution. They described *Lortiella* as being up to 100 mm in length and having a MHI of 35–40%. The shell was described as 'somewhat adze-shaped, tapering anteriorly, somewhat winged posteriorly'. They noted that the genus is restricted to north-western Australia and that it can be distinguished from other Australian genus-group taxa by its low MHI and lack of beak and shell sculpture.

Lortiella rugata (Sowerby, 1868)

(Figs 2, 3*A–I*)

Mycetopus rugatus Sowerby, 1868: pl. 3, sp. and fig. 7.
Solenaia rugata; Simpson, 1900: 657; Simpson, 1914: 462.
Hyridella (Lortiella) rugata Haas, 1969*a*: N461, fig. D51:3.
Lortiella rugata; Iredale, 1934: 70; McMichael & Hiscock, 1958: pl. 9, figs 1, 2 (lectotype – see also Hiscock, 1960: 124); Haas, 1969*b*: 499.

Material examined

Northern Territory: Victoria R, ca 1.5 km upstream from bridge on Victoria Hwy, 15°36.0′S, 131°7.0′E (AMS, C.113749, 7 pr); Victoria R crossing, 15°36.817′S, 131°7.783′E (AMS, C.313605, 2); Victoria R, on Victoria Hwy, 15°36.89′S, 131°7.82′E (AMS, C.427938, 2 pr); Victoria R at Dashwood Crossing, 16°20.02′S, 131°6.86′E, (AMS, C.424068, 2); Victoria R at Coolibah Stn Rd, 15°33.30′S, 130°57.75′E (AMS, C.371676, 13 v). **Western Australia**: Ivanhoe crossing, 15°41.22′S, 128°41.23′E, under rocks and ledges (AMS, C.424069, 10); Kununurra, irrigation area, main supply channel, 15°46′S, 128°44′E (WAM S13758, 2 v; WAM S13757, 2 v; WAM S13759, 5 v); Ord R, 150 m below Kununurra Diversion Dam, on W side of river, 15°47.480′S, 128°41.580′E, under rocks and amongst roots and mud (AMS, C.427600, 6 pr); Lake Kununurra at Kona Caravan Park, 15°47.622′S, 128°43.136′E, in tube-like burrows in mud bank (AMS, C.427109, 3); Behn R, East Kimberley, nr Argyle Downs HS, 16°31′S, 128°55′E (WAM S13773, 1v); Ord R system, ca 1.5 miles downstream from Old Lissadell HS, 16°41′S, 128°33′E (WAM S13756, 20+).

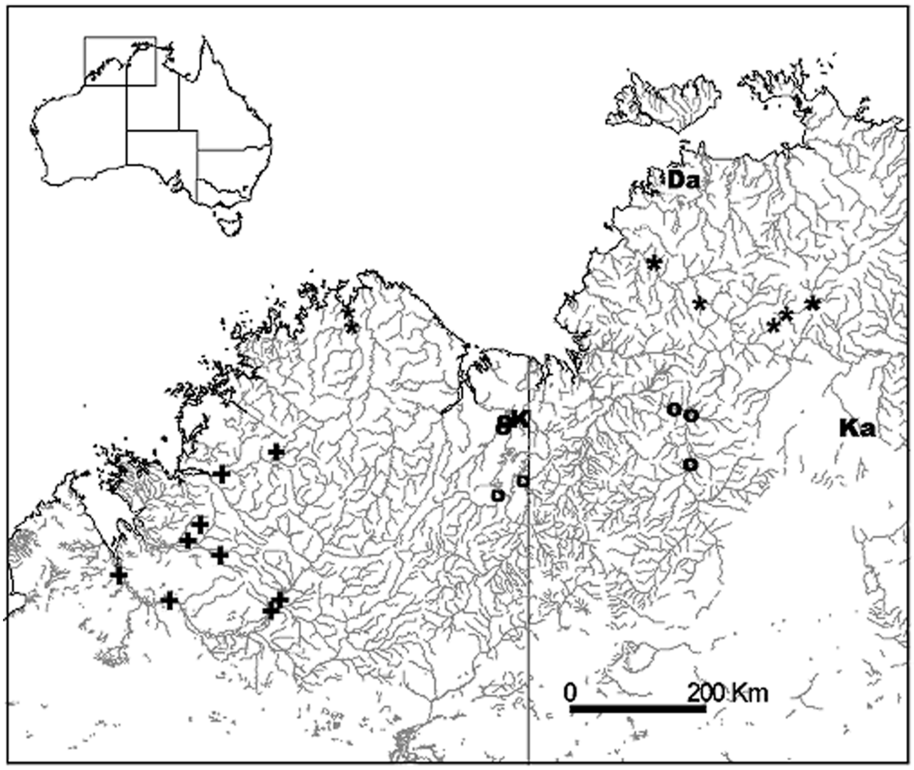

Fig. 2. Distribution of the three species of *Lortiella*: O, *L. rugata*; +, *L. froggatti*; *, *L. opertanea.* (Da, Darwin; K, Kununurra; Ka, Katherine.)

Additional record

Northern Territory: 500 m above river gorge, upper reaches of Wickham R (tributary of Victoria R), SW of Darwin, 16°51.02′S, 130°14.00′E (NTM P010988, 2 pr).

Range and habitat

Victoria and Ord Rivers (Fig. 2); often living under large flat rocks.

Owen Griffiths provided the following information based on his observations made in July 2003 at Kona Caravan Park on the edge of Lake Kununnura, Western Australia. *Lortiella* were very common and found, each in their own burrow, on a steep muddy embankment from 10 to at least 50 cm below the lake surface. Each was ~5 cm inside the burrow, which was very narrow and fully occupied by the mussel, suggesting that they were not occupying a yabby (freshwater crayfish) burrow. They could be located by extending a finger down the burrow and touching the mussel shell. They had to be dug out as they could not be pulled out using forceps because they had their foot extended and were gripping the burrow wall. Over 20 were found in a 4-m stretch of embankment. Only one was located outside a burrow and this was wedged deep between rocks and appeared to be shorter and more stocky than those in the mud burrows.

Remarks

This species was described from material collected in the Victoria River on the second voyage of the Beagle (Iredale 1934; McMichael and Hiscock 1958). McMichael and

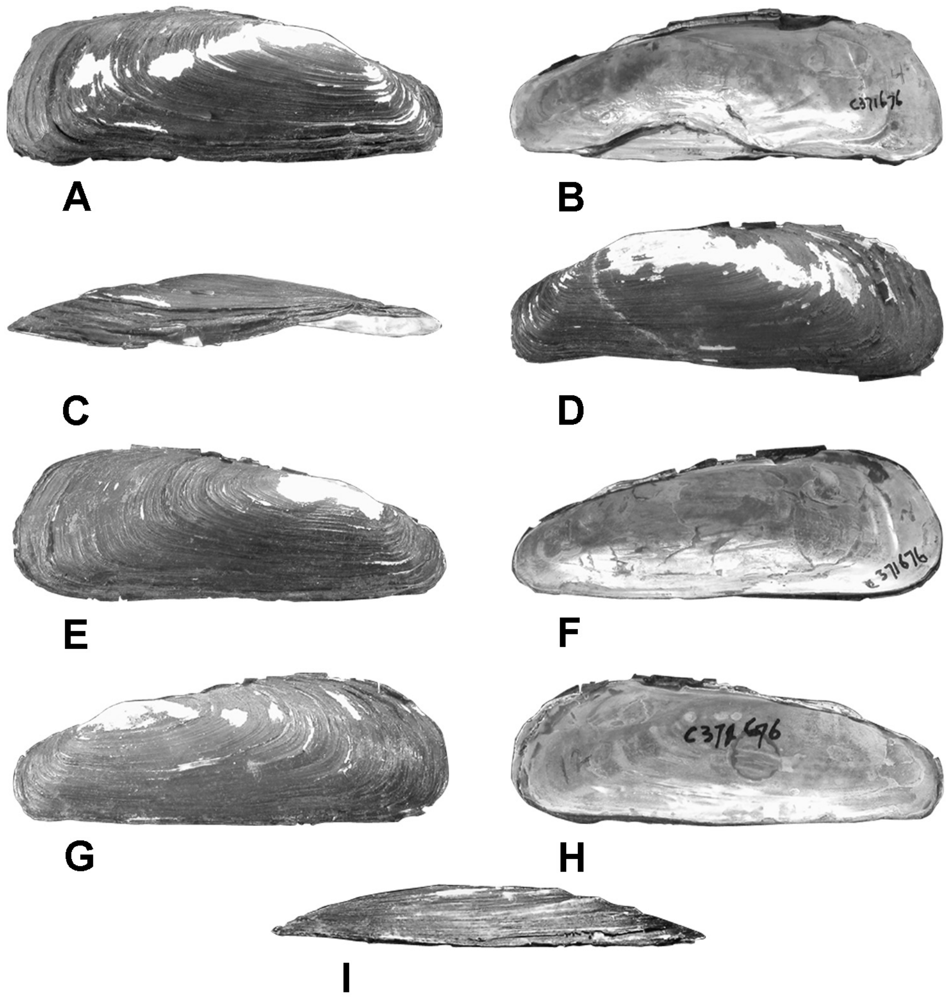

Fig. 3. (*a–i*) *Lortiella rugata* (C.371676): (*a*,*d*,*e*,*g*) external view; (*b*,*f*,*h*) internal view; (*c*,*i*) ventral view. Shell lengths: (*a–c*) 90.70 mm; (*d*) 65.75 mm; (*g–i*) 55.90 mm.

Hiscock (1958) also recorded this species from the Katherine River and gave dimensions of two specimens from that locality. That material, however, is attributable to the new species described below.

Lortiella rugata is characterised by its very elongated, rather thin shell with a very reduced hinge and often squarely truncate posterior end (Fig. 3). The range of the MH/TL (i.e. MHI) is 29–41% (McMichael and Hiscock gave 35%), that of BH/MH (i.e. BHI) 60–91% (McMichael and Hiscock gave 75%) and the inflation *v.* length ratio is 10–15%. The ventral margin is straight to slightly concave, and sometimes distorted (e.g. Fig. 3*C*). The whole shell is slightly twisted in occasional specimens and this distortion, and that of the ventral margin, is presumably a consequence of the nestling (and/or burrowing) habit of this taxon. The periostracum is medium to dark brown and the internal nacre pearly white to silvery.

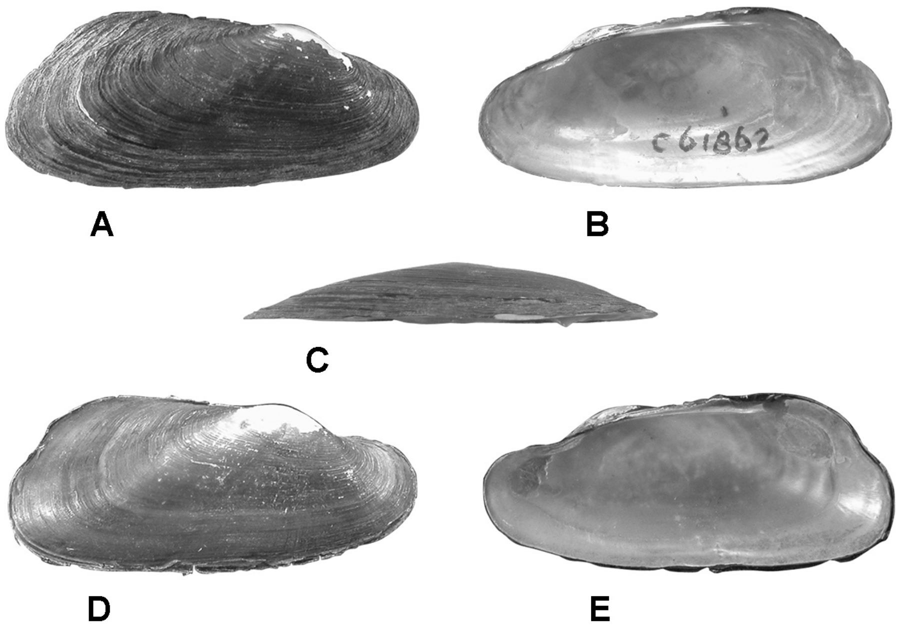

Fig. 4. (*a–e*) *Lortiella froggatti* ((*a–c*) C.61862, holotype; (*d*,*e*) C.427352): (*a*,*d*) external view; (*b*,*e*) internal view; (*c*) ventral view. Shell lengths: (*a–c*) 57.20 mm; (*d*,*e*) 51.90 mm.

Lortiella froggatti Iredale, 1934

(Figs 2, 4*A–E*)

Lortiella froggatti Iredale, 1934: 71, pl. 5, fig. 5 (holotype), pl. 6, fig. 5 (holotype); McMichael & Hiscock, 1958: 434, pl. 9, figs 3, 4 (holotype), 5 (paratype); Haas 1969*b*: 499.

Material examined

Holotype. Lennard R, Western Australia, 17°24.000′S, 124°30.000′E, in sand, 1887, W. W. Froggatt (AMS C.061862, 1 pr).

Paratypes. Same data as holotype (AMS C.061863, 29 v).

Other material: **Western Australia**: Fitzroy R, Sheepcamp Yard (WAM S13770, 4 v); Fitzroy R below Geike Gorge, 16°6.69′S, 125°41.85′E (C.371699, 20+); Charnley R, Walcott Inlet, 16°25.0′S, 124°57.0′E (C.126109, 1 v); Napier Ranges, NW end, 17°4′S, 124°39′E, (WAM S13765, 1 v); Lennard R, 17°24′S, 124°30′E (C.126279, 8 v); West Kimberley, Napier Ranges, Lennard R, Windjana Gorge, 17°25′S, 124°58′E (WAM S13762, 1 v); Napier Ranges, Windjana Gorge, 17°25′S, 124°58′E (WAM S13764, 9 v; WAM S13763, 11 v; WAM S13760, 4 v; WAM S13761, 20+); Fitzroy R, nr Willare Bridge nr Derby, 17°44′S, 123°39′E (WAM S13769, 1 v; WAM S13766, 2 v); Geike Gorge, Fitzroy R, 18°4′S, 125°44′E (C.414981, 7 pr; WAM S13768, 18 v; WAM S13771, 3 v); West Kimberley, Fitzroy R, Myroodah Crossing, 18°5′S, 124°13′E (WAM S1307, 8; WAM S13767, 1 v; WAM S13774, 6 v); Fitzroy R at Old Northern Hwy crossing, 18°10.75′S, 125°35.85′E (C.202368, 20+; C.367894, 5 pr; C.427352, 20+ pr).

Range and habit

Lennard River, Western Australia (types); Fitzroy and Charnley Rivers, western Kimberley, Western Australia (Fig. 2). Burrows shallowly in sand (W. Ponder pers. obs.).

Remarks

The shells of the type specimens of this species were described by Iredale (1934) and McMichael and Hiscock (1958). The shell of this taxon is obliquely truncate, rounded and somewhat winged posteriorly, and is significantly more inflated than the other two species (Fig. 4; Tables 3, 4). The range of the MH/TL (MHI) is 40–55% (McMichael and Hiscock gave 40% based on only the type material). The range of the BH/MH (BHI) is 77–100% (McMichael and Hiscock gave 80%). The shell is typically thicker than that of *L. rugata* (and the new species described below). The posterior lateral hinge tooth is stronger in larger specimens than in the other two species and the ventral margin is moderately convex. McMichael and Hiscock described the periostracum as yellow-brown, marked by fine growth lines, the nacre as bluish iridescent and the shell substance thin. Although this accurately describes the juvenile type material, other lots of *L. froggatti* have a darker brown periostracum with fine growth lines (the growth lines are much more coarse in *L. rugata* and the new species). The nacre is bluish or silvery, with some yellow to yellow-orange coloration and the shell is moderately thick. The nacre in dead shells dulls quickly. The valves of this species are usually symmetrical, a few specimens being only very slightly twisted.

McMichael and Hiscock (1958) noted that *L. froggatti* looked different from *L. rugata*, but considered that because their locations are hundreds of miles apart, ecophenotypic differences were possible. Although they suggested the possibility that the two taxa could be conspecific, they accepted the separation of the species. Based on our observations, these two taxa are very distinct in shape, shell construction and periostracal development. They also have different habits, *L. froggatti* burrowing shallowly in sand rather than nestling beneath rocks or burrowing in mud banks. These differences may well imply a greater level of difference than assumed from their current congeneric status.

Lortiella opertanea n. sp

(Figs 2, 5*A*–*G*)

Material examined

Holotype. Katherine R, Northern Territory, below gorge, 14°19.23′S, 132°24.93′E, in pool alongside river, under stones, 10 June 2003, W. F. Ponder, J. C. Walker & L. Puslednik (AMS C.427618 with ethanol-preserved animal).

Paratypes. **Northern Territory**: Katherine R, below gorge, 14°19.23′S, 132°24.93′E, in pool alongside river, under stones, 10 June 2003, W. F. Ponder, J. C. Walker & L. Puslednik (AMS C.427619, 2 pr (shells broken), with ethanol-preserved animal); Katherine National Park, second gorge, 14°18′S, 132°25′E, in flood debris, April 1988, O. L. Griffiths (AMS C.155936, 7 v; NTM P26186, 2 v).

Other material. **Northern Territory**: Douglas R crossing, 13°40.09′S, 130°39.54′E (AMS C.314474, 7 pr); Oolloo Crossing, Daly R, 14°04.67′S, 131°15.00′E (AMS C.386619, 1); Katherine R, ca 20 km NW of Eva Valley Stn, 14°5.000′S, 132°43.500′E, under rocks in shallow water (AMS C.113750, 4 pr); Katherine R, 14°28′S, 132°16′E (AMS C.126339, 20+ v). **Western Australia**: Kalumburu Mission, 14°18′S, 126°38′E (WAM, 1315, 1 pr, 13755, 1 pr, 13772, 8 pr); nr Kalumburu Mission, Carson R (WAM, 13753, 5 pr); Kalumburu, on King Edward R, large pool, 14°18′S, 126°38′E (WAM, 13754, 2 pr).

Additional records

Northern Territory: Daly R, 1 km upstream of junction of Douglas R and Daly R, 13°50.43′S, 131°08.82′E (NTM P008576, 7 pr, 1 v).

Description

Shell thin (some empty shells rather delicate and brittle; Fig. 5); swollen at rounded posterior ridge, somewhat compressed anteriorly, slightly winged posteriorly. Beaks low and apparently without sculpture (eroded in all specimens). Shell elongate, BH/MH (MHI)

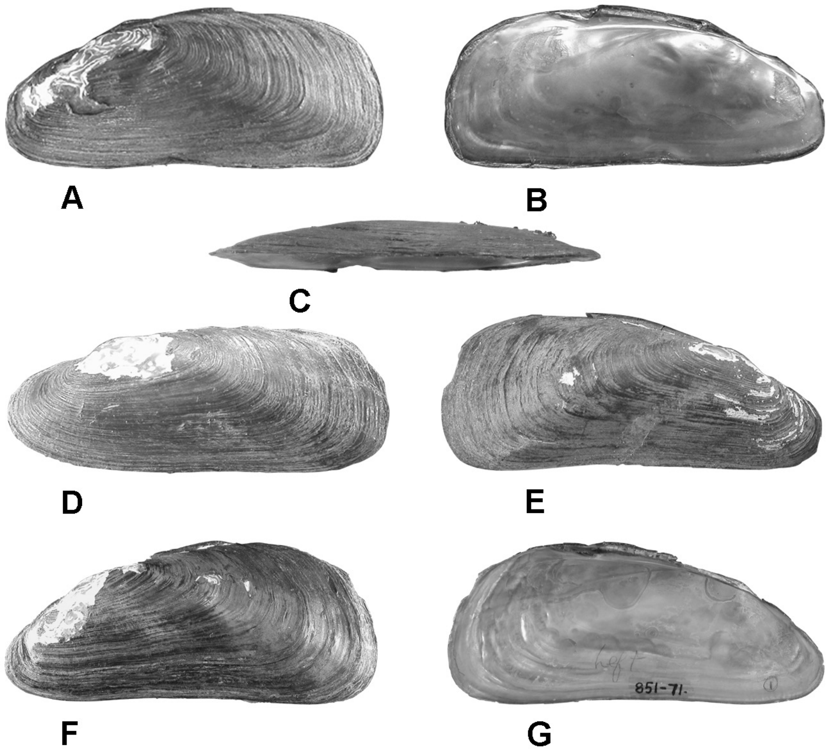

Fig. 5. (*a–g*) *Lortiella opertanea* n. sp. ((*a–c*) C.427618, holotype; (*d*,*e*) C.126339; (*f*,*g*) WAM S13755): (*a*,*d–f*) external view; (*b*,*g*) internal view; (*c*) ventral view. Shell lengths: (*a–c*) 62.25 mm; (*d*) 52.40 mm; (*e*) 66.05 mm.

36–45%; anterior end relatively short (BL/TL 25–36%). Anterior margin truncate and rounded, ventral margin straight to slightly concave, rarely slightly convex; dorsal margin posterior to beak curved gently and elevated slightly (more so than in *L. rugata*), meeting posterior margin at rounded angle; BH/MH (BHI) 73–103%. Posterior margin truncate but usually rounded, rounded to subangled where it meets ventral margin. Interior nacreous, often pale bluish and/or with yellow tinge to dull golden brown. Hinge reduced, cardinal and anterior lateral teeth absent, posterior lateral tooth elongate, extending for about half posterior dorsal margin. Ligament well developed, external, extending about the same length as the posterior lateral tooth. Anterior and posterior muscle scars moderately impressed; retractor, protractor and adductor muscle scars fused. Pallial line moderately distinct. Periostracum well developed, dark brown, with prominent, often irregular and scaly commarginal growth lines. Dimensions are given in Tables 3 and 5.

Range and habit

Known only from the Katherine, Douglas and Daly Rivers, Northern Territory and the Carson/King Edward River System (vicinity of Kalumburu), Western Australia (Fig. 2). Found living beneath large flat rocks in pools in the riverbed where it generally lies on its side with the posterior end towards the outer edge of the stone.

Table 5. Dimensions of the type specimens of *Lortiella opertanea* n. sp. (mm)

	TL	MH	BH	W	BL
Holotype C427618					
Right valve	61.95	25.80	21.60	8.15	19.60
Left valve	62.10	25.70	21.40	7.60	20.85
Paratypes C427619					
Right valve	52.40	22.30	17.50	6.80	17.80
Left valve	52.25	22.50	17.55	6.80	17.10
Right valve	59.10	25.20	20.20	7.525	18.75
Left valve	58.90	25.25	20.50	7.525	18.75

Remarks

This species is not as narrowly elongate as *L. rugata* but is more elongate and compressed than *L. froggatti* (MH/TL and W/TL significantly different ($P < 0.001$) in all three species; Tables 3, 4). *Lortiella opertanea* is more similar to *L. rugata* but is not as flattened anteriorly. Like *L. rugata*, it is not as strongly calcified as *L. froggatti*, although it tends to be more calcified than *L. rugata*. The anterior end is not significantly different in length in *L. rugata* and *L. opertanea* but in both these species it is significantly shorter (measured as BL and relatively as BL/TL) than in *L. froggatti.* The posterior dorsal margin is usually distinctly convex in *L. opertanea* rather than flat or almost so in *L. rugata*. *L. opertanea* also has a higher posterior wing than *L. rugata* (measured as MH and relative to beak height as BH/MH and relative to total length as MH/TL, all of which differ at the $P < 0.001$ level; see also Tables 3, 4), but this wing is not as pronounced as in *L. froggatti*.

Specimens from the vicinity of Kalumburu (Kimberely, Western Australia) agree with the Northern Territory specimens in key shell characters and are assigned to *L. opertanea* on the basis of their similar shell morphology. However, 72% were discriminated successfully in a discriminant function analysis (Table 2; Fig. 1) and two ratios (BH/MH and BL/TL) were also significantly different at the $P < 0.001$ level. These differences are not considered, on their own, sufficiently great to recognise the specimens from the Kalumburu area as a distinct taxon. The markedly disjunct distribution of these populations from those in the Katherine, Douglas and Daly Rivers, with *Lortiella rugata* between them, may be explained by the new species having had a considerably wider distribution in the Pleistocene. It is, however, highly probable that two allopatric cryptic taxa will eventually be recognised when this taxonomy is tested with molecular data.

Discussion

Distinguishing species on shell morphology alone must always be treated with some caution, given the apparent ecophenotypic variation seen in some hyriid taxa (e.g. Walker 1981). Nevertheless, virtually all of the current species-level taxonomy of Australian freshwater mussels is based primarily on shell morphology with the exception of very recent work on some *Velesunio* taxa (Baker *et al*. 2003). McMichael and Hiscock's (1958) monograph placed the systematics of Australian Hyriidae on an excellent footing – and this is attested to by the fact that there have been very few changes to their conclusions in the 46 years since that revision. The recognition of an additional taxon in *Lortiella* using morphometrics was only possible after the acquisition of a large amount of new material collected since that revision. However, despite the additional collecting that has occurred in tropical Australia, very few additional species of hyriids have been found that are separable morphologically.

Walker *et al*. (2001) discussed the status of Australian freshwater mussel systematics and noted the necessity for molecular studies to test the current taxonomy, a call repeated by Ponder and Walker (2003). The need for this was demonstrated recently by Baker *et al*. (2003), who provided molecular evidence that *Velesunio wilsonii* appears to be a polytypic species. Within the four lineages they identified, only one was distinctly separable morphologically, with the others showing considerable overlap.

The anatomical material available for this species, although not examined in great detail, has shown that *Lortiella* is not separable from Velesunioninae, as discussed above. However, these conclusions, together with the species-level taxonomy proposed herein, require further testing with molecular data. In particular, the markedly disjunct distribution of *L. opertanea*, as here recognised, needs to be further examined.

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